The 61st Annual Congress of the Korean Orthopaedic Association

International Symposium
Program & Book of Abstracts

October 19th~21st 2017 (Thu~Sat)
Grand Hilton Seoul
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<td>Opening Ceremony</td>
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<td>08:10-09:20</td>
<td>LCP</td>
<td>Sung Taek Jung</td>
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<td>08:10-08:25</td>
<td>Combined Pemberton and femoral varus osteotomies in Legg-Calvé-Perthes disease</td>
<td>Ting-Ming Wang / NATIONAL TAIWAN UNIVERSITY HOSPITAL, TAIWAN</td>
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<td>08:25-08:40</td>
<td>Treatment Options for Perthes disease</td>
<td>Saw Aik / UNIVERSITY MALAYA MEDICAL CENTRE, MALAYSIA</td>
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<td>08:40-08:55</td>
<td>Tonnis Triple Osteotomy for Containment of Perthes Disease</td>
<td>Yukun Wang / BEIJING JISHUAN HOSPITAL, CHINA</td>
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<td>08:55-09:10</td>
<td>Our treatment strategy for children with Legg-Calvé-Perthes disease</td>
<td>Ryosuke Yamaguchi / FUKUOKA CHILDREN'S HOSPITAL, JAPAN</td>
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<td>09:10-09:20</td>
<td>Discussion</td>
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<td>09:40-10:10</td>
<td>Coffee Break</td>
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<td>10:10-11:10</td>
<td>3D printing in reconstruction surgery</td>
<td>Ye Yeon Won - Yang Soo Kim</td>
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<td>10:10-10:22</td>
<td>Additive manufacturing and FE Simulation for Biomechanics</td>
<td>Koji Murase / NAGOYA UNIVERSITY, JAPAN</td>
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<td>10:22-10:34</td>
<td>Corrective osteotomy or fracture reduction by 3D mirroring</td>
<td>Ahmet Mehmet Demirtaş / ANKARA UNIVERSITY FACULTY OF MEDICINE, TURKEY</td>
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<td>10:34-10:46</td>
<td>Digital surgery techniques used in craniofacial bone reconstruction</td>
<td>Zhigang Cai / PEKING UNIVERSITY, CHINA</td>
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<td>10:46-10:58</td>
<td>3D Printing in Musculoskeletal Oncology</td>
<td>Yang Guk Chung / CATHOLIC UNIV.</td>
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<td>10:58-11:10</td>
<td>Discussion</td>
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<td>11:10-12:10</td>
<td>Periprosthetic fracture of the femur: Reduction and Fixation</td>
<td>Byung Woo Min</td>
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<td>11:10-11:20</td>
<td>Periprosthetic Fracture of the Femur: Decision making (is the stem stable?)</td>
<td>Byung Woo Min / KEIMYUNG UNIV.</td>
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<td>11:20-11:35</td>
<td>Biomechanical challenges of periprosthetic fractures</td>
<td>Toru Sato / NATIONAL HOSPITAL ORGANIZATION OKAYAMA MEDICAL CENTER, JAPAN</td>
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<td>Case-based lecture-fracture around the femoral stem</td>
<td>Takeshi Sawaguchi / KANAZAWA UNIVERSITY, TOYOMA MUNICIPAL HOSPITAL, JAPAN</td>
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<td>12:05-12:10</td>
<td>Discussion</td>
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<td>12:30-13:30</td>
<td>Lunch</td>
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### Oct. 19th. 2017. Thu | Grand Ballroom 1

<table>
<thead>
<tr>
<th>Time</th>
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| 13:30-14:30 | Cutting Edge Technology in the Field of ASAMI Society of Asian Countries  
Chang Hoon Jeong |
| 13:30-13:40 | Comparison of Joint Distraction and Non-distraction using an Ilizarov External Fixator in the Treatment of Ankle Fractures in Older Patients  
Koji Nozaka / AKITA UNIVERSITY GRADUATE SCHOOL OF MEDICINE, JAPAN |
| 13:40-13:50 | Treatment of the lower limb deformities by a multi-axial external fixation system  
Masaki Matsuhashi / NAGOYA UNIVERSITY SCHOOL OF MEDICINE, JAPAN |
| 13:50-14:00 | Novel Management of Larger Bone Defect: Combination of Biomaterials and Distraction Osteogenesis Technique  
Gang Li / THE CHINESE UNIVERSITY of HONG KONG, PRINCE OF WALES HOSPITAL, HONG KONG |
| 14:00-14:10 | Lower Limb Reconstruction in paediatric Orthopedics  
Andrew Lim Keen Sang / NATIONAL UNIVERSITY HOSPITAL OF SINGAPORE, SINGAPORE |
| 14:10-14:20 | Game changers in Limb lengthening and Deformity Correction Field  
Dong Hoon Lee / YONSEI UNIV. |
| 14:20-14:30 | Discussion |
| 14:30-15:30 | Sacro-pelvic bone cancer surgery  
Hyun Guy Kang |
| 14:30-14:45 | Resection and reconstruction for pelvic ring cancer  
Tetsus Hirota / NIIGATA UNIVERSITY HOSPITAL, JAPAN |
| 14:45-15:00 | Sacrectomy: Modern surgical technique  
Hwan Seong Cho / SEOUL NATIONAL UNIV. |
| 15:00-15:15 | Computer-assisted pelvic ring cancer surgery  
Kwek Chuan Woon / PRINCE OF WALES HOSPITAL, HONG KONG |
| 15:18-15:30 | Discussion |

### Oct. 19th. 2017. Thu | Grand Ballroom 2

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<tr>
<th>Time</th>
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| 08:00-08:10 | Opening Ceremony  
Sang Hun Ko - Chul Won Ha |
| 08:10-09:40 | Treatment of Sports-related Injuries & Diseases  
Sang Hun Ko ・ Chul Won Ha |
| 08:10-08:25 | The evaluation and conservative treatment of internal impingement of shoulder for throwing athlete  
Toru Morihara / KYOTO PREFECTURAL UNIVERSITY, JAPAN |
| 08:25-08:40 | Shoulder injuries among japanese professional baseball players  
Shin Yokoya / HIROSHIMA UNIVERSITY, JAPAN |
| 08:40-08:55 | Biological application in ACL surgery  
Chih-Hwa Chen / TAIPEI MEDICAL UNIV HOSPITAL, TAIWAN |
| 08:55-09:10 | Trochleoplasty In Patella Instability...A Necessary Evil?  
James Hui / NATIONAL UNIVERSITY SINGAPORE HOSPITAL, SINGAPORE |
| 09:10-09:25 | Does cutting the lateral retinaculum and reconstructing MPFL result in improved patellofemoral incongruency?  
Hua Feng / BEIJING JISHUITAN HOSPITAL, CHINA |
| 09:25-09:40 | Discussion |
| 09:40-12:10 | TFCC Injury and DRUJ Instability  
Soo Hong Han |
| 10:10-10:25 | Distal Radioulnar Joint Functional Anatomy  
II-Jung Park / CATHOLIC UNIV. |
| 10:25-10:40 | Treatment of Distal radioulnar joint instability  
Jang Pil Kim / DANKOOK UNIV. |
| 10:40-10:55 | DRUJ Instability: My preferred management  
Abhijot L. Wahegaonkar / JEHANGIR HOSPITAL, INDIA |
| 10:55-11:10 | Arthroscopic Repair for the TFCC foveal Tear  
Bo Liu / BEIJING JISHUITAN HOSPITAL, CHINA |
| 11:10-11:15 | The Surgical treatment for TFCC foveal tear - Open vs Arthroscopic repair  
Yuko Abe / SAISERAI SHIMOSONODHI GENERAL HOSPITAL, JAPAN |
| 11:25-11:40 | Arthroscopic TFCC reconstruction with tendon graft  
Wing Lim Tse / PRINCE OF WALES HOSPITAL, HONG KONG |
| 11:40-11:55 | Surgical treatment of ECU tendinopathy associated with TFCC Injury  
Young Kuan Lee / CHONBUK NATIONAL UNIV. |
| 11:55-12:10 | Discussion |
| 12:30-13:30 | Lunch |
Oct. 20th, 2017. Fri | Grand Ballroom 1

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<td>08:30-09:30</td>
<td>International Perspective in Recent Shoulder Updates I</td>
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<tr>
<td></td>
<td>Chang Hyuk Choi ・ Yong Min Chun</td>
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<tr>
<td>08:30-08:42</td>
<td>Arthroscopic Reconstruction of the Acromioclavicular Joint</td>
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<td>James Tan Chung Hui / KHOO TECK PLAT HOSPITAL, SINGAPORE</td>
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<tr>
<td>08:42-08:54</td>
<td>L-shaped Arthroscopic Posterior Capsular Release in Frozen Shoulder</td>
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<td>Mohamed Gamal Morsy / ALEXANDRIA UNIVERSITY, EGYPT</td>
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<td>08:54-09:06</td>
<td>Management options in Young Arthritic Shoulder - now and in future?</td>
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<td>Roshan Wade / GSMC &amp; KEM HOSPITAL, INDIA</td>
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<td>09:06-09:18</td>
<td>Anatomical Medial Patellofermoral Ligament Insertion to the Patella: More Than a Cadaveric Study</td>
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<td>Teo Seow Hui / OSAKA POLICE HOSPITAL, MALAYSIA</td>
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<td>09:18-09:30</td>
<td>Discussion</td>
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<td>09:30-10:00</td>
<td>Coffee Break</td>
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<tr>
<td>10:00-11:00</td>
<td>International Perspective: Injury of Shoulder and Elbow</td>
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<td>Jin Young Park ・ Joo Han Oh</td>
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<tr>
<td>10:00-10:12</td>
<td>Arthroscopic AC Joint Reconstruction and Management of Concomitant Injuries</td>
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<td>JEREMY JAMES C. MUNJI  / DELOS SANTOS MEDICAL CENTER, PHILIPPINES</td>
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<td>10:12-10:24</td>
<td>Traumatic posteromedial varus instability of elbow: My technique</td>
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<td>Ming Xiang / SICHUAN PROVINCIAL ORTHOPAEDICS HOSPITAL, CHENGDU, CHINA</td>
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<td>10:24-10:36</td>
<td>Strategic approach of first time dislocation of shoulder</td>
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<td>Peter Wai Pan Yau / THE UNIVERSITY OF HONG KONG, HONG KONG</td>
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<td>10:36-10:48</td>
<td>Arthroscopic treatment for recurrent shoulder dislocation: Vietnamese Experience</td>
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<td>Trần Trung Đặng / ST PAUL UNIVERSITY HOSPITAL, VIETNAM</td>
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<td>10:48-11:00</td>
<td>Discussion</td>
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<td>11:00-12:00</td>
<td>International Perspective in Recent Shoulder Updates II</td>
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<td>Yong Girl Rhee ・ Jae Chul Yoo</td>
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<td>11:00-11:12</td>
<td>Completion repair shows better healing characteristics in comparison with insitu repair in the partial thickness bursal rotator cuff tear</td>
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<td>Arslan Bereli / ACIBADEM UNIVERSITY SCHOOL OF MEDICINE, TURKEY</td>
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<td>11:12-11:24</td>
<td>No relationship between critical shoulder angle and glenoid erosion after shoulder hemiarthroplasty: a comparative radiographic study</td>
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<td>Simone Carozza / CASA DI CURA VILLA BETANIA GIOMI, ITALY</td>
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<td>11:24-11:36</td>
<td>Biceps tendon tenotomy or tenodesis, what is the evidence? what i do</td>
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<td>Hossein Saromi / BESAT HOSPITAL HAMEDAN UNIVERSITY OF MEDICAL SCIENCES, HAMADAN, IRAN</td>
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<td>11:36-11:48</td>
<td>Bone integrity and morphology of the coracoid process after the coracoid transfer for the recurrent anterior shoulder instability</td>
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<td>Makoto Tanaka / OSAKA POLICE HOSPITAL, JAPAN</td>
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12:00-12:20  Lunchen Symposium (Room A, B)
12:00-12:20  The 62nd Regular General Assembly (Room B) & Lunch (Room A, B)
13:30-14:00  Presentation of Scientific Award Paper (Room B)
14:00-14:30  President Lecture (Room B)
14:30-15:30  limb reconstruction with microsurgical technique  
  Sang Hyun Lee ・ Joo Yeoup Lee
14:30-14:45  A Modified Technique for Harvesting the Reverse Sural Artery Flap from the Upper Part of the Leg: Inclusion of a Gastrocnemius Muscle Cuff Around the Sural Pedicle  
  Nedhal A. Alqumber / PRINCE SULTAN MILITARY MEDICAL CENTER, SAUDI ARABIA  
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14:45-15:00  Immediate closure of Gustilo type IIIb open tibia fracture with calf muscle flap  
  Jong-Wook Kang / KOREA UNIV.  
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15:00-15:15  Fixation methods favorite for soft tissue around elbow in complicated fractures around elbow including ulnar nerve injury  
  Yehlen Francis Reyes Saligumba / ST. LUKE'S MEDICAL CENTER GLOBAL CITY, PHILIPPINES  
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15:15-15:30  Discussion
15:30-16:00  Coffee Break
16:00-17:30  Complications in Total Hip Arthroplasty  
  Gun Il Im ・ Kee Hyung Rhys
16:00-16:15  Vascular injury after revision arthroplasty of the hip- a case report  
  Piyush Mukund Sanje / INDIA  
  142
16:15-16:30  Periprosthetic Femoral Fractures after Hip Arthroplasty  
  Ravi Teja Rudraraju / CENTRE OF EXCELLENCE FOR JOINT REPLACEMENTS, SVS MEDICAL COLLEGE, INDIA  
  143
16:30-16:45  Imaging in Pelvic and Acetabular Surgery - How to Avoid It  
  Kristoffer Roland U. Risa / SOUTHERN PHILIPPINES MEDICAL CENTER, PHILIPPINES  
  145
16:45-17:00  Mid-term Results of Open Debridement for Labral Tear Using Anterolateral Approach with a Mini-incision  
  Ashraf Mohamed Almutasim / Alamal NATIONAL HOSPITAL, SUDAN  
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<td>Presentation of Scientific Award Paper</td>
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<td>14:00-14:30</td>
<td>President Lecture</td>
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<tr>
<td>14:30-15:30</td>
<td>International Spine Session 1</td>
<td>Jin Sup Yeom</td>
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<td>14:30-14:45</td>
<td>Giant Cell Tumor of the Spine: 3 Patients Treated with Intra-lesional Surgery and Denosumab Chemotherapy Post-excision</td>
<td>Romel P. Estillore / UNIVERSITY OF SANTO TOMAS HOSPITAL, PHILIPPINES</td>
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<td>14:45-15:00</td>
<td>Using intra-operatively ideal entrance point and angle of screws with a set square for lower cervical pedicle screw placement: Accurate result?</td>
<td>Tran Hoang Manh / KHANH HOA GENERAL HOSPITAL, VIETNAM</td>
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<td>15:00-15:15</td>
<td>Do Van Minh / HUE CENTRAL HOSPITAL, VIETNAM</td>
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<td>15:15-15:30</td>
<td>Discussion</td>
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<td>15:00-16:00</td>
<td>Coffee Break</td>
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<td>16:00-18:00</td>
<td>International Spine Session 2</td>
<td>Jin Sup Yeom</td>
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<td>16:00-16:15</td>
<td>Unusual presentation of tuberculosis in cervical spine: challenges faced by Spine surgeons in developing country</td>
<td>Dinush Kalle / TRIHUWAN UNIVERSITY, NEPAL</td>
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<td>16:15-16:30</td>
<td>Timing of Surgery and Treatment in Traumatic Central Cord Syndrome: Our Local Experience and Review of Literature</td>
<td>Mary Ruth A. Padua / EAST AVENUE MEDICAL CENTER, PHILIPPINES</td>
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<td>16:30-16:45</td>
<td>C5 Palsy After Posterior Cervical Reconstruction by Pedicle Screw Fixation: 2 Cases Report</td>
<td>Quyen Nguyen Ngoc / 188 MILITARY CENTRAL HOSPITAL, VIETNAM</td>
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<tr>
<td>16:45-17:00</td>
<td>Combining Yeom's and Shiraishi's Technique for the Treatment of Cervical Spondylotic Myelopathy</td>
<td>Nguyen Hau Thuyet / CAN THO UNIVERSITY OF MEDICINE AND PHARMACY, VIETNAM</td>
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<td>17:00-17:15</td>
<td>Cervical Tuberculosis With Big Retropharyngeal Abscess: A Case Report</td>
<td>Huynh Chi Hung / PHAM NGOC TRACH MEDICAL UNIVERSITY, VIETNAM</td>
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<td>17:15-17:30</td>
<td>A Novel Trajectory of C7 Screws: Evaluation using 3-Dimensional Computed Tomography and Simulation Program to Compare with a Pre-existing Trajectory</td>
<td>Choa Keen Lee / MAHAKOTA MEDICAL CENTRE, MALAYSIA</td>
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<td>17:30-17:45</td>
<td>Cervical Spine Alignment - What Have We Understood in The Past Few Years</td>
<td>Hwee-Wong Dennis-Hay / NATIONAL UNIVERSITY HEALTH SYSTEM, SINGAPORE</td>
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<td>17:45-18:00</td>
<td>Discussion</td>
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**Grand Ballroom 3**

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<th>Speaker/Institution</th>
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<tbody>
<tr>
<td>10:00-11:00</td>
<td>Vertebral Bone Resection Using Ultrasonic Aspirator</td>
<td>Dongho Lee / ASIAN MEDICAL CENTER</td>
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<tr>
<td>10:00-10:15</td>
<td>Principles and Working Mechanism of Ultrasonic Aspirator</td>
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<tr>
<td>10:15-10:30</td>
<td>Usage of SONOPET : Cervical &amp; Posterior Lumbar Surgery</td>
<td>Jee Chul Lee / SOOCHUNHUNYANG UNIV.</td>
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<td>10:30-10:45</td>
<td>Usefulness of SONOPET for Complex Thoraco-Lumbar Disorders</td>
<td>Yong Chan Kim / GANGDOONG KYUNGHEE UNIV.</td>
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<tr>
<td>10:45-11:00</td>
<td>Hands-on Session</td>
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<tr>
<td>11:00-12:00</td>
<td>Patient Blood Management in Orthopedic Surgery</td>
<td>Kye Yoed Lee</td>
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<tr>
<td>11:00-11:25</td>
<td>PBM in elective major orthopedic surgery and recent achievement</td>
<td>Gurgal Singh / NATIONAL UNIVERSITY OF SINGAPORE</td>
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<td>11:25-11:50</td>
<td>The role of IV iron in PBM Minimal transfusion in orthopedic surgery is possible?</td>
<td>Jong Hoon Park / KOREA UNIV.</td>
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<td>11:50-12:00</td>
<td>Discussion</td>
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<tr>
<td>12:29-13:30</td>
<td>Lunch</td>
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<tr>
<td>13:30-14:00</td>
<td>Presentation of Scientific Award Paper</td>
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<td>14:00-14:30</td>
<td>President Lecture</td>
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<tr>
<td>14:30-15:30</td>
<td>Session 1. Quantitative Measurement of Pivot Shift</td>
<td>Nam-Hong Choi / Ji-Hoon Bae</td>
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<tr>
<td>14:30-14:42</td>
<td>Intraoperative kinematic evaluation of single- or double-bundle anterior cruciate ligament reconstruction using a navigation system</td>
<td>Nabuo Adachi / HRISHIMA UNIVERSITY, JAPAN</td>
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<tr>
<td>15:06-15:18</td>
<td>How to check the functional instability of ACL injured subjects during sports activities?</td>
<td>Jin-Goo Kim / KONKUK UNIV.</td>
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<tr>
<td>15:00-16:00</td>
<td>Coffee Break</td>
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<tr>
<td>16:00-17:00</td>
<td>Session 2. Revision ACL Reconstruction</td>
<td>Kwang-Won Lee / Joon Ho Wang</td>
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<tr>
<td>16:00-16:12</td>
<td>Slope-decreasing osteotomy in treatment of revision ACL surgery</td>
<td>Hua Feng / BEIJING JISHUITAN HOSPITAL, CHINA</td>
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<tr>
<td>16:12-16:24</td>
<td>One-stage revision ACL reconstruction :Technical strategy and grant optional</td>
<td>Yi-Sheng Chan / CHANG GUNG MENORIAL HOSPITAL, TAIWAN</td>
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<tr>
<td>16:24-16:36</td>
<td>Effects of remnant tissue preservation on clinical outcomes after anatomic double-bundle anterior cruciate ligament reconstruction</td>
<td>Eiji Kondo / HOKKAIDO UNIVERSITY, JAPAN</td>
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<td>16:36-16:48</td>
<td>Availability of anterolateral ligament in revision ACL reconstruction</td>
<td>Kyoung-Ho Yoon / KYUNGHEE UNIV.</td>
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<td>16:48-17:00</td>
<td>Discussion</td>
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■ Oct. 21st, 2017. Sat | Room C-1 ■

08:30-09:30  
**Ultrasoundography in Orthopaedics**  
Jin Young Park, Kyoung Dae Min

08:30-08:42  
Ultrasoundography of the shoulder and elbow up to date  
Katsumasa Sugimoto / NAGOYA SPORTS CLINIC, JAPAN

08:42-08:54  
Ultrasoundography after Rotator cuff repair  
Sang-Jin Shin / EWHA WOMANS UNIV.

08:54-09:06  
Evaluation and Treatment for the Hip Joint Using Ultrasoundography  
Pil Sung Kim / BUMIN HOSPITAL

09:06-09:18  
US in Ankle Instability  
Hak Jun Kim / KOREA UNIV.

09:18-09:30  
Discussion

09:30-10:00  
Coffee Break

10:00-11:00  
**Clubfoot**  
Soo-Sung Park

10:00-10:10  
How to manage relapsed clubfeet after Ponseti method in Japan  
Daisuke Tamura / OSAKA MEDICAL CENTER AND RESEARCH INSTITUTE FOR MATERNAL AND CHILD HEALTH, JAPAN

10:10-10:20  
How to manage residual clubfoot deformity after Ponseti method in Taiwan  
Chia Hishe Chang / CHANGGANG MEMORIAL HOSPITAL, TAIWAN

10:20-10:30  
How to manage residual clubfoot deformity after Ponseti method in Singapore  
Arjandas Mahadev / KK WOMEN'S AND CHILDREN'S HOSPITAL, SINGAPORE

10:30-10:40  
How to manage residual clubfoot deformity after Ponseti method in India  
Alaric John Aroojis / CENTRE FOR BONE & JOINT KOKILABEN DHIRUBHAI AMBANI HOSPITAL, INDIA

10:40-10:50  
How to manage residual clubfoot deformity after Ponseti method in Bangladesh  
Sanwar Ibne Salam / DHAKA MEDICAL COLLEGE HOSPITAL, BANGLADESH

10:50-11:00  
Discussion

11:00-12:00  
**CP**  
Hyun Woo Kim

11:00-11:15  
Decision making: operate or not to operate, when to operate  
Abhay Khot / VICTORIAN ORTHOPAEDIC CENTRE, AUSTRALIA

11:15-11:30  
Surgeries for correction of crouch gait  
Alaric John Aroojis / CENTRE FOR BONE & JOINT KOKILABEN DHIRUBHAI AMBANI HOSPITAL, INDIA

11:30-11:45  
Surgeries for spastic hip disease and spine deformity  
Jason James Howard / SIDRA MEDICAL AND RESEARCH CENTER, CANADA

11:45-12:00  
Cases presentation for panel discussion  
Arjandas Mahadev / KK WOMEN'S AND CHILDREN'S HOSPITAL, SINGAPORE  
Sanwar Salam / DHAKA MEDICAL COLLEGE HOSPITAL, BANGLADESH

12:00–  
Closing Ceremony
Combined Pemberton and femoral varus osteotomies in Legg-Calvé-Perthes disease

Ting-Ming Wang, Ting-Chun Huang, Kuan-Wen Wu, Ken N Kuo
NATIONAL TAIWAN UNIVERSITY HOSPITAL, TAIWAN

Abstract
Containment of the femoral head within the acetabulum by conservative or surgical methods has been popularly accepted as a concept for treatments of LCPD. In patients with onset over the age of 8 years and greater than lateral pillar B or B/C class, surgical treatment was associated with improved Stulberg outcomes compared with conservative treatments. To achieve femoral head containment with surgery, one can choose either acetabuloplasty or proximal femoral osteotomy. However, there are still complications associated with a single procedure alone. In this study, we proposed a combination of Pemberton osteotomy and femoral varus osteotomy as a novel alternative treatment.

Methods
This is a retrospective comparative case series in 19 Children with LCPD underwent Pemberton osteotomies with/without femoral varus osteotomy between July 2002 and January 2012. The radiographic evaluations performed at minimum 5 years post-operatively included migration index, center-edge angle, leg length discrepancy, Mose grading and Stulberg classification. The functional evaluations at latest clinical visit included IOWA hip score, SF36 bodily limitation and pain.

Results
Post-OP femoral head coverage (Center-Edge angle: P<0.001, Migration index: P<0.001), sphericity (Mose grading: P=0.001), and hip congruency (P=0.006) were all significantly better in Combined Group. IOWA Hip Score were significantly better in Combined Group than Alone Group (P=0.02). SF36 bodily limitation and pain did not reveal significant differences between the two groups.

Conclusions
All cases in combined group had leg length discrepancy less than one centimeter.

Combined Group improved femoral head containment, leg length discrepancy, remodeling and functions compared with alone Group.
Treatment Options for Perthes disease

Saw Aik
UNIVERSITY MALAYA MEDICAL CENTRE, MALAYSIA

Aetiology of Perthes disease remained unknown despite the fact that it has been recognised a special entity for more than 100 years. For this reason, treatment is mainly to improve functional outcome or prevent of long term complications. In most cases, the condition is self-limiting and following reparative phase the femoral head remained spherical and congruent. However, for cases that became symptomatic at older age and showing radiological features of extensive head necrosis, risk of subsequent head deformation is very high. Active treatment for Perthes has been focused on these hips since they were associated with poor long term prognosis.

Prolonged bed rest and non-weight bearing with crutches have been shown to be not effective in the management. Concept of containment surgery to increase the coverage for femoral head during the early stages of injury has been shown to modify the subsequent progress of the disease. Although there has been no level one study to support the effectiveness of containment surgery, comparative studies have shown higher percentage of spherical heads in operated compared to non-operated hips. In addition, duration of disease (especially fragmentation phase) was noted to be shorter following surgery. Proximal femur varus derotation osteotomy and acetabular directional osteotomy are effective to improve the antero-lateral coverage of the femoral head, although there is no evidence to indicate which method is better. These procedures should be performed during fragmentation phase of the condition.

For cases presented late with flattened head, shelf and Chiari osteotomy may help to improve the contact surface between femora head and the acetabulum to relief pain. In selective cases with showing hinged abduction, valgus abduction osteotomy or Cheilectomy may offer improvement of hip motion and relief of symptoms. Trendelenburg gait may be contributed by greater trochanter overgrowth, shortened femoral neck or both. Prophylactic epiphysiodesis of the trochanter or trochanteric transfer can be considered for these conditions. Total hip replacement would be indicated for those prevented with advanced secondary osteoarthritis at later stage of life.

There has been reports of favourable outcome following hip distraction using external fixator for Perthes disease. Medical therapy using bisphosphonates has also been shown to reduce the risk of femoral head deformation. Better understanding of the disease and evidence based studies are needed for these newer treatment options.
**Tonnis Triple Osteotomy for Containment of Perthes Disease**

Yukun Wang
BEIJING JISHUITAN HOSPITAL, CHINA

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**[ABSTRACT]**

**Object:** To review and introduce the experience of the operative containment of Perthes disease via Tonnis triple osteotomy in Department of Pediatric Orthopaedics in Jishuitan Hospital.

**Method:** From March 17, 2011 to April 28, 2015, 67 Perthes cases were managed by triple osteotomy under the indication of 1st, L-Pillar B with the onset age $\geq 8y$; 2nd, head subluxation of onset age $< 8y$; and 3rd, Lc while first presentation. Of these children, 46 were followed at least 22 months. The average follow-up time was 37.7 (22~61 months). There were only 5 girls, aging from 4y3m to 11 years at a mean of 7y9m. At the time of operation, the Joseph stages were Ib 6, Iia 19, IIb 20, IIIa 1 cases; the Herring lateral pillar were b 10, b/c 27, c 9 children respectively. Femoral head subluxation occurred in 36 cases, and in detail, 9 in Lb, 19 in b/c, and 8 in Lc.

**Results:** Mean follow-up time was 37.7 months. Stulberg I were rated in 2 children, one was Lc with age of 6y6m when operated and another boy was Lb without subluxation, although aged 8y while operation. Stulberg II and III were in 36 and 8 children, respectively. Leg-length discrepancy (LLD) was from 0~15 mm at an average of 3.2mm. Complete peroneal paralysis occurred in a boy. At final follow-up, the muscle force of the extensor hallucis longus was rated grade II and the extensor digitorum longus was III. All the others muscles around ankle joint were grade V.

Those who was 8 years or more at operation, Lc or Lb/c if with head subluxation, although after sophisticated triple osteotomy, were 3.76 times ($P<0.001$; 95% CI) than as those $< 8y$ or Lb or without subluxation to have a poor outcome, according to binary logistic regression analyses.

**Conclusion:** Triple osteotomy is a good procedure for containment of subluxed and/or enlarged femoral head in Joseph IIa or IIb stage Perthes disease. LLD after operation is minimal.
Our treatment strategy for children with Legg-Calvé-Perthes disease

Ryosuke Yamaguchi1, Tomoyuki Nakamura1, Akifusa Wada2, Toru Yamaguchi1, Haruhisa Yanagida3, Kazuyuki Takamura1, Yasuhiro Nakashima2

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Abstract
Legg-Calvé-Perthes disease (LCPD) is a juvenile form of idiopathic osteonecrosis of the femoral head that can lead to permanent femoral head deformity and subsequent osteoarthritis. Various nonoperative and operative treatments have been applied based on the concept of containment of the femoral head in the acetabulum.

In our institution, we had basically inducted Nishio’s brace (non-weight bearing abduction brace) for two years to almost all LCPD patients until 2009. We consequently found that clinical outcome using Nishio’s brace demonstrated favorable results for LCPD patients under 8 years old at onset, but unsatisfactory results for patients over 8 years old or with an extended necrotic lesion. Therefore, we currently recommend a femoral osteotomy for older LCPD patients with an extended necrotic lesion. Flexion (anterior rotation) and varus osteotomy (FVO) of the proximal femur has been performed using a locking compression plate in our institution. The concept of FVO is to rotate the intact area or repaired area in the posterolateral portion of the femoral head to the superior portion for preventing the progression of femoral head collapse, in addition to the containment of the femoral head. Non-weight bearing walking with crutches for a year following the surgery effectively maintains a spherical femoral head even for older LCPD patients.
Additive manufacturing and FE Simulation for Biomechanics

Kohei Murase
NAGOYA UNIVERSITY, JAPAN

Three-dimensional printing technology (Additive Manufacturing: AM) is one of the great epoch technology in engineering field. Remarkable growth of this innovative technique allows the intricate fabrication with complicated geometry and structure, to construct from biocompatibility materials. Medical applications such as custom-made prosthesis and implants, will be the one of most exciting field for AM. This study introduces AM activities in medical engineering in Japan, for instance, 3D bone shape fidelity and equivalent mechanical strength for development medical implant, concurrency design and fatigue predictions which is combined with FE simulations.

Digital surgery techniques used in craniofacial bone reconstruction

Zhigang Cai
PEKING UNIVERSITY, CHINA

Abstract

The craniofacial hard tissue defect caused by head neck ablative tumor surgery, osteomyelitis or severe trauma would physiologically and psychologically affect patients’ life quality. However, the complexity of this regional anatomy makes it a great challenge for plastic surgeons to reconstruct the facial contour and rehabilitate the occlusion function. Nowadays, the optional approaches for craniofacial reconstruction include reconstructive titanium plate, nonvascularized bone grafts, vascularized osteocutaneous flaps and distraction osteogenesis etc. Improvement in microsurgical techniques, refinement of titanium fixation systems, and development of digital surgery techniques have revolutionized the craniofacial reconstruction. Functional and aesthetic rehabilitation of the patients have become a basic goal for clinicians.

Over the past 30 years, the digital surgery techniques have been widely spread all over the world, more and more attention has been paid to the individual and functional craniofacial bone reconstruction. Optimal 3-dimensional configuration of the graft is the crucial factor affecting the facial contour and the occlusion relationship, which the patients highly concerned. With modern digital surgery techniques, including computer aided design and computer aided manufacture (CAD/CAM), rapid prototyping (RP), reverse engineering (RE) and surgical navigation, the individual bone model can be fabricated based on computed tomography (CT) data, which is valuable for the shaping procedure of the bone graft. Also, the software programs can enable the clinician to operate virtually before the surgery, progressing from simple 2-dimensional images to sophisticated 3-dimension surgical simulation covering intraoperative procedures.
such as virtual reality osteotomies, distraction osteogenesis and placement of bone grafts. The surgical simulation with 3-dimension stereolithographic model helps to establish confidence for the operator, improve the young clinicians’ surgical skills, and make the operation visualized for patients.

The surgical techniques are usually combined to achieve a better outcome for patients, it can dramatically improve the safety and precision of the plastic surgery, achieving a designed purpose of both facial contour recovery and occlusal rehabilitation. With the rapid development of computer techniques, new digital surgical techniques are seen to be created, so it’s believed that the individual and functional craniofacial bone reconstruction is to be achieved precisely according to the pre-operation planning in the future.

3D Printing in Musculoskeletal Oncology

Yang Guk Chung
CATHOLIC UNIV.

1. History
Three dimensional (3D) printing is the additive manufacturing of 3D objects from the digital data. In addition to 3D printing, the terms of rapid prototyping, solid freeform fabrication and additive manufacturing are used to describe this technology. The inception of 3D printing can be traced back to 1976 when the inkjet printer was invented. In 1984, Charles Hull invented streolithography (SLA), a printing process that enables a tangible 3D object to be created from the digital data. Three D model was manufactured from a picture and allowed users to test a design before investing in a larger manufacturing program. In 1990s stroelithographic apparatus (SLA) manufactured three dimensional highly complex building parts with layer by layer accumulation overnight. During 2010s, application of 3D printing technology was extended to various industrial fields such as production of robotic aircraft, car body, jewelry and prosthesis for medical usage.

2. 3D printing Technology
Not all 3D printers use the same technology to produce their objects. There are several ways. Selective laser sintering (SLS) and fused deposition modeling (FDM) used melting or softening of materials to produce the layers. And in stroelithography, liquid materials were laid down and cured. Selective laser melting (SLM), electronic beam melting (EBM) and direct metal fabrication (DMF) are other different ways of 3D printing introduced.

3. Current applications
Concurrent application of 3D printing technology in orthopedic oncology includes manufacturing of patient-specific anatomic models, designing and modeling of patient-specific surgical instruments (PSI),
and production of custom made implant or prosthesis.

a. Anatomic models can be used for preoperative planning in complicated surgery. A separation surgery of conjoined brain twin (Fig 1A-C) was planned and simulated before real surgery using the 3D printed anatomic models. With the aid of 3D real anatomic model, Dr. Kawamoto separated conjoined brains in 22 hours, which was far advanced compared to 97 hours with conventional technique. Hiring the anatomical model manufactured by 3D printing technology is useful for planning complex, multidisciplinary tumor resection procedures based on their visualization of tumor anatomy and its relationship to adjacent critical structures (Fig. 2). It is also very helpful in simulating tumor surgery, multidisciplinary discussion on team approach and patient education.

![Fig. 1. A-C. Preoperative planning and simulation of separation surgery using 3D anatomic model for conjoined brain twin were helpful to reduce the operation time and to perform more accurate surgery. A. A clinical photography of conjoined brain twin. B. MR images showed status of conjoined brains. C. 3D anatomic model of conjoined brains reveals details.](image)

b. Patient-specific instruments (PSIs) for pre-planned bone cutting can also be designed and manufactured by 3D printing methods and used intra-operatively. With PSIs, more accurate and effective tumor resection is possible because compared to navigation method or surgical robotics, PSI method does not require continuous tracing or registration steps, which are sources of errors and time consuming. Using PSIs also allows a perfect matching of custom made prosthesis to bone defect after tumor resection. (Fig. 3) Proper design and accurate fitting to the remaining bone are required to achieve this goal.

![Fig. 3. A: MR image of a patient with an osteosarcoma of the left distal femur. B. A surgical jig was made according to the defined bone resection levels. C. The matching surface contour at the distal resection site. D. A perfect matching of a custom made intercalary prosthesis to bone defect after resection using PSI. (With permission of KC Wong, Computer Aided Surgery 2012;17:284-93)](image)

c. The most important application of 3D printing is the manufacturing of custom made implant and prosthesis. Various types of implants can be manufactured by 3D printing technology (Fig. 4A-C). Using the ability of 3D printing method to reproduce the complex shapes and structures of the resected bones, it is possible to manufacture implants customized to each patient’s needs. This kind of implants are especially useful for reconstruction of pelvic or sacral bone defects after tumor resection, because the results of conventional methods used for pelvic reconstruction were discouraging with high complication rate of infections, loosensings, breakages, fractures and functional deficits.

![Fig. 2. The 3D printed anatomic model reveals the complex Pancoast tumor (arrowheads) that was encasing ribs and nerves of the brachial plexus and surrounding structures in contrast colors. (With permission of Dr. Matsumoto JS, JAMA Oncology 2016;2:1121-2)](image)
Recently, Guo et al. reported 35 patients of pelvic tumors treated with 3D printed pelvic prosthesis made from titanium alloy by electronic beam melting technology. In their series, they used three types of 3D printed endoprostheses: iliac prosthesis, standard hemipelvic prosthesis and screw-rod connected hemipelvic prosthesis. The mean musculoskeletal tumor society functional scores were 22.7, 19.8 and 17.7 respectively (Fig. 5A-F). There were 7 delayed wound healings and 2 dislocations of hip as complications. They concluded that the application of 3D printing technology facilitated the precise matching and osteointegration between implants and the host bone which resulted in good short-term functional results without additional complications.

In our experience, scapular reconstruction is one of the good indications of hiring 3D printing technology, because scapular has complex anatomic and functional elements. A eight year old female patient with Ewing’s sarcoma involving right scapular body was managed with subtotal scapulectomy and reconstruction with 3D printed prosthesis. The glenoid and coracoid process portion and distal pole of scapula were preserved and 3D printed metallic scapular body was implanted into the bone defect site. At 18 months after operation, the patient showed excellent functional outcome and continuous disease free (CDF) status. (Fig. 6)
Combination of surgical cutting jig or navigation with 3D printed prosthesis, an accurate tumor resection and stable reconstruction with perfectly matched implant can be achieved. Donati DM at Instituto Orthopaedico Rizzoli (Bologna, Italy) developed 3D printed custom made prosthesis with bone cutting jig and achieved a wide oncological surgical margin, primary stability of implant and durability of prosthesis.

The manufactured implant had wide trabecular space for muscle integration, porous bone prosthesis bearing surface for bone ingrowth and polished finite parts to avoid muscle friction. (Fig. 7)

Unsolved problems

However, 3D printing in musculoskeletal oncology is still in the stage of beginning and many unsolved problems such as possible fatigue fracture associated with weak biomechanical strength, aseptic loosening of large segmental reconstructed body with insufficient bone ingrowth, inefficient soft tissue attachment and difficult assembly with modular joint prosthesis. Restoration of internal structures resistant to repeated long-standing heavy load on that specific region especially in pelvic and spinal areas is required for long survival of prosthesis. Rapid and efficient bone ingrowth into the surface of prosthesis from the contacting host bone is also one of the key elements of successful reconstruction. Even with recent progression, stable assembly with artificial joint components and durable attachment of muscle, tendon and ligament to restore the function of reconstructed structures are still remaining issues.

Restoration of durable load-bearing trabecular bone structures which reproduce a much complex shapes and stress/strain characteristics of pelvic or spinal bones is necessary to prevent stress failure of prosthesis. At prosthesis-host bone junction, cooperation of ideal porous structures feasible for bone ingrowth and surface treatment friendly to osseous proliferation is required.

Even with PSIs, resection of bone tumors in complex anatomy such as pelvic bone, sacrum and scapula can be inaccurate due to complex geometry, limited visibility and restricted working space of those regions. Designing, manufacturing and precise application of PSIs during operation should be matched to
surgical approaches used and detailed surface anatomicies of specified regions.

Conclusion
To accomplish surgical goals, various factors should be considered, and intimate collaboration between clinicians with anatomical, functional and biological knowledge and engineers who work on metal materials, biomechanics, designing and manufacturing process of prosthesis is essential. Reasonable cost requirements, acceptable time scales and regulatory approval and supporting for clinical application are necessary to activate the clinical use of 3D printing technology in orthopedic oncology.

References
The management of periprosthetic fractures is an issue of increasing importance for orthopaedic surgeons. Because of the expanding indications for total hip arthroplasty (THA) and an aging population with increasingly active lifestyles, the incidence of primary and revision THA is increasing, and there is a corresponding increase in the prevalence of periprosthetic fracture of the femur (PFF). Surgical management of PFF is technically demanding given the often poor bone quality, altered anatomy, and need to manage both the prosthesis and fracture. When deciding on how to treat a PFF, the first decision point surrounds whether or not the stem is well fixed. In general terms, well fixed stems require open reduction and internal fixation, whereas loose stems require revision arthroplasty. The most commonly used classification system for periprosthetic fracture around THA is the Vancouver classification which stratifies these injuries based on the location of the fracture and the stability of the implant. The stability of the femoral component in the proximal fragment is the cornerstone of this classification.

The strongest risk factor for failure after treatment of PFFs is underestimation of stem stability. The surgeon, in many cases, misinterpreted the stability of the stem and classified a type B2 fracture as type B1, and subsequently undertake treatment with plate fixation without revision of the stem. The literature reports a higher rate of failure for osteosynthesis around prostheses considered to be well-fixed. Rates of reoperation following ORIF of PFFs are reported from 13% to 23%. Decision making for stem stability rely on the careful evaluation of high quality standard AP and lateral radiographs of the entire femur and hip. Radiographs should be critically assessed for signs of implant loosening to distinguish between type B1 and B2 fractures. Failure to identify an unstable implant is likely to lead to treatment failure if osteosynthesis rather than revision arthroplasty is performed. Whenever possible, preinjury radiographs should be obtained for comparison. The implant-bone, cement-implant, and cement-bone interfaces should be carefully evaluated. Radiographic signs of definite loosening include progressive periprosthetic or cement mantle lucency, a change in the position of the stem, and component or cement fracture. High energy trauma associated with comminuted fracture also have high chance of loose stem. Radiographic signs of probable loosening include greater than 2 mm of periprosthetic or cement mantle lucency around entire prosthesis, bead shedding, endosteal scalloping, and endosteal bone bridging at the tip of the stem. CT is occasionally useful for evaluating stem loosening if radiographic findings are inconclusive.
Biomechanical challenges of periprosthetic fractures

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Purpose: Figures of peri-THA fractures and treatment options/results were investigated, making a treatment protocol was considered from the view of biomechanical aspect.

Methods: Thirty-two cases were investigated. Intraoperative fracture cases were excluded. The average age at injury is 77.8 years old (range 50-91) and all cases were low-energy trauma. Vancouver’s classification and AO classification for fracture figures were used and investigated a union period and complications in each treatment options.

Results: All cases that fracture occurred within 10 years after THA were classified into Vancouver type B1. Beyond 10 years after THA, 6 cases out of 13 were recognized type B2 loosening, but considering an age and general condition of patients, only osteosynthesis was selected in 4 cases. For osteosynthesis, a plating system was used in all cases. Locking plates (+cable wire) were 11 cases, locking plates (-cable wire) in 4, Non-locking plate (+cable wire) in 10, Non-locking (-cable wire) in 5 and 2 cases were revised a stem. MIPO technique was done in 9 cases, early implant failure was recognized in 2 cases which were no comminution at fracture site. And one case developed delayed union. In cemented THA cases, if a fracture line sited at cement border region, delayed union rate was 50%.

Considerations: Cases no comminution at fracture region need an anatomical reduction regardless of MIPO technique. For this reason, first application of cable system to fix a proximal fragment is mandatory. An accurate contour is not always necessary because of using locking screws. Peri-THA&TKA fracture cases were severe osteoporosis related and comminated fracture pattern. MIPO is good indication for these fractures.

Principles of reduction and fixation

Tak Wing Lau
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Abstract:
Periprosthetic fractures occur in both upper and lower limbs. The principles of fixation are slightly different from normal shaft fractures in elderly. If the prosthesis is stable, early reduction and stable fixation is required. If the prosthesis is loosened, it requires a complete revision. In lower limb periprosthetic fractures, the aim of fracture reduction and stabilization is to allow immediate weight bearing walking and free joint motion after surgery. Before the surgical fixation, correct classification can help with the decision of surgical treatment. Vancouver or AO classification could be used. In periprosthetic fractures of femur, they are usually reduced by semi-open or open technique. Fracture is usually fixed by an extramedullary implant, usually a plate, reinforced with special implants, e.g. cerclage wires, cables and locking plate attachment system. Plate should be as long as possible to span the whole length of femur. In periprosthetic fracture with knee replacement, both plate and nail can be considered. A retrograde femur intramedullary nail can be used if femoral component has an open-box design. In upper limb periprosthetic fracture, plating is the treatment of choice. Reduction and fixation follows the principles of lower limb periprosthetic fracture management.
Case-based lecture-fracture around the femoral stem

Takeshi Sawaguchi
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Abstract:

With the increase of geriatric population, long life and frequent application of arthroplasty, there is an increasing number of periprosthetic fractures. The most common classification for periprosthetic femoral fractures is the Vancouver classification.

In the presentation, mainly Vancouver B cases will be presented and discussed.

Case 1: 74 y.o. female. B1 transverse fracture (cemented stem) treated by MIPO technique with locking plate.

Case 2: 86 y.o. female. B1 spiral fracture (cemented stem) treated by mini open reduction and MIPO with locking plate.

Case 3: 55 y.o. male. B2 comminuted fracture (cemented stem) treated with ORIF, locking plate fixation and stem exchange with cement in cement technique.

Case 4: 79 y.o. female. B2 long comminuted fracture (cemented stem) treated with ORIF, locking plate fixation and stem revision with a longer cemented stem.

Case 5: 77 y.o. female. B3 fracture with severe osteolysis (cemented stem) treated with revision cemented stem (only cemented distally) and proximal autogenous bone graft.

Case 6: 87 y.o. female. B3 fracture (cemented stem) treated with revision cemented stem and impaction grafting with allograft.

Case 7: 90 y.o. female. B3 transverse fracture (cemented stem) treated with distal locking cementless stem and impaction grafting with allograft.

In the treatment of periprosthetic femoral fractures, the location and configuration of the fracture, stem stability, cemented or cementless stem, bone loss should be evaluated. Careful preoperative planning is mandatory. Vancouver B1 and C can be treated with ORIF using a long plate. In B1 cases, always prepared to convert to revision. In B2 cases, the stem should be revised and additional plate fixation sometimes necessary. Former stem fixation mode (cemented or cementless) will influence the revision procedure. In B3 cases, revision and bone restoration is necessary, it can be done mostly with impaction grafting with allograft. In very old age patient distal locking stem can be an option.
MEMO

The 61st Annual Congress of The Korean Orthopaedic Association

Sung Taek Jung

Memorandum


Cutting Edge Technology in the Field of ASAMI Society of Asian Countries

Chang Hoon Jeong
Comparison of Joint Distraction and Non-distraction using an Ilizarov External Fixator in the Treatment of Ankle Fractures in Older Patients

Koji Nozaka
AKITA UNIVERSITY GRADUATE SCHOOL OF MEDICINE, JAPAN

Background:
Periarticular fracture of the ankle in elderly individuals is likely to become posttraumatic ankle arthritis. In osteoarthritis (OA), subchondral bone changes alter the joint’s mechanical environment and potentially influence progression of cartilage degeneration. Joint distraction as a treatment for OA has been shown to provide pain relief and functional improvement through mechanisms in periarticular fracture of the ankle that are not well understood. To conduct a retrospective study comparing treatment effects of joint distraction and joint non-distraction using Ilizarov external fixator methods among elderly patients with periarticular fracture of the ankle.

Subjects:
We investigated a total of 54 patients >60 years old who showed fracture of the distal tibia including tibial plafond fracture or tri- or bimalleolar fracture of the ankle (excluding unimalleolar fractures), upon admission to our department from among the 601 patients for whom after a surgical treatment for an ankle fracture using Ilizarov external fixator who were followed for at least 2 years. Patients were either treated with distraction (n=26) or non-distraction (n=28). The mean age of patients was 72.4 years (range, 60-78 years) in the distraction group and 70.2 years (range, 42-100 years) in the non-distraction group. All patients received partial weight-bearing (as tolerated) 1 day postoperatively, 1/2 partial weight-bearing at 2 weeks postoperatively, and full weight-bearing at 4 weeks postoperatively.

Results:
Bone density (relative to young adult mean, YAM) was 55.8% (range, 28-70%) for the distraction group, and 61.2% (range, 38-70%) for the non-distraction group. Mean range of motion in the sagittal plane was 45.3° for the distraction group and 38.9° for the non-distraction group. The mean AOFAS score was 94.2 (range, 72-100) for the distraction group and 67.2 (range, 42-100) for the non-distraction group. It was significantly higher with the distraction group (p<0.05).

Discussion:
In elderly patients with periarticular fracture of the ankle, those who received joint distraction treatment showed higher in AOFAS score compared to those who received joint non-distraction treatment. Joint distraction may become an useful option in the treatment of periarticular fracture of the ankle in elderly individuals.
Treatment of the lower limb deformities by a multi-axial external fixation system

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¹Department of Orthopaedic Surgery, Nagoya University Graduate School of Medicine, Japan.
²Department of Orthopaedic Surgery, Aichi Children’s Health and Medical Center, Japan.

Background
Deformities of the upper and lower limbs can gradually be corrected by external fixators in a less invasive manner. Monolateral external fixators are simple to apply but have limited capabilities of three-dimensional deformity correction. Using a multi-axial correction (MAC) monolateral external fixation system, we have performed corrective osteotomies with or without simultaneous lengthening for various deformities of the lower limb. We evaluated the final alignment of the treated limbs with the MAC system and determined the effectiveness of this fixator during corrective osteotomies of the lower limb.

Methods
We retrospectively reviewed the medical records and radiographs of 46 bony segments in 32 patients (mean age 12.9 years; range 6-23 years) who underwent correction osteotomies of the lower limb with or without simultaneous lengthening between 2003 and 2016. 19 segments were treated with the MAC system (monolateral group), while 27 were treated with circular fixators (circular group), including Ilizarov and Taylor Spatial Frame. Simultaneous lengthening was performed in 11 segments of monolateral group and 20 segments of circular group. 40 segments in 26 patients were congenital deformities and 6 segments in 6 patients were acquired deformities. At the latest follow-up, we measured leg length discrepancy (LLD) and mechanical axis deviation (MAD).

Results
The average age of surgery was 15.8 ± 4.3 years in monolateral group and 10.8 ± 3.3 years in circular group. The preoperative coronal deformity were 20.8 ± 12.2 degrees in monolateral group and 20.1 ± 9.7 degrees in circular group, respectively. The amount of correction for coronal deformity and the duration of the external fixators were similar between both groups. There were two major complications in the monolateral group, including one compartment syndrome and one regenerate fracture after falling. Transient peroneal nerve palsy after acute correction was observed in 4 segments. The MAC system showed a LLD of 10.9 ± 11.7 mm and MAD of 3.2 ± 22.9 mm medial.

Conclusion
The MAC system provided acceptable alternative for the treatment of deformities in lower extremity.
Novel Management of Larger Bone Defect: Combination of Biomaterials and Distraction Osteogenesis Technique

Gang Li
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Introduction: Distraction osteogenesis (DO) techniques have been widely accepted and practiced in orthopaedics, traumatology, and craniofacial surgery over the last two decades, using DO methods, many previously untreatable conditions have been successfully managed with outstanding clinical outcomes. The major limitation of DO is relatively long period required for new bone consolidation. Here, we investigated whether the application of biomaterials, including polycaprolactone (PCL) and hydroxyapatite (HA) cylinder or composite microspheres could be used to reduce the treatment time and enhance bone formation in DO.

Study 1: A 1.0cm tibial shaft was removed in the left tibia of 36 rabbits and divided into three groups: Group A, the defect gap shortened for 1.0-cm; Group B, the defect gap was filled with 1.0-cm porous hydroxyapatite/tri-calcium phosphates (HA/TCP) cylindrical block; Group C, The 1.0-cm defect gap was reduced 0.5cm and the remaining 0.5-cm defect gap was filled with 0.5-cm HA/TCP block. The tibia was then fixed with unilateral lengthener; for groups A and C, lengthening started 7 days after surgery at a rate of 1.0 mm/day, in two steps. Group A received lengthening for 10 days and Group C for 5 days, there was no lengthening for Group B. All animals were terminated at day 37 following surgery. The excised bone specimens were subject to micro-CT, mechanical testing and histological examinations. Results: Bone mineral density and content and tissue mineral density and content, as well as the mechanical properties of the regenerates were significantly higher in Group C compared to Groups A and B. Micro CT and histological examinations also confirmed that the regenerates in Group C had most advanced bone formation, consolidation and remodeling compared to other groups.

Study 2: Pure PCL microspheres and composite PCL and 10% HA microspheres were synthesized using a modified solvent evaporation method. Bone mesenchymal stem cells isolated from green fluorescent protein rats (GFP-rBMSCs) were cultured with these microspheres in a rotary bioreactor system. The formation of the microstructures was confirmed by scanning electron microscopy (SEM). We confirmed that PCL/HA promotes osteogenic differentiation of rBMSCs in vitro. To investigate the effects of addition biomaterials on bone consolidation during DO process, PCL/HA (20 mg), PCL (20 mg), or PBS were then locally administered into the distraction gap in Sprague-Dawley male rat DO model towards to the end of distraction period and animals were allowed for bone consolidation for 4 weeks after the distraction completed and then terminated. Weekly x-rays, micro-computed tomography, mechanical testing, histology, and immunohistochemical examinations were performed to assess the quality of the newly bone. Results: The microspheres used were of the uniform size and monodisperse. After incubation with rBMSCs in culture, PCL/HA microspheres showed a better ability of cell adhesion and osteogenic differentiation comparing to PCL microspheres. In the rat DO model, the bone volume/total tissue volume, bone mineral density, and mechanical properties of the newly formed bone were significantly higher in the PCL/HA group compared to the PCL and PBS groups. Histological and immunohistochemical analyses confirmed improved bone formation and vascularization in the PCL/HA group.

Conclusions: The combined use of biomaterials such as HA/TCP blocks or PCL/HA composite microspheres in DO is a novel approach for promoting bone regeneration and consolidation, their clinical applications may reduce the treatment time, pain and suffer of the patients.
Lower Limb Reconstruction in paediatric Orthopedics

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Abstract

Lower limb reconstruction in paediatric orthopaedics can be challenging. The spectrum of conditions can range from the simple acquired uniplanar deformity to the complex congenital multi-planar deformity with limb deficiency. Early diagnosis will help with appropriate treatment. Growth plate modulation can be useful for selected cases. The principles of deformity correction are important in limb reconstruction. External fixator treatment is reserved mainly for the correction of more complex deformity and deficiency. It is important to understand the bone and soft tissue constrains for every case. Treatment may occasionally have to be staged and can continue even into skeletal maturity. Pre-operative counselling and post-operative support for the patient will optimise the outcome of treatment. The types and techniques of external fixator treatment will be elucidated for various conditions in paediatric lower limb reconstruction.

Game changers in Limb lengthening and Deformity Correction Field

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골연장 및 변형교정 분야는 최근 급속히 발전하고 있다. 특히 연장 및 변형교정을 위한 기계적혁신은 고식적인 일리자로프 수술방식에 비하여 환자의 통증과 불편을 줄이고 더 좋은 임상적 결과를 가져왔다. 골연장 분야에서 가장 혁신적인 발전은 내고정 기계를 이용한 연장(lengthening with lengthening nail)이다. 일리자로프와 같은 외고정강사를 이용한 전통적인 금속연장에 관한 합병증 중 가장 흔한 것은 릴 관련 문제이다. 가장 흔한 합병증은 pin-site infection으로 minor infection은 2~80%로 보고되었고, major infection도 23%까지 보고되었다. 외고정강사를 이용한 금속연장이 오랫동안 발달됨에 따라 합병증이 많이 줄어 들었으나 외고정강사를 오랫동안 착용하는 것은 불편하며, 문제도다. 1956년 Bost와 Larsen이 처음가능성을 보여주었고, 이후 Paley와 Herzenberg가 정립한 LON(Lengthening Over Nail)은 외고정 및 내고정의 장점을 모두 취할 수 있는 좋은 수술법으로 현재까지 널리 이용되고 있으나 이는 릴 연장 기간 동안 외고정 장치를 착용해야 하므로 합병증이 많아져 극복할 수 없었다. 금속연장은 골연장 기계를 이용한 연장기술과 공존하면서도 합병증을 최소화하는데는 한계가 있었다. 외고정기술이 없이 연장기술이 있는 기술이 요구되었고, 이에 부응하여 1987년 Guichet가 torsional motion으로 활성화되는 mechanical device(Albizia®)을 개발하였는데, 각 rachet 당 0.07mm가 연장되도록 고안되었다. 이후 임상적 적용은 성공하였으나 연장기 기술의 최소 20°의 racheting movement를 위하여 실제적으로는 90°에 가까운 다리의 회전동작이 필요하였다. 이로 인한 통증으로 비판을 받았고, 수술 후 racheting motion을 위한 전신마취가 22~39% 빈도로 보고되었다. 이후 독일의 Dr. Baumgart는 motorized electronic nail(Fitbone®)를 개발하여 다리의 회전동작 없이 연장이 가능하게 되어 연장 중 통증이 많이 줄었다고 보고하였다. 이론적으로 전
기적 작동방식은 연장 속도 및 리듬을 정확하게 조절할 수 있다는 큰 장점이 있으나 Fitbone®은 이에 대한 기계적 신뢰성에 의문을 가지고 있는 의사들이 많은 실정이다. 미국 FDA 승인을 처음 받은 제품은 ISKD®(Orthifix, USA)이다. 1995년 미국의 Dr. Cole가 개발한 ISKD®의 기능적 장점은 3~9° 정도의 정확한 속도로 작동하게 되는 클러치 원리(clutch mechanism)로서, 일정한 움직임만으로도 연장이 가능하고 따라서 Albizzia의 과도한 회전 동작으로 공중을 줄일 수 있다는 것이었다. 또한 연장속도를 모니터로 측정할 수 있게 하여 환자 스스로 조절할 수 있게 하였다. 하지만 ISKD는 많은 문제점들이 보고되었는데, 가장 중요한 단점으로 연장속도 조절의 어려움이 부각되었다. 특히 femur lengthening 시 의도하지 않은 지나치게 빠른 연장(run away)으로 인한 골형성 부전(insufficient bone regenerate)이 25%까지 보고 되었고, 비정상적인 속도조절이 60%까지 보고되었다. Rozbruch는 ISKD를 이용한 대퇴골 연장을 평균 1.9mm/day의 연장속도를 보였고, LON보다 더 긴협성이 좋지 않다고 보고하였다. 그 외에도 느린 연장속도로 인한 premature consolidation, hardware malfunction 등으로 인한 unexpected additional surgery가 필요하였다. 저자들은 ISKD의 문제점으로 속도 조절 자체의 문제 뿐 아니라 속도 조절이 안될 경우 심한 통증도 지적하였다. 또한 내고정 장치 이용한 긴절 연장 시 축만방의 저항을 극복하기 위해서는 매우 강력한 자세적 부하를 필요로 한다. 이론적으로 정화된 속도 조절이 가능한 것은 장점이지만, 실제로는 자세적 부하를 약화함에 따라 체중 부하가 일부 감소하게 된다. 이는 실제 연장 속도가 설계된 속도와 다르게 발생할 수 있으며, 이는 정확도를 저하시키고, 기계적인 문제 발생의 원인이 된다. 또한 연장속도를 모니터로 측정하여 환자 스스로 조절하고자 하는 것은 매우 유리한 방안이지만, 이론적으로 정확한 속도조절이 가능하지만, 실제 연장속도는 측정치에 비해 약간 높아질 수 있다. 이는 연장속도의 정확성을 떨어뜨리게 하며, 이는 환자들의 불안정성을 증가시키고, 더욱 치료의 장애를 초래할 수 있다. 따라서 연장속도를 정확하게 측정하고, 환자 스스로 조절할 수 있게 하는 것은 매우 중요하다.

Reference
Sacro-pelvic bone cancer surgery

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Resection and reconstruction for pelvic ring cancer

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ABSTRACT

INTRODUCTION: Surgical treatment of pelvic ring cancers are still challenging because of the complicated anatomy. Especially, surgical treatment of sacral tumors are most difficult. Massive bleeding, high local recurrence, and poor functional results are serious problem. Our strategy is as follows. P1; Resection only, occasionally bone grafting if the ring is disconnected. P2: Resection and reconstruction with constrained THA, occasionally hip transposition is applied. P3: Resection only. P4; Resection only, exceptional SI joint and spine fusion after total sacrectomy. We will show the advantage of posterior approach for the resection of tumors, and introduce the tips of the technique. Case presentation will be performed by our experience of P4 resection. The results of heavy iron radiation therapy (HIRT) for sacral chordoma will also be showed as a control.

METHODS: About P4 resection, 21 cases operated from 1997 through 2005 were included. After 2005, HIRT was mainly performed. Mean age was 52 year-old. Mean follow up period was 135.7 months. Chordoma was most popular (11 cases) followed by GCT (4), chondrosarcoma (3), and metastasis (3). These were divided into two groups, anterior approach group (AG) and posterior approach group (PG). Survival rate, local recurrence, and complication were examined.

RESULTS: Total 10 and 15-year survival rate was 75 and 47 %, respectively. Recurrence rate was 41 %. Survival rate was worse in AG, but not statistically different. The blood loss of AG and PG were 8,545 and 1,583 ml, which was statistically different. Local recurrence rates of chordoma were 100% in AG and 40% in PG. Limb function was 79 % (ISOLS) due to low emotional acceptance. Vesico-rectal function was also disturbed even in cases whose S2 nerve roots were completely preserved. Thirteen complications were observed in 10 cases. Wound trouble was most frequent (8 events) followed by infection (2). There was no infection in PG of chordoma. We have experienced HIRT for chordoma in 11 cases. Local recurrence and metastasis occurred in 1 and 2 cases, respectively. Vesico-rectal disturbance was observed in 6 cases.

DISCUSSION AND CONCLUSION: Posterior approach was preferable to reduce bleeding and to perform precise osteotomy of the pelvic ring. Safe clearance of the sciatic notch is the most critical point to achieve less invasive and more reliable wide resection for the local control. S3 nerve root may be essential to maintain normal vesico-rectal function. HIRT may be also effective at least for sacral chordoma.
Sacrectomy: Modern surgical technique

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Resection of sacral tumor is one of most difficult surgeries in the field of orthopedic oncology because complex anatomy in the pelvic cavity makes it difficult to achieve safe resection margin. In addition, wide resection of sacral tumors may lead to serious functional impairment due to injury of lumbosacral nerve roots and disruption of load-bearing axis. Recent advances in diagnostic modalities and surgical technique facilitate better surgical planning and can help in the performance of preservation of important structures. We reviewed the recent challenges for elimination of tumor and reduction of functional impairment.

Computer-assisted pelvic ring cancer surgery

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Abstract
Conventionally, tumour surgeons analyse two-dimensional imaging information and mentally integrate and formulate a three-dimensional surgical plan. It is hard to translate the surgical plan to the operating room in complex cases with distorted surgical anatomy, like in pelvic or sacral tumors. Therefore, there is always a strong clinical need for better surgical aids to guide surgeons to achieve what was planned for tumour free margin and bone reconstruction.

Computer Assisted Tumor Surgery (CATS) has been developed and applied in Orthopaedic Oncology for last decade. The technique may enable surgeons:

1) 3D based surgical planning with multi-modal fused images (including anatomical imaging: CT and MR and functional PET imaging)
2) exact correlation of imaging information to the real anatomical, pathological structures at the surgery under navigation guidance;
3) Image-guided bone resection as planned;
4) Accurate matching with prosthetic or allograft reconstruction.

Early results suggested that the technique may be helpful in safe tumour resection and may improve surgical accuracy by replicating the preoperative planning. The improved surgical accuracy may offer clinical benefits. Two recent reports from UK group showed that the improved surgical accuracy might translate into a better oncological outcome in pelvic bone sarcoma surgery by mitigating intralesional resection with better disease-free survival. The technology may also serve as a useful tool to evaluate
surgical margin and its related oncological results.

The navigation assisted technique requires bulky and costly navigation facilities, the presence of a system operator in the operating room, and the lack of industrial support of making a reliable navigated saw or osteotome. A simpler alternative to using 3D-printed Patient Specific Instrument (PSI) has been reported to replicate bone resections with similar surgical accuracy to navigation assistance. Its exact role remains to be determined in bone sarcoma surgery.

Given that bone sarcoma is rare, the published reports from different tumour centres could only analyse relatively small patient population with the heterogeneous histological diagnosis Multicenter comparative studies with long-term follow-up are necessary to confirm its clinical efficacy.
The evaluation and conservative treatment of internal impingement of shoulder for throwing athlete

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Introduction:
Internal shoulder impingement syndrome is frequently encountered in senior high school students and college students. The rate of positive findings of internal shoulder impingement syndrome in senior high school baseball players remains unknown. Therefore, the purpose of this study was to examine the rate of positive findings of internal shoulder impingement syndrome by using the HERT, as well as the utility of self-check methods derived from the HERT.

Subjects and methods:
Baseball skill camps are held annually in Kyoto Prefecture during the off-season. Study subjects were 515 senior high school baseball players who participated in baseball skill camps in fiscal years 2012 and 2013. All participants were male, and the average age was 16.3 ± 0.6 (16-17) years. Next, all players were subjected to 2 self-checks, which were similar to the HERT. The test was considered positive when this induced a subjective symptom consisting of pain in the posterior part of the shoulder joint. The sensitivity, specificity, accuracy, positive predictive value, and negative predictive value of the HERT in each self-check were measured. Chi-squared test was performed to examine the difference in proportions among the 4 groups.

Results:
HERT-positive players with positive findings with the self-check methods during the two-year period accounted for 44 out of 515 players, which represented a rate of 8.5%. The rate of positive findings was high in the following positions: pitchers, outfielders, catchers, and infielders, in the descending order, but no significant difference was found (P=0.417). The sensitivity, specificity, and accuracy in comparison with HERT, as well as positive predictive value and negative predictive value, were 46.2, 87.6%, 84.1%, 34.4%, and 94.5%, respectively for self-check A, and 80.8%, 83.0%, 82.8%, 32.4%, and 97.8%, respectively for self-check B.

Discussion and conclusions:
It is a self-check test which allows for easy reproduction of the HERT performed by physicians, and is a useful method which allows players to check and confirm an internal shoulder joint impingement by themselves. Thus far, we have evaluated the presence or absence of pain in players suffering from shoulder joint pain who decided by themselves to consult a hospital, or in those who participated in a systematic health screening and underwent a medical checkup.

4) Bigliani LU, Morrison DS, and Ahmad LU. The morphology of the acromion and its relationship to rotator cuff tears. Orthop Trans 1986; 10:228
6) Codman EA. The shoulder. the pathology of the subacromial bursa and of the supraspinatus tendon. Thomas Todd, 1934; 65-107.
8) Gerber
Shoulder injuries among Japanese professional baseball players

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Japanese baseball pitchers usually begin to play baseball in their elementary-school days, and they must throw a lot of pitches in their high-school days in order to win the summer baseball championship, as we call the Koshien tournament. Therefore, they often suffer from shoulder pain after they advance in their career to the professional level. The pathology we see most among professional baseball pitchers is internal impingement, either with the SLAP lesion or not. Such players usually have posterior shoulder tightness, weakness around the scapular muscles, and limitation of internal hip rotation. Of course, it is important to help them regain good condition not only their shoulders, but also the scapula, trunk, and hip. Moreover, we must pay attention to the concomitant pathology, such as subacromial impingement or long head tendinitis of biceps brachii. We usually diagnose the pain origin with a block test by injecting local anesthetics to the glenohumeral joint, subacromial space or bicipital groove with ultrasonographic guide assist. Next, we often see muscle atrophy of infraspinatus muscles in baseball pitchers due to the repetitive, eccentric contraction of the infraspinatus muscles. Sometimes, however, the paralabral cyst close to the supraclavicular nerve may cause atrophy. We can diagnose the paralabral cyst easily with ultrasound from the fossa, between the clavicle and scapular spine. Third, we sometimes see first rib stress fractures. Baseball players usually twist their necks in the opposite direction of their trunk while throwing or batting to resist trunk rotation. Such neck muscle contraction, especially anterior and middle scalene muscles may cause the origin of the stress fractures. These players often complain about pain around the medial superior part of scapulae, not at the deep part of clavicles. It is easier to make a diagnosis by the cervical A-P X-ray examination rather than by scapular one. Finally, we often see the thoracic outlet syndrome. They complain of dullness in their shoulder girdles or numbness and loss of muscle strength in their upper extremities. We check for tenderness at the cervical plexus, subclavicular fossa, inferior part

of the coracoid process, or quadrilateral space. The Roos test and Wright test is useful to diagnose this pathology. Although we usually suggest the scapula-thoracic exercise and muscle strengthening of the para-scapular muscles, partial rib excision sometimes needs to be performed to relieve such symptoms.

Biological application in ACL surgery

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ACL repair with biological agents have been an option for future treatment of acute ACL injuries. Novel treatment methods for repair and regeneration of ACL injury with biological approaches have been developed. Identification of obstacles to native ACL healing is crucial for developments of potentially solutions using biological strategies. Understanding the mechanisms of this healing process and the nature and potential of stem cells and progenitor cells for treating ACL injury and the cells involved may lead the way for novel and biology-based techniques for treatment of ACL injury. Several biological factors influence the healing after ACL injury process that mainly through the local growth factors and ACL cell repair mechanisms controlled by stem cells or progenitor cells. Growth factors have demonstrated their roles in the healing process of ACL injury. These growth factors, including transforming growth factor (TGF), epidermal growth factor (EGF), vascular endothelial growth factor (VEGF), insulin like growth factor (IGF), basic fibroblast growth factor (bFGF), and platelet derived growth factor (PDGF), were proved to potentially regulate the ligament cell activities, promote cell proliferation of ligamentous cells, induce extracellular matrix deposition, and influence the differentiation of mesenchymal stem cells into fibroblasts to achieve the repair of ACL tears. The use of platelet rich plasma is considered for improving the healing of ACL injury. Mesenchymal stems cells have demonstrated their roles in the healing process of ACL injury. These stem cells, including adipose derived stem cells and ACL derived stem cells for the repair and regeneration of torn ACL. Successful ACL reconstruction with tendon graft requires solid tendon to bone healing in the bone tunnels and progressive graft ligamentization for biological, structural and functional recovery of ACL. Improvement in graft healing to bone is fundamental and decisive to facilitate early and aggressive rehabilitation after surgery for early return to pre-injury sports ability. Healing of tendon graft in bone tunnel requires bone ingrowth into the tendon or tendon growth into bone to achieve incorporating anchorage. Indirect Sharpey fiber and direct fibrocartilage integration of tendon-
bone interface provide different anchorage strength and interface property of healing. Theoretically, interface fibrocartilage formation as translational structure from tendon to bone is more physiological and functional after implantation of tendon graft into the bone tunnel. Biological enhancement techniques for tendon graft healing in the bone tunnel have been proposed by means of various biomaterials.

Does cutting the lateral retinaculum and reconstructing MPFL result in improved patellofemoral incongruency?

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Patellofemoral malalignment is usually manifested as two major symptoms, patellar instability and anterior knee pain. It may be caused by a variety of dysplasia skeletal deformities and could be classified according to the involved planes as sagittal (patellar alta), axial (trochear dysplasia, excessive femoral antversion and tibial external rotation), coronary (valgus knee) and combined planes (miserable malalignment syndrome). Torsional deformities in the lower limb frequently remain underrecognized as the reason for patellofemoral malalignment and are therefore not addressed by so called targeted therapies. Maltracking of the patella is present as the tracking of the patella deviates from its physiological kinematics and demonstrates as proximal and/or distal subluxation. Proximal malalignment, often called J sign, indicates the patella over-lateralisation in extension and centralization in approximate 20 degrees of knee flexion. J sign is a special subset of injury pattern among recurrent patellar instabilities. Multiple factors including both dynamic (quadriceps muscle) and static factors (skeletal abnormality) were recognized as the pathogenesis. Distal realignment procedures such as MPFL reconstruction, lateral release and tibial tubercle transposition, aiming to reduce the patella into the trochlea, failed to address the underlying torsion deformity and therefore, had a higher recurrent rates due to inability to change the dynamic orientation of quadriceps which could pull the patella into its original maltracking position after operation. Postoperative recurrence of J sign produces negative influence on MPFL graft and should be emphasized and addressed. In another hand, in existence of torsion deformity, distal realignment procedures could likely produce an iatrogenic squinting patella. In this lecture, excessive femoral torsion deformity as a common cause of J sign and lateral subluxation will be introduced and its corrective derotational distal femur osteotomy (D- DFO) and/or derotational HTO (D-HTO) will be presented with
the philosophy of putting the trochea underneath the patella. The author’s preliminary clinical outcomes as well as the relevant literatures demonstrated the D-DFO and/or D-HTO as an encouraging and promising procedure to: 1) restore the normal patella-femoral congruence, 2) stabilize the patellar and 3) eliminate the maltracking J sign.
Distal Radioulnar Joint Functional Anatomy

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Distal Radioulnar Joint (DRUJ)
- Distal link between the radius and ulna
- Pivot for pronation & supination
- Articulation is incongruent
  - soft tissues play a substantial role in guiding and restraining joint

Bony structures
- Sigmoid notch has greater radius of curvature than the ulnar head
- Sigmoid notch is also shallow

Rims of sigmoid notch
- Dorsal and palmar bony rims substantially contribute to DRUJ stability
  - dorsal rim: acutely angled
  - palmar rim: more rounded
- Palmar rim is augmented by fibrocartilaginous lip
- Restraint to traumatic palmar dislocation of ulnar head

Soft tissue stabilizers
- Primary: DRUJ
- Secondary: TFC, ECU, DRUJ capsule, articular disk, UCL
- Innate: DRUJ, TFC, DRUJ capsule, UCL
- Extrinsic: DD, ED, extensor, PQ

Sigmoid notch shape (coronal)
- Parallel (med), Oblique, Reverse oblique
- May affect treatment options such as USO

USO in reverse oblique slope concentrates articular pressure

Sigmoid notch shape (transverse)
- Shape has potential implications for risk of traumatic instability and treatment options
  - Supination: 42%
  - Neutral: 30%
  - Pronation: 14%

Flat face is more prone to instability and less responsive to soft tissue repair alone
Sigmoid notch osteotomy

Ulnar head
- Stable unit of the forearm and supports loads transmitted from the radius and carpus
- Its curvature is slightly asymmetric
  - Small cam effect at the DRUJ during forearm rotation

Fovea of ulnar head
- Geometric center of the ulnar head is a shallow concavity called the “fovea”
- Devoid of cartilage and replete with vascular foramina that supply vessels to the TFCC
- Primary attachment site of distal radioulnar ligament and ulnocarpal ligament

Triangular Fibrocartilage Complex (TFCC)
- Distal radioulnar lig.
- Ulnar collateral lig.
- Meniscus homologue
- Articular disk
- ECU & subshielath

Distal radioulnar ligaments
- Principal stabilizer of the DRUJ
- Longitudinally oriented type-2 collagen to resist tense loads
- Rich vascular supply to allow healing
- Two limbs: deep and superficial

Deep limbs of DRUL
Hammock-like structure

Types of TFCC tear
- Distal capsular tear
- Proximal foveal tear
- Complete tear

Arthroscopic TFCC repair
- Superficial limbs tear
- Foveal limbs tear

Vascularity of TFCC
- Debridement
- Capsular repair
- Trans-osseous repair

Distal radioulnar ligaments
- Superficial limbs
  - Base or mid-portion of US
- Deep limbs: fovea

Fibrocartilage + Ligament
- Superficial limbs
- Distal components
  - Shock absorber
- Deep limbs
  - Proximal components
  - DRUJ stabilizer

The Iceberg Concept
Precise roles of the DRUL have been debated

Roles of DRUL - 1

In one view
- palmar ligament stretches and prevents dorsal displacement of the ulnar head in pronation
- dorsal ligament stretches and restrains palmar displacement of the ulnar head in supination

Roles of DRUL - 2

In the opposing view
- dorsal ligament stretches and restrains dorsal displacement of the ulnar head during pronation
- palmar ligament stretches and prevents palmar displacement of the ulnar head during supination

Distal interosseous membrane

- DIOM acts as a secondary stabilizer of DRUJ
- Distal oblique bundle (DOB) within DIOM - 45%

Distal 2 ligaments changed substantially in length during forearm rotation
- But, distal 3 ligaments (DOB, CB, AB) had little change in length
- Distal 3 ligaments of the IOM are essentially isometric stabilizers of the forearm

Take home message

- Skeletal architecture imparts minimal stability
- Soft tissues are the prime stabilizers

In Galeazzi fracture and dislocation, instability can be managed only by anatomical reduction of the radius fracture by plate fixation
Introduction

The distal radioulnar joint (DRUJ) provides the distal link between the radius and the ulna and a pivot for pronation and supination. Because the osseous structure of the DRUJ gives minimal inherent stability and surrounding soft tissue structures provide main stability, even feeble injury of the DRUJ can cause drastic clinical problems such as reduced forearm rotation, pain, instability, and arthritis. The principles of management for acute DRUJ instability, restoration of the normal anatomy of the radius, followed by the repair of associated TFCC injuries or ulnar styloid base fractures if necessary. In the chronic setting, radioulnar ligament reconstruction may be required if assuming that arthrosis has not developed.

Clinical presentation and physical examination

In an acute isolated dislocation of the DRUJ, a deformity with the dislocated ulnar head, local tenderness, swelling, weakness, and limited motion can be observed. Deep tenderness along the interosseous membrane and pain at the proximal radioulnar joint may indicate a concomitant Essex-Lopresti injury. Chronic DRUJ instability sometimes occurs without a history of a distal radius fracture. Patients usually report ulnar-sided wrist pain of a mechanical nature that is increased with wrist positions such as forearm rotation or ulnar deviation of the wrist. Localized swelling, crepitus, weakness, a sense of instability, painful clunk, and loss of rotation due to chronic subluxation. In addition, patients with ulnar impaction syndrome with a considerably large ulnar positive variance may have instability symptoms in addition to typical ulnar abutment symptoms. The ulnar fovea sign consists of tenderness when pressure is applied to the region of the fovea, in the soft depression between the flexor carpi ulnaris (FCU) tendon, ulnar styloid, and triquetrum. The physician should test the DRUJ stability by stabilizing the radius and translating the ulna to its volar and dorsal limits. The amount of translation and the firmness of the end point should be
compared with the contralateral side in neutral, pronation, and supination of the forearm. The ulnocarpal stress test is useful for provocating symptoms due to articular disc tear or ulnar impaction syndrome.

**Imaging studies**

Initial radiographic evaluation of the DRUJ includes a standard posteroanterior (PA) view and a true lateral radiograph of the wrist in neutral forearm rotation. A neutral rotation position is necessary to standardize ulnar variance measurement. Initial radiographic findings of wide displacement of the DRUJ and severe radial shortening are the most important risk factors for persistent DRUJ instability. A PA view with the forearm pronated and the patient making a power grip may reveal a dynamic ulnar positive variance and may reveal an increase in the DRUJ gap distance. Computed tomography (CT) can be used to evaluate DRUJ congruency and instability. CT imaging in supination, pronation, and neutral is the most accurate modality to evaluate the DRUJ for instability. Magnetic resonance imaging (MRI) is the primary advanced imaging method used for evaluating TFCC injuries. Arthroscopy is the gold standard for the diagnosis of an avulsion of the foveal tear as well as TFCC articular disc tear.

**Treatment**

1) Acute DRUJ instability

Although the most frequent cause for DRUJ instability is a distal radius fracture, instability after accurate reduction and fixation of the distal radius is uncommon. If instability persists after fracture repair, there are several options to promote a stable joint: (1) temporary immobilization of the forearm in the period of maximum stability using a sugar tong splint or long-arm cast and (2) percutaneous pinning of the ulna to the radius. When severe or bidirectional instability exists, ulnar styloid fixation or open or arthroscopic assisted TFCC repair, combined with radioulnar pinning, should be considered. Also in Galeazzi fracture-dislocations of the forearm, TFCC Ib injury is present almost inevitably, although there may be a spectrum of DRUJ instability.

When an isolated DRUJ dislocation is recognized acutely, reduction is accomplished easily, unless there is interposed soft tissue such as ECU tendon. After reduction, if the joint is stable in an acceptable position of forearm rotation, it is treated with an above-elbow cast in this position for 3 to 4 weeks followed by use of a well-molded short-arm cast for 2 to 3 weeks. As injury severity increases with progressive disruption of the secondary stabilizers including the IOM, the DOB, the ECU subsheath, ulnocarpal ligaments, and lunotriquetral intersosseous ligament, there is progressive instability of the DRUJ. Therefore, if the joint is unstable, additional treatment, such as radioulnar pinning in the position of greatest stability or TFCC repair, should be considered.

Peripheral TFCC tears can be diagnosed and sutured to the capsule using arthroscopic-assisted techniques. If the arthroscopic repair does not reconnect the TFCC to its anatomic attachments on the fovea or the ulnar styloid, it may not be as effective as an open repair in this situation. Ulnar-shortening osteotomy may be considered in conjunction with either an open or an arthroscopic TFCC repair to reduce the loads on the TFCC, especially in patients with positive ulnar variance. Fractures through the fovea not the base of the styloid are associated with a higher risk of DRUJ instability because of the increased potential for disruption of the inserting fibers of the deep limbs of the radioulnar ligaments.

2) Chronic DRUJ instability

Symptomatic dysfunction of the DRUJ is commonly noted after wrist injury with or without a distal radius or forearm fracture. DRUJ instability after distal radius or forearm malunion usually manifests as loss of forearm rotation, prominence of the ulnar head, and ulnar-sided wrist pain. Symptoms are caused by a combination of effects of the malunion on the radiocarpal joint, ulnocarpal joint, and DRUJ. Chronic DRUJ instability without a fracture occur in a fall on the outstretched hand or an unexpected forcible rotation of the wrist. In mild instability, pain and weakness occur only with activities that require active rotation of the forearm during forceful gripping. In the more severe cases, a palpable and painful clunk may occur during forearm rotation.

Chronic instability rarely improves spontaneously, which represents that non-operative management for severe, chronic DRUJ instability usually fails. TFCC repair in conjunction with or without a correction of bony deformity is the best choice when the ligament is repairable. However, a soft tissue reconstructive procedure is indicated when the TFCC is irreparable and the sigmoid notch is competent. Boyes and Bunnett and by Hui and Linscheid (Fig. 1) described reconstruction techniques to reconstruct the volar ulnocarpal ligaments using a distally based strip of the FCU tendon, which provides an indirect radioulnar link, which proved a buttress effect for proper ligament function. Such techniques are particularly applicable when ulnocarpal instability is the primary problem, and DRUJ instability is of a lesser concern. Nonetheless, these reconstructions are occasionally used in conjunction with a Darrach excision of the distal ulna or to stabilize a previously resected distal ulna.
An alternative osteoplasty is an angular osteotomy of the ulna. A closing wedge osteotomy is made in the distal third of the ulna to tilt the ulnar head toward the sigmoid notch with the forearm in the position of instability. The osteotomy is fixed with a compression plate.

3) DRUJ arthritis

Degeneration of the DRUJ can be caused by posttraumatic arthritis, inflammatory arthritis, osteoarthritis, but rarely by long-standing DRUJ instability. Early stage of arthritis, where osteophytes form along the proximal margin of the ulnar head whereas the sigmoid notch often is spared, is usually treated by conservative management. In more advanced arthritis, surgical treatments including resecting all or a portion of the distal ulna, fusing the joint, or replacing the distal ulna are designed to eliminate the painful articulation between the distal ulna and radius.

Bowers designed the hemiresection-interposition technique for the treatment of DRUJ arthritis. It may be useful also in patients with severe DRUJ contractures. However, the instability often can be exacerbated when DRUJ arthritis is conjoined with DRUJ instability. Thus preservation of the TFCC and ulnocarpal ligaments is advisable. The concept is to remove all of the articular cartilage and subchondral bone on the radial and dorsal margins of the distal ulna so as to prevent radioulnar impingement during forearm rotation.

In 1936, Sauvé and, later, Kapandji described a procedure consisting of a radioulnar joint arthrodesis and creation of a pseudarthrosis proximal to the fusion. The procedure was developed as an alternative to resection of the distal ulna with an advantage of retaining support for the ulnar carpus and reducing the risk of ulnar translation. The Sauvé-Kapandji procedure may be a better option for active young patients.
Potential complications include instability of the ulnar stump and regeneration of the resected segment resulting in loss of motion.

Darrach procedure (distal ulnar resection) is particularly effective for a low-demand patient with an incongruous or degenerative sigmoid notch owing to the sequelae of an intraarticular fracture. According to Dingman’s study, only resection of the ulna adjacent to the sigmoid notch but preserving the ulnar styloid is recommended and subperostial resection is ideal because patients in whom regeneration had occurred seemed to have had better results.

Summary

Treatment of acute DRUJ instability has several options including: (1) temporary immobilization of the forearm using a sugar tong splint or long-arm cast, (2) percutaneous pinning of the ulna to the radius, or (3) open or arthroscopic assisted TFCC repair combined with or without radioulnar pinning if severe or bidirectional instability exists. The principles of management for chronic DRUJ instability are restoration of normal biomechanics of the joint using TFCC repair, distal radioulnar ligament reconstruction, or volar ulnocarpal ligaments reconstruction using a distally based flat of the FCU tendon, and/or osteochondroplasty of the sigmoid notch. Early stage of DRUJ arthritis is usually treated by conservative management, but in more complex arthritis, surgical treatments including resecting all or a portion of the distal ulna, fusing the joint, or replacing the distal ulna are commonly designed to eliminate the painful articulation.

References

Arthroscopic Repair for the TFCC foveal Tear

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Abstract

Recent anatomic and biomechanical findings have shown that the deep fibers of the triangular fibrocartilage complex (TFCC), which insert at the ulnar fovea, are the key component for the distal radioulnar joint (DRUJ) stability. Avulsion of the TFCC from the fovea may induce DRUJ instability. The traditional arthroscopic capsular repair technique of the TFCC to the joint capsule does not reattach the foveal insertion. Recently, several open and arthroscopic fovea repair techniques were introduced, with promising short term results. We used an arthroscopic assisted fovea 3htrepair technique to reattach the avulsed TFCC fovea insertion. A reliable and favorable outcome was achieved. Recently reported open and arthroscopic fovea repair techniques and their outcomes were reviewed.

The Surgical treatment for TFCC foveal tear- Open vs Arthroscopic repair

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Introduction

The triangular fibrocartilage complex (TFCC) is a well-known structure that acts as a stabilizer of the distal radioulnar joint (DRUJ) and a shock absorber of the ulnocarpal joint. Recent anatomical studies have proven that the distal radioulnar ligament consists of superficial and deep bundles, which attach on the fovea and provides DRUJ stability. Haugstved et al. demonstrated that the deep ligaments provide greater stability of the DRUJ than the superficial ligaments in a biomechanical study. This indicates that disruption of the TFCC at the fovea insertion could lead to DRUJ instability, resulting in disability in daily living. In this situation, a foveal tear might be considered to be repaired. Several procedures have been recommended to repair a foveal tear, and they can be divided into open and arthroscopic repairs. The purpose of this study was to compare open with arthroscopic repair of foveal tears of the TFCC.

Materials and Methods

This was a retrospective study of a group of patients who had complained disability of the wrist and were found to have a foveal TFCC tear at the time of wrist arthroscopy. Our indication for repair of a TFCC foveal tear was divided into two criterions. First one was a foveal tear associated with an acute distal radius fracture (DRF), second one was symptomatic DRUJ instability that had not responded to non-surgical treatment for over 3 months. In this study, however, patients with a foveal tear associated with an acute DRF, and patients who had scapholunate ligament (SL) injury, were excluded. Furthermore, the patients who had foveal tear with an ulnar positive variance of more than +1mm were initially treated with ulnar shortening osteotomy, these were also excluded.
Since December 2004 to January 2014, 42 wrists of 42 patients with a TFCC foveal tear were treated surgically. These included 5 patients with acute DRF, 1 patient associated with SL injury, 7 patients treated with ulnar shortening osteotomy. Thus 29 wrists of 29 patients with a TFCC foveal tear treated surgically were investigated. There were 13 men and 16 women, 14 right and 15 left wrists, and 16 dominant and 13 non-dominant hands. The mean age of the patients was 30 (range 14 to 72) years. Sixteen patients suffered the injury during sports activities, and twelve patients suffered the injury during working, by a fall, or twisting the wrist. One patient could not remember the clear history of wrist trauma. Five patients had a history of DRFs that had healed uneventfully with normal alignment by cast immobilization.

The first 8 patients between December 2004 and October 2008 underwent open repair (group O). Twenty-one patients between November 2008 and January 2014 were repaired arthroscopically (group A). The mean duration of symptoms before surgery was 7.1 months, ranging from 3 to 20 months. The follow-up period ranged from 24 months to 70 months, with an average of 34.4 months.

Clinical and radiological evaluation

All patients complained of ulnar-sided wrist pain with wrist extension and forearm rotation. All patients also felt ulnar head instability during forceful forearm rotation. Some specific physical examinations for the foveal tear were examined. A positive fovea sign represented ulnar-sided wrist tenderness in the ulnar fovea. The ulnar head ballottement test was examined by the piano key sign with neutral forearm rotation and 90-degree flexion of the elbow, holding the radius and the carpal bones. Obvious palmar and dorsal ulnar head instability compared to the contralateral wrist was diagnosed as positive in this test. All patients underwent a radiographic evaluation including neutral rotation posteroanterior and lateral X-rays, and 1.5T coronal plane magnetic resonance imaging (MRI). On the X-rays, none represented ulnar styloid nonunion or DRUJ arthrosis. The mean ulnar variance was -0.7 mm (-3.0 mm to +0.3 mm). Three patients showed a distended DRUJ joint over 1 mm compared to the contralateral X-ray. One patient showed a small fragment just distal to the fovea. On MRI, 18 patients showed lack of continuity of TFCC at the fovea, whereas 11 patients seemed to demonstrate continuity at the fovea on MRI. These were graded by the agreement of two hand surgeons including the first author (Y.A.). All patients underwent an initial trial of conservative treatment, such as cast immobilization, splinting, and administration of nonsteroidal anti-inflammatory drugs, all of which failed.

All patients were assessed with wrist arthroscopy by single surgeon (Y.A.) including radio-carpal (RC) and DRUJ arthroscopy, and they were confirmed to have a foveal tear. According to Atzei’s classification, there were 4 Class 2 (repairable complete tear) and 4 Class 3 (repairable proximal tear) in group O, there were 6 Class 2 and 15 Class 3 in group A. Eleven patients who demonstrated continuity on MRI had fragile scar tissue at the fovea.

Preoperative data

A fovea sign and ulnar head ballottement test were positive in all patients. The mean ulnar variance was -0.6 mm (-2.5 mm to +0.3 mm) in group O, -0.7 mm (-3.0 mm to +0.3 mm) in group A. Preoperative pain was scored as 10 in all patients with NRS. The mean extension of the wrist was 71.7° (range: 64° - 80°), and mean flexion was 61.0° (range: 48° - 84°) in group O; the mean extension was 72.6° (range: 54° - 86°), and the mean flexion was 59.6° (range: 45° - 81°) in group A. The mean pronation of the forearm was 83.3° (range: 70° - 90°), and the mean supination was 89.1° (range: 75° - 90°) in group O; the mean pronation was 81.3° (range: 60° - 90°), the mean supination was 86.9° (range: 45° - 90°) in group A. The mean grip strength was 81.6% (range: 38% - 91%) in group O and 80.2% (range 38% - 100%) in group A.

Postoperative evaluation

The final evaluation included pain, measurements of wrist and forearm motion, grip strength, ulnar head instability, the Disabilities of the Arm, Shoulder, and Hand (DASH) questionnaire, and the Mayo modified wrist score (MMWS). Postoperative pain was evaluated with a numerical rating scale (NRS), and preoperative pain was scored as 10. Wrist flexion-extension was assessed with a goniometer. Forearm supination and pronation were assessed with the elbow flexed 90 degrees at the patient’s side. Grip strength was measured with a calibrated dynamometer and reported as the ratio to the contralateral side. Ulnar head instability was examined with the ulnar head ballottement test and assessed with Nakamura’s DRUJ instability score (0: no end point in any direction, 1: at least one end point either in dorsal or palmar, 2: looser than the intact contralateral side, 4: stable DRUJ).

Statistical analysis

The operating time, NRS score, ROM, grasping power, the ulnar head instability score, and the DASH score for both procedures were compared using the t-test. The MMWS were compared with the Chi-squared test. A p-value of <0.05 was regarded as significant.
Surgical technique

The wrist is suspended in vertical traction and examined by arthroscopy. Generally, two dorsal arthroscopic portals are used: a 3-4 portal and a 4-5 portal to examine the radiocarpal joint. A 2.3-mm arthroscope with a 30-degree angle is introduced through the 3-4 portal, and a probe, a shaver, and a radiofrequency device are interchangeably inserted through the 4-5 portal. The 6U portal is used as an outflow portal with the wet technique. If a foveal tear is present, TFCC tension becomes loose; therefore, loss of the trampoline effect is recognized. A peripheral tear (ulnar styloid tear) of the TFCC should be also investigated through a hook test. Then, the TFCC foveal insertion is evaluated through the DRUJ portal. DRUJ arthroscopy can directly visualize a foveal tear. The TFCC is thoroughly inspected through these portals.

The open repair is started with about a 3-cm straight skin incision on the ulnar side of the ulnar neck. The tendon sheath of the extensor carpi ulnaris (ECU) tendon is incised, and the ECU tendon is retracted palmarly or dorsally and freely mobilized. The ulnar wrist capsule is cut longitudinally, exposing the TFCC disc and the fovea. In general, a foveal tear of the TFCC is easily recognized macroscopically. Two osseous tunnels are made by inserting 2 parallel 1.5-mm Kirschner wires (K-wire) from the ulnar neck to the foveal region. The 2-suture: 3-0 PDS and 3-0 Vicryl suture are threaded horizontally at the ulnar peripheral lesion of the TFCC and directly attached to the fovea macroscopically.

The arthroscopic repair is performed through a similar skin incision, and the ECU tendon is freely mobilized. Two bone tunnels are created in a similar fashion with the direct repair. The location of the bone tunnels is confirmed with not only RC and DRUJ arthroscopy but also using an image intensifier. The two bone tunnels are placed at the foveal region, which was confirmed with macroscopy, arthroscopy, and image intensifier, is the critical point to reconstruct the TFCC foveal tear using the open or arthroscopic procedures.

Postoperative management

After repair, the postoperative protocol was consistent with both procedures. The wrist was fixed with a long-arm cast for 2 weeks with 90 degrees of elbow flexion and neutral forearm rotation. A short arm cast was applied for an additional 2 weeks. Gentle range of motion exercise including rotation of the forearm was started at 4 weeks after surgery, and grip strengthening was started at 2 months. The patients were told they could return to preoperative sports or work 3 to 6 months after surgery.

Results

The average operation time was 89.2 minutes (75-110 minutes) in group O and 55.3 minutes (30-80 minutes) in group A, significantly shorter than in group O (p=0.002). There was no patient who complained of wrist pain at the final follow-up in group O; the average NRS was 0. In group A, 3 patients felt mild ulnar-sided wrist pain during heavy activities. The average NRS was 0.2 (0 to 2). The mean extension of the wrist was 66.6° (range: 60° - 73°), and the mean flexion was 63.0° (range: 50° - 70°) in group O; the mean extension was 72.9° (range: 60° - 85°), and the mean flexion was 66.3° (range: 50° - 80°) in group A. The mean pronation of the forearm was 83.4° (range: 80° - 90°), and the mean supination was 90.0° (range: 85° - 95°) in group O; the mean pronation was 83.3° (range: 75° - 90°), and the mean supination was 89.4° (range: 80° - 90°) in group A. The mean grip strength was 96.9% (range: 92% - 100%) in group O and 97.6% (range: 74% - 115%) in group A. DRUJ instability of all patients was evaluated as 4 in group O; 18 patients were assessed as 4, and 3 patients were evaluated as 2 in group A, the average was 3.7. The mean DASH at final follow-up was 7.8 (0 – 15.3) in group O and 5.7 (0 – 14.7) in group A. The final results according to the MMWS were all excellent in group O, with 18 excellent and 3 good in group A. There were no significant differences between the groups in the t-test (p > 0.05) and the Chi-square test (p > 0.05) except for the operating time. There were no complications, and no patients needed re-operation in both groups.

Discussion

In this study, it clarified that transosseous repair for TFCC foveal tear through both open and arthroscopic approach could provide feasible results. These results suggested that reattachment of the TFCC to the precise location, which was confirmed with macroscopy, arthroscopy, and image intensifier, is the critical point to reconstruct the TFCC foveal tear using the open or arthroscopic procedures.

The foveal tear should be diagnosed precisely. The patient complains of a slack sensation during forearm rotation and loses strong grasping. A positive fovea sign is suggestive but not specific, because this sign may suggest not only a foveal tear, but a tear from the ulnar styloid and the inflammation at the surrounding structure. The ulnar head ballottement test is a reliable physical test. It must be evaluated bilaterally; the instability is more evident if it is examined under general anesthesia. MRI can delineate a foveal detachment clearly. A gradient echo...
sequence T2-weighted image provides a high-delineation image of the TFCC structure. However, evaluation of MRI findings is sometimes confusing when the ligament is continuous with scar tissue like in this study. DRUJ arthroscopy is a definitive procedure to diagnose a foveal tear. DRUJ arthroscopy is still a technically demanding procedure because the joint space is very narrow. However, when a foveal tear exists, the foveal region can easily be visualized through DRUJ arthroscopy, because the DRUJ is loose. The quality of the remnant fibers should be evaluated. If the remnant fibers are severely disrupted, primary repair is not indicated.

Several procedures for open and arthroscopic repair have been described. Moritomo et al. described the open repair through a volar approach with the concept that foveal detachment would initially occur from the volar element. Atzei et al. and Kim et al. described a hybrid approach in which they explored the foveal lesion arthroscopically and used an open technique to reattach the foveal insertion using a bone anchor. Iwasaki et al. described arthroscopic reattachment by creating an osseous tunnel, 2.9 mm in diameter, from the ulnar neck to the foveal surface, and their 2- to 4-year follow up results were good. Nakamura et al. reported a three-dimensional mattress suture technique that can create an anatomical reconstruction using an open ulnar approach. Nakamura et al. also described arthroscopic transosseous repair using their original targeting device. Their comparative study between the open and arthroscopic approaches showed that both procedures could obtain excellent clinical results. Shinohara et al. performed arthroscopically-assisted foveal repair primarily in accordance with the method of Nakamura, and they showed satisfactory outcomes with a mean follow-up of 30 months.

There have been few reports of comparative studies between open and arthroscopic approaches. Anderson et al. stated that there was no significant difference in clinical outcome after open versus arthroscopic repair. However, in this report, TFCC tear was classified as a 1B tear with Palmer’s classification, and it was unclear whether the tear was a foveal tear or avulsion from the ulnar styloid. Luchetti et al. reported successful outcomes with open and arthroscopically-assisted repairs. They confirmed the foveal detachment through DRUJ arthroscopy and repaired it using a suture anchor. They showed no significant postoperative differences between the two groups except for the DASH, which was significantly better in the arthroscopic group. Our open procedure was reattachment by a single pull-out technique, and the arthroscopic procedure was similar with the arthroscopic reattachment described by Nakamura et al. Both procedures provided successful outcomes; there were no significant differences in the outcomes between the groups. The operating time was significantly shorter in the arthroscopic approach than in the open approach. This is because it is not easy to thread the suture horizontally at the critical point of the TFCC through the open approach.

In this study, the average duration of symptoms before surgery was 7.1 months. Although Nakamura et al. pointed out that the clinical results were unsatisfactory when arthroscopic foveal repair was performed over 7 months after the injury; the present clinical results were good. Patients who showed ulnar abutment were excluded from foveal repair. Shinohara et al. stated that a patient with a traumatic foveal tear without ulnar abutment may be a good candidate for arthroscopic foveal repair even 7 months after the injury, and the present clinical results may have proven that. In addition, foveal repair was not indicated if DRUJ arthroscopy showed the unrepairable remnant of the ligament. DRUJ arthroscopy is essential to determine the indication for foveal repair.

Limitations
This study has several limitations. The number of cases was small, especially the number treated with the open approach. The indication for each procedure was determined by the time period of surgery; all surgeries were consecutive, the open repairs were all conducted sequentially before the author converted to an arthroscopic approach. This is a potential significant source of bias. In addition, all surgery was performed by a single surgeon, these cases were subject to the learning curve, and the later cases may have benefitted from the surgical experience.

Conclusions
Satisfactory outcomes were achieved in both open repair and arthroscopic repair groups. If a surgeon becomes familiar with the arthroscopic technique, it might be a quicker and save operating time.
Surgical treatment of ECU tendinopathy associated with TFCC Injury

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Introduction
The extensor carpi ulnaris (ECU) tendon and its subsheath (fibro-osseous tunnel) are an important extrinsic stabilizer of the distal radioulnar joint (DRUJ). Also the floor of the ECU tendon sheath is an important stabilizer of the triangular fibrocartilage complex (TFCC), which provides intrinsic stability to the DRUJ stability. Anatomically, one of the features of ECU tendon is that it occupies a narrow subsheath within the sixth dorsal compartment, and the subsheath is a separate structure from the overlying extensor retinaculum. Another feature is that its relative position changes with rotation of the forearm and this feature impacts not only its function but also its relative stability. Due to these anatomical features, ECU tendon could be easily vulnerable to trauma such as direct blow, excessive stretch, or repetitive overuse. In addition, because it is an important stabilizer of the TFCC, we think that both structures may be accompanied by injury and the disease process of ECU tendon may be difficult to be differentiated from traumatic disruption of the TFCC. Thus accurate diagnosis and proper treatment with an appropriate time is essential.

Anatomy, pathomechanics and pathoanatomy
ECU muscle arises from the lateral epicondyle, and the tendon of the ECU originates from the muscle fibers 2 to 6 cm proximal to the proximal border of the extensor retinaculum. The tendon is inserted on the fifth metacarpal base. At ulnar head, ECU tendon passes through a well-defined fibro-osseous tunnel, averaged about 21 mm long and 6 mm wide. ECU tendon is stabilized by bony restraints, subsheath, and extensor retinaculum. The subsheath is anchored to distal ulnar and it is essential to maintain the tendon in its normal position. The extensor retinaculum is a...
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separate structure from the subsheath, has no attachment to the ulna, but rather on the ulnar aspect of the carpus. It is not the primary stabilizer of the ECU tendon within its groove, however it compresses the ECU tendon in the groove in the condition of active wrist flexion.

The ECU muscle’s actions vary dependent on forearm position. During supination, the ECU tendon moves dorsally closer to the extensor digiti minimi. In full supination, it is subject to maximal traction and exits the sixth compartment at an angle of 30˚ resulting in a greater contribution to true wrist extension (Fig.1). During pronation, the ECU tendon lies more in the palmar and ulnar positions of the ulnar head, far from the extensor digiti minimi and exits the sixth compartment in a straight direction, resulting in diminishing its contribution to wrist extension7). Understanding these anatomical features of the ECU tendon is very important to diagnose the ECU tendon pathology and we should recognize that the ECU subsheath as an integral constituent of the TFCC. Subsheath injury is usually associated with adjacent soft tissue disruption, most often the triangular fibrocartilage (TFC).

Melone and Nathan8) reported that because of the complex anatomy of the TFCC, disruption of the TFC proper, also termed the articular disk, seldom occurred as an isolated injury. Destabilizing injuries of the DRUJ characteristically disrupted not only the TFC but also the adjacent ECU subsheath and other critical soft tissue to a variable extent. In this series, 28 (67%) of their 42 cases had associated injury to the ECU subsheath with subluxation of the ECU tendon. Allende and Le Viet9) also described that the concept of multicomponent injury of the TFCC. In their series of 28 patients with ECU disruption, 15 (54%) demonstrated substantive concomitant injury, usually involving the TFC. This clinical study also emphasized that restoration of ulnar wrist stability requires repair of all pathologic components. Recognition of this variable, often extensive, spectrum of injury at the ulnar wrist is essential to optimal management of ECU subsheath disruption resulting in ECU tendon and DRUJ instability. A successful recovery is often contingent on a comprehensive repair of multiple components of the TFCC.

Clinical Assessment and diagnosis
An accurate clinical history and careful physical examination is critical for diagnosis of ECU tendon disorders. When evaluating a patient with wrist ulnar side pain, the hallmark of the physical examination pointing to localized ECU pathology includes the tenderness directly over the ECU tendon and sixth dorsal compartment. Pain is exacerbated by resisted wrist active extension with ulnar deviation. Ulnar-side wrist pain is also exacerbated by passive wrist flexion and ulnar deviation with forearm supination. Swelling along the course of the ECU tendon will be seen. Occasionally crepitus can be detected with palpation of the sixth dorsal compartment with flexion and extension of the wrist. In the case of the ECU tendon instability, active supination, flexion and ulnar deviation will produce often visible subluxation of the tendon. ECU tendinosis can coexist with other conditions in the ulnar side of the wrist, so the diagnosis must not be considered as an exclusion of all other possible diagnoses. A full clinical and radiological assessment of the other important ulnar-side wrist structures is mandatory to exclude coexistent pathology in the TFCC, lunotriquetral ligament, distal radioulnar joint or ulnar styloid.

Plain radiographs are sometime helpful to rule out other regional pathology such as the disorders of the distal radio-ulnar joint (DRUJ) or TFCC. Occasionally, plain radiographs may demonstrate calcification within the ECU tendon10). However in most cases it is difficult to diagnose ECU tendinopathy and instability with only plain radiographs and clinical presentation. Therefore ultrasound (US) and/or magnetic resonance imaging (MRI) are the imaging modalities of choice in the diagnosis of ECU tendinopathy and instability11). MRI may demonstrate tenosynovitis, recurrent subluxation or dislocation or either partial or complete rupture of the tendon. It is also able to assess other structures in the ulnar side of the wrist to exclude coexistent pathology in the TFCC, DRUJ, intercarpal ligament or ulnar styloid that are not easily accessible to US evaluation12) (Fig. 3).
1) Tenosynovitis
Acute ECU tenosynovitis is defined by inflammation of the tenosynovium of the ECU without significant stenosis or an underlying bony abnormality of the sixth dorsal compartment. The ECU tendon sheath can be irritated by repetitive flexion and extension of the wrist, particularly in supination, at the point of angulation of the tendon as it exits the fibro-osseous tunnel. US demonstrates anechoic, easily compressible fluid surrounding the tendon without or minimal vascularity on Doppler.

The treatment of acute ECU tenosynovitis includes the stop of use until symptoms subside, the short arm splinting of the wrist in a position of 30-40 degrees of extension for 2 weeks, and the oral nonsteroidal anti-inflammatory medication. If symptoms persist, corticosteroid injection into the sixth dorsal compartment is recommended. In rehabilitation, splinting is gradually discontinued if symptoms are resolved and start active/active assisted wrist range of motion, and extension resistance exercise should be carried out before resuming unrestricted activities. Graham et al described to start the strengthening program if the range of motion of the wrist exceeds 75%.

2) ECU tendinopathy
It develops gradually because in general, it is possible for a patient to continue to use despite the pain or a patient with a tenosynovitis fails to respond to appropriate treatment. As the disease progresses, tendon thickening becomes more pronounced resulting in a stenosing tenosynovitis. The tendon can become unstable and dislocated from attenuation or tearing of its subsheath. ECU tendon can be ruptured partially by gliding over the ulnar ridge of the groove or bony spur at tearing of subsheath.

MRI shows moderate increased signal intensity at the area of tendinopathy and tendon thickening. In the case of partial tendon tears, it shows clefts or splits within the tendon substance. Initial treatment is a conservative treatment. If symptoms are not relieved by conservative measures, it can be also treated by corticosteroids injection into the sheath. Montalvan et al described in most their cases, the pain was resolved within 2 to 24 weeks in tennis players. Futami et al reported that 40 of 43 patients recovered in 1 to 9 months using a conservative measures and corticosteroid injection.

However some authors, in trauma patients, described that MRI may not be accurate especially in the investigation of suspected carpal instability because of the post-traumatic changes. Wrist arthroscopy is the gold standard diagnostic tool for diagnosing carpal instability including TFCC lesions. Therefore we stress that wrist arthroscopy should be carried out to get an accurate diagnosis and treatment for all patients undergoing surgical treatment with ECU tendinopathy.

Treatment of specific conditions
ECU tendinopathy can be classified into tenosynovitis of the tendon sheath, tendinopathy and tendon instability. These conditions can occur in isolation or synchronously.
For patients with recalcitrant symptoms, sixth dorsal compartment release should be considered. After the division of retinaculum and subsheath, the tendon is inspected for tearing of sheath, spur and prominent ridges, which should be repaired or trimmed. The thickened sheath of the ECU tendon was excised. We initially performed wrist arthroscopy for the diagnosis of intra-articular pathology and carefully repaired the subsheath and extensor retinaculum. Postoperatively the wrist is immobilized in 30-40 degrees of extension with sugar tong splint for 2 weeks and additionally it is immobilized with short arm cast for 4 weeks to minimize the risk of postoperative tendon subluxation.

3) ECU tendon instability

ECU tendon is stabilized by unique fibro-osseous sheath (subsheath) deep to the extensor retinaculum. Therefore, the instability of the ECU can result in following disruption of the subsheath even if the extensor retinaculum was intact. Exact mechanism is not clear but is generally seen with forceful supination with wrist flexion and ulnar deviation. Therefore, during active forearm supination a painful snapping sensation can occur over the ulnar aspect of the wrist.

Although nonoperative treatment occasionally has been recommended for acute ECU tendon instability, experience with consistent regimens of conservative treatment is limited and invariably clinical studies fail to substantiate its efficacy. Most authors concur that operative treatment is a superior method of consistently achieving through healing and a favorable outcome. Rowland operated on an acute case and found that there was a tear in the subsheath with a considerable gap in the position where the wrist was placed. He suggested surgical repair in all such patients. Inoue and Tamura described three types of disruption of the subsheath and the differentiation between the types of lesion was impossible clinically. They also recommended surgical exploration of the disrupted subsheath to bone either with bone anchors or through drill holes with or without deepening of the osseous groove.

When accompanied by a TFCC injury, concurrent repair of the TFCC, all have been reported as successful method of surgical repair. In cases with relatively deficient TFCC substance, distally based ECU tenodesis for the reconstruction of destabilizing ECU and TFCC pathology can be a treatment option.

Summary

The incidence of TFCC rupture associated with ECU tendonopathy is not known exactly. However, since the ECU subsheath is recognized as an integral part of the TFCC, we think that it is highly likely to occur with ECU tendinopathy. Therefore when we treat the patients with ECU tendinopathy, the possibility of TFCC combined injury should always be considered. If surgical treatment is planned, wrist arthroscopy should be performed to get a more accurate diagnosis of intra-articular pathology and if you get the ECU and DRUJ stability by repair or reconstruction of the ECU subsheath, TFCC and other intra-articular pathology together, there will be favorable results.

References


Figure Legends

Figure 1. Intraoperative view of the right wrist, during full supination showing that the extensor carpi ulnaris (ECU) tendon (blue loops) is subjected to maximal traction and has to adopt an approximately 30° angle to reach the base of the 5th metacarpal.

Figure 2. Intraoperative view of the right wrist, during full pronation showing that the ECU tendon (blue loops) is situated on the inner surface of the ulnar head and having a straight course.

Figure 3. Fat suppressed coronal T2-weighted left wrist MRI images of 45-year-old female with ECU tendinopathy shows high signal intensity within the TFC (white arrows) representing foveal rupture.

Figure 4. Same patient’s left wrist, radio-carpal arthroscopy images show severe synovitis (A) and unstable TFC (B). (TFC: triangular fibrocartilage).
Distal nerve transfer for peripheral nerve injury in BPI and tetraplegia

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Background
In C6 spinal cord injury digit flexion is one of the most required reconstructions. Distal nerve transfers offer new options for functional recovery. There are three parameters for selection of nerve pairs transfers: the surgical feasibility of the transfer, the donor-to-recipient axon count ratio, and the distance from the coaptation site to the motor point. This study investigated pairs of distal nerve transfer for all digit flexion.

Methods
Twenty-two fresh cadaver upper extremities were dissected to determine the anatomic relations and simulated the transfer of brachialis branch and extensor carpi radialis brevis branch as the donor nerve to anterior interosseous nerve and flexor digitorum profundus branch of ulnar nerve as the recipient nerve. Following the simulation, the success of the transfer was estimated by the three parameters. A clinical case report of complete C6 spinal cord injury was managed by eight pairs of bilateral nerve transfer, including a new transfer extensor carpi radialis brevis to the flexor digitorum profundus branch of ulnar nerve.

Results
The newly proposed transfer extensor carpi radialis brevis to the flexor digitorum profundus branch appears to be superior to the other transfers to regain digit flexion determined by the three parameters and able to combine with brachialis to anterior interosseous nerve. Our case report demonstrate that good fingers flexion can be achieved 10 months postoperatively.

Conclusions
Nerve transfer from extensor carpi radialis brevis to flexor digitorum profundus branch combined with brachialis to anterior interosseous nerve offer all digit flexion in C6 spinal cord injury.
Cutting-edge technology for the enhanced neural regeneration

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Tension-free, end-to-end neurorrhaphy is the best surgical solution for injured peripheral nerves. However, it is not always possible. Furthermore, even after simple neurorrhaphy, a long regeneration process follows. When there is a segmental defect, which cannot be directly repaired, a nerve graft is mandatory. Although an autogenous nerve graft is the first choice, donor site morbidity is inevitable.

An autogenous sural nerve graft is the most common source for a nerve graft. Although it is an autogenous tissue without immune-associated problems, non-vascularized nerve grafts have inevitable limitations in their regeneration potential. According to research performed by Millein this sie, grafted nerves obtain their nutrition by diffusion from the surrounding tissue. After three days, neoangiogenesis occurs and active blood perfusion initiates. Wallerian degeneration progresses immediately after injury and the activity of macrophages is delayed or disturbed, and the entire process of neural regeneration is significantly delayed.

An autogenous nerve graft may be substituted by a synthetic nerve conduit or allograft that is harvested and prepared through a decellularization process. Because there are no functioning macrophages or Schwann cells in these substitutes, their limitations in regeneration potential remain.

Recently, many biological and electronical cutting-edge technologies have been developed in the attempt to improve regeneration after peripheral nerve injury. A vein graft, muscle graft, or combined vein and muscle graft can be ideal substitutions for autogenous nerve grafts. According to the author’s basic research and clinical experience, an approximately 3-cm vein graft has successfully recovered the function of an original nerve, especially in the case of pure sensory nerve defect. Furthermore, inside-out vein grafts provide improved regeneration potential with their abundant laminin, which is known to promote axonal regeneration.

Recent technological advances, including electrical stimulation to injured or repaired nerves, indicate new horizons in the field of neural regeneration. Electrical stimulation can be delivered to a target site through a specifically developed electrode interface for a specific duration. However, the optimal time period and strength has not been definitively suggested until now. In addition, removal of the electrode interface is not an easy task.

Low-intensity-focused ultrasound (LIFU) stimulation is another cutting-edge technology for enhanced neural regeneration. Earlier evidence demonstrated successful axonal stimulation through ultrasound stimulation. Because ultrasound stimulation is non-invasive, this technology has tremendous potential in the near future.

Biological approaches to promote neural regeneration include cultured Schwann cell grafts with conduits. Stem cell implantation is a hopeful approach, and enhancing Schwann cell migration in the early stage of regeneration under a magnetic field is another interesting idea. Inducing neoangiogenesis in the early period of regeneration can be promoted by various methods based on the fundamental understanding of the natural process of neural regeneration.

In this lecture, up-to-date trials to promote neural regeneration in the research bases and clinical trials will be discussed, however, there is no single best solution developed until now that can completely replace autogenous nerve grafts.
말초 신경의 재생은 외상이나 중앙 절연술 후, 혹은 정형외과 수술의 합병증으로 발생할 수 있으며, 미국에서는 매년 약 200,000건의 신경 불합성 수술이 시행될 정도로 흔한 손상 중 하나이다. 최근 미세수술의 발달로 신경의 일차 불합성이 수술 후 신경의 일차 불합성 이식 후 신경의 복합적인 치료법으로 시행되고 있으며, 신경단의 간격이 너무 커서 일차 불합성이 불가능할 경우에는 자가 신경 이식술(autogenous nerve graft)을 시행할 수 있다. 그러나 자가 신경 이식술은 공여 부의 신경 손상이 불가피하며, 깔이와 적절한 대로 조절할 수 없는 단점이 있다. 그래서 자가 신경 이식술의 대안으로 신경 도관(nerve conduit)을 이용한 자가 신경 재생이 시도되고 있으며, 새로운 신경 도관을 개발하기 위한 연구가 진행되고 있다. 본 심포지엄에서는 신경 도관 이식의 배경 및 그 종류, 그리고 다양한 신경 도관 이식에 따른 임상 결과를 알아보기로 한다.

자가 도관 (Autogenous nerve conduits)

1. 정맥 (Vein)

신경의 재생을 위한 자가 정맥 도관 이식술은 1982년 Chiu 등에 의하여 소개된 이래 자가 신경 이식술을 대신하기 위하여 시도되고 있다. Chiu 등은 백신의 좌골신경 결손을 이용하여 자가 정맥 도관 이식술을 시행한 후에 조직학적, 전기 생리학적으로 신경이 재생될 수 있음을 밝혔다. 그 이후 1990년 Chiu와 Strauch 등에 의하여 자가 정맥 도관에 대한 임상 연구가 시작되었다. 이 연구에서 총 15명의 환자에게 손과 전완부에 발생한 외상성 신경 손상자에게 자가 정맥 도관으로 재건하였다. 비록 자가 신경 이식술보다 결과는 좋지 않았으나 모든 환자에서 일차 방법을 완전히 회복할 수 있었다. 자가 정맥을 신경 도관으로 사용하는데 있어 몇 가지 우려가 있는데, 그 중 하나는 정맥의 벽이 얇기 때문에 신경이 재생되기 전에 도관의 내부가 막히버릴 수 있다는 점이다. 그러나 Tseng 등은 실험 연구에서 정맥의 내부에 혈종이 발생하기 때문에 도관이 무너지지 않고 신경이 재생되는 기간 동안 유지될 수 있다고 하였다. 또한 Wang 등은 정맥을 직접 불합하지 않고 뒤집어서 불합성하는 inside-out 정맥 이식법을 소개하였다. 이 방법의 장점은 양쪽에 있음지 모르는 정맥 판막으로 인하여 신경의 재생이 방해되는 것을 방지하고, laminin과 collagen이 뛰어난 정맥 외막을 내부로 가져와서 신경의 재생을 촉진하는데 있다. 동물 실험에서 표준적인 정맥 이식 방법과 동일하거나 나은 결과를 나타내었으며, 최근 Jeon 등이 임상적으로도 우수한 결과를 보고하고 있다 (Fig. 1). 그러나 inside-out 정맥 이식법이 표준적인 방법에 비하여 더욱 우수한 결과를 얻는다는 근거는 부족하며 더 많은 연구가 있어야 할 것으로 판단된다.

Fig. 1. Preparation of an inside-out vein graft [From Jeon WJ, et al. Clinical application of inside-out vein grafts for the treatment of sensory nerve segmental defect. Microsurgery 2011;31:268-73]
신경이 회복되지 않았다고 하였다. 다른 합성 도관과 비교하여 collagen 신경 도관은 몇 가지 장점을 가지고 있다. Polyglycolic acid 도관과 비교하여 Poly-lactide-ε-caprolactone 도관은 좀 더 빠르게 치유를 보이며, 신경도관 내부에 collagen-GAG (glycosaminoglycan) 등의 기질을 삽입하는 것이 용이하기 때문에 향후 발전이 기대되는 합성 도관 중 하나이다 (Fig. 2).

Fig. 2. Schematic drawings of collagen conduit repair technique (From Taras JS, et al. Reconstruction of digital nerves with collagen conduits. J Hand Surg Am 2011;36:1441-6)

3. Poly-lactide-ε-caprolactone (Neurolac)
Ploy-lactide-ε-caprolactone은 합성 물질로 인체에서 무해하고 이물 반응을 거의 일으키지 않아 흡수성 신경 도관으로 사용되고 있다.22) 신경 재생을 유지하기 위하여 내부 구조가 약 10주 동안 강도를 유지한다고 하며, 1년 내로 완전히 흡수되는 것으로 알려져 있으나 2년까지도 발견될 수 있다고 한다. Den Dunnen 등은 쥐의 10mm 좌골신경 결손 모델에서 Poly-lactide-ε-caprolactone의 신경 재생 효과를 연구하였다.23) 저자들은 이 합성 도관을 사용하여 매우 우수한 신경 재생 결과를 얻었으며, 심지어 자가 신경 이식술보다 나은 신경 재생을 보고하였다. 그러나 이 실험 연구는 신경의 형태학적 분석만을 시행하였고, 기능적 평가를 시행하지 않았기 때문에 결과 판단에 신중을 기하여야 할 것이다. 최근에 Shin 등18)는 임상에서 사용 가능한 세 가지 신경 도관의 신경 재생 능력을 동물 실험을 통하여 확인하였다. 이 연구에서 Poly-lactide-ε-caprolactone 이 가장 우수한 신경 재생 효과가 있는 것으로 나타났으며 임상적 적용에 희망을 갖게 한다. Bertleff 등24)는 Neurolac을 이용한 임상 시험에서 기존의 방법과 유사한 결과를 보고하여 임상적으로 효과가 있음을 입증하였다. 그러나 이 물질이 2년 이후에도 남아 이물 반응을 일으킬 수 있으며, 박이 매우 단단하여 8~0 바늘이 통과하기 어려우며, 신경 도관이 단단하여 피부에서 만져질 수 있다는 점이 문제점으로 지적되고 있다.
동종 신경 (Nerve Allograft)

자기 신경 이식의 대안으로 기증받은 타인의 신경을 이용하는 동종 신경 이식술은 Mackinnon 등이 처음 입상에서 시도하면서 주목을 받았고, 그러나 일정한 기간 동안 면역제제의 투여가 필요하며 널리 사용되지 않았다. 최근 조직공명영상의 발달 및 동종 신경 처리 기술의 개발로 다시 각광을 받게 되었다. 동종 신경은 축색의 재생에 적합한 환경을 제공한다. 화학 물질로 처리된 동종 신경은 이식물의 항원과 세포들로부터 제거하여 면역 반응을 억제하지만, 신경 재생에 중요한 내부 scaffold, laminin 및 다른 세포의 성분이 보존되어 있기 때문에 신경 재생을 도움을 수 있다. Hudson 등은 처리된 동종 신경이 자기 신경 이식술에 준준한 결과를 얻었다고 보고하였다. 또한 축색 재생의 방해 물질로 알려진 Chondroitin sulfate proteoglycans (CSPs)를 제거함으로써 신경의 재생이 가능함이 알려져 있다.25) 현재 FDA의 허가를 받은 처리된 동종 신경이 Avance (Axogen Inc., Alachua, FL)라는 상품명으로 입상에서 사용이 가능하며, 이것을 사용한 단기 입상 추시 결과가 발표되어 있다.26) 동종 신경의 장점은 신경 봉합 과정이 자기 신경과 완전히 일치하기 때문에 조직이 매우 용이하다는 점이다. 그러나 광범위한 입상 사용을 위해서는 보다 많은 입상적 결과가 필요하다고 판단된다.

미래의 연구 방향 (Future Directions)

현재까지 도관 이식술이 자기 신경 이식술의 결과를 뛰어넘지 못하고 있기 때문에 이를 극복하기 위한 다양한 시도가 진행되고 있다. 새로운 합성 도란 주요 연구 방향은 크게 도관 자체의 다공성과 물리적 성질을 변화시키는 것, 성장 인자 및 세포 세포의 삽입, 도관 내에 축색을 유도할 수 있는 기름을 삽입하는 것 등으로 구별해 볼 수 있다(Fig. 3). Yamas et al.27)은 pressure cuff 이론을 통하여 myofibroblast가 신경의 재생에 중요하게 작용함을 밝혔다. Myofibroblast는 silicone 비흡수성 도란 주위에서 두꺼운 층을 형성하여 신경의 재생을 방해하지만, collagen 도란 주위에서는 얇은 층으로 이어 신경의 재생을 촉진한다고 하였다. 두 번째로 신경 도란에 다공성 구조를 만드는 데 도움을 주던 산소와 다른 대사 물질이 확산되는 환경을 조성할 수 있어 신경의 재생에 도움이 될 수 있다. 그러나 구멍이 너무 긴 경우 주위에서 세포세포가 침투할 수 있으므로 이를 방지할 수 있는 적절한 크기를 찾고 있다. 세 번째로 신경 도란 내에 축색을 유도하는 구조를 삽입할 수 있는 것은 SELF 재거하리라, 다른 대사 물질이 확산되는 환경을 조성할 수 있어 신경의 재생을 촉진할 수 있다. 세 번째로 축색의 성장 및 혈관 형성을 촉진하는 구조를 삽입해야 하는데, 이렇게 처리된 신경 도란 내에 축색을 유도할 수 있는 데, 특히 자기 신경 도란 내에 삽입할 수 있는 구조를 삽입하고자 한다. 세 번째로 자기 신경 도란 내에 침투할 수 있는 구조를 삽입하면, 이와 유사한 구조를 삽입한다면 신경의 재생을 촉진할 수 있을 것이다. 네 번째로 세부 세포나 성장 인자와 신경 도란 내에 삽입할 수 있는 구조를 삽입해야 한다. 세 번째로 축색의 성장 및 혈관 형성을 촉진하는 구조를 삽입하면, 이와 유사한 구조를 삽입한다면 신경의 재생을 촉진할 수 있을 것이다. 네 번째로 세부 세포나 성장 인자와 신경 도란 내에 삽입할 수 있는 구조를 삽입하면, 이와 유사한 구조를 삽입한다면 신경의 재생을 촉진할 수 있을 것이다.

REFERENCES
3. Chi DT, Strauch B. A prospective clinical evaluation of autogenous vein grafts used as a nerve conduit for distal sensory nerve defects of 3 cm or less. Plast Reconstr Surg 1990;86:928-34.
Peripheral nerve injuries (PNI) are mainly related to trauma, tumor, and iatrogenic lesions, leading to neurologic deficits and functional disability. Lesions with loss of nerve substance produce serious problems for the patient. Besides causing pain and morbidity, these injuries usually generate permanent sequelae, such as sensory deficit and functional dysfunction. These lesions cause damages that substantially diminish the quality of life of these patients, including physical disability and total or partial loss of their productive activities, which gives rise to important social and economic consequences.

Nowadays autologous peripheral nerve transplantation represents the gold standard of repair when there is loss of substance that precludes neurorrhaphy. However, it presents some limitations, such as the need to perform two surgical procedures at different sites, the consequent greater morbidity and the shortage of nerve donor sites, besides the resulting sensory deficit in the area from which it was removed. For nerve discontinuities with a gap, nerve autografts are useful but limited by availability and donor site morbidity. The various synthetic conduits and acellular allografts are not generally recommended for gaps > 3cm.

Tissue repair requires a complex interaction between cells, extracellular matrix, and trophic factors, which are all important elements involved in nerve regeneration. Consequently, cell therapy and tissue engineering have been receiving a great deal of attention in recent decades, and are widely used in different areas.

Cell transplantation is one of the cell therapy and tissue engineering strategies aimed at the creation of a favorable microenvironment for tissue regeneration. Stem cells have important characteristics that...
differentiate them from other cell types, are undifferentiated precursor cells that have self-renewal ability and can differentiate into multiple lineages. They are present in several tissues and are responsible for their regeneration in the event of injuries or lesions.

The self-renewal capacity of stem cells makes it possible to deliver numerous cleavage cells to the damage site. The stem cells continue proliferating after migrating to the injured nerve tissue, and further differentiate to the necessary cell type under the appropriate micro environmental conditions. It is confirmed that Neural Stem Cells (NSC) can be induced to a peripheral neuron, Schwann Cells (SC), or smooth muscle phenotype upon co-culture with cells from the nervous system. Furthermore, about 5% of BMSCs can spontaneously transdifferentiate into SCs without specific intervention. However, the differentiation rate of naive precursor cells in the peripheral nerve is relatively low. Pre-differentiating stem cells toward a desired phenotype in vitro by chemical induction, biological treatment, gene transfection, or co-culture with neural cells before injection is an effective method.

Other than differentiation to appropriate cells, stem cells also provide a beneficial micro environment for neural cell survival and neurogenesis by secreting bioactive neurotrophic molecules. MSCs synthesize and release a variety of growth factors, such as nerve growth factor (NGF), brain-derived neurotrophic factor (BDNF), GDNF, neurotrophin-3 (NT-3), VEGF, and ciliary-derived neurotrophic factor (CDNF). Adipose derived Stem Cells also upregulate protein expression of BDNF, glial growth factor, neuregulin-1, VEGF, HGF, and insulin-like growth factor. Furthermore, overexpressed neurotrophic factors facilitate the regeneration of peripheral nerves even beyond the nerve injured region.

Myelination is another major factor that determines the regeneration quality and functional recovery in PNI. Multiple types of somatic stems cells present the ability to myelinate neuronal cells in the form of SC-like cells in vitro. SCs play a critical role for myelin sheath structure and function recover by synthesizing a large amount of myelin proteins. Stem cells differentiated into SC-like cells also show the capacity of supporting myelination in regenerated nerves in vivo.

The use of cells, whether actual Schwann cells or the stem cells obtained from varied sources, demonstrates considerable benefits in the repair of peripheral nerves, with great potential to become one of the most promising options at the clinic.
Arthroscopic Reconstruction of the Acromioclavicular Joint

James Tan Chung Hui
KHOO TECK PUAT HOSPITAL, SINGAPORE

The acromioclavicular (AC) joint is a vital link between the torso and the upper limb and injury to the AC joint is often debilitating. With the advancement of medical technology, surgical techniques to repair and reconstruct the AC joint have evolved and continue to do so, particularly in the realm of arthroscopy-assisted techniques. However, each new solution brings with it a new set of problems. We must remain mindful of the potential pitfalls as we continue to seek the perfect solution for this deceivingly simple problem.

L- Shaped Arthroscopic Posterior Capsular Release In Frozen Shoulder

Mohamed Gamal Morsy
ALEXANDRIA UNIVERSITY, EGYPT

Abstract:
Arthroscopic capsular release in refractory cases of primary frozen shoulder is a well-established and acknowledged procedure with successful outcome. Nonetheless, postoperative limitation of internal rotation is a common complaint that diminishes the postoperative success. The L shaped arthroscopic posterior capsular release in patients with primary frozen shoulder is a new technique that significantly improves the postoperative internal rotation range of motion.
Anatomical Medial Patellofermoral Ligament Insertion to the Patella: More Than a Cadaveric Study

Teo Seow Hui
OSAKA POLICE HOSPITAL, MALAYSIA

Over the past years, the attention of patellar instability disease has been focused on the MPFL ligament, specifically on its role as the primary medial stabilizer of the patella, and the importance of its reconstruction in case of dislocation. In recent years, many studies have confirmed not only its function but also its constancy as a ligamentous structure of the knee. It is placed in the second layer of the knee capsule, and it goes from the proximal extremity of patella to the medial part of the femur. A lot of attention has been paid to understanding its extreme variability, its anatomical relationships and especially how and when it should be reconstructed. To date, this ligament has an identified origin between the adductor tubercle and medial collateral ligament origin, and has been found to insert at the upper 2/3 of the medial border of the patella. However, there is lack of study and consensus at the patellar thickness insertion site. Numerous methods on MPFL reconstruction were described with attachment on different part of the patella, such as bone, bone-fascia tunnel fixation and pre-patellar tissue. A better understanding of the MPFL insertion site on the patella could improve current surgical technique for reconstruction. Instead of identifying the footprint only from cadaveric dissection, evaluation of imaging and histological correlation is utilized. Latest findings will be presented during the talk.
Arthroscopic AC Joint Reconstruction and Management of Concomitant Injuries

JEREMY JAMES C. MUNJI
DELOS SANTOS MEDICAL CENTER, PHILIPPINES

The focus of literature and outcome studies for the Acromioclavicular Joint Injury has always been with regard to method of fixation and various graft options. This lecture focuses on the management of rotator cuff or labral injuries that have been seen even on low grade AC Joint separations and options for management that may affect outcomes even in low-grade lesions. This lecture gives wisdom on offering arthroscopic diagnosis on AC joint dislocations that could be otherwise treated with an open or mini-open technique.

Traumatic posteromedial varus instability of elbow: My technique

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The function of shoulder and elbow is to position the upper extremity in space to perform activities with our hands and the biomechanic study showed loss of 50% of elbow function meant loss of 80% of upper extremity global function. The stability of elbow 50% due to bony articulation and 50% due to collateral ligaments. The muscle forces at the elbow is dorsal net vector and the coronoid resists posterior displacement of the ulna and serves as a buttress against varus stress. Anteromedial facet of coronoid process include anterior articular capsule, brachialis tendon and AMCL. Approximately 58% of the anteromedial facet of the coronoid protrudes from the proximal ulna shaft, which makes the anteromedial facet of the coronoid susceptible to injury. Traumatic posteromedial varus instability of elbow is not rare because gravitational stresses tend to stretch the lateral collateral ligament complex and shear or compress the anteromedial coronoid in most daily life; An axial force combined with posteromedial rotation, varus force, and elbow flexion causes the medial trochlea to abut onto the anteromedial facet of the coronoid.

This results in an anteromedial facet fracture with associated disruption of the LCL due to a varus force. The radial head is usually not fractured in a varus posteromedial instability pattern. The Pathoanatomy of this injury include anteromedial coronoid process fracture in association with LCL injury and /or MCL injury. and the coronoid process fractures almost come from O’Driscoll type 2. The special physical examination is reverse pivot shift test. The goal of treatment is to recover functional ROM without Pain and keep elbow stability and the strength, So we stabilize the elbow including ligamental and bony components in order to actively exercises as early as possible. We used Via neurovascular interval anterior elbow approach to reduce and fix the coronoid process fractures with Herbert screw, K wire, even mini buttress plate and repair the AMCL with suture anchor if necessary. If there was still unstable after
Strategic approach of first time dislocation of shoulder

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THE UNIVERSITY OF HONG KONG, HONG KONG

Anterior dislocation of glenohumeral joint is a common injury in shoulder. There is a bimodal age distribution in the presentation of first time shoulder dislocation. The first peak occurs in the second and third decade of life while the second peak appears in the sixth to seventh decade. The prognosis and treatment are different. A strategic approach is required for proper management of this common injury.

For young patients suffering from first time anterior shoulder dislocation, the main concern is recurrent shoulder dislocation. The incidence is reported to range from 90 to 100% in patients presenting at or less than 20 years old. Damage to anterior inferior glenohumeral ligament complex is inevitable. There is a high incidence of Hill Sachs lesion. Anterior-inferior glenoid bone injury is as high as 20%. Majority of shoulder surgeons recommend early surgical intervention in terms of arthroscopic assisted Bankart repair in young patients suffering from first time anterior shoulder dislocation. This approach reduces the chance of development of “off-track” bipolar bone lesions with repeated recurrent dislocations. More aggressive surgical intervention (e.g. coracoid process transfer) will be required if significant glenoid bone loss is present.

For older patients suffering from first time anterior shoulder dislocation, the risk of recurrent dislocation is low. However, it is notorious that there is a high chance of concomitant rotator cuff tear. After closed reduction and ruling out of associated humeral and glenoid fracture, an initial period of non-operative treatment is recommended. Prolonged immobilization should be avoided to minimize the chance of secondary frozen shoulder. It is important to examine the rotator cuff function three to six weeks after the initial injury. Presence of pseudoparalysis raises the suspicion of acute rotator cuff tear. Early surgical...
Arthroscopic treatment for recurrent shoulder dislocation: Vietnamese Experience

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ST PAUL UNIVERSITY HOSPITAL, VIETNAM

Abstract

Background: Arthroscopic surgery treatment for recurrent dislocation of shoulder has been known for a long time and many experienced surgeons have performed with very good results. This study aims to evaluate the results of arthroscopic treatment for recurrent dislocation of the shoulder in the Bankart lesion with our own experience.

Material: 32 patients diagnosed with recurrent dislocation of shoulder with Bankart lesion were determined by patient’s medical records, clinical examination and diagnostic imaging and treated with arthroscopic surgery method.

Method: Research was done by the prospective method, describing and treating injuries, evaluating results, inferring comments and viewpoints on its treatment efficiency.

Results: There were 5 patients using one anchor accounting for 15.6%, 7 patients using two anchors accounting for 21.9%, 20 patients using 3 anchor accounting for 62.5%. Rowe points after surgery was 87.6 points, in that excellent rate: 56.2%, good rate: 34.4%, fair rate: 9.4%.

Conclusions: Anchor placement and stitching techniques is reasonable to recover anteroinferior cartilage rim and joint in the Bankart lesion with a relatively positive results.
The 61st Annual Congress of The Korean Orthopaedic Association

Oct. 20th. 2017. Fri | Grand Ballroom1

International Perspective in Recent Shoulder Updates II

Yong Girl Rhee / Jae Chul Yoo
Completion repair shows better healing characteristics in comparison with insitu repair in the partial thickness bursal rotator cuff tear

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Abstract

**Purpose:** Very little information is available regarding to healing capacity of in situ and completion repair in the treatment of partial thickness rotator cuff tears. The purpose of the study was to analyse the healing characteristics of both techniques by comparing the Type I collagen and TNF concentrations, number and diameter of fibroblasts and neovascularization.

**Methods:** A partial thickness bursal side tear was created in the supraspinatus tendon of 12 adult Spraque-Dawley rats bilaterally. Three rats were used as a Cham group. Right shoulders were repaired by the insitu and the left shoulders were repaired by the tear completion technique on the 10th day after detachment surgery. Rats were sacrificed on the 10th (T1) and 30th (T2) day after repair surgery. Type I collagen and TNF concentrations, number and diameter of fibroblasts and neovascularization were examined at two different time lines.

**Results:** Collagen concentration (ng/mg total protein) was significantly elevated in both groups than healthy tendon at T1, and then decreased in insitu group while the completion repair continued to increase at T2 (P=0.03). Mean fibroblast diameter in completion repair group continued to increase in both time points (p=0.03). Neovascularization was significantly higher in tear completion compared to insitu repair (p=0.02) at T1. There were no significant differences regarding to TNF concentration (pg/mg total protein) in both surgical techniques at T2 (p=0.8).

**Conclusion:** Despite the concerns of detaching the intact tendon, completion repair shows better healing characteristics than insitu technique. Findings of this study indicate that the debridement of remaining tendon could promote the healing response.
No relationship between critical shoulder angle and glenoid erosion after shoulder hemiarthroplasty: a comparative radiographic study

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CASA DI CURA VILLA BETANIA GIOMI, ITALY

Introduction
Glenoid erosion is a common cause of pain and poor function after shoulder hemiarthroplasty often leading to the need for a revision surgery. A decrease in the critical shoulder angle (CSA) leads to increased loads on the gleno-humeral cartilage and the development of shoulder arthritis. The aims of the present study were to investigate the inter-observer reliability of the CSA and the relationship between CSA and symptomatic glenoid erosion after shoulder hemiarthroplasty.

Materials and methods
Twenty-eight patients with symptomatic glenoid erosion after anatomic hemiarthroplasty were compared to a control group of 30 patients with no signs of symptomatic glenoid erosion. The CSA was measured by two blinded shoulder surgeons at a mean follow-up of 105.2 and 54.7 months, respectively. The inter-observer reliability was calculated.

Results
The mean CSA in the control group in neutral, internal, and external rotations was 34°, 33°, and 33°, respectively. The corresponding values in the study group were 33°, 33°, and 33° (<0.01). The interclass correlation coefficient between the two examiners was 0.917 (P<0.01), 0.924 (P<0.01), and 0.948 (P<0.01), respectively. The Mann–Whitney test between the control group and the study group were, respectively, 0.907, 0.932, and 0.602.

Conclusion
The analysis of the CSA in the two groups showed no significant differences of values between patients with symptomatic glenoid erosion and patients who did not develop it. However good inter-observer reliability was found for the CSA method.
Biceps tendon tenotomy or tenodesis, what is the evidence?

Hossein Saremi

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Biceps tendon pathology usually occurs in conjunction with other shoulder pathologies. This tendinopathy ranges from inflammatory tendinitis to tendinosis and rupture of the tendon. In the literature, still controversy persists regarding management of the biceps pathology. I try to review literature about pathology and treatment of biceps tendinopathy and then mention my technique of treatment according to social and cultural expectations in my community.

Bone integrity and morphology of the coracoid process after the coracoid transfer for the recurrent anterior shoulder instability

Makoto Tanaka

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Introduction:
The coracoid transfer is a reliable procedure for the management of recurrent anterior shoulder instability, particularly in collision sports players and in cases with significant bone loss. There are two ways of coracoid transfer. One is Bristow procedure, in which coracoid tip is fixed with one screw in standing position. The other is Latarjet procedure, in which coracoid tip is fixed with two screws in laying position. We performed both procedures and assessed the advantages and disadvantages of the two procedures.

Materials and Methods:
We performed open Bankart repair with Bristow procedure or Latarjet procedure for the anterior recurrent shoulder instability. 48 shoulders with Bristow procedure and 33 shoulders with Latarjet procedure, evaluated by CT scan at least 6 months after the surgery, were included in this study. We defined the bone-union insufficiency when bone union was not recognized at more than 6 months after surgery.

Results:
In Bristow procedure, bone-union, bone-union insufficiency and the fracture with the displacement were recognized in 41 shoulders (85.4%), 5 shoulders (10.4%) and in 2 shoulders (4.2%), respectively. In Latarjet procedure, bone-union and the fracture with the displacement were recognized in 32 shoulders (97.0%) and 1 shoulder (3.0%). bone-union insufficiency was not identified in Latarjet procedure. CT scans were obtained on the first postoperative day (all shoulders), at 6 months (B: 22 shoulders, L: 20 shoulders), and at more than 1 year (B: 21 shoulders, L: 30 shoulders) of follow-up and the CT images

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on day 1 were used as a baseline. In Bristow procedure, bone-absorption of the coracoid process was recognized in 3 out of 22 shoulders at 6 months, 1 out of 20 shoulders after 1 year. In Latarjet procedure, bone-absorption was identified in all shoulders at both 6 months and 1 year, and severe bone-absorption was identified in 11 out of 30 shoulders after 1 year.

**Conclusion:**
Bone-union insufficiencies and fractures were frequently recognized in Bristow procedure, compared to Latarjet procedure. It could be caused by the weak fixation against the rotation due to a single screw. As for the morphology of the coracoid process after surgery, bone-absorption was rarely recognized in Bristow procedure, once the bone integrity was completed. However, bone-absorption was identified in all cases underwent Latarjet procedure. It seems that bone absorption is caused by the remodeling against the axial load, but there are several cases with severe bone-absorption. The morphology of the coracoid process was steady in Bristow procedure, rather than Latarjet procedure.

**Acknowledgment:**
none.

**Keywords:** coracoid transfer, bone integrity, bone absorption
A Modified Technique for Harvesting the Reverse Sural Artery Flap from the Upper Part of the Leg: Inclusion of a Gastrocnemius Muscle Cuff Around the Sural Pedicle

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Abstract
In the upper part of the leg, the sural nerve and its accompanying median superficial sural artery are buried between the two heads of the gastrocnemius muscle. Several authors found that the reverse sural artery flap was safe only if it was taken from the lower leg along the suprafascial course of the sural pedicle. We present a modified technique of harvesting the reverse sural artery flap from the proximal part of the leg: A midline “cuff” of gastrocnemius muscle containing the buried sural pedicle is harvested with the flap. This modification allowed maintaining a “mesenteric” connection between the sural pedicle and the overlying fascia in the upper part of the leg. A comparison between the incidence of ischemic events that occur with reverse sural artery flaps harvested using the standard and the modified techniques confirmed a more stable blood supply with the latter technique. The arterial and venous drainage of the reverse sural artery flap is discussed.

Immediate closure of Gustilo type IIIB open tibia fracture with calf muscle flap

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Introduction
Even though early flap coverage (within 72 hour after trauma) is important for successful treatment in Gustilo IIIB open tibia fracture, it is commonly impossible to cover the soft tissue defect with technically demanding free flap because of patient’s unstable condition and lack of skilled flap surgeon. Pedicled calf muscle flap surgery is easier and faster than free flap surgery for repair of tibial soft tissue defect. The purpose of this study is to evaluate clinical usefulness of immediate (at the time of the initial debridement) soft tissue coverage with pedicled calf muscle flap in Gustilo IIIB open tibia fracture.

Materials & Methods
Twenty-five patients with Gustilo IIIB open tibia fracture (4 proximal, 16 middle, and 5 distal tibial fractures) were divided into immediate closure group (at the day of injury, 10 cases) and delayed closure group (after 3 day from injury, 15 cases) and compared to evaluation of clinical benefits of immediate flap coverage with calf muscle. Average follow up periods were 4.5 years (12-84) months. Soft tissue defect were covered with proximal based gastrocnemius muscle for proximal fracture, with proximal based hemisoleus muscle for middle fracture, and with distal based hemisoleus or gastrocnemius muscle for distal fracture after initial fracture fixation and initial debridement of contaminated unviable tissue. To evaluation of clinical usefulness of immediate flap coverage with calf muscle, flap survival rate, incidence of osteomyelitis, surgical time during flap coverage, number of orthopedic surgery during hospitalization, Time period to internal conversion of fracture fixation, and length of hospitalization were compared.
Results
Flap survival rate was superior in immediate closure group and incidence of osteomyelitis was higher in delayed closure group. Surgical time during flap coverage was shorter and number of surgery in hospitalization was fewer in immediate closure group. Time period to internal conversion of fracture fixation and length of hospitalization were shorter in immediate closure group.

Conclusions
Immediate flap coverage with calf muscle in Gustilo IIIB open tibial fracture is very beneficial surgical strategy than delayed flap coverage for successful treatment of Gustilo IIIB open tibial fracture.

Key words
:tibia, open fracture, calf muscle flap

Fixation methods favorite for soft tissue around elbow in complicated fractures around elbow including ulnar nerve injury

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Primary or secondary microsurgical repair are preferred for treating ulnar nerve injuries. The timing of nerve repair is classified as primary (within first six to 12 hour), delayed primary (within the first two to 2.5 weeks) and secondary (after 2.5 to three weeks). Primary microsurgical repair is be superior to secondary repair; however, there are few studies regarding the repair of partial thickness injury of the ulnar nerve. Also, ulnar nerve is distinct in the tomographic presence among the major peripheral nerve in upper extremity, at least around elbow joint. This nerve usually injured concurrently with bony and ligamentous structures. Surgical results of ulnar nerve injury are often worse than for radial and median nerve injury. Results are adversely affected in high-level lesions, with low-level ulnar injury generally having better results. Surgical treatment of ulnar nerve injury has been often evaluated at the level of wrist and forearm (5–8). However, these articles do not compare injury level. Basar et al. suggested primary and delayed primary repair using the epiperineural suture technique provides satisfactory results following end-to-end ulnar nerve injury but a proximal lesion and associated massive soft-tissue injury was adversely affected results. However, in compromised soft tissue envelop, secondary repair would be difficult due to the excessive tension due to retraction toward proximally and distally. Thus, in this condition, anterior transposition of the ulnar nerve would be benefit for minimizing the tension, even alternating the nerve graft. Smetana BS et al. revealed that Ulnar nerve transposition was found to increase nerve overlap at an elbow flexion of 30° or greater. No difference was seen between subcutaneous and submuscular transpositions at all wrist and elbow positions. In situ decompression and mobilization alone provided an average of 3.5 cm of length gain with the elbow extended. Transposition in conjunction with clinically feasible wrist and elbow flexion (30° and 60°, respectively) provided 5.2 cm of length gain.
Thus, controlling for mobilization, a statistically significant increase in overlap of approximately 2 cm was gained from transposition. Inevitably after 3~4 weeks, nerve graft from sural nerve would be final options. But, in this nerve graft, transferred nerve both nerve ending would be put on the viable muscle with the hypothesis that more favorable surrounding tissue would be better in recovery. Finally, concurrent bony injury should be fixed. Another hypothesis could be suggested at least use of metallic material would support the healing and regeneration for both recovery of repaired ulnar nerve and compromised soft tissue envelop.

References
**Periprosthetic Femoral Fractures after Hip Arthroplasty**

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**Purpose:** Incidence of periprosthetic femoral fractures after total hip arthroplasty (THA) has been substantially increased due to the increase in the number of primary and revision THA. Various methods of operative treatment in accordance with the classification of periprosthetic femoral fracture have been introduced and applied. However, there is no general consensus as to the best technique for operative fixation. The purpose of study is to evaluate the radiological and clinical results of surgical treatment of periprosthetic femoral fractures after hip arthroplasty.

**Methods:** We retrospectively evaluated the radiological and clinical results of 42 periprosthetic femoral fractures (20 men, 22 women, mean age: 68 years), who underwent a surgical treatment according to the management algorithm of the Vancouver classification between 2004 and 2016. The mean follow-up was 60.4 months (range, 14-150 months). According to Vancouver classification, type A was present in 5 hips, type B1 in 17 hips, type B2 in 17 hips, type B3 in 3 hips. They were radiologically evaluated for bony union, stability of the prosthesis and postoperative complications. The clinical outcomes were determined by Harris hip scores (HSS) at final follow-up.

**Results:** Bony union was achieved in 38 of the 42 cases after initial surgical treatment for periprosthetic femoral fracture and the average time for bony union was 29 weeks (range, 13-61 weeks). Nonunion was observed in 4 cases (9.5%) and all nonunion were occurred after treatment of type B1 fracture. Periprosthetic infection with stem loosening occurred in 3 hips; therefore they were treated with two stage revision THA. 2 periprosthetic femoral re-fractures and 2 plate breakages occurred, which were treated with revision THA in 1 and revision open reduction and plate fixation with bone graft (cortical strut and/or cancellous bone)

**Conclusion:** Major vascular injury caused by loosened protruding acetabular screw after revision THA.
or morselized graft) in 3. The mean HHS was 85 at the final follow-up.

**Conclusion:** In this study, nonunion was observed in 9.5% and all nonunion were related with treatment of type B1 fracture. To reduce complications after surgical treatment of periprosthetic femoral fractures, achievement of adequate and sufficient mechanical fixation and reinforcement for bone deficiency are necessary. In this respect, using the newly developed plate system and cortical strut graft may be considered as alternative managements for optimal fixation and augmenting host bone stock.

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**Imaging in Pelvic and Acetabular Surgery – How to Avoid It**

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**ABSTRACT**

Ionizing radiation exposure in the trauma setting is probably an underappreciated risk for both surgeons and patients. Pelvic and Acetabular surgery are difficult tasks for an orthopedic surgeon, usually requiring prolonged fluoroscopy time during surgery. A 1-minute intraoperative image intensification about the pelvis is equivalent to about 40 mSv (4 rad, 4,000 mrem) of radiation, or approximately 250 chest x-rays or a CT scan of the pelvis. The careful surgeon absorbs little direct radiation during image intensification but is still subject to scatter from the patient’s anatomy. Higher doses are often due to inappropriate equipment or poor technique.

In developing countries, fluoroscopy is not available all the time which presents a difficult situation for an orthopedic surgeon. However, we humans always have the ability to adapt to our environment. This enables us to use the most basic tools that we have within our reach in order to achieve our goal during surgery.

This paper will present a review of the important aspects in decreasing radiation exposure in the operating room, and a practical review of the different procedures in pelvic and acetabular surgery, including the importance of preoperative planning, understanding how the procedure is done (important landmarks), the images needed for optimal implant placement, and the importance of tactile sense and 3D visualization during surgery. This will also include the author’s technique in doing pelvic and acetabular surgeries with less imaging with sample cases.
Mid-term Results of Open Debridement for Labral Tear Using Anterolateral Approach with a Mini-incision

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Abstract

Background: Open debridement was commonly used in patients with labral tear until arthroscopic surgery of the hip joint was widely performed. There are few studies with mid-term or long-term follow-up about open debridement for labral tear.

Purpose: To evaluate the mid-term results of open debridement for labral tear using anterolateral approach with a mini-incision.

Study Design: Case series; Level of evidence, 4.

Material and Methods: The retrospective study was done to evaluate clinical and radiologic mid-term results in 82 patients (100 hips) undergoing open debridement for labral tear with anterolateral approach between June 2006 to March 2010. Fifty-five patients (68 hips) were included in this study after exclusion criteria were applied. Perioperative outcome scores including the Harris Hip Score (HHS) and the Western Ontario and McMaster Universities (WOMAC) Index were used to assess clinical improvement after surgery. Also we also evaluated the degree of patient’s satisfaction, rates of revision surgery and conversion to total hip arthroplasty (THA). Tönnis grade on plain radiographs was used to assess progression of osteoarthritis.

Result: There were 20 male (24 hips) and 35 female (44 hips) and the average age was 42.9 years (range, 19-67). The mean follow-up duration was 7.5 years (range, 2.0-9.9). The HHS improved from 70.2 (range, 46-82) preoperatively to 89.8 (range, 70-100) at the last follow-up. The WOMAC score also improved from 50.3 (range, 29-82) preoperatively to 12.3 (range, 0-40) at the last follow-up. At last follow-up, clinical improvement showed no significant correlation with preoperative Tönnis grade on plain radiographs (P > 0.05). Eight patients (9 hips) underwent revision surgery. There was one patient with early chondrolysis and she had total hip arthroplasty conversion surgery.

Conclusion: Open debridement for labral tear using anterolateral approach with a mini-incision shows relatively good clinical outcome with average 7.5 years follow-up. Long-term follow-up study should be performed because of the rate revision surgery is not low.

Key words: labral tear, open debridement, anterolateral approach
Myung Chul Lee / Choong Hyeok Choi

Current issues in knee arthroplasty

Oct. 20th, 2017. Fri | Grand Ballroom2
Tibial preservation in Fixed & mobile medial UKA: rational & technique.

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Abstract
In general, the tibial bone cut in fixed and mobile bearing unicompartmental knee arthroplasty (UKA) should be minimal, of which the resected bone is 2 to 4 mm thick. However, the tibial varus inclination angle of Asian patients tend to be higher than Caucasian patients. Therefore, cutting the tibial bone according to the recommended surgical technique in both types of medial UKA in Asian patients may result in too deep tibial bone cut, and may associate with medial tibial collapse or tibial fracture. We propose the tibial preservation in fixed & mobile medial UKA in order to preserve more proximal tibial bone and to prevent medial tibial collapse or fracture.

For fixed bearing UKA, after arthrotomy and adequate exposure of the medial compartment, the tibial cutting jig is placed along the tibial axis. By free-hand adjusting, the target position of cutting jig should allow a 90° coronal bone cut with < 5° slope, and 1 mm thick at the lowest part of tibia. Following tibial cut, the extension gap is then evaluated which should provide adequate space for the thinnest polyethylene (PE) combined tibial baseplate. If it is too tight, a 1-2 mm distal femoral bone cut is made, and evaluation of extension space is repeated. Following adequate extension space, the knee is flexed to 90° and the spacer with same thickness of selected PE thickness (plus tibial baseplate) is inserted for flexion space. If the space is too tight, a similar bone cut is made at the posterior femoral condyle until it is decent. Then, the femoral sizing is made and the next steps of bone cuts and preparation are made until finished.

For mobile bearing UKA, the target position of cutting jig may allow 5-7° posterior slope with very thin (1 mm) tibial bone cut. In contrary to the fixed bearing, evaluation of spaces are made from flexion gap, with the same technique. The knee is flexed to 90° and thinnest spacer with selected tibial baseplate is inserted. If the space is too tight, a similar bone cut is made at the posterior femoral condyle until it is adequate. Next, the femoral sizing is made and the next steps of extension gap evaluation using different spigots for increment of distal femoral reaming are made until the gap match to the flexion gap. Then, further steps of bone cuts and preparation are made until finished.

Based on our mid- to long-term experience in 73 fixed bearing medial UKAs using tibial preservation technique, we found that medial joint line elevation occurred in all cases. As the concept of tibial preservation in both fixed and mobile bearing UKA is the same, medial joint line elevation should also occur in mobile bearing UKA. Furthermore, in some cases, the postoperative medial joint line can be higher than the lateral joint line. Although this surgical modification can affect the biomechanics of the knee and clinical of outcomes, our study found that it did not have any effect clinical outcomes in fixed bearing UKA regardless of the amount of elevation. In this series, the survivorship for revision to TKA was 100%.

Keywords: unicompartmental knee arthroplasty, UKA, joint line, tibial preservation
MIS TKA: are you still there?

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Abstract

Since 2002, total knee arthroplasty (TKA) using minimally invasive surgery (MIS) or MIS-TKA has been popularized worldwide. Although MIS-TKA is characterized by a 3- to 4-inch skin incision, less quadriceps injury, no patellar eversion, pain reduction, faster ambulation and shorter hospital stay, current literature has verified that the significant differences of MIS-TKA from conventional TKA are only shorter skin incision and faster early knee range of motion, especially, the first 6 to 12 weeks, postoperatively. Although infection, instability and stiffness are being concerned as the leading causes of early failure after TKA, reports of mid-term to long-term outcomes of MIS-TKA have shown similar survivorships to those of conventional TKA. Based on our 15 years of experiences, to achieve consistent satisfactory outcomes of MIS-TKA, 3 major issues must be addressed, including concepts of MIS approaches, comprehensive anesthesia & postoperative pain control, and early rehabilitation protocol.

To enhance the MIS approach in TKA, the attempt can be successfully achieved by applying 4 major principles, including mobile skin window; using a pair of retractors moving around the knee for specific surgical areas, multiple knee flexion angles; the knee being flexed at multiple angle to accommodate individual step of surgery, patellar subluxation; avoiding patellar eversion with less tension to the extensor mechanism, and facilitating instruments; low-profile instruments to avoid skin and soft tissue damage. Evidences have verified that patients’ satisfaction on postoperative pain relates directly to the efficiency of anesthesia and postoperative pain control. Current literature demonstrated that contemporary multimodal pain control, including continuous peripheral nerve blocks and local joint infiltration in TKA provides similar effectiveness of pain control regardless of MIS or conventional surgical approach. Following the improved efficiency of postoperative pain control, contemporary postoperative rehabilitation for both approaches of TKA has moved to the so-called “enhanced recovery after surgery” (ERAS). However, one should be reminded that the aggressive rehabilitation protocol may increase knee inflammation and may develop subacute postoperative knee pain. Therefore, a well balance between rapid knee function training and control of postoperative synovial inflammation should be considered.

Keywords: minimally invasive surgery, MIS, total knee arthroplasty, TKA
Kinematics after TKA—Normal or Durable?

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R AND D CENTER OF JOINT RECONSTRUCTION, TZU-CHI MEDICAL CENTE, TAIWAN

[Results]
1. All the prosthetic knees revealed erratic rolling and gliding with constant posterior tibio-femoral contact throughout range of motion, which were similar to ACL-deficient knees. In PCL-released group, relatively more anterior tibio-femoral contact with less femoral rollback was seen.
2. In most knees with posteromedial wear, excessive posterior slope of tibial cut was found. Dynamic views in all knees exhibited constant posterior tibia-femoral contact throughout ROM and external subluxation of tibia component in extension phase. The retrieved inserts revealed fatigue failure over posteromedial aspect. In some knees, rotational mismatch of tibia-femoral articulation and tight PCL was found following trial reduction.

[Discussion]
The dynamic studies demonstrate that PCL-retaining knees are similar to ACL-deficient knees. Combined with the pre- and intraoperative evaluation, we postulate that posteromedial wear of the tibial polyethylene is attributed to external rotary subluxation of the tibial component in extension phase. This external rotary subluxation is thought to be associated with (1) absence of both ACL and menisci (2) ignorance of functional meniscal slope leading to excessively posterior slope of tibial cut, and (3) rotational mismatch of tibia-femoral articulation during gait cycle.

[Conclusion]
Normal physiologic rollback could not be reproduced in PCL-retaining TKAs because of the absence of ACL. Instead, the PCL-retaining knee often resulted in premature polyethylene wear arising from erratic motion in both coronal and transverse planes. To enhance prosthetic longevity in primary TKA, the author thinks it is reasonable to convert a cruciate joint into a non-cruciate joint. In primary TKA, the author recommends:
1. Resect PCL with 90-degree tibial cut.
2. Match tibial component rotation to femoral rotation in extension.
3. Select a prosthesis with more sagittally conforming insert with anteriorly positioned sulcus.

[Introduction]
Polyethylene wear is still a challenge issue for the longevity of TKA. The polyethylene material, implant design affected the polyethylene wear behavior have been studied extensively. Another important factor, the knee kinematics of patients underwent TKA, was studied extensive from biomechanical aspect but rare from clinical relevant. In this study, we investigated the relationship between the TKA patients’ kinematics and the polyethylene wear pattern observed from revision retrieval inserts.

[Materials & Methods]
Dynamic weight-bearing lateral views of X-ray at 0°, 30°, 60°, 90° and maximal knee flexion were evaluated to determine in vivo tibio-femoral contact patterns in various groups of knees. These included painless knees in 30 elderly subjects, 20 ACL-deficient knees in young subjects, 121 knees receiving primary PCL-retaining TKA (including 50 knees with PCL release), and 144 revision knees with proved polyethylene wear.

In addition to dynamic X-ray studies, all patients with polyethylene wear were also evaluated by preoperative single-leg standing AP, lateral and stress view, and manual test under anesthesia. Intraoperatively, the rotational alignment of tibia-femoral joint and the motion behavior of the joint following insertion of new trial insert were closely observed. The retrieved inserts were studied for its characteristics, including conformity, the location of sulcus and morphologic change of the wear. The same time, we compared those dynamic x-rays to those knees at least lasting 10 years with good and excellent clinical score with neglectful poly wear.
Infected TKA: Update on Diagnosis and Treatment

Chong Bum Chang
SEOUL NATIONAL UNIV.

1. Epidemiology, risk factors of prosthetic joint infection (PJI)
   - The rate of prosthetic joint infection: 0.5 to 1.0 percent for hip replacements and 0.5 to 2 percent for knee replacements.
   - Kurtz et al. assessed more than 69,000 elective TKA and reported that the rate of infection was highest during the first two years following surgery (1.5%). The rate of infection 2 to 10 years after joint replacement was 0.5%.
   - The reported major risk factors associated with PJI were early-onset superficial surgical site infection, nonsurgical trauma to the prosthetic joint, and bacteremia during the previous year. Additionally, several factors were also associated with PJI: RA, DM, psoriasis, malignancy, poor nutrition, advanced age, high BMI, prior knee surgery, prior joint infection, prolonged surgery, hematoma formation, and nasal colonization of MRSA, MSSA.

2. Definition of PJI (by Parvizi & Gehrke, & The International Consensus Group on PJI, 2014)
   - Definition of PJI could be difficult. Indeed, there is no gold standard tools for diagnosis of PJI. Thus, a working group made effort to define PJI based on several clinical variables and the most recent definition was proposed as below.

<table>
<thead>
<tr>
<th>Criterion</th>
<th>Acute PJI (&lt;90 days)</th>
<th>Chronic PJI (&gt;90 days)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Erythrocyte Sedimentation Rate (mm/hr)</td>
<td>Not helpful. No threshold was determined</td>
<td>30</td>
</tr>
<tr>
<td>C-Reactive Protein (mg/L)</td>
<td>100</td>
<td>10</td>
</tr>
<tr>
<td>Synovial White Blood Cell</td>
<td>15,000</td>
<td>3,000</td>
</tr>
<tr>
<td>Count (cells/μl)</td>
<td>90</td>
<td>80</td>
</tr>
<tr>
<td>Synovial Polymorphonuclear (%)</td>
<td>+ or ++</td>
<td>+ or ++</td>
</tr>
<tr>
<td>Leukocyte Esterase</td>
<td></td>
<td>Same as acute</td>
</tr>
<tr>
<td>Histological Analysis of Tissue</td>
<td></td>
<td></td>
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</tbody>
</table>

3. Classification of PJI
   - The PJIs could be classified based on onset of symptoms: early, delayed, and late onset. Early and delayed infections are mostly acquired during implantation, whereas late infections are primarily due to hematogenous seeding.
• Acute Phase Reactant (ESR & CRP)
  - Most initial work-up
  - Cut off values for Dx of PJI (MSIS): ESR 36.5 mm/hr, CRP 23.5 mg/L (2.35 mg/dL)
  - False (+): Recent surgery, coexistent inflammatory joint disease, UTI, URI, C-V diseases
  - If both are normal: infection is ‘unlikely’

• Joint Fluid WBC: WBC counts higher than 1100, 1700, or 4200/mcL had sensitivities of 91, 94, and 84 percent with specificities of 88, 88, and 93 percent in previous different studies. Furthermore, a synovial fluid leukocyte count differential of > 65 percent neutrophils had high sensitivity and specificity for diagnosis of PJI (97 and 98 percent, respectively)

• Acute phase reactant (ESR & CRP)
  - Cut off values for Dx of PJI (MSIS): ESR 36.5 mm/hr, CRP 23.5 mg/L (2.35 mg/dL)
  - False (+): Recent surgery, coexistent inflammatory joint disease, UTI, URI, C-V diseases
  - If both are normal: infection is ‘unlikely’

• Leukocyte Esterase (LE) test
  - Detect LE secreted by activated neutrophils, Using ‘urine colorimetric strip’
  - Inexpensive, rapid, and practical method
  - But, false (+) risk for blood stained fluid

• Joint fluid inflammatory markers: IL-1, IL-6, and CRP

• Intraoperative frozen section
  - > 5 PMNs/ HPF (× 400 magnification)
  - Very good “rule-in” but limited “rule-out” test

• Imaging studies: in general, not diagnostic
  - Plain X-rays: abnormal lucency, periosteal rxn
  - Scintigraphy (Tc⁹⁹, or Ga⁶⁷ WBC scans): Falsely abnormal for up to 1Y after TKA, High specificity but very low sensitivity
  - FDG-PET: limited report. may be useful in equivocal case
  - CT, MRI: limited value due to artifact & applicability

4. Diagnosis of PJI

• 1st step of PJI diagnosis is confirm the presence of infection, then next is identification of causative microorganism.

• Symptoms and signs
  - Pain
    - Present in > 90 – 95%
    - Persistent pain, night pain (cf. Aseptic loosening: start-up pain, pain during activity)
  - Fever
    - Present in 40 – 50%
    - Less frequent in delayed onset infection
  - Periarticular swelling
    - Present in ~ 40%
    - Less frequent in delayed onset infection
Culture Negative PJI: Reasons
- Recent antibiotic use
- Inadequate preop. testing
- Atypical low virulence infection
- Biofilm protection

The way improving culture (+) rate
- Stop using antibiotics (≥14D)
- Multiple samples from multiple locations
- Extend incubation up to 14D
- Biofilm disruption: sonication
- RT-PCR of bacterial 16S ribosomal RNA
- Culture or PCR for atypical infection

5. Treatment of PJI
- Treatment of PJI should be planned based on timing of infection, microbiology of infection, stability of the prosthesis, quality of the soft tissue envelope and individual patient condition.
- Surgical options include one or two stage reimplantation, debridement and retention of prosthesis, resection arthroplasty or amputation.
- Antibiotic suppression without surgical reimplantation could be an option for a subset of patient.
- Two-stage reimplantation is still regarded as gold standard method for management of PJI, but, one-stage reimplantation is advocated in European schools
- Controversial issues in Treatment of PJI involves two stage vs. one stage reimplantation, value of debridement with prosthesis retention, static spacer vs. mobile spacer in two stage reimplantation, duration and kind of antibiotics usage, and so on

6. References
## Revision TKA: Managing bone defect

Seung-Beom Han  
KOREA UNIV.

### Introduction

Bone defects are often encountered in revision TKA. It affect alignment, stability and longevity of TKA. Surgeon should assess accurately the extent of bone defect, however, preoperative radiologic evaluation is not enough. It is important to anticipate bone defect and prepare variable treatment options.

### Classification

**1. Rand JA, CORR 1991**

- Contained Defects: intact cortical rim
- Uncontained Defects: damaged cortical rim (Non-circumferential/Circumferential)

**2. Anderson Orthopedic Research Institute (AORI) : most widely used system**

<table>
<thead>
<tr>
<th></th>
<th>Femur</th>
<th>Tibia</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Type 1</strong></td>
<td>Normal joint line, condyles intact</td>
<td>Normal joint line, condyles intact</td>
</tr>
<tr>
<td><strong>Type 2</strong></td>
<td>Damaged metaphyseal bone One condyle</td>
<td>Damaged metaphyseal bone One condyle</td>
</tr>
<tr>
<td>2A</td>
<td>Both condyle</td>
<td>Both condyle</td>
</tr>
<tr>
<td>2B</td>
<td>Deficient metaphyseal segment &amp; ligaments</td>
<td>Deficient metaphyseal segment &amp; ligaments</td>
</tr>
</tbody>
</table>

In case of F2, F3, T2 & T3: Stems are required

### Treatment

**1. Defect patterns**

1) Cystic: Small trabecular bone defects in the bone-implant interface can be filled with autogenous bone graft or cement. Bone graft is recommended for cystic defects more than 5 mm in diameter.

2) Epiphyseal: Defects involving the cortical bone of tibial plateau or femoral condyles can be treated by modular prosthetic augmentations. Stem should be used to transfer load into the medullary canal and improve fixation.

3) Cavitary: Massive, intracortical, metaphyseal bone defects can be treated by metaphyseal filling implants or bulk allograft with stemmed implants.

4) Segmental: Combined epiphyseal and cavitary patterns. Large portions of distal femur or proximal tibia are missing. Structural allograft with stemmed implant is recommended in younger patients. Hinge type prostheses also can be used, because often there is no collateral ligament present.
2. Surgical options

1) Cement filling
Cement filling can be used to treat peripheral small defects (<50% of bone surface and <5mm of depth). Because of poor biomechanical property, cement fracture or loosening can occur when the slope is more than 20 degrees. It is not recommended for young patient.

2) Metal augmentation
It is used for bone defect of femur and tibia (40% or more of the bone-implant interface is unsupported by host bone). Because of the various shapes and sizes, it is possible to determine the use of augment during surgery (inability to achieve stability of the trial implants at the time of trial reduction). There is little risk of nonunion or collapse.

3) Metaphyseal filling implant (sleeve & cone)
It was designed to fill contained metaphyseal defects of femur and tibia and provide rotational stability. It is technically easier than allograft and allows immediate weight-bearing. It also reduces the risk of infection and nonunion.

4) Bone graft
The advantages of bone graft are new bone formation and physiological load transfer. Autologous bone graft is to fill contained defect (more than 10mm), uncontained bone defect (less than 50% of bone surface). Structural allograft are used for a stable reconstruction in large or segmental bone defect. But, there are risks of nonunion and disease transmission.

Conclusion
Bone defect in revision TKA is challenging. Therefore, preoperative planning and preparation of surgical options are important. Patterns of bone defects in revision TKA can be anatomically categorized, and management of these can be algorithmically approached depending on bone loss pattern.

Reference
MEMO

The 61st Annual Congress of The Korean Orthopaedic Association

New surgical trend in cervical spine

Hak Sun Kim / Jin Sup Yeom

Oct. 20th. 2017. Fri | Grand Ballroom2
Distraction Arthrodesis of the C1-C2 Facet Joint with Preservation of the C2 Root for the Management of Intractable Occipital Neuralgia Caused by C2 Root Compression

QuanYou Li, Su Chan Oh, Sung Shik Kang, K. Daniel Riew*, Jemin Yi, Gun Woo Lee, Ho Sung Han, Hyo Sae Ahn, Bong-Soon Chang, Choon-Ki Lee, Ho-Joong Kim, Jin S. Yeom
CYANBIAN UNIVERSITY HOSPITAL, CHINA

ABSTRACT

Study Design: Prospective observational cohort study

Objectives: To compare the outcomes of our new technique, distraction arthrodesis of C1-C2 facet joint with C2 root preservation (Study group), to those of conventional C1-C2 fusion with C2 root transection (Control group) for the management of intractable occipital neuralgia caused by C2 root compression.

Summary of Background Data: We are not aware of any report concerning C2 root decompression during C1-C2 fusion.

Materials and Methods: Inclusion criteria were visual analogue scale (VAS) score for occipital neuralgia 7 or more; C2 root compression at the collapsed C1-C2 neural foramen; and follow-up 12 months or more. The Study group underwent surgery with our new technique including (1) C1-C2 facet joint distraction and bone block insertion while preserving the C2 root; and (2) use of C1 posterior arch screws instead of conventional lateral mass screws during C1-C2 segmental screw fixation. The Control group underwent C2 root transection with C1-C2 segmental screw fixation and fusion. We compared the prospectively collected outcomes data.

Results: There were 15 patients in the Study group and 8 in the Control group. Although there was no significant difference in the VAS score for the occipital neuralgia between the 2 groups preoperatively (8.2 ± 0.9 vs. 7.9 ± 0.6, P = 0.39), it was significantly lower in the Study group at 1, 3, and 6 months postoperatively (P < 0.01, respectively). At 12 months, it was 0.4 ± 0.6 versus 2.5 ± 2.6 (P = 0.01). There was no significant difference in improvement in the VAS score for neck pain and neck disability index and Japanese Orthopedic Association recovery rate, which are minimally influenced by occipital neuralgia.

Conclusions: Our novel technique of distraction arthrodesis with C2 root preservation can be an effective option for the management of intractable occipital neuralgia caused by C2 root compression.
The Usefulness of Dynamic MRI in Cervical Myelopathy Caused by OPLL for Selective Surgical Decompression

Yehlen Francis Reyes Saligumba, Gang-Un Kim, Ho Sung Han, Ho-joong Kim, Sung Shik Kang, Bong-Soon Chang, Choon-Ki Lee, Jin S. Yeom
ST. LUKE'S MEDICAL CENTER GLOBAL CITY, PHILIPPINES

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ABSTRACT

Aim:
We aimed to investigate the dynamic effect of the ossification of posterior longitudinal ligament (OPLL) on cord compression using cervical spine MRI.

Patients & Methods
A total of 76 patients with cervical myelopathy caused by OPLL were enrolled in the study. In each neck position including flexion, neutral, and extension, three parameters were measured at each disc level between C2-T1: the spinal canal width, the space available for the spinal cord (SAC), and the spinal cord diameter (SCD). Using these parameters, the canal stenosis ratio (CSR) and cord occupancy ratio (COR) at each position were calculated and compared at each position.

Results:
The SAC and SCD were significantly smaller whereas the CSR and COR were significantly larger in neck extension than in flexion and neutral positions (p < 0.001, respectively). Moreover, the number of levels with significant cord compression increased significantly with neck extension (p < 0.001).

Conclusion:
Our results demonstrate that the degree of cord compression of cervical OPLL as well as the number of levels with significant cord compression increase with neck extension.
Free-hand placement of C7 laminar screws: accuracy and safety in 43 consecutive patients

Feng Shen, Jiwon Park, Hyo Sae Ahn, Quan You Li, Ho-Joong Kim, Bong-Soon Chang, Choon-Ki Lee, and Jin S. Yeom
QINGDAO UNIVERSITY HOSPITAL, CHINA

ABSRTACT

Study Design. Retrospective case study

Objectives. To determine the accuracy and safety of C7 laminar screw placement with a free-hand technique based on clinical and radiologic outcome

Summary of Background Data. Anatomic feasibility and biomechanical stability of C7 lamina screw fixation has been demonstrated in previous studies. However, few studies have described the clinical outcome of C7 laminar screw fixation, and they are limited given small sample size.

Methods. All patients who underwent posterior cervical fixation with C7 laminar screws were chosen from the prospective surgical patient database of the last author. All screws were placed with a free-hand technique without radiographic or fluoroscopic guidance. The operating time for each C7 laminar screw placement was approximately 1 minute. Clinical information and radiologic data of patients were analyzed. For those who received postoperative CT scans, the accuracy of screw placement was evaluated by two orthopedic surgeons by assessing the direction (dorsal versus ventral) and degree of laminar cortical breach.

Results. Forty-three consecutive patients were enrolled. There were 26 males and 17 females, and the age averaged 58.7 ± 13.5 years. A total of 61 C7 laminar screws were used for those patients: twenty-five patients underwent unilateral C7 laminar screw fixation, and eighteen underwent bilateral fixation. All the laminar screws were 3.5 mm in diameter and 20 to 26 mm in length (3 20-mm, 13 22-mm, 38 24-mm, and 7 26-mm screws).

Forty-three patients took postoperative CT scans. Of the 61 screws placed for them, 14 screws (23%) breached the laminar cortical wall, including 3 dorsal and 11 ventral breaches. Of those 14 screws, 11 screws (18%) breached by less than 50% of screw diameter and 3 screws (5%) breached by more than 50% but less than 100% of screw diameter. Nine screws were one of the screws placed bilaterally, and 5 screws were unilaterally placed. No intraoperative neurovascular injury was observed, and none of the screws with cortical breaches resulted in worsening of neurologic symptoms. None of the patients required reoperation for any reasons. Over the follow-up period of 20 months, mechanical failure such as loosening or fractures of screw-rod system has not been observed.

Conclusions. C7 laminar screw may provide a valuable alternative to pedicle screws for C7 fixation in terms of efficiency and safety.

Key words: C7, Laminar screw, Intralaminar screw, Translaminar screw, Lower cervical fixation, Cervical spine
ACDF with Total En Bloc Resection of Uncinate

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Cervical spine has its peculiar anatomical structures. Those are uncinate process and unco-vertebral joint, so called joint of Luschka. Arthritic change in unco-vertebral joint results in foraminal stenosis and compressing nerve root. This condition is cervical spondylotic radiculopathy.

Cervical spondylotic radiculopathy (CSR) has both symptoms of neck and arm pain. When we consider surgical treatment, both neck and arm pain should be relieved. Therefore, we prefer ACDF to foraminotomy. By performing ACDF, we can achieve indirect decompression of the nerve roots by increasing disc height in some patients. But all patients with foraminal stenosis do not have sufficient foraminal dimension even after the ACDF with increasing disc height. Therefore, direct decompression of nerve root by resection of uncinate process is necessary in some patients.

For safe resection of uncinate without injury to nerve roots or vertebral artery, we cut uncinate process at its base as En bloc using osteotome.

Total en bloc resection of uncinate is safe and effective surgical option for cervical spondylotic radiculopathy.
Surgical Treatment of metastatic spinal tumors

Masato Tanaka
OKAYAMA UNIVERSITY HOSPITAL, JAPAN

Metastatic epidural spinal cord compression (MESCC) is a common complication in patients with a malignant tumor, but it is difficult to decide the proper time to perform the necessary surgery. Here we analyzed the prognostic factors for postoperative walking ability.

We retrospectively reviewed the cases of 112 MESCC patients treated surgically at our institute and divided them into ambulatory (n=88) and non-ambulatory (n=24) groups based on their American Spinal Injury Association (ASIA) Impairment Scale grades at the final follow-up. We also classified the patients preoperatively using the revised Tokuhashi score. We assessed the correlation between preoperative or intraoperative factors and postoperative walking ability in both groups.

Of the 10 patients classified preoperatively as grade A or B, 2 (20%) were ambulatory at the final follow-up. Of the 102 patients classified preoperatively as grade C, D or E, 86 (84%) were ambulatory at the final follow-up (p<0.001). There were no significant differences between the groups in the average total Tokuhashi score.

Our analysis revealed that the severity of paralysis significantly affects neurological recovery in patients with MESCC. Patients with MESCC should receive surgery before the preoperative ASIA Impairment Scale grade falls below grade C.
Using intra-operatively ideal entrance point and angle of screws with a set square for lower cervical pedicle screw placement. Accurate result?

Tran Hoang Manh
KHANH HOA GENERAL HOSPITAL, VIETNAM

BACKGROUND CONTEXT:
Cervical pedicle screw (cps) is an excellent technique for spinal fixation, however it is a controversial technique due to its risks of neurovascular complications. The most important factors impacting the accuracy of pedicle screws are the entrance point and the angle of screw. Cps with ideal entrance point and angle is usually guided by navigation or screw guide template system. In Vietnam, there are no studies about using intra-operatively ideal entrance point and angle of screw for cps placement.

PURPOSE:
This study aims to describe the method of using the intra-operatively ideal entrance point of screw and the angle of pedicle axis and frontal plane (angle PF) with a set square for lower cps placement, and to determine the accurate position of screws.

METHOD:
Seven spinal trauma patients underwent surgeries of applying the lower cps fixation. Preoperatively, we utilized CT scanner to determine the ideal entrance point of cps (by Tomomichi Kajino’s method: Ideal entrance point is defined as an Insertion point of surface lateral mass and pedicle axis), measure the distances between ideal entrance point and lateral margin of lateral mass (distance L), and measure angle PF.
We applied Abumi’s technique to insert cps, but intraoperatively, C - Arm in lateral position determined sagittal pedicle axis, the set square determined the ideal entrance point (by distance L, it located on sagittal pedicle axis); after making the entrance hole, we put the straight probe into this hole, the angle of the frontal plane and straight probe is equal to angle PF, that was measured by a set square.

After having the ideal entrance point and angle of screws, pedicle probe, tap and screws were inserted into the pedicle.

The accuracy of the pedicle screw placement was evaluated on postoperative CT scanner (Evaluate the screw position by the classification of Shuichi Kaneyama et al).

RESULTS:
Seven patients were inserted 39 cps (C3-C7), the mean angle PF and distance L were 43.6±5.0° and 2.4±1.0mm. Postoperative CT scanner showed: 36 screws of Grade 0 (92.3%) and 3 screws of Grade 1(7.7%). There were no identified complications related to cps.

DISCUSSION:
The conventional technique for cps is an excellent technique, with high accuracy results for experienced surgeons, however this technique is very challenging for inexperienced surgeons to know exactly where is the entrance point and angle of screws.

Our method of using a set square to determine ideal entrance point and angle of screws has resulted in higher success rates because of more precise measurements which will be beneficial for inexperienced surgeons.

CONCLUSION:
The ideal entrance point and pedicle axis angle to the frontal plane on CT Scanner measured intraoperatively by the set square can improve the accurate position of cps, with 92.3% accuracy rate.
Unusual presentation of tuberculosis in cervical spine: challenges faced by Spine surgeons in developing country

Dinesh Kafle
TRIVHUVAN UNIVERSITY, NEPAL

Tuberculosis of the spine is still prevalent in the developing countries. Myriad of presentations further complicate the diagnosis. Though uncomplicated tuberculosis is a medical disease managed effectively with anti-tubercular drugs, morbidity and mortality with pott’s spine is significant in our country. Pott’s spine of upper cervical spine and cervico-thoracic spine, though uncommon, are frequently encountered in our institute. Pott’s spine of unusual location usually doesn’t present with classical features associated with the disease. High degree of suspicion, critical acumen, and expensive investigative modalities are needed.

Challenges faced by the spine surgeons in developing countries are late presentation of the patients, limited training and experience dealing with such complicated cases, lack of adequate resources and operative techniques, and economic constraints. Few such clinical scenarios and challenges we faced will be discussed.

TIMING OF SURGERY AND TREATMENT IN TRAUMATIC CENTRAL CORD SYNDROME: OUR LOCAL EXPERIENCE AND REVIEW OF LITERATURE

Mary Ruth A. Padua
EAST AVENUE MEDICAL CENTER, PHILIPPINES

INTRODUCTION. Despite the recommendation for early decompression in traumatic central cord syndrome (TCCS), logistical limitations in our setting hinder ideal treatment of such cases. The outcomes and predictors of outcome of these cases remain uncertain in this milieu. This is a retrospective study that aims to evaluate if the timing of surgery predicts outcomes (neurologic improvement, complications, functional outcome) in TCCS.

MATERIALS AND METHODS. All patients with traumatic cervical spine injuries seen at the emergency room from 2014 to present were included in this study. A total of 45 patients with acute TCCS were included for analysis.

RESULTS. Initial results in one institution showed that 6 out of 15 patients underwent surgical treatment. All conservatively treated patients improved to full functionality at an average of 12 weeks from injury. At 12 weeks, improvements of ≥ 2-grade were reported in patients who underwent early surgical management.

CONCLUSION. Early surgical decompression after traumatic central cord syndrome is associated with at least two-grade AIS improvement at 12 weeks. Outcomes and predictors of outcomes will be determined at 6 months after surgery.
C5 PALSY AFTER POSTERIOR CERVICAL RECONSTRUCTION BY PEDICLE SCREW FIXATION: 2 CASES REPORT

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108 MILITARY CENTRAL HOSPITAL, VIETNAM

OBJECTIVE:
To present the cases of 2 patients who developed C5 palsy after cervical pedicle screw insertion for kyphotic correction and laminectomy for decompression.

SUMMARY OF BACKGROUND DATA:
C5 palsy has been reported to be a major complication of both anterior and posterior decompression procedures. Although the etiology of C5 palsy and preventive measures remain unclear, it has been hypothesized that C5 palsy is caused by C5 nerve root impairment induced by potential C4/C5 foraminal stenosis and posterior shifting of the spinal cord after laminectomy and kyphotic correction.

METHODS:
The authors report two cases of two patients who developed C5 palsy after cervical pedicle screw insertion for kyphotic correction and laminectomy for decompression. C5 paralysis was defined as deterioration in muscle power of the deltoid or biceps brachia by at least 1 grade by manual muscle testing. The laminotomy of C4-5 at the side of C5 palsy was done after C5 paralysis had been recognized.

RESULTS:
The first case was 54 year old male, who had cervical myelopathy with progressive paralysis due to cervical spondylotic kyphosis. The cervical pedicle screw fixation was chosen for correction of deformity which was performed by surgeon who had more than 20 year experience about spinal surgery but did not perform cervical pedicle screw technique. The pedicle screw was correctly inserted from C3 to C6, and good reduction was gained and the symptoms were improved after surgery. However, the right C5 root palsy was recognized after 2 days of operation therefore the C4-C5 right foraminotomy was immediately done. After 5 month follow – ups, the paralysis of C5 nerve root was completely improved and the patient had good results of treatment. The second case was 61 year old male who underwent cervical pedicle screw fixation from C2 to C7 for reduction of spondylotic kyposis and the left C5 root palsy was also seen after 3 days of surgery. The accuracy of screw insertion was confirmed by postoperative images thus the authors supposed C5 nerve root paralysis was caused by foraminal stenosis. Left C4-5 foraminotomy was taken after a day of diagnosis and severe C5 nerve root compression was seen.

CONCLUSIONS:
This report suggests that improved lordosis of the cervical spinal column can result in traction injury to the spinal cord and C5 nerve roots and that reoperation may be needed. The foraminotomy at C4-5 level during the surgery of cervical pedicle screw fixation can be a good method of preventing C5 palsy.
COMBINING YEOM’S AND SHIRAISHI’S TECHNIQUE FOR THE TREATMENT OF CERVICAL SPONDYLOTIC MYELOPATHY

*Nguyen Huu Thuyet, *Huynh Thong Em
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We designed the treatment of cervical spondylotic myelopathy by combining Yeom’s method for posterior cervical decompression and fusion with Shiraishi’s minimally invasive technique. We performed laminar exposure with Shiraishi’s technique, used high speed burr and microscope to prepare lateral mass screw holes and facet joints. After en bloc laminectomy decompressions were done, intraarticular fusion of the facet joints and posterolateral fusion were performed with Yeom’s technique. According to our experience, combine Yeom’s and Shiraishi’s techniques can be applied easily and safely for all levels of subaxial cervical spine.

Cervical Tuberculosis With Big Retropharyngeal Abscess: A Case Report

Huynh Chi Hung
PHAM NGOC THACH MEDICAL UNIVERSITY, VIETNAM

Case:
Cervical Tuberculosis With Big Retropharyngeal Abscess: A Case Report

Introduction
The spinal column occurs in less than 1% of all cases of tuberculosis. Spinal tuberculosis is very dangerous because it will destroy the vertebra due to neurologic deficit and deformity. The thoracolumbar junction is the most common area of the spinal column of tuberculosis and it occurs rarely in cervical spine with serious consequences. Although the development of multidrug resistant tuberculosis and imaging modalities such as magnetic resonance imaging and computer tomography have made the early diagnosis and management of spinal tuberculosis better, this disease is challenging. The spinal tuberculosis is still common in underdeveloped and developing countries.

Case report
We report a case of cervical tuberculosis with big retropharyngeal abscess. A 53 years old male presented with six months of neck pain, together with increasing swelling, fever, night sweet, loss weight. The major problem in this patient was dysphagia and weakness that happened more and more serious a few days. A lateral cervical spine x-ray, we can see the large abscess in front of the cervical spine from C3 to T2. Magnetic resonance imaging (MRI) showed a mass pre-vertebral with hyper-intensity and narrow of the pharyngeal. Computer tomography (CT) revealed a destruction of C5 and C6 with large abscess in front. The patient was treated with antituberculosis drugs (isoniazid, rifampicin, pyrazinamide and ciprofloxacin). After 3 weeks, patient fells rapid improvement with the ability to eat normally and
stronger.

Conclusion
Cervical tuberculosis causes retropharyngeal abscess is rare and dangerous. Therefore, we should diagnosis and treatment as soon as possible to prevent serious complications.

Acknowledgment:
Professor Vo Van Thanh

Keywords: Cervical tuberculosis, retropharyngeal abscess, antituberculosis

A Novel Trajectory of C7 Screws: Evaluation using 3-Dimentional Computed Tomography and Simulation Program to Compare with a Pre-existing Trajectory

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Abstract

Study Design: Analysis using 3-dimensional screw trajectory software and computed tomographic scans

Objective: To assess the feasibility of a novel trajectory for C7 bilaminar screw and to compare with an old trajectory.

Summary of Background Data: The old trajectory has a horizontal or downward direction whereas the novel trajectory has an upward direction.

Methods: Sequential C7 laminar screws were simulated using the new and old trajectories. The success rate, the causes of failure and the maximum allowable length of each trajectory were compared.

Results: Computed tomographic scans of 100 patients were analyzed. Using the new trajectory, the success rates of the unilaminar and bilaminar screw were 93% and 83% respectively, which were significantly better than the old trajectory (80%, p<0.0001 and 70%, p=0.0009 respectively). The causes
of failure were similar in both trajectory, which mostly caused by laminar cortical breach. The new trajectory also showed significant longer maximum allowable length in both unilaminar and bilaminar screws (both, \( p<0.0001 \)). With the new trajectory, 70% of unilaminar, 60% of bilaminar-caudal and 32% of bilaminar-cephalic screws could be extended perfectly into the corresponding lateral mass without any facet joint violation.

**Conclusions:** The novel trajectory has higher success rate and longer maximum allowable length than the old trajectory in both unilaminar and bilaminar screws. In a perfectly matched C7 vertebra size, anatomical orientation and projection of screw, the novel trajectory screw can be extended into the lateral mass and hence a lamino-lateral mass screw.

**Key Points:** C7, laminar screw, trajectory, subaxial cervical spine, lamino-lateral mass screw.

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**Cervical Spine Alignment – What Have We Understood In The Past Few Years**

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Concepts in adult spinal deformity have advanced rapidly over the past few years. In tandem with our improved knowledge on the thoracic and lumbar spine in various postures, alignment of the cervical spine is increasingly understood. By convention, the cervical spine is lordotic. Loss of lordosis has been viewed as pathological and restoration of a lordotic profile ideal. This concept, however, has been lately challenged, as we better appreciate the behaviour of the cervical spine. Restoration of lordosis may not be the most ideal strategy during adult spinal deformity surgeries. Key determinants of cervical alignment are the C7 sagittal vertical axis (SVA) and the T1-slope. By altering these parameters, the alignment of the cervical spine can be predicted. This would also imply that control over these parameters is crucial to ensure overall body balance, which is also partly contributed by the cervical spine alignment.
The 61st Annual Congress of The Korean Orthopaedic Association

Oct. 20th, 2017. Fri | Grand Ballroom3

Patient Blood Management in Orthopedic Surgery

Kyu Yeol Lee
PBM in elective major orthopedic surgery and recent achievement

Gurpal Singh
NATIONAL UNIVERSITY OF SINGAPORE

Objective
A cross sectional study done in 2012 revealed transfusion rates of 47.8% for elective THR and 23.7% for elective TKR in our tertiary institution that were significantly higher than the leading centres worldwide. Our aim was to reduce blood transfusion rates by at least 10% for elective THR patients and 5% for elective TKR patients with the implementation of our proposed protocol.

To compare the allogenic blood transfusion rates in 2012 and 2015 after the implementation of a pre-operative anemia clinic, use of intraoperative tranexamic acid and restrictive post-operative transfusion thresholds and analysing the impact on patient’s morbidity and mortality.

Materials and Methods
A multidisciplinary patient blood management (PBM) protocol for all patients undergoing elective hip and knee arthroplasty was drawn up by haematologists and orthopaedic surgeons from our same tertiary centre. Patients with pre-operative anemia (<11 g/dl for females, <13 g/dl for males) were sent to a fast track anemia clinic where they would be worked up for anemia and optimized for surgery. Intraoperatively, tranexamic acid was administered intra-articularly prior to closure. An evidence based restrictive post-operative allogenic blood transfusion threshold was adopted.

In this project, data was collected for who all patients who underwent elective TKR and THR in our tertiary centre in 2012 and 2014, 2015, before and after the implementation of the protocol. Evaluation parameters included demographic data, transfusion rate, haemoglobin concentrations at different time points. Impact on patient’s morbidity and mortality included wound complications, length of stay in the hospital, readmission within 3 months and range of motion.

Results
Data was collected for a total of 849 TKR patients and 111 THR patients. There was 36% drop in transfusion rates for TKR (p=0.02) and 64%(p<0.001) for THR patients. The average length of stay for TKR patients fell from 6.4 and 6.3 in 2012 and 2014 compared to 5.8 in 2015 (p = 0.07); 8.1 and 7.7 for THR in 2012 and 2014 compared to 7.1 in 2015 (p = 0.02). The number of transfusions per patient fell by 57% for TKR and 119% for THR patients. This translated to a cost savings of $354.67 for TKR and $627.12 for THR patients. Cost savings to the system totalled $80,000 in 2015 and $81,500 in 2016 for TKR patients and $16,000 in 2016 for THR patients.


Adverse transfusion reactions fell from 5 in 2012 to 2 in 2015 for TKR and 2 in 2013 to 1 in 2015 for THR. Significant wound complication rates fell 1.7% to 0.8 % for TKR (p=0.03) and 2.3 to 1.1% (p=0.001) for THR patients. For each patient that avoided a wound complication, there was a saving to the patient of $21,842.04 ($1500/OT visit excluding implants x 2 and 6 weeks x $448.62/day for hospitalization)

Conclusion
ABT has multiple potential adverse effects. This implementation of a fast track anemia clinic, use of tranexamic acid and restrictive transfusion thresholds post-operatively is effective in reducing the amount of ABT required post operatively in patients undergoing TKR with no obvious impact on the patient’s morbidity and mortality.
The role of IV iron in PBM Minimal transfusion in orthopedic surgery is possible?

Jong Hoon Park
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The universal thought of blood transfusion in the last century is that blood transfusion save lives. This belief had continued until recently as a medical common sense. However, despite of this common sense, in the Nature 2015, there was an interesting article insisting that saving blood saves lives. This article state that by reducing the blood transfusion by one quarter not only saved 1.6 million dollars per year, but it also reduced average length of stay, and mortality among them also fell from 5.5 to 3.3%. According to this article, they just reassured doctors of the guidelines for proper blood transfusion.

Anemia must be corrected before surgery and bleeding should be minimized during surgery. After surgery, the patient should be able to recover within a short period of time based on his or her competence. For this purpose, EPO (erythropoietin) or high-dose IV iron may be used before surgery. In order to minimize bleeding during surgery, careful hemostasis and use of hemostatic agents such as anti-fibrinolytics are necessary. After surgery, the use of high-dose IV iron and proper fluid therapy will be critical.

We had a retrospective study done with medical records of 17 patients diagnosed with osteosarcoma from January of 2008 to September, 2016. We compared patients treated before and after 2013, the year in which PBM (patient blood management) was implemented in my cases. The purpose of this study was to see if blood transfusion could be reduced in the same procedure. It was not intended to show the effect of reducing blood transfusion. This is because there is no debate for the positive effect of reducing blood transfusion already.

PBM strategies used in this study can be categorized as pre-operative, intra-operative, and post-operative plans. Pre-operatively, we tried to achieve target hemoglobin level within normal range before the time of surgery by using preoperative infusion of high-dose IV iron and erythropoietin. Tranexamic acid was used peri-operatively to reduce blood loss, and meticulous hemostasis and surgical techniques were used intra-operatively. From 2008 and 2012, before the implementation of PBM, there were 10 osteosarcoma patients who underwent either limb salvage operation or amputation, and all of them received allogenic blood transfusion. Average amount of transfusion during this period of time was 6.8 pints of blood for each patient. There are even three patients who have received more than 10 blood transfusions. However, there have been only 0.2 pint transfusions in 7 osteosarcoma patients since 2013. In other words, there was a case of transfusion before the operation at the initial stage of PBM and there was no transfusion during or after the operation.

Peri-operative anemia is one of the main risk factors for transfusion in major surgical procedures and one of the few, that can be modified pre-operative anemia, even mild degree, is an independent risk factor of such as increased post-operative infections, increased hospital length of stay and increased mortality. Pulido pointed out that patients receiving allogenic blood transfusion were 2.1 times more likely to develop peri-prosthetic joint infection compared to patients without transfusion.

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Pre-operative anemia management is an essential part of PBM and IV rion therapy has been shown to increase hemoglobin concentration and reduce the risk of requiring RBC transfusion. According to NATA(Network for Advancement of Transfusion Alternatives) guidelines, patients hemoglobin level should be measured 28 days before surgery to allow sufficient time for evaluation and blood management. If anemia is present, evaluate the underlying causes to determine the appropriate management.

In orthopedic surgery, hematologic evaluation and treatment for anemia is recommended 3-4 weeks before the operation. Pre-operative anemia correction with intravenous supplemental, oral iron or recombinant human erythropoietin therapy and autologous transfusion techniques, such as preoperative autologous blood donation, an intra- or postoperative cell salvage, have been proposed to reduce the need for allogenic blood transfusion. However, the significance of a pre-operative correction of anemia and optimization of red cell mass is easily overlooked in practice. Recent studies demonstrate that a very short-term treatment with erythropoiesis-stimulating agents and intravenously iron starting only 2-0 days before surgery is meaningful for reducing peri-operative RBC transfusions. This concept may be important in orthopedic surgery. A multidisciplinary co-work is very important for the reduction of peri-operative morbidity and mortality. A long tradition of accepting IDA(iron deficiency anemia) as harmless problem that can be easily corrected with transfusion. Whenever there is enough time and no contraindication, iron supplementation should be given in the oral formulation, because of its low cost, easy administration, and acceptable tolerance. However, if there is poor absorption or poor tolerance, or an accelerated response to treatment is required, it would be fully justified to use IV iron, which allows a more rapid and complete bone marrow response and iron store replenishment. With the exception of high molecular weight iron dextran, IV iron formulations have a favorable benefit-risk-profile in the treatment of iron-deficiency anemia in different acute and chronic conditions.

References
Session 1. Quantitative Measurement of Pivot Shift

Oct. 20th. 2017. Fri | Grand Ballroom3

Nam-Hong Choi / Ji-Hoon Bae
Intraoperative kinematic evaluation of single- or double-bundle anterior cruciate ligament reconstruction using a navigation system

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Recently, double bundle anterior cruciate ligament (ACL) reconstruction has become very popular, especially in Korea or Japan. However, biomechanical function of the anteromedial (AM) and posterolateral (PL) bundle in isolated tibiofemoral rotation remains controversial. We evaluated the biomechanical function of the AM and PL bundle of the ACL utilizing a computer navigation system, comparing single-bundle ACL reconstruction.

Intraoperatively, anteroposterior and isolated rotational laxity of the knee was measured with the computer navigation system. In the first study, those laxities were compared between single- and double–bundle reconstruction. In the second study, the measurements were performed before reconstruction, after temporary PL bundle fixation, after AM bundle fixation, and after double-bundle reconstruction. We continuously measured anterior displacement of the tibia under an anterior drawer stress of 100 N in neutral tibial rotation. The total range of tibial rotation was also measured under external and internal rotational torque of 3 Nm.

There was no significant difference between single- and double-bundle reconstruction in terms of anterior displacement and total range of tibial rotation. In the double-bundle reconstruction, fixation of either AM or PL bundle significantly (P < .05) reduced the anteroposterior displacement in all knee flexion angles. Regarding the total range of tibial rotation under external and internal rotational torque, there was no significant difference between AM bundle fixation and PL bundle fixation throughout the range of motion. The total range of tibial rotation was significantly reduced only by double-bundle reconstruction at 20° and 25° of knee flexion.

Quantitative Evaluation of Pivot Shift in Double-bundle Anterior Cruciate Ligament Reconstruction Using Triaxial Accelerometer; Identifying Optimal Conditions to Restore Anterolateral Rotational Stability

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Anterolateral rotational instability (ALRI) in ACL-injured knee is represented by pivot shift phenomenon. However, evaluation of pivot shift phenomenon is difficult due to its subjectivity, wide variation of testing maneuvers, and difficulty in evaluating patients while awake. We evaluated the pivot shift phenomenon using a triaxial accelerometer by 2 different maneuvers, the pivot shift test as a representative of flexion maneuver and N-test as a representative of extension maneuver, and in 2 different conditions, awake and under anesthesia. We found out that the triaxial accelerometer was useful to objectively detect and quantitatively evaluate the pivot shift phenomenon by both the pivot shift test and N-test under anesthesia. On the other hand, its use while the patient was awake was likely limited.

Initial graft tension in double-bundle anterior cruciate ligament (ACL) reconstruction has been determined based on minimum required tension (MRT) by anteroposterior laxity. However, MRT based on rotational stability seems more critical considering importance of controlling rotational stability. We evaluated how the anteromedial bundle (AMB) and posterolateral bundle (PLB) contribute to control rotational instability, as well as to determine MRT based on pivot shift phenomenon in double-bundle ACL reconstruction using the triaxial accelerometer. We found out that double-bundle ACL reconstruction better controlled rotational instability with smaller MRT than single-bundle reconstruction. We also found out that MRT based on the pivot shift phenomenon could be larger than previously-reported MRT based...
on anteroposterior laxity, and relatively wide variation of MRT among patients indicates that initial graft tension should be determined individually by objective evaluation of the pivot shift phenomenon.

Residual ALRI revealed by a positive pivot shift test in some patients after ACL reconstruction and its relation to the patients’ dissatisfaction have been reported. Several factors have been reported to be associated with ALRI in the ACL injured knee, such as lateral meniscus, anterolateral structures and iliotibial tract, period from injury to surgery, and joint laxity. However, the knowledge of what exactly are the risk factors for residual ALRI after ACL reconstruction in the clinical settings is limited. Therefore, we analyzed possible risk factors for residual ALRI after ACL reconstruction at the time of surgery using triaxial accelerometer. We identified that large preoperative side-to-side difference of pivot shift acceleration correlated with residual pivot shift after ACL reconstruction. On the other hand, anterior instability measured with knee arthrometer did not correlate with residual pivot shift, and neither did age, sex, joint laxity, preoperative period and meniscus injury. These results suggest that, in patients with high grade pivot shift, additional anterolateral structure augmentation might have to be considered.

Evolution of the Measurement of the rotational instability of the Knee: What’s in, What’s out?

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THE CHINESE UNIVERSITY OF HONG KONG, HONG KONG

Over the past 10 years, there is a tremendous growing interests in the different concepts and techniques in anatomical ACL reconstructions, in order to achieve a very stable particularly the rotational stability of the knee. These have encouraged the rapid development in different ways in assessing the Knee rotational stability, which have significantly enhancing the understandings of the knee kinematics. This presentation is going to present our evolution in the ways that we assess the rotational stability of the knee, with highlights of some of our innovative approaches in assessment of knee rotational stability after ACL reconstructions, from the laboratory to on-field scenario, such as the usage of Navigation system, Knee rotational meter, Motion analysis, weight bearing MRI system, and functional tracking system. The advantages and disadvantages of individual methods will be discussed.
How to check the functional instability of ACL injured subjects during sports activities?

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KONKUK UNIV.

INTRODUCTION
The validity of current modes of testing that determines one’s ability to return to sports remains questioned by many, and a consensus on a gold standard functional test has not been formed. Many authors have asked whether testing return to sports through simple examinations, such as the single leg hop test or the vertical jump test, during an outpatients visit alone is reliable; whether quadriceps muscle strength alone is sufficient or whether additional parameters such as the hamstring/quadriceps ratio should be used in conjunction; and whether functional performance tests based on closed kinetic chain exercises, which closely resemble sports activities, are more effective alternatives to current tests. It has also been suggested that when assessing return to sports a more multidirectional and holistic approach is required, assessing not only surgical and rehabilitative factors but also emotional and psychological factors.

MUSCLE STRENGTH
Because muscle strength is vital for functional performance of the knee, restored muscle strength, specifically the isokinetic strength, is an important factor for deciding whether a patient can safely return to sports. In our study on ACL reconstructions using either the hamstring autograft or allograft, we found that the peak extensor torques at the 2-year follow-up were 83% and 81% of the contralateral unaffected side in patients who received the hamstring autograft and the allograft, respectively [1]. The corresponding values for peak flexor torque were 87% and 95%, respectively. We reported that standard flexion deficit was significantly associated with the Carioca test, the co-contraction test, the shuttle run test, and the single leg hop for distance test, whereas no correlation was observed between the deep flexion deficit and functional performance tests [2,3].

Wilk et al. [4] found that 16% of patients had a LSI of over 90% for quadriceps strength and that the extension acceleration and deceleration rates at 180°/s and 300°/s, but not isokinetic strength, were strongly correlated with the timed hop test (r = 0.48 and r = 0.49, respectively) and with the triple crossover hop (r = 0.51 and r = 0.49, respectively). They also reported that the isokinetic findings of the knee flexors were not correlated with any functional tests. In patients who underwent ACL reconstruction, Keays et al. [5] found that the 6-month follow-up quadriceps strength, but not the hamstring strength, was significantly correlated with the following functional tests: the shuttle run, the side step, the Carioca, and the single and triple hop tests. Altogether, these results suggest that patients with ACL injury have a “quadriceps-avoidance gait” that leads to markedly weakened extensor peak torque. This is thought to be because of the compensatory role of the hamstring that lends the quadriceps muscles to play a more prominent role in the functional recovery of the knee after ACL reconstruction than the hamstring muscles.

However, results of isokinetic strength tests have been shown to significantly correlate with certain knee mechanics during running, cutting, and one legged-hopping, whilst others have shown they are correlated with only the knee mechanics of the single leg hop. Although the effect of the outcomes of isokinetic strength tests on functional performance is unclear, our opinion was that isokinetic knee extensor strength demonstrating a LSI lower than 15% is appropriate for return to sports.

Because movements such as landing after a jump and pivoting in soccer, handball, and basketball require extensive eccentric contraction, the feasibility of using only measurements of isokinetic strength to judge return to sports is questionable. There is also a need to measure endurance of the hamstring and quadriceps muscles because muscle fatigue can decrease dynamic knee stability and cause ACL re-injury.

FUNCTIONAL ASSESSMENTS
During sports activity, the lower extremity undergoes repetitive motions of acceleration and deceleration, requiring an extensive and convoluted control from the neuromuscular system; therefore, a calculation of muscular function that does not take into account neuromuscular control cannot be an accurate reflection of muscular function. Thus, preexisting functional tests evaluating athletes’ preparedness for return to sports, which do not measure neuromuscular control, may not accurately measure knee function. To
The single leg hop for distance test is used widely as a functional performance test after ACL reconstruction because it shows a high degree of reliability. Barber et al. [9] reported that their test battery consisting of the single leg hop for distance test and the single leg vertical jump test provided a more reliable indicator of knee function after ACL reconstruction than the isokinetic strength test. Noyes et al. [10] tested four types of hop tests (the single leg hop for distance, the timed hop, the triple hop, and the cross over hop) and showed that only the single leg hop for distance test showed a significant correlation with quadriceps isokinetic strength and with the subjective sensation of giving way. Of the types of single leg hop tests, the single leg hop for distance test and the various types of vertical jump tests are often included in test batteries for their simplicity. Amongst the vertical jump tests, the most commonly used test involves the patient, whose hands are placed on hips, to jump as far as possible on flat ground on one leg, and the furthest distance jumped is measured. Several devices have been developed to measure vertical jump height, such as the computerized contact mats, which can be used to measure height even in restricted spaces at one time-point. The single leg hop for distance test on the other hand requires an anterior jumping space and a manual measurement of distance. Both the vertical jump test and the single leg hop for distance test have a significant correlation with proprioception in athletes, and the former has been shown to have a high level of test-retest reliability.

Because of its usability even in restricted spaces, the Y- balance test (YBT) is also widely used, along with the single leg hop for distance and the vertical jump tests. Derived from the star excursion balance test, the YBT is a relatively simple and reproducible test for balance and dynamic control. Reduced performance and a high LSI as determined through the YBT have been shown to be associated with increased risk of lower body injury. The Y-shaped YBT KitTM (Perform Better, West Warwick, RI, USA) requires the patient to balance on one leg whilst stretching and tapping the far ground as far as possible with the other leg in three separate directions (anterior, posterolateral, and posteromedial) and finally to bring the leg back in to its original position. The furthest dis- tance reached, normalized to the contralateral side, is measured in each direction. Therefore, the test evaluates muscle strength, proprioception, and neuromuscular control.

Since the outcomes of the vertical jump test and the YBT have been shown to agree with those of preexisting and validated functional knee scores, further developing them so that they are indicative of extensor power would make them even more ideal functional knee scores for return to sports.
Improvements in the single leg hop for distance test, the vertical jump test, and the YBT through advanced digital sensor and internet technology may lead to easier and real-time measurements of knee performance in restricted in-door settings.

REFERENCES
Identification of risk factors and causes for failed ACL reconstruction is an important step in the development of surgical algorithms. Recently in the literature, there has been a great deal of focus on anatomic risk factors. Most notably, the posterior tibial slope (PTS) has been considered as a potential risk factor for primary ACL injury and failed ACL surgery and PTS >12° was commonly considered as an indication for slope-decreasing osteotomy.

Two kinds of techniques for slope-decreasing osteotomy were available, traditional HTO (including medial open and lateral closing) and anterior closing wedge high tibial ostetotomy (ACW HTO). Traditional HTO is preferred in circumstances with moderately increased (5°-7°) PTS of <12°. For cases of excessive larger PTS (>15°), we used ACW HTO in revision ACL and primary ACL reconstruction surgeries.

As a whole, clinical scenarios that should be taken into account for ACW HTO are: 1) revision ACL surgery with larger PTS >15°, 2) failed ACLR with passive anterior translation of tibial in combination with larger PTS, 3) high grade pivot shift with irreparable posterior horn of lateral meniscus and larger PTS, 4) ACL failure with larger PTS and ligament revision was not considered in sedentary middle-aged patients, 5) ACL graft failure that could not be attributed to technical errors, such as predominant malpositioned tunnels and high-dose irradiated allografts, et al.

Indication: If the femoral and tibial tunnels from the previous procedure are acceptable or the previous tunnels are grossly malpositioned such that they can be avoided completely when drilling new tunnels, then the revision ACL reconstruction can be done in a single operation. Completely inaccurate tunnel placement is commonly seen in vertically malpositioned femoral tunnels prepared with a transtibial technique such that a new anatomic femoral socket can be drilled without risk of convergence with the old tunnel. If this is the case, the old graft can remain in situ, with the new graft offering additional sagittal and rotational stability to the knee. Partially overlapping tunnels are the most problematic and should be reassessed on a case-by-case basis to determine the need for a single versus staged approach. Posterior tibial tunnels with significant widening may be best treated with a staged approach rather than accepting significant malposition, whereas anterior but relatively anatomic tibial tunnels with expansion may be effectively managed by filling with a large graft in a single-stage setting.

Single-Stage Procedure:
Step 1: Diagnostic Arthroscopy and Socket Characterization
Step 2: Hardware Removal
Step 3: Tunnel Preparation including femoral tunnel preparation / tibial tunnel preparation
Step 4: Graft Fixation and Postoperative Course.

Graft Choice:
There is no perfect graft choice for primary or revision ACL reconstruction. Both allograft and autograft options are reasonable. Allografts eliminate concerns of donor site morbidity and may be particularly
useful in the setting of multiligament knee reconstructive surgery. Furthermore, grafts such as the Achilles tendon offer a large cross-sectional area and may be useful to fill large but well-positioned tunnels in a single-stage revision ACL reconstruction. However, there is a small risk of disease transmission with allografts that is not present with autografts. Allografts are frequently used in revision ACL reconstruction, especially if autograft options are limited or compromised by the initial procedure. Achilles tendon, and tibialis posterior, other available options include the quadriceps tendon, hamstring tendons, peroneus longus tendon, and fascia lata. Many surgeons favor autograft because of these additional risks. Patellar tendon or hamstring autograft options may not be viable in revision surgery. In these settings, quadriceps autograft may be favorable due to its large cross-sectional area. The patient should have a full understanding of the risks and benefits inherent with both graft types before surgery. In cases of substantial tunnel expansion and partial tunnel malposition, a staged approach may be required independent of graft selection.

**All the important steps and technical pitfalls will be presented in the lecture!**

**Effects of remnant tissue preservation on clinical outcomes after anatomic double-bundle anterior cruciate ligament reconstruction**

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**Abstract**

Recently, preservation of the anterior cruciate ligament (ACL) remnant tissue has attracted notice in the field of single-bundle ACL reconstruction. Remnant preservation has been expected to have several potential advantages to improve postoperative knee stability, such as enhanced graft coverage, accelerated cell repopulation and revascularization, maintenance of the native broad tibial enthesis, and reduction of bone tunnel enlargement, although these points are arguable. Recently, we reported that preservation of the ACL remnant tissue enhanced cell proliferation, revascularization, and regeneration of proprioceptive organs in the reconstructed ACL and reduced anterior translation using sheep ACL reconstruction model. (Takahashi et al. AJSM 2016) However, the effect of remnant tissue preservation on postoperative knee stability has not yet been established in single-bundle ACL reconstruction because the reported clinical results have been inconsistent.

Several biomechanical studies have shown that double-bundle reconstruction produces better stability in the knee, especially during rotatory loads, compared with the commonly performed single-bundle reconstruction. (Kondo et al. AJSM 2010, 2011) However, no previous studies have shown clinical evidence regarding the utility of ACL remnant tissue preservation in double-bundle ACL reconstruction as of yet. To verify whether preservation of the ACL remnant tissue can actually improve proprioceptive function and enhance revascularization, we should conduct a comparative trial with a sufficient number
of patients to compare the 2 ACL reconstruction procedures with and without the remnant preservation in terms of proprioception and revascularization of the graft. Recently, we have developed a new remnant-preserving technique for anatomic double-bundle ACL reconstruction using the semitendinosus tendon. (Yasuda et al. Arthroscopy 2012) Then, we compared clinical results after anatomic double-bundle ACL reconstruction procedures that preserve the remnant tissue and those that resect the remnant tissue. (Kondo et al. AJSM 2015) In this symposium, the surgical procedure, and clinical results of anatomic double bundle ACL reconstruction with ligament remnant tissue preservation are explained.

There is no perfect graft choice for primary or revision ACL reconstruction. Both allograft and autograft options are reasonable. Allografts eliminate concerns of donor site morbidity and may be particularly

### Availability of anterolateral ligament in revision ACL reconstruction

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**Introduction**

Failure rates of 3% to 15% have been reported in primary anterior cruciate ligament (ACL) reconstruction. This lead to vast revision ACL reconstructions performed annually. The success of revision surgery relies on determining the etiology of failure for the primary operation. Potential causes of failure include re-trauma, technical error, biologic etiology and etc.

**Mode of failure**

Early postoperative period trauma was most common in traumatic failure. Trauma before graft incorporation and imperfect neuromuscular control may be cause of failure in early postoperative period. Soccer is reported as most common cause of re-trauma. Early ROM exercise after anatomic ACL reconstruction using soft tissue graft made graft laxity or failure due to change of graft length. Also weakness of fixation & tunnel widening.

Multicenter ACL Revision Study showed femoral tunnel malposition was most common reason for technical error. Tibia malposition was followed as 2nd common technical error. Femoral tunnel should be placed in anatomic femoral attachments. Nonetheless, there is debate in single bundle reconstruction, whether it should be placed antero-lateral or postero-medial manners.

In primary ACL reconstructions, recent studies have demonstrated a greater failure rate in the revision setting at 2-year follow-up with allografts. Greater tunnel widening has been reported in ACL reconstruction using hamstring grafts than in those using bone-patellar tendon bone grafts. If tunnel
wideness is present, bone graft should be done. In case of enlarged tunnels associated with extensive bone
loss, especially on the femoral side, an anatomic reconstruction in 1 stage is not always possible. In these
cases, a 2-stage surgery, with a preliminary bone grafting of the enlarged tunnels, has to be performed.

Medial meniscus acts as a 2ndary restraint to tibial translation. Meniscal deficiency may increase forces
on the ACL graft, leading to secondary failure of an ACL reconstruction. When medial meniscus is not
functioning, medial MAT (meniscal allograft transplantation) can be considered.

Also, there is an incidence of failure noted between 3% and 31% of missed collateral instability or
concomitant malalignment. unrecognized injuries of the posterolateral or posteromedial structures result
in high forces in the ACL graft, which result in gradual attenuation and eventual early failure.

ALL reconstruction
In 1879, Paul Segond described a pearly, resistant, fibrous band inserting on anterolateral aspect of the
proximal tibia. This structures have been called with many names. Anterior band of the lateral collateral
ligament, mid-third of lateral capsular ligament, anterior oblique band, and finally anterolateral ligament.
As residual pivot shift may be problem in revision ACL reconstruction, ALL reconstruction could be
considered in revision ACL reconstruction.

Studies about ALL biomechanics have focused on the ALL’s role in controlling rotational stability.
Parsons et al. found that the ALL acts as a brake to internal tibial rotation at various knee flexion
angles and in some cases with anterior translation. Rasmussen et al. showed pure internal rotation and
anterolateral rotational laxity during the pivot shift maneuver in cases of ALL transection. Using in vitro
robotic methods, the LaPrade team showed that the ALL helps to control the knee’s rotational stability.
Imbert et al. used navigation system to analyze suitable insertion point for ALL. Proximal and posterior to
Lateral epicondyle was more favorable.

There was systemic review article, addition of lateral extra-articular tenodesis (LET) to anterior cruciate
ligament (ACL) reconstruction provided greater control of rotational laxity and improved clinical
outcomes compared with ACL reconstruction alone. Meta-analysis showed a statistically significant
reduction in pivot shift in favor of the combined procedure. However, no difference was found between
the groups for IKDC and KT 1000/2000. LET has reported good functional outcomes and stability than
ACL reconstruction alone. However, LET was non-anatomic and reported complications like over-
constraint (demonstrated in biomechanical and clinical studies), donor site morbidity, cosmetic problems,
loss of motion, compartment crepitation, limitation in extension, increased risk of septic arthritis, long-
term chronic pain and swelling, and poor long-term functional outcomes with lower subjective and
objective results.

SANTI group from Lyon demonstrated 2-year follow up study after combined ACL and ALL
reconstruction. The reoperation rate after combined ACL and ALL reconstruction in this study was better
to the reoperation rate after isolated ACL reconstruction as reported in previous studies. In addition, the
high rates of knee stiffness and reoperation reported in historical series of non-anatomic, lateral extra-
articular tenodesis were not observed in the current series.

Conclusion
Initial studies were mostly descriptive, and biomechanics studies are to measure the ALL’s role. However,
studies lacked sufficient internal validity, sample size, methodologic consistency, and standardization of
protocols and outcomes. The further study is needed to propose a treatment strategy for revision ACL
reconstruction with ALL reconstruction.

Reference
2. Segond PF. Recherches cliniques et experimentales sur les epanchements sanguins du genou par entorse. Prog Med 1879;7:297-
9, 319-21, 40-1.
45.
7. Parsons EM, Gee AO, Speikereman C, Cavanagh PR. The biomechanical function of the anterolateral ligament of the knee. Am j
sports med 2015;43:669-74.
bundle hamstring and mono-bundle bone patellar tendon-bone combined with a modified Lemaire extra-articular procedure in
14. Mathieu Thamot, MD, Gilles Clowez, MD, Adnan Saibina, MBChB, DipsSEM, MSc, FRCS (T&O), Maxime Cavalier, MD, Eric Choudja, MD, Thais D. Vietsa, MD, Jean-Marie Fayard, MD, and Bertrand Sonnery-Cottet, MD Reoperation Rates After Combined Anterior Cruciate Ligament and Anterolateral Ligament Reconstruction A Series of 548 Patients From the SANTI Study Group With a Minimum Follow-up of 2 Years Am j Sports Med 2017

Ultrasonography in Orthopaedics

Jin Young Park / Kyoung Dae Min
Ultrasonography of the shoulder and elbow-up to date-

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We have been used the ultrasonography(US) for the diagnosis and treatment of the shoulder and elbow joint for about 30 years. In this paper, we show the efficacy of the US for the shoulder and elbow joint. We checked the subscapularis, BLL, anteroinferior labrum, SAB, AC joint, supraspinatus, superior labrum, infraspinatus, teres minor, posterior labrum, epiphysis of the humerus, Rhomboid, Latissimus dorsi and triceps long head in the shoulder. In the case of elbow, Lateral and Medial epicondyle, MCL and LCL, Capitulum, Olecranon, surrounding muscles and Ulnar Nerve were checked by US. When we investigate the superior labrum, we used the superior approach between the acromion and the clavicle. In the case of anterior instability, we used axillary approach to detect the anteroinferior labrum injury (Bankart lesion).

In the case of throwing injury of the shoulder, we could detect SLAP lesion, anterior instability (the anteroinferior labrum injury), Bennett lesion, cuff injury(incomplete tear of the cuff), pulley lesion, A-C joint problem, subacromial bursitis, epiphysis injury(little leaguer’s shoulder) and Ulner Nerve were checked by US. When we investigate the anterior instability, we used axillary approach to detect the anteroinferior labrum injury (Bankart lesion).

Ultrasonography after Rotator cuff repair

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서론
회전근 개 봉합술 후 재파열은 수술 후 통증과 관련되는 인자로 봉합술 이후 재파열 여부를 파악하는 것은 환자들의 통증에 대한 치료 방향을 결정하는 데에 중요한 요소가 된다. 재파열 여부를 파악하기 위한 방법으로 이학적 검사 외에 자기공명영상 (MRI), 컴퓨터 단층 촬영 (CT) 및 초음파 등의 방사선학적 방법들이 사용될 수 있으며 이들의 정밀도를 파악하여 적절한 임상적 판단을 사용하는 것이 중요하다. 이 중 초음파 검사는 비교적 저렴한 비용으로 간단하게 시행할 수 있으며 다양한 봉합 방법 및 상태에 대해 다양한 방법으로 적용할 수 있다는 장점이 있어 의료에서 많이 사용되는 방법 중 하나이다.

회전근 개 초음파 검사

보통 9-15MHz의 high-frequency linear transducer를 사용하여 검사를 시행하게 된다. 회전근 개 진염의 경우 초음파상 건이 thickening되거나 enlargement 되는 소견을 보이며 국소적이거나 전반적인 저에코성 부분을 포함하게 된다. 이는 정상적인 fibrillar tendon architecture를 소실하는 경우가 있어 진단의 구분을 요한다. 회전근 개 파열의 경우 저에코성 혹은 무에코성 결손이 건의 전층 혹은 부분층에 관찰되며 이러한 저지각적인 소견들이 회전근 개 파열을 진단하는데 도움을 줄 수 있다. 이는 회전근 개 부착 부위 피질골의 불규칙성, "cartilage interface" sign, 관절내 혹은 견봉하 점액낭 내 삼출액 증가 소견, 견봉하 점액낭 및 삼각근의 herniation 등으로 특히 피질골의 불규칙성과 관절내 삼출액은 가장 높은 민감도와 특이도를 보인다. 회전근 개 파열, 특히 medial retraction이 심한 만성 파열의 경우 회전근 개 결손 부위에 위치한 삼각근은 회전근 개로 오인하지 않도록 주의하여야 한다. 부분층 파열의 경우 건 내에 저에코성 혹은 고에코성의 변동으로 관찰되어 이는 회전근 개 진염과 혼동될 수 있다. 이를 구분하기 위해 transducer를 toggling하여 검사하거나 transducer로 압박을 하면서 점액낭이 결손부위로 함몰되어 있는지를 파악하는 것이 도움이 된다.
회전근 개 봉합술 이후 초음파 검사의 효용성

초음파 검사는 비교적 높은 민감도와 특이도를 보이며 회전근 개 봉합술 이후 재파열 여부를 파악하는 데 도움이 된다. 회전근 개 봉합술 이후 재파열 여부를 파악하기 위해 초음파 검사를 시행할 경우, 회전근 개 재파열의 비율은 높을 수 있다. 최근에는 초음파를 이용한 회전근 개의 mechanical property 와 vascularity 를 파악할 수 있는 ultrasound elastogram 이나 power Doppler 을 이용한 연구가 진행되고 있다. Ultrasound elastogram 은 external deformation 시 발생하는 건내 local tissue strain 을 측정하여 회전근 개의 quality 를 파악하게 되며, external deformation 을 이용한 power Doppler ultrasound 를 이용하여 간에는 회전근 개의 vascularity 를 파악할 수 있다. 이는 회전근 개 재파열 여부를 파악하기 위해서는 power Doppler ultrasound 를 이용하여 간에 external deformation 을 측정할 수 있는 method 가 필요하다. 전신적인 재파열 여부를 파악하기 위해서는 contrast-enhanced ultrasonography 를 이용하여 간에 contrast-enhanced ultrastronography 를 시행할 수 있다. contrast-enhanced ultrasonography 를 이용한 연구 결과, 회전근 개 재파열 여부를 파악하기 위해서는 회전근 개 재파열 여부를 파악하기 위해서는 contrast-enhanced ultrasonography 를 이용하여 간에 external deformation 을 측정할 수 있는 method 가 필요하다.
Evaluation and Treatment for the Hip Joint Using Ultrasonography

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Introduction

Ultrasonography (USG) has been used effectively in diagnosis and treatment for various musculoskeletal diseases and the clinical usefulness of which has been confirmed through numerous studies. Treatment using USG has been mainly applied in the shoulder and foot/ankle joint. In the hip joint, the evaluation using USG has been confined to diagnosis of pediatric disease such as developmental dysplasia of the hip, Leg-Calve-Perthes disease, and etc. Because the adult hip joint is located deeply inside the skin and is relatively thicker than other joints, technical developments and improvement of resolution of USG image is necessary for clinical usage of USG for hip joint. Although three dimensional computed tomography (3DCT) and magnetic resonance image (MRI) are considered as golden standard for the diagnosis of hip diseases, high cost of the equipment, prolonged examination time, and radiation exposure are indicated as the disadvantages such tools. The recently emerging disease category, such as femoroacetabular impingement, greater trochanteric pain syndrome, snapping hip, piriformis syndrome, deep gluteal syndrome, etc., have been introduced as the causes of hip pain. Moreover, injection therapies has been advanced and performed for analgesia and anesthesia. In this study, we evaluated the clinical usefulness of USG for hip joint.

1) Acetabular labral tear

History taking is important step understanding of hip joint pain, and in physical examination, anterior impingement test, Patrick test, and straight leg raising test should be performed in diagnosis of acetabular labral tear. If the patient is not responding to conservative treatment such as rest, non-steroid anti-inflammatory drug for more than 3 months, radiologic evaluation of the hip joint is necessary. Troslen reported that USG findings of acetabular labral tear were shown as displacement of labrum, hypoechoic lesion within labrum, absence of labrum from acetabular margin, intralbral linear cleft, cystic lesion, and irregular morphology of labrum. USG examination is performed in B-mode state and the linear probe using 5~12 MHz is selected. Low frequency curved probe using 3~6 MHz is useful in obese patients as penetration rate of ultrasound may be low. The examiner attempts to touch the anterior-superior iliac spine (AIIS) of the hip in a neutral or a little internal rotation of the hip position of the patient and situates the probe longitudinally at the just medial portion of AIIS. Then the probe is transferred distally until round shape of the femoral head is shown in USG. The examiner have to control the depth and focus of the probe and should carefully consider the anisotrophy which may lead to misdiagnosis. After checking femoral vessels and nerve on the transverse axis, the probe is located longitudinally at inguinal area. The examiner must find the femoral head-neck view reflecting the longitudinal plane of the anterior part of hip joint. In this plane, correlation between femoral head and acetabulum is most identifiable and the acetabular labrum should be checked. In USG, rectus femoris muscle and joint capsule overlies the hip joint. Synovial recess is hypoechoic space which is located between hyperechoic shadow of cortex of femur and joint capsule and thickness of which should be measured comparing with contralateral normal side. (Fig. 1) Since anisotrophy could occur by different direction of the probe, the examiner should be check the labral echogenecity repetitively and find the exact morphology considering anisotrophy. Paralabral cyst or intraoral labral cyst which is revealed as hypoechoic lesion could be found and may be related with labral tear in USG. (Fig. 2) Acetabular labral tear can be an indication of hip arthroscopic surgery if symptoms continue for a prolonged time or repetitively recurs. Intraarticluar injection under USG is helpful for differential diagnosis between intraarticular and extraarticluar pathologies. Kivlan reported the result of intraarticluar injection for 72 patients with femoroacetabular impingement, labral tear, chondral lesion and extraarticluar lesions. He performed intraarticluar injection of mixture of 1% lidocaine 6ml, 0.25% bupivacaine 6ml and triamcinolone 80mg and checked the changes of symptoms. The patients with chondral lesion showed marked improvement of symptoms, whereas simple rest did not reveal any significant reduction of pain. If the patient has mild osteoarthritic symptoms, intraarticluar injection under USG may be the modality of treatment. The author performed intraarticluar injection of 1% lidocaine 2ml and triamcinolone 40mg/1ml. If symptoms disappeared completely, the patient was regarded to have an inflammatory synovial disease which could be treated to normal state. If the symptoms recurred, more precise examination like magnetic resonance arthrography should be considered.

3) Greater trochanteric pain syndrome

The greater trochanteric pain syndrome (GTPS) is a disease category consisting of trochanteric bursitis and the abductor muscle problems including gluteus medius tendinopathy and gluteus minimus tendinopathy. Middle-
aged female is the most common patient group and patients usually suffer from lateral buttock pain during cross-leg position or sleeping sideways without any trauma history. Physical examination reveals tenderness on greater trochanteric area and Patrick test induces pain on lateral buttock. Ultrasound examination was performed using linear 5–12MHz probe on B-mode with the patient put on lateral position with the affected hip facing up and flexed slightly. The area of pain was checked through history taking and by pressing the lesion with the probe, the exact tender point was recognized. Next, the greater trochanteric region was palpated and the femur was sketched and the location of the gluteal medius and minimus were perceived. (Fig. 3). The probe is placed on the origin of tensor fascia lata along the direction of the muscle and transferred distally and approached to the greater trochanteric region. Then the probe was moved to the posterior area and placed horizontally along the gluteus medius direction and the origin, and lesion and the thickness of which muscle were measured. Keeping the probe longitudinally and by translating it, the origin site of gluteus medius was checked and the lesion and thickness of the tendon was measured. (Fig. 4). The probe was placed perpendicular to the tendon direction at the origin site and the axial image was obtained. By moving the probe proximally, the muscle fibers were checked and by moving distally the continuity of the tendons were checked. (Fig. 5). Tendinosis shows hypoechoic lesion with continuity of the muscle fiber shadow maintained and divided by the lesion size. It was divided into mild, less than 30% of the total thickness, moderate, 30~70%, and severe, over 70%. Partial tear was defined as partial loss of echo inside the tendon or evident hypoechoic lesion, and full-thickness tear was with rupture of the continuity of the gluteus medius or minimus. Majority of the GTPS respond to conservative treatment, such as medication, icing, weight control, physical therapy, or lifestyle modification, however, if such treatment modality fails, steroid or local anesthetic injection could be considered. Shbeeb et al. reported that steroid injection was effective in 77% after 1 week and was maintained in 61% after 6 months. The causes for persistent of symptoms even after steroid or local anesthetic injection includes accompanied mucoid cyst lesion, persistent tendinosis, wrong patient selection, inappropriate site of injection, and recurrence. Labrosse et al. reported superior treatment effect since that USG steroid injection could be performed precisely at the gluteal medius tendinopathy.

**4) Snapping hip**

Snapping hip is divided into internal and external snapping hip, that both cause snapping sound and pain during a specific hip posture. Though other radiologic measures obtained 2-dimensional images, dynamic USG allows us to check the real-time motion of the affected tendons. A linear 5–12MHz B-mode probe is used. For internal snapping hip, patient is placed supine position and the probe is transferred along the iliopsoas muscle longitudinally and distally, and the musculotendinous junction is checked. Using the static USG, tendinosis, tendon showing hypoechoic lesion of irregular muscle fiber, tear, hypoechoic lesion with a definite margin or loss of echoic shadow, and iliopsoas bursitis, expanding of iliopsoas bursa, of the iliopsoas muscle are checked. After static USG, dynamic USG is performed by placing the probe perpendicular to the muscle direction to check the axial image, transferring proximally, to check the motion of the iliopsoas tendon on the upper portion of the pelvis. The snapping of the tendon is confirmed by ordering the patient to move the hip from flexion-abduction-internal rotation posture to neutral position. (Fig. 6). USG for external snapping hip is performed with the patient on lateral decubitus position with the affected joint facing upwards. The probe is placed just distal to the ASIS checking the ITB, and migrated distally along the muscle direction until the greater trochanter, and tendinosis of gluteus medius and minimus was observed. The probe was put perpendicular to the ITB by rotation, and snapping of greater trochanter and ITB was checked by extending the hip from flexed posture. If the pain persist, for internal snapping hip, 2ml of bupivacaine and triamcinolone was injected on the iliopsoas tendon attach site on the lesser trochanter and achieved symptom relief. If the pain was refractory to the injection, surgical intervention (ITB release) was necessary. For external snapping hip, a hypertrophied ITB was shown on the snapping area of greater trochanter and IT tract, and steroid injection on which achieved symptom improvement in majority of cases, however, if jerk motion was evident during ambulation, surgery may be needed.

**5) Piriformis syndrome and deep gluteal syndrome**

Piriformis syndrome and deep gluteal syndrome is a disease category inducing buttock pain around the sciatic nerve. Usually, patient suffer from persistent pain after treatment of spinal disease such as intervertebral disc herniation or spinal stenosis. If buttock pain is refractory to conservative treatment without spinal lesion, with knee extension, by rotating the ankle internally and externally, the sciatic nerve shows excursion inside the piriformis muscle. The hypertrophy of piriformis or adhesion of sciatic nerve could entrap the sciatic nerve and cause pain. In such case, USG guided sciatic block or piriformis block could bring about symptom relief. If injection does not improve the symptoms, piriformis release or adhesionolysis of the sciatic nerve could be applied. The recently emerged ischiofemoral impingement is also a lesion of a similar region, thus, such treatment could be performed also.

**5) Considerations of injection therapy using USG**

We can perform ultrasonographic evaluation of femoral, sciatic, obturator, lateral femoral cutaneous and posterior femoral cutaneous nerve from proximal to distal portion of lower extremities and can execute nerve block for not only diagnostic or therapeutic purpose but also anesthesia. The physician have to thoroughly explain the need of
treatment, process of procedure, post-injective pain and complications after injection to the patient. The site and instruments of injection must be sterile and all procedure should be performed in aseptic condition. To reduce needle fear, the physician should try to hide the needle as much as possible from the patient.

7–10 cm long spinal needle is used for paraspihal injection, around hip injection, and sciatic nerve block. Physician should prepare the syringe be connected with needle via the IV line and simultaneous injection during performing USG. 25 gauge thin needle is commonly used, however, 18 gauge needle may be used in an obese patient for easier control.

Physician should select the procedure between ‘In-plane technique’ and ‘Out-of-plane technique’. Needle is inserted just beneath the probe in In-plane technique. The examiner can observe the exact motion of needle, however requires some skills. From the Out-of-plane technique, needle is inserted outward at lateral side of center of the probe and needle control may be easier than in-plane technique. As only the tip of needle, rather than the whole needle, is only observed in USG field, precise procedure is somewhat difficult. Important considerations in USG procedure are ‘accurate injection’ and ‘no-complication’. The examiner should be well aware of the maintenance of key image, meticulous control of probe, and visualization of tip of needle. Intravenous injection of drug have to be check by regular regurgitation of syringe, as often as every 2–4ml injection.

6) Obturator nerve block

Obturador nerve originates from the L2, 3, 4 nerve roots and runs along the iliopsoas medially to the pelvis, and distributes inside the pelvis and divides in to anterior and posterior around the inguinal area. If patient suffers from hip pain or medial thigh radiating pain, obturator nerve block could be helpful, and such block could be useful in for differential diagnosis of intraarticular lesion such as osteoarthritis, avascular necrosis of femur head, or labral tear that accompany pain on the medial femur or upper portion of the knee. If there is adductor tendinopathy, injection therapy could be considered. Linear 5~12MHz probe is put on the medial side of the head, or labral tear that accompany pain on the medial femur or upper portion of the knee. If there is adductor tendinopathy, injection therapy could be considered. Linear 5~12MHz probe is put on the medial side of the femur longitudinally, and obturator nerve could be observed between the adductor magnus and brevis. Injection performed proximally before the obturator nerve branches into anterior and posterior allows complete nerve blockade. The anterior branch of the obturator nerve lies anterior to the adductor brevis and posterior to the pectineus and adductor longus. Since the branch inside the hip joint divides near the obturator foramen, thus the position of the probe should be carefully controlled. The posterior branch of the obturator nerve lies between the adductor brevis and magnus and the distal branch runs inside the knee joint.

7) Other useful nerve block

There are numerous nerve block techniques of the lower extremity besides the techniques abovementioned. Lateral femoral cutaneous nerve block could be applied for meralgia paresthetica, saphenous nerve block for femoral area pain, USG guided aspiration for ischial bursitis, and genicular nerve block for anterior patellar pain. For posterior pelvic pain, if sacroiliac arthropathy is shown on simple radiograph, along with laboratory studies for ankylosing spondylitis or rheumatoid arthritis, injection treatment for pain relief could be performed. Though fluoroscopy guidance could be helpful, identifying the hyperechoic ilium and sacrum and precisely injecting on the hypoechoic lesion of the ligament indicating arthrosis using USG could be more beneficial.

Conclusion

USG is useful for exact diagnosis and evaluation of intraarticular pathologies of the hip joint and injection therapy under USG can also make the patient’s symptoms decreased. Physicians can understand more and more through USG of femoroacetabular impingement, acetabular labral tear, greater trochanteric pain syndrome and snapping hip.

REFERENCES


Figure 3. Gross anatomy around greater trochanter.(GT, greater trochanter; Gm, gluteus medius; gm, gluteus minimus). (A) Schematic draw of gluteus medius and minimus. (B) Scan direction of gluteus medius. (C) Scan direction of gluteus minimus. (D) Transverse scan of footprint of gluteus medius and minimus.

Figure 4. Longitudinal view of overlapping portion between gluteus medius and gluteus minimus. (GT, greater trochanter; Gm, gluteus medius; gm, gluteus minimus)

LEGEND

Figure 1. Femoral head-neck view.(A, acetabulum; L, labrum; FH, femoral head; SR, synovial recess)

Figure 2. Hypoechoic pathologic image around labrum. (A) Paralabral cyst[asterisk]. (B) Intra-labral cyst[arrow head]


Figure 5. Axial view for footprint of gluteus medius and gluteus minimus.
[GT, greater trochanter; Gm, gluteus medius; gm, gluteus minimus; A, anterior; P, posterior]

Figure 6. Schematic pictures of movement of iliopsoas tendon according to leg position. As hip is brought from frog-leg position to neutral extended position, tendon moves medially, suddenly flipping over iliopectineal eminence. (A) Flexion-Abduction-External rotation. Iliopsoas tendon was located laterally. (B) Neutral position. Iliopsoas tendon was located medially.

US in Ankle Instability

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Ultrasonography (US) in foot and ankle have advantage of low cost, fast examination, real time imaging and superficial structure. Ankle sprains are also most common injuries around lower extremities. Ankle instability can be easily developed after a acute ankle sprain. Lateral ankle instability is most common injury among the ankle instability. Physical examination is most important diagnostic modality of the ankle instability. Associated fracture can be identified at simple radiographs. Magnetic resonance image (MRI) can show the status of ligament proper and stress radiographs also show the static instability around ankle. Many information can be archived from MRI, but MRI have relatively high cost and no instability image. Instability can be obtained from stress radiographs, but there are no images of ligament staus and instability cannot be seen sometimes due to muscle guarding. US can achieve simultaneously the ligament status and stability of ankle and easily be applied at ankle during physical examination. Doctor who using the US have good communication with patient during US exam before and after the treatment. US is good diagnostic imaging modality of ankle instability.

Keywords: Ankle, Instability, Ultrasonography
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Clubfoot

Soo-Sung Park
How to manage relapsed clubfeet after Ponseti method in Japan

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Background: Ponseti method was introduced into Japan in 1999. Ponseti method has dramatically changed the strategy for idiopathic clubfeet treatment and has become the ‘gold standard’ treatment in Japan. Today almost all pediatric orthopedists in Japan use this method and satisfactory initial correction was achieved in 95% of idiopathic cases. However, relapses are not uncommon and the rate varies from 10% to 40% depending on the amount of follow-up. The purpose of this presentation is to review the treatment for relapsed clubfeet in Japan.

Materials and Methods: We investigated studies concerning Ponseti method for idiopathic clubfeet since 2003. One hundred thirty-nine records were identified, in which 35 case studies and 11 review article were excluded. All the remaining 93 articles were therapeutic studies of Ponseti method. From these articles, we reviewed detail of treatment for relapsed clubfeet.

Results: Most of the studies were short term follow-up less than 5 years. Relapses were observed 10% to 40% depending on the amount of follow-up. Only non-compliance for foot abduction brace was correlated with relapse. Recasting were often chosen for the treatment of relapse cases up to 2 years old. Beyond this age, relapses with rigid deformity were treated with conventional soft tissue release and relapsed with flexible deformity were treated with anterior tibial tendon transfer to the third cuneiform with or without Achilles tendon lengthening. Radiographic findings in untreated relapsed cases were not changed beyond age 6 except for equines deformity.

Conclusion: We have reviewed the treatment for relapsed clubfeet in Japan. Because radiographic outcome maintain beyond age 6 and have some relationship with radiography at the age of four, we should treat and achieve better results up to 4 years old to improve final outcome.
How to manage residual clubfoot deformity after Ponseti method in Taiwan

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ABSTRACT

Idiopathic clubfoot can be successfully managed by Ponseti casting and tenotomy, and number of surgeries for clubfeet have decreased in the past 20 years. Under-correction and resistance to long-term bracing still occurred in as high as 30–40% of all cases, and the rate of relapse increased with longer follow-up. The most common residual deformities are supination and metatarsal adduction.

Managements for residual deformities depend on age and specific deformities. The first line treatment is repeat casting before 2 years old. When dynamic supination deformity is more apparent during walking at age of 3-4 years, split tibialis anterior tendon transfer to the cuboid is the treatment of choice. When inadequate ankle dorsiflexion is present with some degree of hindfoot varus deformity, limited posterior release via Cincinnati incision provides good long-term function outcome. Medial subluxation of the navicular is not common after Ponseti casting. Once it is present in severe residual deformities, medial soft tissue release and talo-navicular arthrotyomy are required and additional lateral column shortening further improve deformity correction. Calcaneus shortening is my favored method in lateral column shortening because the relationship between the talus head and the calcaneus can be changed. When isolated metatarsal adduction is present without hindfoot deformity, shortening of the cuboid and lengthening of the medial cuneiform provide satisfying correction.
How to manage residual clubfoot deformity after Ponseti method in Singapore

Arjandas Mahadev
KK WOMEN’S AND CHILDREN’S HOSPITAL, SINGAPORE

Ponseti casting has indeed revolutionised the management of idiopathic congenital talipes equinovarus (CTEV). Extensive soft tissue releases are now rarely done as the primary management of CTEV.

However, residual CTEV remains a problem. Fortunately, in Singapore the numbers are small and it is most times due to non-compliance with the foot abduction orthosis (FAO)

In our Department in KK Women’s and Children’s Hospital, Singapore, we have the following guidelines:

• Below the age of walking (less than 1 year)
  - If there is only hindfoot equinus with good external rotation of the forefoot in supination of more than 60°, then a Tendo Achilles percutaneous tenotomy followed by 3 weeks of casting and FAO. This is followed by the rest of the Ponseti protocol up to the age of 4.
  - If there is both hindfoot equinus and an external rotation of the forefoot of less than 60°, then serial casting is resumed until the 60° of external rotation is achieved followed by Tendo Achilles percutaneous tenotomy as noted above.

• Walking age below 4 years old
  - Follows the above protocol except that the Tendo Achilles percutaneous tenotomy is replaced with open Strayer releases of the gastrocnemius to lengthen the Tendo Achilles followed by 6 weeks of casting instead of 3 weeks.

• Above the age of 4 years old (after the appearance of the medial cuneiform)
  - Any equinus will be treated with an open Strayer release of the gastrocnemius as noted above
  - If there is swing phase forefoot supination due to Tibialis anterior over-activity, then an Anterior Tibialis Transfer (ATT) would be added as recommended by the Ponseti protocol.

Mahadev A, Munajat I, Mansor A, Hui JH
Combined Lateral and Transcuneiform without Medial Osteotomy for Residual Clubfoot for Children

Ponseti casting has indeed revolutionised the management of idiopathic congenital talipes equinovarus (CTEV). Extensive soft tissue releases are now rarely done as the primary management of CTEV.

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Mahadev A, Munajat I, Mansor A, Hui JH
Combined Lateral and Transcuneiform without Medial Osteotomy for Residual Clubfoot for Children
How to manage residual clubfoot deformity after Ponseti method in Bangladesh

Sarwar Ibne Salam
DHAKA MEDICAL COLLEGE HOSPITAL, BANGLADESH

Clubfoot is the commonest congenital anomaly in children. More than 100,000 babies are born worldwide each year with congenital clubfoot. Around 80% of the cases occur in developing nations. With an annual birth rate of approximately 3.2 million, an estimated incidence of 1:900 live births, Bangladesh has approximately 5000 new cases of idiopathic congenital talipes equinovarus per annum.

The Ponseti method is safe and effective & considered gold standard in treating congenital clubfoot, it decreases the need for extensive corrective surgery. Still relapse and residual deformity after treatment of congenital clubfoot are common problems. Recurrences have been reported in up to 48% of cases after successful initial treatment using Ponseti’s method. Casting and anterior tibial tendon transfer as recommended by Ponseti a flexible and well functioning foot can be achieved in most cases. Neglected clubfoot even after initial Ponseti method , remains a challenge. Depending on the severity of the deformity, the impairment of function and patient age, conservative and/or different operative treatment options can be considered. Manipulation and casting according to Ponseti is also recommended in toddlers with relapses even after peritalar joint release. Thus the need and extent of operative treatment can be reduced. Additional osteotomy may be needed in more rigid feet and older children. Accurate evaluation of the existing deformity and functional impairment is mandatory for the individual choice of treatment. The number of previous operative procedures reduces the amount of improvement and mobility of the foot. Therefore, the best and most efficient treatment for recurrent clubfoot is prevention in the form of consistent primary treatment, consistently wearing braces and regular follow-up examinations.

How to manage residual clubfoot deformity after Ponseti method in India

Alaric John Aroojis
CENTRE FOR BONE & JOINT KOKILABEN DHIRUBHAI AMBANI HOSPITAL, INDIA

Recurrences are known to occur after the Ponseti method of clubfoot treatment. In Ponseti’s original series (Ponseti JBJS 1963), a recurrence rate of 56% was reported. With a better understanding of the manipulation, casting and bracing techniques, the recurrence rate has now dropped to approximately 15%. However, some recent reports in literature indicate a much higher rate of recurrence, in the order of 30 – 45% (Haft JBJS 2007). Various factors are responsible for a high recurrence rate, and include, failure to achieve full abduction upto 70° in the casting phase, non-compliance with foot abduction brace, over-active tibialis anterior muscle and growth spurts in children. Most recurrences (60 – 70%) occur in the first 2 years of life but some recurrences (~30%) can occur upto the age of 5 years. Non-compliance with brace wear has been found to be one of the biggest risk factors for recurrence, with some studies reporting a 70 – 80% recurrence rate in children who did not adhere to the bracing protocol (Dobbs JBJS 2004). Recurrence is defined as any child presenting with one or more components of the deformity (equinus, hindfoot varus, forefoot adductus or cavus) that requires further treatment. Early recognition of recurrence is essential, so that treatment can begin early. Early recurrences can be easily managed by re-casting and / or re-tenotomy of the Tendo Achilles. Dynamic supination is best treated by a tibialis anterior tendon transfer to the lateral cuneiform. However, recent reports (Morcuende JPO 2012, Milbrandt JPO 2015) have shown that 15 – 20% of feet can relapse even after a tendon transfer, thus highlighting the importance of constant vigilance at least up to 5 years of age.
Bangladesh being the 8th most populous nation in the world, one of the highest density and a large group of less educated & poor population has to face these problems a lot like many other developing countries. We report our experience in Bangladesh of the management of such residual deformities of CTEV after Ponseti method.
Decision making: operate or not to operate, when to operate

Abhay Khot
VICTORIAN ORTHOPAEDIC CENTRE, AUSTRALIA

Purpose: This lecture will present an overview of the journey from the decision-making process to the outcomes for musculo-skeletal issues in CP. The indications for intervention in the context of CP will be briefly discussed, as will a review of the outcomes in the literature. Multi-disciplinary team planning to prepare the child and the family will be outlined to provide tips used to minimize peri-operative risk. The technical details will be discussed with suitable case examples. Issues raised during the post-operative recovery period will be discussed to help clinicians navigate a potentially difficult time for the child and the family.

Summary:

Surgeries for correction of crouch gait

Alaric John Aroojis
CENTRE FOR BONE & JOINT KOKILABEN DHIRUBHAI AMBANI HOSPITAL, INDIA

Crouch gait is frequently seen in spastic diplegia and quadriplegia, and is one of the most difficult gait patterns to treat. It is usually precipitated by the adolescent growth spurt and pre-existing lever arm disease, such as femoral anteversion, external tibial torsion & planovalgus feet. Iatrogenic weakening of the gastroc-soleus causes excessive ankle dorsiflexion during the 2nd ankle rocker leading to an incompetent plantarflexion-knee extension couple. This results in excessive energy consumption and an inefficient gait. Various treatment strategies have been in practice for crouch correction, ranging from physiotherapy, bracing, casting and soft tissue procedures to bony surgeries or a combination of both. Soft-tissue surgeries (hamstring lengthening, semitendinosus transfer, rectus femoris transfer) as part of single-event multilevel surgery were popular for the correction of crouch gait over the years. It was thought that crouch gait resulting from tightness of hamstring muscles can be corrected by lengthening of the muscle-tendon unit; however, gait analysis studies have shown that the hamstrings can be of normal length, shorter or even lengthened in cases of crouch. Hence nowadays, 2nd generation techniques such as distal femoral extension osteotomy and patellar tendon advancement have become popular in the treatment of crouch gait. Several studies have confirmed the effectiveness of this combined procedure in improving crouch by increasing knee extension in stance, improving quadriceps strength and extensor lag, and improving postoperative kinematic measurements of gait.
**Surgeries for spastic hip disease and spine deformity**

Jason James Howard  
SIDRA MEDICAL AND RESEARCH CENTER, CANADA

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**Abstract:** Deformities of the hip and spine are common in cerebral palsy with incidence directly related to disease severity according to the Gross Motor Function Classification System (GMFCS). Untreated hip displacement can lead to painful degenerative arthritis as well as concerns with seating, perineal hygiene, and decubitus ulceration. Scoliosis, on its own or in conjunction with hip displacement, can exacerbate these issues and can effect quality of life. As such, when large and progressive, both scoliosis and hip displacement are typically indicated for surgical correction. This talk will review the most up to date evidence regarding the pathophysiology, natural history, epidemiology, and surgical management for hip displacement and scoliosis in cerebral palsy.
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