Global Perspectives for the Physical Therapist and Athletic Trainer

Sunday, May 12–Tuesday, May 14, 2013

Sports Rehabilitation Concurrent Course
The revolutionary new electrotherapy device, without cables!

Created especially for professional therapists - enjoy autonomous, cable-free use, give patients the freedom to move and exercise during electrotherapy treatment, improve your practice, save time, and optimize patient results. With a sleek design, advanced interface, 71 specific treatment programs, and its unique in-built Muscle Intelligence™ technology, the Wireless Professional lets you deliver outstanding results by adapting to each patient's individual physiology.

Discover the Wireless Professional's advantages at ISAKOS, Booth #515, and subscribe to the FREE lunchtime workshop on Monday 13th May.
May 12, 2013

Dear Colleagues,

On behalf of the course chairs, we welcome you to Toronto and to the ISAKOS Sports Rehabilitation Concurrent Course: Global Perspectives for the Physical Therapist and Athletic Trainer.

This course brings together world leaders in sports medicine, physical therapy and athletic training to discuss the most prevalent and innovative topics related to your daily practice. Special consideration will be given to understanding different modalities and treatment strategies utilized in other nations when dealing with similar injuries, and topics such as returning an athlete to play, and the use and misuse of performance enhancement substances and techniques.

Our goal is to give physicians, athletic trainers, physiotherapists and coaches concerned with the management or prevention of injuries to the team athlete new insight and up to date information from an international perspective. Speakers and topics have been selected that will provide an international and current perspective on a wide range of issues, including the management of knee, shoulder and elbow, hip, foot and ankle and muscle injuries in athletes.

We have assembled an international faculty, including experts from around the world, presenting on their areas of expertise. We thank them in advance for their time and their presentations.

Thank you for your participation, and we hope you find the ISAKOS Sports Rehabilitation Concurrent Course: Global Perspectives for the Physical Therapist and Athletic Trainer to be a valuable educational experience.

Best Regards,

Trevor Birmingham, BSc PT, PhD, CANADA
Moises Cohen, MD, PhD BRAZIL
James Irrgang, PT, PhD, ATC, FAPTA USA
Lynn Snyder-Mackler, PT, ScD, FAPTA USA
ISAKOS Congress 2013: Sports Rehabilitation Concurrent Course
Global Perspectives for the Physical Therapist and Athletic Trainer
May 12-14, 2013 • Toronto, Canada

Course Chairs
Trevor Birmingham, BSc PT, PhD, CANADA
Moises Cohen, MD, PhD BRAZIL
James Irrgang, PT, PhD, ATC, FAPTA USA
Lynn Snyder-Mackler, PT, ScD, FAPTA USA

Faculty
Greg Alcock, MScPT, BHScPT, BA HonsPE, Dip. Manip., FCA CANADA
Annunziato Amendola, MD USA
James Andrews, MD USA
Michael Axe, MD USA
Klaus Bak, MD DENMARK
Eduardo Benegas, MD BRAZIL
Mario Bizzini, PT, PhD SWITZERLAND
Gary Calabrese, PT USA
Constance Chu, MD USA
Ramon Cugat, MD, PhD SPAIN
George Davies, DPT, PT, ATC, CSCS USA
David Dejour, MD FRANCE
Benno Ejnisman, MD BRAZIL
Lars Engebretsen, MD, PhD NORWAY
Keelan Enseki, MS,PT,OCS,SCS,ATC,CSCS USA
Julian Feller, FRACS AUSTRALIA
Reed Ferber, ATC, PhD CANADA
Freddie Fu, MD USA
J. Robert Giffin, MD, FRCS CANADA
Christopher Harner, MD USA
Timothy Hewett, PhD USA
Per Hölmich, MD DENMARK
Johnny Huard, PhD USA
Elizaveta Kon, MD ITALY
Robert LaPrade, MD, PhD USA
Joy Macdermid, PT, PhD CANADA
John Nyland, EdD, DPT USA
Marc Philippon, MD USA
May Arna Risberg, PhD NORWAY
Kathryn Schneider, PT, DSc, FCAMT, PhD CANADA
Karin Gravare Silbernagel, PhD, PT, ATC USA
Guy Simoneau, PT, PhD USA
Kevin Wilk, PT, DPT, FAPTA USA
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2. Speaker
3a. Employee
3b. Paid Consultant
3c. Unpaid Consultant
4. Stock
5. Research or Institutional Support
6. Financial or Material Support
7. Royalties (Publisher)
8. Editorial or Governing Board of Medical or Orthopaedic Publication
9. Board of Directors, Owner or Officer for Healthcare Organization

ISAKOS does not view the existence of these disclosed interests or commitments as necessarily implying bias or decreasing the value of the author’s participation in the ISAKOS Biennial Congress. An indication of the participant’s financial disclosure appears after their name, as well as the commercial company or institution that provided the support.

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<thead>
<tr>
<th>Course Chairs</th>
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<tr>
<td>Birmingham, Trevor B.</td>
<td>5 - Arthrex Inc.</td>
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<td>Cohen, Moises</td>
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<tr>
<td>Irrgang, James J.</td>
<td>9 - President of the Orthopaedic Section of the American Physical Therapy Association</td>
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<td>Snyder-Mackler, Lynn</td>
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<tr>
<td>Amendola, Annunziato</td>
<td>1 - Arthrex; Arthrosurface; 3b - Arthrex; MTP Solutions</td>
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<td>Andrews, James R.</td>
<td>3b - Bauerfiend, Biomet Sports Medicine, Theralase, MiMe; 4 - Patient Connection, Connective Orthopaedics - Stockholder; 6 - Medical Director, Physiotherapy Associates; 9 - Fast Health Corporation-Board Member</td>
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<td>Axe, Michael James</td>
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<td>Dejour, David Henri</td>
<td>1 - Tornier, SBM</td>
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<td>Ejnisman, Benno</td>
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<td>Fu, Freddie H.</td>
<td>1 - ArthroCare - Fund Deposited to Univ of Pittsburgh Account; 3a - Gordon Fu - Stryker Employee (son); 8 - Editor: Operative Techniques in Orthopaedics</td>
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<td>Giffin, J. Robert</td>
<td>1 - Arthrex; 3b - Arthrex; 5 - Arthrex</td>
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<td>Harner, Christopher D.</td>
<td>5 - ConMed Linvatec, Smith &amp; Nephew; 7 - Wolters Kluher; 9 - MTF Board of Directors, AOSSM Executive Committee, AOA Membership Committee</td>
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<td>MacDermid, Joy</td>
<td>7 - Slack, Evidence-based Rehabilitation; 8 - JOSPT, J Hand Ther, Journal of Physiotherapy; 9 - AAHS</td>
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<td>Philippon, Marc J.</td>
<td>1 - Smith &amp; Nephew, Arthosurface, Bledsoe, DonJoy; 3b - Smith &amp; Nephew, MIS; 4 - HIPCO, ArthroSurface; 7 - Slack, Elsevier; 8 - ; 9 - ISHA, Steadman Philippon Research Institute</td>
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<td>Risberg, May Arna</td>
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<td>Schneider, Kathryn</td>
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<td>Wilk, Kevin</td>
<td>3c - Advisory Boards - Alter G. Treadmill, Intelliskin; 4 - Theralase Lasers; 5 - Educational Grants - Dynasplint, JAS, ERMI; 7 - WB Saunders, Elsevier</td>
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**ISAKOS Staff Disclosure**

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<td>Anderson, Kathryn</td>
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<td>Matthews, Hilary</td>
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<td>Warden, April</td>
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CME Hours
The ISAKOS Sports Rehabilitation Concurrent Course: Global Perspectives for the Physical Therapist and Athletic Trainer is planned and implemented in accordance with the essential areas and policies of the Accreditation Council for Continuing Medical Education (ACCME) through joint sponsorship.

CME Accreditation
This activity has been planned and implemented in accordance with the Essential Areas and policies of the Accreditation Council for Continuing Medical Education (ACCME) through joint sponsorship of the American Academy of Orthopaedic Surgeons (AAOS) and the International Society of Arthroscopy, Knee Surgery and Orthopaedic Sports Medicine (ISAKOS).

The AAOS is accredited by the ACCME to sponsor continuing medical education for physicians.

The American Academy of Orthopaedic Surgeons designates this live activity for a maximum of 22.5 AMA PRA Category 1 Credits™. Physicians should only claim credit commensurate with the extent of their participation in the activity.

Course Objectives
Upon completion of this course, participants should be able to:

- Describe current developments in the management of knee, shoulder and elbow, hip, foot and ankle and muscle injuries in athletes
- Better evaluate and manage sideline or onsite issues in sports medicine
- Describe controversial issues concerning return to play in athletic events
- Understand different modalities and treatment strategies utilized in other nations when dealing with similar injuries
- Improve technical knowledge of the athlete’s sports return
- Discuss the use and misuse of performance enhancement substances and techniques
ISAKOS Congress Sports Rehabilitation Concurrent Course:

*Global Perspectives for the Physical Therapist and Athletic Trainer*

May 12-14, 2013 • Toronto, Canada

ISAKOS thanks **DJO Global** for their generous donation to the

*ISAKOS Congress Sports Rehabilitation Concurrent Course: Global Perspectives for the Physical Therapist and Athletic Trainer.*

Their sponsorship allows this concurrent course to be more affordable to our attendees and we would not have been able to organize this course without their support.

*DJO Global* is a leading global developer, manufacturer and distributor of high-quality medical devices and services that provide solutions for musculo-skeletal health, vascular health and pain management. The Company’s products address the continuum of patient care from injury prevention to rehabilitation after surgery, injury or from degenerative disease, enabling people to regain or maintain their natural motion. Our products are used by orthopaedic specialists, spine surgeons, primary care physicians, pain management specialists, physical therapists, podiatrists, chiropractors, athletic trainers and other healthcare professionals. In addition, many of the Company’s medical devices and related accessories are used by athletes and patients for injury prevention and at-home physical therapy treatment. The Company’s product lines include rigid and soft orthopaedic bracing, hot and cold therapy, bone growth stimulators, vascular therapy systems and compression garments, electrical stimulators used for pain management and physical therapy products. The Company’s surgical division offers a comprehensive suite of reconstructive joint products for the hip, knee and shoulder. DJO Global’s products are marketed under a portfolio of brands including Aircast®, Chattanooga™, CMF™, Compex®, DJO Surgical, DonJoy®, Empi® and ProCare®. For additional information on the Company, please visit [www.DJOglobal.com](http://www.DJOglobal.com).
Agenda
CONCURRENT COURSE AGENDA

SUNDAY, MAY 12

8:30 - 9:00 Welcome Address
   Chair: Trevor Birmingham, PT, PhD CANADA
   Chair: James Irrgang, PT, PhD, ATC, FAPTA USA
   Chair: Lynn Snyder-Mackler, PT, ScD, FAPTA USA

8:45 - 9:00 Evidence Based Rehabilitation - The View of a Journal Editor
   Guy Simoneau, PT, PhD USA

9:00 - 10:30 Session I: Knee - Sports Medicine
   Moderators: Trevor Birmingham, PT, PhD CANADA
               James Irrgang, PT, PhD, ATC, FAPTA USA

9:00 - 9:30 Running After Knee Injury
   Reed Ferber, ATC, PhD CANADA

9:30 - 9:45 Biomechanics of Exercise for the Knee and Lower Extremity
   Trevor Birmingham, PT, PhD CANADA

9:45 - 10:00 Non-Operative Management of ACL Injuries
   Lynn Snyder-Mackler, PT, ScD, FAPTA USA

10:00 - 10:15 Anatomic ACL Reconstruction
   Freddie Fu, MD USA

10:15 - 10:30 Discussion
   Trevor Birmingham, PT, PhD CANADA
   Reed Ferber, ATC, PhD CANADA
   Freddie Fu, MD USA
   Lynn Snyder-Mackler, PT, ScD, FAPTA USA

10:30 - 10:45 Break

10:45 - 12:00 Section II: Knee - Sports Medicine
               Lynn Snyder-Mackler, PT, ScD, FAPTA USA

10:45 - 11:00 Immediate Post-Operative Rehabilitation After ACL Reconstruction
   James Irrgang, PT, PhD, ATC, FAPTA USA

11:00 - 11:15 Intermediate and Late Stages of Rehabilitation After ACL Reconstruction
   Kevin Wilk, PT, DPT, FAPTA USA

11:15 - 11:30 Return to Sports After ACL Reconstruction: A Surgeon's Perspective
   Julian Feller, FRACS AUSTRALIA

11:30 - 11:45 Functional Training and Return to Activity
   John Nyland, EdD, DPT USA

11:45 - 12:00 Discussion
   Julian Feller, FRACS AUSTRALIA
   James Irrgang, PT, PhD, ATC, FAPTA USA
   John Nyland, EdD, DPT USA
   Kevin Wilk, PT, DPT, FAPTA USA
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<tr>
<td>12:00 - 1:30</td>
<td>Lunch</td>
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<tr>
<td>1:30 - 3:00</td>
<td><strong>Session III: Knee - Sports Medicine</strong></td>
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<td></td>
<td>Moderators: George Davies, DPT, PT, ATC, CSCS USA</td>
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<td>Mario Bizzini, PT, PhD SWITZERLAND</td>
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<td>1:30 - 1:45</td>
<td>Procedure Modified Rehabilitation</td>
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<td>James Irrgang, PT, PhD, ATC, FAPTA USA</td>
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<td>1:45 - 2:00</td>
<td>High Tibial Osteotomy in the Athlete's Knee - Rehabilitation and Biomechanics</td>
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<td>Trevor Birmingham, PT, PhD CANADA</td>
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<td>2:00 - 2:15</td>
<td>High Tibial Osteotomy in the Athlete's Knee</td>
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<td>J. Robert Giffin, MD, FRCSC CANADA</td>
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<td>2:15 - 2:30</td>
<td>Multiple Ligament Injury</td>
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<td>Christopher Harner, MD USA</td>
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<td>2:30 - 2:45</td>
<td>PCL and PLC Reconstruction</td>
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<td>Robert LaPrade, MD PhD USA</td>
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<td>2:45 - 3:00</td>
<td>Discussion</td>
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<td>Trevor Birmingham, PT, PhD CANADA</td>
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<td>Robert LaPrade, MD, PhD USA</td>
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<td>3:00 - 3:30</td>
<td>Break</td>
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<td>3:30 - 5:00</td>
<td><strong>Session IV: Knee - Sports Medicine</strong></td>
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<td>Moderators: May Arna Risberg, PhD NORWAY</td>
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<td>John Nyland, EdD, DPT USA</td>
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<td>3:30 - 3:45</td>
<td>Meniscus Repair and ACL Reconstruction in Athletes</td>
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<td>Moises Cohen, MD, PhD BRAZIL</td>
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<td>3:45 - 4:00</td>
<td>Rehabilitation for Meniscus Injuries</td>
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<td>James Irrgang, PT, PhD, ATC, FAPTA USA</td>
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<td>4:00 - 4:15</td>
<td>Non-Operative Management of Patellofemoral Pain</td>
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<td>Greg Alcock, MScPT,BHS, B.A. Hons.P.E., Dip. Manip., FCA CANADA</td>
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<td>4:15 - 4:30</td>
<td>Surgical Management of Patellofemoral Pain and Instability</td>
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<td>David Dejour, MD FRANCE</td>
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<td>4:30 - 4:45</td>
<td>Core Stabilization and Knee Injury Prevention</td>
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<td>Timothy Hewett, PhD USA</td>
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<td>4:45 - 5:00</td>
<td>Discussion</td>
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<td>Greg Alcock, MScPT, BHS, B.A HonsPE, Dip. Manip., FCA CANADA</td>
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MONDAY, MAY 13

8:30 - 10:00  **Session V: Degenerative Knee**  
*Moderators: James Irrgang, PT, PhD, ATC, FAPTA USA  
Reed Ferber, ATC, PhD CANADA*

8:30 - 8:45  Overview of Articular Cartilage Surgery  
*Ramon Cugat, MD, PhD SPAIN*

8:45 - 9:00  Rehabilitation After Articular Cartilage Surgery  
*Lynn Snyder-Mackler, PT, ScD, FAPTA USA*

9:00 - 9:15  Non-Operative Management of Knee Osteoarthritis  
*May Arna Risberg, PhD NORWAY*

9:15 - 9:30  Surgical Options for Osteoarthritis  
*Robert LaPrade, MD, PhD USA*

9:30 - 9:45  Functional Testing Algorithm for the Knee  
*George Davies, DPT, PT, ATC, CSCS USA*

9:45 - 10:00  Discussion  
*Ramon Cugat, MD, PhD SPAIN  
George Davies, DPT, PT, ATC, CSCS USA  
May Arna Risberg, PhD NORWAY  
Robert LaPrade, MD, PhD USA*

10:00 - 10:30  **Break**

10:30 - 11:45  **Session VI: Hip**  
*Moderators: Ingard Holme, Professor NORWAY  
Kevin Wilk, PT, DPT, FAPTA USA*

10:30 - 10:45  Growth Factors and Healing  
*Elizaveta Kon, MD ITALY*

10:45 - 11:00  Non-Operative Treatment of Extra-Articular Hip Pain  
*Keelan Enseki, MS,PT,OCS,SCS,ATC,CSCS USA*

11:00 - 11:15  Hip Arthroscopy  
*Marc Philippon, MD USA*

11:15 - 11:30  Rehabilitation After Hip Arthroscopy  
*Keelan Enseki, MS,PT,OCS,SCS,ATC,CSCS USA*

11:30 - 11:45  Discussion  
*Keelan Enseki, MS,PT,OCS,SCS,ATC,CSCS USA  
Elizaveta Kon, MD ITALY  
Marc Philippon, MD USA*

11:45 - 1:30  **Lunch / Lunchtime Lecture**  
A New and More Effective Way to do Functional Rehab – The Role of Wireless Active Muscle Stim  
*Supported by and educational grant from DJO Global*

*Heiko van Vliet, Bachelor Physical Education  
Chattanooga Expert Electrotherapy Rehab & Training*
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1:30 - 3:00 **Session VII: Muscle and Tendon Sports Injuries**
   *Moderators: Keelan Enseki, MS,PT,OCS,SCS,ATC,CSCS USA
    Gary Calabrese, PT USA*
1:30 - 1:45 Evidence Based Prevention of Muscle and Tendon Injuries in Soccer Players
   *Per Hölmich, MD DENMARK*
1:45 - 2:00 Rehabilitation of Groin Pain and Athletic Pubalgia
   *Mario Bizzini, PT, PhD SWITZERLAND*
2:00 - 2:15 Rehabilitation of Hamstring, Quadriceps and Gastrocnemius Strains
   *Mario Bizzini, PT, PhD SWITZERLAND*
2:15 - 2:30 Treatment Options for Tendinopathy: What is the Evidence
   *Karin Gravare Silbernagel, PhD, PT, ATC USA*
2:30 - 2:45 Muscle Healing and Regeneration
   *Johnny Huard, PhD USA*
2:45 - 3:00 Discussion
   *Mario Bizzini, PT, PhD SWITZERLAND
    Karin Gravare Silbernagel, PhD, PT, ATC USA
    Per Hölmich, MD DENMARK
    Johnny Huard, PhD USA*

3:00 - 3:30 **Break**

3:30 - 4:45 **Session VIII: Foot and Ankle**
3:30 - 3:45 Orthopaedic Management of Ankle Instability
   *Annunziato Amendola, MD USA*
3:45 - 4:00 Non-Operative Management of Ankle Sprains
   *Gary Calabrese, PT USA*
4:00 - 4:15 Achilles Tendinopathy
   *Karin Gravare Silbernagel, PhD, PT, ATC USA*
4:15 - 4:30 Rehabilitation After Achilles Tendon Repair
   *Karin Gravare Silbernagel, PhD, PT, ATC USA*
4:30 - 4:45 Discussion
   *Annunziato Amendola, MD USA
    Gary Calabrese, PT USA
    Karin Gravare Silbernagel, PhD, PT, ATC USA*
TUESDAY, MAY 14

8:30 - 10:15  **Session IX: Elbow**  
Moderator: Karin Gravare Silbernagel, PhD, PT, ATC USA

8:30 - 8:45  Elbow Anatomy  
Gregory Bain, MB BS, FRACS, PhD AUSTRALIA

8:45 - 9:00  Elbow Arthroscopy  
Benno Ejnisman, MD BRAZIL

9:00 - 9:15  Elbow Instability  
James Andrews, MD USA

9:15 - 9:30  Medial and Lateral Epicondilitis of the Elbow  
Eduardo Benegas, MD BRAZIL

9:30 - 9:45  Rehabilitation After Ulnar Collateral Ligament Reconstruction  
Kevin Wilk, PT, DPT, FAPTA USA

9:45 - 10:00  Management of Tennis Elbow  
Joy Macdermid, PT, PhD CANADA

10:00 - 10:15  Discussion  
James Andrews, MD USA  
Eduardo Benegas, MD BRAZIL  
Benno Ejnisman, MD BRAZIL  
Joy Macdermid, PT, PhD CANADA  
Kevin Wilk, PT, DPT, FAPTA USA

10:15 - 10:45  Break

10:45 - 12:00  **Session X: Shoulder**  
Moderator: Kevin Wilk, PT, DPT, FAPTA USA

10:45 - 11:00  Shoulder Anatomy  
James Irrgang, PT, PhD, ATC, FAPTA USA

11:00 - 11:15  Biomechanics of Shoulder Function  
James Irrgang, PT, PhD, ATC, FAPTA USA

11:15 - 11:30  Throwing Progression for Youth Sports  
Michael Axe, MD USA

11:30 - 11:45  Functional Testing Algorithm for the Shoulder  
George Davies, DPT, PT, ATC, CSCS USA

11:45 - 12:00  Discussion  
Michael Axe, MD USA  
George Davies, DPT, PT, ATC, CSCS USA  
James Irrgang, PT, PhD, ATC, FAPTA USA

12:00 - 1:30  **Lunch and Lunchtime Session**

12:00 - 1:30  Role of Radial Shockwave Therapy in the PT Practice – Practical Use in Evidence-based Indications  
Supported by and educational grant from DJO Global  
Freddy Romano, MSc Physical Therapy and Biomedical Physics
<table>
<thead>
<tr>
<th>Time</th>
<th>Session XI: Shoulder</th>
<th>Session XII: Sports Medicine</th>
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<td>1:30 - 3:00</td>
<td><strong>Operative Management of Shoulder Instability</strong>&lt;br&gt;<strong>Klaus Bak, MD DENMARK</strong></td>
<td><strong>Olympic Sports Medicine: Lessons from London</strong>&lt;br&gt;<strong>Lars Engebretsen, MD, PhD NORWAY</strong></td>
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<tr>
<td>1:30 - 1:45</td>
<td><strong>Post Operative Rehabilitation After Rotator Cuff Repair</strong>&lt;br&gt;<strong>Kevin Wilk, PT, DPT, FAPTA USA</strong></td>
<td><strong>PT Management of Concussion</strong>&lt;br&gt;<strong>Kathryn Schneider, PT, DSc, FCAMT, PhD, CANADA</strong></td>
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<td>1:45 - 2:00</td>
<td><strong>Treatment of Stiff Shoulder</strong>&lt;br&gt;<strong>James Irrgang, PT, PhD, ATC, FAPTA USA</strong></td>
<td><strong>The Future of Joint Healing</strong>&lt;br&gt;<strong>Constance Chu, MD USA</strong></td>
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| 2:00 - 2:15 | **Scapular Disfunction**<br>**George Davies, DPT, PT, ATC, CSCS USA** | **Discussion**<br>**Constance Chu, MD USA**
| 2:15 - 2:30 | **SLAP Lesions**<br>**Kevin Wilk, PT, DPT, FAPTA USA** | **Lars Engebretsen, MD, PhD NORWAY**
| 2:30 - 2:45 | **Discussion**<br>**Klaus Bak, MD DENMARK**<br>**George Davies, DPT, PT, ATC, CSCS USA**<br>**James Irrgang, PT, PhD, ATC, FAPTA USA**<br>**Kevin Wilk, PT, DPT, FAPTA USA** | **Kathryn Schneider, PT, DSc, FCAMT, PhD, CANADA** |
| 2:45 - 3:00 | **Break** | **Closing Remarks** |
| 3:00 - 3:30 | **Closing Remarks**<br>**Chair: Trevor Birmingham, PT, PhD CANADA**<br>**Chair: Moises Cohen, MD, PhD BRAZIL**<br>**Chair: James Irrgang, PT, PhD, ATC, FAPTA USA**<br>**Chair: Lynn Snyder-Mackler, PT, ScD, FAPTA USA** |
Session I

Knee - Sports Medicine
Evidence-Based Rehabilitation – A Journal Editor’s Point of View
Guy G. Simoneau, PhD, PT, ATC
Editor-in-Chief, Journal of Orthopaedic & Sports Physical Therapy (JOSPT)
Professor, Physical Therapy Department, Marquette University, USA

Over the past few years, we have witnessed an exponential growth in musculoskeletal rehabilitation publications considered to be near the top of the evidence-based practice pyramid: randomized controlled trials, systematic literature reviews, and clinical practice guidelines. A more global view of the literature also shows a growing recognition of the importance of knowledge across the broader spectrum of evidence, including important areas of clinical management such as diagnosis, prognosis, prevention, and harm, in addition to the more commonly mentioned area of therapy. This broader view of the literature calls attention to the fact that not all clinical questions can be answered with the same standard research design. Noteworthy is also the increasingly higher standards placed on research methodologies as well as the publicly available tools that can help authors meet these standards. Similarly, advances in technology continue to support researchers who are asking questions that are often mechanistic in nature; their findings being critical to guiding clinical decision-making and the design of eventual clinical studies.
Running After Knee Injury

Dr. Reed Ferber holds a Ph.D. in sports medicine and gait biomechanics from the University of Oregon and he is a board certified athletic therapist. He has completed post-doctoral research fellowships at the University of Delaware and the University of Calgary and specializes in the research and clinical treatment of lower extremity injuries. He is the Director of the Running Injury Clinic and an Associate Professor in the Faculties of Kinesiology and Nursing at the University of Calgary. Dr. Ferber is also a Population Health Investigator through the Alberta Heritage Foundation for Medical Research.

In the past few years, several research studies from our lab, and labs around the world, have investigated the pathomechanics associated with running-related knee injuries. Of most concern is the research question: how do movement mechanics change as a result of injury and what are the optimal rehabilitation protocols to treat the injury and prevent injury reoccurrence? The purpose of this talk is to provide an overview of these research studies and discuss the role of muscle strengthening in the treatment and prevention of musculoskeletal injuries.
BIOMECHANICS OF EXERCISE FOR THE KNEE AND LOWER EXTREMITY

Trevor Birmingham PhD, PT Fowler Kennedy Sport Medicine Clinic, London, ON Canada

INTRODUCTION

- The purpose of this presentation is to outline some of the different types of biomechanical investigations used to inform rehabilitation methods, and highlight examples that have influenced clinical practice.

BIOMECHANICAL INVESTIGATIONS

- Motion analysis labs capable of measuring 3D kinematics and kinetics during human locomotion, often in combination with EMG, are used extensively. These investigations rely on accurate measurements of body-segmental motion, the forces applied to the body, and precise knowledge of the anatomy (Pandy & Andriacchi 2010).

- 3D positions and orientations of the body segments are most often measured using video-based motion-capture systems that monitor markers placed on the skin, while force platforms concurrently measure ground reaction forces during various activities (Pandy & Andriacchi 2010).


- Some researchers have developed ways to directly measure knee joint forces in vivo using a total knee joint replacement telemetric implant, (Halder et al. 2012) and directly measure ACL strain using a transducer temporarily implanted arthroscopically (Fleming et al. 2001).

- Finite element analysis (FEA) is a mathematical technique that can be applied to joint images (CT and MRI) to model stresses and strains. The technique is growing in popularity with advances in imaging and computing power (Bei & Fregly 2004).

- These biomechanical measures (i.e. motion-capture, ground reaction forces, EMG, dynamic imaging, forces measured in vivo, FEA) can all provide important information independently, and may also be combined in computational models of varying complexity. There are considerable strengths and important limitations to all of these approaches.
EXAMPLE INFLUENCES ON REHABILITATION

- Biomechanical studies describing ACL strain and modeled ACL loads during open and closed kinetic chain exercises have helped guide exercise selection and parameters (Fleming et al. 2005; Escamilla et al. 2012). Results of clinical trials vary, but including both open and closed kinetic chain exercises at appropriate time points after ACL reconstruction has been proposed (Mikkelsen et al. 2000).

- Biomechanical studies have emphasized the influence of proximal segments (hip, pelvis, trunk) on the knee. Implications on rehabilitation for tibiofemoral OA, the ACL, the patellofemoral joint and the iliotibial band have all been described (Crossley et al. 2012; Hewett et al. 2013; Powers 2010; Sritharan et al. 2012).

- An increasing focus of biomechanical and clinical studies is on the control of movement patterns during dynamic and sporting activities. Based on these findings, interventions focused on neuromuscular control and perturbation training are encouraged (Adams et al. 2012; Hewett et al. 2013; Powers 2010).

- Exercise and rehabilitation goals may include weight-loss in patients who are overweight. Biomechanical studies have demonstrated a substantial decrease in knee joint load per step for each kilogram decrease in weight (Messier et al. 2005).

References


Non-Operative Management of ACL Injuries
Lynn Snyder-Mackler, PT, ScD, FAPTA USA
Anatomic ACL Reconstruction
Freddie H. Fu, MD, DSc (Hon), DPs (Hon);
University of Pittsburgh, Department of Orthopaedic Surgery
Correspondence: ffu@upmc.edu

I. Rationale for Anatomic Double-Bundle ACL Reconstruction
- Anatomy is the basis of orthopedic surgery. The goals of anatomic ACL reconstruction are to restore 60-80% of the native ACL anatomy, and to maintain a long term knee health.
- Traditional ACL-R has been successful in returning patients to sports activities. However, radiographic evidence of degenerative changes has been observed in up to 90% of patients at mid-term follow-up study after traditional single-bundle ACL reconstruction.1-2
- Critical review of the literature from the last ten years reveals that between 10% and 30% of patients complain of pain and residual instability following traditional single-bundle ACL reconstruction.3 Meta-analysis showed that no more than 60% of the patients will make a full recovery after their ACL reconstruction.4
- The PL bundle, which is not traditionally reconstructed, plays a significant role in rotatory stability in the knee. Numerous clinical and basic science studies have demonstrated that: 1) traditional single-bundle ACL reconstruction does not adequately restore normal knee kinematics, particularly tibial rotation5, and 2) anatomic double-bundle reconstruction more closely restores normal knee kinematics when compared to single-bundle reconstruction.6

II. The principle of anatomic ACL double bundle reconstruction
- Reproducing the two bundle anatomy of ACL
  - The ACL is composed of two functional bundles, the anteromedial (AM) bundle and the posterolateral (PL) bundle.7 Cadaveric studies have demonstrated that the AM bundle is approximately twice as long as the PL bundle, and that the two bundles have a similar cross-sectional diameter.

- Reproducing the insertion sites of ACL
  - The insertion sites of the AM and PL bundle should be identified and marked for anatomic tunnel placement. The femoral insertion sites of the AM and PL bundle are oriented vertically with the knee in extension and become horizontal in 90° of knee flexion (surgical position for ACL reconstruction surgery). In extension the two bundles are parallel and in flexion they become crossed.7

- Reproducing the tension pattern of ACL
  - The AM bundle has its highest tension at 45 degrees of knee flexion, and is taut throughout the range of motion. The PL bundle has its highest tension at full extension,
and becomes lax as the knee flexes. The AM and PL graft should be fixed at these angles of knee flexion to closely reproduce the native tension pattern.\textsuperscript{8}

- **Individualized surgery**
  - The insertion sites of each bundle should be identified and marked, and the size of the insertion sites should be measured to tailor the surgery for each individual. The concept of double bundle ACL reconstruction can be applied to all ACL reconstructive techniques (single bundle, double bundle, revision, one-bundle augmentation). The decision of whether to utilize either a single or a double bundle technique should be dictated by the unique anatomy of the patient.\textsuperscript{9}

### III. Pitfalls in Traditional ACL reconstruction

- Femoral insertion sites orientation changes with knee flexion: The femoral AM and PL insertion sites are horizontally oriented when the knee is close to 90 degrees of flexion, while they are vertically oriented in knee extension. This important concept is often neglected in ACL reconstruction.

- The use of clock face reference: The knee is a 3 dimensional structure. The clock concept is easy to use, but a 2 dimensional description and inaccurate in describing the location of femoral tunnel placement, which may lead to non-anatomic tunnel position.

- Inability to observe the femoral insertion site: traditional 2portal techniques do not provide a clear view of the femoral insertion site. By using a 3portal technique with a high lateral portal (LP) a central portal (CP) and a medial portal (MP) this problem is overcome. The CP provides a clear view of the notch and femoral insertion site, while the MP can be used as a working portal. The LP provides a good view of the tibial insertion site.
Graft impingement: is caused by non-anatomic graft placement. The native ACL does NOT impinge with notch and PCL. Adequate restoration of the size, shape and orientation of the native ACL anatomy prevents from impingement.

Mismatch tunnels: With fear of impingement, we traditionally mismatch our tunnel placement by placing the tibial tunnel more posteriorly (close to the PL insertion site), and placing the femoral tunnel at the native AM or high AM position.10-11 This non-anatomic ACL reconstruction leads to inferior biomechanical properties and inferior biological healing due to non-physiological biomechanical stress to the graft.

Double bundle ACL-R does not necessarily mean anatomic reconstruction, if the native anatomy was not followed as a guideline for double tunnel placement.

IV. Anatomic Double Bundle ACL Reconstruction

- Pre-operatively, the ACL insertion site and ACL length can be measured on the sagittal MRI. The ACL inclination angle can also be measured, as can be seen below.12

The MRI can also be used to measure the size of the certain autografts. Both the patellar tendon and the quadriiceps tendon size can be measured on the sagittal MRI cut. As can be appreciated below, the quadriiceps tendon is often much larger than the patellar tendon and provides a vigorous autograft.13
- Anatomic double-bundle ACL reconstruction is an “Insertion Site Surgery”. We utilize three portals: LP, CP and MP.

- We routinely place the arthroscope in the CP and work through the MP. Doing so, visualization of the femoral insertion of the ACL is greatly enhanced and the need for notchplasty is virtually eliminated.\(^{14}\)

- The anatomic insertion sites of each native ACL bundle are marked on the femur and tibia with a thermal device, with care taken to preserve the border of the bundles for later reference. This is a critical step in identifying the correct placement of the tunnels, and is performed prior to resection of any residual ACL tissue. In addition, the length and width of the AM and PL bundle insertion site are measured as references to decide tunnel diameters. The surgery is individualized for each patient.

- There is a large area on the medial wall of lateral femoral condyle for potential non-anatomic tunnel placement. Our preliminary data suggested that it may occupy more than 65% of the area on the wall.

- A “lateral bifurcate ridge” is often seen on the femoral insertion between the AM and PL bundles, where as a “lateral intercondylar ridge” is often seen on the upper limit of both the AM and PL bundles. These are useful surgical landmarks in addition to the native insertion fibers.\(^{15,16}\)
- Notchplasty destroys the femoral anatomy of the ACL insertion site and is not necessary if CP and MP are used.
- The tibial and femoral tunnels are placed at their native insertion site, which are marked with a thermal device.
- The PL femoral tunnel is always drilled through the anteromedial portal. A potential advantage of drilling the femoral AM tunnel transtibially is the creation of a longer tunnel which diverges from the PL femoral tunnel, and we routinely attempt this approach first before using the MP. However, oftentimes it cannot reach the anatomic insertion site. In that case, the tunnel will be drill through the anteromedial portal.
- Finally, the grafts are passed. First the PL graft is passed, followed by the AM graft. Femoral fixation is typically performed with an EndoButton.
- Post-operatively, MRI can be used to compare the pre- and post-op insertion site size to measure how much of the insertion site is restored. In addition, the pre- and post-operative inclination angle can be compared. Post-anatomic ACL reconstruction, the ACL inclination angle should be similar to the native ACL inclination angle.
3D CT scan can be used to evaluate tunnel position.

V. Anatomic Single Bundle ACL Reconstruction

- Except for one bundle augmentation (performed when only one of the two native bundles are torn), there are a few other scenarios where we prefer to perform single bundle surgery (30%):¹⁷
  - Small native ACL insertion site (< 14mm)
  - Open growth plates
  - Severe arthritic changes
  - Multiple knee ligament injuries
  - Severe bone bruises
  - Narrow intercondylar notch

- Our single bundle surgery is performed with careful attention to soft tissue and bony landmarks. We carefully investigate the rupture pattern of the ACL and we identify the native ACL insertion sites -just as we do for double bundle ACL surgery. Then, the tibial tunnel is placed at between the native insertion sites of the AM bundle and PL bundles, or at the center of the entire tibial insertion site.
The distance from anterior margin of ACL footprint to center of tibial tunnel should be measured, and the femoral tunnel should be placed at the same distance from the posterior margin (knee in 90° flexion) of the femoral ACL footprint.

VI. One Bundle Augmentation
- In cases only the AM or the PL bundle was torn, we save the intact bundle and “augment” this bundle with a single bundle graft.

VII. Revision ACL Reconstruction
- The same double bundle concept and its principles for primary anatomic ACL reconstruction can be applied to revision ACL surgery.
- Pre-operative imaging can inform the surgeon about placement of the previous tunnels. Below is an example of a bilateral MRI. This shows that the inclination angle of the primary ACL reconstruction is higher than that of the contralateral native ACL, suggesting non-anatomic tunnel placement. This can then be confirmed by the 3D CT scan.
- If the old tunnels are anatomic, they can be reused. If the old tunnels are non-anatomic, new tunnels need to be created. If there is enough room, new tunnels can be created in one stage. Alternatively, the graft can be placed “over the top” on the femoral side, or a two-staged procedure, with bone-grafting, can be considered.

- After the revision surgery, the native inclination angle should be restored.
VIII. Biological Enhancement

- Typically the graft heals to the bone through bleeding created by drilling the tunnels.
- We have begun using a “fibrin clot” to try to enhance the healing of the two bundles together and to the bone.
- A fibrin clot is created from the patient’s own blood by gently stirring it in a glass beaker for 5–10 minutes and contains many of the same growth factors advertised as being present in commercially available blood preparation products, such as platelet rich plasma (PRP).

IX. Clinical Outcome of Anatomic ACL Reconstruction

- Clinical improvements have been demonstrated in recent prospective and randomized level I and level II studies. These studies have shown superior outcomes for double bundle reconstruction than single bundle reconstruction.18-20
- While the first results are encouraging, additional work is needed to critically evaluate the outcomes of anatomic ACL reconstruction in terms of joint kinematics, degenerative joint changes, and patient-reported outcomes. Better methods for rotational laxity measurement, medium- and long-term outcomes are needed in the future.
- In an excellent meta-analysis by Lubowitz et al. the results of pivot shift consistent with the convention of IKDC were summarized. The normal and nearly abnormal data were pooled together for pivot shift and therefore, SB and DB achieved 94.6% and 97.5% of good pivot shift results respectively with no difference between the two groups. This is how we reported clinical outcome for many years. However, if we want to review the data more critically by only comparing the “normal” category, DB provided significantly better results (83.1% DB vs. 67.9% SB).21-22
- To fully assess the outcome of ACL reconstruction, we need to improve our outcome measures. New outcome measures should be accurate, precise and reliable. Some examples are: in-vivo kinematics with dynamic stereo x-ray, high resolution/ 3D MRI and 3D CT scan.
- Only when we have good outcome measurements, can we improve our surgical technique and protect the long-term knee health of our patients.

X. Conclusion

- The goals of anatomic ACL reconstruction are to restore 60-80% of the native ACL anatomy, and to maintain a long term knee health.
The double bundle anatomy, insertion sites, and tension pattern need to be reproduced to restore native ACL anatomy and knee kinematics

Anatomic Double-Bundle ACL Reconstruction is a concept that can and should be applied to single bundle, one-bundle augmentation and revision ACL surgeries

We need better, more objective outcomes measures, including biology, kinematics and imaging.

References:


Immediate Post-Operative Rehabilitation After ACL Reconstruction

James Irrgang, PT, PhD, ATC, FAPTA USA
Current Concepts in Rehabilitation
Following ACL Reconstruction:
The Later Phases

Kevin E. Wilk, PT, DPT
Associate Clinical Director
Champion Sports Medicine
Birmingham, Alabama

I. Introduction

A. Rehabilitation Following ACL Surgery
   1. Plays a vital role in functional outcome
   2. Patients during rehabilitation have an improved outcome

   Howe et al: AJSM ‘91

   3. Rehabilitation process has changed dramatically since 90’s

B. Current Rehabilitation Approach
   1. Immediate motion
   2. Full passive knee extension
   3. Immediate weight-bearing
   4. Closed kinetic chain exercise
   5. Early return to functional activities
   6. Earlier return to sports

   More Aggressive Rehabilitation Approach
   Dramatic Change in Rehabilitation Approach & Philosophy

C. Rehabilitation Program multiple phases based on tissue healing
   1. Patient must progress through these phases of recovery
   2. Main purpose of phases:
      a. Return knee to “normal state”
      b. Return normal motion, strength, proprioception & Function
Successful Outcome Today and 10 Years Later!!

Restore Knee Homeostasis

Dye et al: CORR ’96
Dye et al: AJSM ’93

High Incidence of Osteoarthritis Following ACL Injury

II. Specific Rehabilitation Phases & Goals:

A. ACL Rehabilitation Program – 6 Phase Program

1. Phase I: Pre-Operative Phase (from injury to surgery)
   a. Goals:
      1. “normalize the knee”
      2. reduce swelling & inflammation
      3. improve motion
      4. voluntary quadriceps contraction
      5. control activity level

2. Phase II: Immediate Post-Operative (post-op day 1 till day 7)
   a. Goals:
      1. restore “full” passive knee extension
      2. diminish swelling & pain
      3. restore patellar mobility
      4. gradual restore knee flexion
      5. restore quadriceps control
      6. reestablish independent ambulation

3. Phase III: Acute Phase (week 2 till week 4)
   a. Goals:
      1. full passive knee extension
      2. gradual improvement knee flexion
      3. restore proprioception & neuromuscular control
      4. independent ambulation
      5. control swelling & activity level

4. Phase IV: Intermediate Phase (week 4 till week 10)
   a. Goals:
      1. gradually restore “full” knee flexion
      2. improve lower extremity strength
      3. enhance proprioception & neuromuscular control
      4. enhance endurance
      5. restore limb confidence
5. Phase V: Advanced Phase (week 10 till week 16)  
a. Goals:  
   1. normalize limb function  
   2. normalize lower extremity strength  
   3. enhance neuromuscular control  
   4. gradually restore function

6. Phase VI: Return to Functional Activities Phase (month 4 - return)  
a. Goals:  
   1. gradual return to sport specific activities  
   2. gradual return to unrestricted activities  
   3. continuation of lower extremity programs

Wilk et al: Ortho Clin North Am ‘03  
Wilk et al: J Athl Trn ‘99  
Wilk et al: JOSPT ‘93

III. The ACL Reconstruction Rehabilitation Program

The Later Phases – TCC Course

A. Intermediate Phase (Weeks 4-10)

1. Concepts:  
a. “stabilization the knee from above & below”  
i. Hip & core stabilization  
ii. Foot & ankle stability  
   Powers et al: JOSPT ‘03  
b. “muscles are shock absorbers”  
i. Quadriceps  
ii. Hip & Hamstrings  
c. “gradually increase stress on knee”  
i. Soft tissue hypertrophy  
ii. Graft strength  
d. “restore neuromuscular control”  
i. Perturbation drills  
ii. Neuromuscular control drills  
iii. Gradually increase difficulty  
e. “emphasis functional activities”  
i. Rehabilitation = Function  
ii. Gradual restoration

2. Specific Exercise Drills:
B. Advanced Activity Phase (Weeks 10-16)

1. Concepts:
   a. “normalize limb function”
      i. Control functional activities
   b. “normalize lower strength”
      i. Quadriceps hypertrophy- exercises
   c. “restore neuromuscular control”
   d. “gradual restore functional activities”

2. Specific Exercises & Drills:

   **Functional Progression**
   - Pool drills → Dry land drills
   - Plyos → Running
   - Lateral drills → Backward drills
   - Backward → Forward running
   - Running → Cutting drills

C. Return to Activity Phase (Weeks 16-26)

1. Based on fulfillment of criteria (testing)
   a. KT results
   b. Isokinetic results
   c. Proprioception test
   d. Hop test

2. Objective testing of ACL patient
   a. Subjective knee form *(Noyes)*
   b. Knee arthrometer testing (KT-2000)
   c. Isokinetic testing (Biodex)
   d. Functional hop testing
      *Barber: Clin Orthop ’90*
      *Noyes: AJSM ’91*
   e. Specific Testing sequence
      *Irrgang: CSM 2013*
   f. Correlation between isokinetic and function
      1. Correlation between quad strength and functional abilities
Wilk, Soscia, Romaniello: JOSPT '94

1) Neoprene sleeve and brace

Noyes & Barber: Arthroscopy '97

IV. Key Points:

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1. Rehabilitation plays a key & vital role to outcome
2. Rehabilitation program continues to change/progress

“Push the envelope, how fast can we go”
“Faster is Not Better” Wilk: JOSPT '05

Biology of Rehab

Speed limits in Rehab

3. Key Points for Me:
   a. all about milestones & goals
   b. gradually increase stresses & challenges
   c. progressive & sequential
   d. enhance neuromuscular control

4. Today’s trend is more aggressive rehabilitation
   a. Accelerated rehabilitation
   b. Is it appropriate for all patients?

4. Current trends
   a. Closed kinetic chain exercise
   b. Proprioception and neuromuscular control
   c. Plyometrics
   d. Specific concerns for the female athlete

Successful Outcome Today (at 6 months)
Asymptomatic Knee 5-10 Years Later!
KEW: 4/13
Enclosure: ACL Protocol
Return to sports after ACL reconstruction: A surgeon’s perspective

Julian A Feller
Melbourne, Australia

Most people undergoing ACL reconstruction want to return to some level of sporting activity. ACLR is generally reported to be successful, but a more critical analysis of return to pre-injury sport rates is less encouraging.

Precise terminology is important. A fundamental question is what constitutes a return to sport?

- Pre-injury sport may well be different to pre-operative sport or sports activity level, particularly in the setting of chronic ACL insufficiency.
- If patient returns to the sport in which they previously participated, is it to training or competition. If competition, is at the same level of competition as prior to injury.
- Even if returning to the same level of competition, does the patient play with the same competency?
- Sports activity levels may appear to provide an objective measurement of sporting participating levels, but there may still be a discrepancy between the sports activity level and participation in pre-injury sport.

Patient aspirations may change following surgery.

- Age an important factor. Older patients may not be as likely to return to their pre-injury sport as younger patient.
- Multiple reasons: work and family commitments, motivation and ability – perceived or real - to recover from surgery.
- Elite sportspeople, although facing potentially greater challenges in resuming their sport at the same level, may have a greater motivation and greater support to achieve a successful return to sport.

What is the current reported rate of return to sport following ACL reconstruction?

- Overall, typical rates are 80-90% return to some kind of sport, 60-65% return to pre-injury sport, but only 40-50% return to competitive sport. Rates do vary.
- Impairment and activity-based outcomes indicate 85-90% are normal/near normal.
- High drop off after 2-3 years.
- 12 months may be too early to assess rates of return to sport.

Relatively little is documented about when patients actually resume sport.

- Mean values may be as short as 4 months, but wide range of values is usually reported, e.g. 2 to 24 months.
- Patient groups are heterogenous in terms of type and level of sport.
- Worth noting that clearance to return to sport at a certain time point does not necessarily mean that patients actually returned to sport at that time.
Many factors that influence an individual’s ability, desire and decision whether or not to return to sport and at what level.

- Higher pre-injury activity level strong predictor of return to sport at two years.
- Role of gender unclear.
- Psychological factors important:
  - Fear of re-injury
  - ACL-RSI score predictive
- Graft type does not appear to be important
- Little information about the impact of other surgical variables on return to sport.

Lack of correlation between rates of return to pre-injury sport and measurements of strength and knee laxity, or activity outcome measures.

- What should we be measuring following ACL reconstruction?
- Do current assessment tools address the appropriate issues?
- Are they limited by a ceiling effect.

Relatively little information about effect of rehabilitation protocols on outcome, in terms of return to sport.

- Shelbourne and Nitz, and Beynnon et al papers refer to patellar tendon autograft.
- Effect of an accelerated rehabilitation protocol on hamstring grafts has not been evaluated in a controlled fashion.

Return to sport criteria.

- Is the athlete is capable of resuming sport?
- Is it safe for the athlete to resume sport?
- Need data to establish whether the ability to resume sport, either effectively or safely, reflects having met the various criteria.

- Minimum requirements:
  - No effusion
  - Essentially full ROM
  - Stable knee
  - Good strength (single leg press body weight – 3 sets of 5)
  - Normal running and landing
  - 4 weeks unrestricted training (full contact)

Returning to sport puts the individual at rate of both ACL graft rupture and rupture of the contralateral ACL.

- Risk of graft rupture: 6% at 5 years
- Rate of contralateral ACL rupture is 12% at 5 years.

Risk factors for further injury (graft and contralateral ACL) – conflicting evidence:

- Young age (possibly a surrogate for other factors)
- Return to pivoting sports
- Allografts in young and active people
Early return to sport:

- For patellar tendon grafts, not been shown to be a risk factor for further injury.
- Effect on hamstring grafts unknown.
- Animal models suggest distinct phases of graft maturation with revascularization being a potential period of risk for further injury. But mismatch with experience in humans.

Returning to sport following ACL reconstruction puts knee at risk of sustaining damage to the menisci or articular surfaces, or of aggravating damage sustained at the time of ACL rupture.

- May increase risk of OA
- Should the athlete consider not returning to sport in an attempt to protect their knee from further injury long-term degeneration? If so, why reconstruct the ACL in the first place?
- Little evidence to show a protective effect of ACL reconstruction in terms of osteoarthritis.

**Useful References**


Functional Training and Return to Activity

J. Nyland
Division of Sports Medicine
Department of Orthopaedic Surgery
University of Louisville

Beware the Literature

• What does return to activity really mean?
• ADLs
• Recreational Activities
• Sports Specific-Training
• Sports Practice
• Sports Competition
• Of what volume (frequency, intensity, duration)?

Beware the One-Legged Athlete

Therapeutic Exercise + Education

• Create an Active Learning Environment
• Use Social Cognitive or Learning Theory Concepts

Garbage in = Garbage out

• Avoid generic, regimented, irrelevant, non-valid therapeutic exercise activities
• Ultimately a not so simple equation!

Correct other Deficiencies

• Co-morbidities
• Long-standing impairments
• Past Injury History
Re-establish Normal Joint Kinematics

- 1st, 2nd, and 3rd Priority
- Throughout the lower extremity kinetic chain and core
- Essential before focusing on strength, endurance, power

Where the Head Goes the Body Follows

- Neuromuscularly
- Cognitively
- Psychobehaviorally

Protocols become Less Clear after Acute Care!

Biology, Biomechanics, Behaviors

- More than time post-surgery and post-rehabilitation
- Graft Type
- Rehabilitation Type

Open Chains, Closed Chains, No Chains!

Therapeutic Strategies for Developing Neuromuscular Control in the Kinetic Chain
Seasons of the Athletic Lifespan

- Confluence of chronological, physiological, and quality of life considerations

Yesterday I was an Athlete.
Today I am a Patient.
What will I be tomorrow?

When does a Patient Return to being an Athlete?

Patients can Become Better Athletes Perhaps, but they are Not the Same!

The Neuro-Musculoskeletal System as a Computer

Shiftimg Movement Education Paradigm to Better Facilitate Neuromuscular Control
Sport Specific Training From A Chaos Theory Perspective

What will the Athlete be Returning to?
- Activity (multiple sports, endless seasons?)
- Role
- Level
- Position
- Style of Play
- Intensity
- Preparation considerations

Criteria YES, but which one?
- Why flip a coin?

Field Testing a Basketball Player

Summary

Thanks
- Correspondence
- John Nyland DPT, SCS, EdD, ATC, CSCS, FACSM
- john.nyland@louisville.edu
Session III

Knee - Sports Medicine
Procedure Modified Rehabilitation
James Irrgang, PT, PhD, ATC, FAPTA USA
INTRODUCTION

- High tibial osteotomy (HTO) is a surgical option for patients with frontal plane malalignment and tibiofemoral OA primarily affecting one compartment. It is most commonly performed in relatively young (e.g. 40’s & 50’s) active patients. Overall goals are to improve pain and function, and delay disease progression.

- The purposes of this presentation are to review the biomechanical rationale and general rehabilitation strategies for HTO.

BIOMECHANICAL RATIONALE

- Medial opening wedge HTO aims to decrease excessive loads on the medial compartment by correcting varus alignment. Surgical biomechanical considerations include the amount of correction desired, and the potential effects on the tibial slope and the patellofemoral joint (1-3).

- Knee OA more commonly involves the medial compartment, largely because of biomechanical factors related to how the knee is loaded during walking. During the stance phase of gait, the line of action of the ground reaction force typically remains medial to the weight-bearing knee, thereby producing a lever arm in the frontal plane, an external adduction moment about the tibiofemoral joint and greater loads on its medial relative to lateral compartment (4,5).

- Varus alignment (6,7) and a high knee adduction moment (8,9) are strong risk factors for disease progression. As medial OA progresses, so do varus alignment, the knee adduction moment, and medial compartment loading. An important goal of HTO is to break that viscous cycle.

- HTO causes large reductions in the knee adduction moment (approximately 50%) and therefore a lateral shift in the distribution of loads across the tibiofemoral joint (10-12). Large decreases in the knee adduction moment imply substantial decreases in medial compartment load. Other factors affecting internal loading, such as the contribution of muscular co-contraction, soft tissues and geometry of the femoral condyles, must also be considered (13,14).

REHABILITATION

- Early rehabilitation after HTO focuses on attaining full range of motion and limiting muscle atrophy. Weight-bearing activities depend largely on bone healing where the osteotomy cut is performed.

- Later rehabilitation focuses on deficits typical of patients with knee OA that are present before HTO and may worsen after surgery. Muscular strengthening and neuromuscular training programs generally suggested for knee OA are often indicated. Any persisting decreases in range of motion are addressed. Weight-loss is advised where appropriate.
Increased muscle co-contraction during gait may lessen after HTO (15,16) and may depend on the accuracy of correction (17).

Quadriceps activation and strength deficits typically remain and may worsen after surgery (15,18).

HTO does not appear to affect postural control when tested using tests of standing balance (19).

Decreased sagittal plane kinematics during walking can be present after HTO (15).

Many patients gain rather than decrease weight after surgery (20). Even small changes in weight can have substantial changes in knee joint loading (21,22).

Pre-operative strength gains are achievable, but largely diminish after surgery (23,24). Pre-operative strengthening can result in greater postoperative patient-reported sport and recreation outcomes (24).

Clinically important increases in patient-reported outcomes, including sports and recreation, exist two (11) and five years after medial opening wedge HTO.

Most patients can return to sports and recreational activities similar to their preoperative level (25).

Systematic reviews and national registry data suggest approximately 70-80% of patients receiving HTO retain their native knee joint 10 years after surgery (26-28).

References


High Tibial Osteotomy in the Athlete's Knee

J. Robert Giffin, MD, FRCSC CANADA
Multiple Ligament Injury
Christopher Harner, MD USA
Combined Anatomic PCL and PLC Reconstruction

ISAKOS Sports Rehabilitation Course: Global Perspectives for the Physical Therapist and Athletic Trainer
Toronto, Canada
May 12, 2013

Robert F. LaPrade, M.D., Ph.D.
Chief Medical Officer
Steadman Philippon Research Institute
Deputy Director, Sports Medicine Fellowship
Complex Knee and Sports Medicine Surgeon
The Steadman Clinic Vail, CO
Adjunct Professor, University of Minnesota

Incidence of PLC Injuries with PCL Tears

- Fanelli et al. Arthroscopy 1995
  - 222 pts with hemarthrosis, 27% with injury PLC
  - Of 85 PCL injuries, 53 had (62%) PLC injury
- Most patients with grade 3 posterior drawer (≥12 mm on stress x-rays)

Disclosures

I, Robert F. LaPrade, have relevant financial relationships to be discussed, directly or indirectly, referred to or illustrated with or without recognition within the presentation as follows:

- Editorial Boards for AJSM & KSSTA
- Consultant: Arthrex
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- Össur Americas
- Small Bone Innovations, Inc.
- Opedix
- Evidence Based Apparel

Combined > Isolated PLC Injuries

- Two Studies - 173 total patients
  (LaPrade, 1996; Geeslin, 2010)
- Isolated 28%
- Combined 72%

* Lachman or posterior drawer 3+ - Think posterolateral

Clinically Relevant Biomechanics of the Posterolateral Knee and PCL

- PCL - main restraint: 8 mm PT (grade 2)
- Combined PCL/PLT: >12 mm PT (grade 3)

Posterior Translation

- PCL - main restraint: 8 mm PT (grade 2)
- Combined PCL/PLT: >12 mm PT (grade 3)
Dial test at 30° and 90°

- External rotation of tibial tubercle (10° - 15° increase): (Grood, 1988; Fanelli, 1998)
- If increases at 90° > 5°, PCL (Grood, 1988) and / or ACL also injured (Wroble, 1993)
- PCL injuries alone don’t have ↑ ER

Effect of PLC Injuries on a PCL Reconstruction Graft

- PCL grafts loaded with Varus
- PCL grafts also loaded with PD & ER

Effect of PLC Injuries on a PCL Reconstruction Graft

- Repair / reconstruct posterolateral structures at time of PCLR to decrease chance of post-reconstruction PCL graft failure
- Assess for PLC knee injury prior to PCL graft fixation

Combined PLC/PLC Treatment Overview

- Acute - timing, concurrent injuries, peroneal nerve
- Chronic - alignment, concurrent injuries

Treatment of Acute Combined PLC/PCL Knee Injuries

Preoperative Planning

- Identify injury pattern (exam, MRI)
- Try to operate within first 2-3 weeks
- ID peroneal nerve injuries
- Address all torn structures
- Approach PLC first
Systematically ID PLC Injury Locations
1. Fibular based
2. Tibial based
3. Femoral based
4. Lateral meniscal attachments

(Geeslin, JBJS 2011)

PLC Lateral Hockey Stick Incision
- Gerdy’s Tubercle
- Along posterior border of ITB
- Develop posteriorly based flap

Peroneal Neurolysis
- Along posterior border of long head of biceps
- Gain Access to PFL / posterior knee
- Use caution for biceps avulsions

Identify Fibular and Tibial Attachment Injuries
- Proximal release of avulsed biceps
- Identify common peroneal nerve
- Identify FCL, PFL and meniscotibial lateral capsule

Expose FCL-Biceps Bursa
- FCL attachment on Fibula
- PEARL: Traction suture to find proximal FCL injury

Identify Femoral Attachment Sites
- Split superficial layer of iliotibial band
- Identify FCL and popliteus attachments
- Separate out underlying lateral capsule
**Lateral Arthrotomy Incision**
- 1 cm anterior to FCL
- Access to popliteus attachment, popliteomeniscal fascicles, LM

**Arthroscopic Evaluation** (LaPrade, AJSM, 1997)
- Perform after exposure to avoid fluid extravasation
- “Drive-through sign” > 1 cm of lateral joint line opening
- Assists with surgical incision placement
- Femoral or tibial based lesions

**Arthroscopic Evaluation**
- Popliteus avulsion
- Mid-third lateral capsular ligament
  - meniscofemoral
  - meniscotibial
- Popliteomeniscal fascicles
- Coronary ligament

**Double Bundle PCL Reconstruction Steps**
- Identify/mark femoral attachments

**Double Bundle PCL Reconstruction**
- Establish posteromedial portal

**Double Bundle PCL Reconstruction**
- Identify tibial attachment/ drill pin/ fluoroscopy
Double Bundle PCL Reconstruction Steps

- Ream femoral tunnels (endoscopic closed sockets)

Double Bundle PCL Reconstruction Steps

- Ream tibial tunnel last
- Verify guide pin placement
- Protect posterior structures with curette

Double Bundle PCL Reconstruction Steps

- Endoscopically pass grafts into femur
- Secure grafts in femur
- Pass grafts down tibia
- Hold tibial fixation

Double Bundle PCL Reconstruction Steps

- Endoscopically pass grafts into femur
- Secure grafts in femur
- Pass grafts down tibia
- Hold tibial fixation

Systematic PLC Repair / Reconstruction Method

1. Femoral attachments
2. Meniscal attachments
3. Tibial attachments
4. Fibular attachments

*Same stepwise Rx almost every case

Avulsions Off Femur

- Popliteus avulsion - recess procedure
  (Jakob, 1982; LaPrade, 1997; Geeslin, JBJS, 2011)
  - Transfemoral eyelet pin
  - Ream 1 cm tunnel
  - Pull sutures across femur, tie over medial button

*Secure in full extension

Meniscal - Based Tears

- Coronary ligament of posterior horn of meniscus - direct repair
- Popliteomensical fascicle tears - direct repair if lateral meniscus unstable
Repair Lateral Capsule
- Anchors at joint line
- Suture into undersurface LM
- Separate capsule from ITB

Avulsion Off Fibular Head / Styloid
- Popliteofibular ligament - suture anchors
- Biceps femoris - suture anchors
- FCL - suture anchors
- Allow for secure repair / early ROM

Midsubstance Tears of FCL or Popliteus Tendon
- Consider augmentation (biceps femoris, ITB, hamstrings)
- Anatomic reconstructions of FCL, popliteus tendon or entire PLC

FCL Reconstructions
(Coobs, 2007; LaPrade, 2010)
- Anatomic FCLR
- Midsubstance tears, unable to reduce in extension
- Semitendinosus autograft harvested

Popliteus Tendon Reconstructions
(LaPrade, 2010)
- Nonrepairable PLT tear
- Restores ER
- Often concurrent with PCLR
- Consider with PCL stress XR > 12 mm and collaterals intact

PLC Graft Fixation
- FCL at 20°
- PLT at 60°
PCL Reconstruction Fixation - Tibia

- Fix tibial graft ends once PLC repair/reconstruction grafts secured on femur
- AL bundle at 90°
- PM bundle in extension

Determine “Safe Zone” of Knee Motion

- Full extension a must
- Amount of safe flexion assessed (>90°)

Postop Rehab of Acute PLC/PCL

- NWB 6 weeks
- ROM
  - Start POD #1
  - Stress full extension
  - Prone flexion 0 - 90° for 2 wks, then ↑ ROM
  - No isolated hamstrings for 4 months
  - Avoid posterior sag!
  - PCL brace x 6 months

Treatment of Chronic Grade III PLC/PCL Injuries

- Assess for varus alignment first
  - Long leg standing x-ray is necessary
  - Correct for varus alignment or soft tissue reconstruction will stretch out
- Sagittal Plane
  - Posterior tilt in PCLD knee

Healed Proximal Tibial Osteotomy

- Reassess at 6 months postop osteotomy for need for soft tissue reconstruction
- If still unstable, consider 2nd stage PLC reconstruction
Indications for Chronic and Combined PLC/PCL Reconstruction

- Normal or corrected (varus) alignment
- Chronic PLC/PCL

Case Based Video - Chronic PLC Injury

Anatomic Posterolateral Knee Reconstruction Technique

- Reconstructs FCL, PLT, PFL
- Biomechanically validated
- Prospective study (>200 pts)
- 30 minute procedure

Surgical Steps - Abbreviated Overview

1. Posteriorly based flap
2. Peroneal neurolysis
3. Prepare tunnels at attachment sites
4. Address intraarticular pathology
5. Prepare grafts
6. Pass / fix grafts

*No tourniquet needed

Anatomic PLC Reconstruction Overview

- 2 grafts
- FCL, PLT, PFL reconstructed

Chronic PLCR/PCLR Post-op Rehab

- NWB 6 wks; start ROM POD #1
- Prone knee flexion 0-90° x 2 weeks then ↑ as tolerated
- Exercise bike - POW #7
- Avoidance of isolated hamstrings x 4 months
- PCL brace x 6 months
Posterolateral Outcomes Studies

(LaPrade, AJSM 2007; LaPrade, JBJS 2010; LaPrade, AJSM 2010; Geeslin JBJS 2011)

Outcomes of Acute Hybrid-Anatomic Repairs/Reconstructions

- Early identification and treatment important!
- Geeslin, LaPrade (JBJS, 2011)
  - 30 Knees, 2.4 yr F/U
  - IKDC Preop = 29.1,
    Postop = 81.5
  - Varus Stress Preop = 6.2 mm,
    Postop = 0.1 mm
  - 8 isolated, 22 combined
- Midsubstance repairs do not do well
  (37-40% failure) (Stannard 2005, Levy 2010)

PTO for Chronic PLC Injury

- 21 pts, 3.8 year avg. f/u
- 38% did not need PLCR
- Most isolated PLC injuries did not need PLCR
- Low velocity < high velocity

Outcomes of Anatomic Posterolateral Knee Reconstructions

- 64 pts., 4.3 year f/u
- Final Cincinnati scores 65.7
- Varus preop (IKDC): 1-B, 4-C, 49-D
- Varus postop: 45-A, 5-B, 4-D

Outcomes of Anatomic FCLR

- Prospective - 20 Patients
- Preop varus stress x-rays 3.9 mm
- Postop varus stress x-rays -0.4 mm
- IKDC improved from 34.7 to 88.1

Outcomes of DB-PCLR

- 39 Pts, 2.5 yr avg. f/u (8 lost)
- 7 isolated PCLR, 32 combined reconstructions
- Cincinnati and IKDC subjective scores improved from 34.5 & 39.3 → 73.2 & 74.3
- On post stress x-rays, post tib translation ↓ 15 mm → 0.9 mm
Conclusions – Combined PCL-PLC Reconstructions

- Most PCLR = combined
- Utilize stress x-rays
- Combined acute/chronic PCL-PLC reconstructions provide excellent objective/subjective pt outcomes
- Anatomically placed PLC/PCL grafts do not stretch out with early ROM
Session IV

Knee - Sports Medicine
Meniscus Repair and ACL Reconstruction in Athletes
Moises Cohen, MD, PhD BRAZIL
Rehabilitation for Meniscus Injuries
James Irrgang, PT, PhD, ATC, FAPTA USA
Non-Operative Management of Patellofemoral Pain

Surgical Management of Patellofemoral Pain & Instability

David DEJOUR
LYON ORTHOCLINIC
FRANCE

What makes you having that!

Unlucky schedule
Traumatic
Genetics
Fortune teller...

The question Is:
Who is your patient?

- Average annual incidence of primary patellar dislocations is 5.8 per 100,000
- Incidence increases to 29 per 100,000 in the 10-17 year age group
- Recurrence rates of 15-44% after non-op treatment

Fithian et al AJSM 2004
Hawkins et al AJSM 1986

General agreement
Abnormalities in the “pulley system”

- Alignment ?
- Global system
  - Extensor mechanism
  - Tilting observation
  - Torsional data

Malalignment
Clinical testing : Subjective

- Question ?
- Angle evaluation
- Torsion
- Dynamic evaluation
- Tilting
- Mobility
- No statistical threshold correlated to PF dislocation...

Malalignment
Radiological testing : Objective

- Axial 30°
- CT Scan
- MRI
**CT Scan Information - Advantage**

**CT Scan Evaluation - Lyon’s Protocol**

- Supine position
- On a wood board
- Knee extended
- Feet closed together
- Symmetrical position
- Fixed with strap

1. Femoral torsion
2. Knee rotation
3. TT-TG
4. Patellar tilt
5. Trochlear slope
6. Tibial rotation

**56% > 20 mm Dislocation population**
**Abnormal if > 20°**
83% in the dislocation population

**Tibial Tubercle Transfer**

**Is Indicated IF…**

- True Patellar Instability
- Patella Alta or/and
- Excessive TT-TG
- “malalignment”

**Tibial Tubercle Transfer Technical Tricks**

- Patellar tendon exposure
- Pre drilling 3.2
- Osteotomy saw
- Quantify the correction
- Fixing with 4.5 AO screw perpendicular

**Indication for TT Transfer**

- **Distalisation**
  - If Patella Alta > 1.2
- **Medialisation**
  - If excessive TT-TG > 20 mm

**Technical Note**

- Tibial Tubercle Transfer Distalisation Medialisation
  - 5 to 6 cm Osteotomy
  - • 2 Bicortical Screw
  - • Distal Hinge
  - • Perpendicular
  - • 1 Bicortical Screw
Medialisation

- 5 to 6 cm Osteotomy
- Distal Hinge +++
- 1 Bicortical Screw

Technical Note

Amount of Medialisation

10 < TT-TG< 15 mm

23.2 mm
Medialisation = 10 mm
New TT-TG 13.2 mm

Post operative care

- Full weight bearing with crutches
- Extension brace for walking 30 days
- Isometric Muscle strengthening
- Passive motion 0° / 100° 30 days

Medialisation & Trochlear shape

Flatter trochlea is, higher could be the transfer

Clinical results

- 88 % Satisfied , VS
- TT-TG < 10 mm 30% Poor

Correlation

Hypercorrection

Flatter trochlea is, higher could be the transfer
**Patella Index…**

<table>
<thead>
<tr>
<th>Blackburne &amp; Peel</th>
<th>Insall &amp; Salvati</th>
<th>Insall &amp; Salvati</th>
<th>Caton Deschamps</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Normal = 1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Alta ≥ 1.2</td>
</tr>
</tbody>
</table>

**TKA Analysis**
Patellar shape: +/ - ++

**Patella Alta gives specific Cartilage damage**
- Pain
- Instability

**TKA Analysis Patellar shape +/- ++**

**Distalisation if index > 1.2**

- Patella Alta gives specific Cartilage damage
- Pain and +/- Instability

**Distalisation could relocate the patella where the groove is deeper**

- But also if
  - Index borderline
  - No patella on the CT scan
  - No trochlear groove

**Distalisation leads to automatic medialisation = 4 mm**

- Patellar tendon length correction
  - Patellar tendon tenodesis (Ph Neyret 2002)

- Decreased TT-TG Medialised the patella
Conclusion

The best indication for Tibial Transfer is the Patella Alta

Mostly combined to a MPFL Procedure to correct the tilt

General agreement

Abnormalities in the “pulley system”

- Patellar shape
- Cartilage shape and status
- Soft tissue restraints

Soft tissues

Medial Lateral

Biomechanical studies from A. Amis…

Important Principles

- Position the graft anatomically. Placing the femoral tunnel too far proximal results in excessive PF forces.
- Tension the graft with the knee in flexion. Over-tightening the graft causes excessive PF forces. Too loose is better than too tight
- Drill patellar tunnels cautiously. Violation of the anterior cortex increases the risk of fracture.
- Autologous hamstring grafts are frequently used because they are strong and long enough, readily available and easily harvested.
- An MPFL reconstruction is sturdy enough to allow “aggressive rehabilitation” with early weightbearing and unrestricted motion ???

MPFL reconstruction

BONY Approach

MPFL Techniques …

Numerous techniques but the first was Brazilian!


- Soft tissue procedure
- Bony procedure
- Mix procedure
Soft tissus MPFL ...

Vincent Chassaing (Fr)
All in sub cutaneous technique
Third adductor fixation

Bony procedure MPFL ...
Anchor on patella
Blind tunnel on femur
Trans patella tunnel...

Fixation Options- Patella
Bone Anchors
Bone Tunnel Bridge

Complications...
Fracture

MPFL Plasty

MPFL Reconstruction
• Gracilis
• Tension = Full flexion
• Lateral Release if no medial displacement
The Best Indication
Low Grade Abnormalities

- No patella Alta
- TT-GT < 20 mm
- Dysplasia Type A

MPFL rupture or distension

Patello-Femoral Anatomy?
Local system

- Cartilage & Patella
- Deep Trochlea
- MPFL & Soft Tissue

Trochleoplasty
The surgical technique...

Why doing a Trochleoplasty?

Trochlear Dysplasia Type B and D

- Trochlea Bump +++ impingement with Patella

Patellar medio-lateral tracking

Biomechanical effect on patellar tracking

Only for dislocation !!!!
High grade Trochlear dysplasia

Maltracking: Horizontal plane

Impingement: Sagittal plane

Trochleoplasty

Elevation
Lateral Facet

Closing wedge trochleoplasty

Deepening and create a groove

ALBEE Procedure

Elevating trochleoplasty

- Very efficient: Stability
- Good if no proeminence, if short trochlea (Biedert)
- Increase lateral pressure
- Increase trochlear proeminence

Pain ?? Future arthritis ?? Medial Tilt !!!

Closing Wedge trochleoplasty

Goutallier 2002 (RCO)

Reduce the bump
No change of the trochlear shape

Ph Beaufils

Ph Beaufils
Deepening TROCHLEOPLASTY
H. Dejour 1987 (Masse 1978)
Create a new groove – remove the prominence +++

Deepening TROCHLEOPLASTY
H Bereiter technique
Total Trochlear Flap
Cancellous bone modelling (burr)
PDS Band in the groove
Knot in the gutter under the synovium

Deepening TROCHLEOPLASTY
Arthroscopic Technique Blond-Schottle technique
Blond L, Schöttle PB.
Knee Surg Sports Traumatol Arthrosc. 2010

Deepening TROCHLEOPLASTY
S. Donell technique
Modified Dejour trochleoplasty for severe dysplasia: operative technique and early clinical results.
Donell ST, Joseph G, Hing CB, Marshall TJ.
Knee. 2006

Deepening TROCHLEOPLASTY
Lyon’s Procedure (H. Dejour) 1987
The sulcus deepening trochleoplasty-the Lyon’s procedure. Dejour D, Saggia P.
Int Orthop. 2010
Osteotomies in patello-femoral instabilities. Dejour D, Le Coultre B.
Sports Med Arthrosc. 2007

Deepening Trochleoplasty
H. Dejour 1987
**Cartilaginous Supra-trochlear Dysplasia and Bump**

The supra trocheal spur

*++++*

→ Patellar tilt

→ Missed engagement

**Trochleoplasty effect**

*Decrease the TT-TG value*

"**Trochlear Groove Lateralisation**"

**Isolated Trochleoplasty**

Correct 2mm

**Proximal re-alignment**

**TT-TG : 19 mm**

**TT-TG : 14 mm**

**Proximal Re-Alignment**

Original Groove

Lateralization of the Groove

Reduce the TT: TG

Sulcus angle 172°

Sulcus angle 155°

**MPFL has to be repaired !!!**

*VMO plasty shouldn’t be done !!!*

As a combined procedure

**Indication for Deepening TROCHLEOPLASTY**

- Rare & high demanding
- Very efficient on the stability
- Aetiologic
- Indicate for Type B et D

**FAQ about trochleoplasty ?**

- Cartilage viability ?
  
  *No influence “Shoettle KSSTA 2007”*

- Congruence with the patella ?

- Associated instability factors ?

  *MPFL rupture or distention ++++*
Congruence with patella? Patellar Dysplasia?

Patella Osteotomy: Rare!!!

Be aware of a hypermedialisation!!!!!

Deepening Trochleoplasty

Salvage procedure +++
Difficult population
Very efficient on stability +++
Good correction of patellar tilt &

Stability = Balancing
Bony structures
Soft tissues balancing

Surgical Algorithm
"le menu à la carte" de LYON
Correct One by One anatomical abnormalities
Thank You!!!

Surgical planning
"menu à la carte" H. Dejour
Correct one by one all anatomical abnormalities

General agreement
Abnormalities in the "pulley system"

Power activation? Central system
- Muscle
- Brain
Management Patello-Femoral Pain

David DEJOUR
LYON ORTHO CLINIC
FRANCE

Primitive Patellar Painful Syndrome
Adolescent
Mostly female
Sometime initial trauma
Uni or bilateral
None sport addicted
No swelling knee

Patient analysis
GLOBAL ANALYSIS
Relationship between morphotype and the muscle organisation?

Stiffness and morphotype
External analysis rest position
Think to the back

Stiffness or muscle asymmetry
Increment fold Patello-femoral pressure in flexion

Pain !!!

Management of Patellar painful syndrome
Do not say!
• It's nothing!
• It's psychological!
• It's not surgical: Goodbye!

Treatment Patellar Painful Syndrome
But EXPLAIN!
• No future arthritis
• No surgery
• Always back to normal
• No sport limitation
• What is muscle stiffness !!!
Stretching !!!

• With Physiotherapist first
  To learn exercises
• Patient education two times / Week (15 Min)

Strengthening
Core Stabilization and Knee Injury Prevention

Timothy Hewett, PhD USA
Session V

Degenerative Knee
Overview of Articular Cartilage Surgery
Ramon Cugat, MD, PhD SPAIN
Rehabilitation After Articular Cartilage Surgery
Lynn Snyder-Mackler, PT, ScD, FAPTA USA
Non-Operative Management of Knee Osteoarthritis
May Arna Risberg, PhD NORWAY
Surgical Options for Osteoarthritis

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Robert F. LaPrade, M.D., Ph.D.
Chief Medical Officer
Steadman Philippon Research Institute
Deputy Director, Sports Medicine Fellowship
Complex Knee and Sports Medicine Surgeon
The Steadman Clinic Vail, CO
Adjunct Professor, University of Minnesota

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Background: Osteoarthritis
• OA is a complex interaction of biological, mechanical, and biochemical (Goldring, J Cell Phys 2007)
  – Aging is the primary risk factor (Loeser, Clin Geri Med 2010)
  – Greater stress to joints due to decreased dissipation of forces (Chen, JAAOS, 2005)
  – Injury and malalignment accelerate the process (Muthuri, OA Cartilage 2011, Felson, Arthritis Rheum 2006)

Treatment Modalities
• OA can be treated with numerous modalities:
  – Dietary & lifestyle modifications, physical therapy, bracing
  – Pharmacotherapies: most are systemic drugs that target pain relief, but have potential GI, renal, hepatic, and cardiac side effects (Sirisas, Am Fam Physician 2012)
  – Injections/Biologics
  – Knee Replacements

Background: Osteoarthritis
• Older athletes are prone to develop symptoms of OA, but should not avoid sports
  – Active, enjoyment of sports and exercise can improve and extend life (Hunter, Sport Med 2004)

Surgical Interventions
• The focus of this talk will be on:
  • Arthroscopic Treatments
  • Osteotomy
**Arthroscopic Treatment**

- **Knee OA involves Pain Generators**
  - Stiffness
  - Synovitis
  - Loose bodies
  - Meniscus tears
  - Closed spaces due to adhesions
  - Contractures

**Arthroscopic Treatment**

- Removal of unstable cartilage/loose bodies
- Synovectomy
- Remove adhesions to restore normal biomechanics
- Partial meniscectomies
- Remove osteophytes to improve ROM

**Arthroscopic Treatment**

- In OA, joint mobility is important
- Suprapatellar and infrapatellar adhesions effect knee kinematics
  - Subtle patella infera
  - Increased patellofemoral joint reaction force
  - Increased tibial-femoral reaction force. (Ahmad, Mow, Steadman, et al. 1998)

**Microfracture**

- If pain generators are addressed arthroscopically, then symptoms decrease 60 to 70% of the time without microfracture
- Microfracture not used in OA where surrounding cartilage is thin to none

**Osteophyte Excision**

- Lack of Extension
- Proximal Anterior Tibial Osteophytes
- Notchplasty

**Arthroscopic Rehab Principles**

- Structured Rehab: Start POD#1, Daily (1-2x/day) for 1-2 weeks
- Key to regaining full activity is obtaining full mobility
- Protected weight bearing
- Delayed/gradual strengthening to avoid stiffness and scar tissue recurrence
Arthroscopic Rehab: Early
- Ice, CPM, GameReady to decrease swelling
- Manual patellar mobility
  - Medial-Lateral
  - Superior-Inferior
- ROM/muscle activity without joint strain
  - Stationary bike without resistance
  - SLR
  - Wall slides
  - Water exercise when wound OK

Arthroscopic Rehab: At 6 Weeks
- Increase strengthening IF NO PAIN:
  - Increased intensity on bike
  - Uphill treadmill
  - Elliptical
  - Short knee bends (0 to 30°)
  - Emphasize closed chain exercises

Arthroscopy for OA Outcomes
- 69 knees with 10 year minimum f/u
- Mean age of 58 at time of treatment
- Kellgren-Lawrence grade 3 or 4 radiographic changes
- TKA recommended, none wished to undergo
- Endpoint defined at TKA for survivorship

Arthroscopy for OA Outcomes
- Repeat arthroscopy in 21%
- 62% were converted to TKA at an average of 4.4 years
- Failures were older, KL4 and kissing lesions

Role of MM Root Tears and OA
- Meniscal extrusion
- Joint overload
- Osteonecrosis, insufficiency fracture

MM Root/Radial Root Repairs
- Restore joint loads
- Restore contact area
Knee Osteotomy

- Proximal tibial osteotomy for medial compartment OA and genu varus alignment
- Distal femoral osteotomy for lateral compartment OA and genu valgus alignment

- Indications:
  - Single compartment OA
  - Active lifestyle
- Contraindications:
  - Age > ~55 or Severe OA

Preop Radiographs

- Long leg standing AP X-ray
  - Determine mechanical axis / coronal plane correction amount
- Lateral X-ray to consider sagittal plane correction
  - Anterior tilt - ACLD knee, flexion contracture, posterior OA
  - Posterior tilt - PCLD knee, recurvatum

Pre-op Planning - Varus Knee

- Goal - restore corrected mechanical axis through the apex of the lateral tibial eminence (LTE)
- Draw lines from LTE apex through center of the femoral head and center of talar dome
- Angle formed provides osteotomy correction angle

Mechanical Axis Weight Bearing Line Landmarks:

- Analysis on 274 knees with AP notch x-rays determined apex of LTE to be 56% width of proximal tibia
- Goal for correction of mechanical axis because it produces 10° anatomic axis
- (When mechanical axis is 0°, the anatomic axis is 6°)

Biplanar Slope Issues

- Consider staple of anterior cortex when ↓ slope desired and posteromedial plate position
- Hyperextend knee to close anterior cortex
- Anterior plate position to increase slope

Postop Rehab = Key to Success

- Indwelling pain catheters for 48 hrs
- Full ROM (90° minimum 2 weeks)
- NWB x 8 weeks
- Exercise bike - no resistance @ 6 weeks
- Progress WB 25% / wk
- Wean off crutches if 3 month x-rays - WNL
Unloader Bracing for Knee OA

- Increased use in past decade
- Recommended by AAOS
- Reduces pain/stiffness and improves function (Briggs J Knee Surg 2012)
- Can use as trial before osteotomy to see if it relieves symptoms

Postop Rehabilitation

- Low impact - exercise bike, walking, deep pool floatation jogging

PTO for Medial OA Outcomes

- 47 patients, mean age of 40.5 years
- Modified Cincinnati Knee Scores improved from 42.9 to 65.1 at a mean 3.6 years f/u

Distal Femoral Opening Wedge Osteotomy

- Isolated lateral compartment arthritis, genu valgus
- Genu valgus with:
  - LFC OCD ORIF (consider)
  - LM transplant
  - Lateral compartment cartilage resurfacing

DFO Post-op Rehabilitation

- Similar to PTO
- NWB x 8 weeks, FROM
- Progress WB weeks 9-12

DFO Outcomes Studies

- Jacobi, Arch Orthop Trauma Surg, 2011
  - 14 pts, 45 month follow up
  - Good outcomes once plate removed

- Koschachvili, Int Orthop, 2010
  - 31 patients, 15 year follow up
  - 50% converted to TKA
  - Viable option in younger patients
Conclusions

- Arthroscopic treatment in carefully selected patients is effective for mild to moderate OA and can delay the need for knee replacement.

- Osteotomy is effective for unicompartmental OA associated with malalignment in pts ≥ 55 yrs old.

THANK YOU

Steadman Philippon Research Institute
BioEngineering Research Department
Functional Testing Algorithm for Return to Play Following Knee Injuries

George J. Davies, DPT, MEd, PT, SCS, ATC, CSCS, PES, FAPTA
Professor, Armstrong Atlantic State University, Savannah, GA.
Coastal Therapy, Savannah, GA. & Gundersen Lutheran Sports Medicine, LaCrosse, WI.

I. Introduction
II. Importance of establishing discharge criteria: safety for patient, legal implications, etc.
III. Literature review
IV. Functional Testing Algorithm:
   - Visual Analog scale
   - Basic Measurements
     - Time/soft tissue healing
     - VAS (0-10 scale) (<3+1)
     - Physical Examination
     - Anthropometric measurements
     - KT 1000
     - AROM (<10%)
     - PROM
     - Core testing
     - Quantitative & Qualitative LE-Movement assessment
   - Outcome rating scales: IKDC, KOOS, Tegner, Etc.

   - Gait Evaluation
   - Sensorimotor System Testing: Kinesthetic/Proprioceptive Testing
     - Angular joint replication testing
     - Balance testing
   - Computerized Dynamic Closed Kinetic Chain - Isokinetic Testing
   - OKC Isokinetic Testing
     - Manual Muscle Testing
     - Hand Held Dynamometer
     - Computerized Dynamic Open Kinetic Chain - Isokinetic Testing

   **LOWER EXTREMITY FUNCTIONAL TESTING**
   - 2-Legged Jump Test
   - 1-Legged hop tests: single, triple, timed, cross-over
   - Sergeant Vertical Jump test
   - Lower Extremity Functional Test (LEFT): agility tests
   - Sport Specific Testing
   - Outcome rating scales: IKDC, KOOS, Lysholm, Tegner Activity Scale, Cincinnati Knee Rating Scale, Marx Activity Scale, Etc.

### Table 4.4 Functional (Relative/Normalized) Jump and Hop Test

<table>
<thead>
<tr>
<th></th>
<th>Males</th>
<th>Females</th>
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<tr>
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<td>(distance as % of height)</td>
<td>(distance as % of height)</td>
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<td>Jump test (R + L)</td>
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<td>80–90</td>
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<tr>
<td>Hop test (uninjured leg)</td>
<td>80–90</td>
<td>70–80</td>
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<tr>
<td>Hop test (injured leg)</td>
<td>80–90</td>
<td>70–80</td>
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</table>
Sport Specific Testing for the Lower Extremity in Athletes

- Key Points:
  - No consensus on which test(s) are best or most reliable/valid
  - No consensus on which values to use
  - Numerous really excellent test methods available
  - What's appropriate for your practice

  - Professional Athlete  -------------  Recreational Athlete
  - Football Player  ----------------  Basketball Player

  If you do test – you will not know if a deficit exists

We need objective criteria

Summary and Conclusions

References:

12. Barber-Westin, SD, Noyes, FR. Factors used to determine return to unrestricted sports activities after ACL-R. Arthroscopy. 27:1697-1705, 2011
Session VI

Hip
GROWTH FACTORS AND HEALING: HIP APPLICATION

Elizaveta Kon, Giuseppe Filardo, Berardo Di Matteo, Francesco Perdisa, Luca Andriolo, Francesco Tentoni, Alessandro Di Martino, Maurilio Marcacci

AFFILIATION

Nano-Biotechnology Lab and II Orthopaedic Clinic, Rizzoli Orthopaedic Institute, Via di Barbiano 1/10, 40136 Bologna, Italy

INTRODUCTION

Recent years have seen the flourishing of a completely new approach for the treatment of cartilage lesions. What we have seen is the transition from a traditional approach focusing on the concept of “repair” to the revolutionary idea of “regeneration” [1,2,3]. This fascinating perspective is one of the hottest topics of the current pre-clinical and clinical cartilage research: although orthopaedic practitioners have been always managing chondropathy and osteoarthritis, the most recent discoveries in the field of growth factors (GFs) have led to widespread enthusiasm about the application of innovative biological strategies for treating these conditions. A new figure is emerging: the “orthobiologist”, i.e. an orthopaedic surgeon specializing in biological and bio-engineered treatments, both conservative and surgical. In this particular field, the role played by blood derivatives, and in particular Platelet-rich Plasma (PRP), is preeminent. Platelet-derived GFs contained in PRP are the most exploited way to administer a biological stimulus to several different damaged tissues, such as cartilage, tendons and muscle that might benefit from this particular approach [4]. Being able to treat patients with a product derived directly from their own blood is an attractive proposition due to the theoretical reduced risks of intolerance and side effects than those commonly ascribed to traditional commercial drugs. Concerning the application of this biological treatment, cartilage is one of the most targeted tissues [5]. In fact, the incidence of this kind of lesions is increasing in relation to the ever-growing interest in sport which, beyond some unquestionable beneficial effects on health, is also responsible for both traumatic and degenerative lesions of musculo-skeletal tissues [6, 7]. Young people, the most sport-active population, are often affected by these lesions. The treatment of cartilage pathology in these patients is often conservative, due to the limits of the current surgical treatments for cartilage lesions and the lack of indication for invasive joint metal resurfacing [3]: the constant research for innovative solutions has been one reason for the booming interest in biological approaches.
BIOLOGICAL RATIONALE AND DEFINITION OF PRP

The biological rational behind this kind of treatment is the topical administration of several important molecules normally involved in joint homeostasis, healing mechanism and tissue regeneration. First of all platelet-derived GFs: a group of polypeptides playing important roles in the regulation of growth and development of several tissues, including cartilage. Platelets contain storage pools of GFs [4,8,9] such as: platelet-derived growth factor (PDGF); transforming growth factor (TGF-β); platelet-derived epidermal growth factor (PDEGF); vascular endothelial growth factor (VEGF); insulin-like growth factor 1 (IGF-1); fibroblastic growth factor (FGF); epidermal growth factor (EGF) etc…

Alpha granules are also a source of cytokines, chemokines and many other proteins [4] involved in stimulating chemotaxis, cell proliferation and maturation, modulating inflammatory molecules and attracting leukocytes [4]. Besides alpha granules, platelets also contain dense granules, which store ADP, ATP, calcium ions, histamine, serotonin and dopamine, that also play a complex role in tissue modulation and regeneration [10]. Finally, platelets contain lisosomal granules which can secrete acid hydrolases, cathepsin D and E, elastases and lisozyme [11], and most likely other not yet well characterized molecules, the role of which in tissue healing should not be underestimated. Several in vitro and in vivo animal studies have showed the potential beneficial effect of PRP in promoting cellular anabolism and tissue regeneration [8] and set the rational for the application of platelet concentrates in humans.

PLATELET DERIVED GROWTH FACTORS AND HIP PATHOLOGY

Some studies concerning injective application of PRP in hip osteoarthritis have been published. The first one, authored by Battaglia et al. [12] reported the results of PRP ultra-sound-guided injective treatment in 20 patients affected by hip OA (Kellgren-Lawrence Score from I to III): 3 intra-articular injections 2 weeks apart were performed and patients were followed-up for 1 year. The clinical outcome was positive but a worsening occurred after 3 months up to the final evaluation, thus confirming the time-dependent effect of PRP. The same group led a randomized trial comparing PRP and viscosupplementation in a cohort of 100 patients affected by hip OA. Results were encouraging: both PRP and viscosupplementation provided time dependant symptomatic relief, even if a clear superiority of the biological treatment was not proved.

The second one was recently published by Sanchez et al. [13], who treated 40 patients affected by OA with 3 weekly ultrasound-guided injections of PRP. Evaluation was carried out for up to 6 months using the WOMAC, Harris, and VAS scores for pain. Satisfactory results were reported with a significant reduction in pain level at the first evaluation after 6 weeks, which was confirmed even
at the final follow-up of 6 months. Functional recovery was encouraging as evaluated through a specific subscale of the WOMAC score. However, 11 out of 40 patients did not have any beneficial effect after injective treatment: in these cases, a metal resurfacing was required.

Beyond cartilage application, PRP has also been tested in the treatment of avascular hip osteonecrosis: a case series has been published by Guadilla et al [14] describing an original treatment consisting in the association of core decompression and PRP therapy. Four patients were treated and the biological augmentation provided by PRP resulted in a good clinical outcome in all the cases considered and the patients were able to get back to their common everyday activities. More recently a case report by Hibrahim and Dowling [15] described the positive result obtained after a single PRP injection in a woman refusing more invasive treatment.

Furthermore, this biological treatment, associated with bone marrow concentrate, was used to treat a 27 years old football player suffering from a gluteus minimus tendon and hip anterolateral capsular lesions [16]: a good results was achieved and resumption of sport practice was possible after a few weeks from the end of the injective treatment.

**CONCLUSION**

For what concerns the current understanding on the potential and feasibility of applying PRP in the management of cartilage pathology, it is not possible to draw definite conclusions about the efficacy of this approach, especially when applied during surgical procedure as a biological augmentation: high quality comparative studies aimed at assessing the specific role of PRP are needed. Growth factors’ administration is certainly a fascinating approach to treat cartilage pathology and at the present moment lots of researches are ongoing to establish which particular molecules could provide the best therapeutic effects and to determine the best application protocol. PRP is a widely exploited way to supply platelet-derived growth factors in the articular environment. However, the current available literature is not conclusive on the real efficacy of this approach in treating hip disorders. There are difficulties related to the great number of variables concerning PRP production, storage and administration, which make study comparison very challenging. Beyond that, the average quality of the published articles is low, with lack of randomized controlled double blind trials. Thus, no clear indication can be asserted in favour of PRP application for hip pathology with respect to other traditional approaches. What we need is more biological studies to identify the best formulation for PRP preparation and more high level clinical trials to define the best application protocol and the real therapeutic potential of this biologic treatment option.
REFERENCES


NON-OPERATIVE TREATMENT OF EXTRA-ARTICULAR HIP PAIN

Keelan R. Enseki, PT, MS, OCS, SCS, ATC, CSCS
University of Pittsburgh
Centers for Rehab Services
University of Pittsburgh Center for Sports Medicine
Pittsburgh, PA
USA

DISCLOSURES

- No personal disclosures/conflicts
- No institutional disclosures/conflicts

SCREENING FOR HIP JOINT INVOLVEMENT

- Strains
- Tendonopathy
- Bursitis
- Painful snapping hip syndrome
- Athletic Pubalgia
- etc.

COMMON EXTRA-ARTICULAR CONDITIONS OF THE HIP REGION

- Pain and/or weakness with strength testing
- Tightness and/or weakness with flexibility testing
- Potential pain with palpation of specific suspected structures
- ...and negative tests for intra-articular involvement

EXTRA-ARTICULAR CONDITIONS
COXA SULTANS: THE SNAPPING HIP
(Allen & Cope)

Three Forms:
- External: occurs when the thickened area of the posterior ITB or leading edge of the anterior gluteus maximus snaps forward over the greater trochanter with hip flexion
- Internal: occurs when the musculotendinous portion of the iliopsoas snaps over deep structures; usually the femoral head and anterior capsule
- Intra-articular: is due to lesions within the joint itself (example: labral tear)

EXTRA-ARTICULAR SNAPPING HIP
- Relative rest/activity modification
- Identify and treat
  - Flexibility issues (iliopsoas, ITB)
  - Strength asymmetries
- Central stabilization
- Soft tissue mobilization
- Re-screen for intra-articular involvement if not responsive to treatment

GLUTEAL TENDONOPATHY AND TROCHANTERIC BURSITIS
- Two tests have show high sensitivity and specificity:
  - 30 second single leg stance test
  - Resisted external de-rotation test (supine)
  - (Luquesne, Arthritis Rheum 2008)

ADDUCTOR LONGUS STRAIN
- Common in sports requiring repetitive, explosive movements or heavy eccentric demands

TREATMENT PRINCIPLES
- Strength in all planes of motion
- Central stability
- Perturbation
- Soft tissue mobilization techniques
- Functional considerations
SYMMETRY

- Side-to-Side
  - Attempt to minimize the discrepancy between dominant and non-dominant sides
- Group-to-Group
  - External vs. internal rotators
  - Abdominal vs. lumbar extensors
  - * Not specifically equal strength, but appropriate ratio
- Strength-to-Flexibility
  - Avoid over-emphasizing stretching without an appropriate strength foundation
  - Do not create motion that can not be controlled

TOP OVER BOTTOM ROTATIONAL STRENGTH

REPRODUCE FUNCTIONAL DEMANDS

- Attempt to recreate demands of activity
  - Planes of movement
  - Concentric vs. eccentric activity
  - Speed progression

MANUAL PERTURBATION
SOFT TISSUE MOBLIZATION

BIOMECHANICAL CONSIDERATIONS

- Recurrent cases may be the result of biomechanical asymmetries; consider:
  - Foot/ankle: over-pronation
  - Knee: Poor motor control with loaded activities

REFERENCES

I- Introduction

Epidemiological aspects:

- Greater incidence of symptomatic FAI in athletes
- Association between labral tears, capsular laxity and rotational movements
- Greater incidence of CAM in males and Pincer in females
- Mixed-type FAI is the most common pathology

Tip:
Always look for the cause of the labral tear: associated pathology is the rule and must be addressed during treatment

Differential diagnosis:

- Groin pain is the most common complaint for labral tears, however it is not patognomonic. Sports hernia is an important differential diagnosis that must be made in advance. Both conditions may co-exist in athletes (labral tear and sports hernia)
- Labral tear can also present as lateral or posterior hip pain, and Greater Trochanteric Pain Syndrome, Piriformis syndrome, irradiated pain and sacroiliac joint pain must be identified.
- Mechanical symptoms (popping, clicking and locking) may be of intra or extra-articular etiology. Physical examination can usually differentiate between sources.
Indications:

- Labral tears
- Capsular laxity
- Femoroacetabular impingement
- Ligamentum teres injuries
- Loose bodies
- Chondral Injuries

**Tip:**
More than one procedure is usually necessary during hip arthroscopy. The most common association is the need to address the labral tear and the bony impingement, but other combinations are not rare. Address all the possible causes of pain to optimize the chances of a successful procedure.

**II- Hip arthroscopy**

**Setting:**

- Supine position
- Traction table
- Padded bolster
- Padded boots
- Step-by-step positioning

**Team:**

- Scrubbed assistant to hold the leg
- Non-scrubbed to move the leg
- Systematic preparation ease and fasten the procedure
- Anesthesiologist:
  - Hypotensive anesthesia
  - Complete relaxation
  - Minimum post-operative pain
  - Allow early mobilization

**Instruments:**

- Flexible radiofrequency
- Adequate cannulas (long enough)
- Slotted cannula and switcher-sticks
- Arthroscopic pump (set initially at 50mmHg)
- Epinephrine in fluid bags
- Curved shavers
- Burrs

Portals:
- Referred to patient landmarks
- Antero-lateral (AL) portal: 1cm proximal and 1cm anterior to the tip of the greater trochanter.
- Mid-anterior (MA): about 7 cm distal and medial to the antero-lateral portal in a line subtending 45-60º to the long axis of the femur.
- AL is performed first with aid of fluoroscopy

Tricks:
1- Be sure that adequate traction and joint space are available
2- Use spinal needle and nitinol wire before using a canula
3- Tactile sensation of the capsule and its perforation are a good method to confirm adequate positioning
4- Aim closer to the head to avoid labrum penetration
5- Confirm the location of the needle by injecting saline and observing rebound of fluid under pressure
6- Avoid scratching the head by being gentle with instrument insertion. Rotatory movements usually allow easier penetration with less trauma.

- MA portal performed under direct visualization of the anterior triangle (capsule, labrum and head)

Tricks:
1- Rotate the limb internally to “open” the anterior triangle
2- Aim at the apex of the triangle: coming to close to your camera may difficult triangulation before the capsulotomy

Capsulotomy:
- Keep it parallel to the labrum about 1 cm distant from the free edge of the labrum
- A sleeve of capsule allows easier instrumentation in the capsule-labral space
• Keep it small: usually connecting both portal is just enough to obtain adequate visualization and instrumentation on both central and peripheral compartments
• If extended capsulotomy is needed keep in mind that the lateral epiphyseal vessels must be inspected laterally and that further extension medially may compromise the iliofemoral ligament (IFL)
• If the IFL is divided, usually a repair with a strong suture in the end of the procedure is able to prevent iatrogenic instability.

Central compartment:
• Use both portals for inspection
• Document your findings
• Use curved instruments and flexible RF to reach the fossa, medial head and inferior acetabulum

Peripheral compartment:
• Use camera and instruments as retractors
• More flexion gives access to the medial part of this compartment and less flexion ease the access to the lateral part.
• Don’t remove too much capsule: it will make fluid containment more difficult
• Use the medial and lateral synovial fold as landmarks
• Don’t do deep osteoplasties. In most cases few millimeters depths form larger extensions are enough to avoid impingement and restore the labral seal.
• Deep bone resections create a hook effect that can put traction on the labrum and disrupt the labral seal.
POSTOPERATIVE REHABILITATION FOLLOWING HIP ARTHROSCOPY

Keelan R. Enseki, PT,MS,OCS,SCS,ATC,CSCS
University of Pittsburgh
Centers for Rehab Services
University of Pittsburgh Center for Sports Medicine
Pittsburgh, PA
USA

DISCLOSURES

- No personal disclosures/conflicts
- No institutional disclosures/conflicts

POSTOPERATIVE REHABILITATION

- Surgical options available for pathological conditions of the hip have evolved significantly
- Rehabilitation protocols for individuals undergoing such procedures must evolve as well
- Postoperative protocols for hip arthroscopy patients should be designed based on:
  - Healing properties of involved tissues
  - Available evidence
  - Demands of patient population
  - Clinician experience

POSTOPERATIVE BRACING

- Typically limits sagittal plane ROM from neutral/slight extension to 80 or 90 degrees of flexion
- Time varies
  - 10 days to 4 weeks

NIGHT IMMOBILIZER

- Night immobilizer system may be prescribed to prevent hips from falling into external rotation while sleeping
- Typically prescribed from one to four weeks depending on the concern for limiting rotation
- Immobilizer system consists of a cylinder placed between legs and straps to keep the lower extremities secure and toes in an upward position

Neural (Proprioceptive)
Passive (Bony, Labrum, Capsuloligamentous)
Active (Muscular)
Rehab Focus
IMMEDIATE POSTOPERATIVE TREATMENT

- Early ROM
- Stationary bike
- Strength Integrity
  - Emphasis on maintaining strength of lower extremity and lumbopelvic musculature
- Aquatic Program
  - Typically initiated after suture removal
  - Early gait training and AROM
  - Early cardiovascular conditioning

EARLY RANGE OF MOTION

- Gentle ROM permitted within the first week
- Excessive flexion and abduction is initially avoided, to avoid tissue impingement
- Circumduction motion
- Typically allow full PROM after 2 weeks
  - Anterior capsular procedure: avoid forced external rotation and extension for 3-4 weeks
  - Posterior capsular procedure: avoid forced internal rotation and flexion for 3-4 weeks
- Initiate gentle stretching at approximately 3 weeks

FLEXION IN QUADRUPED

WEIGHT BEARING

- 10 –14 days, partial weight bearing for more basic procedures (labral resection)
- Up to 4 weeks (occasionally longer) for more involved procedures (osteoplasty, microfracture, labral repairs in weight bearing region of joint)
- Progression off crutches often guided by symptoms

STRENGTH

- Tendon release procedures
  - Iliopsoas: Defer supine straight leg raise 4 weeks
    - Short lever hip flexion to 90 degrees is usually well tolerated
  - ITB: Hold side-lying straight leg raise 2 – 3 weeks
- Open chain activities replaced with weight bearing activities as weight bearing status permits
- Guided primarily by symptoms after 4 weeks

EXTERNAL ROTATION STRENGTH PROGRESSION
COMBINATION PROCEDURES
- Combination of combined procedures is not uncommon
- Commonly will see labral resection/repair combined with another procedure
  - Labral resection/repair & osteoplasty
  - Labral resection/repair & capsular modification

COMBINATION PROCEDURES
- Rehabilitation protocols usually follow the most conservative aspect of each procedure
- Labral resection & osteoplasty
  - ROM as tolerated at 2 weeks
  - PWB until 4 weeks
- Labral resection & capsular modification (anterior)
  - Caution with external rotation & extension until 4 weeks
  - Weight bearing progression as tolerated at 2 weeks

LUMBOPELVIC STABILIZATION
- Similar to shoulder and scapular stabilization principles
- Recurrent hip pain often associated with lumbopelvic dysfunction
FUNCTIONAL PROGRESSION

ENDURANCE TRAINING

General Considerations
- Patient tolerance to required ROM
- Patient tolerance to weight-bearing activities
- Known integrity of the joint
- Patient’s previous cardiovascular status

General Considerations
- Patient tolerance to required ROM
- Patient tolerance to weight-bearing activities
- Known integrity of the joint
- Patient’s previous cardiovascular status

ESTIMATED RETURN TO OCCUPATIONAL DUTIES

- Varies secondary to:
  - Individual patient characteristics
  - Nature of surgical procedure
  - Low load occupation
    - 6 to 12 weeks
  - Manual labor
    - 8 to 24 weeks

ESTIMATED RETURN TO ATHLETIC ACTIVITIES

- Varies by:
  - Individual athlete characteristics
  - Demand of sport
  - Nature of procedure
  - Return to sport
    - 8 weeks minimal for isolated labral resection
    - 12 to 24 weeks for capsular procedures
    - 12 to 32 weeks for osseous/chondral or involved combination procedures

*return to sport may occasionally be accelerated in high-level athletes, within the boundaries of tissue healing properties

THE FUTURE DIRECTION...

- Basic science and biomechanical studies
- Develop appropriate outcome scales
  - Hip Outcome Scale (HOS)
  - International Hip Outcome Tool (iHOT-33)
- Refine rehabilitation protocols
  - Tissue Healing properties
  - Evidence-based approach
  - Clinical experience

REFERENCES

Session VII

Muscle and Tendon Sports Injuries
Evidence Based Prevention of Muscle and Tendon Injuries in Soccer Players

Per Hölmich, MD DENMARK
Rehabilitation of Groin Pain and Athletic Pubalgia

Mario Bizzini, PT, PhD, FIFA-Medical Assessment Research Centre, Schulthess Clinic, Zürich, Switzerland (mario.bizzini@f-marc.com)

Groin and hip injuries in football are common, yet often difficult to diagnose and treat. Whereas the differential diagnoses previously consisted of more than 90% of tendinopathies and muscle weakness/hernias, the new knowledge of the hip joint anatomy and impingement symptoms in the young player has necessitated a shift in diagnostic focus and clinical skills during the last decade (however, to date, there is little knowledge about the prevalence and incidence of femoro-acetabular impingement in football). In general, the correct diagnosis is the paramount for a targeted treatment of groin/groin area’s problems.

Groin injuries are among the four most common types of injury in football. They account for 7-11% of all injuries in some Olympic sports, including ice hockey, football, and athletics. Groin strain injuries have been cited as accounting for 20% of all muscle strain injuries at elite levels of football. Groin injuries may be acute but often become chronic in nature. The most common location (>50%) of groin pain reported in athletes in general is the adductor muscle tendon region. Acute onset pain in this region is commonly attributable to an adductor longus muscle insertion tendinopathy but may also be related to the iliopsoas and/or the abdominal muscles. The differential diagnoses for groin pain in football players are multiple (ref).

Three major areas of anatomy require attention to and knowledge of the groin and hip area. The adductor group consisting of adductor longus, magnus, brevis and gracilis and the rectus femoris and pectineus, the pelvis groin group consisting of transversus abdominis, obliquus externus and internus and rectus abdominis, and the anatomic structures of the hip (femur, acetabulum), the labrum and the surrounding muscles and tendon of the hip all require the attention of the clinician in a footballer with pain in the groin or the hip.

It can be estimated that about 40% of players experienced an acutely painful incident during training or competition, and that 60% experienced gradually developing pain in the groin region, which is typical of an overuse injury. An acute strain usually involves one or more muscles and happens during forceful action. In most cases, the lesion lies within the musculo-tendinous junction, but in some cases the site of the injury is the tendon itself or the entheses where the tendon inserts into the bone. Adductor muscles are often acutely strained during an eccentric contraction (e.g. in a forced abduction), when this muscle is at its weakest and as such more prone to injury. This could be the sudden resistance of an opponent’s foot in an attempt to reach a ball or a sliding tackle. Another mechanism is forceful concentric adduction, for instance during a kick for a ball.
in the air, or after direct blunt trauma by an opponent.

Previous groin injury is one of the major risk factors for sustaining a new groin injury. Consequently, rehabilitation needs to be completed prior to the return to play (i.e. pain-free and functional range of motion completely regained, full strength on resistance testing, concentric and eccentric muscle-specific function fully retrained). The treatment needs to be specifically geared to the individual injury, and must be functional for the demands of the player, i.e. including football activities. To successfully prevent the recurrence of groin injuries, treatment aimed at healing the structural damage should be combined with correction of the initial dysfunction causing the pain. Otherwise there is a risk that the factors that originally led to the structural damage will again “take over” and, combined with fatigue due to lack of sport specific rehabilitation, may eventually lead to groin re-injury.

Recently prevention programs (focusing on: core stabilization/strength, abductor & adductor muscle strength, specific balance and agility drills) have shown to significantly reduce (by ca 30%) groin injuries in professional soccer players.

References

Hölmich et al. Effectiveness for active treatment in adductor-related groin pain in athletes. Lancet 1999
Rehabilitation of Hamstring, Quadriceps and Gastrocnemius Strains

Mario Bizzini, PT, PhD, FIFA-Medical Assessment Research Centre, Schulthess Clinic, Zürich, Switzerland (mario.bizzini@f-marc.com)

Thigh muscle injuries occur frequently as contusion injuries in contact sports, and as strains in sports involving maximal sprints and acceleration. Because football combines maximal sprints with frequent player-to-player contact, it is not surprising that up to 30% of all football injuries are thigh muscle injuries. In fact, results from the elite leagues in England, Iceland and Norway show that hamstring strains are the most common type of injury in male football, accounting for between 13% and 17% of all acute injuries. Other studies have shown that muscle contusion injuries to thigh account for up to 16% of all acute football injuries at an elite level.

Muscles are injured by two different mechanisms, through direct contact or by muscle strain. The quadriceps muscles are the muscle group most susceptible to contusion injuries because they are located ventrally and laterally on the thigh. The hamstrings are the muscle group at the posterior thigh, and injury to these muscles typically occurs when they are acutely stretched beyond the limits of tolerance during maximal sprints. Since, in the vast majority of cases, the hamstrings are injured through strains and the quadriceps muscles through contusions. Classification systems exist to classify muscle injuries according to the amount of tissue damage and bleeding seen. One aspect of particular importance, at least for the prognosis, is whether the haematoma is intermuscular or intramuscular. Bleeding is classified as either intramuscular, where there is no injury to the muscle fascia, or intermuscular, where the blood escapes from the muscle compartments through a defect in the muscle fascia. In general, healing time is significantly longer with intramuscular bleeding than it is with intermuscular bleeding.

A number of candidate risk factors have been proposed for hamstring strains, the most prominent being the following three internal factors: previous injury, reduced range of motion (ROM), and poor hamstring strength. Intramuscular bleeding will gradually subside, but after significant injuries there will be some bleeding for as long as 48 hours after the injury. The main objective – whether treating a contusion injury or a muscle strain – is to control haemorrhage – through rest and compression with a compression bandage. Massage is contraindicated during this period. If the patient has a major injury, it may be necessary to wait four or five days before beginning active exercises, but rehabilitation of minor injuries should begin two or three days after the injury. The goals of the subsequent rehabilitation phases are, first, to restore pain-free range of motion and, second, to reach a performance level that allows return to play through a functional rehabilitation programme. Progression from one stage to the next is guided by function, not time. Massage may be used at this stage to improve circulation. The rehabilitation of most minor thigh injuries should begin
with active mobilisation. The player should start with gentle motion exercises of the relevant joints and should allow the pain to control how long to move. Pressure should not be applied during the start phase. Use of a cycle ergometer is a gentle and effective method of increasing mobility. The seat should be adjusted so that it is high, and the foot should be placed further forward on the pedal than normal. This position reduces the demand on knee flexion and makes it easy to pedal when cycling. If mobility is reduced to the extent that the player cannot pedal, then the player should oscillate gently forth and back as far as possible on the bicycle. Exercises are of primary importance during the rehabilitation phase, but other physical therapy may be useful in removing bleeding residue and avoiding scar tissue formation in the injured area. Massage, stretching and various types of electrotherapy may be indicated.

The exercise programme should include various stretching exercises, strength exercises, neuromuscular exercises and functional exercises aimed at a return to football. The progression of the exercises is individually controlled by pain and function. In general, numerous repetitions and low loads (up to a total of 100 repetitions split into four to five series) are emphasised early in the rehabilitation phase. Then load is gradually increased, and the number of repetitions decreased. Easy exercises are used during the start-up phase, later the tempo is gradually increased. Football players with muscle strain injuries must not run at their maximum pace during training until the injury is completely healed. It often takes as long as six to eight weeks before the musculature will tolerate maximum spurs or turns. Light running training in a relaxed manner may begin as soon as the pain allows. An insulating neoprene sleeve is useful during the retraining phase to keep the muscles warm. A good warm-up, including gentle stretching, is critical before more vigorous exercises are undertaken. Building maximal strength, especially eccentric strength, is key to avoiding re-injuries. One such exercise, Nordic hamstring lowers (see: The 11+), has been shown to be much more effective than regular hamstring curls in improving eccentric strength, and has also been shown to reduce the risk of hamstring strains in footballers.

Healing often takes as long as six to twelve weeks after intramuscular bleeding. However, an injury with intermuscular bleeding can heal within a couple of weeks. If the injury is minor, after a week the muscles will regain strength and the ability to contract. About 50% of the strength is regained within 24 hours. After seven days, 90% of the strength returns. The player should be able to train without symptoms at the intensity level of a competition, and be tested thoroughly before participating in matches or competitions. Returning to explosive sports such as football too early may however cause a re-injury.


ISAKOS Congress Sports Rehabilitation Concurrent Course

Global perspectives for the Physical Therapist and Athletic Trainer

**Treatment options for tendinopathy: What is the evidence.**
This lecture will review the reasoning and scientific evidence behind the most common conservative treatments for tendinopathy such as exercise, deep friction massage, ultrasound, shock-wave therapy, laser therapy, nitric oxide, injection therapies (for example autologous blood and platelet-rich plasma) and sclerosing therapy. An emphasis will be placed on the use of these treatments in sports medicine.
Muscle Healing and Regeneration
Johnny Huard, PhD USA
Session VIII

Foot and Ankle
A. Most Common Foot and Ankle Injuries in Athletes

1. Ankle Sprains
   i. Lateral Ankle ligament injury
   ii. Syndesmosis /High ankle sprains
   iii. Deltoid injuries
2. Osteochondral Lesions of the Talus
   i. Medial
   ii. Lateral
3. Ankle impingement
4. FHL tenosynovitis/OS trigonum
5. Midfoot sprains
6. Stress Fractures
   i. Navicular
   ii. Base of 5th MT
   iii. Sesamoid fractures
7. Plantar plate ruptures
   i. 1st MTP (turf toe)
   ii. 2nd MTP
8. Tendon Disorders
   i. Peroneal tendon tears / instability
   ii. Achilles tendinopathy/ ruptures
9. Periarticular fractures
   i. Lateral process of the talus
   ii. Anterior process of the calcaneus
   iii. Medial and lateral malleoli avulsions
10. Subtalar joint sprain/instability

B. Acute inversion Ankle Sprain
   i. Probably the most common soccer / sports injury ; ~ 25% -35 %of all MS injuries
   ii. Vast literature on the topic, many reviews available , but still many areas controversial: diagnosis; treatment; operative vs non operative; return to play considerations
   iii. Still a high incidence of residual pain/dysfunction likely secondary to associated injuries
iv. Therefore treatment needs to be individualized depending on severity, associated injuries

1. Common associated or missed diagnosis:
   i. Bone
      1. anterior process fracture calcaneus
      2. lateral/posterior talar process fracture
      3. malleolar fractures
      4. base of 5 MT
      5. subtalar joint injury
      6. os peroneum syndrome
   ii. Cartilage
      1. osteochondral lesions tibia/talus
   iii. Soft Tissue
      1. syndesmosis injury
      2. subtalar joint/sinus tarsi
      3. peroneal tendinopathy/instability
   iv. Neural
      1. neuropraxia
         a. superficial peroneal nerve
         b. sural nerve
   v. Other causes/issues to consider
      1. chronic causes of ankle/hindfoot pain following sprains
         a. tibiotalar bony impingement
         b. anterolateral soft tissue impingement
         c. tarsal coalition
         d. alignment / pes cavus

2. Management of the isolated acute ankle sprain
   i. Diagnosis
      1. Clinical exam still the best
      2. Xrays/MRI to assess for suspected associated injury
   ii. Treatment
      1. Early functional non operative treatment
         a. Reduce swelling, pain, obtain full ROM
         b. Functional strengthening
         c. Progression to ground based participation / functional drills with bracing /taping
         d. Return to play as tolerated with bracing /taping
   iii. Surgery
      a. At present, no indication for isolated, mild or severe sprains
      b. Consider with associated displaced osteochondral talar fracture
3. **Chronic Ankle Instability**
   I. Functional instability ankle
   II. Mechanical Instability
   III. Subtalar Instability

   a) Instability with Osteochondral Lesions of Talus
      - lateral subluxation with rotation of the talus about the deltoid ligament axis (with inversion sprain)
      - this mechanism may cause medial or lateral osteochondral lesions of the talus with convex talus abutting against the anterior edge of the tibia
      
      Lippert, *Sportverletz Sportschaden, 1989*
      962 patients - 7% (osteochondral lesion)
      Bosien, *JBJS, 1955*
      133 patients - 6.7% (osteochondral lesion)

   b) Acute Ankle Arthroscopy Following Inversion Sprain
      van Dijk, *PhD Thesis Amsterdam, 1994*
      30 patients - 66% incidence of medial talar chondral lesion

**B) CHRONIC INSTABILITY**

*If pain is present between giving way episodes or is the cause of giving way, you must rule out all other causes of functional instability.
*If pain is a result of the sprain and is not present between sprains or prior to the inversion sprain, this may be true mechanical instability.*

1. Assessment
   a) history
   b) physical exam: anterior drawer test
   c) x-ray
   d) value of stress x-rays: talar tilt?: anterior drawer most valuable with anterior subluxation $>= 10$ mm
   e) CT/MRI - specific indications cartilage/ bone anatomy
      - CT/MRI:
        - osteochondral lesions of the talus
        - arthrosis
        - tarsal coalition
        - associated bony injuries

**C) FUNCTIONAL INSTABILITY**

*Definition:
Freeman, *JBJS Br, 1965*
subjective feeling of giving way during physical activity
mobility beyond voluntary control, but the physiologic range is not exceeded

Causes:
- peroneal (muscular) weakness
- proprioceptive deficit
- subtalar instability
- other associated conditions (above) simulating “giving way”

D) MECHANICAL INSTABILITY

Definition: ankle mobility beyond the physiologic range of motion, demonstrated by abnormal laxity.*

*Criteria: these are controversial
- stress x-rays may be useful but controversial
- in general anterior drawer test demonstrates > 10 mm translation of talus vs. tibia and > 3 mm side to side difference accepted as abnormal (Karlsson)
- talar tilt stress test not as useful in predicting chronic instability

Authors Approach: history and physical exam are most useful investigations, does not utilize stress x-rays routinely for diagnosis

E) SUBTALAR INSTABILITY

Definition: not a clearly defined entity but estimated in 10% of ankle instability.

Diagnosis: based on history and examination consistent with subtalar joint irritation, joint line tenderness and possibly positive subtalar stress view.

Imaging:
- talar tilt/subtalar stress view
- MRI/CT

F) OTHER CAUSES OF INSTABILITY (MALALIGNMENT)

Note: if foot or ankle malalignment is present, should be corrected or else soft tissue reconstruction will fail.

ie.
1. valgus forefoot with dropped 1st ray needs a 1st, possible 2nd MT dorsiflexion osteotomy
   - often in cavovarus feet, ie. CMT, but can be idiopathic
2. hindfoot varus may need calcaneal / forefoot osteotomy

G) TREATMENT

1. Acute Sprains
   a) functional nonoperative treatment
   b) prophylactic bracing
   c) muscle strengthening
   d) proprioceptive program

2. Chronic

Conservative Management
   a) correct diagnosis
   b) proper rehabilitation
      • muscular strengthening (invertors & evertors)
      • proprioceptive/balance program
      • taping, bracing
         – prophylactic
         – chronic bracing

3. Surgical Indications
   a) symptomatic mechanical instability AND
   b) failure of appropriate conservative treatment

Goal of surgery - to prevent recurrent giving way episodes
Some evidence that instability predisposes to arthrosis

H) SURGICAL OPTIONS:

- Anatomic
  - Brostrum (and modifications)
  - Free graft (ie. Colville, Engebretsen, Coughlin)
    (i) autograft
    (ii) allograft

- Non-anatomic
  - Evans
  - Watson-Jones
  - Chrisman-Snook
  - Others

2. Authors Approach:
   a) Chronic Ankle Instability:
      Anatomic Repair
      • Brostrum repair
      • direct repair to bone
• Gould (extensor retinaculum)
• +/- Arthroscopy at time of repair

b) Problem: Subtle instability:
   stability: ATFL, CFL intact but very subtle laxity?
   • Brostrum
   • inferior extensor retinaculum (Gould advancement)

c) Problem: Peroneal tendon symptoms and instability:
   Approach:
   • modify incision to expose peroneals
   • repair peroneal tendon/retinaculum
   • modified Brostrum type repair

d) Problem: Recurrent instability post repair or reconstruction:
   Approach
   • failed tenodesis ie. Evans
     – release tenodesis
     – Brostrum repair (modified)
   • failed Brostrum
     – anatomic repair ie. Colville
     – free graft
   • tenodesis is “too tight”: reduced subtalar motion/pain
     – release tenodesis (extra capsular)

e) Chronic Ankle Instability: Revision with free graft
   Authors Approach:
   if failed Brostrum (ie. revision): allograft in “anatomic” repair
   • revision: Achilles allograft: 7mm, interference screw fixation
   • comprehensive reconstruction using a free gracilis graft

f) Indications for Arthroscopy in Chronic Ankle Instability
   Ankle lesions at time of ligament stabilization:
   • osteochondral injuries
   • impingement lesions
   • synovitis

Literature review:
Komenda, Ferkel, Foot&Ankle, 1999
Hintermann, Boss, Schafer, AJSM 2002
Taga, Shino, Inoue, Nakata, Maeda, AJSM, 1993

Hintermann et al., AJSM 2002
148 patients with chronic ankle instability (greater than 6 months)
• pre op: talus lesions in 4%,
• at arthroscopy: 50% had cartilage lesions of the talus.
• tibial pilon (8%), medial malleolus (11%), and lateral malleolus (2.5%)

Authors Approach:
if any evidence of intraarticular pathology or pain:
• arthroscopy first to treat intra-articular pathology
• ligament reconstruction : concerns : swelling

I. Syndesmosis Sprains (Normal mortise relationship)
1. Diagnosis
   i. Clinical Exam still the best
   ii. Investigations:
      1. X-ray
         a. Normal mortise relationship, if not, RX is easy decision
         b. May see post tibial avulsion (early) or calcification (late);
         c. syndesmotic calcification late
      2. MRI – non specific acutely but can identify deltoid and may be related to severity of the injury
      3. CT SCAN
         a. Avulsion # anterior / post tib-fib joint
         b. Bone scan (chronic) Increased uptake in syndesmotic area
   2. Treatment:
      i. Acute Diagnosis:
         1. Wide mortise on x-ray or stress x-ray → ORIF
         2. Normal x-ray relationships Operative vs. non-operative
            a. Non-op:
               i. ?longer time to recovery
               ii. ↑ incidence residual dysfunction
               iii. chronic (micro) instability
               iv. calcification interposers space
            b. Author’s preferred Rx: Operative
               i. Arthroscopy to confirm diagnosis
               ii. Anterolateral debridement
               iii. Syndesmotic fixation / tightrope (vs screws)
               iv. Early ROM, strengthening and gradual progression as if non-op treatment
               v. WBAT / strengthening, return to sport as tolerated
   3. Controversies
      a. Indications for fixation
b. Type of fixation
c. Return to play
d. complications of surgery
   • hardware complications (screw breakage)
   • heterotopic ossification
   • syndesmotic pain

I) Deltoid Ligament Injuries
   a) More commonly recognized
   b) Usually associated with other injuries, ie syndesmosis
   c) Usually stable grade 1-2 injuries, conservative treatment with early mobilization
   d) Need to carefully assess with pes planus and spring ligament injuries
e) J) SUMMARY:
   1. Giving way episodes of the ankle does not always equal mechanical instability, therefore
      a detailed history and examination is most important in diagnosis.
   2. Dysfunction following ankle sprains is common, most often due to a missed or
      associated injury.
   3. Rehabilitation to correct muscular and proprioceptive deficits is essential in chronic
      ankle instability prior to contemplating surgery.

J) REFERENCES

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9. Coughlin MJ, Schenck RC Jr, Grebing BR, Treme G. Comprehensive reconstruction of the
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Non-Operative Management of Ankle Sprains

Gary Calabrese, PT USA
ISAKOS Congress Sports Rehabilitation Concurrent Course

Global perspectives for the Physical Therapist and Athletic Trainer

Achilles tendinopathy
For athletes with Achilles tendinopathy the consensus is that the initial treatment should be an exercise program. It should consist of strengthening exercises, including an eccentric component, for the Achilles tendon and calf musculature. The rehabilitation process is, however, time consuming and often frustrating for the athlete, athletic trainer, physical therapist, coach and doctor. Moreover many questions arise such as regarding how much pain is allowed, can the athlete continue to run and how should the return to sport phase be designed? This presentation will review the scientific evidence and give recommendations for how this is applied to the clinical practice.
Rehabilitation after Achilles tendon repair

An Achilles tendon rupture mostly occurs without any preceding warning sign. The recovery following an Achilles tendon rupture takes up to a year or longer and many athletes are not able to return to their pre-injury level. Complications such as rerupture, calf muscle weakness, tendon elongation and gait abnormalities are reported after this injury. How should then the rehabilitation program be designed to achieve optimal functional outcome while minimizing the occurrence of complications? This lecture will review the scientific evidence and give recommendations for how this is applied in the clinical situation.
Session IX

Elbow
Elbow Anatomy

Gregory Bain, MB BS, FRACS, PhD AUSTRALIA
Arthroscopic surgery of the elbow is challenging because of the joint's anatomy. Elbow arthroscopy is a minimally invasive technique used by orthopaedic surgeons to diagnose and treat a range of conditions affecting the joint. The bones lie close together, and nerves and blood vessels are located very close to the joint. Although it is a difficult procedure, arthroscopic surgery is often the ideal choice for treating certain elbow conditions.

Burman first discussed elbow arthroscopy in 1931, but he stated that the elbow is “... Unsuitable for examination since the joint space is so narrow for the relatively large needle”.

In contrast to traditional surgery, using large incisions to open the joint, there is no injury to surrounding soft tissues with arthroscopy. Moreover, the technique allows the surgeon to view the elbow joint from multiple angles, allowing for a more thorough evaluation.

- **Anatomy**
- **Indications**
  - removal of osteophytes due to impingement or osteoarthritis
  - synovectomy in patients with inflammatory arthritis
  - removal of adhesions and capsular release in patients with contractures
  - resection of symptomatic plicae
• removal of loose bodies,

• evaluation of patients with chronic elbow pain.

• osteochondritis dissecans,

• septic arthritis,

• Epicondylitis

• elbow fractures

• Equipment

• Portal placement:
  
  o Medial
  
  o Lateral
  
  o Posterolateral
  
  o Posterior

• Complications

• Postoperative Management

REFERENCES


• ANDREWS JR, CARSON WG. Arthroscopy of the elbow. Arthroscopy. 1: 97-107, 1985
Elbow Instability
James Andrews, MD USA
Medial and Lateral Epicondilitis of the Elbow
Eduardo Benegas, MD BRAZIL
Rehabilitation Following UCL Reconstruction in Throwers

Kevin E. Wilk, DPT
Associate Clinical Director
Champion Sports Medicine
Birmingham, AL

I. INTRODUCTION:

A. Elbow Injuries in Overhead Sports

1. Appear to be increasing
   Second most common injury in professional baseball (22%)
   Conte et al: AJSM ’01
2. Repetitive forces – overhead throwing (baseball, javelin)
3. Increasing injury rates due to numerous factors:
   a. bigger stronger athletes
   b. tremendous forces generated
   c. specific pitches may increase forces
   d. split-finger, & slider
4. Better recognition of injuries
   a. improved clinical exam skills
   b. MRI

B. Principles of Elbow Rehabilitation

1. Must be specific to imposed demands of sports
   a. Overhead thrower -
   b. Tennis players -
   c. Weight lifting –
   d. Collision sports (football) -

   Demands of each are different
   Rehabilitation must be specific to patient’s demands

C. The Overhead Thrower’s Elbow Joint

1. Tremendous forces during the acceleration and deceleration phases of the pitch
2. Max. elbow extension velocity ≈ 2300 0/sec
b. Acceleration phase: valgus stress 60 NM
c. Humeroulnar compression of 800 N
d. High level of muscular activity

Werner, Fleisig, Andrews: JOSPT ‘93

2. Range of motion during the throw

a. Extension 19 ± 4° to flexion 99 ± 11
Flexion contracture commonly seen

Fleisig et al: JOSPT ‘93

II. PHYSICAL CHARACTERISTICS OF THE THROWER’S ELBOW:

A. Range of Motion

1. Normal elbow/forearm ROM

a. Ext/flexion: 0-145 degrees
b. Supination 90 degrees, pronation 85 degrees

Morrey & Askew: JBJS ‘81

2. Thrower’s ROM

a. Extension: 12 ± 7°
Flexion: 147 ± 4°
Pronation: 98°, Supination: 93°

Wilk, Reed, Reinold: Unpub ‘05

Loss of Extension “Flexion Contracture” Most Common Motion Adaptation in Throwers

b. Thrower’s elbow less elbow extension (7 deg) & flexion (5 deg) compared to non-throwing elbow
Total ROM difference 13 degrees

Wright, O’Neal, Paletta: AJSM ‘05

c. Loss of motion post-throwing – elbow extension loss 5 degrees

Reinold, Wilk, Crenshaw, Porterfield: AJSM ‘08

d. Functional ROM

Necessary motion to perform tasks!

3. Muscular strength
a. Overhead throwers:

1) Flex peak torque/BW ratios: 18-23%
2) Extension peak torque/BW ratio: 22-28%
3) Flex/ext ratio: 73-80% (75%)

Wilk et al: Elb Injuries '91

b. General population

1) Bilateral differences 5-8%

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<thead>
<tr>
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<th>60°/s</th>
<th>180°/s</th>
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<tbody>
<tr>
<td>Flex PT/BW</td>
<td>29%</td>
<td>17%</td>
</tr>
<tr>
<td>Ext PT/BW</td>
<td>23%</td>
<td>17%</td>
</tr>
<tr>
<td>Flex/Ext Ratios</td>
<td>128%</td>
<td>99%</td>
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Schexnieder,Davies: Isokin Ex Sci '91

4. Dynamic stabilization of the elbow

a. Flexor carpi ulnaris overlying the UCL flexor digitorum superficialis contributes somewhat

Davidson et al: AJSM '95

b. Stabilization during throwing

1) During throwing FCU high levels of EMG data (112% MVIC)
2) FDS (80% MVIC) acceleration

DiGiovine et al: JSES '92

c. EMG analysis in pitchers with UCL insufficiency

FCU significant less EMG activity
FCR significant greater 1 cm EMG
Extensor group tended to exhibit slightly greater EMG activity

Hamilton et al: JSES '96

d. EMG studies indicate minimal stabilizing capability – anatomical overly

Funk et al: J Orthop Res '87

5. Proprioception

a. Elbow proprioception testing

Khabie et al: JSES '98

1) 20 uninjured male subjects (Biodex System)
2) Joint reposition sense and detection of motion
3) No difference b/t dominant and nondominant arms
4) Reposition sense within $3.3^\circ \pm 1.3^\circ$ of actual
5) Significant improvement in proprioception after application of elastic bandage

6. Elbow laxity

   1) Valgus laxity in throwers
   2) Baseball players more medial laxity compared to other overhead athletes
   3) Not significantly greater than non-throwing side
   4) Displacement values approx. 0.5 mm

   Singh et al: AJSM '01

III. ELBOW INJURIES IN OVERHEAD THROWERS:

A. Valgus Extension Overload (VEO) Syndrome

   1. Pathomechanics
      a. Medial traction
      b. Lateral compression
      c. Posteromedial osteophyte

         Wilson, Andrews, Blackburn: AJSM '83

   2. Clinical examination
      a. Pain posteromedial
      b. Pain early acceleration
      c. Carefully assess laxity
      d. Plain radiographs

   3. Operative procedure
      a. Excision of posteromedial osteophyte

4. Postoperative rehabilitation


a. Immediate motion to tolerance (swelling)
b. Emphasis on passive elbow extension (gradually)
c. Stretch & restore normal shoulder ROM for thrower
d. Full ROM in 2-3 weeks
e. Gradual strengthening program
f. Caution with triceps extension, bench press, etc early
g. Throwers ten program week 4
h. Emphasize medial elbow dynamic stabilization
   Strengthening & NM drills for Flexor/Pronator muscles
   i. Begin Plyometrics week 4-6
j. Initiate throwing week 6-8
k. Gradual return to competition

B. UCL Injuries in Throwers (Overhead Athletes)

Reconstruction of the UCL

1. Rehabilitation must be based on surgical technique
   Osseous Tunnel ----------------------------- Docking Procedure
   Andrews: Op Tech Spts Med ’96              Altchek: AJSM ’02

2. Modification of Jobe procedure
   Jobe: JBJS ’86

3. Surgical procedure
   a. Graft source
      1) Palmoris longus graft (contralateral/ipsilateral)
      2) Gracilis graft (contralateral side)

4. Rehabilitation guidelines
   Wilk, Reinold, Andrews: Clin Spts ’04
   Wilk, Reinold, Andrews: Spts Med Arthroscopy ’03

5. Recent Adaptations to Our Rehabilitation Program
a. Earlier restoration of motion
   - *With strict compliance, earlier restoration of full ROM
   - Previous protocol: 8 weeks full ROM & discontinue brace
   - Recent protocol: full ROM 6 weeks and discontinue brace 5-6 weeks

b. Emphasis on wrist flexors, elbow flexors and shoulder external rotators
   - Emphasize dynamic stabilization of wrist flexor/pronator muscles
   - Focus on shoulder external rotators
   - Emphasis on dynamic stabilization drills
   - Grip strength

c. Performing plyometrics for longer period of time prior to throwing
   - Plyometric drills for 4 weeks instead of previously advocated 2 weeks (initiated at 12 weeks postoperative)
   - Emphasize biomechanics and proper mechanics

d. Throwing program
   - Delaying throwing for at least 4-5 months
   - More time in long toss program
   - Slower progression to “off the mound” throwing

C. Phase One - Immediate Motion (week 0-4)

Goals:
- Re-establish non-painful ROM
- Decrease pain and inflammation
- Retard muscular atrophy
- Protect healing tissue

1. Range of Motion Progression
   a. Posterior splint at 90° flexion for one week
   b. Week two - functional ROM brace (30-100)
- progress ROM; 5° extension and 10° flexion per week
c. Full ROM* - 6 weeks (if able full ROM at week 5)
- prevent flexion contracture

2. Elbow Joint Compression Dressing (2-3 days)
   a. Wrist and hand ROM and gripping exercises
   b. Ice and compression*
   c. Isometrics for shoulder and elbow joint

*Assessment of neurologic status

3. Week 2
   a. Initiate AROM (ROM 30-100)
      • Safe ROM following UCL reconstruction
      Bernas et al: AJSM ‘10
   b. Continue AAROM
   c. Manual resistance drills (isometrics, RS)

4. Week 3
   a. ROM 15 to 110° (at least)
   b. Continue stretching and ROM exercises
   c. Initiate isotonic program (AROM, lightweight #1)
   d. Treat soft tissue restrictions – graft site

B. Intermediate Phase (Week 4-8)

Goals:
- Gradually restore full ROM
- Promote healing of repaired tissue
- Restore strength, power and endurance

1. Week 4
   a. Functional brace 10-120° (at least)
   b. Initiate isotonics for entire arm and shoulder
   c. AAROM, PROM, stretching
   d. Continue soft tissue techniques
   e. Initiate a “modified Thrower’s ten program”

2. Week 5-6
   a. Discontinue functional ROM brace
   b. Full ROM 0-145°
   c. Progress isotonic strengthening
d. *Manual resistance exercises for elbow and wrist
   - Isotonic strengthening
   - Manual resistance RS

   *Assess for flexion contracture of LOM
   - May enhance dynamic joint stability
   - Increased muscular stiffness

Treatment of Flexion Contracture

1. Warm-up (active or passive)
2. Joint stretch (passive stretch, PROM)
3. LLLD stretch
4. Heat or ultrasound
5. CR techniques
6. Passive stretching and joint mobilization (HR HU, RU joints)
7. Strengthening in new ROM
8. Repeat 2-7 steps
9. Perform program 2-3 times per day
10. Consider use of splint

Treatment of LOM (Flexion)

1. Contract-relax technique (CR)
2. LLLD
3. Joint mobilization
4. Passive stretching

Tissue Remodeling vs. Transient Tissue Changes
*Efficiency of low load long duration stretching

The Elbow Joint is a Unforgiving Joint

C. Advanced Strengthening Phase (Weeks 8-13)

Goals:
- Improve arm strength, power and endurance
- Maintain full ROM
- Gradually initiate sport activities

1. Week 8-10

   a. **Thrower's Ten Program**
   b. Emphasize following:
      (1) concentric biceps
      (2) concentric triceps
      (3) stabilization wrist flex/pronaturs
(4) shoulder ER

c. Neuromuscular drills

2. Week 11-13

a. *Initiate plyometric (3-4 weeks of plyos) 2 hand drills
b. Continue all exercises
c. Interval sport program (golf, swimming)
d. **Advanced Thrower’s Ten program - week 12**

D. Return to Activity Phase (Weeks 14-20)

Goals:
- Continue improvement of power, strength and endurance
- Gradual return to sports

1. Week 14

a. Initiate one hand plyometric throwing drills
b. Continue Throwers’ Ten Program
c. Maintain flexibility and stretching

2. Week 16

a. **Initiate interval throwing program (Phase I)**
   Reinold, Wilk: JOSPT ‘02
   Fleisig, et al: JOSPT ‘11
   b. Continue all exercises listed above
   c. Emphasize alternating day training

3. *Week 22-26*

a. **Initiate interval throwing from mound Phase II throwing**
   Continue isotonics
   Utilize periodization model – adjust intensity (wts)

Criteria to Return to Throwing

- Full ROM
- Satisfactory stability
- Isokinetic test

Complications Following UCL Reconstruction
1. Ulnar Neuropathy
2. Loss of motion
3. Loss strength
4. Post-operative instability

CLINICAL FOLLOW-UP STUDIES:

Andrews, Azar, Wilk, Groh: AJSM '00

1. 91 UCL reconstruction
2. 41% professional players, 45% collegiate
3. Average follow-up 35.4 months
4. 79% returned to play, return to play 9.8 months


1. 1281 UCL reconstructions (from 1988-2006)
2. 959 baseball players
3. 942 available for at least 2 yr follow-up
4. Average follow-up 38.4 months
5. 83% return to higher or previous level
6. Average time surgery to throwing 4.4 months
7. Average time to competition 11.6 months

IV. PREVENTION OF ELBOW INJURIES:

A. Several Specific Concepts

1. Proper throwing mechanics
   a. “Leading with elbow”
   b. “Opening up too soon”
2. Adequate flexor/pronator strength
3. Proper shoulder strength, especially posterior cuff
4. Adequate rest
5. Not throwing (i.e. pitching) too often
6. Fatigue; emphasize muscular endurance
   a. leading cause of elbow injuries in adolescent throwers
Lyman, Fleisig et al: AJSM ‘02
Lyman et al: Med Sci Spts Ex ‘01
Olsen, Fleisig et al: AJSM ‘07

7. Types of pitches – elbow pain
8. Recommendations: when to throw curve ball (what age)?
9. Lateral epicondylitis
10. Not all tennis elbow is the same!!

V. KEY POINTS AND SUMMARY:

A. Key Points

1. Elbow joint is frequently injured
2. Elbow injuries are increasing
3. Proper mechanics may assist in preventing injuries
4. Restoring motion is often difficult
5. Nonoperative treatment – first treatment option
6. Gradually increase applied loads
7. Dynamic stabilization is critical
8. Gradual return to throwing

KEW: 4/13 – attachments
UCL rehab protocol
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Management of Tennis Elbow

Joy Macdermid, PT, PhD CANADA
Session X

Shoulder
Shoulder Anatomy
James Irrgang, PT, PhD, ATC, FAPTA USA
Biomechanics of Shoulder Function
James Irrgang, PT, PhD, ATC, FAPTA USA
Throwing Progression for Youth Sports

Michael Axe, MD USA
Functional Testing Algorithm for Return to Play Following Shoulder Injuries

George J. Davies, DPT, MEd, PT, ATC, CSCS, PES, FAPTA
Professor, Armstrong Atlantic State University, Savannah, GA.
Coastal Therapy, Savannah, GA & Gundersen Lutheran Sports Medicine, LaCrosse, WI.

I. Introduction
II. Importance of establishing discharge criteria: safety for patient, legal implications, etc.
III. Literature review
IV. Quantitative and qualitative functional testing algorithm for clinical decision making for criteria for return to play
V. Functional Testing Algorithm:
   • Visual Analog scale
   • Basic Measurements
     o Time/soft tissue healing
     o VAS (0-10 scale) (<3+1)
     o Physical Examination
     o Anthropometric measurements
     o AROM (<10%)
     o PROM
     o Core testing
     o LE-Movement assessment
     o Quantitative & Qualitative Upper Extremity movement assessment
     o Outcome rating scales: DASH, ASES, KJOCC
     o Etc.
   • Sensorimotor System Testing: Kinesthetic/Proprioceptive Testing
     o Angular joint replication testing
     o 3-D Angular joint replication testing
   • OKC Isokinetic Testing
     o Manual Muscle Testing
     o Hand Held Dynamometer
     o Isokinetic Testing
     o OKC 3-D muscle power testing – BBI
   • Closed Kinetic Chain - Upper Extremity Stability Test
   • Closed Kinetic Chain - Upper Extremity Force plate testing
   • 1-Arm Seated Shot Put - Medicine Ball Power Test
   • Functional Throwing Performance Index
   • Underkoffler Overhand Softball Throw for Distance
   • Sport Specific Testing
   • Upper extremity Outcome Scoring Systems
VI. Summary and Conclusions
VII. References
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Session XI

Shoulder
Operative management of shoulder instability

Klaus Bak, MD, Parkens Privathospital,
Teres Medical Group, Copenhagen, Denmark

The operative management of shoulder instability is constantly under evolution. Non-operative treatment programs develop and implies better outcome prognosis. Diagnostic options are improved as well. This gives a much larger palet of treatment possibilities. It has been proposed by the French shoulder surgeon Pascal Boileau, that surgical treatment of shoulder instability should be regarded as looking at a menu at a restaurant. In this way you are able to individualize the treatment and hopefully decrease the risk of redislocation. It is not possible to recommend one single type of stabilizing procedure for all patients. Boileau developed the Injury Severity Index (JBJS 2007) that evaluated the risk of recurrence after arthroscopic surgery. According to this study, patients with a total score over 6 points had a risk of recurrence of 70% after arthroscopic Bankart repair.

Pascal Boileaus Instability severity index score JBJS 2007

<table>
<thead>
<tr>
<th>Prognostic factors</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age at surgery (yrs)</td>
<td></td>
</tr>
<tr>
<td>≤ 20</td>
<td>2</td>
</tr>
<tr>
<td>&gt; 20</td>
<td>0</td>
</tr>
<tr>
<td>Preoperative sports activity</td>
<td></td>
</tr>
<tr>
<td>High level/competition</td>
<td>2</td>
</tr>
<tr>
<td>Recreational or no sport</td>
<td>0</td>
</tr>
<tr>
<td>Type of sport (preoperative)</td>
<td></td>
</tr>
<tr>
<td>Contact or forced overhead</td>
<td>1</td>
</tr>
<tr>
<td>Other</td>
<td>0</td>
</tr>
<tr>
<td>Shoulder hyperlaxity</td>
<td></td>
</tr>
<tr>
<td>Shoulder hyperlaxity (anterior or inferior)</td>
<td>1</td>
</tr>
<tr>
<td>Normal laxity</td>
<td>0</td>
</tr>
<tr>
<td>Hill-Sachs on antero-posterior x-ray</td>
<td></td>
</tr>
<tr>
<td>Visible in external rotation</td>
<td>2</td>
</tr>
<tr>
<td>Not visible in external rotation</td>
<td>0</td>
</tr>
<tr>
<td>Glenoidal defect on AP-rtg</td>
<td></td>
</tr>
<tr>
<td>Loss of contour</td>
<td>2</td>
</tr>
<tr>
<td>No lesion</td>
<td>0</td>
</tr>
<tr>
<td>Total (points)</td>
<td>10</td>
</tr>
</tbody>
</table>

Indications for operative treatment

Indications are widely individual, but some trends can be extracted from the literature. Indications for surgery should consider several factors:
• Age of the patient – the younger the patient – the higher the risk of recurrence without operation. One exception is teenagers with atraumatic instability where non-operative treatment should be encouraged for as long as possible

• The rate of dislocations – the more common - the less likely of success of non-operative treatment

• The patient’s activity demands – the higher the risk of collision involving the arm the more likely to chose operation.

**Arthroscopic Bankart**

Arthroscopic treatment of glenohumeral instability has been an established surgical option for more than 25 years. Primary reports showed unacceptably high failure rates. With increasing evolution of techniques, implant strength, suture quality, and proper patient selection, the results are more promising. Studies comparing arthroscopic and open repair still show that the failure rate is lower in open repair, in particular in contact athletes, but the trend is moving towards choosing a technique tailored for the individual patient, rather than selecting one technique over the other. Over the last years bone block procedures are becoming more widely used in particular in high-risk athletes.

Arthroscopy has advantages over open repair in more easily detecting and addressing associated lesions (SLAP, PASTA etc.) and more rare lesions like HAGL.

Before arthroscopic repair is planned a number of factors should be taken into consideration:

• The age of the patient (under 25 is a high indicator of surgical repair)
• The activity level (participation in contact or throwing sports indicates repair)
• Associated lesions that affects outcome and function (cuff, brachial plexus)
• Inherent hypermobility (additional repair needed or longer rehabilitation)

Patients suited for Arthroscopic repair will score less than 6 points on Pascal Boileau’s instability severity index score (Table 1). Patients well-matched for arthroscopic repair are young, active first time dislocators, or patients with few recurrent dislocations and no severe glenoid bone loss (< 20%), bony Bankart lesions, presence of a HAGL-lesion, and patients with associated cuff tears. In multidirectional unstable shoulders (MDI), arthroscopic capsular
plication or capsular-labral reconstruction results in good outcome in those patients where there is no progression in dysfunction after intensive physiotherapeutic training emphasizing scapular function. Closing of the rotator interval remains a controversy but may be indicated in some individuals with severe inferior instability in order to create a temporary increase contact between the glenoid and the humeral head. It seems that the capsule and ligaments of the MDI-patients gradually get loose with time, but during the time where stability is present the MDI-patient may have the possibility of regaining normal neuro-muscular control of the shoulder girdle.

**Surgical choices**

There seem to be a least four different groups to consider for treatment

1. Simple unidirectional anterior instability – arthroscopic Bankart
2. Instability with significant bone loss
   a. Bone block procedure (Latarjet or Edin Hybinette, J-span and others)
3. Isolated Hill-Sachs w Bankart – Reimplissage
4. Multidirectional instability and isolated posterior instability – open inferior capsular shift or arthroscopic capsule-labral plication

**Tips and tricks – arthroscopic repair**

I prefer arthroscopic Bankart over a mini-open procedure, but there may be no difference in outcome between the two procedures. The arthroscopy bears the advantage of detecting unexpected associated lesions that were overlooked on MR.

Tips and tricks:

- The first task is: Identification of the lesion and associated pathology
- The second task of mobilizing the capsulolabral complex may be the most important part of the procedure. A sharp ablator is the preferred instrument together with an aggressive shaver blade
- I prefer a knotless anchor and a non-resorbable suture
Postoperative treatment

Postoperatively the arm should be immobilised in a sling with or without abduction pillow. The length of immobilisation is depending on the quality of the tissue and the repair. Usually 4 weeks as a standard, and 6-8 weeks in cases of weak tissue or weak repair. Early passive range of motion and isometric muscle training/activation with arms at the side is allowed the first postoperative day. Addressing scapular function in the rehabilitation is crucial. Increasing resistance exercise is allowed after six weeks and functional rehab from week 10-12. The time to resume normal sports activities depends on the sport. Contact and throwing sports can normally be resumed after 4-6 months. When the indication is right and the patient is compliant in restrictions and rehabilitation, the recurrence rate is lower than 10%.

References


Rehabilitation Following Rotator Cuff Repair Surgery

Kevin E. Wilk, DPT
Champion Sports Medicine
Birmingham, AL

I. INTRODUCTION

A. The Post-Operative Rehabilitation – Overview

1. Gradual change in past several years

   a. Slightly more progressive and aggressive
   b. Due to:

      1) Patient selection – move active patients
      2) Increased functional demands
      3) Improved surgical techniques (stronger fixation methods)
      4) Minimizing deltoid involvement

2. Arthroscopic repairs

   a. Increasing popularity among orthopaedic surgeons
   b. Gradual increase in numbers
   c. Patients experience less pain & less stiffness
   d. Special concerns for this type of patient

3. Rehabilitation program must allow for tissue healing constraints

4. Keys to successful rehab in rotator cuff repaired shoulder

   a. establish passive range of motion
   b. restore ER muscular strength
   c. establish shoulder balance
   d. improve scapular position & posture
   e. gradually increase applied loads
   f. caution against over-aggressive activities - early
   g. control applied forces for first 6 months
   h. gradual return to functional activities
B. Primary Goals of Surgery/Rehabilitation

1. Restore functional abilities of the upper limb
   a. Maintain integrity of repair
   b. Re-establish passive mobility
   c. Re-establish muscular balance
   e. Reduce pain; muscular inhibition
   f. Improve dynamic stabilization

2. The rehabilitation formula following rotator cuff repair
   a. Restore passive motion
   b. Control active motion for 2 weeks up to 8 weeks
   c. Allow soft tissue healing then progress to active motion

C. Specific Clinical Questions:

1. When is the repaired cuff the weakest?
2. When is the repaired cuff the strongest?
3. When is it safe to perform specific activities? weight lifting? sports?

II. FACTORS INFLUENCING THE REHABILITATION PROGRAM

A. Ten Critical Factors to Consider Before Initiating the Program

1. Type of repair
   a. Deltoid split (mini-open)
   b. Deltoid take down (open)
   c. Arthroscopic technique

2. Tissue quality
   a. Soft tissue integrity
   c. Osseous integrity
      1) Fixation strength

3. Size of tear
   a. Absolute size
   b. Number of tendons/muscles involved

4. Location of tear
a. Which musculotendinous structures are involved
   1) Isolated supraspinatus
   2) Supraspinatus and infraspinatus
   3) Subscapularis
   4) Etc.

*Burkhart SS: Clin Orthop ’92*

5. Surrounding tissue quality
   a. Integrity of infraspinatus, teres minor and subscapularis
   b. Important for force couples

6. Mechanism of failure (onset)
   a. Traumatic (approx. 3-5%)
   b. Gradual and progressive failure

7. Patient’s variables:
   a. Activities (work, sports)
   b. Motivation
   c. Worker’s compensation

*Hawkins: JBJS ’85*
   d. Healing potential

8. Rehabilitation potential
   a. Supervised rehabilitation
   b. Unsupervised rehabilitation

9. Physician’s philosophical approach
   Conservative ← Continuously Aggressive

10. Type of rotator cuff tear
   a. Horizontal
   b. Vertical
   c. Avulsion

B. Classification of Rotator Cuff Tears
Small < 1 cm
Medium 1-3 cm
Large 3-5 cm
Massive > 5 cm

C. Five Types of Rehabilitation Programs

Type I - Small Tear (Excellent Tissue)
Type II - Medium to Large Tear (Good Tissue)
Type II - Large to Massive Tear (Poor Tissue)
Arthroscopic Repairs – small to medium
Arthroscopic Repairs – medium to large

The Rehabilitation Program Must Match the Surgical Procedure
Physician – Therapist communication is vital for successful outcome!

III. REHABILITATION FOLLOWING MINI-OPEN ROTATOR CUFF REPAIR

Example: Mini-Open Repair Type II

A. ROM Guidelines

1. Immediate PROM to tolerance
2. Sling 14-21 days
3. Elbow/hand ROM and gripping exercises
4. PROM for 1-3 weeks
5. Full PROM at weeks 2-4
6. AAROM L-bar ROM ER/IR days 7-10
7. AAROM L-bar ROM flex days 10-14 (with arm support)

B. Muscle Training Guidelines

1. Isometrics submaximal and sub-painful
   Use of Electrical muscle stimulation to rotator cuff
   Emphasize: ER, IR and Scapular Muscles

2. Rhythmic stabs ER/IR week 2
3. Rhythmic stabs flex/ext week 3
4. Scapular strengthening weeks 3-4
5. Active ROM flexion and abduction
6. Use of EMS to shoulder musculature

   a. ER/IR ratio
   b. Time from surgery
Factors which determine rate of progression

C. Functional Activity Guidelines

1. Sports activities interval sport programs
   a. Golf weeks 14-16
   b. Tennis weeks 20-22
   c. Swimming weeks 22-26
   d. Weight lifting activities
      - May begin at 4-5 months close to body than away from body

D. Long Term Exercises Program

1. Fundamental shoulder exercise program
2. Control heavy lifting for 6-9 mos.
3. No lifting overhead for 6-9 mos.

IV. ARTHROSCOPIC ROTATOR CUFF REPAIR

A. Advantages of Arthroscopic Repair

1. Less soft tissue disruption
2. Diminished scar formation and adhesions
3. Less postoperative pain


1. 85% routinely perform arthroscopic repairs (2000)
2. Criteria for arthroscopic repair – size & ability to mobilize
3. Rehab slower, faster or the same?
4. 100% routinely perform arthroscopic repairs (2005)

C. Arthroscopic Repair Fixation Strength

Burra, Jablonski, Cain, Andrews: AOSSM '02

- Significant differences between mini-open and arthroscopic technique
- Arthroscopic gap formation at 320 N
- Mini-open gap formation at 510 N

Waltrip, Zheng, Dugas et al: AJSM '03

- significant difference in number of cycles to failure
- single row arthroscopic technique failed at 6x fewer cycles
D. Rehabilitation Guidelines

1. Abduction pillow splint 30 days for 2-3 weeks
2. Immediate PROM exercises
3. ER/IR at 45 degrees Abd scapular plane
4. Full PROM 3-4 weeks
5. ER/IR tubing at side weeks 4-5
6. Sidelying flexion
7. Progress to resistance exercises weeks 12-16
8. Initiate interval sport programs

V. RE-ESTABLISH DYNAMIC HUMERAL HEAD CONTROL

A. Re-Establish Dynamic Stabilization of GH Joint! (Key Goal)

1. Initiate rhythmic stabilization drills

   “Balance Position” - supine position

   Wilk: Athlete’s Shoulder '93

2. Dysfunctional arc of motion

Arc of motion 0-30° then 100-125° – Why?

a. “Balanced Position”

   100° flexion
   20° horizontal abd

   1) Perform RS flex/ext
   2) Perform RS horizontal flex/ext

b. Muscular force vectors

   1) Deltoid compresses humeral head at 100° and above
   2) Supraspinatus compressor throughout ROM
   3) Rhythmic stabilization drills

   Flexor/extensor above 90°
   ER/IR in scapular plane @ 45° Abd

c. Gradual progression in muscular strength

   1) Exercise tubing ER/IR
   2) Initiate scapular muscle strengthening
3) Continue isometrics

VI. FUNCTIONAL OUTCOMES

A. Shoulder Strength Following Rotator Cuff Repair Surgery

*Rokito et al: JSES ‘96*

1. 42 consecutive patients
2. Isokinetic testing every 3 months for one year
3. Recover of strength correlated with size of the tear
4. Greatest improvement occurred in first 6 months (80%)
5. Slowest muscular group to regain strength, ER!

B. Evaluation of the Shoulder Functionally

1. Rate comfort (pain)
2. Satisfaction level
3. AROM/PROM
4. Functional abilities

*Harryman et al: JBJS ‘91*

C. Success vs. Failure

1. What determines outcome?
   a. Integrity of repair?
   b. Re-establishing dynamic stability

*Harryman et al: JBJS ‘91*

*Patients 5 years following surgery, approximately 48% recurrent deficit however 87% with recurrent defect satisfactory outcome.*

D. *Wilk et al: Tech Shoulder and Elbow Surg ‘00*

1. 22 patients, mini-open repair
2. Average follow-up 40 months
3. Average age 64.7 years (40-76)
4. Size of tears: 1, 9, 8, 4
5. Results:
   a) 73% excellent
   b) 22% good
   c) 4% fair
6. Average score (ASES)
   a) Pre-op: 30.7
   b) Postop: 92.0

VII. IRREPARABLE ROTATOR CUFF TEARS

A. Rehab Guidelines
   1. Re-establish full PROM
   2. Reduce pain – muscle inhibition
   3. Activate rotator cuff muscles
   4. Re-establish unilateral muscle ratio
   5. Turn on and strengthen rotator cuff
   6. EMS to rotator cuff musculature

   *Re-assess – Adjust weekly*

   *Balance of Muscular Forces – Wilk*

   *Suspension bridge concept - Burkhart*

VIII. SUMMARY

A. Key Points
   1. Rehabilitation must be based on type of surgery, tissue quality, and size of tear
   2. Communication is vital

   Physician ↔ therapist

   3. Gradual restoration of motion
   4. Re-establish dynamic stability
      a. Emphasize muscular balance (ER/IR ratio)
      b. Do not exercise through shoulder shrug sign
      c. Scapular strength

   5. Muscular balance (ER/IR ratio)
   6. Watch out for “empty can” - may be painful if -
   7. Do not overload healing tissue
   8. Gradual restoration of function

   Keys to successful rehab in rotator cuff repaired shoulder
   a. establish passive range of motion
   b. restore ER muscular strength
c. establish shoulder balance
d. improve scapular position & posture
e. control applied forces for first 6 months
f. gradual return to functional activities

KEW: 03/13
References - Rotator Cuff Repair Rehabilitation


Treatment of Stiff Shoulder
James Irrgang, PT, PhD, ATC, FAPTA USA
Scapular Dysfunction

George J. Davies, DPT, MEd, PT, SCS, ATC, CSCS, PES, FAPTA
Professor, Armstrong Atlantic State University, Savannah, GA.
Coastal Therapy, Savannah, GA. & Gundersen Lutheran Sports Medicine, LaCrosse, WI.

I. Introduction
II. Scapulo-Thoracic Kinematics
III. Scapulo-Thoracic Dyskinesis (Pathomechanics)
IV. Classification of scapular dysfunction:
   - Kibler Type I (Inferior Angle Pattern)
   - Kibler Type II (Medial Border Pattern)
   - Kibler Type III (Superior Border Pattern)
   - Kibler Type IV (Symmetrical Scapulohumeral Pattern)
V. Scapulo-Thoracic Dyskinesis (Pathomechanics)-Proximal causative factors
VI. Scapulo-Thoracic Dyskinesis (Pathomechanics)-Distal causative factors
VII. Examination of Scapulo-Thoracic Joint
VIII. Examination Techniques
   A. Scapular Assistance Test
   B. Scapular Retraction Test
   C. Others
IX. How do we measure the scapular kinematics?
   a. Modified Lateral Scapular Slide test
X. How do we measure the scapular muscle function?
   a. MMT
   b. Hand Held Dynamometry
      1. Rank order of muscle groups (UT, SA, MT, R, LT)
      2. Unilateral ratio of muscles
         Unilateral Ratios:
         - Elevation/depression (UT/LT): 2.62
         - Protraction/retraction (SA/R): 1.45
         - UR/DR (SA/MT):
         - 1.23
   c. Isokinetic Testing
XI. Examination Techniques – Others
XII. Treatments
XIII. Posture/Spine/LE
XIV. Flexibility
XV. Rehabilitation of the entire kinematic chain
XVI. Others
XVII. Reductionist approach to rehabilitation of the scapula
XVIII. Moseley-Jobe Scapulo-thoracic exercises
XIX. Rehabilitation of the entire shoulder complex
XX. TAS
XXI. Neuromuscular Dynamic Stability Exercises
XXI. Neuromuscular Dynamic Stability Exercises-Open Kinetic Chain Exercises
XXI. Neuromuscular Dynamic Stability Exercises-Closed Kinetic Chain Exercises
XXII. Functional Exercises
IX. References:

- Scapular Dyskinesis: 56 references
  Scapular dysfunction: 607 references
  Current concepts in scapular dyskinesis: 3
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  Scapulo-thoracic rehabilitation: 24

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Rehabilitation Following SLAP Surgery in the Overhead Athlete

Kevin E. Wilk, DPT, PT
Champion Sports Medicine
Physiotherapy Associates
Birmingham, AL

I. INTRODUCTION

A. Glenoid Labrum Lesions

1. Common injury seen clinically
2. May occur in isolation or concomitantly
3. SLAP lesions
4. SLAP first described by James Andrews, MD
   Andrews & Carson: AJSM ’85
5. Superior labrum lesion anterior posterior
   Snyder: Arthroscopy ’90
   Maffet et al: AJSM ’95
   Tokish et al: JBJS ‘09

6. SLAP lesions in throwers are common
   a. Some have established 70-90% occurrence
      Miniaci et al: AJSM ’02 (79%)
      Connor et al: AJSM ’03
      Wilk et al: (Unpub) ’00 (90%)

   b. Injury or Adaptation
   c. Isolated lesion or Concomitant lesion
      1. rotator cuff lesions
      2. humeral head changes – cystic changes
      3. is the SLAP lesion the cause of the athlete’s pain

7. SLAP lesions in the general population
   a. 84% exhibited degenerative changes of their labrum
   b. 50% exhibited a labrum detachment
      Kohn et al: Arthroscopy ’87

8. SLAP repair surgeries reported in the literature
a. SLAP repair surgery from 1.1% to 26% in Orthopaedist Practice
   Snyder et al: JSES ‘95
   Weber: Spts Med Arthroscopy ‘10
   Kim et al: JBJS ‘03
   Weber: AOSSM ‘10

9. SLAP lesions are often difficult to diagnosis

a. Often subtle symptoms
   1) Clicking, popping, grinding, pain
   2) Sometimes apprehensive ROM
   3) Internal Impingement complaints
   4) Symptoms from SLAP or Cuff

b. Can be a cause of functional limitation
c. Numerous special tests for SLAP
   Some tests are better for overhead throwers than for non-overhead athletes
   Wilk et al: JOSPT ‘05
   Myers et al: AJSM ‘05

II. MECHANISMS OF INJURIES

A. Macrotraumatic Forces
   1. Fall onto outstretched arm
   2. Traction force applied while lifting
   3. Pushing heavy object
   4. Weight lifting activities
   5. Blow to shoulder

B. Repetitive Microtraumatic Forces
   1. Commonly seen in overhead athletes

a. Throwers, swimmers, tennis players, divers, etc.
   Andrews et al: Orthop Trans ’84

   Reported 83% of throwers undergoing arthroscopy exhibited SLAP lesion

b. Thrower’s undergoing thermal capsular shrinkage
   Wilk, Reinold, Andrews: JOSPT ’02

   91% of patients exhibited labral pathology present
c. MRI exam on asymptomatic pitchers
   79%  *Miniaci et al: AJSM ‘02*
   90%  *Wilk: Unpublished ‘00*

d. “Peel back” Lesion
   Due to excessive shoulder ER
   *Burkhart et al: Arthroscopy ‘98*
   *Shepard et al: AJSM ‘04*

III. CLASSIFICATION OF SLAP LESIONS

A. Original Classification System
   *Snyder et al: Orthopaedics ’90*

   **Type I:** Superior Labrum Frayed
   **Type II:** Superior Labrum Frayed/Detached
   **Type III:** Bucket handle Tear, Displaced
   **Type IV:** Bucket Handle Tear/Biceps Involvement

B. Additional SLAP Lesion Classification

   *Burkhart & Morgan: Arthroscopy ’98*

   Type II Subclass  *“Peel Back Lesion”*
   IIA: Anterior type II
   IIB: Posterior type II
   IIC: Combined anterior-posterior lesion type II

   *Maffet, Gartsman: AJSM ’98*

   38% of patients with labrum lesion did not fit into Snyder classification

   **Type V:** An anterior-inferior Bankart lesion continuous superiorly to include separation of the biceps tendon

   **Type VI:** An unstable flap tear of labrum and biceps tendon separation

   **Type VII:** Superior labrum-biceps tendon separation extends anteriorly beneath MGH ligament


   **Type VIII:** SLAP extending posterior to the 6 o’clock position
Type IX: pan-labral lesion, entire circumference of glenoid

Type X: SLAP with reverse Bankart lesion

IV. TREATMENT GUIDELINES

A. Specific Surgical Approach

1. Type I: Arthroscopic debridement to intact labrum, preserve biceps attachment
2. Type II: Arthroscopic debridement and re-attachment of labrum to glenoid (ensure stability)
   a. Type IIB: Stabilize labrum and capsule
3. Type III: Excision of bucket handle tear, maintain stability of labrum to glenoid
4. Type IV: Excision of bucket handle tear, biceps tenodesis of greater than 50% (age), biceps tenotomy
5. Type V: Bankart repair with SLAP repair – biceps tendon pathology treatment is dependant
6. Type VI: Debridement of flap tear and repair Type II SLAP
7. Type VII: Repair capsular tear and repair Type II SLAP
8. Type VIII: Repair posterior labral tear and SLAP repair
9. Type IX: Repair entire SLAP tear – maybe 360 deg repair
10. Type X: Posterior Bankart Repair with SLAP Type II repair

B. Rehabilitation Guidelines

Wilk, et al : JOSPT ’05

1. Postoperative rehabilitation program must match the surgical procedure
   a. Based on type of SLAP
   b. Concomitant lesions – rotator cuff lesions
   c. Based on severity of lesion
   d. Concomitant procedures (stabilization, acromionplasty)
   e. Consider patient’s age
   f. Emphasize dynamic stabilization
   g. Maintain static stability
   h. Minimize biceps activity (esp. Types II & IV)
   i. Repetitive overhead athletes – think dynamic stability

C. Specific Rehabilitation Guidelines
1. **SLAP Type I & III: Post-Op Rehabilitation Program**  
   **SLAP Debridement – Post-Op Rehab**

   **Arthroscopic Debridement Program:**
   a. Immediate ROM exercises, POM, AAOM  
   b. Full PROM by 2 weeks  
   c. Active ROM week 2  
   d. Isotonics at 2 weeks  
   e. Thrower’s Ten Program at week 3-4  
   f. Emphasis on dynamic stabilization  
   g. Advanced strengthening program at weeks 4-6  
      **Advanced Thrower’s Ten Program**  
   h. Return to sports (criteria-based)  

   **Rate of Progression Based on Rotator Cuff Involvement**

2. **SLAP Type II: Post-Op Rehabilitation Program:**
   a. Sleep in immobilizer for 3-4 weeks  
   b. No motion above 90° for 4 weeks  
   c. Full ROM at week 8  
   d. No isolated biceps for 6-8 weeks  
   e. Isotonics at weeks 4-6  
   f. Advanced strengthening at weeks 10-12  
   g. Interval throwing week 14-16

3. **Type IV: Arthroscopic SLAP Lesion Repair Program**
   a. Same protocol as for Type II  
   b. Depends on what id done on biceps  
      1. Biceps tenodesis: Biceps precautions for 12 weeks  
      2. Biceps tenotomy: rest biceps initial then full activity  

D. **Rehabilitation Following Type II SLAP Repair in Throwers**

1. **Precautions:**
   a. control forces & loads on repaired labrum  
   b. no excessive ER & IR for 8-12 weeks  
   c. no weight bearing forces for 10-12 weeks  
   d. no isolated biceps for 8 weeks  
   e. no heavy lifting (overhead, bench press, push-ups) 12wks  
   f. no throwing for 4 months

2. **Protection:**
   a. abduction pillow sling for 4 weeks
b. immobilization while sleeping for 4 weeks  
c. no excessive elevation for 4-6 weeks  
d. no excessive ER or IR for 12 weeks  

Protection is based on Severity of Lesion (Size)  

3. Range of Motion Progression:  
a. immediate restricted PROM  
b. flexion to 90 degrees fro 4 weeks  
c. ER/IR at 30-45 deg abduction for 4 weeks  
d. ER/IR at 90 deg begin at week 4  
e. Gradually increase ER/IR PROM till 8 weeks  
f. Progress ER beyond 90 deg at 8-12 weeks  

Gradually Increase PROM  

4. Muscular Strengthening Exercises:  
a. Immediate submax isotonic muscle training  
b. Immediate dynamic stabilization drills (RS)  
c. Active ROM- week 3  
d. Thrower’s ten program – week 4  
e. Advanced Thrower’s Ten Program – week 12  
f. Plyometrics:  
   i. 2 hand plyos week 12  
   ii. 1 hand plyos – week 14  
g. Lifting program – week 12-14  
h. Closed chain exercises – week 12  

5. Functional Progression:  
a. Throwing programs:  
b. Interval throwing program – Phase I – at 4 months  
c. Phase II Throwing – off mound – 5 ½ months  

E. SLAP repairs with concomitant procedures  

Voss et al: AJSM ’07  
Coleman et al: AJSM ‘07  
Wilk et al: JOSPT ‘05  

a. SLAP repair with decompression –  
b. SLAP repair with cuff repair –  
c. SLAP repair with cuff debridement -  
d. SLAP repair with capsular stabilization Bankart –  
e. SLAP repair with thermal shrinkage –  
f. SLAP repair in degenerative shoulder –  

Beware of SLAP repairs with concomitant surgeries – stiffness  

Monitor Patient Closely & Adjust Appropriately
F. SLAP Repair with Anterior Bankart (Type V)
1. Immediate motion – but controlled restricted motion
2. Protection against excessive ER PROM & AROM
3. Sling with pillow for 4 weeks
4. Flexion to 90 degrees first 2 weeks then gradually increase flexion
5. ER/IR at 45 deg abd first 3-4 weeks then initiate ER/IR at 90 deg of abduction – gradually increase PROM
6. Full ROM at 8-10 weeks post-op
7. Isometrics for first 2 weeks
8. Isotonics week 3-4 (AROM first then 1 lb dumbbell)
9. Weight lifting at 12 weeks
10. Plyometrics at week 12-14
11. Sport specific training at week 16
12. Return to sports: collision sports 6 months
13. Return to sports: overhead sports 7-9 months

G. SLAP Repair with Posterior Bankart (Type X)
   Slower rehabilitation program anterior bankart
   More precautions – esp IR, Horizontal adduction
1. Immediate motion – but controlled restricted motion
2. Protection against excessive IR &/or Hz Add PROM & AROM
3. Sling with pillow – arm in ER for 6 weeks
4. Flexion to 90 degrees first 2 weeks then gradually increase flexion
5. ER at 45 deg abd first 3-4 weeks then initiate ER at 90 deg of abduction – gradually increase PROM
6. No IR PROM for 4-6 weeks (depends)
7. Full ROM at 10-12 weeks post-op
8. Isometrics for first 2 weeks
9. Isotonics week 3-4 (AROM first then 1 lb dumbbell)
10. Weight lifting at 14-16 weeks (no bench for 4 mos)
11. Plyometrics at week 16
12. Sport specific training at week 20-22
13. Return to sports: collision sports 9 months
14. Return to sports: overhead sports 9 months

H. Rehabilitation a Type IX Repair
1. Difficult rehabilitation program
2. Slow rehab but immediate motion
3. Rehab program dependent on type of patient
   Overhead Athlete --------------- Non Overhead Athlete
4. Needs to be individualized
5. Let’s talk specifics

V. SUMMARY & KEY POINTS
A. Recognition of Labral Lesions (SLAP) Is often difficult
   1. Monitor patients, subjective complaints, pathomechanics

B. Rehabilitation Must Match the Type of Lesion
   1. Type I through Type IV
   2. Severity of Lesion (How many anchors)
   3. Concomitant procedures

C. Emphasize Dynamic Stability!
   1. Throwers did well initially but at 2 years 70% had recurrent of symptoms with debridement

   Altchek et al: Orthop Trans ’90

D. Minimize Biceps Brachii Activity in Types II and IV
   1. Especially with biceps tenodesis

E. Closely monitor patient’s signs and symptoms

KEW:3/13 attachments: Type II SLAP Repair Rehab
Session XII

Sports Medicine
Disclosures 2013:

- Consultant
  - Arthrex equipment development
  - Smith and Nephew
- Fellowship grants
  - Smith and Nephew
  - Arthrex
- Editor and Editorial board
  - BJSM
  - JBJS (Am)
  - SJMSS
  - KSSTA
  - Oslo Sports Trauma

- Research grants
  - Smith & Nephew
  - Fin-Ceramica
  - TBF-Tissue Engineering
- Competitive grants
  - Norwegian NIH
  - FIFA
  - IOC
  - NIH
  - Health South East
    - Norway
  - Department of Culture
    - Norway

Projects

- IOC Research Centres
- IOC Journal Injury Prevention and Health Protection
- IOC Injury Prevention Conference
- IOC Advanced Team Physician Courses
- IOC Sports Med Publications
- IOC Consensus meetings
- IOC NOC and IF medical conference
- IOC Periodic Health Exam (PHE)
- IOC Sports Med Courses (Olympic Solidarity)
- IOC Beijing, Vancouver and London
  - Injury and disease surveillance and prevention study
- IOC SHA and Body composition group
- IOC Advanced Sports Medicine Diploma

Frequency of injury

- 1055 injuries
- 96.1 injuries per 1000 registered athletes
- 49.6% time-loss injuries
  - approx. 5% of athletes
Participants and injuries/illnesses

Included
- 82 National Olympic Committees (NOC)
- 2567 athletes (41% females, 59% males)
- All sports of the Games (19)

Incidences
- 112 injuries/1000 athletes (slightly higher than in Beijing)
- 72 illnesses/1000 athletes (similar as in swimming, athletics and soccer)

Injuries in sports – all athletes

- Head and knee most common and most severe injuries (45% of all injuries in skiing and snowboarding)
- 20 concussions (7% of athletes)

ALL ATHLETES
Snowboard Cross: 35%
Bob: 20%
Freestyle Aerials: 19%
Freestyle Cross: 19%
Ice Hockey: 18%

Injuries in sports – female athletes

<table>
<thead>
<tr>
<th>Sport</th>
<th>Female</th>
<th>Male</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Snowboard Cross</td>
<td>15</td>
<td>43</td>
<td>58</td>
</tr>
<tr>
<td>Freestyle Aerials</td>
<td>16</td>
<td>25</td>
<td>41</td>
</tr>
<tr>
<td>Freestyle Cross</td>
<td>13</td>
<td>14</td>
<td>27</td>
</tr>
<tr>
<td>Bob</td>
<td>10</td>
<td>34</td>
<td>44</td>
</tr>
<tr>
<td>Ice Hockey</td>
<td>9</td>
<td>6</td>
<td>15</td>
</tr>
</tbody>
</table>

FEMALE ATHLETES
Snowboard Cross: 73%
Freestyle Aerials: 26%
Freestyle Cross: 23%
Bob: 24%
Ice Hockey: 23%

Conclusion

- At least 11% of the athletes incurred an injury during the games, and 7% of the athletes an illness
- The incidence of injuries and illnesses varied substantially between sports
  - High injury risk in snowboard and ski cross
  - Low injury risk in the Nordic skiing disciplines
  - Highest illness risk in skating disciplines, skeleton, biathlon and snowboard cross
How did we do it in London?

TEAM PHYSICIAN MEETING
6-8 June, 2012, at the
London Olympic Village, Elbhalle Meeting Hall

8 Languages
- English
- Spanish
- French
- German
- Arabic
- Russian
- Chinese
- Japanese

The Research team
- Prof Lars Engebretsen IOC
- Prof Jiri Dvorak FIFA
- Prof Per Renström IOC
- Dr M Jegathesan IOC
- Dr Juan Manuel Alonso IAAF
- Dr Margo Mountjoy FINA
- Dr Mark Aubry IHF
- Dr Winne Meeuwisse
- Debbie Palmer-Green LOCOG
- Ivor Vanhagan LOCOG
- Richard Budgett LOCOG
- Torbjorn Solgard IOC
- Kathrin Steffen IOC
Parts of the study

1. Injury surveillance
2. Compliance study
3. Video analysis
4. The imaging studies
5. The Pharmacy study
6. The Dental study

Data acquisition

1. Daily encounter forms from 74 NOCs (90% of the athletes (paper or pdfs))
2. ATOS encounter system from all medical venues and the polyclinic

What is reported?

All injuries and illnesses which received medical attention (traumatic and overuse) newly incurred during competition or training in the Olympic period

Compliance study based on 74 NOCs

<table>
<thead>
<tr>
<th>NOC size</th>
<th>30-100 athletes</th>
<th>101-200 athletes</th>
<th>&gt;200 athletes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>89%</td>
<td>88%</td>
<td>97%</td>
</tr>
</tbody>
</table>

Based on data by Aug 8 (13 days)
We used to have a back log of 1-3 days (Compliance by Aug 7 is 95%)
Injuries & Illnesses per Oct 13

- 10,748 participants (44% females)
- 205 NOCs
- 36 sports
- 1,361 injuries – incidence: 12.7 per 100 athletes
- 758 illnesses – incidence: 7.1 per 100 athletes

“High-risk” sports – injuries (per 100)

<table>
<thead>
<tr>
<th>Olympic Sport</th>
<th>Injuries per 100 athletes (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Taekwondo</td>
<td>39</td>
</tr>
<tr>
<td>Football</td>
<td>36</td>
</tr>
<tr>
<td>BMX</td>
<td>31</td>
</tr>
<tr>
<td>Handball</td>
<td>23</td>
</tr>
<tr>
<td>MTB</td>
<td>20</td>
</tr>
<tr>
<td>Hockey</td>
<td>17</td>
</tr>
<tr>
<td>Weightlifting</td>
<td>17</td>
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<tr>
<td>Athletica</td>
<td>17</td>
</tr>
<tr>
<td>Badminton</td>
<td>15</td>
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<tr>
<td>Triathlon</td>
<td>15</td>
</tr>
<tr>
<td>Sailing</td>
<td>15</td>
</tr>
<tr>
<td>Synchronized Swim</td>
<td>14</td>
</tr>
<tr>
<td>Water Polo</td>
<td>13</td>
</tr>
<tr>
<td>Beach Volleyball</td>
<td>13</td>
</tr>
<tr>
<td>Basketball</td>
<td>11</td>
</tr>
</tbody>
</table>

Severe Injuries (>1 week absence)

- 14 shoulder, elbow, and knee dislocation (0.13%)
  (Hockey, Football, Judo, BMX, Weightlifting)
- 36 thigh strains (0.33%) (mostly in Athletica)
- 43 fractures + 6 stress fractures (0.46%)
  (mostly in Team Sports, all locations, Running)
- 27 knee sprains and dislocations, incl. 6 ACL, 1 PCL (0.25%)
  (Fencing, Handball, Judo, Wrestling, Badminton, Badminton, Table Tennis, Tennis, Football)
- 6 concussions (0.06%)

Illnesses – affected systems (top 3)

758 illnesses – 7.1 illnesses/100 athletes

- Respiratory (41%)
- Gastro-intestinal (16%)
- Dermatologic (11%)

- Severity:
  - No absence from sport: 80%
  - 1-7 days absence: 18%

Some facts

- 29% of severe injury data from ATOS
- 46% females
- 87% 0-7 days absence (5% >28 days)
- No gender risk difference for severe injuries
- 25% overuse injuries
- Beach Volleyball (19% mostly respiratory)
- 43% of data from ATOS
- 53% females
PT Management of Concussion
The Future of Joint Healing
Constance Chu, MD USA