BRUSSELS HAND/UPPER LIMB INTERNATIONAL SYMPOSIUM
Genval
Brussels, Belgium
January 24-25, 2014

22nd year

ULB

TENDON DISORDERS AND INJURIES AT THE UPPER LIMB:
BASIC KNOWLEDGE, ADVANCES IN DIAGNOSIS AND TREATMENT

PROGRAM

www.brusselshandsymposium.eu
22nd BRUSSELS HAND/UPPER LIMB
INTERNATIONAL SYMPOSIUM

Tendon Disorders and Injuries at the Upper Limb: Basic Knowledge, Advances in Diagnosis and Treatment

January 24-25, 2014

CHÂTEAU DU LAC
GENVAL-BRUSSELS

DIRECTOR:
F. SCHUIND

DEPARTMENT OF ORTHOPAEDICS & TRAUMATOLOGY,
HÔPITAL ERASME, CLINIQUES UNIVERSITAIRES DE BRUXELLES,
UNIVERSITÉ LIBRE DE BRUXELLES, BRUSSELS, BELGIUM
TABLE OF CONTENTS

Introduction.................................................................................................................. 2
Organizing Committee and International Faculty ....................................................... 4
Information for Participants ......................................................................................... 5
Information for Presenters ......................................................................................... 5
Social Program ........................................................................................................... 5
Acknowledgements ..................................................................................................... 6

Scientific Program

24 January 2014 ........................................................................................................... 9
25 January 2014 .......................................................................................................... 12

Abstracts

Session 1: An Introduction to the Symposium (1) ....................................................... 18
Session 2: An Introduction to the Symposium (2) ....................................................... 24
Session 3: Degenerative Tendon Lesions at the Elbow (1) ......................................... 32
Session 4: Degenerative Tendon Lesions at the Elbow (2) ......................................... 40
Session 6: Degenerative Tendon Lesions at the Shoulder ......................................... 48
Session 7: Degenerative Tendon Lesions at the Hand and Wrist ............................. 62
Session 8: Tendon Lacerations at the Hand and Wrist (1) ........................................... 82
Session 9: Tendon Lacerations at the Hand and Wrist (2) ........................................... 94
Posters ....................................................................................................................... 102
Notes .......................................................................................................................... 108
INTRODUCTION TO THE SYMPOSIUM

The 22nd edition of the annual Brussels/Genval Symposium will take place on Friday January 24 and Saturday January 25, 2014, again in the beautiful Château du Lac at Genval. As always, the Symposium will be dedicated to a specific interdisciplinary topic involving the hand and the upper limb. The previous meetings have been attended by 80-150 participants, from 15-25 different countries. In 2014 the topic of upper extremity tendon problems will be the main feature.

Rotator cuff/long biceps tendinosis and tears are leading causes of shoulder pain, especially after the age of 50. “Epicondylitis”, either lateral or medial, causes severe professional and sportive disabilities. The results of flexor tendon lacerations are suboptimal in too many cases.

The Brussels/Genval Symposium has a long tradition of mixing basic researchers, clinicians and physiotherapists - with the ultimate aim to improve the care of our patients. New knowledge of tendon anatomy (including variations, vascularisation and innervation), physiology and biomechanics will be first presented in up-to-date lectures. In the second part of the symposium, the causes of tendon degeneration leading to rupture and the healing potential, with or without tendon repair, will be discussed. In particular, the aetiologies of shoulder, elbow and wrist tendon degeneration will be reviewed (impingement, infectious, inflammatory, microcrystalline, tendon attrition in presence of an arthroplasty or osteosynthesis implant). How do tendons heal, in particular what is the intrinsic healing potential of poorly vascularized tendons? Can we enhance tendon healing, by pharmaceutical agents, stem cells or genetic modifications? Is smoking or other toxics deleterious? The third part of the program will deal with diagnostic aspects. The diagnosis is indeed challenging in many cases (eg: rupture of pectoralis major at the shoulder or of triceps at the elbow). The imaging modalities have markedly improved in the last fifteen years; it is important in the context of cost control of medical expenses to define the optimal investigation for each suspected diagnosis. For example, what is the best technique to confirm a rotator cuff lesion, simultaneously evaluating the possible osteoarthrotic associated lesions and the state of the muscles? How to evaluate tendon healing after surgical repair? In the fourth part of the symposium, the treatment of tendon disorders and injuries will be discussed, starting with non-surgical management. What is the place of new techniques of physiotherapy? of plateletrich plasma injections? of infiltrations, new medications, of physical therapy? These techniques should be scrutinized in the light of new surgical (open or arthroscopic) options. The surgical management of tendon diseases has evolved tremendously in recent years, and many lesions previously treated with open technique are now addressed with minimally open procedures (distal biceps reinsertion) or arthroscopically, with the use of special knots, double-row repair at the rotator cuff, anchors etc. What are the results of these sophisticated techniques, including in elderly patients with poor tendons and inferior bone quality? How to treat re-tears? At the hand, stronger flexor tendons sutures allow early active finger motion, what are the results in terms of adherences and re-ruptures? In general, what are the relative indications of tenotomy, tendon suture, augmentation, transfer, graft, tendon prosthesis – or neglect? In case of tendon repair, which type of postoperative immobilization/protected mobilization should be instaured, what are the indications and limitations of unprotected motion, what is the place of botulinum toxin muscular injections? The symposium will indeed end with aspects of physiotherapy and evaluation of the clinical results, including return to sport activities.

The primary goals of the Brussels/Genval annual upper limb symposium are to promote the exchange of ideas, to establish guidelines on a consensual basis, and to foster collaborative investigations among various specialists. Much time will be set aside for the discussions.
SPECIFIC AIMS

• To summarize the state-of-the-art knowledge about anatomy, biochemistry, physiology and biomechanics of upper extremity tendons;
• To discuss advances in diagnosis and treatment of degenerative, infectious, and traumatic tendon lesions;
• To evaluate new concepts, surgical techniques, adapted physiotherapy and evaluation of the results;
• To assess – also in the patient’s perspectives - the innovative techniques, the clinical results and the complications;
• To formulate on these bases recommendations to the medical community;
• To discuss unsolved problems and possible solutions;
• To explore future directions of research.

F. Schuind
Erasme University Hospital, Brussels, Belgium
ORGANIZING COMMITTEE

PROGRAM DIRECTOR

F. Schuind, MD, PhD
Department of Orthopaedics and Traumatology
Erasme University Hospital
Route de Lennik 808, B-1070 Brussels, Belgium
Tel. +32 2 555 36 45
E-mail: scientific@kingconventions.be

SCIENTIFIC DIRECTORS

F. Schuind (Brussels, Belgium)
J. Bahm (Brussels, Belgium and Aachen, Germany)
K. Cermak (Brussels, Belgium)
R. van Riet (Deurne and Brussels, Belgium)

INTERNATIONAL FACULTY

P. Amadio (Rochester, MN, USA)
J. Bahm (Aachen and Brussels, Germany and Belgium)
O. Barbier (Brussels, Belgium)
E. Brassinne (Brussels, Belgium)
K. Cermak (Brussels, Belgium)
V. Creteur (Brussels, Belgium)
L. De Smet (Leuven, Belgium)
K. Drossos (Brussels, Belgium)
W. El Kazzi (Brussels, Belgium)
V. Feibel (Brussels, Belgium)
F. Handelberg (Brussels, Belgium)
P. Hemigou (Paris, France)
M. Jayankura (Brussels, Belgium)
J. Leijnse (Brussels, Belgium)
F. Mulpas (Brussels, Belgium)
N. Pouliart (Brussels, Belgium)
Ch. Robert (Brussels, Belgium)
F. Schuind (Brussels, Belgium)
M. Shahabpour (Brussels, Belgium)
P.N. Soucacos (Athens, Greece)
R. van Riet (Deurne and Brussels, Belgium)
A. Van Tongel (Ghent, Belgium)
O. Verborgt (Deurne, Belgium)
D. Warwick (Southampton, United Kingdom)
INFORMATION FOR PARTICIPANTS

Welcome to Belgium. We hope that you had a pleasant journey and that your stay in Genval will be enjoyable. Please, read this important information.

BADGES
Your badge should be worn at all times.

OPENING HOURS OF THE REGISTRATION DESK
Thursday, January 23, 2014: 18.00 - 19.00
Friday, January 24, 2014: 07.30 - 17.00
Saturday, January 25, 2014: 07.30 - 17.00

LUNCHES
On Friday and on Saturday, lunch will be served at the Château. The price is included in the registration fee.

CONTINUING MEDICAL EDUCATION CREDIT
A certificate will be provided to interested participants. We will send the certificate to the participants who wish to receive this document, when available.

INFORMATION FOR PRESENTERS

We would like to draw your attention to the following points:

• The allocated time of presentation should be strictly respected.
• The standard presentation format is by computer. The audiovisual projection system in the meeting room will include a Personal Computer (PC) along with PowerPoint for Windows and USB port. Request to use any equipment other than this must be arranged at the presenter’s expense.

Each presenter should check with the technician 20 min before the session, and introduce himself to the moderators of the session. The technician will be available in the meeting room from 07h45 on both congress days. There will be a laser pointer at your disposal.

SOCIAL PROGRAMME

Friday, 24 January 2014
Chocolate Workshop and Congress Dinner Le Tomate Rouge
18h30-23h00

Discover all the fascinating secrets of spices and chocolate. There’s no better place to enjoy chocolate demonstrations and chocolate workshops than in a Belgian chocolate shop. Not only do you get to learn about chocolate and see how chocolate is made, you get to taste it and even make it yourself!
The restaurant Le Tomate Rouge offers a unique restaurant experience rooted in timeless interior design and a balanced approach to sourcing, preparing and enhancing food.
ACKNOWLEDGEMENTS

Frédéric Schuind, Director of the Symposium, and the Members of the Organizing Committee, gratefully acknowledge the following Authorities, companies and individuals for their precious support:

- the **FNRS** ("Fonds National Recherche Scientifique")
- **Companies**

**Platinum Partner**
- Novel GmbH

**Gold Partners**
- Biomet Belgium
- DePuy Synthes
- DJO Benelux
- Orfit Industries
- Smith & Nephew
- Vigo

**Silver Partners**
- Aleamed
- Duomed
- Stryker

**SYMPOSIUM SECRETARIAT**

King Conventions bvba
Korte Meer 18 - Belgium, 9000 Ghent
Tel: +32 (0)9 235 22 95   Fax: +32 (0)9 233 85 97   Email: info@kingconventions.be
SCIENTIFIC PROGRAMME
<table>
<thead>
<tr>
<th>Time</th>
<th>Session</th>
</tr>
</thead>
<tbody>
<tr>
<td>07.30 - 17.00</td>
<td>Registration</td>
</tr>
<tr>
<td><strong>08.30 – 10.15</strong></td>
<td><strong>SESSION 1: AN INTRODUCTION TO THE SYMPOSIUM (1)</strong></td>
</tr>
<tr>
<td></td>
<td>Moderators: P. Amadio, M. Jayankura</td>
</tr>
<tr>
<td>08.30</td>
<td><strong>Opening Address</strong></td>
</tr>
<tr>
<td></td>
<td>F. Schuind (Brussels, Belgium)</td>
</tr>
<tr>
<td>08.35</td>
<td><strong>Basic Tendon Biomechanics</strong></td>
</tr>
<tr>
<td></td>
<td>V. Feipel, S. Van Sint Jan, M. Rooze (Brussels, Belgium)</td>
</tr>
<tr>
<td>08.50</td>
<td><strong>Flexor Tendon Forces – an Update</strong></td>
</tr>
<tr>
<td></td>
<td>F. Schuind (Brussels, Belgium)</td>
</tr>
<tr>
<td>09.05</td>
<td><strong>Imaging of Chronic Overuse Injuries of the Wrist Tendons</strong></td>
</tr>
<tr>
<td></td>
<td>M. Shahabpour, S. Doering, C. Boulet, M. De Maeseneer (Brussels, Belgium)</td>
</tr>
<tr>
<td>09.20</td>
<td><strong>Physiopathology of Rotator Cuff Tears. Why, How, and in which Individuals?</strong></td>
</tr>
<tr>
<td></td>
<td>F. Handelberg (Brussels, Belgium)</td>
</tr>
<tr>
<td>09.35</td>
<td><strong>Flexor Tendon Sheath Infections of the Hand</strong></td>
</tr>
<tr>
<td></td>
<td>O. Barbier, X. Libouton, J.C. Yombi (Brussels, Belgium)</td>
</tr>
<tr>
<td>09.50</td>
<td><strong>Discussion</strong></td>
</tr>
<tr>
<td>10.15</td>
<td><strong>Coffee-Break and Visit of the Commercial Exhibition</strong></td>
</tr>
<tr>
<td><strong>10.45 – 12.30</strong></td>
<td><strong>SESSION 2: AN INTRODUCTION TO THE SYMPOSIUM (2)</strong></td>
</tr>
<tr>
<td></td>
<td>Moderators: P.N. Soucacos, F. Schuind</td>
</tr>
<tr>
<td>10.45</td>
<td><strong>Mesenchymal Stem Cells are Useful for Open Re-Surgery to Treat Degenerative Recurrent Rotator Cuff Tears</strong></td>
</tr>
<tr>
<td></td>
<td>P. Hernigou (Paris, France)</td>
</tr>
<tr>
<td>11.00</td>
<td><strong>Enhancement of Tendon Healing by Genic Therapy</strong></td>
</tr>
<tr>
<td></td>
<td>M. Jayankura (Brussels, Belgium)</td>
</tr>
<tr>
<td>11.15</td>
<td><strong>Tissue Engineering to Improve the Results of Tendon Repair, Tenolysis, and Grafting</strong></td>
</tr>
<tr>
<td></td>
<td>P.C. Amadio (Rochester, MN, USA)</td>
</tr>
<tr>
<td>11.30</td>
<td><strong>Rehabilitation Protocols after Flexor Tendon Repair</strong></td>
</tr>
<tr>
<td></td>
<td>Ch. Robert, D. Mouraux (Brussels, Belgium)</td>
</tr>
</tbody>
</table>
11.45 010 Conservative Treatment for Shoulder Impingement  
E. Brassinne, M. Tits (Brussels, Belgium)

12.00 Discussion

12.30 Lunch and Visit of the Commercial Exhibition

<table>
<thead>
<tr>
<th>Time</th>
<th>Session 3: Degenerative Tendon Lesions at the Elbow (1)</th>
</tr>
</thead>
</table>
| 14.00 | Biomechanics of Biceps at Elbow  
F. Moungondo, A. Andrzejewski, R. van Riet, V. Feipel, M. Rooze, F. Schuind (Brussels, Belgium) |
| 14.10 | Role of Lacertus Fibrosus  
O. Snoeck, P. Lefèvre, P. Salvia, B. Beyer, J. Coupier, V. Feipel, S. van Sint Jan, F. Moiseev, V. Sholukha, M. Rooze (Brussels, Belgium) |
| 14.20 | Discussion |
| 14.25 | Epicondylosis  
D. Warwick (Southampton, United Kingdom) |
| 14.35 | Epicondylitis: Is There a Tendon Disease?  
J. Bahm, S. Vossen (Aachen, Germany and Brussels, Belgium) |
| 14.50 | Radiographic Abnormalities in Epicondylitis  
P.B. De Keyzer, S. Huijs, R. van Riet (Deurne, Brussels, Belgium) |
| 15.05 | Discussion |
| 15.15 | Professional Overuse Tendon Diseases. Epidemiology in Belgium  
D. Ayadi (Brussels, Belgium) |
| 15.25 | Discussion |
| 15.30 | Coffee-Break and Visit of the Commercial Exhibition |
16.00 – 17.15  SESSION 4: DEGENERATIVE TENDON LESIONS AT THE ELBOW (2)

Moderators: Ph. Hernigou, J. Bahm

16.00 017 Effectiveness and Cost-Effectiveness of Conservative Interventions for Tendinopathy
L. Long, S. Briscoe, C. Cooper, C. Hyde, L. Crathorne (Exeter, United Kingdom)

16.10 Discussion

16.15 018 Diagnosis and Treatment of Biceps Tendon Lesions
D. Warwick (Southampton, United Kingdom)

16.30 019 Distal Biceps Endoscopy: a Cadaveric Feasibility Study
I. Kormpakis, L. Galatz, M. Vanhees, R. van Riet (Deurne, Brussels, Belgium and St. Louis, MO, USA)

16.40 020 Operative Treatment of the Distal Biceps Brachii Tendon
J. Rois, G. Gudernatsch, L. Greiner, J. Russe, A. Meznik (Vienna, Austria)

16.50 Discussion

17.00 021 Triceps Ruptures
R. van Riet (Deurne, Brussels, Belgium)

17.10 Discussion

17.15 – 18.00  SESSION 5: BIOMECHANICS OF TENDONS, EPIDEMIOLOGY, TENDON DEGENERATION AT THE ELBOW - ROUND TABLE AND CASE PRESENTATIONS - DISCUSSION OF POSTERS

Moderators: V. Feipel, O. Barbier

18.30 – 23.00 Social Program: Chocolate Workshop and Dinner

POSTERS

P1 052 Shortening Osteotomy and Flexor-Extensor Tendon Balance
B. Craggs, B. Vanmierlo, C. Goorens, M. Hamdi (Brussels, Belgium)

P2 053 Oppositely Located Palmaris Longus Muscle Forming a Mass in the Distal Forearm: A Case Presentation
F. Eren, C. Melikoglu, D. Kok, S. Iskender, E. Ulkur (Ankara, Istanbul, Turkey)

P3 054 Triceps Brachii Distal Tendon Reattachment with a Double-Row Technique
Z.T. Kokkalis, A.F. Mavrogenis, P.N. Soucacos, D.G. Sotereanos (Athens, Greece)
SATURDAY, JANUARY 25, 2014

08.00 – 10.00  SESSION 6: DEGENERATIVE TENDON LESIONS AT THE SHOULDER

Moderators: O. Verborgt, K. Cermak

08.00  022  Variations of the Intra-Articular Portion of the Long Head of the Biceps Tendon. A Classification of Embryologically Explained Variations
C. Dierickx, E. Ceccarelli, M. Conti, J. Vanlommel, A. Castagna (Hasselt, Belgium and Milano, Italy)

08.10  023  Function of Long Head of Biceps: Implications for its Treatment
O. Verborgt, P.B. De Keyzer, G. Declercq (Antwerp, Belgium)

08.25  Discussion

08.35  024  Will the Long Head of the Biceps Survive? Current Attitude for Lesions of the Biceps Long Head
F. Mulpas (Brussels, Belgium)

08.50  Discussion

08.55  025  Rotator Cuff Lesions: To Repair or Not to Repair
N. Pouliart, B. Staelens (Brussels, Belgium)

09.10  026  Techniques of Surgical Repair of the Rotator Cuff – Update
K. Cermak (Brussels, Belgium)

09.25  027  Biologic Patches for Augmentation of Rotator Cuff Repair
Z.T. Kokkalis (Athens, Greece)

09.35  Discussion

09.40  028  Tendon Transfers around the Shoulder Girdle
A. Van Tongel, L. De Wilde (Ghent, Belgium)

09.55  Discussion

10.00  Coffee-Break and Visit of the Commercial Exhibition
### 10.30 – 12.50  SESSION 7: DEGENERATIVE TENDON LESIONS AT THE HAND AND WRIST

Moderators: P. Amadio, L. De Smet

<table>
<thead>
<tr>
<th>Time</th>
<th>Session</th>
<th>Title</th>
<th>Authors</th>
</tr>
</thead>
<tbody>
<tr>
<td>10.30</td>
<td>029</td>
<td>Anatomical Variations of Extensor Tendons</td>
<td>V. Feipel, J. Monot, N. Vanmuylder, M. Rooze (Brussels, Belgium)</td>
</tr>
<tr>
<td>10.40</td>
<td>030</td>
<td>Why Juncturae Tendinum in the Finger Extensors?</td>
<td>J.N. Leijnse (Brussels, Belgium)</td>
</tr>
<tr>
<td>10.55</td>
<td></td>
<td>Discussion</td>
<td></td>
</tr>
<tr>
<td>11.05</td>
<td>031</td>
<td>Relationship between ECRB and ECRL Tendons and Scaphoid</td>
<td>A. Elsaftawy, J. Jablecki (Trzebnica, Poland)</td>
</tr>
<tr>
<td>11.15</td>
<td></td>
<td>Discussion</td>
<td></td>
</tr>
<tr>
<td>11.20</td>
<td>032</td>
<td>Hand and Wrist Ultrasonography. Application to Tendons</td>
<td>V. Creteur, S. Pather, K. Cermak (Brussels, Belgium)</td>
</tr>
<tr>
<td>11.35</td>
<td></td>
<td>Discussion</td>
<td></td>
</tr>
<tr>
<td>11.40</td>
<td>033</td>
<td>Indications of Synovectomy in Degenerative Tendon Conditions</td>
<td>J. Bahm (Aachen, Germany and Brussels, Belgium)</td>
</tr>
<tr>
<td>11.50</td>
<td>034</td>
<td>Flexor Pollicis Longus Attrition Rupture. A rate of 0.3% in 1687 Volar Plate Fixations of Distal Radius Fractures</td>
<td>L.P. Larsen, P.V. Madsen (Aalborg, Denmark)</td>
</tr>
<tr>
<td>12.00</td>
<td></td>
<td>Discussion</td>
<td></td>
</tr>
<tr>
<td>12.05</td>
<td>035</td>
<td>Genetics of Carpal Tunnel Syndrome</td>
<td>M. Burger, H. de Wet, M. Collins (Cape Town, South Africa)</td>
</tr>
<tr>
<td>12.15</td>
<td>036</td>
<td>Ultrasound Imaging as a Biomarker. Can it Help Indicate Treatment for Patients with Carpal Tunnel Syndrome?</td>
<td>P.C. Amadio (Rochester, MN, USA)</td>
</tr>
<tr>
<td>12.25</td>
<td>037</td>
<td>Our Experience with the USSR (Ulnar Superficial Slip Resection) for Recurrent Trigger Finger</td>
<td>L. De Smet (Leuven, Belgium)</td>
</tr>
<tr>
<td>12.40</td>
<td></td>
<td>Discussion</td>
<td></td>
</tr>
<tr>
<td>12.50</td>
<td></td>
<td>Lunch and Visit of the Commercial Exhibition</td>
<td></td>
</tr>
<tr>
<td>Time</td>
<td>Session</td>
<td>Title</td>
<td>Presenters</td>
</tr>
<tr>
<td>-------</td>
<td>----------</td>
<td>-------------------------------------------------------------------------------------------</td>
<td>-----------------------------------</td>
</tr>
<tr>
<td>13.45</td>
<td>038</td>
<td>Extensor Tendon Lacerations</td>
<td>D. Warwick (Southampton, United Kingdom)</td>
</tr>
<tr>
<td>13.55</td>
<td></td>
<td>Discussion</td>
<td></td>
</tr>
<tr>
<td>14.00</td>
<td>039</td>
<td>Metacarpophalangeal Arthrodesis as an Alternative to Reconstruction of the Flexor Pulley Apparatus in the Thumb. Case Description and Literature Review</td>
<td>L.P. Larsen, P.V. Madsen (Aalborg, Denmark)</td>
</tr>
<tr>
<td>14.05</td>
<td>040</td>
<td>Acute Flexor Tendon Repair in Zone 2. State of the Art in 2014</td>
<td>K. Drossos, N. Chahidi (Brussels, Belgium)</td>
</tr>
<tr>
<td>14.30</td>
<td>042</td>
<td>The Effect of Suture Preloading on the Force to Failure and Gap Formation after Flexor Tendon Repair</td>
<td>M. Vanhees, A. Thoreson, P.C. Amadio, K.N. An, C. Zhao (Rochester, MN, USA)</td>
</tr>
<tr>
<td>14.50</td>
<td>044</td>
<td>Preliminary Data of a Prospective Double-Blind, Randomized Concept Study of PXL01 in Hyaluronic Acid versus Placebo in Flexor Tendon Surgery</td>
<td>M. Wiig, M. Mahlapuu (Uppsala, Sweden)</td>
</tr>
<tr>
<td>15.00</td>
<td></td>
<td>Discussion</td>
<td></td>
</tr>
<tr>
<td>15.10</td>
<td>045</td>
<td>Locking Finger due to Partial Laceration of Flexor Digitorum Superficialis Tendon</td>
<td>Y. Seki, Y. Hoshino, H. Kuroda (Kamogawa City, Japan)</td>
</tr>
<tr>
<td>15.15</td>
<td></td>
<td>Discussion</td>
<td></td>
</tr>
<tr>
<td>15.20</td>
<td>046</td>
<td>Effects of Wrist Position on Maximum Flexion Force during Mobilization in a Kleinert Orthosis</td>
<td>A. Burssens, N. Schelpe, J. Vanhaecke, M. Dezillie, F. Stockmans (Kortrijk, Belgium)</td>
</tr>
<tr>
<td>15.30</td>
<td></td>
<td>Discussion</td>
<td></td>
</tr>
<tr>
<td>15.35</td>
<td></td>
<td>Coffee-Break and Visit of the Commercial Exhibition</td>
<td></td>
</tr>
</tbody>
</table>
16.05 – 17.15 SESSION 9: TENDON LACERATIONS AT THE HAND AND WRIST (2)

Moderators: E. Vögelin, F. Moungondo

16.05 047 Wide Awake Tendon Surgery
P.C. Amadio (Rochester, MN, USA)

16.15 048 Two-Stage Tendon Reconstruction in Zone II
P.N. Soucacos, Z. Kokkalis (Athens, Greece)

16.30 049 Flexor Tendon Pulley Reconstruction after Previous Surgery of the Flexor Tendon System
N. Badur, B. Juon, E. Vögelin (Bern, Switzerland)

16.40 Discussion

16.50 050 Effect of Tenolysis on Adhesion after Flexor Tendon Suture in an In Vivo Dog Model
Y. Mimata, J. Nishida, Y. Matsuo, T. Akasaka, M. Suzuki (Morioka, Japan)

17.00 051 Results One Year post Tenolysis in Hand Surgery
M. Rousié, N. Cuylits, K. Drossos, N. Chahidi, L. Kinnen, A. Lejeune, D. Lumens, S. Van Den Dungen, J.P. Moermans (Brussels, Belgium)

17.10 Discussion

17.15 – 18.00 SESSION 10: DEGENERATIVE AND TRAUMATIC TENDON LESIONS - ROUND TABLE AND CASE PRESENTATIONS - DISCUSSION OF POSTERS – SUMMARY AND CONCLUSIONS

Moderators: F. Schuind, J. Bahm, K. Cermak, R. van Riet

17.15 Ten Questions to the Floor and the Faculty

17.45 Summary and Conclusions
F. Schuind, J. Bahm, K. Cermak, R. van Riet (Brussels, Deurne, Belgium)

18.00 End of Symposium

POSTERS

P1 052 Shortening Osteotomy and Flexor-Extensor Tendon Balance
B. Craggs, B. Vanmierlo, C. Goorens, M. Hamdi (Brussels, Belgium)

P2 053 Oppositely Located Palmaris Longus Muscle Forming a Mass in the Distal Forearm: A Case Presentation
F. Eren, C. Melikoglu, D. Kok, S. Iskender, E. Ulkur (Ankara, Istanbul, Turkey)

P3 054 Triceps Brachii Distal Tendon Reattachment with a Double-Row Technique
Z.T. Kokkalis, A.F. Mavrogenis, P.N. Soucacos, D.G. Sotereanos (Athens, Greece)
SESSION 1: AN INTRODUCTION TO THE SYMPOSIUM (1)

001  Basic Tendon Biomechanics
     V. Feipel, S. Van Sint Jan, M. Rooze (Brussels, Belgium)

002  Flexor Tendon Forces – an Update
     F. Schuind (Brussels, Belgium)

003  Imaging of Chronic Overuse Injuries of the Wrist Tendons
     M. Shahabpour, S. Doering, C. Boulet, M. De Maeseneer (Brussels, Belgium)

004  Physiopathology of Rotator Cuff Tears. Why, How, and in which Individuals?
     F. Handelberg (Brussels, Belgium)

005  Flexor Tendon Sheath Infections of the Hand
     O. Barbier, X. Libouton, J.C. Yombi (Brussels, Belgium)
001 Basic Tendon Biomechanics

V. Feipel, S. Van Sint Jan, M. Rooze

Abstract not received in due time.
Direct measurement of tendon forces is difficult in the clinical setting. Biomechanical hand modelling allows the calculation of static forces during various isometric functions. In vivo dynamic forces during hand and wrist motion are largely unknown. In 1992, we published a study of the forces along intact tendons during passive and active motion of the wrist and fingers. The measurements had been performed in five patients operated for carpal tunnel syndrome. Tendon forces in the range of 0.1 to 0.6 kgf were measured during passive mobilization of the wrist; tendon forces up to 0.9 kgf were present during passive mobilization of the fingers; tendon forces up to 3.5 kgf were present during active unresisted finger motion. These results have been later on confirmed in other reports, and our article has been largely cited in publications dealing with flexor tendon repair. Indeed, especially for lesions in zone II, early passive and active motion rehabilitation protocols are currently recommended to improve tendon nutrition, healing and remodelling, to reduce adhesions’ formation and to ensure better functional results. The tendon repair should withstand the forces present during these motion protocols. It should be recalled that suture rupture is not the only issue (and the resistance of the suture changes according to the type of postoperative mobilization and the time since the repair): another issue is gap formation. Also, our measurements were done in patients with normal (or subnormal) gliding of the intrasynovial tendons, without tendon adhesions, without finger edema or other causes of increased resistance to finger mobilization.

Reference
003 Imaging of Chronic Overuse Injuries of the Wrist Tendons

M. Shahabpour, S. Doering, C. Boulet, M. De Maeseneer

Department of Radiology, Vrije Universiteit Brussel, Brussels, Belgium

Overuse injuries of the wrist tendons are commonly seen in many sports (particularly the ones that involve club or racquet use, such as tennis and golf, and repeated loading and stresses on the wrist, such as rowing and gymnastics) but also in manual workers. Ultrasonography and MR imaging are used to complement clinical and radiographic assessment in the diagnosis and management of these injuries. Ultrasound provides a reliable, noninvasive and dynamic method for detecting tendon tears. MR imaging is able to image accurately the tendons but also the surrounding bones, ligaments and nerves. The presentation will provide an overview of specific overuse injuries encountered in athletes and manual workers and review the MR imaging and sonographic appearances.

Most tendon pathology related to overuse is degenerative in nature (tendinosis, tendinopathy with or without tenosynovitis).

The most common sites of tendon pathology due to overuse are the first (abductor pollicis longus and extensor pollicis brevis) and sixth (extensor carpi ulnaris ECU) extensor compartments.

First-compartment tenosynovitis and tendinopathy, also known as de Quervain tenosynovitis, is commonly seen in rowing, racquet sports and weight trainers. It is also a common workplace-related repetitive-stress injury.

ECU overuse injuries are encountered in sports requiring repetitive wrist use such as rowing and tennis. They may also be associated with other ulnar-sided wrist pathologies, including tears of the TFCC. Dislocation and subluxation of the ECU tendon out of the ulnar groove is usually seen in golfers, tennis players and weightlifters. The diagnosis is often made on dynamic US manoeuvres with the wrist in supination.

Flexor tendinopathies also occur in golfers and racquet sport players and most commonly involve the flexor carpi radialis and the flexor carpi ulnaris.

Intersection syndrome occurs in sports that cause overuse and friction, such as rowing, racquet sports and skiing.

Reference: MR Imaging of Traumatic and Overuse Injuries of the Wrist and Hand in Athletes
Physiopathology of Rotator Cuff Tears. Why, How, and in which Individuals?

F. Handelberg
Department of Orthopedics, UMC-CHU St Pierre, Brussels – Vrije Universiteit Brussel –Université Libre de Bruxelles, Brussels, Belgium

Rotator cuff structure, anatomy and vascularisation play of course an important role in the development of tears. Different hypothesis concerning the origin of perforating tears were already described in 1931 by Codman and Ackerson: they distinguished trauma, weakness due to calcific bodies, constitutional cell necrosis and attritional wear as most important factors. Traumatic tears are mostly found in the anterior part of the cuff and appear frequently as a result of a gleno-humeral dislocation in a population older than 45 y. On the other hand degenerative tears can appear after minor trauma or repetitive micro-traumata in an older population.

The theory of constitutional necrosis was further developed by Charles Neer III and he described 3 stadia in combination with his famous “impingement” theory.

Later studies however showed that most of degenerative tears arise at the articular surface of the cuff and are frequently located more posterior.

Total perforating cuff tears are probably of multi-factorial origin and related to age, intrinsic weakness, overuse, extrinsic pressure and trauma, but probably a number of less known factors such as cell degeneration by autoimmune response or iatrogenic lesions(corticoids), but also smoking.

The natural history of cuff tears was extensively documented by K. Yamagushi and others have stressed the role of the biceps tendon.

The final outcome of a neglected tear has been called “cuff tear arthropathy” although this presentation is relatively rare (only 4% according to Neer) and the clinical and radiological picture is identical to the so-called Milwaukee Shoulder that some rheumatoid patients develop.
005  Flexor Tendon Sheath Infections of the Hand

O. Barbier, X. Libouton, J.C. Yombi

Abstract not received in due time.
SESSION 2: AN INTRODUCTION TO THE SYMPOSIUM (2)

006 Mesenchymal Stem Cells are Useful for Open Re-Surgery to Treat Degenerative Recurrent Rotator Cuff Tears
P. Hernigou (Paris, France)

007 Enhancement of Tendon Healing by Genic Therapy
M. Jayankura (Brussels, Belgium)

008 Tissue Engineering to Improve the Results of Tendon Repair, Tenolysis, and Grafting
P.C. Amadio (Rochester, MN, USA)

009 Rehabilitation Protocols after Flexor Tendon Repair
Ch. Robert, D. Mouraux (Brussels, Belgium)

010 Conservative Treatment for Shoulder Impingement
E. Brassinne, M. Tits (Brussels, Belgium)
006  Mesenchymal Stem Cells are Useful for Open Re-Surgery to Treat Degenerative Recurrent Rotator Cuff Tears

P. Hernigou  
*Hospital Henri Mondor, University Paris East, France*

**Purpose**

The frequency and treatment of recurrent rotator cuff (RC) tears are not clearly defined. Management of symptomatic re-ruptures remains a challenge to surgeons and if several options exist, long term results reports are not frequent. The objective of this study is to retrospectively evaluate the results of a technique using Mesenchymal Stem Cells (MSCs) and open surgery performed on 30 patients with symptomatic re-rupture (and tear size from 2.5 cm to 4.5 cm) of the rotator cuff, over a period of 5 years between 2005 and 2010. The purpose of this study was to compare the clinical, imaging, and revision outcomes of MSCs suture fixation with a control group treated with the same technique but without MSCs.

**Methods**

A case series of 30 consecutive patients with symptomatic re-rupture of the rotator cuff, over a period of 5 years between 2005 and 2010 performed with MSCs suture fixation in open rotator cuff repair was compared to an historic case matched (for tear size and tendon rupture) control series of 30 patients performed between 2000 and 2005 with the same technique but without MSCs. Patients were observed at 21 days and 3, 6 and 12 months and at the most recent follow up (average 5 years; range 3 to 8 years for MSCs group). End points for evaluation in each group included the reporting of adverse events; clinical results evaluated by applying the UCLA score and the ASES index and assessing muscle strength in abduction and external rotation; postoperative rotator cuff integrity evaluated by ultrasound and magnetic resonance imaging; number of re-re-operation for re-re-re-rupture; and histological analysis comparisons at the time of the first re-operation and of the second re-re-operations. For the MSCs group, MSCs were obtained from the iliac crest just prior to surgery and the number of MSCs that received each patient was evaluated.

**Results**

Statistically, the UCLA score; the ASES index; and muscle strength were significantly increased in both groups after surgery, but there was significant difference between the 2 groups. The muscle strength of the shoulder was significantly better in the MSCs group. At 3-year follow-up, intact rotator cuffs were found in 17 patients in the control group and 26 in the MSCs group, based on ultrasound and magnetic resonance imaging results. The number of patients who had re-re-operation was lower in the MSCs group (3 versus 10 in the control group). Tendon healing capability was correlated with the number of MSCs that received the patients evaluated at re-re-surgery.

**Conclusions**

Rotator cuff re-repair with MSCs fixation and open surgery showed better results in patients with recurrent rupture and large tear size (2.5 to 4.5 cm) in comparison with control without MSCs.
Degenerative or traumatic tendon injuries are extremely common but often heal poorly without restoring the normal function of the injured tissues. In other situations as flexor tendon injuries of the hand, repair is associate to adhesion formation which will restrain functional results. This failure to obtain optimal healing conditions prompts new approaches integrating recent advances in the comprehension of the tendon’s healing process at the cellular and molecular level. Several growth factors and cytokines have been shown to play a role in the tendon repair process. If different studies aiming to optimize the healing process have been done to deliver growth factors locally with encouraging histological and biomechanical results, the bio-availability of the mediators that were rapidly eliminated from the tissues was a main problem. Alternatively, gene transfer could be used to maintain locally at the healing area an adequate concentration of a specific substance, e.g. growth factors, by local expression of the corresponding transgene. Two modalities of delivery of gene into tendinous cells are available: the \textit{in situ} approach by direct injection of viral or non-viral vector into the tendon and the \textit{ex vivo} approach by \textit{in vitro} gene transfer in tendon derived cells (or stem cells) and secondary reinjection of transgene expressed cells into the tendon. We have developed both approach of gene transfer into tendon. Gene transfer in tendons has been successfully obtained with non viral and viral vector in different animal models. This permitted to efficiently express different mediators which were able to improve the tendon healing process in some models. Nevertheless, in this perspective, further investigations are still needed to assess the more efficient mediator(s). Mediators like PDGF, TGF-β, VEGF and bFGF could be considered for this purpose. More recently, BMP-13 (GDF-6), BMP-12 (GDF-7), Scleraxis and Membrane Type 1 matrix metalloprotease (MT1-MMP) gene transfer permitted to improve significantly the tendon repair process in animal models. Finally, as in natural healing where the repair process results from activation of a cascade of cytokine production, simultaneous or consecutive expression of gene coding for different mediators is another promising approach that has also to be developed.

The \textit{ex vivo} approach could be particularly of interest in situation of large rupture associated with tissular defect and degenerative tendons as presented in large rotator cuff lesions for instance. These last specific pathological conditions of large degenerative lesion prompted to develop new approaches combining tissue engineering, cell and gene therapy. This advocate for new composites combining a scaffold (collagen, polymer of polyglycolic acid, etc.) and transduced cells expressing gene coding for specific mediators enable to enhance the mechanical qualities of the repaired tendons. Favorable results were obtained by such a combined approach in a preliminary experiment of a rotator cuff tear in rats.

Yet, despite promising approach with significant histological and biomechanical results in animals’ experimentations, questions concerning the safety of gene therapy using viral vectors and the risk of immunological reaction to viral proteins must be correctly assessed before clinical application can be considered in human for non life-threatening pathology.
Tendon Disorders and Injuries at the Upper Limb: Basic Knowledge, Advances in Diagnosis and Treatment
January 24-25, 2014

008 Tissue Engineering to Improve the Results of Tendon Repair, Tenolysis, and Grafting
P.C. Amadio
Mayo Clinic, Rochester, MN, USA

Tendon repair and reconstruction remain important challenges to the hand surgeon. While results have improved, the typically reported outcome in zone 2 is still a finger that averages 80% or less of normal motion. When the tendon cannot be repaired, and must instead be reconstructed, results are even less good. New innovations promise to improve these results by increasing the strength of the repair, reducing the amount of friction created by the repair, improving tendon rehabilitation by better matching forces to requirements, accelerating the healing process, and engineering tendon grafts to more better approximate the normal function and physiology of the tendon they are replacing.

Tendon repair strength can be improved by the use of stronger suture material, better suture design, and even stronger knots. The use of locking loops and circumferential finishing sutures that are also locking are helpful.

Tendon friction can be reduced both by using lower profile sutures and by reducing bulk of the repair. Resection of one slip of the FDS can be a useful “trick” in this regard. “Wide awake” surgery can inform the surgeon if the repair meets specifications in the operating suite rather than in the clinic.

Postoperative therapy that matches forces within the “safe zone” of rehabilitation can reduce the risk of postoperative repair failure.

Tissue engineering offers great promise. Repairs and grafts can be lubricated to improve gliding and reduce adhesion formation. Growth factors and stem cells can accelerate healing.

A combination of these factors will likely result, before many more years, in tendon repair and reconstruction becoming highly reliable procedures, with faster recovery and better outcomes.

References [1-21]


For nearly half a century, improvement of surgery techniques allows early mobilization after flexor tendon repairs. Positive influence of stress on tendon healing is well documented, and tendon suture techniques can withstand protected mobilization. Immobilization provides a high rate of adhesion formation, tissues stiffness and fibrosis which will lead to unsatisfactory functional outcomes. Nevertheless, occasionally, immediate mobilization is contraindicated.

A few rehabilitation protocols for tendon repairs have been described but there is no consensus about the best approach. Patients with their own injury, surgery, physiologic and psychological response need of an adapted program. It is important to start from the first days using protective splints, control edema and pain and start the patient education. The rehabilitation program starts within 5 days with passive motion as described by Duran and Houser (1975), and then gentle active motion: first type “Place and hold” described by Cannon-Strickland (1985) then gradually increased as described by Small 1989; Elliot (1994)...

Several authors have proposed algorithms providing guidelines to progress in flexor tendon rehabilitation (Groth’s pyramid 2004; algorithm Sueoka 2008...)

The lag (the difference in passive and active ROM) can be used to guide clinical decision making when managing patients after flexor tendon repairs: If there is a difference of more than 15° (or 10%), it would mean the assumption of an adherent tendon. The lag provides guidance for the progression of exercises. If the lag is less of 5°, PTs will have to proceed with caution to avoid tendon rupture. An adapted workout exercises and a good patient education is the key of a good rehabilitation protocol.

References
Impingement syndrome (IS) is the most diagnosed shoulder pain disorder and disability in primary health care. The impingement syndrome represents a spectrum of pathologies. Prevalence is known to increase with computer workload or with participation in an overhead sport.

Currently, many authors describe two types of impingement: subacromial and internal. The subacromial impingement is now understood as a much broader category than those described by Neer, such as the mechanical compression of the soft tissues (bursa, rotator cuff tendons, long head of the biceps brachii) underneath any structure of the coracoacromial arch (including the coracoacromial ligament).

The internal impingement consists of the mechanical encroachment of the rotator cuff tendons between the humeral head and the glenoid rim. The most common is the posterior internal impingement (first described by Walch), it is considered to be the primary cause of chronic shoulder pain in overhead athletes. Some authors have also described an anterior internal impingement, but less commonly discussed in the literature.

Many authors agree that the etiology is multi-factorial. The literature proposes different classification for the potential mechanism which will lead to an impingement syndrome, intrinsic or extrinsic factors, primary or secondary impingement. We will only discuss, in this paper, about the biomechanical factors which will be the cause of the consequence of the impingement.

These biomechanical factors are (Cools 2008; Ludwig 2011):

1. Inadequate rotator cuff activation or partial tearing, resulting in a cranial migration of the humeral head
2. Scapular dyskinesia, due to inadequate serratus activation, excess upper trapezius activation, pectoral minor and major tightness, leads to a lack of upward rotation, posterior tilting and external rotation of the scapula during arm elevation (the claviculus is also involved in these mechanisms)
3. Posterior capsule tightness results in a greater scapular anterior tilt, a gleno humeral internal rotation deficit (GIRD) and a greater humeral superior translation.
4. The association between impingement and shoulder instability
5. Thoracic cyphosis or flexed posture leads to lesser scapular upward rotation.

We believe, as De Witte (2011): “that patients should be treated according to their predominant etiological mechanism(s)”. The key point for the physiotherapist is to diagnose, with his clinical assessment, which of these biomechanical factors is present to address an adequate treatment.

The application of techniques will be tailored specifically to the impairments identified during the clinical examination.

The manual techniques consist of:

- Strengthening the rotator cuff and scapular girdle muscles
- Manual therapy (Rhon), which must be considered for the stretching of the posterior capsule and pectoralis minor, mobilizing of the humeral head, and also for spinal mobilizations if necessary
- Motor control retraining exercises, which are also effective
- Home exercises must be given

There is a general consensus in the literature that a comprehensive and supervised rehabilitation programme with exercises and manual therapy is the first line of treatment of the shoulder impingement syndrome (Khan 2013, Hanraty 2012)
References:


SESSION 3: DEGENERATIVE TENDON LESIONS AT THE ELBOW (1)

011 Biomechanics of Biceps at Elbow
F. Moungondo, A. Andrezejewski, R. van Riet, V. Feipel, M. Rooze, F. Schuind (Brussels, Belgium)

012 Role of Lacertus Fibrosus
O. Snoeck, P. Lefèvre, P. Salvia, B. Beyer, J. Coupier, V. Feipel, S. van Sint Jan, F. Moiseev, V. Sholukha, M. Rooze (Brussels, Belgium)

013 Epicondylosis
D. Warwick (Southampton, United Kingdom)

014 Epicondylitis: Is There a Tendon Disease?
J. Bahm, S. Vossen (Aachen, Germany and Brussels, Belgium)

015 Radiographic Abnormalities in Epicondylitis
P.B. De Keyzer, S. Huijs, R. van Riet (Deurne, Brussels, Belgium)

016 Professional Overuse Tendon Diseases. Epidemiology in Belgium
D. Ayadi (Brussels, Belgium)
Biomechanics of Biceps at Elbow

F. Moungondo¹, A. Andrezejewski¹, R. van Riet¹, V. Feipel², M. Rooze³, F. Schuind¹

¹Department of Orthopaedics and Traumatology, ULB Erasme University Hospital, Brussels, Belgium, ²Laboratory of Functional Anatomy, Faculty of Motor Sciences, Brussels, Belgium, ³Université Libre de Bruxelles, Brussels, Belgium

Proximaly, Biceps brachii present two origins, the long head coming from its supraglenoid tubercle insertion and the short head coming from its the coracoid process insertion and this cleavage in two head persist up to the distal insertion of the muscle, distal biceps tendon presenting a lateral component corresponding to the long head and inserted proximaly and slightly dorsal on radial tuberosity and a medial component corresponding to the short head inserted more distal and anterior on radial tuberosity. These two components of parallel fascicles joined by a common paratenon are separated by an endotenon septum allowing an independent sliding of each one. Both components realize a 90° external rotation before their radial insertion. The effect of these components are quite different, the short head component being a more efficient flexor and, in pronation and neutral forearm positions, a more efficient supinator; the long head component being stronger supinator in supination. These differences enhance the importance to repair with correct location the long and short head component tendon to restore the biceps native function. Furthermore, the radial tuberosity offset contributes to naturally increase biceps brachii lever arm for forearm rotation.

Beside biceps motor action for the elbow flexion and the supination, bicipital insertion on the proximal radius bring to this muscle a further role in the stabilization of radiocapitellar joint. In the extended elbow, biceps tension produce a force component applying a compressive action on this joint but this force component decrease with elbow flexion and after 90° elbow flexion, the force component exerted by this muscle become distracting on the joint and stretch joint stabilizing structures as annular ligament and collateral lateral ligament opposing to anterior dislocation of the joint. Forearm rotation modulates these effects with some consequences on joint contacts. This highlights the importance of repair these structures after surgical approach for radial head osteosynthesis or arthroplasty.
012 Role of Lacertus Fibrosus

O. Snoeck, P. Lefèvre, P. Salvia, B. Beyer, J. Coupier, V. Feipel, S. van Sint Jan, F. Moiseev, V. Sholukha, M. Rooze

Abstract not received in due time.
013 Epicondylosis

D. Warwick
University of Southampton, United Kingdom

Pathology
The pathology in lateral or elbow pain is fibrous and vascular hyperplasia. The condition is essentially degenerative. It occurs spontaneously in middle aged people- it is rare below the age of 40 and over the age of 60. Symptoms can be provoked by unaccustomed overuse. There is scant evidence that occupation is a risk factor.

Terminology
There are several terms for tendon-related pain in the lateral or medial side of the elbow. Many of these terms are inappropriate, not least of which is the title of this talk!

There are no inflammatory cells, so the suffix “itis” (which means inflammation) is not suitable. So it is not tendonitis and it is not epicondylitis.

The term epicondalgia correctly describes pain (the Greek suffix algia) but the epicondyle, a bone prominence, is not involved. Similarly, the term epicondylosis cannot be correct either.

The condition may occur in Tennis or Golf players but not always; golfers often have tennis elbow and vice versa. So these terms are not suitable

The best term, to describe what is a degenerative condition of the tendon, is TENDINOSIS

Sites
In lateral tendinosis: The ECRB tendon is specifically involved, sometimes the EDC. In medial tendinosis, the common pronator-flexor origin is involved.

Diagnosis
Clinical tests will specifically stress these tendons actively and passively. There is tenderness directly over the affected tendon. The site is precise- if more diffuse or elsewhere, then another diagnosis should be considered.

Xrays are not needed but may occasionally show calcification. Ultrasound and MRI will confirm the diagnosis but again are not usually needed if the clinical diagnosis is secure.

Treatment
- Wait- the great majority recover by themselves over a few weeks or several months
- Analgesics
- Rest
- Modification of activity
- Training (eg golf or tennis coach)
- Splints alter proprioception
- GTN patches- short term benefit first three months, no long term benefit
- Botulinum Toxin effective for several weeks but 33% weakness and 15% paralysis (Wong et al Ann Int Med 2005; 143:793-7
- Extracorporeal Shock Wave Therapy: varying evidence, inconsistent results
• Platelet Derived Plasma- complex technique, evidence is weak, no better than placebo or cortisone at three months (Krogh et al 2013 Treatment of lateral epicondylitis with platelet rich plasma, glucocorticoid or saline- a randomised double blind placebo controlled trial)

• **Platelet Derived Plasma:** Evidence is fairly weak. Similar outcome to placebo at three months. Krogh et al 2013 Treatment of lateral epicondylitis with platelet rich plasma, glucocorticoid or saline- a randomised double blind placebo controlled trial Am J Sports Med. 2013 Mar;41(3):625-35

• **Surgery:** 80-% have a good result, simple operation with low morbidity. This can be performed by open surgery or by arthroscopic techniques.
014 Epicondylitis: Is There a Tendon Disease?

J. Bahm, S. Vossen

Abstract not received in due time.
Introduction

Lateral epicondylitis is one of the most common tendinopathies of the human body, with an incidence of 1-3% in the general population. It is typically found in patients between 40 to 50 years old with equal prevalence in men and women. It consists of a tendinosis of the common extensor tendon, more specifically to the extensor carpi radialis brevis, and is most likely to be caused by overuse. While epicondylitis is mostly a clinical diagnosis, additional imaging is often acquired. In general practice, radiographs and ultrasound are used because of their low cost and easy availability over MRI. Ultrasound has been shown to be very accurate in the detection of associated abnormalities, namely tendon thickening, hypoechoic regions, calcifications and diffuse heterogeneity. However, the added value of plain radiographs remains controversial. In the current study, we tried to determine whether radiography is of use in the differential diagnosis of lateral epicondylitis.

Experiment

We retrospectively reviewed radiographs of 111 cases of lateral epicondylitis, which were all confirmed on ultrasound. Our goal was to evaluate for abnormalities, with a primary focus on calcifications located around the lateral epicondyle. Subsequently, we evaluated whether these abnormalities were distributed normally in our population and if they could predict therapy resistance and therefore surgery. Interobserver agreement was determined to evaluate reproducibility of protocols.

Methods

166 consecutive patients with a medial or lateral epicondylitis confirmed on ultrasound were selected. From these, 111 patients with lateral epicondylitis and anteroposterior and lateral elbow radiographs were extracted for use in this study. Two reviewers, one experienced elbow surgeon and one 1st year trainee in orthopaedic surgery, evaluated each radiograph independently, blinded to any abnormalities found on ultrasound.

Results

111 patients were included. Mean age was 49y (28-91), of which 64% were men. 31 patients received surgery after initial conservative treatment. 27 patients (24,3%) had calcifications around the lateral epicondyle, while 5 had a calcification around the medial epicondyle. Twenty-five (22,5%) patients had an osteophyte at the coronoid tip. Five patients showed joint space narrowing. A traction spur at the olecranon was found in 15 patients.

No significant differences or correlations between radiographic abnormalities and age and sex were found. Furthermore there were no significant associations between patients who finally needed surgery and initial radiographic findings.

Reproducibility of radiographic evaluation was substantial to excellent with kappa scores of a minimum of 0,658 for most structures and fair agreement for anteroposterior joint space narrowing and anterior humeral osteophytes.
The Fund for Occupational Diseases (FOD) was created 50 years ago. It is a public institution in charge of prevention of the occupational diseases, protection and improvement of the workers’ health. The FOD evaluates and compensates the damages caused by the occupational diseases.

Occupational diseases are those caused directly and decisively by the exercise of a profession. The Belgian legislator has compiled an official list of more than 150 diseases. Since 1990, an “open system” was added to the “list system”. That system allows a worker to be recognized for a disease that is not on the list. However the open system obliges the victim to demonstrate for his individual case, a determining and direct causal relation between disease and occupational exposure. It is obviously difficult to bring such evidence, which explains a rather low rate of positive decisions (of the order of 15%).

The inscription of the tendinopathy on the official list of the FOD in November 2012 facilitates the compensation for the patients. Thanks to this decision, officialized in a royal decree published in the Belgian Monitor on 23 October 2012, the compensation for all the employees suffering of tendinopathy of the upper limb, caused by their work, is facilitated: they don’t have to prove that their affection is due to their work. This, of course, facilitates and curtails considerably the procedure of recognition of the disease and its compensation.

The professions most concerned by the tendinopathy are the construction workmen, the masons and tilers, the packers, the cleaning personnel and the cashiers. And according to the current data of the FOD, women are concerned as much as men by this affection.

In 2011, the FOD compensated 362 workers and in 2012, 1196 workers suffering from upper limb tendinopathy, via the open system (the worker victim must prove that his disease is caused by his work), which is largely under the European statistical projections.

For the FOD, the prevention plays a capital part. It is essential that the tendinopathy is correctly diagnosed as an occupational disease, in order to be able as soon as possible to set up an effective system of prevention on the place of work (ergonomic measurements, adaptation of the working stations and vocational rehabilitation in company…). This prevention will make it possible to the worker to keep his work, which is obviously capital, but also to exert it under more adapted conditions.
SESSION 4: DEGENERATIVE TENDON LESIONS AT THE ELBOW (1)

017 Effectiveness and Cost-Effectiveness of Conservative Interventions for Tendinopathy
L. Long, S. Briscoe, C. Cooper, C. Hyde, L. Crathorne (Exeter, United Kingdom)

018 Diagnosis and Treatment of Biceps Tendon Lesions
D. Warwick (Southampton, United Kingdom)

019 Distal Biceps Endoscopy: a Cadaveric Feasibility Study
I. Kompakis, L. Galatz, M. Vanhees, R. van Riet (Deurne, Brussels, Belgium and St. Louis, MO, USA)

020 Operative Treatment of the Distal Biceps Brachii Tendon
J. Rois, G. Gudernatsch, L. Greiner, J. Russe, A. Meznik (Vienna, Austria)

021 Triceps Ruptures
R. van Riet (Deurne, Brussels, Belgium)
Effectiveness and Cost-Effectiveness of Conservative Interventions for Tendinopathy

L. Long, S. Briscoe, C. Cooper, C. Hyde, L. Crathorne
Peninsular Technology Assessment Group, Exeter University Medical School, Veysey Building, Salmon Pool Lane, Exeter, United Kingdom

Introduction
Lateral elbow tendinopathy (LET) is associated with pain over the lateral epicondyle on gripping and manipulating the hand. (1) It is an overuse injury, caused by repetitive loading of the extensor tendons of the forearm where they attach at the lateral epicondyle. (2) LET is challenging to treat and prone to recurrent episodes. The average duration of a typical episode ranges from six to 24 months, with most (89%) reporting recovery by one year. (1, 3)

Objectives
This systematic review aims to summarise the evidence concerning the clinical and cost effectiveness of conservative interventions for LET by:

• Providing an overview of systematic reviews of the evidence for the clinical effectiveness of conservative interventions for the treatment of LET
• Identifying which RCTs could contribute further evidence to existing systematic reviews (included in the overview); and identify where there may be a need for a systematic review to synthesise evidence for newer treatments.
• Performing a systematic review of cost-effectiveness studies.

Methods
Medline, Embase, AMED, CINAHL, Web of Science, The Cochrane Library and other important databases were searched up to November 2012.

Results
29 systematic reviews published since 2003 matched our inclusion criteria. These were quality appraised independently by two reviewers using the AMSTAR (A Measurement Tool to Assess Systematic Reviews) checklist; five were considered high quality and evaluated using a Grading of Recommendations Assessment Development and Evaluation (GRADE) approach. 236 RCTs were identified that were not included in a systematic review; and 29 RCTs were identified that had only been evaluated in an included systematic review of intermediate/low quality. These were then mapped to existing systematic reviews where further evidence could provide updates. Two economic evaluations were identified.

Conclusions
In this overview of systematic reviews, we review the effectiveness of the following interventions: low level laser therapy, extracorporeal shock wave therapy, ultrasound, combination physiotherapy, exercise, glucocorticoid injection, botulinum toxin injection, sodium hyaluronate injection, ultrasound (sonographically) - guided injection of sclerosing solution, glycosaminoglycan polysulphate injection, prolotherapy. We present information relating to the effectiveness of acupuncture, “wait and see”/“watch and wait”, orthotics, Cyriax physiotherapy, soft tissue therapy, iontophoresis, cryotherapy, myofascial release, electrical stimulation, non-steroidal anti-inflammatory drugs, platelet-rich plasma injections and autologous blood injections.

Clinical effectiveness evidence from high quality systematic reviews continues to suggest uncertainty as to the effectiveness of many conservative interventions for the treatment of LET. Although new RCT evidence has been identified with either placebo or active controls there is uncertainty regarding size of effects reported within them due to small sample size. Conclusions regarding cost-effectiveness are also unclear. We consider that, while updated or new systematic reviews may also be of value, the primary focus should be on conducting large scale, good quality clinical trials using a core set of outcome measures (for defined time points), and appropriate follow-up. Subgroup analysis of existing RCT data may be beneficial to ascertain whether certain patient groups are more likely to respond to treatments.
2 The GRADE approach classifies the quality of evidence as high, moderate, low and very low. GRADE addresses many of the perceived shortcomings of existing models of evidence evaluation. Evidence is rated across studies for specific clinical outcomes.

References
Diagnosis and Treatment of Biceps Tendon Lesions

D. Warwick
University of Southampton, United Kingdom

Anatomy
The Lacertus Fibrosus (otherwise known as the bicipital fascia or bicipital aponeurosis) protects the underlying neurovascular structures and redirects the flexion force around the ulna. Biceps contributes to elbow flexion (along with brachioradialis and FCR-pronator teres and brachialis). Its main function is supination especially when the elbow is flexed (which reduced the function if its agonist Supinator muscle). If biceps tendon is ruptured, even without treatment flexion recovers to within 15% of normal due to hypertrophy of the other muscles. Power and endurance in supination are much more reduced as Supinator muscle cannot compensate adequately.

The long head of biceps inserts into the bicipital tuberosity more proximally and anteriorly than the short head. The latter has a better torque for supination passing over the tuberosity which acts as a cam. An anterior repair cannot easily achieve a posterior enough reinsertion of the tendon to restore the full potential supination. The article by Schmidt et al “The Distal biceps tendon” JHS (Am) 2013 38A: 811-821 is highly recommended.

Bursitis
There is a bursa which lies radial to the tendon. This bursa slides in the interosseous space on rotation. It allows the entry of a bursoscope for the diagnosis of chronic biceps tendonitis. The bursa can become inflamed. Treatment is along standard lines- rest, anti-inflammatories and cortisone injection

Chronic Tendinopathy
The biceps tendon can degenerate in time, as do other tendons in middle age (eg tennis elbow, Achilles tendon, rotator cuff). This can present with pain and then sometimes sudden rupture. The diagnosis is made by examination, MRI and sometimes bursoscopy. If non operative measures fail, the tendon remnants are excised from their insertion, the end is debrided and then formally reattached. Post-operative management is the same as for an acute rupture.

Acute Rupture
This usually occurs without warning in middle aged men who suddenly lift a heavy weight in supination. The diagnosis is clinical- delay for an MRI scan can compromise surgical intervention because the tendon retracts and scars, as well as occlusion of the interosseous space after two to four weeks. The hook sign is particularly helpful. The muscle belly retracts proximally unless inhibited by a particularly effective lacertus fibrosus.. Supination in flexion is particularly weak.

Treatment can be non-operative for those who are not suitable for surgery due to concurrent health problems, low functional demands or aversion to the inevitable risks of surgery (stiffness, nerve damage, infection, prominent scar). The functional outcome without treatment is not so poor- about 15% loss of flexion power and 30 to 50% loss of supination power. Loss of stamina can be a concern.

Reattachment can be through a single incision or double incision, The latter allows a more accurate biomechanical placement of eh tendon insertion and I s probably less hazardous to the posterior interosseous nerve. The theoretical higher risk of interosseous ossification is mitigated by a muscle splitting approach. Tendon insertion is biologically effective even with direct apposition to cortex. Insertion techniques include suture anchors, interference screws, endobuttons and a trough with bone sutures.

Post-operative management should allow pronation-supination to promote glide in the interosseous space but extension should be restricted and gradually increased over 6 weeks with an adjustable brace.

Delayed Treatment of rupture
Surgery becomes much more demanding after a few weeks. There is a higher risk of complications due to the scarred tissue planes and tendon retraction. After several weeks a graft may be needed. Hamstring grafts are perhaps the most suitable. The advantages and disadvantages of reconstruction must be balance carefully with the individual patient, bearing in mind the good results that can occur without surgery.
019 Distal Biceps Endoscopy: a Cadaveric Feasibility Study

I. Kormpakis¹, L. Galatz¹, M. Vanhees², R. van Riet²,³
¹Washington University, St. Louis MO, USA, ²AZ Monica, Antwerp, Belgium, ³Erasme University Hospital, Brussels, Belgium

Introduction
Biceps tendon ruptures are relatively uncommon with a reported prevalence of 1.2/100,000 per year. The diagnosis of a full rupture is usually made by clinical examination only. Radiographs, ultrasound and magnetic resonance scanning may aid the diagnosis but don’t always offer additional information. The opposite is true for partial distal biceps tendon tears, tendonitis and bicipital bursitis. These are more difficult to diagnose by clinical examination only, and imaging modalities are usually needed in these patients. Even then, it may prove to be difficult to differentiate between these pathologies. Even intra-operatively it is often difficult to estimate the percentage of tendon that is involved. Tears seem to initiate from the radial portion of the tendon. This is the portion facing the tuberosity and in order to inspect this side of the tendon, it needs to be dissected and retracted. This may potentially have a detrimental effect on the already weakened insertion. Biceps endoscopy has recently been developed in order to overcome this disadvantage.

Technique
A mini open approach is used to identify the tendon and its bursa. The 4.5 mm trocar is introduced into the bursa and advanced between the tendon and the bicipital tuberosity. The tendon can safely be evaluated and a decision on further treatment can be made, based on a direct inspection of the footprint. The technique and decision making process will be discussed using a video presentation.

The goal of the current experiment was to evaluate the safety of the endoscopic technique and to examine the possibility of developing a full endoscopic repair for partial and full distal biceps tendon ruptures.

Aim
To analyze accuracy and safety of endoscopic distal biceps repair.

Methods
Sixteen paired cadaveric specimens were used. A 2 cm anterior incision was made approximately 3 cm distal to the elbow crease. The scope was placed between the tendon and bicipital tuberosity. The tendon and insertion site were identified and injury created. Using an endobutton technique, 8 endoscopic repairs and 8 open repairs were performed. Open dissection was performed. Distances of neurovascular structures to the bicipital tuberosity were measured. Accuracy of tunnel placement was assessed. Distance between the PIN and endobutton was measured. Measurements were compared using Student’s T test.

Results
Brachial, recurrent radial, ulnar and radial arteries were an average of 19, 19, 1 and 3 mm from the tuberosity. Median nerve, superficial branch of the radial nerve and the PIN were an average of 10, 12 and 12 mm from the tuberosity. On the posterior aspect of the radius, average distance between PIN and endobutton was an average of 6 mm. There were no significant differences between the endoscopic and open technique, with regards to tunnel placement and distance to the PIN.

Conclusion
Endoscopic distal biceps repair is possible. Accuracy of tunnel placement and safety are similar to open techniques. Due to the close proximity of anterior neurovascular structures, the use of retractors is imperative when drills or shavers are used.
Operative Treatment of the Distal Biceps Brachii Tendon

J. Rois, G. Gudernatsch, L. Greiner, J. Russe, A. Meznik
Trauma Center Vienna, Meidling, UKH Meidling, Vienna, Austria

Purpose

Rupture of the distal biceps brachii tendon is an uncommon injury, representing only 3% of all biceps muscle injuries. Early diagnosis and treatment are critical to achieve the best possible clinical and functional results. The purpose of this retrospective study was to evaluate the outcome after distal biceps tendon repair.

Patients and Methods

Between 2000 and 2011, 97 patients with 98 complete ruptures of the distal biceps tendon were treated surgically. The records of these patients (96 men, 1 woman) with a mean age of 46.4 (29-66) years were reviewed. The surgical procedure was performed in 17 cases with a single incision technique with the use of a suture anchor and on the other hand (81 cases) the tendon was repaired in a double incision technique, transosseous refixation at the bicpital tuberosity of the radius without dissection between radius and ulna. The postoperative treatment consisted of elbow immobilization in 90° flexion on average of 5.8 weeks.

38 patients with 39 repairs (39.8%) could be located for final follow-up, 7 from the single incision and 32 from the double incision group. All these patients were evaluated by clinical examination including assessment of elbow mobility and measurement of supination strength, radiological investigation comprising of bilateral X-rays, as well as completion of the Disability of Arm, Shoulder and Hand (DASH) score.

Results

The mean follow-up time was 5.4 (1.5-11.9) years, the mean age of the patients at final follow-up was 51.5 (31-70) years. Active elbow motion averaged 0 degrees extension (100% as compared with the uninjured side) and 136 degrees flexion (99.2% as compared with the uninjured side). The average supination was 82 degrees (95.3 % as compared with the uninjured side) and the average pronation was 82 degrees (97.6% as compared with the uninjured side). Mean supination strength at final follow-up was 75% of the unaffected side. The mean DASH score was 8.2 (range 0-54.1). 4 patients complained of mild persistent dysesthesia referred to the area innervated by the lateral antebrachial cutaneous (2) and by the superficial radial nerve (2). The radiographs revealed heterotopic ossification along the distal biceps tendon in 20 cases (51%), with no uniform pattern. These heterotopic ossifications did not lead to functional impairment.

Summary

Unrepaired complete rupture of the distal biceps tendon frequently leaves the patient with substantial weakness of supination and elbow flexion. Despite the observed complications in our study patients provided satisfactory subjective and objective clinical results. On the basis of our results we advocate early surgical repair, particularly in young physically active individuals.
Definition

Triceps tendinitis and ruptures are rare in comparison to the other tendons attaching to the elbow. It can occur in patients with heavy manual laborers or people that are bound to a wheelchair and use their arms to bear weight. A rupture can also occur traumatically due to a fall on the outstretched hand. The sudden eccentric contraction can avulse the tendon, with or without a fleck of bone, from the olecranon. Some systemic diseases and the (ab)use of corticosteroids will also increase the risk of a triceps tendon rupture.

The natural history of a triceps tendinitis is unknown. Nonoperative measures are preferred and a minimum of six months of specific conservative treatment is recommended before a rare surgical intervention may be considered.

Diagnosis

Tendinosis

The elbow is usually stable with a full range of motion. Mild pain may be present with flexion due to a stretching of the tendon. Resisted extension is usually painful. Strength may be reduced but this can sometimes be subtle and only caused by pain. The insertion at the olecranon is often painful with deep palpation. Contraction of the triceps during palpation will increase the pain. Radiographs are usually normal but a traction spur may be present. This traction spur may be fractured and a cause for the tendonitis or refractory bursitis. Ultrasound or MRI can confirm the diagnosis.

Rupture

Sudden pain during an eccentric contraction is typical of a triceps tendon rupture. This can occur traumatically such as with a fall on the outstretched hand or a motor vehicle accident but can also occur during normal everyday activities. The acute diagnosis is often missed because extension strength can be preserved to some degree. Palpation is often difficult due to extensive swelling.

Radiographs can show a bony avulsion of the olecranon. Ultrasound and MRI will confirm the diagnosis.

Even complete ruptures of the triceps tendon are often misdiagnosed leading to late referrals of these patients. Treatment and surgical options depend on the time passed between the injury and the operation.

Surgical procedure

The operative technique depends on the pathology and will differ when dealing with a for example a traction spur or an acute or chronic rupture. The procedure can be performed under locoregional or general anesthesia.

The treatment of a triceps tendon rupture depends on the quality of the tissue and the amount of retraction of the tendon. In practice this means that the treatment is influenced by the time between the rupture and the surgical treatment.
A posterior incision is made. The proximal ulna and the tendon stump are visualized. In acute cases, the stump can easily be identified. Some lateral or medial fibers are often still attached to the olecranon, with the central part of the tendon completely avulsed. The repair can be done by bone anchors but we prefer to perform a transosseous repair through bone tunnels in the proximal ulna. The tendon is pulled back to its insertion and fixed with multiple non-resorbable strong sutures. In chronic cases, it may be necessary to debride a large amount of scar tissue.

It may not always be possible to lengthen the triceps sufficiently to fix it back to the proximal ulna.

An interposition with an allograft tendon may be necessary in these cases. Due to the shape of the Achilles tendon, it is the optimal graft for a triceps tendon reconstruction.

**Postoperative protocol**

The risk of a recurrence of the triceps tendinosis is high after removal of a traction spur. The elbow is therefore immobilized for two weeks in a lightweight removable splint. Mobilization of the elbow starts at two weeks and loading of the triceps is permitted after 6 weeks. Full use of the arm is only permitted after 3 months.

The postoperative protocol after a repair or reconstruction depends on the strength and the quality of the tissues and the fixation. If the strength of the repair is considered to be insufficient, it may be necessary to, besides not allowing load on the triceps, limit the amount of flexion of the elbow. This can be done by temporary immobilization in a splint or by using a dynamic elbow brace that can be blocked in certain degrees of flexion and extension. Complete flexion and stretching of the tendon will not be allowed until six weeks after surgery. If it is decided that the quality of the tissue and the repair are sufficient, the patient will be allowed to mobilize the elbow immediately as tolerated. Resisted extension will not be allowed for six weeks.
SESSION 6: DEGENERATIVE TENDON LESIONS AT THE SHOULDER

C. Dierickx, E. Ceccarelli, M. Conti, J. Vanlommel, A. Castagna (Hasselt, Belgium and Milano, Italy)

023 Function of Long Head of Biceps: Implications for its Treatment
O. Verborgt, P.B. De Keyzer, G. Declercq (Antwerp, Belgium)

024 Will the Long Head of the Biceps Survive? Current Attitude for Lesions of the Biceps Long Head
F. Mulpas (Brussels, Belgium)

025 Rotator Cuff Lesions: To Repair or Not to Repair
N. Pouliaert, B. Staelens (Brussels, Belgium)

026 Techniques of Surgical Repair of the Rotator Cuff – Update
K. Cermak (Brussels, Belgium)

027 Biologic Patches for Augmentation of Rotator Cuff Repair
Z.T. Kokkalis (Athens, Greece)

028 Tendon Transfers around the Shoulder Girdle
A. Van Tongel, L. De Wilde (Ghent, Belgium)

C. Dierickx¹ E. Ceccarelli², M. Conti², J. Vanlommel¹, A. Castagna²
¹ Virga Jesseziekenhuis, Hasselt, Belgium, ² Istuto Clinico Humanitas Rozzano, Milano, Italy

Background:
Although the intra-articular portion of the long head of the biceps (LHB) usually runs free, different types of fusions with the inferior surface of the capsule are known to be possible. Anatomic variations of this part of the LHB have been previously described and were nearly always considered to be innocent.

Materials and Methods:
Out of 2 populations of 1500 arthroscopies each, we collected prospectively and retrospectively all possible variations of the proximal portion of the LHB.

Results:
We included 57 cases (1.91%) of this total population in an attempt to describe the complete range of these form variants: the simple vinculum or pulley-like sling, the partial or complete mesotenon between biceps and capsule, the complete adherent LHB, the double-tendon origin, the reversed-type split-tendon, and the complete absence of the LHB. We suggest a classification of 12 variations of the intra-articular portion of the LHB.

Discussion:
By taking into account an extensive literature review, we suggest that these conditions are congenital and consider them as a result of partial detachment from the mesothelial or synovial fusion with the inferior surface of the capsule. The incidence of these variants and their associated pathologies are investigated.

Conclusion:
By offering this new classification and a physiopathologic hypothesis, we try to explain why some of these anatomic variants may also acquire a pathologic significance.
<table>
<thead>
<tr>
<th>Table II: Classification of Variations of the Intra-articular Portion of the Long Head of the Biceps</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Mesotenon (MESO)</strong></td>
</tr>
<tr>
<td><strong>MESO-VI (vixinum)</strong></td>
</tr>
<tr>
<td>Fine string, providing vascularity to the tendon.</td>
</tr>
<tr>
<td><strong>MESO-SB (small band)</strong></td>
</tr>
<tr>
<td>Small synovial band from medial to lateral, connecting the rotator cuff with the biceps. They are never on stress.</td>
</tr>
<tr>
<td><strong>MESO-PU (pulley-like sling)</strong></td>
</tr>
<tr>
<td>Pulley or hammock-like sling, whereby the biceps can move or slide freely up and down.</td>
</tr>
<tr>
<td><strong>MESO-PA (partial mesotenon)</strong></td>
</tr>
<tr>
<td>A hammock-like synovial sling in which the biceps tendon is able to move but not to glide.</td>
</tr>
<tr>
<td><strong>MESO-PO (complete mesotenon)</strong></td>
</tr>
<tr>
<td>The biceps tendon runs in a synovial sheath that is connected, loose woven but well vascularized, to the inferior surface of the capsule. No sliding is possible.</td>
</tr>
<tr>
<td><strong>Adherent (ADH)</strong></td>
</tr>
<tr>
<td><strong>ADH-PM (partially adherent to the SSP)</strong></td>
</tr>
<tr>
<td>A partial but strong medial adhesion runs cranial and medial to the inferior surface of the capsule. This fan-wise expansion to the articular side of the SSP tendon stops laterally and does not involve the adductor. This type of adhesion becomes taut on the abduction maneuver and will usually give a downward and inferior traction on the rotator cuff.</td>
</tr>
</tbody>
</table>

(continued on next page)
<table>
<thead>
<tr>
<th>Classification</th>
<th>Description</th>
<th>Patients, %</th>
<th>Illustrations</th>
<th>Arthroscopic examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADH-PL (partially laterally adherent to the SSPl)</td>
<td>The adhesion is laterally located and involves also the rotator cuff tendons. This adhesion becomes taut on abduction. The medial portion of the LHB is free from the upper synovial layer and will relax on abduction. This gives an hourglass-type of impression of the free medial portion of the LHB between humeral head and glenoid, well seen during dynamic arthroscopic inspection.</td>
<td>5.3(^{\dagger})</td>
<td><img src="image1.png" alt="Illustration 1" /> <img src="image2.png" alt="Illustration 2" /></td>
<td><img src="image3.png" alt="Arthroscopic example 1" /> <img src="image4.png" alt="Arthroscopic example 2" /></td>
</tr>
<tr>
<td>ADH-CL (complete adherent: attaching to the labrum)</td>
<td>No mototenon is visible instead of a taut synovial covering runs in front of and behind the biceps tendon in continuity with the capsular synovium. The biceps tendon, formalizing or the upper labrum, appears no longer to be able to move up and down during the abduction maneuver in this extracapsular position.</td>
<td>8.8(^{\dagger})</td>
<td><img src="image5.png" alt="Illustration 1" /> <img src="image6.png" alt="Illustration 2" /></td>
<td><img src="image7.png" alt="Arthroscopic example 1" /> <img src="image8.png" alt="Arthroscopic example 2" /></td>
</tr>
<tr>
<td>ADH-CD (complete adherent to SSPl not attaching to the labrum)</td>
<td>A complete adherent course, without extension to the upper labrum, was only seen in a case with full-thickness SSPl tear. The biceps tendon was located in the mass of the rotator cuff (SSPl tendon).</td>
<td>1.7</td>
<td><img src="image9.png" alt="Illustration 1" /> <img src="image10.png" alt="Illustration 2" /></td>
<td><img src="image11.png" alt="Arthroscopic example 1" /> <img src="image12.png" alt="Arthroscopic example 2" /></td>
</tr>
<tr>
<td>SPl-DO (split biceps double origin)</td>
<td>The biceps partially originates from the inferior surface of the SSPl, partially from the glenoid, and joins before the bicapital groove. This extra band gets tight in abduction.</td>
<td>15.6</td>
<td><img src="image13.png" alt="Illustration 1" /> <img src="image14.png" alt="Illustration 2" /></td>
<td><img src="image15.png" alt="Arthroscopic example 1" /> <img src="image16.png" alt="Arthroscopic example 2" /></td>
</tr>
<tr>
<td>SPl-RE (split biceps reversed type)</td>
<td>Besides the loose-woven mototenon there is also a part that is clearly firmer and harder, running out from the biceps tendon, then laterally to the inferior surface of the capsule. This type of adhesion relaxes upon the abduction maneuver when the SSPl tendon moves medially and the biceps glides laterally.</td>
<td>3.5(^{\dagger})</td>
<td><img src="image17.png" alt="Illustration 1" /> <img src="image18.png" alt="Illustration 2" /></td>
<td><img src="image19.png" alt="Arthroscopic example 1" /> <img src="image20.png" alt="Arthroscopic example 2" /></td>
</tr>
<tr>
<td>Absent biceps (ABS)</td>
<td>A complete absence of the LHB</td>
<td>3.5(^{\dagger})</td>
<td><img src="image21.png" alt="Illustration 1" /> <img src="image22.png" alt="Illustration 2" /></td>
<td><img src="image23.png" alt="Arthroscopic example 1" /> <img src="image24.png" alt="Arthroscopic example 2" /></td>
</tr>
</tbody>
</table>

LHB, Long head of the biceps; SSPl, supraspinatus.

\(^{\dagger}\) Use suggested classification of the four families and a total of 12 subgroups. Excluding the incidence in our population, illustrations from Mendoza-Williams (Drop) as seen in the arthroscopic posterior view in the back-shoulder position with traction (except where noted) together with a transactional or coronal anatomic view.

\(^{\dagger}\) Picture was taken in lateral decubitus position with traction.

\(^{\dagger}\) Illustration of the hourglass-type impression in abduction, due to a lateral adhesion.
Figure 1  The transmigration from extra-articular to intra-articular according to Welcker.  (A) Adherent long head of the biceps, (B) mesotenon, and (C) free intra-articular LHB. Photographs ©Massimiliano Crespi, used with permission.
Function of Long Head of Biceps: Implications for its Treatment

O. Verborgt¹², P.B. De Keyzer¹, G. Declercq¹
¹AZ Monica, Antwerp, ²University Hospital of Antwerp, Antwerp, Belgium

The biomechanical function of the long head of the biceps (LHB) tendon is debated in the literature, and its role in glenohumeral kinematics remains controversial. The LHB tendon has been described to function as a head depressor, an anterior stabilizer and a posterior stabilizer. It has even been said to have no role and has been described as a vestigial structure. However, being an important source of shoulder pain as an isolated pathology or in combination with other conditions (cuff tears, SLAP lesions etc) surgical treatment often is necessary. Most typically, the surgical management of biceps tendon pathology includes tenotomy or tenodesis, both having their disadvantages such as cosmetic, tension and fixation issues. In order to deal with this, an arthroscopic soft-tissue transfer of the LHB tendon to the conjoint tendon has been introduced by Steve O’Brien. Potential advantages over classic tenotomy or tenodesis may be: 1) to more closely reproduce the native axis of pull of the biceps muscle and allowing the long head and short head to share load; 2) to allow for soft-tissue healing, which may be more favorable than soft-tissue to bone; 3) to provide the surgeon with direct visualization during tensioning and suturing to help prevent overtensioning of the tendon; 4) to avoid the cosmetic deformity or muscle cramping that may occur with tenotomy alone.

In this presentation, we will present our early experience with this technique focusing on indications, technical details and early results.
Disorders of the long head of the biceps (LHB) tendon can exist in conjunction with several other shoulder pathologies.

Currently, the function of the LHB tendon remains unresolved.

It is clear, however, that this tendon can be a significant source of shoulder pain and dysfunction. But pain into the bicipital groove is really aspecific, and there are possibilities of resolution of LHB signs after treatment of the other glenohumeral lesions. The right knowledge of the anatomy, of the LHB and its pulleys of reflection help us to a better understanding of his pathology and therapeutic solutions. The arthroscopy allows us to a better therapeutic management of the LHB according to the association lesions of the cuff and pulleys (ligament).

Many great arthroscopists described in scientific reports new classifications of LHB and cuff diseases bringing us to a better specific therapeutic treatment.

SLAP repair without LHB tenotomy can nearly restore baseline glenohumeral translation and also reduce the increased LHB load after SLAP lesions.

Biceps tenodesis is proposed as an alternative treatment modality certainly for patients > 40 years.

The importance of the sheath of the LHB is described with statistically significant difference between revision rates in biceps treatment methods that do not address the biceps sheath and those that do.

SLAP repair without LHB tenotomy can nearly restore baseline glenohumeral translation and also reduce the increased LHB load after SLAP lesions.

Biceps tenodesis is proposed as an alternative treatment modality certainly for patients > 40 years

In conclusion, several possibilities exist for the resolution of « LHB signs » after treatment of other lesions and: so don’t kill the biceps unnecessarily!

References:

• Clinical success of biceps tenodesis with and without release of the transverse humeral ligament.
  Brett Sanders, MD; Kyle P. Lavery,BA, Scott Pennington,MD, Jon J.P. Warner, MD. J Shoulder Elbow S. 2012; 21: 66-71
• Arthroscopic tenotomy of the long head of the biceps in the treatment of the rotator cuff tears: Clinical and radiographic results of 307 cases. G Walch ;Bradley Edwards; Aziz Boulahia; Laurent Nové-Josserand; Lionel Neyton; Istvan Szabo; J Shoulder Elbouw S. vol 14, numero3
• Superior labral tears:repair versus biceps tenodesis Joseph P. Burns; Michael Bahk; Stephen J. Snyder; J Shoulder Elbouw S. 2011; 20: 52-58
• Suprapectoral or subpectoral position for biceps tenodesis : biomechanical comparison of four different techniques in both positions.Thilo Patzer; Gerwin Santo; Gavin D. Olinger; Mathias Wellmann; Christof Hurschler; Markus D. Schofer; J Shoulder Elbow S. 2012; 21:116-125
• Biceps tenotomy versus tenodesis: a review of clinical outcomes and biomechanical results
  Andrew R. Hsu; Neil Ghodadra; CDR Matthew T. Provencher; Paul B. Lewis; Bernard R. Bach; J Shoulder Elbow S. 2011;20:326-332
• Functional anatomy of the superior glenohumeral and coracohumeral ligaments and the subscapularis tendon in view of stabilization of the long head of the biceps tendon; Ryuzo Arai; Tomoyuki Mochizuki; Kumiko Yamaguchi;Hiroyuki Sugaya;Masahiko Kobayashi; Takashi Nakamura; Keiichi Akita.; J Shoulder Elbouw S. 2010;19:58-64
• Anteriosuperior impingement of the shoulder as a result of pulley lesions: A prospective arthroscopic study. Peter Habermeyer; Petra Magosch; Maria Pritsch; Markus Thomas Scheibel; Sven Lichtenberg; J Shoulder Elbouw S. 2004, January, February.
• Diagnostic accuracy of five orthopedic clinical tests for diagnosis of superior labrum anterior posterior (SLAP) lesions; Chad Cook; Stacy Beaty; Michael J. Kisslenberth; Paul Siffri; Stephan G. Pill; Richard J. Hawkins; J Shoulder Elbow S. 2012; 21: 13-22.
• Minimally invasive proximal biceps tenodesis: an anatomical study for optimal placement and safe surgical technique; Claudius D. Jarrett; Walter B. McClelland; John W. Xerogeanes.; J Shoulder Elbow S. 2011; 20:477-480.
• The influence of superior labrum anterior to posterior (sLAP) repair on restoring baseline glenohumeral translation and increased biceps loading after simulated SLAP tear and the effectiveness of SLAP repair after long head of biceps tenotomy.; Thilo Patzer;Peter Habermeyer; Christof Hurschler; Evgenij Bobrowitsch; Mathias Wellmann; Joern Kircher; Markus D. Schofer.; J Shoulder Elbow S. 2012; 21: 1-8.
025  Rotator Cuff Lesions: To Repair or Not to Repair

N. Pouliart, B. Staelens
Universitair Ziekenhuis Brussel, Brussels, Belgium

When a cuff tear is diagnosed the question arises whether it can and should be repaired.

Several factors determine the reparability of a tear. Matters of biology dictate the healing capacity. As "simple" factors size matters, the quality of the remaining tendon is of paramount importance as well as the state of the muscles. More complex factors include inflammatory molecules and metalloproteinases that are modulated amongst others by smoking and other comorbidity.

This amounts to the conclusion that large and massive tears in elderly patients with degenerative tendons of poor quality, especially when associated with fatty degeneration and atrophy, will not yield good results when a repair is attempted. Whether the patient will benefit from other surgical options - be it debridement, bicepstenotomy or reversed arthroplasty - is another matter. In these patients, conservative management should be exhausted before considering these other possibilities.

What patient will benefit from a repair? Clear-cut evidence is hard to find as most reports concern outcome studies of surgical techniques. Few papers have directly compared the results of nonoperatively and operatively treated patients, let alone in a randomized-controlled manner.

Confounding factors include age (young versus elderly), tear size (small versus medium versus large), acute versus chronic tears, traumatic versus degenerative tears. In addition, we are all aware that most of us will eventually develop a hole in their cuffs, that many tears are diagnosed but remain or become asymptomatic without surgery, but that tear size may progress, and that follow-up studies show a high rate of retear.

This lecture will provide an overview of these deliberations, the anatomical background of why cuff tears can do well and what should be included in conservative treatment.
026  Techniques of Surgical Repair of the Rotator Cuff – Update

K. Cermak
Department of Orthopaedics and Traumatology, Free University of Brussels, Belgium

Rotator cuff repair is one of the most common shoulder procedures. However, precise indications of repair are still debated and little consensus exists concerning most of the aspects of this surgical option.

Type of Approach

Arthroscopic repair has imposed itself for the past decade as the gold standard. However, studies comparing arthroscopic versus mini-open rotator cuff repair seem to display overall substantially equal outcomes. In some recent studies, re-tearing rate has even been shown to be higher after arthroscopic procedures eventhough no systematic clinical correlation has been found.

Type of Lesion

Tear patterns has to be accurately identified in order to restore anatomic fixation. Recent reviews comparing results of arthroscopic repair of mobile crescent- or L-shaped tears vs large-sized U-shaped rotator cuff tears did not show significant differences in re-tear rates, all providing substantial improvements in shoulder function.

Type of Suture Anchors

The evolution of suture anchors design has entitled arthroscopic repair progress. Current suture bridging constructs have surpassed the biomechanical strength and healing rates of transosseous repairs. Recently, new generations of multithreaded bioresorbable anchors are designed to engage both cortical and cancellous bone and provide optimal fixation strength. These anchors are now available with 2 or 3 strands of suture.

Type of Suture Fixation

The single- vs double-row repair debate has been written about extensively in the past decade. The double-row technique is supposed to increase the tendon-bone contact area, creating a more anatomic footprint. But, comparing to the standard single-row technique that gave good clinical results, double-row objective superiority had not always been clear. Nevertheless, recent studies and meta-analysis show statistically significant differences in favour of double-row repair for overall clinical score and re-tear rate especially in tear size > 30 mm (antero-posteriorly).

Finally, improving the healing potential of rotator cuff repairs remains a challenging problem. Therefore, there has been an increase in the use of augmentation techniques of rotator cuff repairs with xenografts or synthetic patches for large and massive tears. Biceps tenodesis or more recently free biceps tendon autograft have also been proposed to augment rotator cuff repairs.
027 Biologic Patches for Augmentation of Rotator Cuff Repair

Z.T. Kokkalis
First Department of Orthopaedics, Orthopaedic Research & Education Center, National and Kapodistrian University of Athens, School of Medicine, “Attikon” University Hospital, Athens, Greece

Management of massive irreparable rotator cuff tears represents a therapeutic challenge. Massive cuff tears most commonly are irreparable due to atrophy, fibrosis, fatty infiltration, and severe tendon retraction. In some cases the poor-quality tissue and cicatrix coupled with wide-tear margin makes surgical mobilization difficult and anatomical tension-free repair almost impossible. Recently, the use of tissue engineered biomaterials has been proposed as an alternative reconstructive procedure for the treatment of massive cuff tears. Collagen patches derived from porcine small intestine submucosa have demonstrated low healing potential with high failure rate, poor functional outcomes, and aseptic drainage. Cross-linked porcine dermis patches have also been used but the reports have demonstrated mixed results. Promising results were noted after the use of the acellular human dermis allograft for the reconstruction of chronic massive cuff tears. Moreover, nonresorbable synthetic scaffolds may provide permanent structural support to strengthen repairs and decrease anatomic failure rates. Advances in tissue engineering may provide better and enhanced graft options with improved regenerative ability in the future.
Tendon Transfers around the Shoulder Girdle

A. Van Tongel, L. De Wilde
Department of Orthopaedic Surgery and Traumatology, Ghent University Hospital, Gent, Belgium

A tendon transfer is a surgical process in which the insertion of a tendon is moved, but the origin remains in the same location. The goal is to replace a nonfunctioning or irreparable unit. The ideal transfer has similar excursion, force generation, and line of action. The transfer should be expendable, of adequate strength, and designed only to replace one function (1). Because of its complex, polyaxial anatomic structure, it is often not possible to follow all the basic principles when performing shoulder tendon transfers.

Concerning the technique, the insertion of the tendon can be released at the tendon-bone junction, released with a sliver of bone or with a bone block. The goal of using a bony attachment is to obtain a bone-to-bone healing at the new insertion instead of the weaker tendon-to-bone healing.

Tendon transfer without glenohumeral arthritis
The indication for a tendon transfer is a nonfunctioning or irreparable unit of one of the two components of the transversal force couple (subscapularis - infraspinatus/teres minor). There is no indication to perform a tendon transfer in solitary irreparable supraspinatus tendon rupture or in case both components of the transversal force couple are involved.

In case of irreparable subscapularis or anterosuperior rotator cuff rupture a pectoralis major transfer can be performed. Several techniques can be used. Complete (2) or partial (sternal or clavicular part (3)) pectoralis major transfer, over or underneath the conjoined tendon(4) and attachment of the tendon medial or lateral to the biceps groove.

This procedure results in reasonable pain relief but unpredictable functional outcomes. Patients with well-centered humeral heads do much better than patients with anteriorly and/or superiorly subluxated humeral heads.

In case of posterosuperior irreparable cuff rupture (without teres minor involvement) four types of tendon transfer can be used: 1) isolated latissimus dorsi transfer (double incision) – 2) latissimus dorsi/teres major transfer (single incision)– 3) isolated teres major (5, 6) or 4) trapezium (7).

Latissimus dorsi and/or teres major tendon transfer provides good pain relief in most patients; however, the functional results are less predictable. Proper patient selection is critical. Factors associated with poor outcome include subscapularis dysfunction, deltoid dysfunction, osteoarthritis of the glenohumeral or acromioclavicular joint, and loss of teres minor function.

Anatomically, the trapezius transfer may be better situated to have a more direct line of pull to improve external rotation. A recent cadaver biomechanical study illustrated that the lower trapezius transfer was more effective than latissimus dorsi transfer in restoring shoulder external rotation with the arm at the side. But an avascular allograft is necessary to bridge the gap between the trapezius tendon and the bone. Further clinical and biomechanical testing is necessary before this transfer can be recommended.

Tendon transfer with glenohumeral arthritis
There is no indication to perform a solitary tendon transfer in patients with cuff tear arthropathy. In these cases, currently the best option is reversed shoulder prosthesis.

In case of cuff tear arthropathy caused by an anterosuperior tear, thanks to the medialisation and distalisation of the centre of rotation of the shoulder joint, the moment arm of resting internal rotators (pectoralis major, latissimus dorsi/teres major) is larger and they can compensate partially the loss of internal rotation force due to the subscapularis rupture.

In case of cuff tear arthropathy caused by a posterosuperior tear with involvement of the teres minor, there is no other muscle to provide active external rotation, and any attempt at shoulder elevation results in the forearm swinging in toward the trunk. In these cases a latissimus dorsi/teres major is indicated.

Also here several techniques have been described: double (8) or single incision (9), attachment at the greater tuberosity (10) or around the humerus and reattachment at the original location (modified l’Episcopo technique) (9), tendon-bone release or tendon release with sliver of bone (10) or bone block attached.

Clinical results showed a high patient satisfaction and restoration of active elevation and external rotation and low complication rate (10).
References
SESSION 7: DEGENERATIVE TENDON LESIONS AT THE HAND AND WRIST

029 Anatomical Variations of Extensor Tendons
V. Feipel, J. Monot, N. Vanmuylder, M. Rooze (Brussels, Belgium)

030 Why Juncturae Tendinum in the Finger Extensors?
J.N. Leijnse (Brussels, Belgium)

031 Relationship between ECRB and ECRL Tendons and Scaphoid
A. Elsaftawy, J. Jablecki (Trzebnica, Poland)

032 Hand and Wrist Ultrasonography. Application to Tendons
V. Creteur, S. Pather, K. Cermak (Brussels, Belgium)

033 Indications of Synovectomy in Degenerative Tendon Conditions
J. Bahm (Aachen, Germany and Brussels, Belgium)

034 Flexor Pollicis Longus Attrition Rupture. A rate of 0.3% in 1687 Volar Plate Fixations of Distal Radius Fractures
L.P. Larsen, P.V. Madsen (Aalborg, Denmark)

035 Genetics of Carpal Tunnel Syndrome
M. Burger, H. de Wet, M. Collins (Cape Town, South Africa)

036 Ultrasound Imaging as a Biomarker. Can it Help Indicate Treatment for Patients with Carpal Tunnel Syndrome?
P.C. Amadio (Rochester, MN, USA)

037 Our Experience with the USSR (Ulnar Superficial Slip Resection) for Recurrent Trigger Finger
L. De Smet (Leuven, Belgium)
029  Anatomical Variations of Extensor Tendons

V. Feipel, J. Monot, N. Vanmuylder, M. Rooze

Abstract not received in due time.
Why Juncturae Tendinum in the Finger Extensors?

J.N. Leijnse

**Department of Bio-, Electro- and Mechanical Systems (BEAMS), Faculty of Applied Sciences, Université Libre de Bruxelles, Brussels, Belgium**

The junctura tendinum are tendon expansions interconnecting the finger extensor tendons at the hands' dorsum. Their presence is anatomically constant, but their individual morphology highly variable, between different fingers in the same hand and between individual hands. The variability exists, amongst others, in the junctura’s width, thickness, orientation, length and points of attachment to the tendon. This variability is superimposed upon the variability in the extensor tendons, which can consist of single tendons or multiple more or less interconnected strands.

Mechanically, the junctura limit the relative displacements of the tendons they connect and as such finger independence. In tasks requiring finger independence, as in playing a musical instrument, a lack of finger independence can be a severe handicap. Independence limitations may exist in other finger muscles, such as in the finger and thumb flexors.

Why junctura exist remains a question to our knowledge not yet fully answered. On the one hand, the hand would be functionally more versatile without. On the other hand, their constant presence points to evolutionary selection, while the high variability yet indicates that the selection pressure was not highly morphologically specific.

**Hypothesis** Biomechanical evidence will be provided that the junctura form a back-up system for fixation of the extensor tendons at the MCP joints in full finger flexion. The biomechanical boundary conditions for this are not very specific and they are consistent with the observed variability. Statistical variability suggest that the functional-morphological variability range was evolutionary used to optimize the morphology of the junctura between each tendon pair with respect to normal hand tasks.

**Note on junctura classification** Some authors tried to introduce a morphological classification of the junctura, defining types. However, in reality the variability is a morphological continuum that can hardly be fitted in discrete types. A more comprehensive description would require statistically continuous variables, such as width, length, thickness, and attachment points (from which follows the orientation), in a given finger reference position. Even so, the variability is such that a fully parameterized description remains hard to realize. Practically, in reconstructive surgery, understanding the underlying biomechanical-functional boundary conditions and the statistical gross functional lay-out may be more useful than typifications.
Wrist stabilization is ensured by the complex of stabilizers, both static (intrinsic and extrinsic, volar and dorsal ligaments) and dynamic ones (flexors and extensors of the wrist). We would like to share and discuss a theory of effect of the radial wrist extensors on the scaphoid. Correction of the scaphoid flexion seen in clenched fist stress view, that can coexist with incomplete SL lesion, may result from influence of radial extensors of the wrist (both short and long) as dynamic stabilizers of SL complex. This X-ray imagining is a completion of the radiological signs so far occurring in the SL instability. Anatomical arrangement of these sinews was presented in fig. 1, and the possible mechanism of such action was shown in fig. 2 and 3.

Figure 1. Diagram demonstrating anatomical arrangement of radial wrist extensors in relation to scapholunate complex, EPL – extensor pollicis longus, ECRL – extensor carpi radialis longus, ECRB – extensor carpi radialis brevis, S – scaphoid, C – capitate, L – lunate, Lt – Lister’s tubercle.
figure 2. Diagram presenting rotary subluxation of the scaphoid in the wrist in neutral position with partial injury of SL tear and injury of ligaments that provide secondary stabilization of scapholunate complex. EPL – extensor pollicis longus, ECRB – extensor carpi radialis brevis, ECRL – extensor carpi radialis longus, APL – abductor pollicis longus.

032 Hand and Wrist Ultrasonography. Application to Tendons

V. Creteur¹, S. Pather¹, K. Cermak²
¹Department of Radiology and ²Department of Orthopaedics and Traumatology, Erasme University Hospital, Brussels, Belgium

Conventional X-rays and High-Resolution Ultrasonography (US) represent a winning combination to evaluate pathologies affecting hand and wrist. A lot of medical specialties recommend US imaging: sport medicine, emergency medicine, anesthesiology, rheumatology, orthopedic surgery… The constantly growing clinical impact of musculoskeletal US is based on increased US image quality allowing dynamic and detailed exploration of structures. Better anatomical and biomechanical knowledge allows also better realization, interpretation and transmission of US images. Interactions between radiologist and clinician, as well as between different imaging techniques such as computed tomography or magnetic resonance, contribute also to improve indications and limitations of US. We would like to emphasize the impact of US in three pathological conditions: Conflicts between Tendons and Orthopedic Hardware, Dupuytren Disease, Foreign Bodies.

Conflicts between Tendons and Orthopedic Hardware
US allows detection of orthopedic hardware, especially in the hand or wrist, because this modality is not affected by the metallic nature of such material. Strong reflective hyperechoic surface that generates posterior ring-down artifact is the key-point sonographic finding. US allows not only the distinction between screw, end-plate, nail, wire or prosthesis, but also the demonstration of pathologic modifications in tendons or muscles adjacent to orthopedic hardware (Fig1A –B) [1]

Dupuytren Disease
Dupuytren’s contracture is characterized by two underlying lesions, nodules and cords. These involve the palmar fascia at the distal palmar crease, especially at the level of the third and fourth rays with progressive disabling finger contracture. The normal superficial palmar aponeurosis appears as a thin echogenic lamellar structure overlying the flexor tendons. The demonstration of hypoechoic bands adhering to the marging of the flexor tendons and deep surface of the dermis appears to be pathognomonic of the disease. Compared to tendons, young nodules are hypoechoic and typically hypervascular at Doppler imaging, whereas older nodules are iso- to hyperechoic, without significant Doppler signal. US may demonstrate arterial and nervous encasement by fibrous or scarring tissue (Fig2) [2]

Foreign Bodies
Soft tissue foreign bodies (FBs) are a common cause of consultation. Conventional radiography does not show all foreign bodies and clinical examination alone may not identify them. US can detect different types of foreign bodies (metallic, glass, plastic, stone, vegetal or animal shards…) as small as 1 mm and precise their relationships with soft tissues, vessels, nerves, joints or bones. Removal of the FBs is essential, because retained FBs may contribute to chronic pain and disability, serious septic complications, tendinopathies, neuroma or even migration of FBs into vessels. Successful extraction of FBs under US may avoid open surgery (Fig3A-B) [3-4]

References
Fig1A
Wrist longitudinal ultrasonographic (left) and lateral radiographic (right) views. A long radial orthopedic pin penetrates Pronator Quadratus (red arrows) and flexor muscle. Flexor muscle appears abnormally heterogeneous at the top of the pin, resulting from hematoma. The pin has a hyperechoic straight continuous surface on ultrasonographic image.

P = Pronator Quadratus   FT = flexor muscle   R = radius

Fig1B
Wrist longitudinal ultrasonographic (left) and lateral radiographic (right) views. A radial orthopedic screw impingement is clearly demonstrated with deep flexor tendons (white arrows). The screw threads are visualized as a regularly hyperechoic dotted line on ultrasonographic image.

P = Pronator Quadratus   TF = flexor tendons   R = radius
NM = median nerve   LP = Palmaris Longus Tendon
Fig 2
Dupuytren disease recurrence five years after surgery. Transversal ultrasonographic (top) and longitudinal power Doppler (bottom) views demonstrate hypoechoic nodules (arrows) inserted on the superficial palmar aponeurosis (arrow heads). Pathologic topography and deformation of flexor tendons and arterial vessels are obvious.
M3 = third metacarpal  M4 = fourth metacarpal  N = Dupuytren nodule  T = flexor tendons
apdc = digital communis palmar artery  amp = palmar metacarpal artery

Fig 3A
Various appearances of foreign bodies. Unpainted wood or sea urchin prickles as well small glass fragments are undetectable by radiography, but well recognized by ultrasound.
Transversal view of the dorsal wrist at the level of Extensor Pollicis Brevis and Abductor Pollicis Longus tendons. A hyperechoic 1 mm foreign body within a hypoechoic granuloma is detected under the skin, one year after a glass wound.

CE = foreign body   CE = Extensor Pollicis Brevis tendon   LA = Abductor Pollicis Longus tendon
033 Indications of Synovectomy in Degenerative Tendon Conditions
J. Bahm

Abstract not received in due time.
**Purpose**

To discover the rate of attrition rupture of the flexor pollicis longus tendon after volar plate fixation of distal radius fracture in our orthopedic unit and to identify risk factors involved in the development of this complication in order to determine whether our operative treatment needs to be adjusted.

**Methods**

We performed a systematic search of the University Hospital database containing data from four individual hospitals in our catchment area. We identified all cases of flexor tendon rupture operated from 2003 to 2013 and through examination of patient files we found a total of five cases of FPL attrition rupture due to volar plating of a distal radius fracture. Volar plating was performed in 1687 cases in the period from 2003 to 2013. In all cases of attrition rupture the volar plating had been performed in one of the four hospitals in the area.

**Results**

The rate of attrition rupture was 0.3%. Four were females, mean age was 69 years, median time between surgery and tendon rupture was eight months. Plate positioning was examined on postoperative x-rays. Four out of five cases were classified as Soong Grade 1 or 2. The postoperative volar tilt ranged from 14 degrees dorsal to 10 degrees volar angulation. Distal screw prominens and/or loosening was present in four cases. Repositioning of the pronator quadratus muscle was described in two out of five cases. No steroid treatment was identified and none of the case patients were smokers. Direct end-to-end suture of the FPL tendon was performed in four cases and one patient had a tendon transposition done. All received twelve weeks of hand therapy after tendon surgery. Three achieved full ROM in the thumb IP joint, one had 10 degrees extension defect and one achieved a ROM of 0 to 40 degrees. Re-rupture of the FPL was not seen.

**Conclusion**

FPL rupture is a rare complication after volar plating of the distal radius fracture in our unit. Risk factors seem to include plate positioning on or beyond the watershed line, prominent screw heads and increased dorsal tilt of the distal radius. Care should be taken to ensure positioning of the plate proximally to the watershed line in addition to achieving accurate anatomical reduction of the fracture. Routine removal of volar plates due to the risk of flexor pollicis longus tendon rupture seems unnecessary considering the low prevalence of this complication. In cases of recognized suboptimal plate positioning patients should be monitored closely for signs of tendon irritation and early removal of the plate as a preventive measure should be considered.
The COL5A1 gene is associated with increased risk of carpal tunnel syndrome

The direct causes of idiopathic Carpal tunnel syndrome (CTS) remain unknown. It is generally accepted that an increase in pressure within the carpal tunnel structure, which contains nine flexor tendons and peritendinous subsynovial connective tissue (SSCT), cause compression of the median nerve. The involvement of these connective tissues in the aetiology of CTS cannot be excluded. In support of this, tendinopathy and tenosynovitis have both been mentioned as being comorbid conditions or a precursor of CTS.

The collagens are the major structural components of tendons, of which type V collagen plays an important role in collagen fibril formation and the regulation of fibril diameter (fibrillogenesis). Variants within the COL5A1 gene, which encodes for the α1 chain of type V collagen, an important regulator of fibril assembly in tendons, have previously been associated with Achilles tendinopathy. The aim of this study was to determine whether these COL5A1 variants are also associated with CTS.

A total of 103 self-reported South African participants of mixed ethnicity (94 female and 9 male), with a history of bilateral or unilateral carpal tunnel release surgery (CTS) as well as 150 matched control participants (CON) without any reported history of CTS symptoms were recruited. The CON and CTS participants were matched for the type of occupation and years of exposure for wrist activity. All participants completed were genotyped for the rs13946 (C/T), rs14774622 (C/T), rs55748801 (G/A), rs12722 (C/T) and rs71746744 (-/AGGG) variants within the functional 3′-untranslated region.

The TT genotype of COL5A1 rs13946 was significantly over-represented in the CON (69.3%) compared to the CTS (50.6%) group (p=0.007, OR=0.45, 95% CI=0.26-0.79). When the combined rs14774622/rs55748801 (W/M, W=CG) and rs12722 genotypes were analysed, the WW+CC (41.7%, p=0.008, OR=0.45, 95% CI=0.26-0.80) and WW+CT (40.3%, p=0.009, OR=2.0, 95% CI=1.2-3.4) genotypes were significantly over- and under-represented in the CON group, respectively, when compared to the CTS group (24.5% WW+CC, 59.2% WW+CT) (Figure 1). Furthermore, the T-W-C inferred haplotype was significantly over-represented (p<0.001) in the CON (51.2%) compared to the CTS group (34.9%) (Figure 2).

In conclusion, this is the first study to report that variants within the 3′-UTR of the COL5A1 gene are associated with the CTS. The results from this study highlight the possible important role that pathology within connective tissue structures in the carpal tunnel has, at least in part, in the aetiology of CTS. These findings need to be replicated in other independent populations and larger sample sizes.

REFERENCES:
2. Diao E, Shao F, Liebenberg E, Rempel D, Lotz J. Carpal tunnel pressure alters median nerve function in a dose-dependent manner: a rabbit model for carpal tunnel syndrome. J Orthop Res. 2005;23:218–223.
Figure 1: The combined genotype frequency distributions of the (A) COL5A1 DpnII restriction fragment length polymorphism (RFLP) and the (B) COL5A1 BstUI RFLP for all participants in the carpal tunnel syndrome (CTS, solid bars) and control (CON, clear bars) groups. The COL5A1 BstUI RFLP can genotype the rs12722 (C/T) variant and the adjacent rs146776422 (C/T) and rs55748801 (G/A) variants. Since the method is unable to distinguish between the adjacent variants, the CG wild-type allele of these adjacent variants, which contains a BstUI restriction site, was designated as a W, while the three alternative nucleotide combinations, CA, TG and TA were designated as a M. The BstUI restriction site is destroyed in all three alternative sequence combinations. The global p-value and the significant differences between the groups for a specific genotype combination (asterisks) are indicated. The total number (n) of genotypes within the CON and CTS groups is also indicated in parenthesis on the graph. For all participants the allele phases of the WM and CT genotypes in the CTS and CON groups were 4 and 4 for WT/MC and 0 and 2 for MT/WC, respectively.
Figure 2: Inferred haplotype frequency distributions constructed from the \(COL5A1\) 3'-untranslated region (UTR) variants for the control (CON, clear bars) and carpal tunnel syndrome (CTS, solid bars) groups. (A) Inferred haplotypes constructed from (i) rs13946 (C/T), (ii) combined rs146776422 (C/T) and rs55748801 (G/A) (designated as W/M, where W=CG) and (iii) rs12722 (C/T). Significant differences between the groups are indicated with a solid line and the p-value. The number (n) of subjects in each group is in parenthesis.

The \textit{ACAN} and \textit{BGN} genes and carpal tunnel syndrome

Carpal tunnel syndrome (CTS) is generally considered to be an overuse injury with the prevalence being as high as 61% in occupations with a high percentage of repetitive upper-limb exposure\(^1\). It has been suggested that the connective tissue structures surrounding the nerve are directly involved in the aetiology of CTS\(^2\) and it has also suggested that genetic factors are associated with CTS\(^3\). In support of this, we have recently shown that sequence variants within a functional region of the \(COL5A1\) 3'-untranslated region (UTR) are associated with altered risk of CTS. \(COL5A1\) encodes for the \(\alpha_1\) chain of type V collagen, which is responsible for the regulation of fibril assembly and fibril diameter in connective tissue\(^4\). In addition to collagens, the proteoglycans, such as aggrecan (encoded by the \textit{ACAN} gene) and biglycan (encoded by the \textit{BGN} gene) are also important structural components of tendons and other connective tissues. Increased mRNA expression of both \textit{ACAN} and \textit{BGN} have been reported in chronic tendinopathy\(^5\). Considering the repetitive wrist flexion and extension in certain occupations with high frequencies of CTS and the resulting forces created by these movements, it is tempting to speculate that alterations in the proteoglycans affected by these forces could lead to altered properties of the tendon, ultimately predisposing to injury. The aim of this study was therefore to determine whether the \textit{ACAN} rs1516797 (G/T) and the \textit{BGN} rs1126499 (C/T) DNA sequence variants, are associated with CTS.

Ninety-nine self-reported South African participants of mixed ancestry, with a history of carpal tunnel release surgery (CTS) as well as 136 matched participants without any reported history of CTS symptoms were recruited as control (CON). Participants were genotyped for the \textit{ACAN} rs1516797 (G/T) and \textit{BGN} rs1126499 (C/T) variants.
Although there was no significant difference in the genotype distribution between the CTS and CON groups for ACAN rs1516797, there was a significant difference (CC vs CT+TT, p=0.0498) between the CON and CTS groups for BGN rs1126499 where CC was over-represented (OR=0.545, 95% CI=0.30-0.99) in the CON group (Figure 1). Since the previously associated COL5A1 gene (M. Burger, In review) is also involved in collagen fibrillogenesis, inferred pseudo-haplotypes were constructed from COL5A1 rs13946 (T/C), rs12722 (C/T) and BGN rs1126499 (C/T). The C-C-C (24.9% CTS vs 12.3% CON) and T-T-T (11.2% CTS vs 7.6% CON) pseudo-haplotypes were significantly over-represented in the CTS group (p=0.001 and p=0.033 respectively) whilst the T-C-C (30.8% CTS vs 51.1% CON) pseudo-haplotype was significantly under-represented in the CTS group (p<0.001) (Figure 2).

In conclusion, we have shown that a variant within the BGN gene and inferred pseudo-haplotypes of variants within the COL5A1 and BGN genes, both involved in collagen fibrillogenesis, are significantly associated with altered risk of CTS. Although the investigated ACAN variant was not associated with CTS, it does not exclude this and other ACAN variants to be important in the risk of CTS.

REFERENCES:

**Figure 1**: Genotype frequency distributions BGN rs1126499 (C/T) in carpal tunnel syndrome (CTS) and control (CON) groups for the female participants. Because of the small sample size of the TT genotype in the CTS and CON groups, the CC genotype was compared with the combined CT and TT genotypes. (CC vs CT and TT p=0.0498, OR=0.545, 95% CI=0.30-0.99). The number of participants in each group is indicated. Significant differences between the groups are indicated with a solid line and asterisk with the p-value shown.
Figure 2: Inferred haplotypes constructed from the COL5A1 DpnII rs13946 (C/T), COL5A1 BstUI rs12722 (C/T) and BGN rs1126499 (C/T) gene variants from female participants for carpal tunnel syndrome (solid bars) and controls (clear bars). Significant differences between the groups are indicated with a solid line and the p-value.
Ultrasound Imaging as a Biomarker. Can it Help Indicate Treatment for Patients with Carpal Tunnel Syndrome?

P.C. Amadio
Mayo Clinic, Rochester, MN, USA

Carpal tunnel syndrome (CTS) is the most common peripheral neuropathy, with a prevalence of 3-5% of adults, and a lifetime risk of roughly 30% (1-7). The treatment in roughly half of cases is surgery (8, 9), a carpal tunnel release (CTR). CTR is usually an effective treatment, but the associated costs and temporary disability are substantial. To date, it has been difficult to identify factors in the patient presentation that might help predict those who might improve without surgery, those in whom CTR alone might provide the best outcome, and those who might benefit from adjunctive or alternative procedures such as synovectomy, neurolysis, or ligament reconstruction (10-12). This is important, because the unpredictability of simple treatments such as steroid injection argues against their use in many cases (11, 13-21).

While the etiology of CTS is most often listed as idiopathic, fibrosis of the subsynovial connective tissue (SSCT) within the carpal tunnel is know to be an important pathological feature (22-26). Recent ultrasound and MRI studies (27-33) have demonstrated notable differences in the motion of the tendons, the median nerve, and the SSCT within the carpal tunnel, when comparing CTS patients and normal subjects. These differences can be attributed to the effect of SSCT fibrosis to alter nerve and tendon movement (29, 30, 32, 34, 35). Of relevance to this proposal, while the motion in normal subjects is relatively consistent from one individual to another, the alterations in motion patterns vary among CTS affected individuals. For example, normally, tendons and SSCT move in synchrony, with a roughly 2:1 ratio of tendon to SSCT motion. In contrast, in some CTS patients there is strong adherence of the SSCT to the tendons, while others show a complete lack of connection between the SSCT and the tendons (33, 36, 37). Nerve motion is also affected by SSCT fibrosis. With wrist flexion, normally the nerve moves from the anterior to the posterior aspect of the carpal tunnel(28). In CTS patients, the SSCT fibrosis blocks this motion to various degrees (38), or may direct it radially or ulnarly.

This suggests that ultrasound detectable variations in nerve, tendon and SSCT mobility in patients with CTS may be useful clinically, not to diagnose CTS, but instead as functional biomarkers that correlate with, and thereby serve as predictors for, treatment response. To test this hypothesis, a longitudinal clinical study is in progress, in which patients presenting for treatment of CTS will be monitored by ultrasound and by clinical assessment before and after non-surgical and surgical treatment. The clinical outcomes will be correlated with the initial ultrasound motion patterns that are most variable in CTS patients.

References


Our Experience with the USSR (Ulnar Superficial Slip Resection) for Recurrent Trigger Finger

L. De Smet

Abstract not received in due time.
SESSION 8: TENDON LACERATIONS AT THE HAND AND WRIST (1)

038  Extensor Tendon Lacerations  
D. Warwick (Southampton, United Kingdom)

039  Metacarpophalangeal Arthrodesis as an Alternative to Reconstruction of the Flexor Pulley Apparatus in the Thumb. Case Description and Literature Review  
L.P. Larsen, P.V. Madsen (Aalborg, Denmark)

040  Acute Flexor Tendon Repair in Zone 2. State of the Art in 2014  
K. Drossos, N. Chahidi (Brussels, Belgium)

041  Current Practice in Acute Flexor Tendon Repair in Israel  
O. Sarig, M. Weizenbluth, A. Oron (Rehovot, Israel)

042  The Effect of Suture Preloading on the Force to Failure and Gap Formation after Flexor Tendon Repair  
M. Vanhees, A. Thoreson, P.C. Amadio, K.N. An, C. Zhao (Rochester, MN, USA)

043  The A4 Pulley Pocket Technique for Augmentation of Flexor Digitorum Superficialis Insertion Repair. A Biomechanical Study  
A. Oron, L. Schnapp, J. Couceiro, G. Boland, H. Tien, C.M. Kleinert (Rehovot, Israel)

044  Preliminary Data of a Prospective Double-Blind, Randomized Concept Study of PXL01 in Hyaluronic Acid versus Placebo in Flexor Tendon Surgery  
M. Wiig, M. Mahlapuu (Uppsala, Sweden)

045  Locking Finger due to Partial Laceration of Flexor Digitorum Superficialis Tendon  
Y. Seki, Y. Hoshino, H. Kuroda (Kamogawa City, Japan)

046  Effects of Wrist Position on Maximum Flexion Force during Mobilization in a Kleinert Orthosis  
A. Burssens, N. Schelpe, J. Vanhaecke, M. Dezillie, F. Stockmans (Kortrijk, Belgium)
Extensor Tendon Lacerations

D. Warwick

*University of Southampton, United Kingdom*

**Functional Anatomy**

The anatomy of the extensors becomes more complex distally. The juncturae share extension force across the back of the hand; the sagittal bands hold the tendon centrally over the metacarpal head; the central slip elevates the PIP whereas the lateral bands elevate the DIP. The oblique retinacular ligaments co-ordinate the DIP and PIP in flexion and extension.

The extensor tendons are divided into 8 Zones in the fingers, with I over the DIPJ and VIII in the forearm. The thumb extensors have 5 zones, with Zone V over the CMCJ. The odd numbers are over joints and the even numbers over bones. In the thumb

**Repair techniques**

Traditional core locking sutures are fairly strong; a running interlocking mattress suture is slimmer, flatter and equally strong. Altobelli et al JHSA (2013) 38A:1079–1083

**Postoperative rehabilitation**

Traditional static methods are reliable, but active controlled techniques provide better outcome in the first three months although not beyond. Talsma E, de Haart M, Beelen A, Nollet F. *The effect of mobilization on repaired extensor tendon injuries of the hand: a systematic review.* Arch Phys Med Rehabil 2008;89:2366 –2372.

**Central Slip Injuries**

These can be overlooked because of the secondary but temporary extensor effect of the lateral bands. Any laceration over the back of the PIP should be explored. Post operative rehabilitation is probably most effective with the short arc protocol. McAuliffe JA (2011) *Early active short arc motion following central slip repair.* J Hand Surg Am 36; 143-6

**Fight Bites**

These may seem innocuous but can be catastrophic. The shutter effect of the tissue layers (skin, subcutaneous fat, tendon, capsule, synovium) trap infected saliva (alpha strep, Eikinella, Strep Anginosus, Anaerobes). Treatment is with immediate and thorough lavage and antibiotics (Ampicillin or Augmentin) Staiano J, Graham K. *A tooth in the hand is worth a washout in the operating theater.* J Trauma. 2007;62:1531–2.
Not much is written in the literature on reconstruction of the flexor pulleys of the thumb. Most articles are on anatomical and biomechanical aspects and we have found only a few outcome studies.

Case: A young fisherman had his thumb caught and squeezed in a trawl net and sustained a closed injury causing swelling and pain. Months later he was operated on for trigger thumb. This was complicated by postoperative infection leading to reoperation and in the end painful bowstringing of the thumb. Despite only little clinical and radiographic sign of osteoarthritis the MP joint was fused in full extension. At the latest follow up two and a half years postoperatively he remained without pain and back in heavy manual work as a fisherman. The case is illustrated with clinical photos, radiographs and a dual energy CT scan showing the position of the flexor tendons.

Discussion: Reconstruction of flexor pulleys is still a controversial issue and an operation flawed by complications. Arthrodesis of the thumb MP-joint repositions the flexor pollicis longus tendon at a low expense of useful range of motion in the thumb.
Acute flexor tendon injuries are uncommon but their treatment remains challenging in the modern era of hand surgery.

Efforts have been made by researchers and clinicians to improve outcomes; minimize the rate of post operative rupture or adhesions formation.

A meta-analysis of clinical studies published by Dy C. et al.(JHS Am 2012) reported a rate of rupture of 4%, adhesion formation of 4% and reoperation after flexor tendon repair of 6%.

Using only the modified Kessler technique, decreases the likelihood of adhesion formation, by 134%.

The use of the epitendinous suture decreases the likelihood of reoperation by 84%.

It is unclear why modified Kessler stitches lead to a reduction in adhesion formation, especially when other suture methods have been showed to be stronger in mechanical testing or animal studies.

Chesney et al. (PRS 2011) showed in their systematic review that there was no significant difference in rupture rates when comparing rehabilitation protocols.

In conclusion, despite of considerable allocation of research, the rate of complications in flexor tendon surgery has not changed significantly since 2000.

Is it possible to do better?

We try to answer to this question based on a review of the recent literature and your clinical experience.
Current Practice in Acute Flexor Tendon Repair in Israel

O. Sarig, M. Weizenbluth, A. Oron
The Department of Hand Surgery, Kaplan Medical Center, Rehovot, Israel

Background

Various methods of core suture and suture material are acceptable for use in acute flexor tendon repair.

Objectives

To assess the current practice in acute flexor tendon repair among Israeli hand surgeons.

Methods

A five question survey was held among certified Israeli hand surgeons as to their preferred materials and method for performing acute flexor tendon repair. Statistical analysis was done using the SPSS software.

Results

Forty Eight Israeli hand surgeons participated in the survey. In zone 2 the most widely used core suture was the modified Kessler type (58.3%). In zones 3 & 4 the most widely used core suture was the modified Kessler type (62.5%) as well. The most widely used suture material is nylon. All surgeons incorporate epitendinous sutures to augment their core sutures.

Conclusions

The modified Kessler core suture technique is the most widely used technique amongst Israeli hand surgeons when repairing acute flexor tendon lacerations in zones 2, 3 & 4. This coincides with data gathered around the world and emerging data that this method carries a lower chance of adhesion formation and post operative tendon ruptures. The core suture technique initially popularized by the late Prof. Isidor Kessler, who headed our department during the years 1973 through 1992, remains the most practiced acute flexor tendon repair technique among hand surgeons in Israel.
Introduction

Gap formation is a common and severe complication after flexor tendon repair that can affect the outcome and prolong tendon healing. The purpose of this study was to investigate the effect of a pre-tensional force applied to the suture during tendon repair on the repair strength and gap formation.

Methods

A total of 48 flexor digitorum profundus (FDP) tendons from 12 human cadaver hands were used. The tendons were dissected and cut 50 mm proximal to their insertion. A core tendon suture was introduced into the proximal and distal tendon ends separately using the modified Pennington looping technique. The sutures were inserted in each tendon end, were loaded by hanging a weight for 10 seconds, and then the two tendon ends were connected using a two strand overhand knot plus 2 square knots. Subsequently, and finally, a running suture was applied. Four different loads were selected: 0 N, 5 N, 10 N and 15 N, for the comparison effect of loading magnitude. After repair, the tendon was mounted on a servohydraulic testing machine. The specimens were gripped just above and under the core suture a displacement sensor was attached at the repair site. The tendons were distracted at a rate of 20 mm/min until complete rupture of the repair site had occurred. The measured gap formation was compared for different amounts of tension load. The outcomes analyzed included force at gaps of 1, 2 and 3 mm; the peak force; and the gap at peak force. Separate analyses were performed for each outcome.

Results

Force at 1mm gap: There was no significant difference between preload groups (p = 0.45).
Force at 2mm gap: There was a significant difference between 15N and 0N preload groups, between 15N and 5N preload groups (p = 0.005).
Force at 3mm gap: There was a significant difference between 15N and 0N preload groups, between 10N and 5N preload groups, and between 5N and 0 N preload groups (p= 0.002).
Peak Force: There was a significant difference between 15N and 0N preload groups, between 15N and 5N preload groups, and between 10N and 0N preload groups (p< 0.001).
Gap at Peak Force: There was no significant difference between preload groups (p = 0.41).

Discussion

The force needed to reach a 2 mm gap after flexor tendon repair increases as the pre-tension applied to the suture/tendon interface increases, and is the highest when a 15 N preload is applied to the sutures before tying the knot. The force needed to reach a 3 mm gap is significantly higher if any preload is applied, and is the highest at 10 N preload. 10 N to 15 N pre-tension appear to be the most effective to eliminate tendon gap formation. The peak force sustainable by the repair also seems to be improved by pre-tensioning the sutures before tying the knot. The peak force increases as the pre-tension increases, and is the highest when a 15 N preload is applied.

Acknowledgements

This study was funded by a grant from the Mayo Foundation.
043  The A4 Pulley Pocket Technique for Augmentation of Flexor Digitorum Superficialis Insertion Repair. A Biomechanical Study

A. Oron, L. Schnapp, J. Couceiro, G. Boland, H. Tien, C.M. Kleinert
The Department of Hand Surgery, Kaplan Medical Center, Rehovot, Israel

Hypothesis

Repair of an injury to the Flexor Digitorum Superficialis (FDS) at its insertion site by inverting the proximal part of the A4 pulley and creating a pocket engulfing the repair site and lined with synoviocytes is stronger and enhances flexor excursion.

Methods

Eight pairs of matching digits from the left and right hands of a fresh cadaver were randomly allocated to either a treatment group wherein the FDS was sutured back to its insertion utilizing the A4 pulley pocket technique or to a control group where a regular local suturing technique was utilized. The Flexor Digitorum Profundus tendon was not severed. Hydrated samples were loaded in our Instron ElectroPuls E1000 with integrated BioPuls misting bath (Instron Corp) using a 5N load cell (excursion) or 250N load cell (pullout) with soft tissue grips. Force and tendon excursion were measured directly and these data were time synced with a video image capture system to extract flexion information.

Results

The average pullout strength of the treatment group was 37.87N and that of the control group was 20.95N. This difference was statistically significant (p=0.028). The average early excursion value was 0.456N/mm in the treatment group and 0.317N/mm in the control group. The average late excursion value for the treatment group was 0.761N/mm for the treatment group and 0.678N/mm in the control group. These differences were not statistically significant.

Summary

Utilization of the A4 pulley pocket technique for augmentation of FDS insertion repair offers enhancement of pullout strength and a theoretical advantage in tendon excursion. Utilization of this newly suggested technique effectively transforms a distal flexor Zone II injury into a flexor Zone I injury while enhancing initial pullout strength.
044 Preliminary Data of a Prospective Double-Blind, Randomized Concept Study of PXL01 in Hyaluronic Acid versus Placebo in Flexor Tendon Surgery

M. Wiig¹, M. Mahlapuu²
¹Department of Surgical Science, Hand Surgery, Uppsala University, Uppsala, Sweden, ²CSO of Pergamum AB

Purpose

The objectives of this study were to evaluate efficacy variables and safety, including rate of tendon rupture, of a single local administration of PXL01 in sodium hyaluronate in patients with a deep flexor tendon injury in zone I or II of the hand for the reduction of post-surgical adhesion formation.

Methods

This was a multi-centre, randomized, double-blind, parallel group study evaluating the efficacy and safety of PXL01 compared to placebo in patients admitted for flexor tendon repair in zone I or II of the hand. Patients were administered PXL01 (0.5 ml of 20 mg/ml PXL01 in 15 mg/ml sodium hyaluronate) or placebo (0.5 ml of a 9 mg/ml sodium chloride solution) locally between the flexor tendon and the tendon sheath, and around the tendon sheath, following surgical repair of the flexor tendon prior to closure of the surgical wound.

A total of 138 patients were included in the study.

Safety was followed up immediately post-surgery (adverse events [AEs], vital signs, clinical chemistry and haematology) and up to 12 months after surgery/IMP administration (AEs and rate of tendon rupture).

Efficacy was tested by measuring total active motion [TAM] of the fingers, TAM at the distal interphalangeal joint [DIP], tip-to-crease distance, 12 weeks, 6 and 12 month post-surgery. DASH (Disabilities of the Arm Hand and Shoulder), quality of life (QoL) questionnaire and sensory evaluation of patients with complete nerve damage were also analyzed.

Results

Rupture rate was similar in patients in the PXL01 group and the placebo group (PXL01: 8%, placebo: 9%). The AE frequency was similar between the PXL01 and placebo groups.

TAM grading of functional hand recovery according to Strickland’s original classification indicated a higher proportion of patients with excellent or good post-surgical mobility of the injured finger in the PXL01 group compared to the placebo group at 12 weeks, 6 months and 12 months after surgery/IMP administration. The difference was most pronounced at 6 months post-surgery, when 61% of the patients treated with PXL01 demonstrated a “good” or “excellent” range of motion compared to 38% of the patients receiving placebo (statistically significant).

DIP-mobility: Clinically and statistically significant improvement in the PXL01 group compared to the placebo group at 6 months (mean 12 degrees difference, median 19 degrees difference, p=0.01).

Tip-to-crease distance differed between the treatment groups, in favor of the PXL01 group (mean 11 versus 17 mm, median: 5 versus 16 mm) for the PXL01 versus placebo group respectively, p=0.04.

Recommendation for tenolysis: At 12 months post-surgery, there were more patients in the placebo group (30%) who were considered to benefit from tenolysis, compared to the PXL01 group (12%). There was no statistically significant difference in DASH, QoL scores between patients in the PXL01 group and patients in the placebo group.

Summary

Administration of 20 mg/ml PXL01 in sodium hyaluronate to patients admitted for flexor tendon repair surgery of the hand was safe, well tolerated and did not interfere with tendon healing. Several efficacy parameters reflecting functional hand recovery after surgery – TAM classified by Strickland’s original classification system, DIP-mobility, tip-to-crease distance, rate of tenolysis recommendation, and sensory evaluation – indicated that PXL01 has benefits in this patient category.
Hypothesis

The purpose of this study is to show the combined nonclinical efficacy data and safety parameters in man as a base for a prospective, double blinded, randomized concept study to assess safety, efficacy and handling of PXL01 in hyaluronic acid versus placebo in adhesion prevention in flexor tendon surgery.

Methods

The efficacy of PXL01 in adhesion prevention was evaluated in a flexor tendon repair surgery model in rabbit. PLX01 with hyaluronic acid (HA) as a carrier, or sham, was applied as a single treatment between the tendon and the tendon sheath at the time of surgery. After 7 weeks the rabbits were euthanized and tendon pullout forces together with toe range of motion (ROM) were measured as an assessment of adhesion formation. Following the range of motion test, load-to-failure was measured as an assessment of tendon healing.

A phase I study investigating the local tolerability, safety and pharmacokinetics of PXL01 in HA and HA was conducted in 15 healthy male volunteers. Different doses (10, 20 or 40 mg) of PXL01 in HA were administered by single abdominal subcutaneous injection.

The primary variables were local tolerability, ECG/telemetry, vital signs, safety laboratory investigation, and frequency, seriousness and intensity of adverse events.

Results

PXL01 in HA significantly improved the function compared to sham-operated digits as well as digits treated with the carrier HA, and brought the mobility of the injured digit back to close to normal level.

In a dose response study, the dose of 20 mg/ml of PXL01 was demonstrated to be the most optimal concentration of the peptide for preventing adhesion formation in hand surgery. No adverse effects on the tendon healing were observed, as assessed by load-to-failure test.

The phase I trial in healthy volunteers demonstrated that subcutaneous administration of PXL01 in HA induced no findings of concern related to local tolerability and safety. The systemic exposure of PXL01 after local administration was very low.

Summary

The nonclinical efficacy studies in the rabbit model of flexor tendon surgery suggest a pronounced effect of PXL01 in adhesion prevention without any adverse consequences on tendon healing. The phase I trial in healthy volunteers supports that PXL01 is safe and well tolerated in man.
Introduction

Trigger finger due to partial laceration of flexor tendon are relatively uncommon and locking finger due to partial laceration of the flexor tendon is much rarer. No case of the locking finger has been reported. We experienced the case and obtained a good result by surgery.

Case

A 39-year-old woman tumbled, holding a glass in her right hand. She had a small wound, which recovered naturally soon, on her palm, because the glass broke. In a few weeks, pain and limited ROM were noted in her right ring finger; therefore, she presented a nearby clinic. Since steroid injection was ineffective, she was referred to our hospital. A small wound scar was found on the palmar surface of the fourth metacarpal joint (on the A1 pulley) and she could not extend the proximal interphalangeal joint of the ring finger, either actively or passively.

Surgery

Via volar approach the A1 pulley was opened, revealing partial tear of flexor digitrum superficialis (FDS). Proximal stump of the partly torn tendon formed a flap, hooking to the A1 pulley when the ring finger extended. The proximal stump of the tendon was trimmed, whereas the distal stump was not because it was smooth. Finally the A1 pulley was resected, and smooth glide of the tendon and full extension of the finger were confirmed. After the surgery, rehabilitation was started and at the last observation, her finger showed full and smooth ROM and she complained of no pain.

Conclusions

Trigger finger due to partial laceration of FDS are relatively uncommon and some cases have been reported. However, locking finger due to that have never been. The surgery led to a good outcome for the very rare
Effects of Wrist Position on Maximum Flexion Force during Mobilization in a Kleinert Orthosis

A. Burssens¹, N. Schelpe², J. Vanhaecke¹, M. Dezillie¹, F. Stockmans¹,³
¹Department of Orthopaedics, AZ Groeninge, Kortrijk, Belgium, ²V!GO Campus Wetteren, Wetteren, Belgium, ³KU Leuven-KULAK, Faculty of Medicine, Kortrijk, Belgium

Introduction

Flexor tendon repair in no-mans land still remain challenging. In order to achieve the best possible clinical outcome both the surgical technique and postoperative treatment have to be optimal. The most frequent complications remain tendon adhesion, stiffness and tendon rupture. Kleinert supported the concept of primary tendon healing and applied passive mobilization protocols of the flexor tendon in an orthosis with the wrist in flexion. This prevented both the tendon adhesion and joint stiffness by allowing early passive tendon gliding. Tendon rupture is prevented in this concept by passive mobilization of the flexor tendon during active extension of the finger. Since patients still have active flexion moments such as during sleep the wrist is placed in flexion to reduce force transmission through the sutured tendon during involuntary active flexion. The same principle applies for the more recent rehabilitation protocols that are based on protected active flexion. This study investigated the influence of wrist position on the maximum grip force in a Kleinert orthosis.

Material and methods

Thirty male healthy subjects mean age: 38 yr [range 20-50yr] were given an orthosis according to Kleinert. This orthosis was manufactured with an incorporated Caroli-hinge making it possible to position the wrist in different angles ranging from -30° extension until 80° of flexion. Throughout these different positions the maximum grip strength was measured three times in succession on a 10° degrees interval using a Vigori dynamometer. The mean of these measurements were subsequently plotted in a regression curve. To assess the coherence of the measurements an intra-class correlation coefficient was ascertained.

Results

The maximum grip strength correlated negatively with increasing wrist flexion according to a sigmoidal regression curve [Correlation coefficient = 0.91 (P< 0.001)] when going form -30° extension to 80° of flexion (Fig 1.). The maximum gripstrengths differed significantly between both outer angels (P < 0.001) with a median 12 fold decrease between 30° extension and 80° flexion. The successive measurements were shown to be coherent [Intra-class Correlation Coefficient = 0.86-0.92 (P<0.001].

Conclusion

The ability of the forearm muscles to generate grip strength increases as the wrist is placed towards a more extented position. According to the obtained sigmoidal curve a decrease of 33% in maximum grip strength was already achieved with 4.4° degrees of flexion. A decrease of 50% was achieved with 23.2° of flexion and a decrease of 66% was achieved with 51.8° of flexion (Fig 2.).

Clinical relevance

These results indicate that immobilization of the wrist in a flexed position effectively reduces the maximum grip strength generated by the forearm muscles. Immobilization of the wrist in 23.2° of flexion reduces the maximum force transferred on the sutured tendon with 50%.
Fig 1. Maximum grip force according to a different immobilization angle

Fig 2. Force reduction according to different immobilization angle
SESSION 9: TENDON LACERATIONS AT THE HAND AND WRIST (2)

047  Wide Awake Tendon Surgery  
P.C. Amadio (Rochester, MN, USA)

048  Two-Stage Tendon Reconstruction in Zone II  
P.N. Soucacos, Z. Kokkalis (Athens, Greece)

049  Flexor Tendon Pulley Reconstruction after Previous Surgery of the Flexor Tendon System  
N. Badur, B. Juon, E. Vögelin (Bern, Switzerland)

050  Effect of Tenolysis on Adhesion after Flexor Tendon Suture in an In Vivo Dog Model  
Y. Mimata, J. Nishida, Y. Matsuo, T. Akasaka, M. Suzuki (Morioka, Japan)

051  Results One Year post Tenolysis in Hand Surgery  
M. Rousié, N. Cuylits, K. Drossos, N. Chahidi, L. Kinnen, A. Lejeune, D. Lumens,  
S. Van Den Dungen, J.P. Moermans (Brussels, Belgium)
I have been using the wide awake approach for the past several years, on more and more patients. In my own practice, in a large institution with many referred patients, I have found the following significant advantages related to the use of local anesthetic with epinephrine as an alternative to blocks or general anesthesia, or even to local anesthesia without epinephrine:

- No tourniquet=no tourniquet pain intraop, no risk of tourniquet palsy, no risk of skin problems under the tourniquet, no post deflation flush, no need to get hemostasis after deflation
- No risk of complications related to general anesthesia, axillary or Bier block
- Less postop hematoma, less total bleeding, less time cauterizing
- No/less sedation= faster recovery and discharge from ASC
- Block in holding area=less OR time
- If truly ‘wide awake’, no need for anesthetist (cost savings); no risk of complications related to sedation
- The patient knows everything that is going on, especially if they watch (which I always encourage). A better informed patient is a happier patient and a better partner in postop recovery
- Most important, patient cooperation is key to setting tension and checking motion after any kind of tendon surgery, and in confirming active motion after contracture releases.

Roughly half my patients chose the local without sedation, and are truly ‘wide awake’. I leave this to the patient’s choice. I have not found that this choice relates to patient age, gender or whether they are local or referred. There are some cultural differences of course, but aside from that it seems to be a matter of patient preference.

This is the only anesthetic method I have used where patients will often say, as they are being wheeled from surgery, “Thank you, doctor. It was fun, and I learned a lot.”

References
Two-Stage Tendon Reconstruction in Zone II

P.N. Soucacos, Z. Kokkalis
Orthopaedic Research & Education Center, Attikon University Hospital, University of Athens, School of Medicine, Athens, Greece

Zone II is considered the most difficult area to restore good gliding function. In severely mutilated hands with extensive damage to the flexor tendon sheath, two-stage flexor tendon reconstruction using silicone rods is indicated. This restores the gliding mechanism of the tendon within the fibro-osseous canal and reconstructs the pulleys with good results. Extensive damage to the flexor tendon sheath is known to result in adhesion formation. This is one of the main causes that prevent active finger flexion, attributed to the fact that adhesions obliterate the free gliding mechanism of the flexor tendons within the tendon sheath. In 1965, James Hunter first demonstrated that implantation of a silicone-dacron tendon prosthesis led to the formation of a pseudo-tendon sheath with a smooth and gliding surface that enabled the insertion of a secondary tendon graft thus, restoring active finger flexion. Indications for the staged flexor tendon method include: 1) patients with extensive scarring of the tendon bed where primary suture or immediate tendon grafting are contra-indicated; 2) replantation patients with multiple digital amputations and extensive damage of the fibro-osseous canal; and 3) cases where primary suture and grafting techniques have failed. A standard prerequisite in the selection criteria is a total passive motion of no less than 220° compared to the 260° achieved in normal motion or that the finger-tip can be passively bent to less than 2cm from the distal palmar crease.

Stage I involves the excision of scarred tendon remnants, release of joint contractures, nerve repair and the insertion of flexible silicone-Dacron reinforced tendon implant along with pulley reconstruction. (Fig1) During Stage II a tendon graft is used to replace the implant with minimal disturbance to the newly formed sheath. The graft is then attached distally to the base of the distal phalanx and proximally to the profundus motor. During pulley reconstruction and rod insertion, the finger is exposed through a zigzag incision over the volar surface from the finger-tip to the wrist, avoiding exposure of the palm whenever possible. Scarred tendons, sheath and retinaculum are then excised and undamaged portions of the flexor retinaculum retained. Reconstruction of the pulley system is key in restoration of the gliding mechanism of the tendon, where three to four pulleys can usually be restored; one proximal to the axis of the each finger joint and one at the base of the proximal phalanx using portions of the undamaged retinaculum sheath or segments of the superficialis tendon.

Stage II follows after an interval of three to five months. A xerogram or MRI prior to surgery for the Stage II is useful for determining the exact position of the rod's distal end. Only a small portion of the distal and proximal incision is exposed so that the ends of the silicone rod can be identified. After the tendon graft is sutured to the proximal end of the silicone rod, the rod is withdrawn through the distal incision, which threads the graft into the newly formed sheath. The prosthesis is removed, and the distal part of the tendon graft secured to the distal phalanx with pull-out sutures and additional sutures to the periosteum and surrounding tissues. Once the skin is closed, the proximal part is secured to its motor muscle by interweaving the tendon using a fishmouth technique according to Pulvertaft. Once the proximal incision is closed, the hand is placed in a bulky dressing with a dorsal splint keeping the wrist in neutral position and the MP joints in 90° flexion. Active motion begins the day after surgery following the Kleinert technique. Passive motion should be initiated at about 3 weeks. Dynamic splitting may be needed to prevent joint contracture. By 8 weeks, full activity is allowed and by 12 weeks the patient can perform a full-power grip. (Fig2)

Complications during two-stage flexor tendon reconstruction using either silicone or Hunter rods are serious, and may jeopardize the final functional outcome of the repaired tendons. Complications encountered during stage I include, skin necrosis, rod buckling, rupture of the distal end of the silicone rod or Hunter implant, rod migration, synovitis and infection, while those encountered during stage II include, distal or proximal disruption of the graft juncture, grafts which are too loose or too tight, bowstringing, impingement of the proximal suture in the sheath at the level of the wrist, flexion deformities of the PIP and/or DIP joints and infection. The most common
complication is a flexion deformity of the PIP and/or DIP joint, which is related to the surgical procedure. While zone II is considered the most difficult area to restore, particularly in severely mutilated hands with excessive scarring tissue and extensive damage to the flexor tendon sheath and pulley system, good gliding function and results can be achieved using two-stage flexor tendon reconstruction with silicone rods.

Legends
Fig1. Stage I. Pulley reconstruction, Hunter rod placement, and digital nerve repair with micrografts.

Fig 2. (A) Pre-op middle finger with laceration of both flexor tendons. (B) Post-op extension with minor flexion-contracture of DIP joint, with (C) finger-tip flexion to distal palmar crease.
Flexor Tendon Pulley Reconstruction after Previous Surgery of the Flexor Tendon System

N. Badur, B. Juon, E. Vögelin
Department of Plastic and Hand Surgery, Inselspital, University of Bern, Bern, Switzerland

Introduction

Flexor tendon pulley reconstruction is relatively uncommon. Many technical treatment options have been described. Surgery is challenging, especially after previous surgery involving the flexor tendon system including arthrolysis or tenolysis or debridement after infection. We present a focused review on a modified loop technique in 8 patients with pulley insufficiency.

Material and Methods

8 Patients suffering of global pulley insufficiency from A1-A4 pulley. Seven of 8 patients had previous surgery including flexor tendon repair (2), debridement of a flexor tendon infection (4) or previous tenolysis (1). One patient developed pulley insufficiency after conservative treatment of a luxated PIP joint. Despite conservative treatment, limiting flexion contracture of the PIP joint respectively incomplete flexion of the involved finger required further surgery. Diagnosis was made sonographically and clinically. Pulley reconstruction was performed with either a FDS slip or a tendon graft in a multiple loop technique. Especially towards the PIP joint, good fixation of the gliding flexor tendon with a pulley is important depending on the amount of bowstringing. Postoperatively, intensive Hand therapy and splinting was added to balance extension and flexion. Patients have been followed up for at least 12 months.

Results

All but one of 8 patients improved function significantly after surgery. They improved flexion of 40° (40-110° active flexion preoperatively, 80-110° postoperatively). However in 2 patients, an extension deficit of 50° was encountered with better flexion. One patient was reoperated again with an additional pulley reconstruction in combination with an PIP arthrolysis.

Conclusion

Pulley reconstruction at secondary surgery is challenging. It may be performed as a one or two stage procedure depending on the intact, repaired, adherent or deficient tendon system. Pulley tensioning (distal A2) and reconstruction towards the PIP joint is crucial. In longstanding flexion contractures, skin flaps may be required. Postoperative hand therapy includes pulley protection in flexion and splints in extension. Ultrasonography is helpful in planning and monitoring pulley sufficiency.

References:
Effect of Tenolysis on Adhesion after Flexor Tendon Suture in an In Vivo Dog Model

Department of Orthopaedic Surgery, School of Medicine, Iwate Medical University, Morioka, Japan

Introduction

Adhesion between a tendon and a tendon-pulley often occurs after tenosuture. The sutured tendon loses its ability to move smoothly resulting in a poor clinical outcome which is problematic. However, there have been few studies which have evaluated the effect of tenolysis on the gliding resistance between a tendon and a tendon-pulley after tenosuture.

Purpose

The purpose of this study is to clarify the effect of tenolysis on adhesion and gliding resistance between a tendon and a tendon-pulley after tenosuture in models using dogs.

Material and Methods

Six male beagles (weight range, 9.85–10.90 kg; average, 10.45 kg) were used in this study. After a sharp laceration was made through the flexor digitorum profundus tendon (FDP), the lacerated FDP was sutured by the modified Kessler technique for the core suture with two single knot sutures to conform the cut edges. The evaluation of adhesion and the measurement of gliding resistance between the tendon and the annular pulley of the forepaw of canines were performed in the following five different groups: the automated movement group, Tenolysis group I, Tenolysis group II, the in vitro group and the control group. In the automatic movement group, movement was permitted under non-load in the third week after tenosuture and euthanasia was done 3 weeks after the tenolysis for the evaluation. In Tenolysis groups I and II, tenolysis was performed in the third (group I) or sixth week (group II), respectively. Tendon suture and euthanasia were done three weeks after the tenolysis. For the in vitro group, only tendon suture was performed by utilizing the contra-lateral forepaw of the automatic movement group, Tenolysis I group and Tenolysis II group. After euthanasia, the same evaluations were done. In the control group, the intact FDP of the contra-lateral forepaws of the dogs having undergone euthanasia was evaluated as a control. Eight digits were evaluated in each group. The evaluation of adhesion followed the method of Rothkoph et al. The gliding resistance measurement followed the method of An et al.

Result

Adhesion was observed in Tenolysis group I, Tenolysis group II and the automatic movement group. The adhesion rating score of Tenolysis group II was lower than the scores of Tenolysis group I and the automatic movement group, and the difference between Tenolysis group II and the automatic movement group was significant. The gliding resistance of the control group was significantly lower than those of all other groups. The gliding resistances of Tenolysis groups I and II were significantly lower than that of the automatic movement group. The gliding resistance of Tenolysis group II was significantly lower than that of Tenolysis group I.

Discussion and Conclusion

Although there was no significant difference of adhesion scores between Tenolysis groups I and II, the score of Tenolysis II was lower than that of Tenolysis I. The gliding resistances were significantly lower in Tenolysis group II than those of Tenolysis group I. Therefore, we have concluded that tenolysis should not be performed too early after tendon suture to avoid poor clinical outcomes. Evaluation of the histological difference between these two groups should be done in the future.
051 Results One Year post Tenolysis in Hand Surgery

M. Rousié\textsuperscript{1}, N. Cuylits\textsuperscript{2}, K. Drossos\textsuperscript{3}, N. Chahidi\textsuperscript{3}, L. Kinnen\textsuperscript{3}, A. Lejeune\textsuperscript{3}, D. Lumens\textsuperscript{3}, S. Van Den Dungen\textsuperscript{3}, J.P. Moermans\textsuperscript{3}

\textsuperscript{1}General Surgery, Université Libre de Bruxelles, \textsuperscript{2}Plastic Surgery, Hopital Erasme Bruxelles, \textsuperscript{3}Hand surgery, Clinique du Parc Léopold Bruxelles, Brussels, Belgium

Introduction

When practiced on the hand, Tenolysis is a surgery for which short term results may seem satisfying; however clinical experience shows that over a longer period of time (over a year) results tend to deteriorate. Yet few studies have supported this observation. Therefore the objective of this work is to quantify the results in terms of mobility, satisfaction and disability gain resulting from a Tenolysis of the flexor and extensor tendons of the hand over the long term.

Methods

We conducted a post-surgical study (1 year after the surgery) with 16 patients who received a Tenolysis of the flexor tendon and with 14 patients who received a Tenolysis of the extensor tendon.

Results

For the Tenolysis of the flexor tendon, we recorded an average active mobility of 25,63° for the MP; 20,06° for the IPP and 40,83° for the IPD. The disability rate improved to 29% and the satisfaction rate was of 43%.

For the Tenolysis of the extensor tendon, we recorded an average active mobility gain of 22,5° for the MP; 22,75° for the IPP and 16° for the IPD. The disability rate rose to 26% and the satisfaction rate was of 33%.

Factors which showed a more significant impact on the long-term results were: the gender of the patient with an advantage for men, and the magnitude of the trauma which induced the primary adhesion formation, the larger the trauma was and the worse the results were.

Conclusion

Based in these results, it seems that Tenolysis delivers results that are difficult to foresee and often less than satisfactory for the patients. This procedure should therefore be strictly reserved for patients who will be made aware of the physiotherapy they will need to receive after the surgery in order to assure clinical improvements.
POSTERS

052  **Shortening Osteotomy and Flexor-Extensor Tendon Balance**  
B. Craggs, B. Vanmierlo, C. Goorens, M. Hamdi (Brussels, Belgium)

053  **Oppositely Located Palmaris Longus Muscle Forming a Mass in the Distal Forearm: A Case Presentation**  
F. Eren, C. Melikoglu, D. Kok, S. Iskender, E. Ulkur (Ankara, Istanbul, Turkey)

054  **Triceps Brachii Distal Tendon Reattachment with a Double-Row Technique**  
Z.T. Kokkalis, A.F. Mavrogenis, P.N. Soucacos, D.G. Sotereanos (Athens, Greece)
052 Shortening Osteotomy and Flexor-Extensor Tendon Balance  
B. Craggs¹, B. Vanmierlo¹, C. Goorens², M. Hamdi¹  

¹ Department of Plastic & Reconstructive Surgery, Brussels University Hospital – UZ Brussel, Brussels, Belgium; ² Department of Orthopaedic Surgery, Brussels University Hospital – UZ Brussel, Brussels, Belgium

Introduction  
Lower arm injuries with soft tissue loss can be so extensive that primary suture of tendons, nerves, and arteries is not possible. Each gap can be bridged by either tendon grafts in case of severed tendons, conduits or grafts for nerve repair, and venous grafts for arterial repair. Textbooks and articles refer to the so called shortening osteotomy as a way of making primary repair possible despite tissue loss. Unfortunately no articles up to date actually describe the technical execution of shortening osteotomy for the treatment of partial amputation, or do they explore the biophysical consequences of a shortening osteotomy and functional outcome.

Material and Methods  
In this article we describe two patients who were treated with a shortening osteotomy with good functional outcome in our unit following traumatic, partial amputation. Using these two cases as a base, we elaborated on the technical execution, biophysical consequences and functional outcome of shortening osteotomy. More specifically we looked at the effect of the shortening osteotomy on intact tendons, i.e in the case described what is the effect on the intact extensor tendons that have not been shortened and may seem too long?

Discussion  
Bone shortening allows direct arterial repair without a vein graft and so shortens ischemia time and decreases the incidence of fasciotomy. It also enhances the quality of nerve repair by facilitating tensionless nerve coaptation after trimming. End-to-end neurorrhaphy remains the gold standard for transected nerve repair, if repair is tension free. The work of Tarbary, Goldspink and Crawford have shown that muscle fibres adapt rapidly; the fibre length will accommodate to its new resting position by lengthening or shortening so that at rest the fibre is neither loose nor tight. In other words it does not seem necessary to surgically shorten the intact extensor tendons because of natural accommodation of fibre length to its new resting position.

Conclusion  
In case of partial amputations shortening osteotomy is advocated by several authors as standard therapy although a true work-up of shortening osteotomy in partial amputation and its functional outcome is lacking in the current literature. Based on our clinical experience and those in the available literature the amount of shortening depends on the nerve gap (up to 7cm) that needs to be bridged. There is no biophysical reason to shorten the intact tendons because of natural accommodation of fibre length to its new resting position.

REFERENCES  
12. Masson J. SRPS 2003, Hand 3: flexor tendons, volume 9, number 34, ref 12., number 34, pg 11
23. Murovic JA. Upper-extremity peripheral nerve injuries: a Louisiana State University Health Sciences Center literature review with comparison of the operative outcomes of 1837 Louisiana State University Health Sciences Center median, radial, and ulnar nerve lesions. Neurosurgery. 2009;65:A11-7
Oppositely Located Palmaris Longus Muscle Forming a Mass in the Distal Forearm: A Case Presentation

F. Eren¹, C. Melikoglu¹, D. Kok¹, S. Iskender¹, E. Ulkur²
¹Etimesgut Military Hospital, Plastic Surgery Department, Ankara, Turkey; ²GATA Haydarpasa Training Hospital, Plastic Surgery Department, Istanbul, Turkey

Objective

To present a rare anatomical variation with clinical significance encountered by surgeons who perform upper extremity surgery.

Case Presentation

A 21-year old male patient applied to our outpatient clinic with the complaint of swelling and mild discoloration in the distal portion of his right forearm and on the volar side of his wrist that has been present from childhood.

In the physical examination, a mass was observed with pale purple reflections on the skin, which was located on the volar side of the distal 1/3 of the right forearm, homogenous in structure, without definite borders, soft when compared to the opposite side, without any change in its location and size during wrist movements, and was not discoloring with pressure application. Motor and sensorial examinations of the extremity were within normal limits. Tinel’s sign and Phalen’s maneuver were negative in the trace of the median nerve. No radiological or neurophysiological evaluation was performed. Explorative surgery was performed on the patient under regional anesthesia. Skin and subcutaneous tissue were traversed by applying a zigzag incision on the mass. It was observed that the muscle body located opposite the distal portion was covered by the forearm fascia. When the muscle mass was dissected completely, it was observed that it was single headed, and exerting no marked pressure on the median nerve. It was observed that the muscle did not extend to the Guyon’s canal. The muscle body and tendon were excised.(Figure -1,2,3,4)

Conclusion:

The palmaris longus muscle originates from the medial epicondyle of humerus with other flexor muscles, and is involved in the structure of palmar fascia. The palmaris longus muscle is the most anatomically variable muscle of the upper extremity. Muscle agenesis was determined in 12% of cases, which were included in the cadaver studies. In addition to cases in which the muscle body was 1/3 centrally or 1/3 distally (oppositely) located, there was a case in which double palmaris longus muscles were located both distally and proximally, and the tendon was also located between these two muscle bodies. Again, a normally located muscle can be present in advanced hypertrophic conditions. It has been reported in the literature that these types of muscle variations were most commonly accompanied by neuropathies related to the presence of a mass and nerve compression caused during exertion. In some of those cases, it was shown that the muscle extended to the Guyon’s canal. No electrophysiological study was performed due to the fact that there were no complaints or signs from the physical examination indicating nerve compression in this presented case, although there were many signs of compression determined during effort in many of the reported cases in the literature. Simple and effective treatment with the surgical excision can be provided in these cases in which a mass has been present for a significant amount of time, and the clinical picture of nerve compression does not accompany.(1)

References

Case reports and small series have reported variable results regarding the treatment of choice for patients with triceps brachii tendon ruptures. Early surgical repair has been recommended for acute, complete ruptures of the triceps brachii distal tendon to prevent late functional disability. However, controversy exists regarding the optimum surgical technique of reattachment. Additionally, various attachment techniques have been described with none shown clinically to be superior.

This paper presents a technique for triceps brachii distal tendon reattachment following acute, complete rupture. The edges of the ruptured triceps tendon are debrided, and a No. 5 Ethibond suture is inserted through the tendon using a Bunnell stitch technique. Next, Keith needles are drilled through the olecranon in a crossed pattern. Two to three suture anchors are drilled into the olecranon for augmentation of the reattachment; the sutures of the bone anchors are passed through the tendon in a horizontal mattress pattern. The Ethibond suture is inserted into the holes of the Keith needles, and the needles are advanced through the olecranon. With the elbow in extension, the tendon is reattached to the olecranon; the Ethibond sutures are tied first, followed by the sutures of the bone anchors. Postoperatively, the arm is immobilized in a long arm posterior splint in 20 degrees of extension for 2 weeks, followed by a supervised assisted range of motion rehabilitation program including progressive elbow flexion, full passive extension and passive/active assisted forearm rotation exercises with the elbow in extension for the next 4 weeks. At 6 weeks after surgery, active extension of the elbow is initiated, followed by strengthening exercises at 10 to 12 weeks.
http://www.brusselshandsymposium.eu