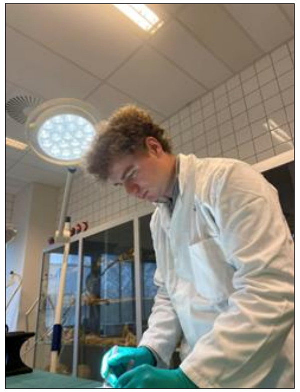



JAN PALFIJN
ANATOMY LAB

Kulak anatomie studies

F. Michels, W. Beel, J. Vanhaecke, J. De Buyser, E. Vereecke

Sarah Algoed, Céleste Descamps, Bavo Decavele, Marjolein Theeten,
Jérome Vercruysse, Louka Minne, Martijn Steen en Charles T'Jollyn

Teaching assistant in anatomy and histology

Research Team

Prof. dr. Evie Vereecke

Head of the lab and Associate professor

Prof. dr. Frederick Michels

Orthopedic surgeon

Elise Lesage

Responsible of the Human Body Donation program

Janou De Buyser

Teaching assistant in anatomy and histology

Timo van Leeuwen

Post Doc student

An innovative modelling approach to estimating loading history from bone micro-architecture

Océane Cluzeau

Doctoral student

Developing a framework to understand how anatomical traits impact the hominoid shoulder's function.

Xiaoshan (Serena) Song

Doctoral student

Acceptance of technology-enhanced learning materials in medical and healthcare education

Mythili Damal Kandadai

Doctoral student (KU Leuven , University Ghent)

Developing musculoskeletal models of the primate shoulder

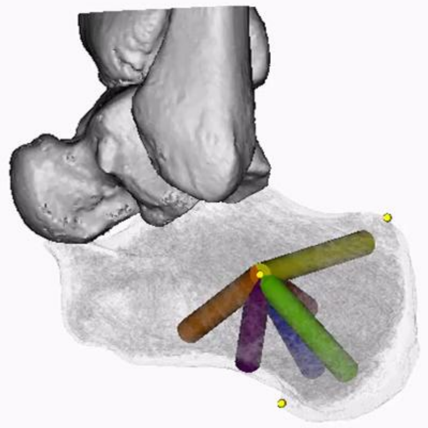
Clinical practice

Clinical problem

- Feasibility
- Safety
- Anatomical properties
- Anatomical landmarks

Question

Tunnel direction?



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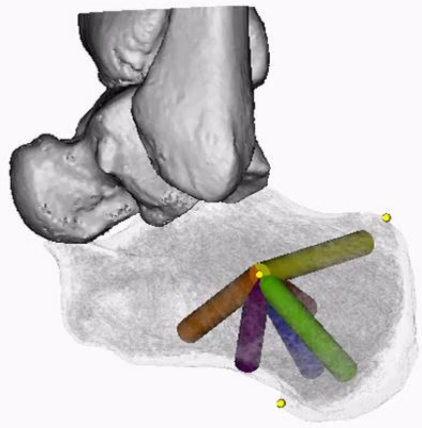
Question

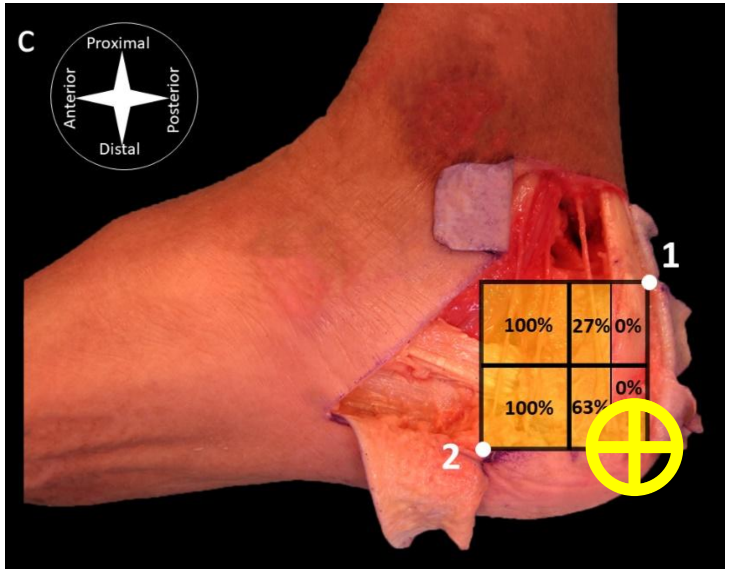
Anatomy Lab

Study

- Research question
- Research protocol
- Pilot study/study
- Results & conclusion

Tunnel direction?





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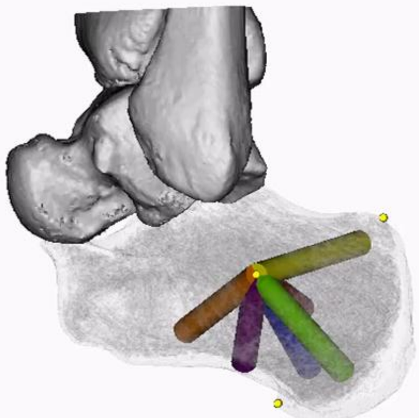
Conclusion →

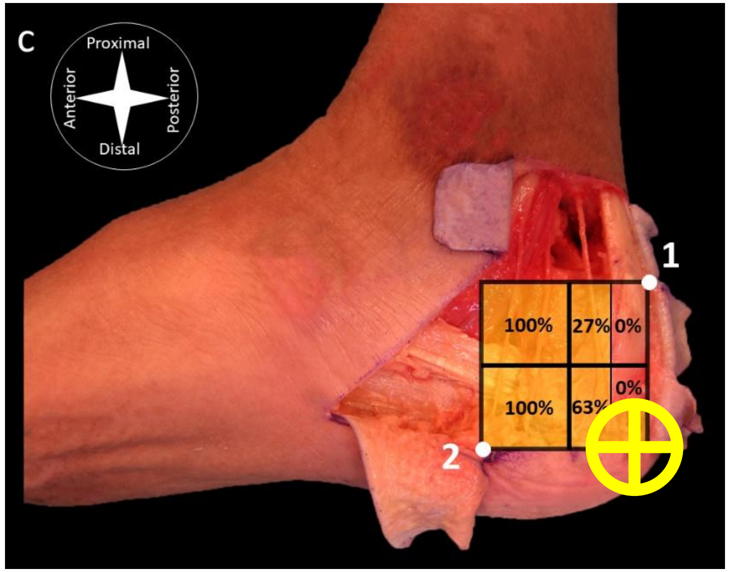
Scientific literature

Communication

- Presentation
- Poster
- Publication

Tunnel direction?






Knee Surgery, Sports Traumatology, Arthroscopy
https://doi.org/10.1007/s00167-020-06134-x

ANKLE

A calcaneal tunnel for CFL reconstruction should be directed to the posterior inferior medial edge of the calcaneal tuberosity

Frederick Michels[1,2,3,6] · Giovanni Matricali[4,5,6] · Heline Wastyn[7] · Evie Vereecke[7] · Filip Stockmans[1,7]

Received: 24 February 2020 / Accepted: 26 June 2020

Abstract

Purpose Anatomical reconstruction of the calcaneofibular ligament (CFL) is a common technique to treat chronic lateral ankle instability. A bone tunnel is used to fix the graft in the calcaneus. The purpose of this study is to provide some recommendations about tunnel entrance and tunnel direction based on anatomical landmarks.

Methods The study consisted of two parts. The first part assessed the lateral tunnel entrance for location and safety. The second part addressed the tunnel direction and safety upon exiting the calcaneum on the medial side. In the first part, 29 specimens were used to locate the anatomical insertion of the CFL based on the intersection of two lines related to the fibular axis and specific landmarks on the lateral malleolus. In the second part, 22 specimens were dissected to determine the position of the neurovascular structures at risk during tunnel drilling. Therefore, a method based on four imaginary squares using external anatomical landmarks was developed.

Results For the tunnel entrance on the lateral side, the mean distance to the centre of the CFL footprint was 2.8 ± 3.0 mm (0–10.4 mm). The mean distance between both observers was 4.2 ± 3.2 mm (0–10.3 mm). The mean distance to the sural nerve was 1.4 ± 2 mm (0–5.8 mm). The mean distance to the peroneal tendons was 7.3 ± 3.1 mm (1.2–12.4 mm). For the tunnel exit on the medial side, the two anterior squares always contained the neurovascular bundle. A safe zone without important neurovascular structures was found and corresponded to the two posterior squares.

Conclusion Lateral landmarks enabled to locate the CFL footprint. Precautions should be taken to protect the nearby sural nerve. A safe zone on the medial side could be determined to guide safe tunnel direction. A calcaneal tunnel should be directed to the posterior inferior medial edge of the calcaneal tuberosity.

Keywords Hindfoot instability · Calcaneofibular ligament · Ligament reconstruction · Bone tunnel · Neurovascular bundle

Frederick Michels
frederick_michels@hotmail.com

1 Orthopaedic Department, AZ Groeninge, President Kennedylaan 4, 8500 Kortrijk, Belgium

2 GRECMIP-MIFAS (Groupe de Recherche et d'Etude en Chirurgie Mini-Invasive du Pied-Minimally Invasive Foot and Ankle Society), Merignac, France

3 ESSKA-AFAS Ankle Instability Group, Luxembourg, Luxembourg

4 Department of Development and Regeneration, KU Leuven, Leuven, Belgium

5 Department of Orthopaedics, Foot and Ankle Unit, University Hospitals Leuven, KU Leuven, Leuven, Belgium

6 Institute of Orthopaedic Research and Training, KU Leuven, Leuven, Belgium

7 Department Development and Regeneration, Faculty of Medicine, University of Leuven Campus Kortrijk, Etienne Sabbelaan 53, 8500 Kortrijk, Belgium

Introduction

Chronic lateral ankle instability is a disabling complication after an acute ankle sprain, and surgery is indicated if conservative treatment fails [23]. In patients with generalized laxity or poor ligament quality and in revision cases, lateral ligament reconstruction of both the anterior talofibular ligament (ATFL) and the calcaneofibular ligament (CFL) should be considered [23].

The evolution towards more anatomical procedures to restore normal joint mechanics increases the need for detailed knowledge of the normal anatomy [21, 22, 25]. When performing a ligament reconstruction, bone tunnels are commonly used. The entrance of the tunnel should be at the normal anatomical footprint. However, the exact position of the calcaneal insertion of the CFL is difficult to locate, and no agreement exists about the optimal direction of the

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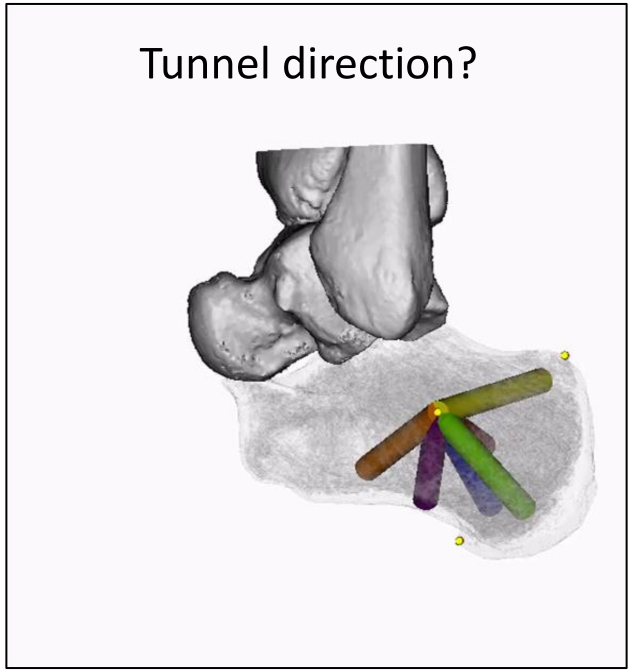
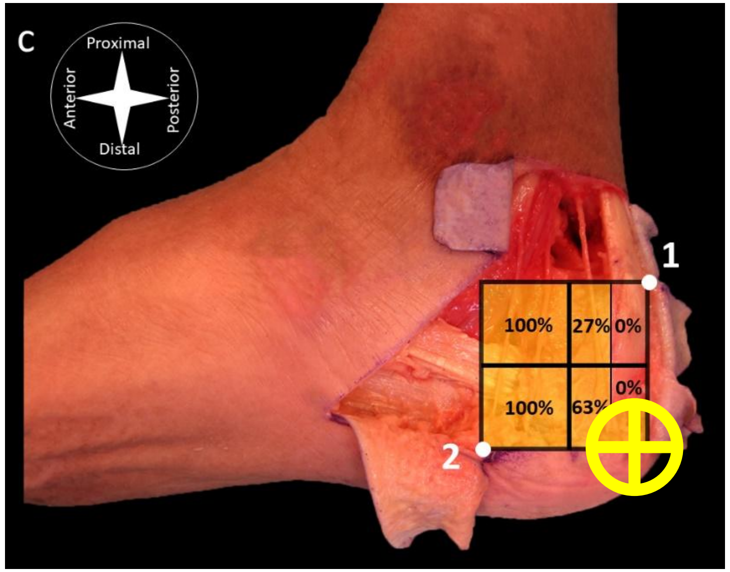
Implementation = impact on clinical practice





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Check for updates

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✉ Frederick Michels
frederick_michels@hotmail.com

1 Orthopaedic Department, AZ Groeninge, President Kennedylaan 4, 8500 Kortrijk, Belgium

2 GRECMIP-MIFAS (Groupe de Recherche et d'Etude en Chirurgie Mini-Invasive du Pied-Minimally Invasive Foot and Ankle Society), Merignac, France

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Dissectie en klinische anatomie

Dissectie en klinische anatomie

LEERDOELEN

1. **Verdieping van anatomische kennis:**
   - Dissectievaardigheden
   - Interpretatie van anatomische bevindingen
   - Combinatie met chirurgische technieken

2. **Ontwikkeling wetenschappelijke vaardigheden**
   - Literatuurstudie
   - Kritische benadering
   - Protocol uitwerken
   - Paper schrijven
   - Paper presenteren

3. **Ontwikkeling klinische vaardigheden**
   - Link tussen wetenschappelijk onderzoek en klinische praktijk

4. **Samenwerking en communicatie**
   - Groepswerk
   - Communicatie met docenten
   - Planning

Projecten 2017-2024

- **Bepalen safe zone in mediale enkel voor boren tunnel door calcaneum** (dr. F. Michels, AZ Groeninge)
- **Impact van osteotomie van metatarsaal 2, 3, 4 op innervatie voetrug** (dr. F. Michels, AZ Groeninge)
- **Vervolgstudie safe zones enkel** (dr. F. Michels, AZ Groeninge)
- **Hamerteen correcties** (dr. F. Michels, AZ Groeninge)
- **Hallux rigidus studie met echografie** (dr. S. Clockaerts)
- **Anatomie knieligamenten** (Dr. Geert Vandamme, kniechirurg, AZ St Lucas, Brugge)
- **Anatomie laterale ligamenten knie** (dr. Thomas Luyckx, AZ Delta)
- **Thoraxdrainage, pericarddrainage, thoracostomie** (dr. D. Helsloot, AZ Groeninge, Kortrijk)
- **Morton neuroma** (dr. F. Michels, AZ Groeninge)
- **Fasciotomie** (dr. F. Michels, AZ Groeninge)
- **Carpal tunnel** (dr. A. Decraemer, AZ Delta)
- **Anatomical Study of the Ulnar Nerve Branching Patterns in the Hand** (dr. J. Vanhaecke, AZ Groeninge)
- **The existence of the Anterior Oblique Ligament** (dr. W. Beel, AZ Groeninge)

History Inspires Science

20-22 MAY 2026 PRAGUE

22ND ESSKA CONGRESS

Is Routine Neurolysis of the Common Peroneal Nerve Necessary for Safe Transfibular Drilling in Posterolateral Corner Reconstruction? An Anatomical Study

W. Beel [1], J. Lauwers [2], L. Rambour [2], L. Top [2], J. De Buyser [2], F. Michels [12], E. Vereecke [2]

1 Orthopaedic departement, AZ Groeninge, Kortrijk, Belgium; 2 Departement of Development and Regeneration, Faculty of Medicine, KU Leuven Campus Kortrijk, Kortrijk, Belgium

OBJECTIVES

Neurolysis of the common peroneal nerve (CPN) during posterolateral corner reconstruction may unnecessarily prolong surgical time and carries a risk of iatrogenic injury. Moreover, it is not feasible in minimally invasive reconstructions. This study aimed to evaluate the distance between the transfibular tunnel and the CPN, and to determine whether routine neurolysis is required for safe drilling.

METHODS

Six fresh-frozen cadaveric knees were dissected at 90° of flexion. After removal of subcutaneous tissue, the biceps femoris was detached from the fibular head to expose the lateral collateral ligament (LCL). The peroneus muscle was carefully removed from the proximal fibular head to identify the tunnel entry point, located just anterior to the LCL insertion at the downslope of the fibular head. The tunnel was oriented from anterolateral to posteromedial, and a reference pin was placed at the entry site. CPN injury was considered present if the nerve lay within 3 mm of the pin, simulating a 6 mm drill tunnel. The CPN was then exposed without altering its anatomical position. Presence or absence of injury and distances from the pin to predefined anatomical landmarks along the CPN were measured with a digital caliper at 0°, 45°, and 90° of flexion. Results are reported as mean ± standard

RESULTS

No direct injury to the common peroneal nerve was observed at the tunnel entry. The posterior border (line A) consistently showed the greatest nerve-to-pin distance, with means of 15.6 ± 2.5 mm at 90°, 13.9 ± 1.8 mm at 45°, and 14.3 ± 1.2 mm at 0° of knee flexion. The distal border (line D) showed the shortest distances, with mean distances of 10.2 ± 2.2 mm at 90°, 10.1 ± 2.0 mm at 45° and 9.7 ± 1.9 mm at 0° of knee flexion. Across all specimens, the smallest recorded distance was 7.5 mm at 45° flexion (line D). Overall, the greatest mean CPN-to-pin distances were consitently observed at 90° of knee flexion.

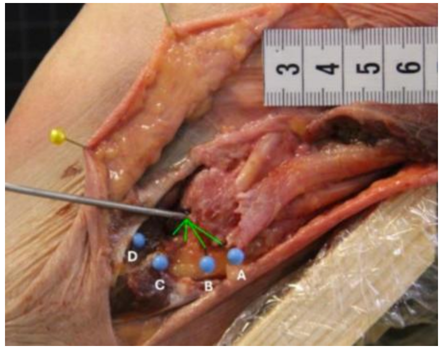


Figure 1 left knee positioned at 45° of flexion. Line A represents the distance from the pin to the posterior edge of the common peroneal nerve (CPN). Additional measurements were taken at 30° clockwise intervals, designated as lines B and C. Line D represents the distance from the pin to the distal edge of the CPN.

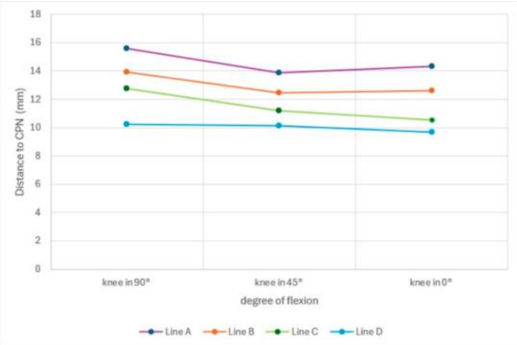


Figure 2 shows the mean distance from the pin to the common peroneal nerve for each reference point at the different knee flexion angles. Common peroneal nerve (CPN); millimeter (mm).

CONCLUSIONS

Transfibular tunnel drilling can be performed safely without direct injury to the CPN. The greatest safety margin was achieved with the knee at 90° of flexion, maximizing the distance between the tunnel entry and the CPN. Routine neurolysis of the common peroneal nerve therefore appears unnecessary in routine posterolateral corner reconstructions.

CONTACT INFORMATION

Wouter Beel
wouter.beel@azgroeninge.be

Landmarks on the medial malleolus to determine the optimal direction of the syndesmosis screw: a cadaveric study

Authors: Louis Cool*[1], Niels Mahieu*[1], Arne Raçon*[1], Frederick Michels[1,2], Janou Debuyser[1], Evie Vereecke[1]

* Shared first authorship, equal contribution

[1] Dept. Development and Regeneration, Faculty of Medicine, KU Leuven Campus Kulak, Etienne Sabbelaan 53, 8500 Kortrijk, Belgium

[2] Orthopaedic Department, AZ Groeninge, President Kennedylaan 4, 8500 Kortrijk, Belgium

KU LEUVEN kulak

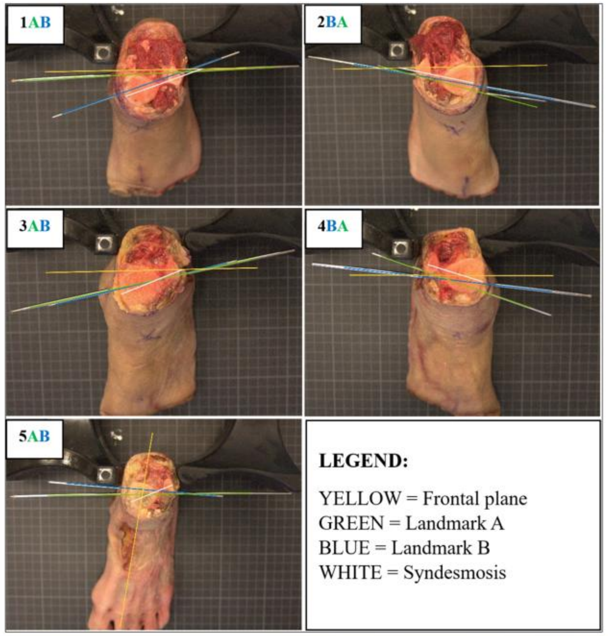
JAN PALFIJN ANATOMY LAB

Purpose & background:

Positioning of a syndesmotic screw or a tightrope is a challenge to restore the integrity of the tibiofibular syndesmosis. Use of a 30-degree angle is a commonly used guideline. The purpose of this study is to assess the use of anatomical landmarks on the tibia to aid in placing the screw in the optimal direction.

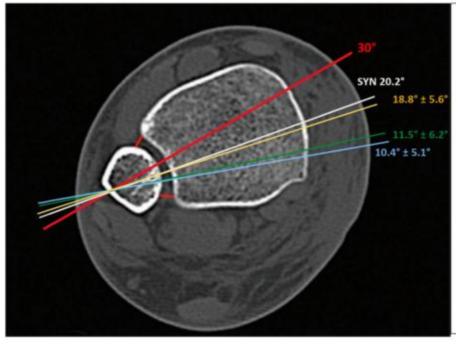
Methods:

A cadaveric study was performed using 5 specimens. In each specimen 2 K-wires were drilled towards 2 specific anatomical landmarks: the anterior half of the medial malleolus(landmark A) or the anterior and medial border of the tibia(landmark B). Subsequently, a cross-sectional analysis was performed to compare the results with the 30-degree guideline. In addition, the area of exit of the K-wire was dissected to assess for damage of anatomical structures.



Results:

The average orientation of the K-wires was 11.5±6.2 degrees using landmark A and 10.4±5.1 degrees using landmark B. The orientation of the syndesmosis averaged 20.2±6.7 degrees. The distance between the K-wire and the great saphenous vein averaged 2.1 mm.



LEGEND:

YELLOW = Frontal plane
GREEN = Average landmark A
BLUE = Average landmark B
WHITE = Syndesmosis
RED = 30° guideline

Conclusion:

The landmarks used in this study offered an orientation closer to the ideal position compared to the 30-degree guideline. In addition, the great saphenous vein is at risk if a K-wire exits the medial side.

Contact: frederick_michels@hotmail.com, evie.vereecke@kuleuven.be

18th ESKA Congress
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Glasgow, UK

ESSKA

The lateral malleolus as a landmark to find the calcaneofibular ligament footprint on the calcaneus

F Michels[1,2], S Clockaerts[1,2], L Baekelandt[2], K Callens[2], E Matthys[2], G Matricali[2], E Vereecke[2], F Stockmans[1,2]
1 AZ Groeninge Kortrijk, Belgium
2 University KU Leuven, Belgium

az|groeninge|kortrijk orthopedisch centrum

KU LEUVEN

GRECMIP

INTRODUCTION

The advent of new endoscopic and percutaneous techniques to treat ankle instability increases the need for anatomical landmarks. When performing an anatomical reconstruction of the calcaneofibular ligament(CFL), the footprint on the calcaneus is difficult to indicate.

AIM

The purpose of this study is to evaluate a method to locate the footprint of the CFL related to the palpable landmarks of the lateral malleolus.

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METHOD

10 lower leg cadaveric specimens

K wire is drilled at the intersection of 2 lines:

1. A line parallel with the fibula passing through the posterior point of the lateral malleolus was determined.
2. A second line with an angle of 45 degrees to the first one and passing through the fibular obscure tubercle was marked.

A second wire was drilled blinded to the earlier marked landmarks and pin to assess the interobserver reliability.

Dissection and measurements

RESULTS

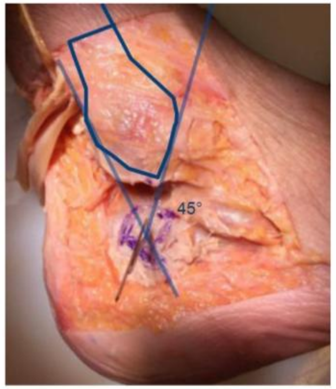
Measurements

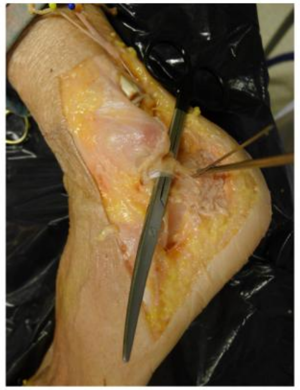
The mean distance to the centre of the CFL footprint was 1.7 mm (0-11mm).

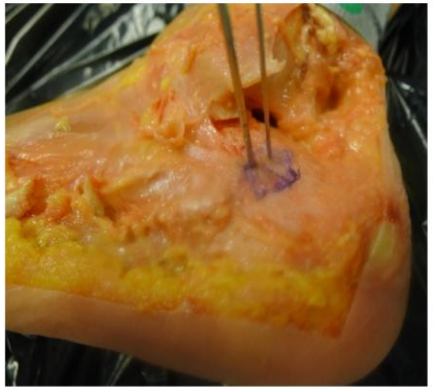
The mean distance between both pins was 3.17 mm.

The mean distance to the sural nerve was 1.7 mm.

The mean distance to the peroneal tendons was 7.1 mm.







CONCLUSIONS

The described guidelines are useful to locate the CFL footprint when reconstructing the CFL. In addition, relative positions to local landmarks may be more adapted to the variation in foot size in patients.

The close position of the CFL footprint to the sural nerve and the peroneal tendons increases the risk of damage when using percutaneous techniques.

A small percutaneous placed needle at the estimated footprint can be very helpful during endoscopic and even open surgical techniques.

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CONTACT INFORMATION

Frederick.michels@azgroeninge.be

KU LEUVEN kulak

Depth and localization of the common plantar interdigital nerve for infiltrative therapy in Morton's Neuroma: a cadaver study

Jarno Vanhove*[1], Louis Bonte*[1], Jonas Derluyn*[1], Frederick Michels[1,2], Evie Vereecke[1]

*Shared first authorship, equal contribution

[1]Dept. Development and Regeneration, Faculty of Medicine, KU Leuven Campus Kulak, Etienne Sabbelaan 53, 8500 Kortrijk, Belgium

[2]Orthopaedic Department, AZ Groeninge, President Kennedylaan 4, 8500 Kortrijk, Belgium

OBJECTIVES

Morton's Neuroma is a painful condition which affects the **common plantar interdigital nerve** (CPIN). In case of infiltration or percutaneous release of the deep transverse metatarsal ligament (DTML) more guidelines are needed to localize the DTML and CPIN.

The purpose of this study is to determine the localization and depth of both anatomical structures in cadaveric specimens.

MATERIAL AND METHODS

Five fresh-frozen cadaver feet were segmented at the level of the metatarsal heads (**Fig. 1**). Measurements were taken in the coronal plane to determine a safe zone around the CPIN of webspace 2 and 3. The dorsum pedis and the metatarsals were used as anatomical landmarks. All specimens were obtained via the human body donation programme of the university after written consent.

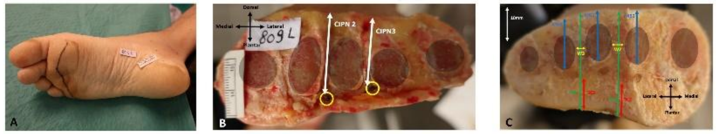

Figure 1 (left to right): (**A**) *black line* indicating the location of the segmentation at the level of the metatarsal heads; (**B**) *yellow circles* indicating the position of CPIN2 and CPIN3 at the plantar side of the foot; (**C**) *colored arrows* indicating the different measurements taken in each specimen: *blue*: depth of plantar side metatarsal heads 2-4, *green*: full thickness of intermetatarsal space 2 and 3, *red*: thickness of subcutis at intermetatarsal space 2 and 3, *yellow*: width of the intermetatarsal space 2 and 3.

RESULTS

The average depth of the DTML was 22.1 mm (95% CI: 15.6 – 28.6 mm) for webspace 2 and 21.3 mm (95% CI: 15.26 – 27.34 mm) for webspace 3. The average depth of CPIN2 was 24.6 mm (95%CI: 21.2 – 28.0 mm) and 23.0 mm (95%CI: 19.8 – 26.2 mm) for CPIN3. The average lower border distance was 26.3 mm (95% CI: 22.7 – 29.8 mm) for webspace 2 and 25.0 mm (95% CI: 21.7 – 28.2 mm) for webspace 3. If the needle is injected beyond this distance, the infiltrate will be injected into the plantar subcutis and necrosis will occur (**Fig. 2**).

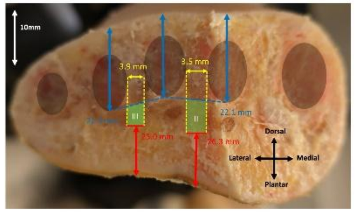

Figure 2: The average location of the safe zone is shown as *green shaded area.*

CONCLUSION

This anatomical study quantified the depth of common plantar digital nerve and deep transverse metatarsal ligament in five cadaver specimens. These measurements allowed delineating of a safe zone which can be used in clinical practice when performing an infiltration of the nerve or a sectioning of the DTML using a percutaneous technique.

Contact: frederick_michels@hotmail.com, evie.vereecke@kuleuven.be

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Localization of the relevant neurovascular structures of the lower leg at risk in a fasciotomy: a cadaveric study

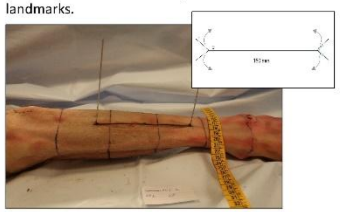
Andreas Baert*, Wobbe Dermaux*, Guillaume De Vlaminck*, Frederick Michels, Evie Vereecke

- Shared first authorship, equal contribution
- Andreas Baert, andreas.baert@student.kuleuven.be Institution: Dept. Development and Regeneration, Faculty of Medicine, University of Leuven campus Kortrijk, Etienne Sabbelaan 53, 8500 Kortrijk, Belgium
- Wobbe Dermaux wobbe.dermaux@student.kuleuven.be Institution: Dept. Development and Regeneration, Faculty of Medicine, University of Leuven campus Kortrijk, Etienne Sabbelaan 53, 8500 Kortrijk, Belgium
- Guillaume De Vlaminck guillaume.devlaminck@student.kuleuven.be Institution: Dept. Development and Regeneration, Faculty of Medicine, University of Leuven campus Kortrijk, Etienne Sabbelaan 53, 8500 Kortrijk, Belgium
- Frederick Michels, frederick_michels@hotmail.com Institution: 1/Orthopaedic Department, AZ Groeninge, President Kennedylaan 4, 8500 Kortrijk, Belgium 2/Dept. Development and Regeneration, Faculty of Medicine, University of Leuven campus Kortrijk, Etienne Sabbelaan 53, 8500 Kortrijk, Belgium
- Evie Vereecke, evie.vereecke@kuleuven.be Institution: Dept. Development and Regeneration, Faculty of Medicine, University of Leuven campus Kortrijk, Etienne Sabbelaan 53, 8500 Kortrijk, Belgium

ABSTRACT

Objectives

Acute compartment syndrome of the lower leg is treated by an immediate fasciotomy. This procedure is usually performed by an extended dual-incision fasciotomy. The surgical approach is related with injuries of the superficial neurovascular structures. A minimally invasive approach increases the risk to these injuries. The purpose of this study is to perform a cadaveric study to assess the location of relevant anatomical structures in the lower leg based on anatomical landmarks.

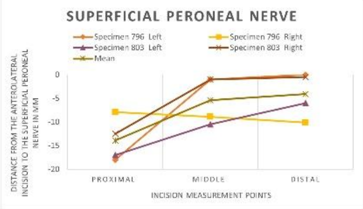


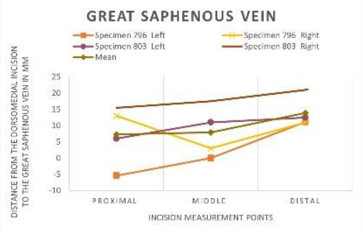
Results

The findings of this study demonstrated that the GSV and SN are very stable in their course and run next to each other. The distance between the GSV and the posteromedial incision averaged 7.3±9.4 mm proximally, 7.9±7.9 at the midpoint and 13.9±4.8 distally. The distance between the SN and the posteromedial incision averaged 8.7±4.6 mm proximally, 7.8±7.9 at the midpoint and 13.8±4.8 distally. The SPN hiatus appeared to be very relatively constant in all specimens. The distance between the SPN hiatus and the fibular head averaged 247.4±10.5 mm. The distance between the SPN and the anterolateral incision averaged 13.9±4.6 mm proximally, 5.4±5.1 at the midpoint and 4.1±4.8 distally.

Material and methods

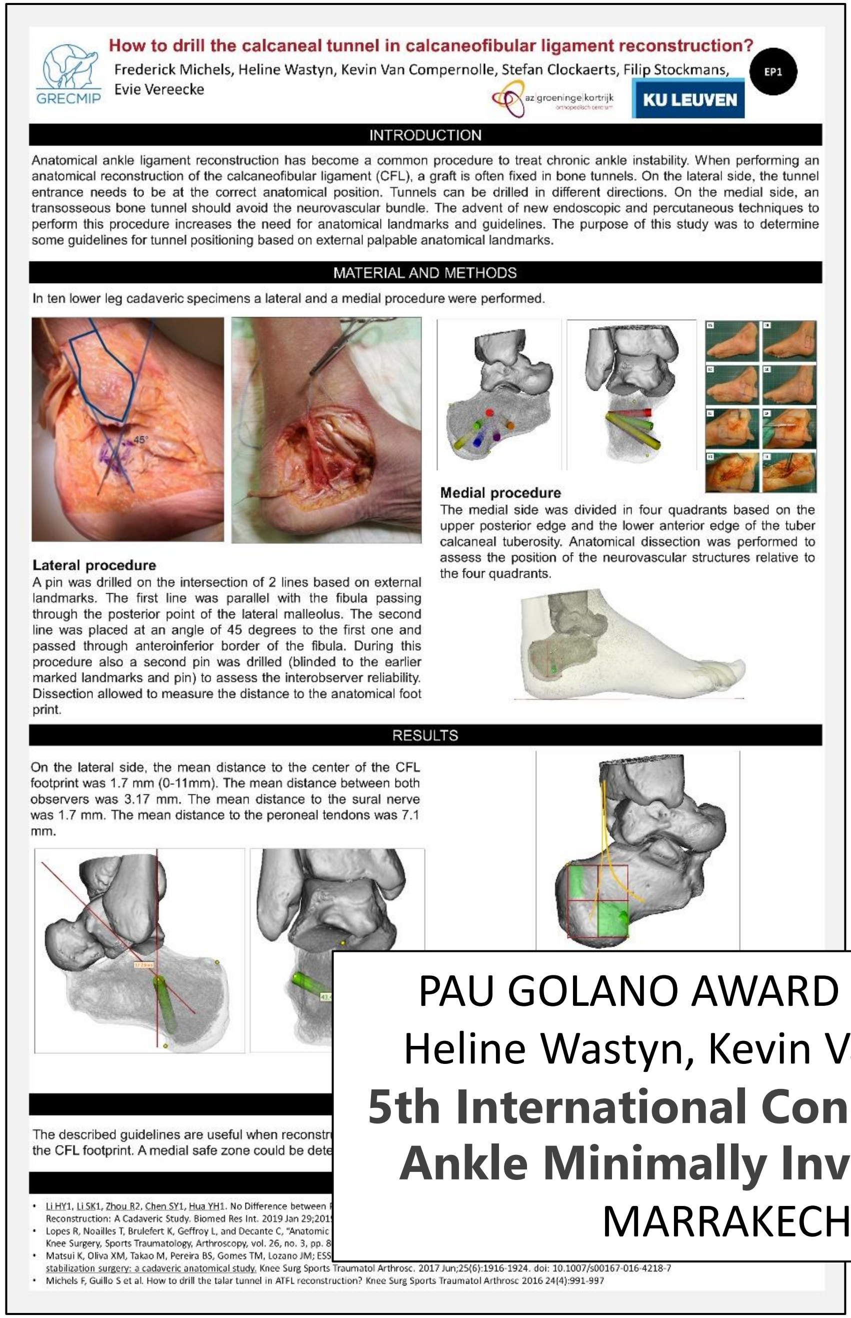
In four fresh frozen cadavers a dual-incision fasciotomy was performed using a standardized technique. Next, complete dissection was performed and the location of the relevant superficial neurovascular structures was assessed: the great saphenous vein (GSV), the saphenous nerve (SN) and the superficial peroneal nerve (SPN). The location was related to local anatomical landmarks and the incision.





Conclusion

This anatomical study demonstrated the location of the relevant superficial structures of the lower leg. These findings are useful in clinical practice when performing a dual incision open fasciotomy. These findings are also useful for the development of a minimally invasive approach.



How to drill the calcaneal tunnel in calcaneofibular ligament reconstruction?

Frederick Michels, Heline Wastyn, Kevin Van Compernolle, Stefan Clockaerts, Filip Stockmans, Evie Vereecke

GRECMIP — az groeninge kortrijk — KU LEUVEN — EP1

INTRODUCTION

Anatomical ankle ligament reconstruction has become a common procedure to treat chronic ankle instability. When performing an anatomical reconstruction of the calcaneofibular ligament (CFL), a graft is often fixed in bone tunnels. On the lateral side, the tunnel entrance needs to be at the correct anatomical position. Tunnels can be drilled in different directions. On the medial side, an transosseous bone tunnel should avoid the neurovascular bundle. The advent of new endoscopic and percutaneous techniques to perform this procedure increases the need for anatomical landmarks and guidelines. The purpose of this study was to determine some guidelines for tunnel positioning based on external palpable anatomical landmarks.

MATERIAL AND METHODS

In ten lower leg cadaveric specimens a lateral and a medial procedure were performed.

Lateral procedure

A pin was drilled on the intersection of 2 lines based on external landmarks. The first line was parallel with the fibula passing through the posterior point of the lateral malleolus. The second line was placed at an angle of 45 degrees to the first one and passed through anteroinferior border of the fibula. During this procedure also a second pin was drilled (blinded to the earlier marked landmarks and pin) to assess the interobserver reliability. Dissection allowed to measure the distance to the anatomical foot print.

Medial procedure

The medial side was divided in four quadrants based on the upper posterior edge and the lower anterior edge of the tuber calcaneal tuberosity. Anatomical dissection was performed to assess the position of the neurovascular structures relative to the four quadrants.

RESULTS

On the lateral side, the mean distance to the center of the CFL footprint was 1.7 mm (0-11mm). The mean distance between both observers was 3.17 mm. The mean distance to the sural nerve was 1.7 mm. The mean distance to the peroneal tendons was 7.1 mm.

The described guidelines are useful when reconstru
the CFL footprint. A medial safe zone could be dete

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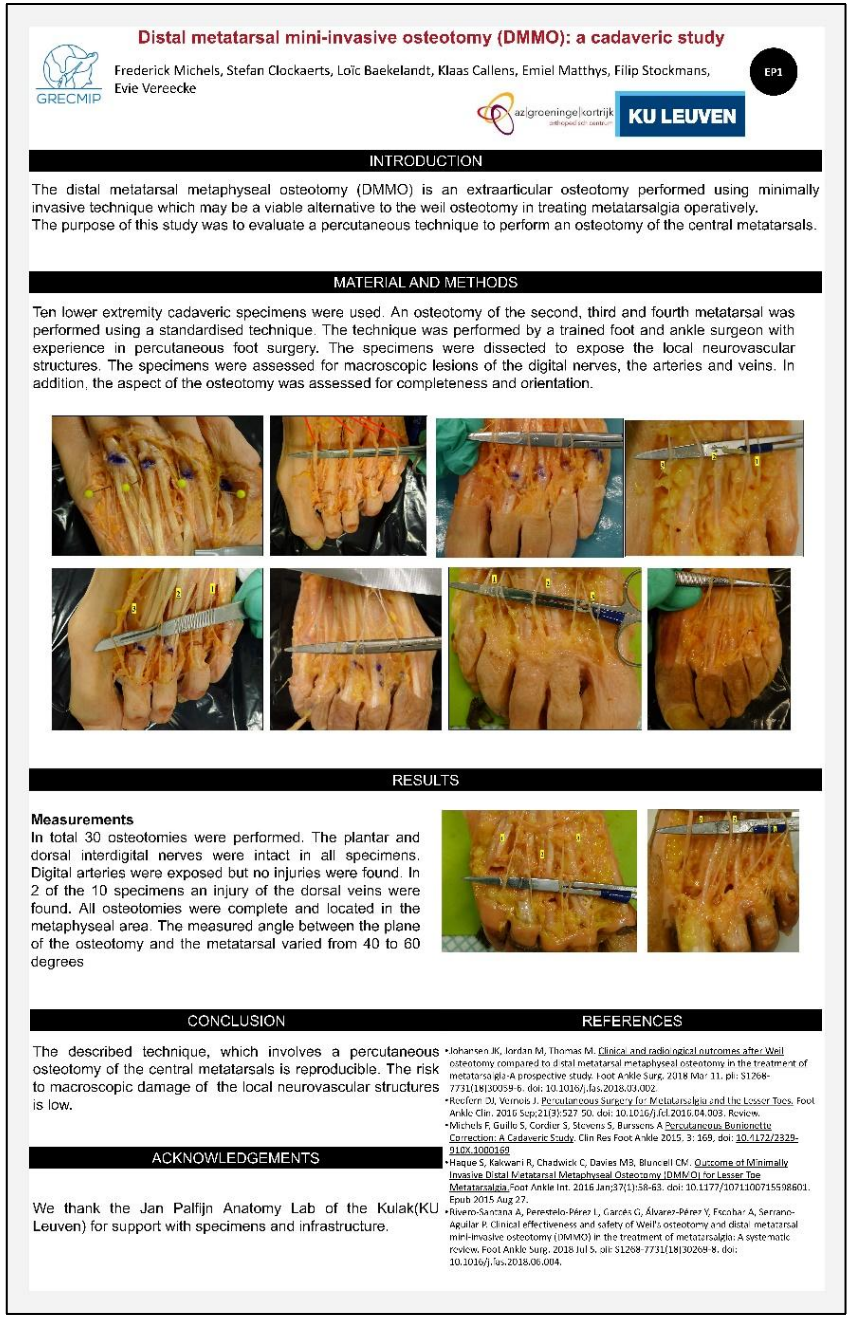

Distal metatarsal mini-invasive osteotomy (DMMO): a cadaveric study

Frederick Michels, Stefan Clockaerts, Loïc Baekelandt, Klaas Callens, Emiel Matthys, Filip Stockmans, Evie Vereecke

GRECMIP — az groeninge kortrijk — KU LEUVEN — EP1

INTRODUCTION

The distal metatarsal metaphyseal osteotomy (DMMO) is an extraarticular osteotomy performed using minimally invasive technique which may be a viable alternative to the weil osteotomy in treating metatarsalgia operatively.
The purpose of this study was to evaluate a percutaneous technique to perform an osteotomy of the central metatarsals.

MATERIAL AND METHODS

Ten lower extremity cadaveric specimens were used. An osteotomy of the second, third and fourth metatarsal was performed using a standardised technique. The technique was performed by a trained foot and ankle surgeon with experience in percutaneous foot surgery. The specimens were dissected to expose the local neurovascular structures. The specimens were assessed for macroscopic lesions of the digital nerves, the arteries and veins. In addition, the aspect of the osteotomy was assessed for completeness and orientation.

RESULTS

Measurements

In total 30 osteotomies were performed. The plantar and dorsal interdigital nerves were intact in all specimens. Digital arteries were exposed but no injuries were found. In 2 of the 10 specimens an injury of the dorsal veins were found. All osteotomies were complete and located in the metaphyseal area. The measured angle between the plane of the osteotomy and the metatarsal varied from 40 to 60 degrees

CONCLUSION

The described technique, which involves a percutaneous osteotomy of the central metatarsals is reproducible. The risk to macroscopic damage of the local neurovascular structures is low.

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ANKLE

A calcaneal tunnel for CFL reconstruction should be directed to the posterior inferior medial edge of the calcaneal tuberosity

Frederick Michels[1,2,3,6] · Giovanni Matricali[4,5,6] · Heline Wastyn[7] · Evie Vereecke[7] · Filip Stockmans[1,7]

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Abstract

Purpose Anatomical reconstruction of the calcaneofibular ligament (CFL) is a common technique to treat chronic lateral ankle instability. A bone tunnel is used to fix the graft in the calcaneus. The purpose of this study is to provide some recommendations about tunnel entrance and tunnel direction based on anatomical landmarks.

Methods The study consisted of two parts. The first part assessed the lateral tunnel entrance for location and safety. The second part addressed the tunnel direction and safety upon exiting the calcaneum on the medial side. In the first part, 29 specimens were used to locate the anatomical insertion of the CFL based on the intersection of two lines related to the fibular axis and specific landmarks on the lateral malleolus. In the second part, 22 specimens were dissected to determine the position of the neurovascular structures at risk during tunnel drilling. Therefore, a method based on four imaginary squares using external anatomical landmarks was developed.

Results For the tunnel entrance on the lateral side, the mean distance to the centre of the CFL footprint was 2.8 ± 3.0 mm (0–10.4 mm). The mean distance between both observers was 4.2 ± 3.2 mm (0–10.3 mm). The mean distance to the sural nerve was 1.4 ± 2 mm (0–5.8 mm). The mean distance to the peroneal tendons was 7.3 ± 3.1 mm (1.2–12.4 mm). For the tunnel exit on the medial side, the two anterior squares always contained the neurovascular bundle. A safe zone without important neurovascular structures was found and corresponded to the two posterior squares.

Conclusion Lateral landmarks enabled to locate the CFL footprint. Precautions should be taken to protect the nearby sural nerve. A safe zone on the medial side could be determined to guide safe tunnel direction. A calcaneal tunnel should be directed to the posterior inferior medial edge of the calcaneal tuberosity.

Keywords Hindfoot instability · Calcaneofibular ligament · Ligament reconstruction · Bone tunnel · Neurovascular bundle

✉ Frederick Michels
frederick_michels@hotmail.com

1 Orthopaedic Department, AZ Groeninge, President Kennedylaan 4, 8500 Kortrijk, Belgium

2 GRECMIP-MIFAS (Groupe de Recherche et d'Etude en Chirurgie Mini-Invasive du Pied-Minimally Invasive Foot and Ankle Society), Merignac, France

3 ESSKA-AFAS Ankle Instability Group, Luxembourg, Luxembourg

4 Department of Development and Regeneration, KU Leuven, Leuven, Belgium

5 Department of Orthopaedics, Foot and Ankle Unit, University Hospitals Leuven, KU Leuven, Leuven, Belgium

6 Institute of Orthopaedic Research and Training, KU Leuven, Leuven, Belgium

7 Department Development and Regeneration, Faculty of Medicine, University of Leuven Campus Kortrijk, Etienne Sabbelaan 53, 8500 Kortrijk, Belgium

Introduction

Chronic lateral ankle instability is a disabling complication after an acute ankle sprain, and surgery is indicated if conservative treatment fails [23]. In patients with generalized laxity or poor ligament quality and in revision cases, lateral ligament reconstruction of both the anterior talofibular ligament (ATFL) and the calcaneofibular ligament (CFL) should be considered [23].

The evolution towards more anatomical procedures to restore normal joint mechanics increases the need for detailed knowledge of the normal anatomy [21, 22, 25]. When performing a ligament reconstruction, bone tunnels are commonly used. The entrance of the tunnel should be at the normal anatomical footprint. However, the exact position of the calcaneal insertion of the CFL is difficult to locate, and no agreement exists about the optimal direction of the

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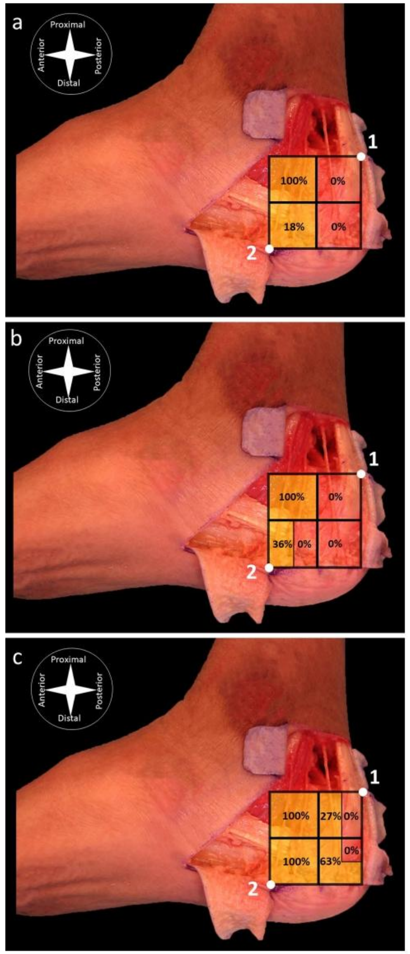

Fig. 4 Medial view of the hindfoot with four squares. (1) The upper edge of the calcaneum at the insertion site of the Achilles tendon. (2) The anterior edge of the tuber calcanei defined by palpation. **a** Arteries, **b** motor branches, **c** sensory branches

of the main rectangle was 52 mm (34–88 mm), and the vertical length was 50 mm (34–98 mm).

Discussion

The most important finding in this study is that anatomical surface landmarks can be very useful to obtain information about the location of the calcaneal CFL footprint on the lateral side and the neurovascular bundle on the medial side. This information is valuable with respect to the optimal tunnel entry point and safe tunnel orientation to reconstruct the CFL.

The different surgical techniques for treating chronic lateral ankle instability can be divided into two major groups [10]. First, anatomical repair has been commonly used and corresponds to suturing the torn lateral ligaments. Second, reconstruction refers to the replacement of chronically deficient lateral ligaments with other tissue, which can be local tissue, autograft or allograft [10]. Since 2006, anatomical reconstruction has become more popular [6, 28, 31]. According to a recent systematic review, anatomical reconstruction using a tendon graft seems to give the best results, but may be more invasive than anatomical repair [31]. Especially in patients with generalized laxity or poor ligament quality, lateral ligament reconstruction (with grafting) of both the ATFL and CFL should be considered [23]. The CFL, which is the only ligament bridging both the tibiotalar and subtalar joint is generally assumed to be an important stabilizer of both joints. Lesions of the CFL and the suspicion of subtalar instability serve as an extra argument for reconstructing the CFL in addition to the ATFL [11, 19, 23]. Pereira et al. described several distinct anatomical variants of the CFL: single bundle, Y-shape, V-shape and double bundle [26]. The contribution of the different bundles to the stability of the hindfoot is still unclear, but may be important when an anatomical reconstruction is being considered. In particular, the bundle towards the talus is probably important to provide stability of the subtalar joint. In contrast, the calcaneal footprint showed limited morphological variability, with a single calcaneal footprint in 89.4% of the specimens.

Takao et al. published the anatomical ankle ligament reconstruction method in 2005 [28]. They fixed a gracilis autograft in a calcaneal tunnel to reconstruct the CFL. In later years, similar open [6, 12], endoscopic [5, 9, 11, 20, 21, 27, 32, 34] and percutaneous [8] techniques of CFL reconstruction were published. However, those publications presented different tunnel directions and offered only limited information on finding the CFL footprint.

When performing an anatomical reconstruction of the CFL, the entrance of the calcaneal tunnel, which represents the fixation site of the graft, should be as close as possible to the anatomical footprint. In most cases, some tissue remnants are still present and can be used to determine the

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The cervical ligament has similar dimensions as the ATFL and CFL: an anatomical study of the subtalar ligaments

F. MICHELS [1,2], G. MATRICALI[2], E. VEREECKE[2], DEWILDE M[2], F. STOCKMANS[1,2]
1 AZ Groeninge, Kortrijk, Belgium
2 University KU Leuven, Leuven, Belgium

INTRODUCTION

Besides tibiotalar instability, also subtalar instability is a disabling complication after acute ankle sprains.

The relative contribution of each ligamentous structure in the stability of the subtalar joint is still unclear. The CFL, the only ligament bridging both the tibiotalar and subtalar joint, is seen as an important stabilizer of the subtalar joint. However, the intrinsic subtalar ligaments, also seem to play an important role to stabilize the subtalar joint.

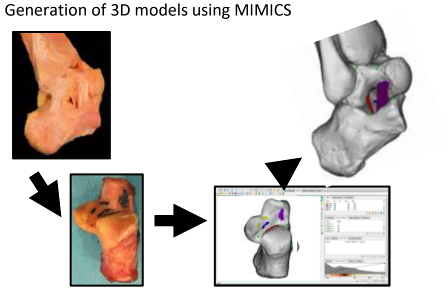
Currently the literature on the anatomy of the intrinsic subtalar ligaments is limited and unclear. Besides the ambiguous terminology, there is also confusion about the anatomical characteristics such as dimensions and location.

AIM

The purpose of this study was to assess the anatomical characteristics of the subtalar ligaments and to compare them with the anterior talofibular ligament and calcaneofibular ligament.

METHOD

- 16 fresh frozen cadaveric feet
- CT-scan
- Dissection & assesment of dimensions and locations of subtalar ligaments
- Indication of the footprints with radio-opaque paint
- CT-scan
- Generation of 3D models using MIMICS

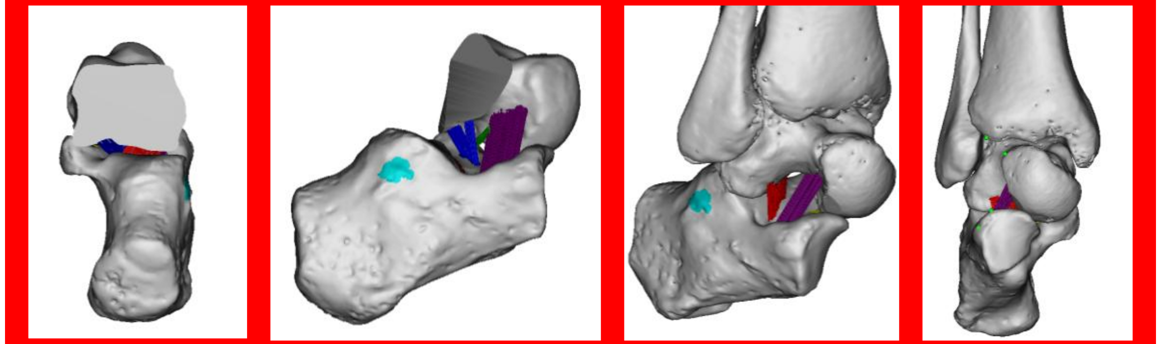


RESULTS

The cervical ligament had similar dimensions as the lateral ligaments: anterior length 13.9±1.5 mm, posterior length 18.5±2.9 mm, talar width 13.6±2.2 mm, calcaneal width 15.8±3.7 mm .

The anterior capsular ligament and interosseous talocalcaneal ligament were found to be smaller structures with consistent dimensions and locations.

The different osseous landmarks and footprints indicated on talus and calcaneus. The footprints and ligaments are indicated: CL (purple), ACaL (red), ITCL (blue).



The anterior capsular ligament (red) and the interosseous talocalcaneal ligament (blue) are 2 different ligamentous structures.

The interosseous talocalcaneal ligament (blue) is located more deeply in the tarsal canal. It is almost impossible to see during surgery from a lateral approach. This ligament has a small connection (green) with the cervical ligament (purple).

The anterior capsular ligament (red) and the cervical ligament (purple) are located in the sinus tarsi. The anterior capsular ligament can easily be seen during an endoscopic approach of the posterior facet.

The cervical ligament (purple) is located behind the extensor retinaculum.

CONCLUSIONS

This study identified consistent characteristics of the intrinsic subtalar ligaments and clarifies the local anatomical situation.

The anterior capsular ligament and the interosseous talocalcaneal ligament are 2 different ligamentous structures.

The dimensions and footprints of the intrinsic ligaments of the subtalar joint suggest a more important role of the cervical ligament and anterior capsular ligament in the stability of the subtalar joint.

The results of this study are relevant to improve diagnostic tools and offer some guidelines when reconstructing the injured ligaments.

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CONTACT INFORMATION

Frederick Michels

Orthopaedic Department, AZ Groeninge Kortrijk, Belgium

frederick.michels@azgroeninge.be

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The intrinsic subtalar ligaments have a consistent presence, location and morphology

Frederick Michels[a,b,*], Giovanni Matricali[c,d,e], Evie Vereecke[f], Miloud Dewilde[f], Frederik Vanrietvelde[g], Filip Stockmans[a,f]

[a] Orthopaedic Department, AZ Groeninge, President Kennedylaan 4, 8500 Kortrijk, Belgium
[b] GRECMIP - MIFAS (Groupe de Recherche et d'Etude en Chirurgie Mini-Invasive du Pied - Minimally Invasive Foot and Ankle Society), Merignac, France
[c] Department of Development and Regeneration, KU Leuven, Leuven, Belgium
[d] Department of Orthopaedics, Foot and Ankle Unit, University Hospitals Leuven, KU Leuven, Leuven, Belgium
[e] Institute of Orthopaedic Research and Training, KU Leuven, Leuven, Belgium
[f] Dept. Development and Regeneration, Faculty of Medicine, University of Leuven Campus Kortrijk, Etienne Sabbelaan 53, 8500 Kortrijk, Belgium
[g] Radiology Department, AZ Groeninge Kortrijk, President Kennedylaan 4, 8500 Kortrijk, Belgium

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ABSTRACT

Background: Chronic subtalar instability is a disabling complication after acute ankle sprains. Currently, the literature describing the anatomy of the intrinsic subtalar ligaments is limited and equivocal which causes difficulties in diagnosis and treatment of subtalar instability. The purpose of this study is to assess the anatomical characteristics of the subtalar ligaments and to clarify some points of confusion.
Methods: In 16 cadaveric feet, the dimensions and locations of the subtalar ankle ligaments were assessed and measured. CT-scans before dissection and after indication of the footprints with radio-opaque paint allowed to generate 3D models and assess the footprint characteristics.
Results: The cervical ligament (CL) had similar dimensions as the lateral ligaments: anterior length 13.9 ± 1.5 mm, posterior length 18.5 ± 2.9 mm, talar width 13.6 ± 2.2 mm, calcaneal width 15.8 ± 3.7 mm. The anterior capsular ligament (ACaL) and interosseous talocalcaneal ligament (ITCL) were found to be smaller structures with consistent dimensions and locations.
Conclusion: This study identified consistent characteristics of the intrinsic subtalar ligaments and clarifies the local anatomical situation. The dimensions and footprints of the intrinsic ligaments of the subtalar joint suggest a more important role of the CL and ACaL in the stability of the subtalar joint. The results of this study are relevant to improve diagnostic tools and offer some guidelines when reconstructing the injured ligaments.

1. Introduction

Chronic lateral hindfoot instability is a common complication of an ankle sprain. Anatomically, two forms of ligamentous instability can be distinguished: ankle instability and subtalar instability [1]. Ankle instability has been well documented in the literature and experts agree on several aspects of diagnosis and treatment [2]. Anatomical reconstruction of the anterior talofibular ligament (ATFL) and calcaneofibular ligament (CFL) has been extensively described [3,4].

In contrast to ankle instability, literature addressing subtalar instability is rather limited. The diagnosis is still difficult, which compounds adequate treatment [2,5–7]. Subtalar instability has been related to injuries of different ligaments: the calcaneofibular ligament (CFL), the cervical ligament (CL), the anterior capsular ligament (ACaL), and the interosseous talocalcaneal ligament (ITCL) [7–9]. The CFL, the only ligament bridging both the tibiotalar and subtalar joint, has an important function in the stability of the subtalar joint [10,11]. The other ligaments, called the intrinsic subtalar ligaments, also seem to play an important role to stabilize the subtalar joint, but literature about their anatomy is equivocal [12–17]. Today, the contribution of each ligamentous structure in the stability of the subtalar joint is still unclear [7,15].

The purpose of this study is to assess the anatomical characteristics of the subtalar ligaments and to clarify some points of confusion. To this end, we performed a cadaveric study to quantify the dimensions and footprints of the intrinsic subtalar ligaments (ITCL, CL, ACaL and the tarsal canal ligament (TCL)) in comparison with the dimensions of the ATFL and CFL in the same

* Corresponding author at: Orthopaedic Department, AZ Groeninge, President Kennedylaan 4, 8500 Kortrijk, Belgium.
E-mail address: frederick.michels@azgroeninge.be (F. Michels).

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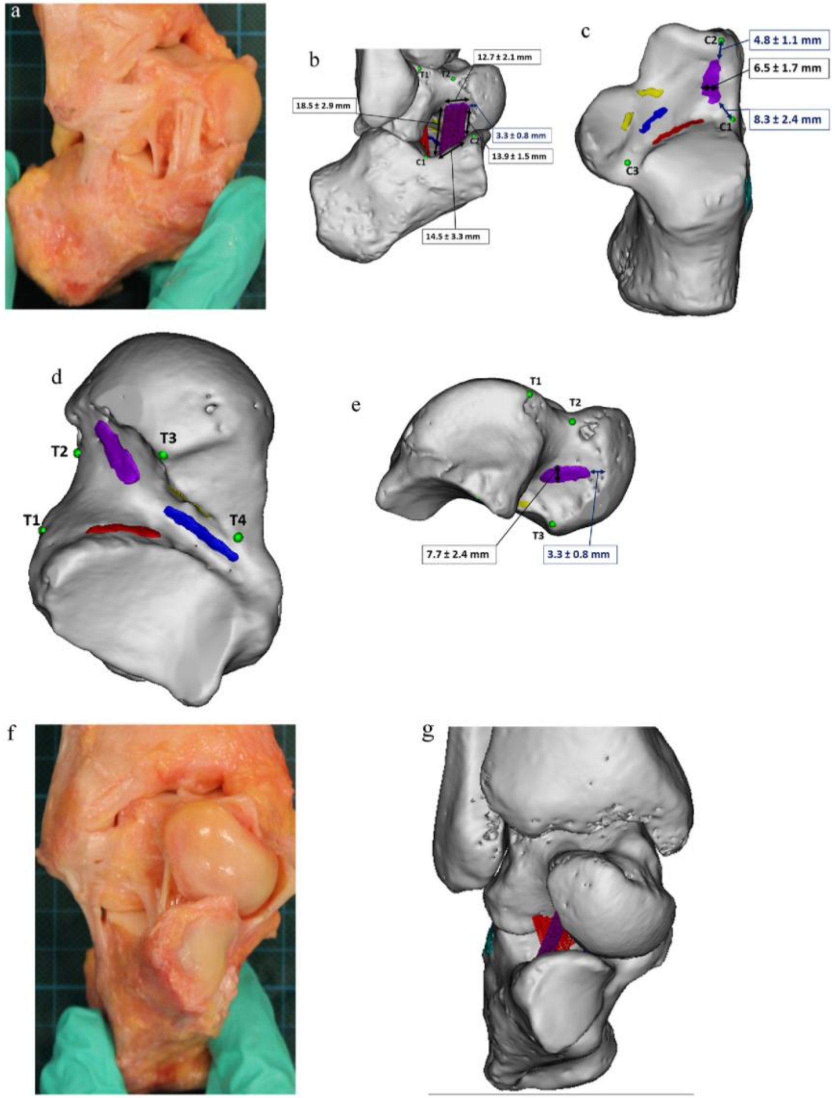

Fig. 2. The cervical ligament. **a** Lateral view specimen. **b** Dimensions CL and distance anterior border footprint to cartilage. **c** Footprint location on calcaneus. Superior view. **d** Footprint location on talus. Inferior view. **e** Footprint location on talus. Lateral view. **f** Anterior view specimen. **g** Anterior view 3D.
The different osseous landmarks and footprints indicated on talus and calcaneus.
The footprints are indicated: CL (purple), ACaL (red), ITCL (blue), TCL (yellow).
The osseous landmarks on the calcaneus: the intersection between the most anterior point of the posterior articular facet and the calcaneal lateral ridge (C1), the intersection between the calcaneal lateral ridge and the calcaneocuboid joint line (C2), the midpoint of the medial exit of the tarsal canal (C3). The osseous landmarks on the talus: most anterior point of the lateral surface of the talar body (T1), deepest point of the lateral superior ridge of the talar neck (T2), posterolateral intersection between the anterior and the middle calcaneal articular surface of the talus (T3), most posteromedial point of the middle calcaneal articular surface of the talar neck (T4). (For interpretation of the references to colour in the figure legend, the reader is referred to the web version of this article.)

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  Sarah Algoed en Céleste Descamps

- **De maximale spanningsvrije transpositielengte van de nervus interosseus anterior naar de diepe motorische tak van de nervus ulnaris: een anatomische dissectiestudie**
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Laterale enkelinstabiliteit: hoe anatomisch onderzoek de chirurgische resultaten verbetert

Sarah Algoed - Céleste Descamps
Prof. Dr. Frederick Michels
Prof. Evie Vereecke – Janou De Buyser

Vrouw, 45j

Scherpe pijn buitenenkel
Enkel zwelt op => blauwe kleur
Mogelijkheid tot steunen op voet
Geen afrollen van de voet mogelijk

Vrouw, 45j

- Consultatie Orthopedie
  - Klinisch onderzoek: lichamelijk onderzoek, voorste schuifladetest, talar tilt test
  - Beeldvorming: MRI
  - Diagnose: chronische enkelinstabiliteit
  - Beleid: enkelbandreconstructie
    - Primaire indicatie voor operatieve ingreep = falen van niet-heelkundige behandeling

Probleemstelling en relevantie

- Reconstructie vereist gedetailleerde kennis van:
  - Ligament morfologie en bundelconfiguratie
  - Aanhechtingsplaatsen
  - Materiaal eigenschappen

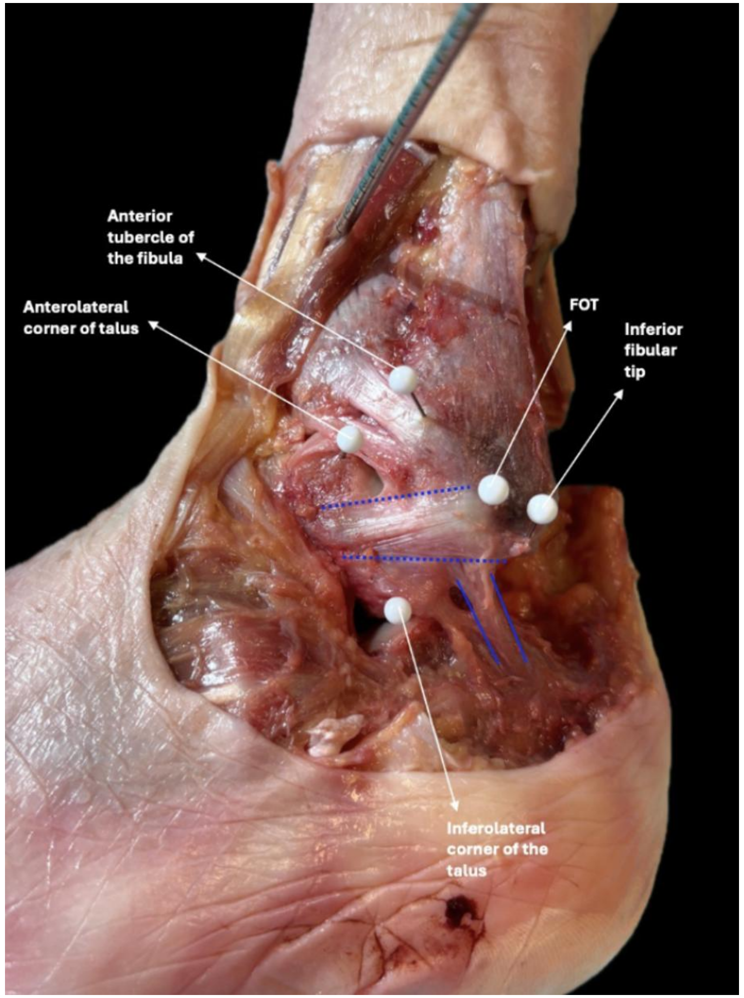
- Probleemstelling
  - Verschillende functionele rol binnenin bundels ATFL
  - Beschrijving ligament aanhechtingen t.o.v. benige referentiepunten
  - Huidige enkelbandreconstructies en adequaat herstel biomechanica

Onderzoeksvragen

- Hoe verandert de vorm van de laterale ligamenten (ATFL en CFL) afhankelijk van de positie van de enkel?
- Welke anatomische landmarks zijn relevant voor correcte plaatsing van boortunnels tijdens reconstructie?
- Wat is het effect van reconstructie van de verschillende bundels op de range of motion?

Protocol

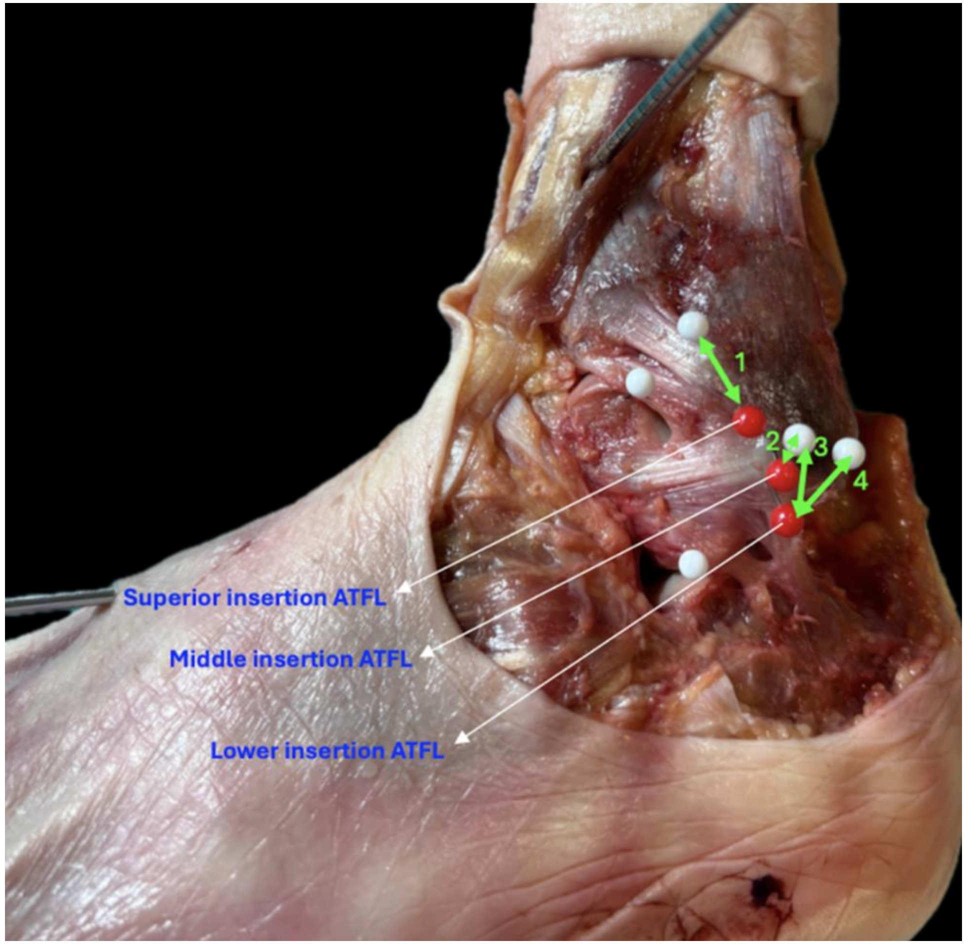
- Lengte van ligamenten in plantair- en dorsiflexie
- Anatomische landmarks
- Afstand van ligament tot landmarks
- ROM voor en na reconstructie met kunstligament



KU LEUVEN kulak

Resultaten

- Lengtemetingen ATFL en CFL
  - Positieafhankelijke lengteveranderingen: superieure bundel ATFL
  - Isometrisch: CFL + inferieure bundel ATFL
- Consistente ruimtelijke relaties aanhechtingsplaatsen ATFL en CFL t.o.v. geselecteerde referentiepunten.



Resultaten

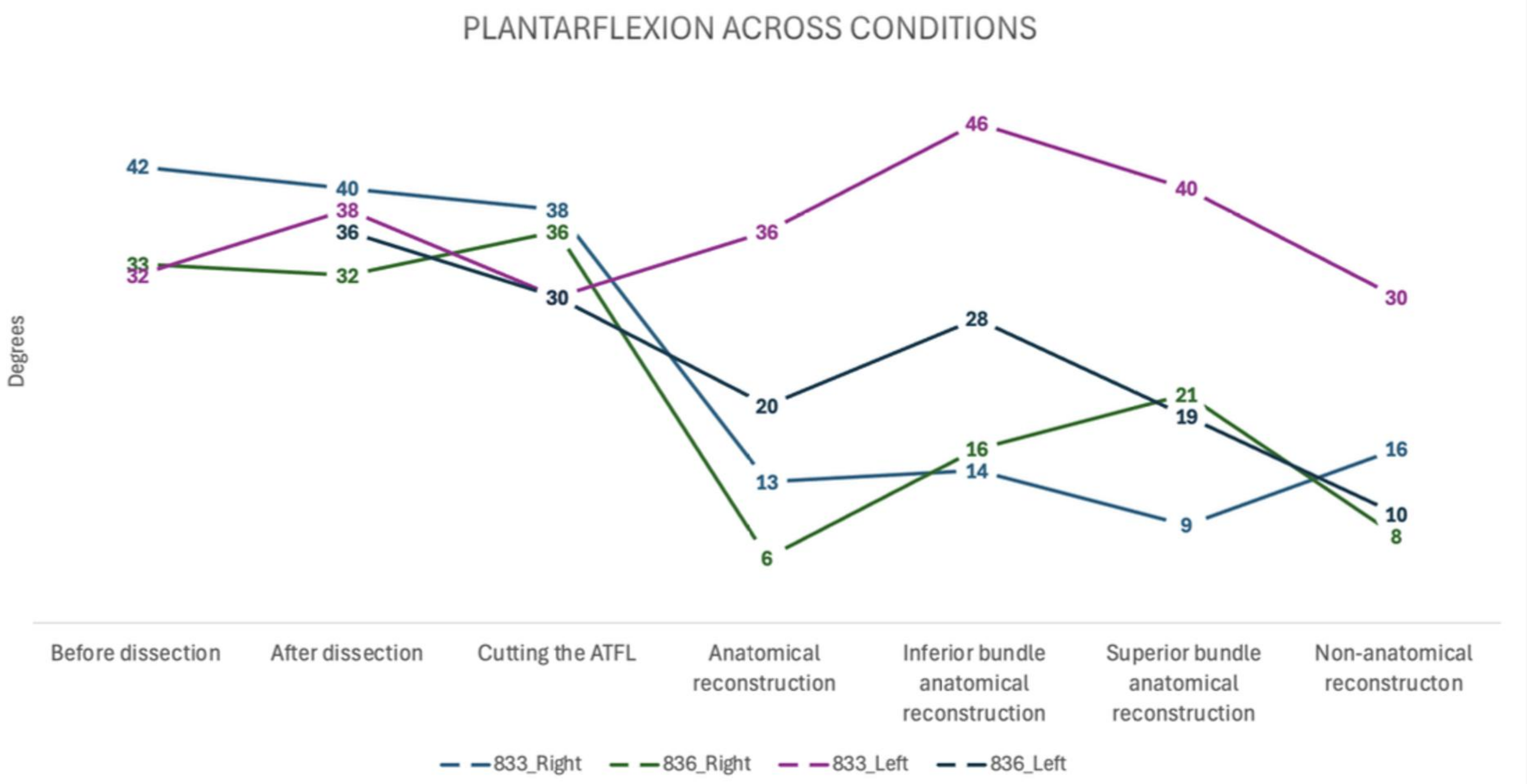


Figure 5- Overview of ROM in plantarflexion for each of the four feet, presented across the experimental conditions on the x-axis.

Conclusie

- Invloed op natuurlijke enkelbiomechanica ATFL reconstructie
  - Bundel
  - Locatie aanhechtingsplaatsen
  - Type graftmateriaal (transplantatiemateriaal)

Referenties

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Maximal tension-free range of the anterior interosseous nerve transposition

Decavele B., Vercruysse J., Theeten M.
Prof. Vereecke E., Prof. Dr. Michels F., De Buyser J., Dr. Vanhaecke J.

Casus M.V., 29 jaar, ♂

Anamnese

Patiënt werd via de spoedgevallendienst opgenomen na een accidentele val door een glazen deur -> diepe laceraatwonde aan de ulnaire zijde van de proximale rechteronderarm

Onmiddellijk na het trauma meldde patiënt:

- gevoelloosheid van pink en ulnaire helft van ringvinger
- krachtverlies van de hand
- moeilijkheden met spreiden van de vingers
- verminderde grijpkracht

Geen voorgeschiedenis van neurologische aandoeningen

Klinisch onderzoek

Inspectie:

- Diepe snijwonde van ± 8 cm mediale zijde elleboog
- Geen actieve bloeding, beperkt oedeem

Motorisch onderzoek:

- Uitval passend bij een proximale laesie n. ulnaris
- Juist distaal van eerste motorische aftakking.

Probleemstelling

Proximale sectie n. ulnaris ➜ functie- en sensibiliteitsverlies

- Intrinsieke handspieren
- Verschillende flexoren (FDS/FDP – FCU)*

Klinische gevolgen

- Klauwhand
- Verminderde grijpkracht
- Verminderde vingerspreiding en –sluiting
- Uitval sensibiliteit n ulnaris gebied

Verwacht neurologisch herstel

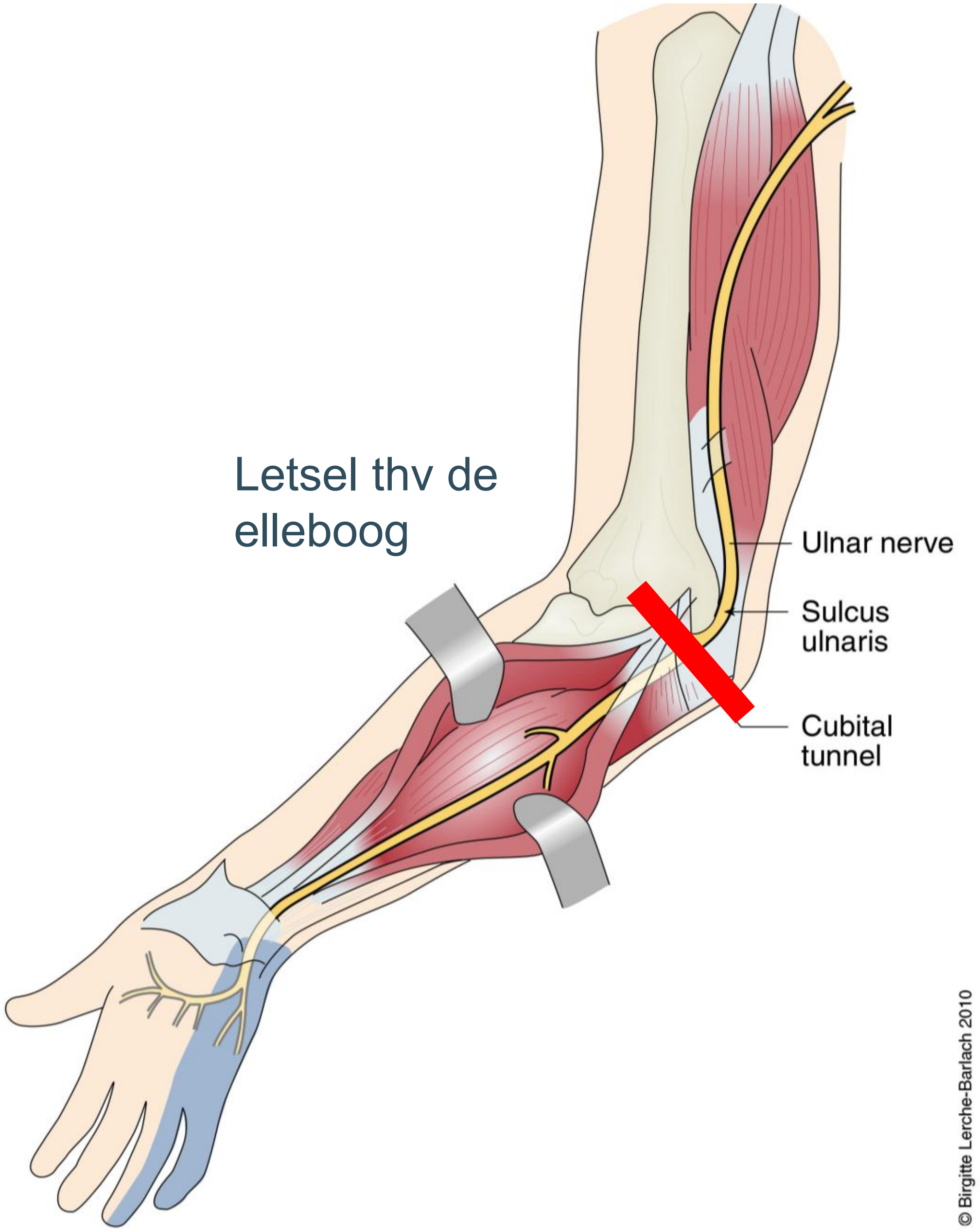
- Perifere zenuwregeneratie: ~ 1mm/dag
- Grote afstand letsel -> intrinsieke handspieren
    - Eerste tekens herstel: 4-6 maanden
    - Verder herstel: 12 - 24 maanden

*Afhankelijk voor of na de motorische aftakkingen proximaal

Oplossing

Exploratie van de wonde aangevuld met een zenuwhechting

Letsel thv de elleboog

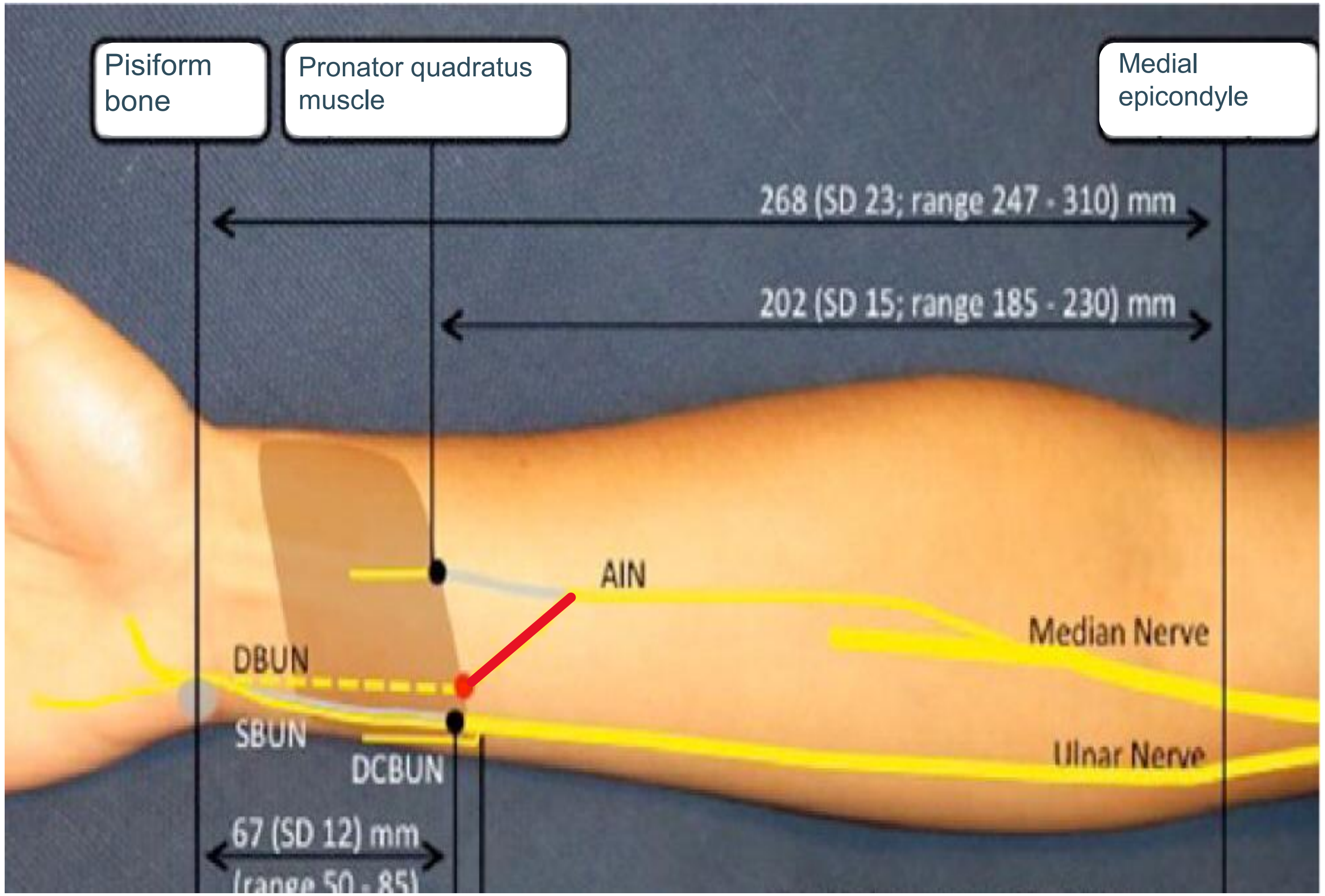


Oplossing: zenuwtransfer AIN naar Ulnaris

Techniek:
- N. interosseus anterior (AIN) zo distaal mogelijk vrijdisseceren
- Transponeren naar motorische tak n. ulnaris

Indicaties:
- Proximale ulnaire letsels
- Hoge cubitale laesies
- Ernstige axonale schade

Minder nuttig bij:
- Zeer distale letsels



Adapted from Schenck et al., 2015

Winst AIN transfer

Eerste tekenen van re-innervatie

- Vaak reeds na 3-6 maanden (↔ 9-15 maanden)

Functionele winst

- Merkbaar binnen 6-9 maanden (↔ 12-24 maanden)

Tijdswinst herstel intrinsieke functie:
6-12 maanden

Cadaverstudie – Maximale tension-free range AIN

Methode:
- 3 lichaamsdonoren
- Dissectie protocol: McLeod, G. et al en Qing, X. et al.
- 5 meetpunten
- AIN zo distaal mogelijk vrij disseceren om zo distaal mogelijk op motorisch deel n ulnaris te plaatsen.

Resultaten:
- Gemiddeld tension free transpositie: 5.56 cm
- Vergelijkbaar met andere studies en in alle cadavers was een transfer mogelijk.

Maximal tension-free range of the anterior interosseous nerve transposition: a cadaver study

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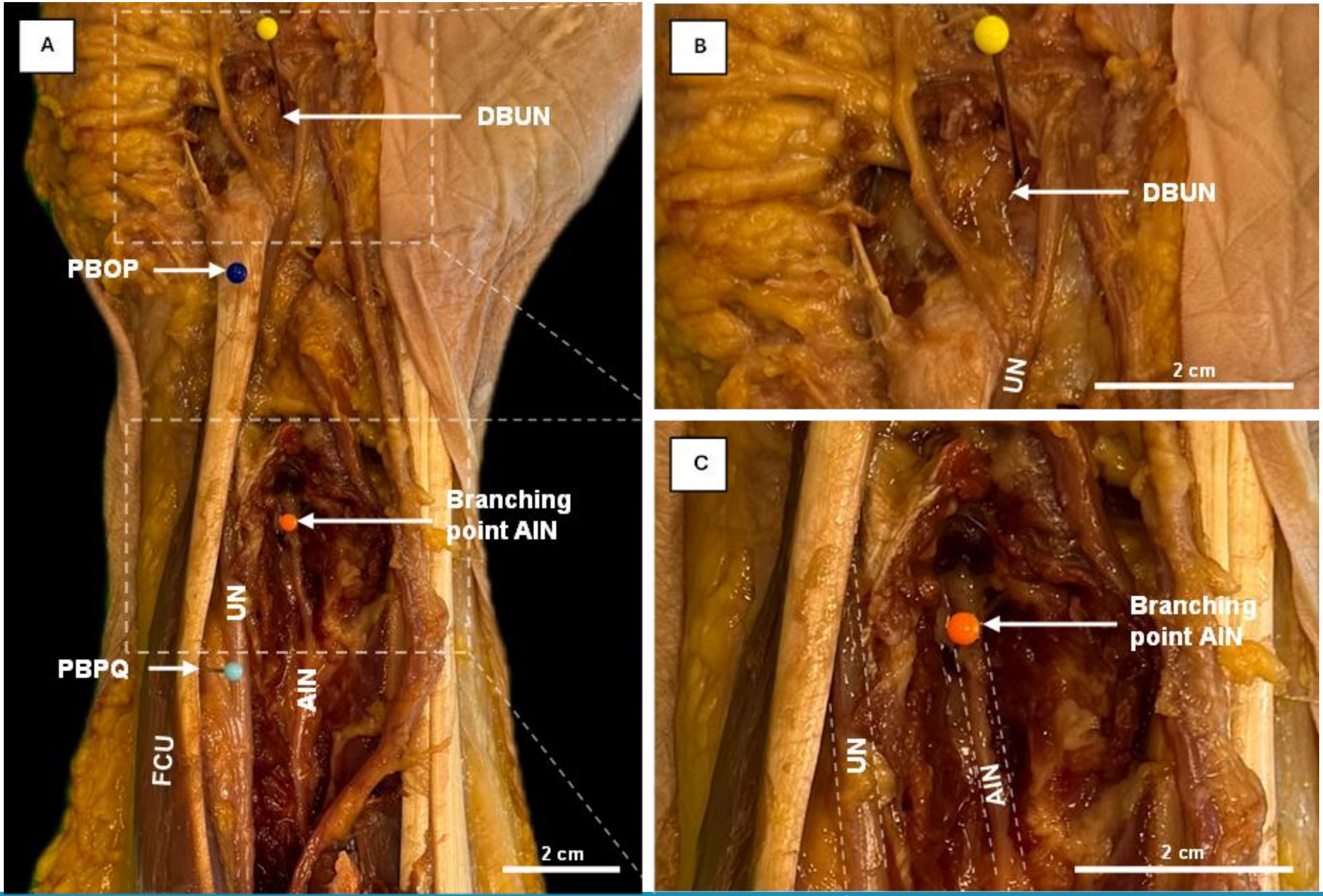
[1]Faculty of medicine, KU Leuven Kulak, Belgium, [2]Orthopedic surgery, AZ Groeninge Kortrijk, Belgium

Keywords: Guyon's canal, transfer surgery, ulnar deep motor branch, nerve injury, tissue reinnervation


A
DBUN
PBOP
Branching point AIN
UN
PBPQ
AIN
FCU
2 cm
B
DBUN
UN
2 cm
C
Branching point AIN
UN
AIN
2 cm

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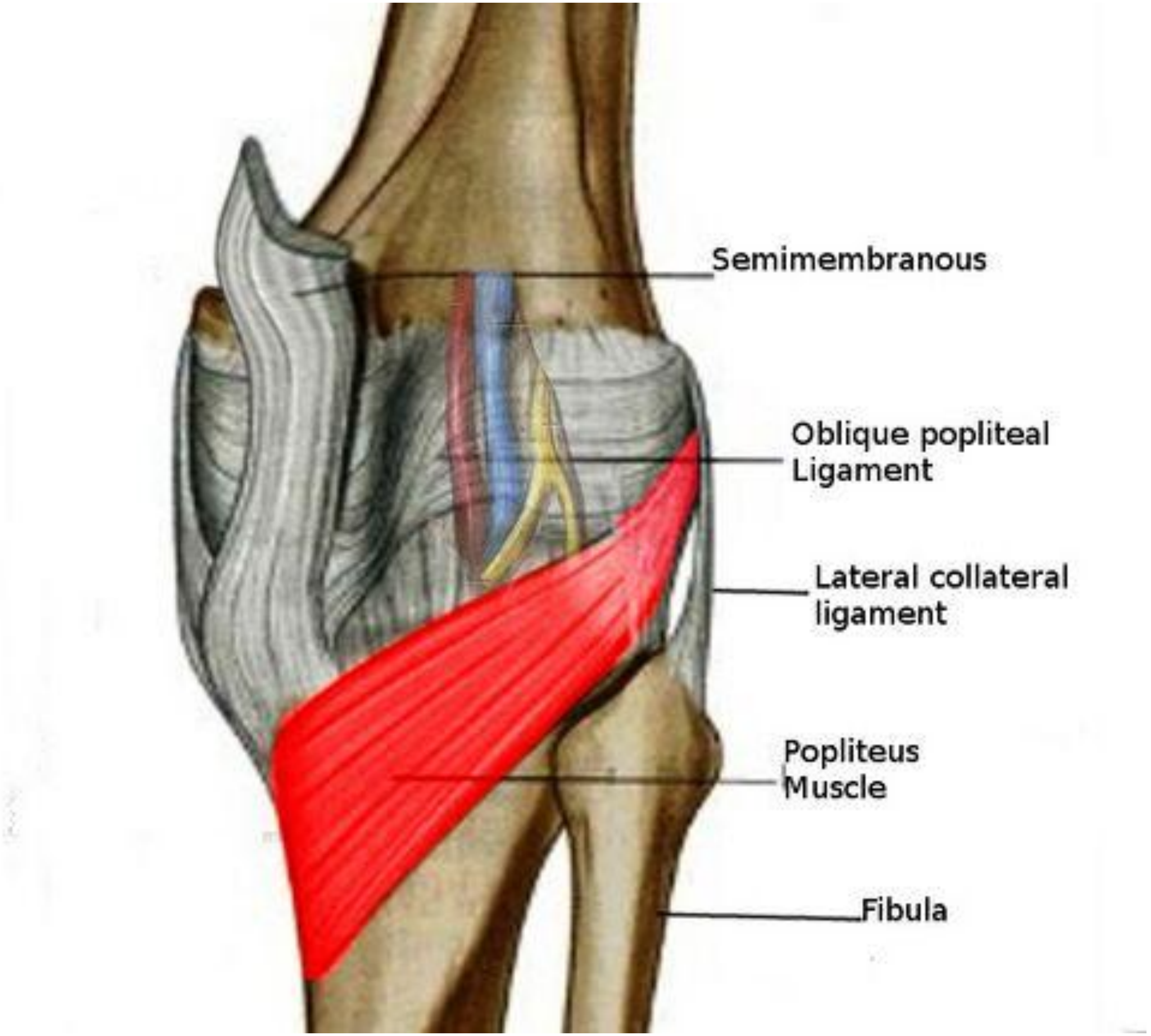
Martijn Steen
Charles T'Jollyn

Supervisie: Wouter Beel, Frederick Michels, Evie Vereecke & Janou De Buyser

3e bachelor geneeskunde Kulak

Musculus popliteus

- Posterolaterale hoek
- Functioneert als ligament
- Stabiliseert posterolaterale translatie
- Letsel vaak gemist
- Ruptuur
  - Verhoogt posterolaterale instabiliteit
  - Verhoogt stress op achterste kruisband



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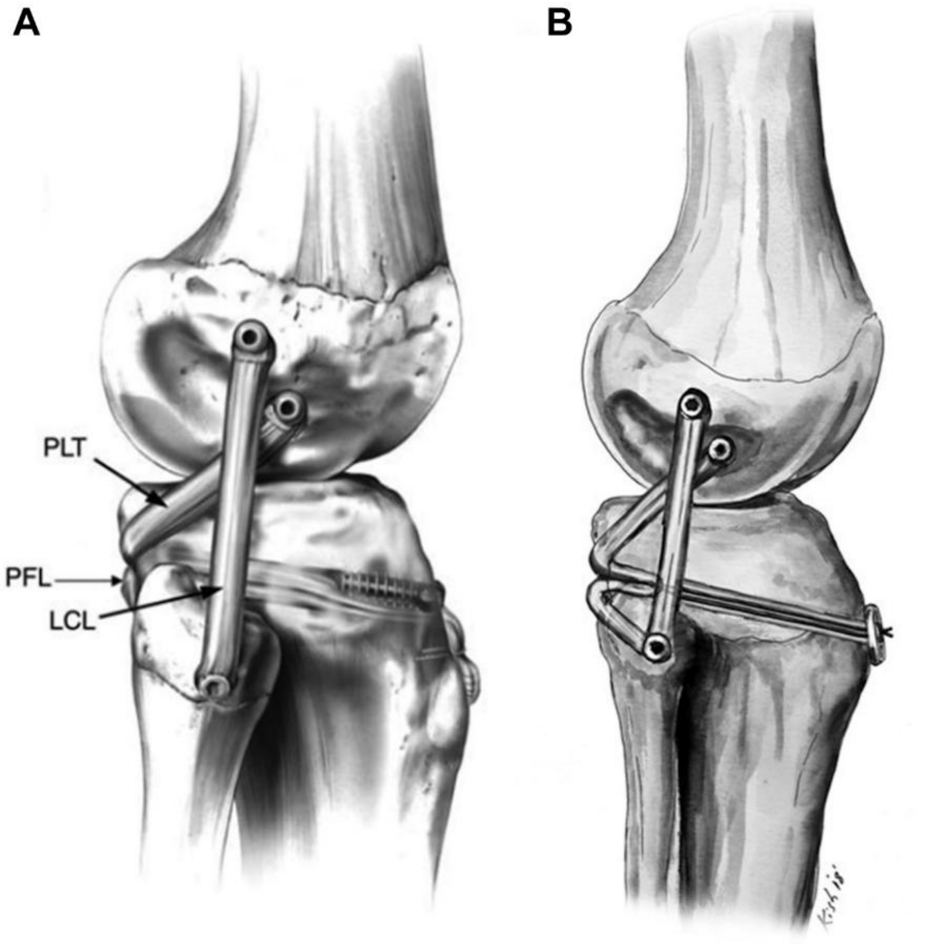
Kruisbandreconstructies

Letsel achterste kruisband (AKB)

- AKB + volledig stabiliserend systeem reconstrueren
- Musculotendineuze overgang proximaal & lateraal van tibiale sulcus
- Anatomische tunnel
  - Literatuur: tibiale sulcus
  - NVB dichtbij



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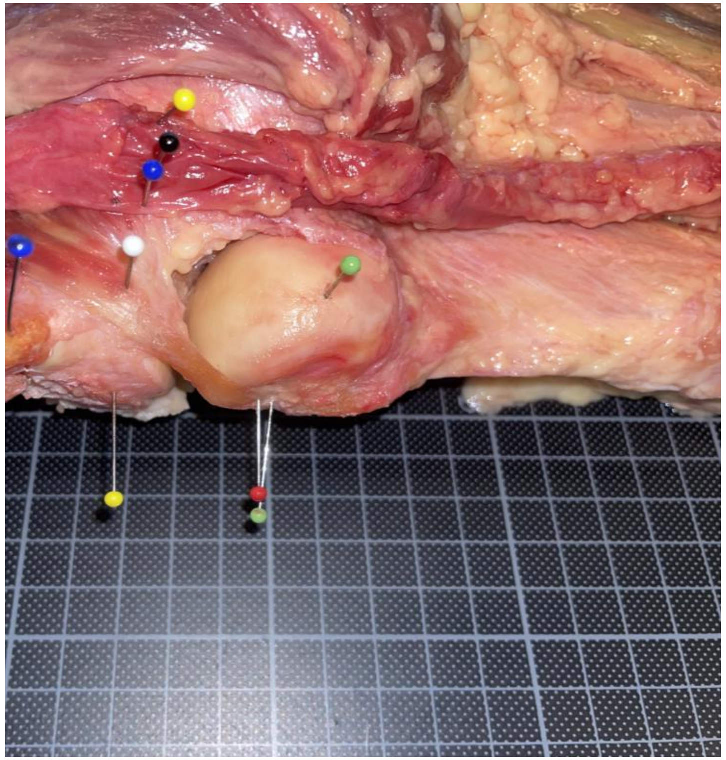
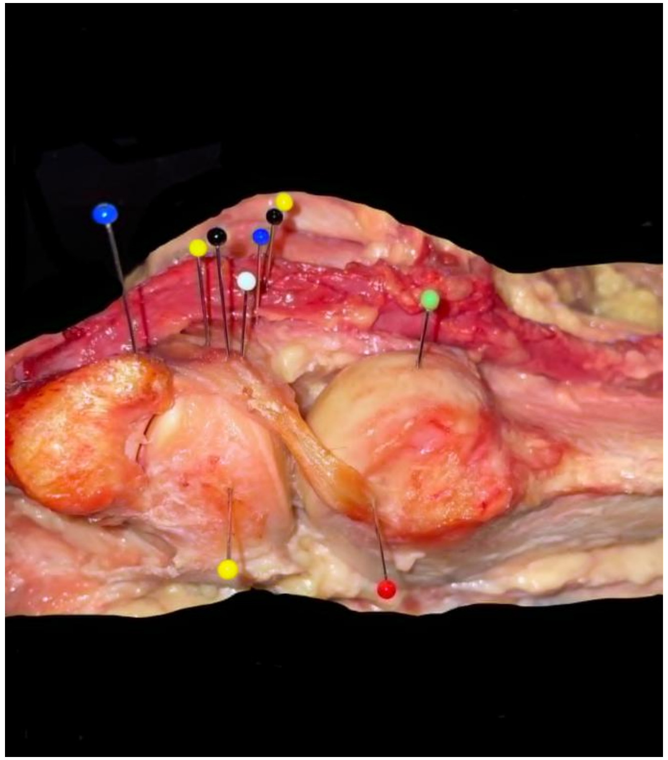
Relevantie kliniek

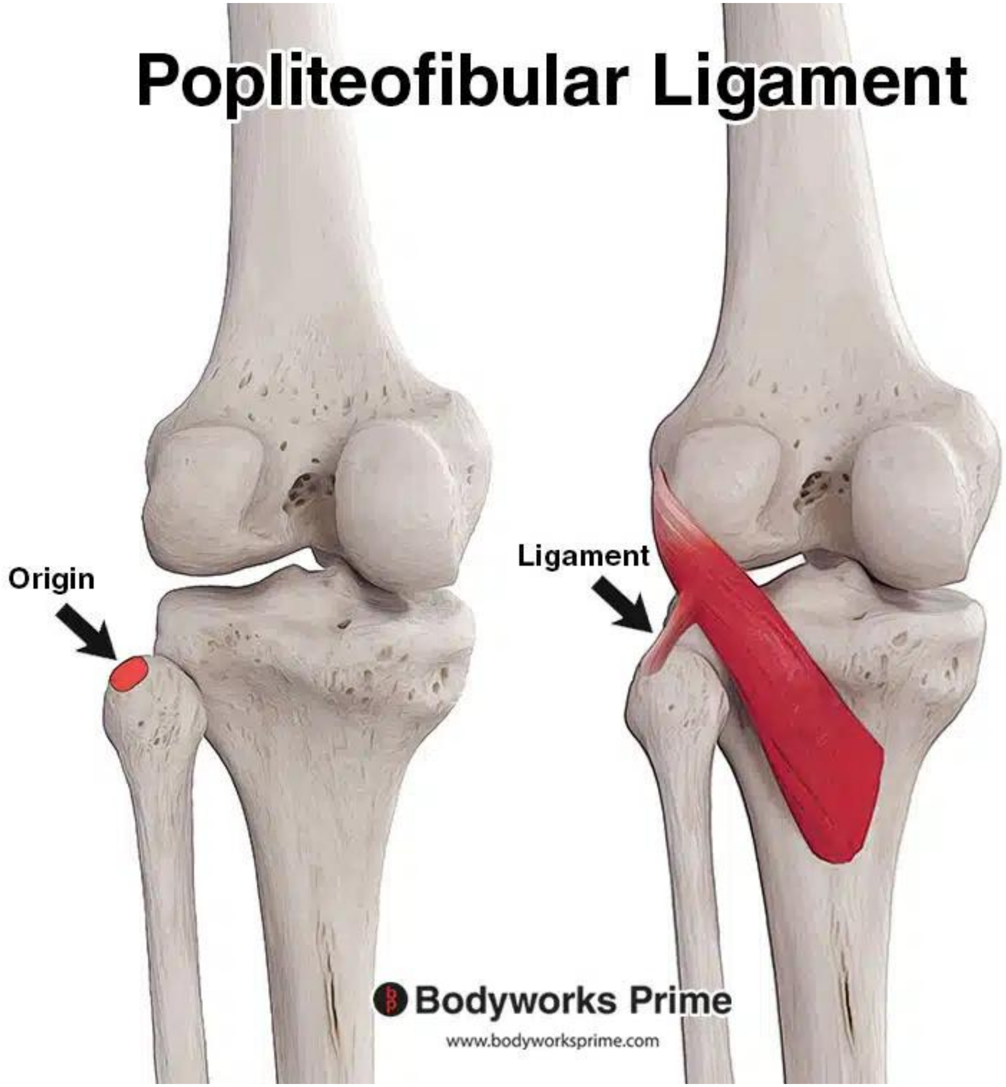




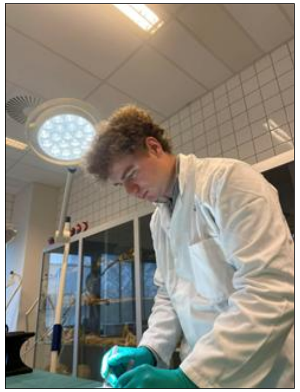
- MTJ proximaler & meer lateraal
  - Gemiddeld 14.8 mm
- MTJ ~ NVB
  - Gemiddeld 16 mm
- Popliteusreconstructie
  - Tunnelplaatsing herzien

Inzichten voor toekomst

- Fibulaire bottunnel
  - Greffe fixatie op fibula kop
  - Betere visualisatie
  - Nervus peroneus
- Meer veiligheid
  - Afstand tot NVB
- Anatomische studies
  - Reconstructie popliteofibulaire ligament
  - Posterolaterale stabiliteit






JAN PALFIJN ANATOMY LAB

Kulak anatomie studies

F. Michels, W. Beel, J. Vanhaecke, J. De Buyser, E. Vereecke

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