Histological analysis and clinical implications of the structural composition in the ankle ligaments

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Conflict of interest statement

My disclosure is in the Final AOFAS Program Book.

I have a potential conflict with this presentation due to:

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Material
Dissection of 140 ankle ligaments from 10 human cadaver feet

Anatomical complexes

syndesmosis
• ATiFL

lateral
• ATFL
• CFL
• PTFL

medial
• TNL
• TCL
• STTL
• ATTL
• PTTL

sinus tarsi
• IER (L, I, M)
• TCOL
• CTL

Histology
• HE, EvG
• S-100 protein
• neurotrophin receptor p75
• protein gene product 9.5
• smooth muscle actin
Structural ligamentous composition

The diagram shows the number (n) of different ligamentous structures. The structures are categorized into Syndesmosis, Lateral, Medial, Sinus tarsi, and their variations. The bars are color-coded to represent different types of ligamentous composition:

- Pink: densely packed parallel
- Green: mixed tight and loose parallel
- Yellow: densely packed interlaced

The structures include ATiFL, ATFL, CFL, PTFL, TNL, TCL, STTL, ATTl, PTTL, IERL, IERI, IERM, TCOL, and CTL.
Densely packed parallel collagen

- mainly found in lateral ligaments and CTL
- gives the ligament the tensile strength

HE- (a, b, e, f), EvG (c, d, g, h), transmission (a, c, e, g), polarization (b, d, f, h), x25 (a, b, c, d), x100 (e, f, g, h)
Mixed tight and loose parallel collagen primarily seen in the IER and TCOL

The undulating ligamentous structure (white arrows), the loose interstitial connective tissue and the elastic fibers (black arrow) give the ligament a certain flexibility to elongate without immediately rupture.

HE- (a, b, e, f), EvG (c, d, g, h), transmission (a, c, e, g), polarization (b, d, f, h). x25 (a, b, c, d), x200 (e, f, g, h)
Densely packed interlaced collagen

• mainly found at areas of ligament insertion into bone of the deltoid ligament

• indicates that these insertion areas are susceptible to tension in a multitude of directions

HE (a, b, e, f), EvG (c, d, g, h), transmission (a, c, e, g), polarization (b, d, f, h) x25 (a, b, c, d), x100 (e, f, g, h)
Epiligament

It contains abundant black stained elastic fibers (arrow heads in d), blood vessels (arrow in e and f) as well as free nerve endings (arrow in g and h).

HE- (a, b), EvG (c, d), sm-actin (e, f), S100 (g, h) x100 (a, c, e, g), x200 (b, d, f, h)
Interstitial area

contains abundant

elastic fibers (arrow in c; d),

blood vessels (arrow in e; f),

free nerve endings (arrow in g; h)
Abbreviations

distal tibiofibular syndesmosis
ATiFL = anterior tibiofibular ligament

lateral complex
ATFL = anterior talofibular; CFL = calcaneofibular; PTFL = posterior talofibular ligament

medial complex
a) superficial layer
TNL = tibionavicular; TCL = tibiocalcaneal; STTL = superficial tibiotalar ligament
b) deep layer
ATTL = anterior tibiotalar; PTTL = posterior tibiotalar ligaments

sinus tarsi
IER (L, I, M) = inferior extensor retinaculum with its lateral, intermediate and medial roots
TCOL = talocalcaneal oblique ligament; CTL = canalis tarsi ligament

References
