Three-dimensional Volume Rendering of the Tendons of the Foot and Ankle with Fractures

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My disclosure is in the Final AOFAS Program Book.
I have no potential conflicts with this presentation.
Three-dimensional volume rendering of tendons

- Fractures of the foot and ankle → Injuries or displacement of the tendons around the fractures
- Computed Tomography (CT) of the fracture ... Multiplanar reformatted images, three-dimensional CT images
- Tendons are detectable using three-dimensional volume rendering (VR) images.
Materials & Methods

• 2004～2009
• Foot and ankle trauma ... 12 feet
  – Ankle fracture ...  5 feet
  – Calcaneal fracture ...  6 feet
  – Fracture-dislocation of Lisfranc joint ...  1 foot
• Depiction of tendons with VR images
• Assessment of tendon disorders (injuries, displacement)
• CT...SOMATOM Sensation 16, SIEMENS
• Software for VR imaging...Aquarius Workstation, TERARICON, INC.
Results

• Ankle fractures
  – Dislocation of the tendon (−)
• Calcaneal fractures
  – Dislocation of the peroneal tendon (−)
  – Displacement of the tendon by bone fragments (+)
• Fracture-dislocation of Lisfranc joint
  – Displacement of the tendon by bone fragments (+)
Ankle fracture (SER stage 4)

The VR image shows that there is no tendon in the space between the medial side of the talus and the medial malleolus, although the depiction of the tibialis posterior tendon (red arrow) is fair. These findings were confirmed at surgery.
Calcaneal fracture

Peroneal tendons (red arrows) were pushed up by the displaced lateral fragment of the calcaneus, but were not dislocated.
Fracture-dislocation of Lisfranc joint

The depiction of the peroneus longus tendons was good and the continuity seemed normal. The peroneus longus tendon (red arrow) was pushed down by the bone fragment of the cuboid, but the tendon did not seem to be caught in the joint. These findings were confirmed at surgery.
Discussion & Conclusion

• Tendon injuries
  – Tendon volume gap > 3mm, or tendon meanders caused by the loss of the normal tension
    → complete tendon rupture (Sunagawa et al, 2005)
  – It depends on the operator’s technique, and the CT values of the tendon are not always fixed.
    → It is difficult to evaluate the continuity of the tendon.
• Depiction of tendon location … good
  – Dislocation of the peroneal tendons associated with calcaneal fracture … clearly depicted (Ohashi et al., 2007)
  – Tendon location was clearly depicted in our study.
• Three-dimensional CT with VR techniques gave good information concerning the relationships of the tendons and adjacent bones although it gave poor information concerning the continuity of the tendons.
References

• Tendons of the Hand
  – Sunagawa et al. (J Computer Assisted Tomography, 2003)
  – Ohashi et al. (Am J Roentgenol, 2004)

• Hamstrings tendons
  – Nakamura et al. (Arthroscopy, 2004)
  – Yasumoto et al. (Arthroscopy, 2006)

• Tendons of the Foot and Ankle
  – Ohashi et al. (Am J Roentgenol, 2004)
  – Ohashi et al. (Radiology, 2007)
  – Choplin et al. (Seminers in musculoskeletal radiology, 2004)
  – Geijer et al. (Emerg Radiol, 2006)