Anatomical study of the carpal attachment of the triangular fibrocartilage complex
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There have been few descriptions of the site of attachment onto the triquetrum, the so-called meniscal homologue, of the triangular fibrocartilage complex (TFCC). We have investigated the sites of attachment onto the triquetrum of 87 TFCCs collected from embalmed cadavers.

All TFCCs were smoothly attached to the triquetrum. In 79 (46 cases, 90%) they were attached to the triquetrum and fifth metacarpal bone, and in eight (5 cases, 10%) they were attached widely on the articular surface of the triquetrum.

It is necessary to have accurate positional information about the normal triquetrum and TFCC in order to perform arthroscopy. The meniscal homologue attached to the triquetrum is smooth in almost all cases. In about 10% of joints the TFCC is attached to the lunotriquetral ligament, either partly or completely obscuring the articular surface of the triquetrum.

Materials and Methods

We collected 87 wrists (40 right and 47 left) from 51 embalmed cadavers (20 male and 31 female). The mean age at death was 74.1 years (40 to 99). In wrists with severe osteoarthritis it was difficult to observe the ulnar attachment of the TFCC because of wear. Hence, in only 26 cadavers, was it possible to examine both right and left wrists. A horizontal incision was made at the dorsum of the
wrist and the triquetrum, lunotriquetral ligament (LT) and TFCC were examined macroscopically.

**Results**

In gross observation of the ulnar side of the wrist, the joint surface of the lunate and the triquetrum and the lunotriquetral ligament were observed. The TFCC was attached to the ulnar side of the triquetrum (Sca, scaphoid; Lu, lunate; Tri, triquetrum; Ra, radius; TFCC, triangular fibrocartilage complex; LT, lunotriquetral ligament).

Attachment to the ulnar side of the triquetrum was seen in 79 joints (46 cases, 90%). The joint surface of the lunate and the lunotriquetral ligament were observed. A part of the TFCC attached to the lunotriquetral ligament and the joint surface of the triquetrum was partially observed (Fig. 2). These were in group 3. The TFCC was attached widely on the articular surface of the triquetrum in four joints (3 cases, 4.6%), and the joint surface of the lunate was observed. The TFCC attached to the lunotriquetral ligament and the joint surface of the triquetrum was covered by the TFCC (Fig. 3). In four joints (3 cases, 4.6%) of group 4, the attachment to the ligament completely covered the articular surface of the triquetrum. The attachment patterns belonging to groups 3 and 4 were noted in three of the 26 specimens which were examined on both sides. Two of these showed the same pattern of attachment on both sides (group-3-type attachment in one and group-4-type in the other). The other case showed unique patterns on each side (group 3 on the right side and group 4 on the left side).

**Discussion**

There have been few descriptions of the morphology of the meniscal homologue of the attachment site on the carpal bone. Lewis, Hamshere and Bucknill observed the shape of the TFCC from the viewpoint of comparative anatomy.
They concluded that during the evolution of man from anthropoids, the discoid section of the TFCC developed distal to the ulnar head where the triquetrum and pisiform had formed a joint within the wrist, separating the pisiform completely and the triquetrum partially. They added that by successive evolution, this discoid section joined the ulnar carpal ligament on the palmar aspect.

The TFCC is a structure which developed during the evolutionary stage when man, with his wrists and forearms newly released from the role of supporting body-weight, acquired bipedal locomotion and forearm rotation, and the movement of the distal radio-ulnar joint was separated from that of the wrist. During the embryonic stage, the TFCC extends from the palmar side of the distal radio-ulnar joint, with its site of attachment extending widely from the ulnar side of the radius to the ulnar side of the carpal bone, and undergoes involution as the embryo develops. Eventually, it settles at the pivotal position for the tissues composing the ulnar side of the wrist.

In their radiological evaluation of 870 wrists, Ono et al observed seven (0.8%) with congenital bicompartmentalisation, which is an abnormal dividing wall extending from the LT to the TFCC separating the wrist into the radial and ulnar sides. This wall may be the cause of pain at the ulnar side of the wrist and can be seen on arthrograms. This condition resembles group 4 of the classification of Hogikyan and Louis in which the attachment section to the carpal bone of the TFCC covers the ligament section so that the articular surface of the triangular bone cannot be observed. In their study, one of the 18 cases (6%) was classified as group 4. In our study, four of the 87 joints (4.6%, 3 cases) have the same classification.

In the study of Ono et al, five of 18 cases (28%) belonged to group 3, while our study showed a much smaller figure with three cases, four joints (4.6%). The reason for this discrepancy may be that we examined the articular surface grossly, and only recognised the portion facing the discoid section of the TFC as the articular surface of the triquetrum, failing to identify the exact dimensions of the latter. Because only those cases in which the triquetrum is covered extensively are included in group 3 of the Hogikyan classification system, which was originally designed for the evaluation of histological specimens, it is possible that our count was lower than expected.

After examining the area of attachment of the TFCC to the carpal bone, we showed that there are variations in the attachment as indicated by Hogikyan and Louis and Ono et al. This finding requires further study to differentiate between these variations and injuries to the LT, and to show the relationship to the triquetral impingement ligament tears reported by Watson and Weinzeig.

In the diagnosis and treatment of pain on the ulnar side of the wrist, accurate arthroscopic assessment is essential. It is necessary to have information about the appearances of the normal triquetrum and TFCC. At arthroscopy, the meniscal homologue may appear to extend in a meniscal
form on the ulnar side of the wrist but, in reality, it resembles a smooth synovium-like membranous structure which extends from the discoid section of the TFC to the triquetrum with no meniscoid projection. The section attached to the triquetrum is smooth and, as confirmed in our study, the site of attachment is on the ulnar articular side of the triquetrum in almost all cases. In about 10% of cases, the meniscal homologue is attached to the ligament of the lunotriquetral ligament, obscuring the articular surface of the triquetrum (Fig. 4).

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References

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