RESEARCH ARTICLE

Discovery of Posterior Oblique Ligament (POL) within the Distal Forearm Cruciate Complex (DFCC)

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Abstract

Objectives: To introduce a ligament in the posterior distal extent of the forearm interosseous membrane (IOM).

Methods: Ten cadavers were dissected in which the ligament was consistently present extending obliquely from the distal radius metaphysis to the distal radioulnar joint capsule. The ligament was also explored in a patient during posterior interosseous nerve (PIN) excision.

Results: The posterior oblique ligament (POL) is found consistently in all cadavers via a dorsal approach.

Conclusion: This discovery highlights the complexity of forearm ligamentous structures and their role in the proximal, middle, and distal radio-ulnar stabilization.

Level of evidence: V

Keywords: DFCC, DOB, DRUJ, IOL, POL

Introduction

The interosseous membrane (IOM) of the forearm is a stout ligamentous complex that reportedly comprises several ligamentous components.[1,2] Five distinct ligaments were described within the forearm IOM including the central band (CB), accessory band (AB), distal oblique bundle (DOB), proximal oblique cord, and dorsal oblique accessory cord [Figure 1].[3]

The distal oblique bundle (DOB) is a relatively thick fiber within the distal membranous portion along the distal ulnar shaft. This bundle of fibers is named the DOB. It exists in the same coronal plane as the CB and AB fibers. The DOB originates from approximately the distal one-sixth area of the ulnar shaft, approximately coinciding with the proximal border of the pronator quadratus muscle and run distally toward the distal radioulnar joint (DRUJ). The fibers blend into the capsular tissue of the DRUJ and eventually the DOB inserts to the inferior rim of the sigmoid notch of the radius. Furthermore, some fibers extend more distally along the anterior and posterior ridges of the sigmoid notch, so the DOB appears to display continuity with the dorsal and palmar radioulnar ligaments of the triangular fibrocartilage complex (TFCC). The mean width was 4.4 ± 1.1 mm (range, 2–6 mm) and the mean thickness was 1.5 ± 0.5 mm (range, 0.5–2.6 mm).[3]

Materials and Methods

Description of the Anatomy

In a cadaver dissection study, a new ligament is found in the distal IOM running obliquely attached from the ulnar border of the distal radius shaft to the DRUJ capsule, creating a cruciate complex together with the DOB. This ligament was identified during dorsal dissection of the cadavers, whereas the DOB is more easily explored through volar approach, beneath the pronator quadratus muscle. Therefore, this newly-identified ligament is called the posterior oblique ligament (POL), and, along with the DOB, it forms the distal forearm cruciate complex (DFCC) [Figure 2].

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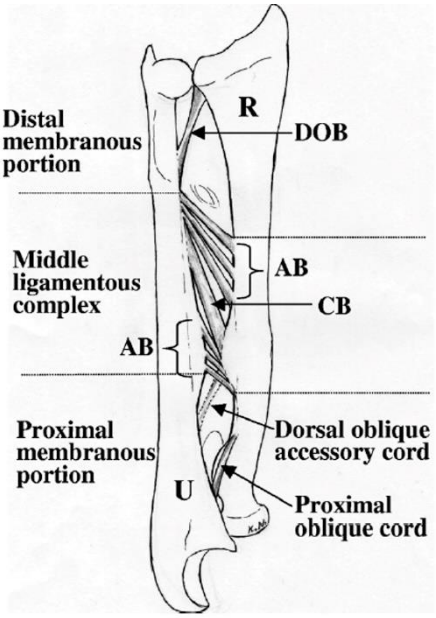

Figure 1. Five distinct ligaments were described within the forearm IOM including the central band (CB), accessory band (AB), distal oblique bundle (DOB), proximal oblique cord, and dorsal oblique accessory cord

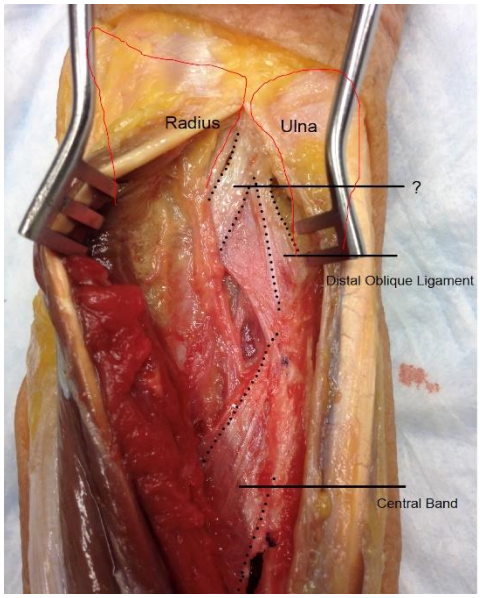

Figure 2. The borders of the distal oblique ligament (DOB) and the central band (CB) are shown, however, the other ligament indicated with a question mark (?) is not described in the literature, which creates a cruciate complex along with the DOB. It is called a posterior oblique ligament (POL) as it is better explored through a dorsal approach

Cadaver study

Using detailed anatomical dissection of 10 forearm cadavers, the posterior oblique ligament (POL) was explored through a dorsal approach without using loupe magnification [Figure 3 A-E]. The interval between the 5th and 6th extensor compartments was approached and the extensor digitorum muscle was retracted. The POL was consistently present, varying in size and diameter, attaching to the ulnar border of dorsal distal radius on one side and merging with the DRUJ capsule on the other side.

Case presentation

The POL was also explored and documented in a 58-year-old female patient during a planned posterior interosseous nerve excision [Figure 4a-b]. An incision was made just proximal to the DRUJ and extended proximally for 4-5 cm along the radial border of the extensor carpi ulnaris (ECU) tendon. The interval between the ECU and the extensor digiti quinti (EDQ) was approached and the extensor muscles and tendons were retracted radially to expose the IOM. The posterior interosseous nerve (PIN) was visualized travelling distally over the posterior aspect of the IOM. The PIN was explored proximal to the POL. It then transected and excised at this level, while care was taken to avoid injury to the POL [Figure 4 A-B].

Results

The POL is found consistently in all cadavers via a dorsal approach. The DOB can better be visualized via the volar approach. Together, the POL and DOB form a cruciate structure that is speculated to apply appropriate tension to the volar and dorsal ligaments and the capsule of the DRUJ, helping to maintain the congruency of the ulnar head within the lesser sigmoid notch.

Discussion

This discovery highlights the complexity of forearm ligamentous structures and their role in the proximal, middle, and distal radio-ulnar stabilization. It is speculated that there may be clinical implications, including DRUJ instability following a distal radius fracture or malunion, variations in surgical approaches for DRUJ and TFCC reconstruction, and tightening of these ligaments during an ulnar shortening osteotomy.[4,5] It is likely that POL lacks significant clinical importance. The ulnar shortening osteotomy typically enhances the stability of the distal ulna, which is believed to result from the tightening of the DOB. Conversely, due to its dorsal-distal connection to the DRUJ capsule, the POL may contribute to anteroposterior stability, helping to prevent dorsal subluxation of the ulnar head. Thus, ulnar shortening may further enhance anteroposterior stability by pulling and tightening the capsule. Additionally, we can infer that contractures in the structures attached to the DRUJ capsule may restrict forearm rotation.

A thickening in the distal interosseous membrane (IOM), referred to as the "distal radioulnar tract" by Gabl et al.,[6] was further delineated by Moritomo et al.,[7] who found this structure consistently present in all 45 cadaver wrist

dissections in their study.[6] However, the clinical significance of the distal radioulnar tract, its influence on the distal radioulnar joint (DRUJ), and its connection to the dorsal oblique band (DOB) were not addressed. This raises the question of why the distal radioulnar tract, commonly identified in cadaver dissections, is often overlooked in discussions about the distal IOM, while the more variable DOB is frequently highlighted. Various studies have noted the DOB's presence in 30%,[8] 40%,[9,10] and 50%[11] of cadaver specimens, with discrepancies potentially arising from the wrist's approach during examination—where the dorsal approach reveals the posterior oblique ligament (POL), and the palmar approach enhances visualization of the DOB. Further studies examining functional implications in a larger population are warranted.

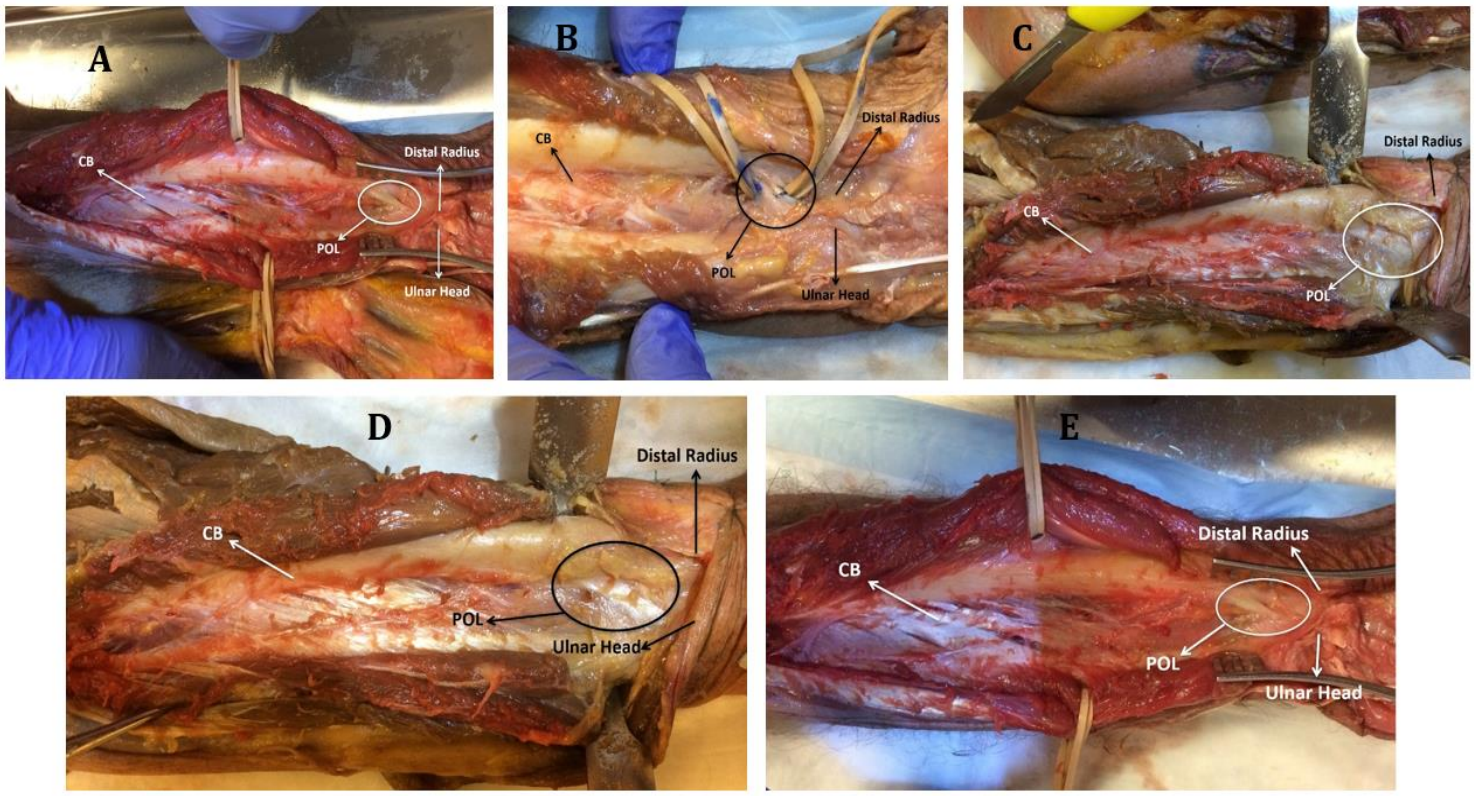

Figure 3. The POL was found consistently in all cadavers

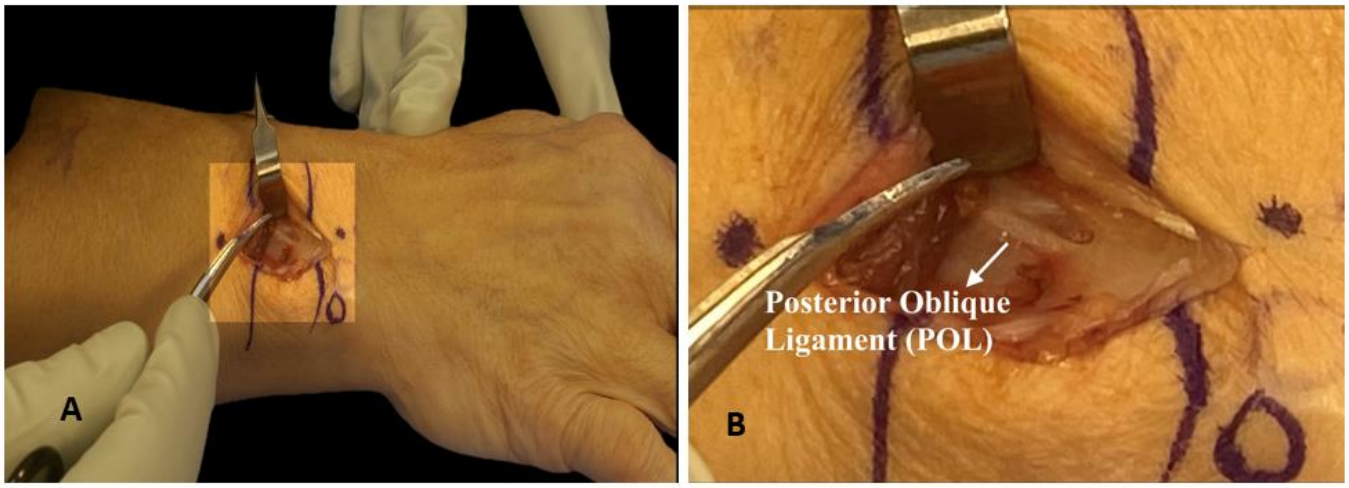

Figure 4. Intraoperative image of the posterior oblique ligament (POL) approaching between the 5th and 6th extensor compartments which is found distal to the posterior interosseous nerve (PIN)

Conclusion

This study identifies the posterior oblique ligament (POL) as a consistent anatomical structure in the distal interosseous membrane, forming a cruciate complex with the distal oblique bundle (DOB). This discovery underscores the complexity of forearm ligamentous structures and their critical role in stabilizing the proximal, middle, and distal radio-ulnar joints. The POL and DOB together help maintain the congruency of the ulnar head within the lesser sigmoid notch, with potential clinical implications for addressing DRUJ instability, surgical approaches, and procedures like ulnar shortening osteotomy. Further research is warranted to explore the functional significance of this ligamentous complex in a broader population.

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