Anatomy and approaches of the wrist

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Abstract

A thorough knowledge of the anatomy of the wrist is key to performing successful approaches to the complex tendon, ligament, neural and articular structures of the wrist. Several approaches have been described in the literature employing a range of anatomical planes. These approaches can be categorized into dorsal, volar and specialized approaches. Eight surgical approaches within the three categories are described in this article. The relevant anatomy for each approach is described, including details of vascular, neural, osseous, articular and ligamentous relations. This is followed by description of the surgical approaches to the distal radius, distal radio-ulnar joint, carpal tunnel, Guyon's canal, volar distal radius, volar scaphoid, dorsal scaphoid and de Quervain's release.

Keywords carpal ligaments; carpal tunnel; distal radius; surgical approach; wrist anatomy; wrist approach; wrist replacement

Introduction

Wrist approaches vary in precise execution between surgeons and may depend on indication and surgeon preference. Several different skin incisions are commonly used, but approaches can be categorized into dorsal, volar and specialized approaches. The dorsal approach to the wrist joint is mainly used for treating arthritis and working on the bones of the carpus;[1] the volar approach is used primarily for exploring the carpal tunnel and its structures.[2] Specialized approaches include those to the trapezium, scaphoid, de Quervain's tendons and the ulnar nerve. In this article, the applied surgical anatomy of the wrist and surgical approaches are described.

Dorsal approach to the wrist

Applied anatomy of the dorsal approach

Two bony landmarks are crucial to this approach: the radial styloid process and Lister's tubercle. The brachioradialis muscle is attached to the radial styloid. The tendon of the extensor pollicis longus (EPL) muscle angles around the distal part of Lister's tubercle to change direction by 40–45°.[2] The skin around the dorsum of the wrist is loose and glides easily, allowing for longitudinal, straight incisions to be performed without risking joint contracture.

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The extensor retinaculum is a narrow (2 cm), fibrous band that lies obliquely across the dorsal aspect of the wrist.[3] Its radial side is attached to the anterolateral border of the radius; its ulnar border is attached to the pisiform and triquetral bones. Twelve tendons pass under the extensor retinaculum, forming six compartments separated by fibrous septae (Table 1). The first compartment contains the abductor pollicis longus (APL) and extensor pollicis brevis (EPB). Extensor carpi radialis longus and brevis are in the second compartment on[4] the radial side of Lister's tubercle. The EPL tendon is in the third compartment on the ulnar side of Lister's tubercle. In the fourth compartment are found the extensor digitorum communis (EDC) and extensor indicis. The last two compartments contain one tendon each: the extensor digiti minimi (EDM) and extensor carpi ulnaris (ECU). The ECU tendon is contained in the subsheath and passes over the ulnar styloid process. Underneath the extensor compartments are the dorsal carpal ligaments.[2,3]

The dorsal carpal ligaments consist of the intrinsic and extrinsic ligaments (Table 2).[4] The dorsal extrinsic ligaments are detailed in Table 1. The surgically relevant ligaments include: 1) the dorsal radiocarpal ligament (radiocapitate, radiotriquetral, radiolunate and radioscaphoid); 2) the dorsal ulnotriquetral ligament; 3) the dorsal intercarpal ligament (originating from the triquetrum and extending radially and attached onto the lunate, inserted into the dorsal groove of the scaphoid and trapezium). The latter can be split in a dorsal approach to access the carpus. The intrinsic ligaments connect the adjacent carpal bones and they include: 1) the scapholunate interosseous ligament; 2) the lunotriquetral interosseous ligament; 3) the capitohamate, trapeziocapitate and trapeziotrapezoid ligaments.[4,5] The latter connects the bones of the distal row, making them move as one. Injury to the extrinsic dorsal radiocarpal ligament causes volar intercalated segment instability (VISI), while injury to the intrinsic scapholunate ligament can cause dorsal intercalated segment instability (DISI).[4,5]

Two nerves cross the wrist on the dorsal side and they can be at risk. The dorsal cutaneous branch of the ulnar nerve emerges from the main trunk of the ulnar nerve proximal to the ulnar styloid and passes dorsally to innervate the skin of the little and

The extensor compartments

Compartment	Tendon	Pathology
1	EPB APL	De Quervain's tenosynovitis
2	ECRL ECRB	Intersection syndrome
3	EPL	Drummer's wrist Traumatic rupture
4	EIP EDC	Extensor tenosynovitis
5	EDM	Vaughan–Jackson syndrome
6	ECU	Snapping ECU

APL, abductor pollicis longus; ECRB, extensor carpi radialis brevis; ECRL, extensor carpi radialis longus; ECU, extensor carpi ulnaris; EDC, extensor digitorum communis; EDM, extensor digiti minimi; EIP, extensor indicis proprius; EPB, extensor pollicis brevis; EPL, extensor pollicis longus.

Table 1

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Extrinsic and intrinsic ligaments of the wrist

Carpal ligaments	Subcategory	Ligament complex	Ligaments
Extrinsic	Proximal	Radial collateral	Radial collateral ligament
		Volar radiocarpal	Radioscaphocapitate
			Long radiolunate
			Radioscapholunate
			Short radiolunate
		Volar ulnocarpal	Ulnotriquetral
			Ulnolunate
			Ulnocapitate
		Dorsal radiocarpal	Radiocapitate
			Radiotriquetral
			Radiolunate
			Radioscaphoid
		Dorsal intercarpal (DIC)	Dorsal intercarpal ligament
		Ulnocarpal complex	Dorsal ulnotriquetral
			Triangular fibrocartilage
			Ulnolunate ligament
			Ulnar collateral ligament
	Distal	Carpometacarpal	
Intrinsic	Proximal row	Interosseous	Scapholunate interosseous
			Lunotriquetral interosseous
	Mid row	Volar midcarpal	Scaphotrapeziotrapezoid
			Scaphocapitate
			Triquetrocapitate
			Triquetrohamate
	Distal row	Volar intercarpal	Deltoid ligament
		Distal dorsal intercarpal	Capitohamate
			Trapeziocapitate
			Trapeziotrapezoid

Table 2

ring fingers.[3] The superficial radial nerve emerges from beneath the brachioradialis, proximal to the radial styloid, to innervate skin over the dorsum of the first web space and most of the dorsum of the hand.

Universal dorsal approach to the wrist

The ideal dorsal wrist approach has to provide the best exposure whilst preserving sensitive dorsal nerve branches, dorsal veins, and skin integrity.[6] A longitudinal incision is commonly used in wrist surgery. Several authors have described a transverse dorsal approach, following Langer's lines,[7] but this is not commonly practised. The longitudinal dorsal approach described here allows access for scaphoid surgery, four-corner fusion, carpectomy, vascularization of the lunate, capitate fracture, dorsal capsulodesis and wrist replacement.[8,9]

Incision: a longitudinal incision on the dorsal aspect of the wrist, centred over Lister's tubercle, is made and the incision can be extended as necessary (Figure 1). The skin and subcutaneous fat flap are separated from the extensor retinaculum and elevated away with self-retaining retractors (Figure 2a and b).

Superficial dissection: the extensor retinaculum is defined and incised over the fourth compartment of the wrist. The EPL is exteriorized and the EDC and extensor indicis proprius (EIP) are mobilized off the compartment and lifted to the radial and ulnar sides respectively, exposing the distal radius and joint capsule (Figure 2c and d). This view can be expanded by dividing the fibrous pillars between compartments (second and third, third and fourth, fourth and fifth) which are divided transversely by sharp dissection at their base as they attach to the back of the radius. Retracting the retinaculum will expose the extensor carpi radialis longus (ECRL) and extensor carpi radialis brevis (ECRB) on the radial side and EDM on the ulnar side.

Deep dissection: the joint capsule is incised either longitudinally over the distal radius and carpal bones, or in an inverted-T shape fashion (Figure 2e and f). The dissection continues below the capsule (the dorsal radiocarpal ligament) towards the radial and ulnar sides of the radius to expose the entire distal end of the radius and carpal bones. Berger et al. described a radially-based anatomical dorsal capsulotomy to expose the radial aspect of the radiocarpal joint and entire midcarpal joint.[8,9] This is achieved by identifying the direction of the radioscaphoid, dorsal radiotriquetral and the dorsal intercarpal (DIC) ligaments then dividing the capsule along the tension lines of these ligaments (Figure 2). Carpal stability is achieved by leaving intact half of each capsular ligament (Figure 3).

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