Surgical Approaches to the Distal Radioulnar Joint

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• Distal radioulnar joint • Proprioception
• Surgical approaches • Triangular fibrocartilage complex

For the distal radioulnar joint (DRUJ) to be stable, not only do the articulating surfaces need to be congruent and well aligned but also the capsule and ligaments need to be mechanically and sensorially competent. According to recent investigations, ligaments should not be regarded as simple static structures maintaining articular alignment but as complex arrangements of collagen fibers containing mechanoreceptors, which are able to generate neural reflexes aiming at a more efficient and a more definitive muscular stabilization.[1–4] It is certainly through a proper interaction of the 2 major DRUJ constraints, namely the triangular fibrocartilage (TFC) and the ulnocarpal ligaments, and the 2 most effective DRUJ muscle stabilizers, the extensor carpi ulnaris (ECU) and the pronator quadratus (PQ) muscles, that joint stability is achieved.[5–7] Indeed, patients with substantial passive laxity of the DRUJ may remain asymptomatic if the destabilizing forces experienced by the joint are anticipated and quickly inhibited by an adequate ECU and PQ muscle reaction. If the time between aggression and muscle reaction, the so-called latency time, is unusually prolonged, instability may worsen and result in further ligament injury.[1,2] The latency time, however, is directly dependent on the speed of afferent proprioceptive stimuli from the mechanoreceptors in the joint to the spinal cord, and back to the muscles. If the DRUJ capsule and ligaments have been denervated, muscle reactions may also appear, but the response may not be quick enough to provide stability, because this neuromuscular reaction will be a result of afferent stimuli from extra-articular receptors in adjacent tendons and skin. Joint denervation, a procedure often defended as an effective means to achieve pain relief, certainly may not be as benign a procedure as often suggested, and this is a factor worth considering in the planning of joint capsulotomies.

One of the most notable, yet poorly recognized, advantages of arthroscopy is the ability to observe, manipulate, and correct problems within the joint without creating substantial damage to capsular innervation. This probably explains why procedures done arthroscopically tend to recover function faster than those performed through an open approach. If a condition can be solved arthroscopically, open surgery is certainly not indicated. There are instances, however, where an open approach is mandatory. Depending on the location of the anatomic structure to be addressed, one may choose from various surgical approaches.

INNERVATION OF THE DISTAL RADIOULNAR JOINT

According to Gupta and colleagues[8] and Shigemitsu and colleagues,[9] the palmar capsule, anterior radioulnar, and ulnolunate ligaments are mostly innervated by branches of the ulnar nerve. Branches from the anterior interosseous nerve (AIN) are additionally found to innervate the volar DRUJ capsule,[10,11] but detailed microscopic studies have not disclosed AIN contributions to

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the actual DRUJ ligaments.[8] The dorsal DRUJ capsule, the posterior radioulnar ligament, and the dorsal ulnocarpal capsule are innervated by branches of the posterior interosseous nerve. Everything else, including the meniscus homolog, the foveal attachment of the TFC, the prestyloid recess, and the ulnotriquetral ligament is innervated by articular extensions of the dorsal sensory branches of the ulnar nerve.[8,9] The central portion of the TFC, the so-called discus articularis, is avascular and aneural, explaining why central TFC perforations may remain asymptomatic unless they are associated with another local injury causing synovitis.

When discussing surgical approaches to the TFC, certain aspects of the DRUJ innervation are important to note. First, most ulnar branches of the posterior interosseous nerve enter the joint along the dorsal margin of the TFC. Consequently this structure will be denervated if the TFC is detached off the dorsal capsule. Second, no matter how the DRUJ is surgically approached, it is always essential to identify and carefully protect the articular extensions of the dorsal branch of the ulnar nerve. These branches are the only ones that transmit proprioceptive information from the most important functional portions of the TFC.[9] Finally, there is a safe zone through which the joint can be entered without creating substantial denervation; namely, the zone between the meniscus homolog and the ulnotriquetral ligament, and proximally along the ulnar insertion of the palmar radioulnar capsule.

With this information in mind, several surgical alternatives have been investigated in cadaver specimens at the Anatomy Department of the University of Barcelona, Spain. This article describes 3 surgical approaches to the DRUJ—dorsoulnar, ulnar, and palmar—with emphasis on their respective ability to expose different DRUJ structures, and their morbidity in terms of sensory innervation of the joint.

DORSOULNAR APPROACH

Most surgical approaches to the DRUJ described in the literature are dorsal or dorsoulnar.[12–15] Bower's approach involves 2 retinacular flaps, 1 radially based and 1 ulnarly based. The medial edge of the radially based flap overlies the thin ECU sheath, an important structure that may be inadvertently damaged with rising of this retinacular flap. The capsular incision is C-shaped, creating an ulnar-based capsular flap with a distal incision along the proximal edge of the dorsal radioulnar ligament; therefore, the distal aspect of the TFC is not well visualized.[12] The technique of Berger and Bishop[13] involves an inverted-V capsulotomy based on the line of the dorsal radiotriquetral ligament and the edge of the VI compartment. This approach only visualizes the distal aspect of the TFC and lunotriquetral joint and does not allow access to the proximal aspect of the TFC or DRUJ, because any proximal extension of the vertical limb of the capsular incision would disrupt the ECU sheath. Tubiana and colleagues[14] recommends division of the ECU sheath to expose the underlying capsule. It is the authors' belief, however, that the ECU and its surrounding stabilizing structures should not be violated during the surgical approach.[6] Webhe's approach[15] to the ulnar side of the wrist is similar to what is described here, except that the TFC is not dissected off the capsule, thus limiting the overall exposure of the DRUJ joint including the TFC.

The dorsoulnar approach suggested provides excellent exposure to the ulnocarpal and radioulnar joints, the dorsal edge of the TFC, the meniscus homolog, and the dorsal aspect of the lunotriquetral joint.[16] The major drawback of this approach is that it denervates the dorsal capsule almost completely and denervates the posterior radioulnar ligament partly. If carefully executed, the dorsal branches of the posterior interosseous nerve supplying the ulnar head and the area adjacent to the foveal attachment of the TFC may be preserved.

The dorsoulnar approach described was first published by the first author of this article in 2003,[16] and it is mostly indicated in chronic DRUJ dysfunctions with joint degeneration requiring some sort of salvage procedure. In such instances, proprioception stabilization of the joint has long been altered, and denervation may even be beneficial for its pain-controlling effects. This approach is also indicated when surgery is planned to solve pathology to the ECU tendon sheath. What follows is a step-by-step description of this approach.

Step 1: A 2-cm oblique incision at the level of the distal corner of the ulnar head is used to identify and protect the dorsal branch of the ulnar nerve (DBU) (**Fig. 1**A). This incision is prolonged proximally and distally, in a zigzag fashion. Using a blunt dissection, the subcutaneous tissue is elevated en bloc and all small perforating vessels are coagulated. Anomalous transverse branches toward the radius proximal to the ulnar styloid are not uncommon, and need to be identified and protected.[6]