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Review article

Wrist osteoarthritis

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ABSTRACT

Painful wrist osteoarthritis can result in major functional impairment. Most cases are related to post-traumatic sequel, metabolic arthropathies, or inflammatory joint disease, although wrist osteoarthritis occurs as an idiopathic condition in a small minority of cases. Surgery is indicated only when conservative treatment fails. The main objective is to ensure pain relief while restoring strength. Motion-preserving procedures are usually preferred, although residual wrist mobility is not crucial to good function. The vast array of available surgical techniques includes excisional arthroplasty, limited and total fusion, total wrist denervation, partial and total arthroplasty, and rib-cartilage graft implantation. Surgical decisions rest on the cause and extent of the degenerative wrist lesions, degree of residual mobility, and patient's wishes and functional demand. Proximal row carpectomy and four-corner fusion with scaphoid bone excision are the most widely used surgical procedures for stage II wrist osteoarthritis secondary to scapho-lunate advanced collapse (SLAC) or scaphoid non-union advanced collapse (SNAC) wrist. Proximal row carpectomy is not indicated in patients with stage III disease. Total wrist denervation is a satisfactory treatment option in patients of any age who have good range of motion and low functional demands; furthermore, the low morbidity associated with this procedure makes it a good option for elderly patients regardless of their range of motion. Total wrist fusion can be used not only as a revision procedure, but also as the primary surgical treatment in heavy manual labourers with wrist stiffness or generalised wrist-joint involvement. The role for pyrocarbon implants, rib-cartilage graft implantation, and total wrist arthroplasty remains to be determined, given the short follow-ups in available studies.

1. Introduction

Osteoarthritis is a chronic non-inflammatory joint disease characterised by degenerative lesions of the cartilage. At the wrist, osteoarthritis is usually secondary to posttraumatic sequel or metabolic disease and selectively arises in the joints that involve the scaphoid bone [1].

Although well tolerated for many years, wrist osteoarthritis can result in severe functional impairments. With the exception of a few patients seen at an early stage, surgery is not indicated unless conservative therapy has failed. Surgery is considered to be based on palliative procedures. The choice among the array of available techniques depends on the cause of the disease, joints involved, and patient-related factors [2].

Although the distal radioulnar joint is associated with the wrist, its involvement with osteoarthritis is related to specific causes and raises distinctive therapeutic challenges, which are not discussed here.

2. Biomechanics

The cohesion of the articular complex of the wrist is ensured by both the shape of the carpal bones and over 30 ligaments. The two-row model of the wrist is the most effective for understanding wrist biomechanics and the genesis of intra-carpal lesions.

The carpal bones receive no tendon attachments, and their movements are produced by compression forces. The second row of carpal bones (R2) behaves as a unit that is moved by off-center forces, similar to the beam of a scale moving around an instantaneous axis through the head of the capitate [3]. The first row (R1) is a deformable structure whose cohesion is provided in part by two intrinsic ligaments, the scapho-lunate (SL) and lunotriquetral (LT) ligaments. The strong forces applied to these ligaments can cause traumatic and degenerative lesions. In the three-link concept of the wrist, the intercalated segment is R1, which bridges the radial glenoid cavity and R2. Movements of R2 determine those of the three main bones of R1 and, in return, the cohesion of R1 ensures proper centring of the capitate head and R2 [3].

The shape and position of the scaphoid result in flexion of this bone in response to application of an axial compression force. Thus, the scaphoid converts compression forces to flexion forces. On the

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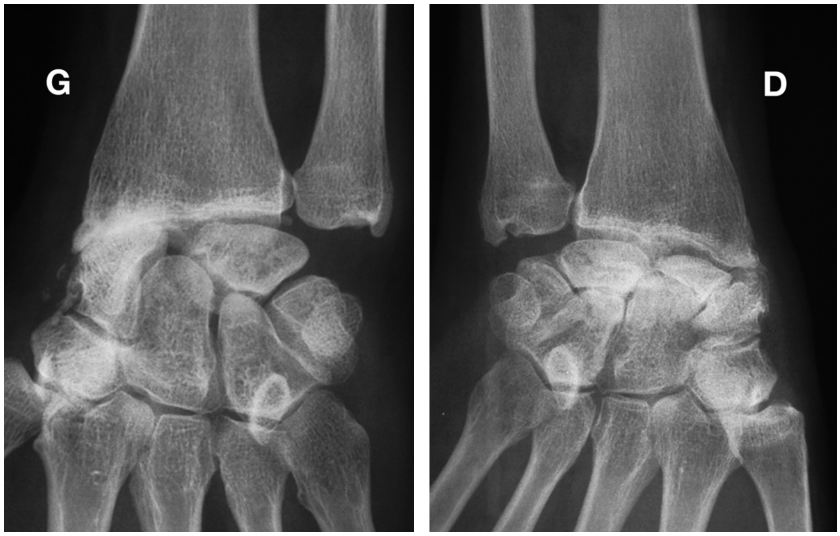

Fig. 1. Radiographs of both wrists of a patient with SLAC wrist on the left and SNAC wrist on the right, both stage III. Note the radial translation of the row 2-scaphoid complex.

ulnar side, when axial compression is applied, the shape of the triquetro-hamatal joint surface moves the triquetrum in extension: compression forces are converted to extension forces. The balanced position of the lunate results from the combined effects of opposite forces applied to the two sides of the bone. If this balance is lost, the lunate can tilt into extension, an abnormality known as dorsal intercalated segment instability (DISI) or into flexion, which characterises volar intercalated segment instability (VISI).

Whereas flexion-extension movements are evenly distributed between the radiocarpal and midcarpal joints, movements in the frontal plane occur chiefly through the midcarpal joint. Functional motion arcs for activities of daily living are 5°–10° of flexion, 30°–35° of extension, 10° of radial inclination, and 15° of ulnar inclination. Wrist motions during everyday activities replicate the dart-thrower's arc of wrist motion, from radial inclination and wrist extension to ulnar inclination and wrist flexion. This complex wrist motion occurs chiefly through the midcarpal joint, with virtually no motion of the lunate [4]. The dart-thrower's arc is the most widely used wrist motion during everyday activities.

3. Aetiological diagnosis and pathophysiology of wrist osteoarthritis

Wrist osteoarthritis is usually secondary to a pathological condition, whose identification is important to ensure optimal management [2]. The main injuries responsible for wrist osteoarthritis are ligament lesions that impair the cohesion of R1 (scapholunate and lunotriquetral malalignment, scaphoid bone non-union, or malunion of a fracture involving the distal radial joint surface). Other causes include inflammatory joint diseases and metabolic diseases, chiefly articular chondrocalcinosis, or gout as a less common cause; primary avascular necrosis (Kienböck disease and Preiser disease); and deformities such as Madelung's disease [5–7].

There may be no detectable cause, for instance in some cases of scapho-trapezio-trapezoid osteoarthritis [7].

3.1. Osteoarthritis after disruption of the first carpal row (R1)

Scaphoid bone non-union and dissociative instabilities of R1 are responsible for carpal collapse with DISI or VISI and secondary osteoarthritis. In addition to this classical mechanism, any disruption of the intercalated segment can result in shear stress application to the midcarpal joint, which eventually causes midcarpal osteoarthritis [3].

Non-union of a scaphoid fracture is consistently followed by the development of osteoarthritis within 5–10 years. This pattern is known as scaphoid non-union advanced collapse (SNAC) wrist [5,8]. Progressive anterior wear with palmar flexion of the scaphoid results in loss of scaphoid height and in adaptive intra-carpal instability with DISI of the lunate, which follows the extension of the proximal pole of the scaphoid [9]. This malalignment is combined with radial translation and supination of the R2-distal scaphoid pole complex [8]. The result is osteoarthritis of the scaphostyloid joint (stage I) then of the scapho-capitate joint (stage II) and capitolunate joint (stage III) [5,8] (Fig. 1D).

Osteoarthritis complicating scapholunate instability (scapholunate advanced collapse or SLAC wrist) [1] occurs only in wrists characterised by the presence of static instability with DISI [3]. Disruption of the structures that normally stabilise the scapholunate joint puts the scaphoid in a horizontal and pronated position. With lunate DISI, the result is radial translation and supination of the R2-scaphoid complex responsible for dorso-radial subluxation of the proximal pole of the scaphoid [3] followed by osteoarthritis of the radioscaphoid joint, which is localised initially (stage I) then extensive (stage II). In parallel, loss of capitolunate centring produces shear stress with gradual development of midcarpal osteoarthritis (stage III) (Fig. 1G).

In most cases, the radiolunate joint space is spared [1], as it is not subjected to shear stress. However, osteoarthritis can develop in the radiolunate joint, producing the type IV SNAC or SLAC wrist pattern [5,9]. The cause may be sequel of perilunate lesions with partial lunate destabilisation (Fig. 2) or articular chondrocalcinosis.

Although midcarpal osteoarthritis may suggest articular chondrocalcinosis [6], another possible cause is lunotriquetral dissociation [10] in the absence of any metabolic disease (Fig. 3), accompanied with degenerative changes between the lunate and triquetral bone [5]. Also worthy of note is the existence of perilunate dislocation equivalents, either without dislocation or with spontaneous reduction, responsible for double instability [3,10]. The osteoarthritis may predominantly affect the radioscaphoid joint in the event of marked scapholunate dissociation or be confined to the midcarpal joint if lunotriquetral dissociation is the predominant abnormality [3] (Fig. 4).