Focus On
Avoiding fusion in wrist arthritis

Advanced non-inflammatory arthritis of the wrist can lead to significant disability. Traditionally, the treatment for arthritis of the wrist which does not respond to either anti-inflammatory medication, splintage, steroid injections and time, would be a total wrist fusion. However, wrist fusion substantially diminishes function and is usually avoidable. Two facts should prompt the surgeon to avoid wrist fusion. First, arthritis rarely affects all the joints of the wrist; secondly, there are now several movement-sparing procedures which can give predictably good outcomes.

The history, examination and investigation of a patient with non-inflammatory arthritis of the wrist, and who is a candidate for surgery, should be directed towards one goal – avoiding total wrist fusion if possible.

This article describes the options available for surgical treatment of arthritis of the wrist and emphasises the ways in which the disability of total wrist fusion can be avoided.

Limited intercarpal arthrodesis

Many different techniques to secure union in intercarpal fusion have been described; these include Kirschner wires (K-wires), cannulated screws, bone staples and circular plates. Many combinations of intercarpal fusion have been undertaken since Peterson and Lipscomb’s description of available options in 1967. The more commonly performed and reliable fusions are scaphoid-trapezium-trapezoid (STT), radio-lunate, capitate-hamate-lunate-triquetral (four-corner), and radio-scaphoid-lunate.

Scaphoid-trapezium-trapezoid fusion. This procedure (Fig. 2) is used primarily to treat STT arthritis although has been proposed as a solution for chronic scapho id-lunate instability and Kienbock’s disease. It should be accompanied by a radial styloectomy, which allows an improved post-operative range of movement. K-wires may achieve high union rates (87%) while a post-operative range of movement of 62% of normal can be expected. However, there can be a high complication rate, with...
49% of patients having persisting wrist pain. Additionally, altered wrist biomechanics and loading may explain the findings of subsequent radio-scaphoid arthritis that occur in 23% of patients after STT fusion. Dissatisfaction with STT fusion is common among patients and surgeons; however, there are alternatives. For example, excision of the very distal pole of the scaphoid for STT arthritis. However, only a small amount should be excised, and it should be avoided in those with pre-existing hyperextension of the lunate, as the proximal row can extend into a DISI deformity and thus cause secondary midcarpal collapse.

**Radio-scapho-lunate fusion.** A radio-scapho-lunate fusion (Fig. 3) is considered for patients in whom isolated radiocarpal arthritis is present but who have a normal midcarpal joint. This is typically seen after previous fractures of the distal radius. When combined with excision of the distal pole of scaphoid, 50% of the normal range of movement of the wrist can be preserved.

**Radio-lunate fusion.** This procedure (Fig. 4) was originally described by Chamay for patients with rheumatoid arthritis. The aim was to address the tendency of the rheumatoid proximal carpal row to slide ulnarwards and into supination. Other indications now include traumatic ulnar translation, radiocarpal incongruity after fracture of the lunate fossa, static volar intercalated segment instability (VISI) and dynamic midcarpal instability. Only a small series features in the literature although this reports acceptable rates of union (12/14 cases). Radio-lunate fusion is not currently recommended for Kienbock's disease, with Tambe et al. demonstrating a 50% failure rate in this cohort of patients. The lunate-radius distance must be preserved after decortication, which usually requires interposition of a cortical bone block.
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Scapho-luno-capitate fusion. Scapho-luno-capitate (SLC) fusion is indicated in patients with VISI deformity, non-union of a scaphoid fracture, scapholunate instability, Kienbock’s disease, or in patients with isolated midcarpal arthritis.²,⁴ Fusions which cross the midcarpal row produce the greatest restriction – approximately 60% – of post-operative movement. However, it is also suggested that the larger the surface area of the arthrodesis, the higher the fusion rates. This is reflected in the low non-union rate of 12% reported for this procedure.⁴ Technical considerations include reduction of the scapholunate joint before formal arthrodesis; the use of dorsal plates or K-wires has been described.¹⁷ As with STT fusion, concurrent radial styloidectomy is recommended in order to improve radial tilt and flexion.

Proximal row carpectomy and scaphoid excision with capitate-hamate-lunate-triquetral (four-corner) fusion. Proximal row carpectomy (PRC) (Fig. 5) and scaphoid excision with a capitate-hamate-lunate-triquetral, or four-corner fusion (4CF) (Fig. 6) are the more commonly undertaken procedures for degenerative changes affecting the proximal carpal row. The typical indication for these procedures is osteoarthritis of the radioscaphoid joint which can occur primarily but which may follow scaphoid non-union, fracture of the scaphoid fossa of the radius, or an interosseous ligament rupture of the scapholunate joint.

Plain radiographs, CT arthrography and a possible wrist arthroscopy are used to determine which joint surfaces are preserved and which are degenerate. If the lunate-capitate articulation shows arthritis then a PRC is contraindicated. If the lunate-radius articulation shows arthritis then both a PRC and a 4CF are contraindicated. If the capitate-lunate joint is degenerate then a PRC is contraindicated and a 4CF is performed. If both the lunate-radius and lunate-capitate of surfaces are preserved, then the choice is either a PRC or a 4CF.

A PRC is technically easier to perform, as there is no need for metalwork and no need for bone fusion. However, a 4CF is technically more difficult although has several theoretical advantages. For example, it will allow locking of the wrist during grip in those who require resistance to torque, such as might occur during twisting and gripping, whereas the PRC will not. A 4CF also preserves carpal height and maintains the original congruity of the central and ulnar thirds of the carpus. However, for a PRC, incongruency between the proximal pole of the capitate and the lunate fossa will cause point loading and theoretically increase the risk of radiocapitate arthritis. Despite the theoretical advantages of 4CF, no difference has been found in clinical follow-up studies.¹⁸,¹⁹ The outcomes for the two procedures – PRC and 4CF – are similar with satisfactory results in carefully selected patients. Approximately 80% of grip strength and 60% of the arc of movement are maintained post-operatively.²

Both PRC and 4CF are performed through a dorsal approach. Great care is taken to preserve the volar radiocarpal ligaments in order to prevent post-operative ulnar translation of the carpus.²,¹⁸

A 4CF involves excision of the scaphoid followed by decortication and fusion of the capitate, hamate, lunate and triquetrum. The lunate must be reduced to a neutral position before arthrodesis. Methods of fixation include K-wires, headless screws and dorsal circular plates. Some studies have suggested that higher rates of non-union may be associated with the use of circular plates; however, advocates argue that results are satisfactory in expert hands.²⁰ Impingement of the plate during wrist extension can be avoided by adequately recessing the plate beneath the dorsal lunate cartilage.²,²¹
Pancarpal arthritis
In patients for whom pancarpal arthritis is present, the options for surgical treatment are a total wrist fusion or a total wrist arthroplasty.

**Total wrist arthroplasty.** Total wrist arthroplasty (TWA) (Fig. 7) seeks to maintain a range of movement that allows the activities of daily living to be performed. Most experience with this procedure has involved patients with rheumatoid arthritis. In this situation, multiple joints are often affected, including the contralateral wrist. For patients who have previously undergone a wrist fusion followed by a contralateral TWA, the wrist replacement is preferred.22 Furthermore, in one outcome study, 100% of patients would have undergone a second procedure to restore wrist movement after a previous arthrodesis.23 Total wrist arthroplasty has evolved significantly over the past thirty years and important lessons have been learned from early implant failures and design errors. It is now generally accepted that several key design features are required. Minimal bone resection of the distal radius enables preservation of the carpal ligament attachments, enhancing both wrist proprioception and stability.24 The articulation should be a semi-constrained, broad and ellipsoid in shape.25 The distal fixation should aim to be within the carpus, rather than using metacarpal fixation as was seen in earlier designs. The use of an associated distal row intercarpal fusion enables a broad base of support for the distal component.26 Uncemented prostheses, with screws to augment their initial fixation, is recommended as the best method of implant fixation.24 Preservation of the distal radioulnar joint and ulnar head is desirable, given the catastrophic instability that can be associated with excision of the ulnar head.

Patient selection is critical to the success of TWA. Patients with osteoarthritis typically have good bone stock, good soft-tissue quality, and good alignment of the wrist.26 It is essential that such patients understand the implications of TWA. Permanent modification of activities is required, specifically avoiding impact-loading activities such as tennis and only allowing intermittent lifting of objects over 10lbs in weight. Although these modifications can maintain wrist movement, they may also make the implant less appealing to younger patients with their higher physical demands. Typically, after TWA one might expect a 60° arc of movement for flexion and extension26,27 although there are presently no long-term results for the most modern designs. This is particularly relevant in respect of implant subsidence, wear of the polyethylene liner and deposition of debris. Consequently, TWA should be seen as an experimental option for pancarpal arthritis, albeit one that offers significant promise and normally satisfactory early outcomes. Patient consent must carefully cover this issue.

**Total wrist arthrodesis.** Arthrodesis of the wrist remains the traditional treatment for pancarpal osteoarthritis in young active patients. The goal of surgery is to relieve pain and provide a stable base for power grip. In rheumatoid arthritis with erosive collapse of the wrist, simple fusion with a pin can give reliable results (Fig. 8). The use of pre-contoured dorsal wrist plates is now widespread. This allows fusion of the wrist in 10° to 15° of extension and slight ulnar deviation, which optimises grip strength.2 Fusion rates of 95% to 100% can be expected.2,28,29 Total wrist arthrodesis historically appeared to provide satisfactory post-operative outcomes.30 However, with
the advent of better functional outcome criteria, the desirability of wrist fusion has been challenged. Although most patients are satisfied with pain relief and their ability to return to employment, there are substantial functional limitations. These include difficulty with perineal care and working in confined spaces where the shoulder and elbow are unable to compensate for the lack of wrist movement. When bilateral wrist arthrodeses are required, the non-dominant wrist should be fused in 5° to 10° of flexion in order to allow for perineal care. As with all surgical procedures, careful pre-operative counseling of patients is required to ensure patients have a realistic expectation of the likely outcome.

Conclusion
Osteoarthritis of the wrist is common and has a significant effect on the activities of daily living. Careful surgical planning is required in order to provide the most appropriate treatment to enable satisfactory pain relief while maintaining adequate function. Historically, the emphasis has been orientated more towards arthrodesis as a means of offering predictable pain relief. However, with the evolution of new designs of wrist arthroplasty as well as the satisfactory outcomes for limited, partial arthrodeses, the surgical options for arthritis of the wrist now require careful consideration.

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