Management of 'radiocarpal arthritis'

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Abstract

Radiocarpal arthritis is common and may seriously affect hand function, the ability to carry out simple activities of daily living and work activities. This article describes the aetiology and treatment of wrist arthritis as well as key features that should be elicited in the history and examination.

Keywords Osteoarthritis; radiocarpal; rheumatoid; scapholunate; wrist fusion

Background

Patterns of osteoarthritis of the hand and wrist were described by Watson and Ballet[1] in 1984. Four thousand wrist radiographs were reviewed to identify patterns of progressive changes in degenerative arthritis of the wrist. After exclusion of other arthritides, 210 cases were reviewed. It was noted that most commonly, arthritis was present between the scaphoid, lunate and radius (57%); scaphoid, trapezium and trapezoid arthritis occurred in 27% of patients; with a further 15% of patients having a combination of these two patterns.

Incidence, age and sex

There is a paucity of information regarding the incidence of radiocarpal arthritis as a whole. An American single-centre study by Miller et al.[2] published in 2017 reviewed over 1000 wrist radiographs taken over a 3-month period investigating radiocarpal and/or midcarpal osteoarthritis (RC/MC OA). Patient age averaged 54 years (range 18–97 years), with 393 men and 614 women included. Exclusion criteria were evidence of idiopathic arthritis (Kienböck's disease), isolated scapho-trapezio-trapezoidal (STT) arthritis, as well as inflammatory arthritis. Overall, 49 radiographs from 47 patients were identified as showing RC/MC OA, giving a prevalence of 4.9%. Seventeen out of 47 patients (40%) were female, whereas the remaining 30 patients were male (60%). The average age of patients with RC/MC OA was 55 years. Statistical analysis showed that males have a higher risk of arthritis compared to females, $p < 0.05$, with increasing age also positively correlated with arthritis, $p < 0.05$. RC/MC OA prevalence of 4.9% from this study is similar to that of the 4.5% given by the Watson and Ballet study which again excluded STT arthritis.

By contrast to the above findings, STT OA has been investigated by Scordino et al.[3] in 2014. This study noted STT OA in 16% of radiographs; study size 700. It noted that increasing age, female sex, scapholunate ligament gap of over 3 mm and thumb carpometacarpal joint OA correlated with STT OA. However, female gender was not strongly predictive of STT OA.

Aetiology

Radiocarpal arthritis has multifactorial aetiology.

Post-traumatic arthritis

Trauma leading to post-traumatic arthritis of the wrist may occur following intra-articular fractures of the distal radius, scaphoid fractures, scaphoid non-unions or after ligamentous injury of the wrist resulting in carpal instability. These allow abnormal joint loading distorting the wrist kinematics.[4]

Scapholunate advanced collapse (SLAC) pattern (Figure 1) of wrist arthritis was described by Watson and Ballet. The arthritic process develops sequentially, eventually giving pancarpal arthritis. Firstly, the scapholunate ligament is injured which allows the scaphoid to flex. Osteoarthritis then develops between the proximal end of the scaphoid and the dorsal lip of the radius. This progresses to the involve the entire radioscaphoid joint.[1]

Scaphoid non-union advanced collapse (SNAC) pattern (Figure 2) of wrist arthritis occurs when the scaphoid is fractured and with non-union occurring. The radial styloid tip is first to be involved, thereafter the distal radioscaphoid joint is included with sparing of the proximal radioscaphoid joint.[4]

Inflammatory arthritis; rheumatoid

The wrist joint is the most commonly involved joint in the upper limb of patients with rheumatoid arthritis, which itself has a worldwide prevalence of approximately one per cent. Wrist symptoms are found in approximately 75% of rheumatoid patients, with 95% of these having bilateral involvement. The wrist is comprised of the radiocarpal, midcarpal and distal radioulnar joints, therefore rheumatoid arthritis (Figure 3) may affect all three components of the wrist. Rheumatoid arthritis affects synovium, therefore the 'stabilizers' of the wrist are affected which include the radiocarpal and intercarpal ligaments, the triangular fibrocartilagenous complex (TFCC) and overlying tendons. The ligaments become lax, the TFCC degenerates, and the surrounding tendons are infiltrated with hyperplastic synovium. Furthermore, inflammatory cytokines and proteolytic enzymes degenerate cartilage and cause bony erosions.[5] Volar subluxation of the carpus with radial deviation can occur leading to the typical appearance of the rheumatoid wrist.

Idiopathic avascular necrosis of the carpal bones; Kienböck's/Preiser's

In Kienböck's disease there is a vascular disturbance in an 'at-risk' lunate bone. The precise aetiology is unknown, although the 'at-risk' patients are believed to be young active males with manual labouring jobs. Repetitive loading causes a stress fracture to the proximal end of the lunate. The fracture starts at the point where the lunate moves relative to distal edge of the radius. It is thought that the stress fracture is the origin of vascular injury to

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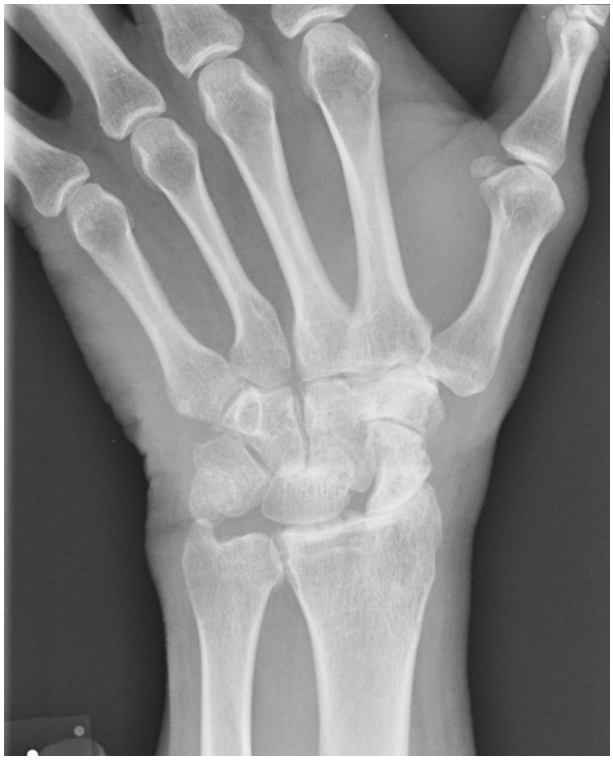

Figure 1 Scapholunate advanced collapse.

the lunate with avascular necrosis being the end result[6] (Figure 4).

Preiser's disease is defined as a progressive avascular necrosis of the scaphoid bone without a known pre-existing fracture. The aetiology of this is unknown, but is thought to be multifactorial with biomechanical or anatomical variations giving an 'at risk' scaphoid.[7]

Congenital malformation; Madelung's deformity

Madelung's congenital deformity of the wrist is a rare condition more commonly found in females. Asymmetric growth at the distal radial physis develops secondary to partial ulnar sided growth arrest. The distal radius develops ulnar and volar curvature, with positive ulnar variance and proximal subsidence of the lunate.[8]

Septic arthritis

Septic arthritis of the radiocarpal joint may be caused by penetrating injury, with *Staphylococcus aureus* being the most common causative organism. Other micro-organisms can also be the cause of radiocarpal arthritis such as *Streptococcus*, *Haemophilus influenzae* and *Pseudomonas* to name only a few.[9] The radiocarpal joint can also develop sepsis resulting from haematogenous seeding of the vascular synovial membrane due to a systemic bacteraemia.[10] Intra-articular sepsis damages articular cartilage leading to joint degeneration.

History

When taking a history from a patient with suspected radiocarpal arthritis, it is imperative to know the hand dominance of the patient relative to which wrist is causing concern. Patient-specific factors such as age, occupation and hobbies are vital pieces of information as these can indicate the functional need of the patient.[4]

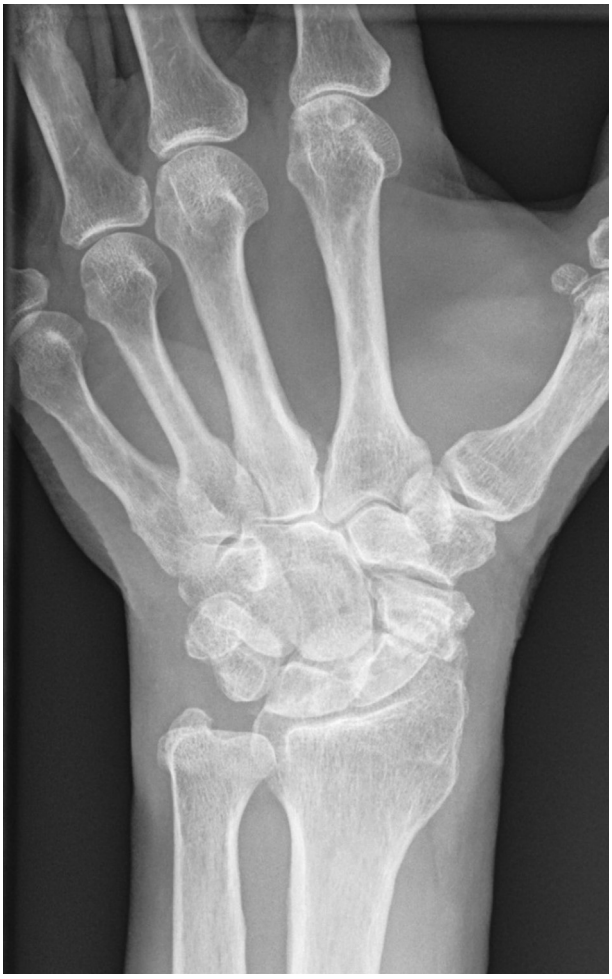

Figure 2 Scaphoid non-union advanced collapse.

Following a surgical sieve can also provide useful information, elucidating whether there is a history of trauma, infection, or familial (genetic) problems with the radiocarpal joint.

When taking a patient history, there are useful clues which help to differentiate between rheumatoid and osteoarthritis. Symptoms indicative of rheumatoid arthritis include pain worst on waking, prolonged early morning stiffness, pain following periods of rest but relieved by exercise and/or non-steroidal analgesia, systemic effects distant from the radiocarpal joint, background positive family history and autoimmune disease. By contrast, osteoarthritis pains are worst at the end of the day or with exercise, relieved by rest, shorter periods of early morning stiffness, relieved by simple analgesia, no systemic effects but potential previous injury to the affected area.[11]

Examination findings

Meticulous physical examination of the wrist is essential to ascertain where pain is originating from. Palpation will help to identify which part of the wrist any tenderness or crepitus is originating from. As well as the radiocarpal joint, other joints giving discomfort may include the ulnocarpal joint, distal radioulnar joint (DRUJ) or the intercarpal joints.[12]

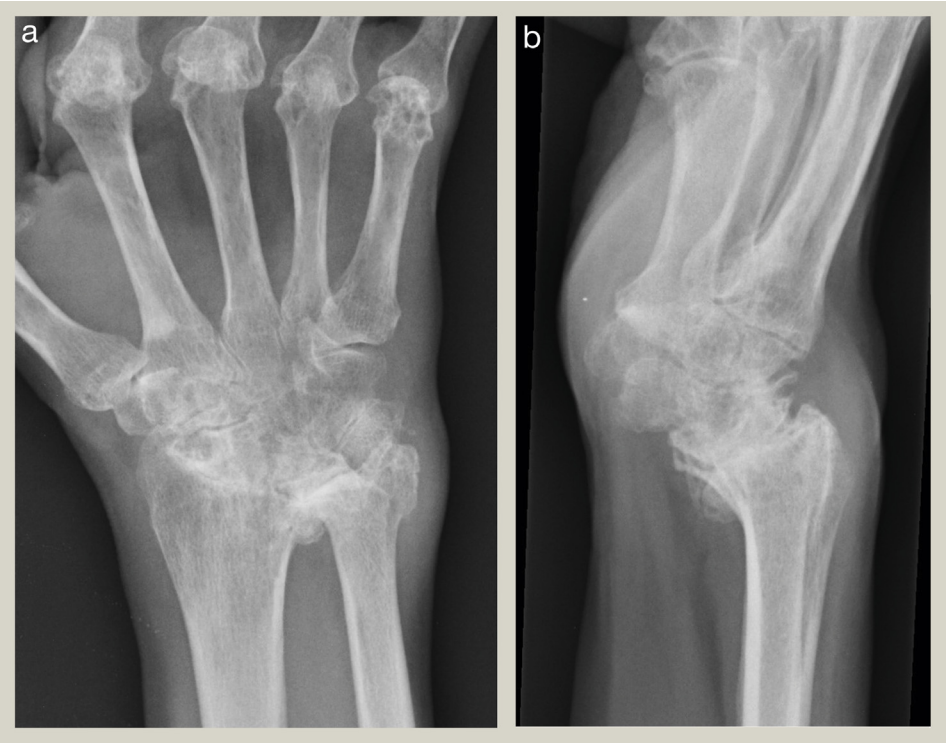

Figure 3 Rheumatoid arthritis.

Range of motion (ROM) of the wrist is assessed via flexion and extension in the sagittal plane, with radial and ulnar deviation in the coronal plane. A wrist without radiocarpal arthritis can achieve in the region of 70° extension, 75° flexion, 35° ulnar deviation and 20° radial deviation.[13] Pronation and supination can be used to assess the distal radioulnar joint (normal range 80 degrees in each direction).

In rheumatoid arthritis the wrist becomes shortened. Dorsal wrist bulging is suggestive of tenosynovitis. The ulna head becomes prominent via subluxation with widening of the anteroposterior wrist dimension in advanced cases. The hand develops radial deviation as well as flattening of the ulna border of the wrist. The wrist should be assessed for range of motion, strength and function. Examination of the tendons may identify rupture or subluxation.[5]

Septic arthritis presents with systemic upset to the patient. The patient is febrile, with local findings including joint pain, warmth, swelling, and decreased range of motion.[10] There is also severe pain on movement.

Any musculoskeletal assessment should include neurovascular examination.

Investigations

Imaging studies to help identify radiocarpal osteoarthritis initially start with radiographs of the wrist. Both posteroanterior (PA) and lateral radiographs must be obtained. Osteoarthritis will be demonstrated by joint space narrowing, osteophyte formation, subchondral sclerosis and cyst formation.[12] For both osteoarthritis and rheumatoid arthritis, plain radiographs are generally all the imaging that is required. Ultrasound scans may be used if evaluating for tendon rupture in the rheumatoid patient, or magnetic resonance imaging (MRI) for assessing more subtle osteoarthritis.[5,12]

Blood testing is useful, particularly to assess for potential septic arthritis. Inflammatory markers including white cell count, C-reactive protein (CRP) as well as erythrocyte sedimentation rate (ESR) will be raised in septic arthritis. A radiocarpal joint aspiration should also be performed to evaluate the synovial fluid. If the synovial fluid is turbid, of low viscosity and with a leukocyte count in excess of 50,000/mm^3 this is suggestive of joint sepsis. The synovial fluid should also be assessed to exclude crystal arthropathy (i.e. gout and/or pseudogout). Urgent microscopy analysis should be performed. A positive Gram stain of the synovial fluid would support a diagnosis of septic arthritis. Culture analysis should then be performed. However, it should be noted that Gram-stain analysis is only sensitive approximately 50% of the time, while culture analysis may be negative if the patient has already commenced antibiotic therapy prior to wrist aspiration.[10]

To assess articular cartilage in the most detail, diagnostic arthroscopy is the gold standard.[13] This may be used to assess sites of cartilage wear and thereby guide further surgical management.

Treatment

Non-operative

Where osteoarthritis is the cause of symptoms, pain relief and improved wrist function can be achieved using a combination of non-operative methods initially. A stepwise approach can be followed including simple analgesia, activity modification, splint immobilization and intra-articular steroid injection(s).[4] If the

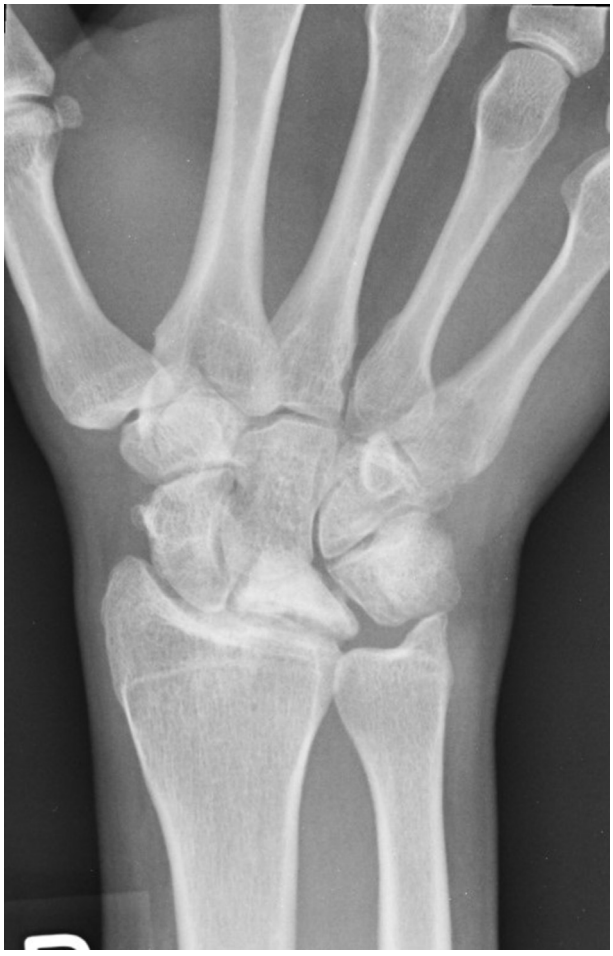

Figure 4 Kienbock's disease.

osteoarthritis is more advanced, then these methods may be of limited benefit, so operative management may need to be considered.

In the rheumatoid wrist, in addition to pain relief and improved function, treatment goals also include prevention of further rheumatoid disease and cosmesis. All of the treatments described above can be used for the rheumatoid wrist, with specific anti-rheumatoid medications also providing benefit. These include immune modulators such as TNF inhibitors.[5] As such the treating orthopaedic surgeon will need to manage the patient in conjunction with the rheumatology team.

Patients with suspected septic arthritis of the wrist, following obtaining a sample of synovial fluid, should be started on a broad spectrum antibiotic. If joint sepsis is confirmed then the joint must be washed-out in theatre. When the culture results are known then the antibiotic can be adjusted as necessary according to antibiotic sensitivity results.[10]

Operative

Overview: When operative management is chosen, surgery is performed with the intention of trying to eliminate pain while attempting to preserve as much motion as possible in adjacent joints. Surgery is dependent on the joints involved and may vary from single joint fusion (such as radiolunate), to partial fusion (radio- or mid-carpal), or even total wrist fusion.[12]

Approach: The surgical procedures briefly mentioned above may be performed via a dorsal longitudinal skin incision, extending from the third metacarpal to the distal radius. Upon entering the third dorsal wrist compartment, the extensor pollicis longus (EPL) tendon is moved radially to reveal Lister's tubercle; this can be harvested to provide autologous bone graft. Thereafter the capsule may be opened to expose the dorsal aspect of the carpal bones.[12]

Arthrodesis: Total wrist arthrodesis is used where there is pancarpal arthritis (Figure 5). The wrist is fused with some dorsiflexion present to enable a powerful grip postoperatively. From an operative perspective pre-contoured plates are used, and autologous bone graft use gives fusion rates between 93% and 100%. The fusion is performed from the distal radius to the third metacarpal.[4] Disadvantages of total wrist arthrodesis include difficulties working in a confined space as well as difficulties performing personal hygiene.[12]

Fusion of the radiocarpal joint (partial arthrodesis), is preferred in young or high-demand patients as well as those with gross instability from severe synovitis. Pain relief is achieved while preserving the majority of grip power.[13] If the arthritic process is

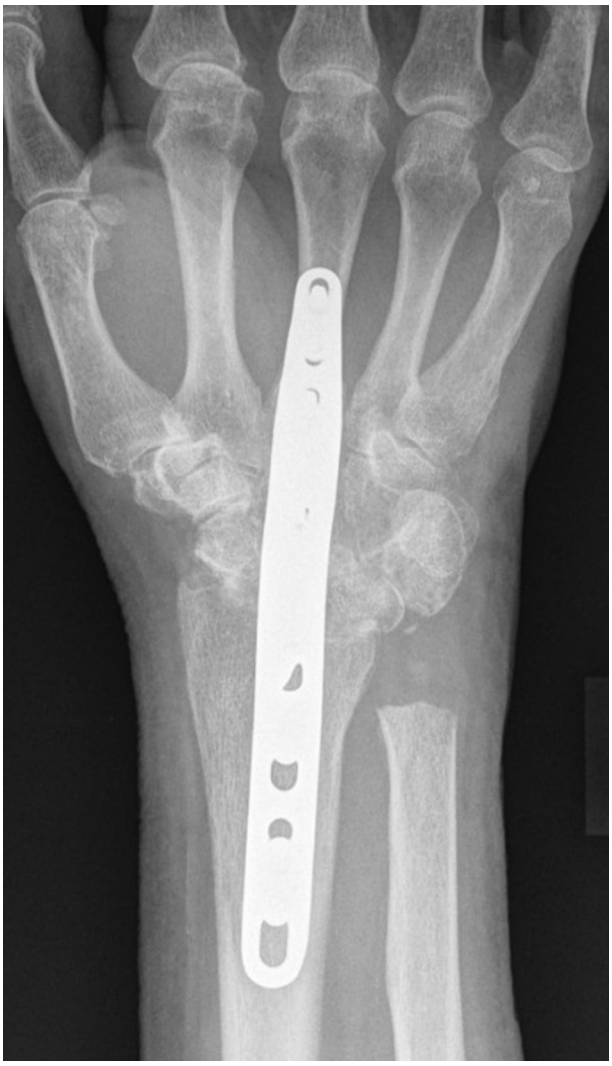

Figure 5 Total wrist arthrodesis.

localized to the lunate fossa of the distal radius, then an isolated radio-lunate fusion can be performed. This has yielded good results in patients with mal-union of the lunate fossa, rheumatoid arthritis and complex ligament instability. Conversely, results of radio-lunate fusion used in patients with Kienböck's disease have been poor due to a high rate of non-union. Patients who have diffuse radiocarpal arthritis with preservation of the midcarpal joint may undergo fusion of the radio-scapho-lunate portion of the wrist. Where radio-scapho-lunate fusion is performed, there is a significant reduction in ROM of the wrist with a 60° arc of movement postoperatively. Additionally this procedure has a risk of high rates of non-union and subsequent development of mid-carpal arthritis. This can be improved by excising the distal scaphoid and triquetral bone.[13]

Arthroplasty: Total wrist arthroplasty (Figure 6) provides pain relief with preservation of movement of approximately 60% of 'normal' wrist motion. First-generation implants showed a high incidence of implant failure, while more recent prostheses have had problems secondary to loosening. Total wrist arthroplasty tends to be used in patients with lower functional demand due to postoperative activity restrictions.[4] This procedure is used in patients with pancarpal arthritis, with complications including stiffness, dislocation, impingement and aseptic loosening.[13]

Scaphoid excision with four-corner arthrodesis: This is used in patients who have arthritis secondary to a SLAC wrist. The radio-lunate joint must be intact for this procedure to be performed whereas the radioscaphoid and midcarpal joints may be arthritic. The scaphoid bone is excised in its entirety, thereafter the lunate, triquetrum, capitate and hamate may be fused using a plate or headless compression screws.[4] The latter are buried within the carpal bones thus providing minimal risk of impingement.[12] Alternatively, Kirschner wires or staples may be preferred to perform the fusion depending upon surgeon preference. By fusing the four carpal bones together, mid-carpal instability is prevented.[13] Arc of movement is approximately 60° postoperatively. Grip strength following this procedure may be greater than after proximal row carpectomy but union needs to occur. Scaphoid excision with four-corner arthrodesis (Figure 7) may therefore be more appropriate in the younger patient, as compared to proximal row carpectomy.

Proximal row carpectomy (Figure 8)**:** This is where the entire proximal row of the carpus is excised, i.e. the scaphoid, lunate and triquetral bones. To make this a viable option the capitate and the lunate fossa of the distal radius need to be unaffected by arthritis. It can be performed via a transverse or longitudinal skin incision. The volar radioscaphocapitate ligament needs to be preserved to prevent ulnar translation of the capitate relative to the distal radius. The capitate will then articulate with the lunate fossa of the distal radius. Postoperatively, 80% of grip strength and 60% ROM are preserved.[4,13] Secondary degenerative changes may develop at the radiocapitate articulation, but these

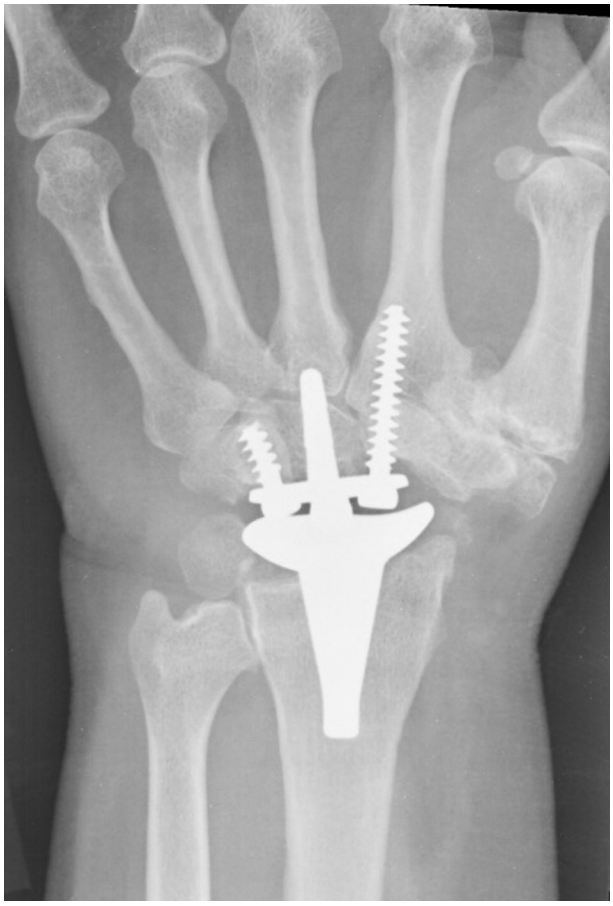

Figure 6 Total wrist arthroplasty.

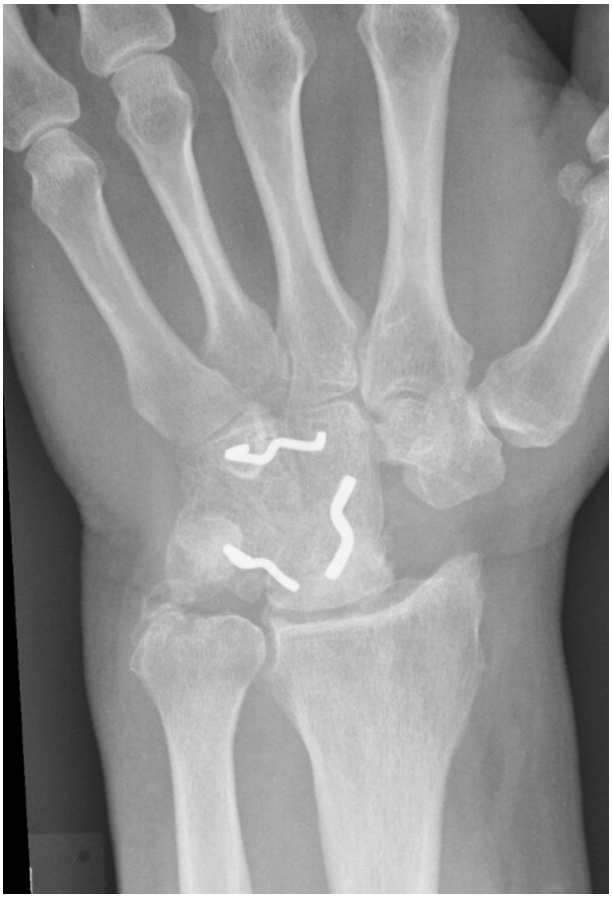

Figure 7 Scaphoid excision and four-corner fusion.

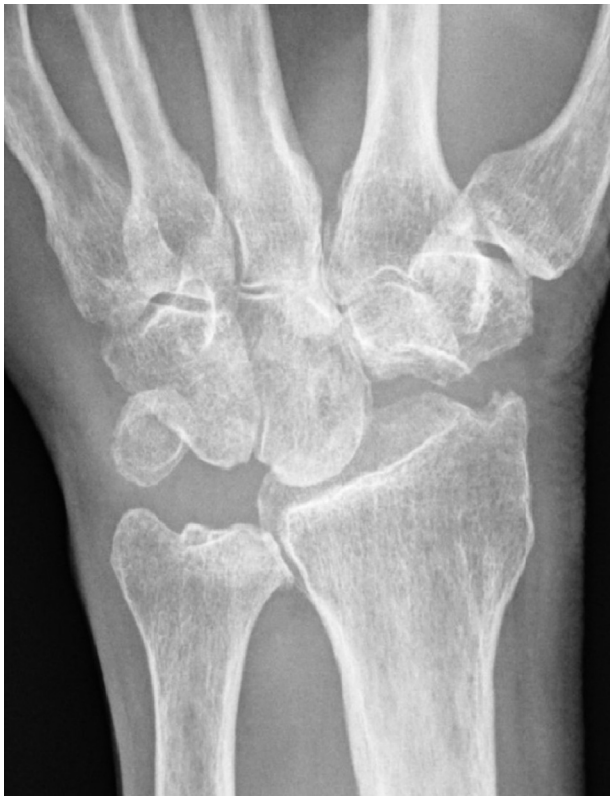

Figure 8 Proximal row carpectomy.

usually do not cause poor clinical outcome especially in the lower functional demand patient category.[12]

Scapho-trapezio-trapezoidal arthrodesis: When STT OA is the main cause of discomfort this procedure can be performed via a dorsal transverse or longitudinal incision. The STT joint is then filled with autologous bone graft taken from the distal radius. Internal fixation (arthrodesis) is then completed using Kirschner wires or screws. This technique can provide good rates of union and pain relief. A radial styloidectomy should be performed also to allow maximal ROM following the fusion. Approximately 65% of normal motion following this procedure can be achieved.[12]

Kienböck's disease management: The disease is staged according to the presence or absence of lunate collapse. When the lunate collapses in Kienböck's disease, the wrist is structurally compromised. The capitate migrates proximally between the volar and dorsal portions of the lunate. This causes the proximal carpal row to become unstable, with the scaphoid developing a flexed position and dorsal lunate becoming extended. The central column of the wrist becomes deformed and collapses with degeneration of its articulations. In the early stages joint levelling or revascularization can be considered; in very late Kienböck's disease or after failed surgery salvage procedures including partial or total wrist fusion may be required. These may include proximal row carpectomy or scaphocapitate fusion.[6]

Rheumatoid arthritis management: Operative intervention initially may include tenosynovectomy with or without tendon transfers. The distal ulna may be excised with radiocarpal synovectomy. As described above, limited arthrodesis may be performed with radio-lunate or radio-scapho-lunate fusion. If the rheumatoid arthritis is advanced with severe radiocarpal instability and joint destruction, then a total wrist arthrodesis may be used. This provides patients with good pain relief, improved function and deformity correction. By contrast to arthrodesis, a total wrist arthroplasty may be performed as described above. This may be considered if the patient has limited deformity within the wrist.[5]

Septic arthritis management: When aspirated the joint should be drained of the effusion to dryness.[10] If the presence of bacteria is confirmed, open or arthroscopic washout of the wrist should be performed and antibiotic therapy commenced with advice from the microbiologists.

Summary

Radiocarpal arthritis has multifactorial aetiology; consequently there are a variety of treatment modalities available. Treatment is directed at the relief of pain. Non-invasive cost-effective methods should be tried first; should these be insufficient to alleviate a patients symptoms then the operative methods described above can be considered. Multidisciplinary input from the orthopaedic surgeons, microbiologists and/or rheumatologists is also vital depending on the cause of the arthritis. ◆

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