

Management of osteoarthritis of the wrist and hand

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Abstract

Osteoarthritis of the wrist and hand can cause significant functional impairment and disability. Its management is as much an art as it is science, as one has to consider increasing patient expectations, functional demands, pain relief and preserving motion. A sound knowledge of the wrist and hand anatomy, biomechanics, appreciation of the specific location and grade of wrist and hand joints arthritis and various treatment options and their pros and cons is important to successfully manage patients with this condition. Wrist osteoarthritis can be idiopathic, however more commonly it is secondary to distal radius and/or carpal fractures and ligamentous injuries. A small proportion still can occur due to avascular necrosis of carpus or congenital and developmental causes. Osteoarthritis of the hand is often idiopathic with a high familial tendency, especially in younger patients but can be secondary to other causes such as trauma, gout and ligamentous laxity. Once the non-surgical management options such as analgesia, activity modifications, steroid injections and splints have been exhausted, then there are various surgical options available for wrist and hand osteoarthritis. These are tailored to the exact location of arthritis and patient factors. For the wrist, these include anterior and posterior interosseous nerve neurectomy, arthroscopic debridement, selective bony excisions, wrist arthroplasty and focal or total fusion. Whilst for finger osteoarthritis, surgical options include arthroplasty and arthrodesis. This article aims to describe the pathology of wrist and hand arthritis and various treatment options available.

Keywords four-corner fusion; proximal row carpectomy; wrist arthroplasty; wrist fusion; wrist osteoarthritis

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Introduction

Wrist and hand arthritis are the third most common arthritic conditions in England after knee and hip arthritis. Six percent (1.3 million) of the over-45-year-old population in England seek treatment for osteoarthritis of the wrist and hand.¹ Wrist arthritis can involve the whole wrist or specific parts of the wrist (i.e. radioscaphoid, scaphotrapeziotrapezoidal etc). The radiological extent of wrist and finger arthritis does not necessarily equate to the clinical picture. One also has to consider patient factors (age, co-morbidities, occupation and patient expectations etc) as treatment strategies differ for manual labourers compared to patients with a sedentary life style.² Meticulous diagnostic work-up is important to decide the most appropriate treatment options.

Anatomy and biomechanics of wrist and hand

The wrist is a complex joint that consists of distal radius and ulna, eight carpal bones and bases of the five metacarpal bones. The articular surface of distal radius has scaphoid and lunate facets, separated by the scapholunate ridges, for articulation with scaphoid and lunate respectively. The distal radius also has a sigmoid notch for articulation with the ulna head to make the distal radioulnar joint.^{3,4} The triangular fibrocartilage complex inserts into the fovea at the base of styloid process of distal ulna.

Carpal bones have been traditionally separated into proximal and distal rows based on their location and kinematic behaviour during global wrist motion.⁵

The motion of the proximal row of carpal bones (scaphoid, lunate, triquetrium and pisiform) entirely depends on mechanical signals from their surrounding articulations as there is no tendon insertion upon them. Hence the proximal row can be described as an intercalated segment between the radius and ulna and distal row.^{5,6} The bones of the distal carpal row (trapezium, trapezoid, capitate, and hamate) are tightly bound to one another via stout intercarpal ligaments, and function as a single unit as motion between them can be considered negligible.

The wrist ligaments are divided into intrinsic and extrinsic ligaments based on their attachments; intrinsic ligaments originate and insert on carpal bones whilst extrinsic ligaments connect carpals to the radius, ulna and metacarpals. Scapholunate and lunotriquetral ligaments are the two most important intrinsic ligaments and are divided into dorsal, volar and proximal parts. The thickest and strongest part of the scapholunate ligament (SLL) is located dorsally and that of lunotriquetral ligament is located palmarly.⁷ As the anterior cruciate ligament is considered the primary stabilizer of the knee, so, too, can the SLL be considered the primary stabilizer of the scapholunate joint (SLJ), if not the entire carpus.⁵ The volar extrinsic ligaments that include the radioscaphocapitate, the long radiolunate, and the short radiolunate ligaments are considered as greater restraint to wrist instability compared to dorsal extrinsic ligaments.⁷

The flexion/extension axis of the wrist is just distal to the radial and ulnar styloids and the radial and ulnar deviation axis passes through the head of capitate. The axis of pronation and supination passes from the radial head to the tip of the ulna styloid and occurs through radio-ulnar articulation.⁸ Movements in sagittal plane (flexion and extension) occur almost evenly between the radiocarpal and midcarpal joints. Ulnar deviation also occurs evenly through radiocarpal and midcarpal joints

whilst radial deviation mostly occurs through the midcarpal joint around the axis of capitate (Table 1).

In the wrist kinetics, lunate acts as a torque lever suspended between opposing moments of the scaphoid (via the SLL) and triquetrum (via lunotriquetral ligament). As the hand flexes or radially deviates, mechanical forces from the distal carpal row drive the distal scaphoid into flexion, and the lunate follows passively into flexion through the strong SLL. As the hand ulnarly deviates, the unique helicoidal articular surface of the hamate engages the concordant surface of the triquetrum and, via a screwlike engagement, directs it into a dorsally tilted and palmarly translated position. The lunate and scaphoid rotate into extension through a combined effect of their unyielding interosseous ligaments and the coupled rotation of the distal row into a dorsally translated position. The whole system is under constant and changing tension; therefore if any part is disrupted, then abnormal and unlinked rotation will occur. The lunate will then tilt with the intact part of the chain. It is the direction of the lunate that is described in instability, that is, dorsal intercalated segment instability (DISI) due to SLL disruption causing lunate to tilt into extension, or volar intercalated segment instability (VISI) due to LTL disruption causing lunate to tilt into flexion.⁵

During the common dart thrower wrist motion (radial inclination and wrist extension to ulnar inclination and wrist flexion), as in using a mallet, the scaphoid is effectively locked in flexion with the proximal row. Thus this complex wrist motion occurs chiefly through the midcarpal joint. In the less common action of moving from ulnar deviation to radial flexion, the scaphoid is free to move and so this is a radiocarpal movement.⁹

With regards to the fingers, the anatomy and function of the three joints (metacarpophalangeal, proximal and distal interphalangeal joints) within each finger (index through little finger) and two joints in thumb (metacarpophalangeal and interphalangeal joints) are mutually complementary. The interphalangeal are hinge joints, whereas the metacarpophalangeal joints are condyloid, with a rounded head in a shallow cup. A complex, yet precise, intrinsic and extrinsic soft-tissue support links these joints and provides a precisely articulated balance for the mobility of the fingers and thumb. This complex interrelationship requires both strength and stability, which are inherent in the design of the bony architecture and their surrounding soft tissues. Stabilization is provided by a combination of bony restraints, ligaments, and other static soft-tissue stabilizers, and the dynamic action of muscles¹⁰

Movements at the wrist joint

Type of wrist movement	Normal range	Functional range	Joints involved
Flexion	65–80°	5–10°	Midcarpal, radiocarpal
Extension	55–70°	30–35°	Radiocarpal, midcarpal
Radial deviation	15–20°	10°	Midcarpal
Ulnar deviation	30–35°	15°	Radiocarpal, midcarpal

Table 1

Aetiology of wrist and hand osteoarthritis

Primary degenerative arthrosis in the wrist is uncommon.¹¹ Aging, being female and hereditary factors are the most compelling culprits in the culmination and progression of the primary hand and wrist osteoarthritis.¹² Isolated scapho-trapezotrapezoidal joint (STTJ) arthroses is usually primary though in some cases it may be secondary to chondrocalcinosis.¹⁰

Secondary causes of wrist osteoarthritis include sequel of trauma (non-union or malunion of fractures, ligamentous injuries); congenital causes (e.g. Madelung's deformity, positive and negative ulna variance); metabolic causes (e.g. gout and pseudogout); infection and idiopathic conditions such as idiopathic avascular necrosis of lunate (Kienbock's disease) and scaphoid (Preiser's disease). All these conditions lead to wrist degeneration due to joint incongruity and abnormal loading patterns.

Among various injury types that can lead to wrist osteoarthritis, chronic SLL injury, scaphoid non-union and distal radius fracture malunion are the common causes of post-traumatic wrist arthritis. Degenerative changes following SLL insufficiency and scaphoid non-union progress in a specific pattern from onset to advanced wrist arthritis and are termed scapholunate advanced collapse (SLAC) and scaphoid non-union advanced collapse (SNAC) wrist arthritis respectively.^{13,14} This is due to abnormal joint kinematics as lunate loses its connection to the whole of scaphoid in the SLAC and distal end of scaphoid in the SNAC scenario resulting in a DISI. In case of scaphoid non-union, there is also the additional local repetitive irritation from the non-congruent articular surfaces.¹⁰ As per Kirk Watson's description, stage 1 of both SLAC and SNAC wrists involves degenerative changes of the radial styloid and distal scaphoid (Figure 1). In stage 2, degenerative changes progress to the whole of radio-scaphoid articulation in SLAC wrist and scaphocapitate articulation in SNAC wrist (Figures 2 and 3). The arthritic process progresses to involve the capitulate articulation in stage 3. The radiolunate articulation is typically spared in a large majority of cases and its involvement should alert one of a different aetiology of arthritis (e.g. inflammatory arthritis and gout). However the degenerative process from SLAC and SNAC wrist does culminate



Figure 1 Stage 1 of both scapholunate advanced collapse (SLAC) and scaphoid non-union advanced collapse (SNAC) wrists involves degenerative changes of the radial styloid and distal scaphoid.



Figure 2 Stage 2 SLAC wrist.



Figure 3 Stage 3 SLAC wrist; capitolunate joint is involved and radiolunate articulation is spared.



Figure 4 Stage 4: Pancarpal arthritis.

in pancarpal arthritis (stage 4) involving radiolunate articulation in some cases (stage 4)^{15,16} (Figure 4).

Intra-articular and malunited fractures of distal radius lead to radiological wrist arthritic changes, in most cases within 10 years, if there remains a malalignment of the articular surface of 2 mm or more.¹⁷ Malunited extra-articular distal radius fractures

cause degenerative changes due to changed wrist biomechanics from secondary adaptive changes in the carpus. However even in the presence of radiological arthritic changes, many patients remain asymptomatic for a number of years.¹⁰

Osteoarthritis of finger joints is commonly idiopathic with a high frequency of family history specially in younger patients. Secondary causes include trauma, instability, gout and post-infection¹⁸

Diagnostic work-up

As radiographic findings do not necessarily correlate with clinical picture, so attention to detail is required in clinical assessment of patients presenting with wrist and hand symptoms to decide about appropriate management options. History about the location and type of symptoms, hand dominance, occupation, sports/hobbies, co-morbidities and expectations from treatment helps in focusing management strategies. In case of wrist arthritis, symptoms can be a combination of pain, stiffness, swelling and subsequent limitations of functions as wrist provides a stable base for hand function so pain and instability leads to weakness of grip and impairs fine hand movements.

Clinical examination further helps in localizing pain, assessing ligament and tendon integrity, quantifying functional limitations and excluding differential diagnosis (e.g. neuropathies and tenosynovitis).

A detailed analysis of posteroanterior and lateral wrist radiographs plays a central role in diagnosis of wrist arthritis, localization of the joints involved and can reveal clues about possible aetiology of the degenerative process especially in early stages of the disease. Assessment of all the individual wrist joints such as radioscaphoid, radiolunate and capitolunate articulations is essential to plan appropriate management. Additional views can further aid in evaluation of specific joints such oblique wrist view for STTJ and carpal tunnel views for pisotriquetral joint.¹⁹ Plain posteroanterior and lateral radiographs are also the mainstay of diagnosis of finger joint arthritis. MRI/arthrogram and/or CT scans of the wrist can be useful in early disease and in cases of limited joints involvement to help in accurately assessing the extent of disease and help plan treatment. Image guided diagnostic local anaesthetic and steroid injection can be useful in cases where it is difficult to localize the exact symptomatic articulation(s).²⁰

Treatment

Optimal management of wrist and hand arthritis needs a multi-disciplinary team approach including involvement of hand therapists, occupational therapists, orthotists and hand surgeons. Non-operative treatment modalities should be optimized initially. This includes non-steroidal anti-inflammatory medication, intra-articular steroid injections, activity modification and immobilization with splints for pain relief and optimization of function.

When symptoms become refractory to non-operative measures, then options of a variety of surgical procedures exist to cater for the type of arthritis (localized or generalized) and patient factors. The aims of surgical treatment are a pain-free and stable joint with preservation of as much range of motion as possible to achieve optimum function. Before a planned fusion

procedure, a trial of static splintage to immobilize the joint in the position of planned fusion can provide very useful information to the patient about the movement restriction expected post-operatively.²¹ Using the results of biomechanic studies as a guide, radiocarpal arthrodesis reduces the wrist flexion-extension arc by 60–77%, midcarpal arthrodesis reduces it by 33–50%, whilst proximal row carpectomy causes a reduction in flexion-extension arc by 25–50% compared to the contralateral unaffected side.^{20,22}

Surgical options for wrist arthritis include wrist denervation, arthroscopic procedures, excision arthroplasty, partial or total wrist arthrodesis and total wrist replacement (TWR). Commonly multiple procedures are combined to achieve the desired results such as doing wrist denervation and/or distal pole scaphoid excision at the time of limited fusions. The two main surgical treatment options for finger joint osteoarthritis are arthrodesis and arthroplasty.

We shall be describing these treatment options in our review as follows.

Wrist denervation

Wrist denervation is an effective option for wrist arthritis as it helps with pain relief, improvement of function and mobility of the wrist and still leaves other surgical options open. Terminal branches of the anterior interosseous nerve (AIN) and the posterior interosseous nerve (PIN) are responsible for painful stimuli at the wrist. Combined neurectomy of both PIN and AIN gives better results in terms of pain relief and improvement of function compared to PIN neurectomy alone.²³ Whilst performing AIN neurectomy through a dorsal approach the resection of the AIN must be performed close to the distal margin of the pronator quadratus to reduce the risk of damage to the motor branches to pronator quadratus.²⁴ As well as several reports of good short-term results, Schweizer et al. reported subjective improvement in two third of their patients at 9.6 years following complete wrist denervation for a variety of indications. The best results were achieved in patients with scapholunate dissociations and the worst results occurred in old distal radius fractures.²⁵ Some authors also recommend attention to the articular branches of the superficial radial and ulnar nerves as well as stripping of the venae comitantes around the radial artery.²⁶

Wrist arthroscopy

The developments in arthroscopic instruments and techniques have enabled the hand and wrist surgeons to use this technique for diagnostic and an ever-expanding variety of treatment procedures in wrist arthritis. It can give useful diagnostic information by assessing the extent of degenerative changes in various wrist articulations, in particular looking at radiolunate and capitulate articulations to assess suitability for various different surgical procedures. Degenerative triangular fibrocartilage tears, damaged chondral surfaces, osteophytes and exuberant synovium can be debrided and radial styloidectomy completed arthroscopically in early degenerative disease. More complex procedures such as carpectomy, and partial arthrodesis can also be completed arthroscopically. At an average follow-up of 24 months following arthroscopic proximal row carpectomy, Weiss et al. reported an average wrist flexion extension arc 80% of the contralateral side, average radial-ulnar deviation arc 78% of the

contralateral side and grip strength averaged 81% of the contralateral side. It also allowed rapid mobilization of the wrist compared with the open procedure.²⁷ Ho performed 23 cases of arthroscopic partial wrist fusion. These include STT fusion in three, scaphoidectomy plus four-corner fusion in five, scaphoidectomy plus capitulate fusion in four, lunatectomy plus scaphocapitate fusion in three, radioscapulunate fusion in four, radiolunate fusion in two, and luno-triquetral fusion in two. Articular cartilage was denuded using arthroscopic burr and curette and autogenous cancellous bone graft or bone substitute was inserted and impacted to the fusion site through a cannula under the direct arthroscopic view. Final fixation was achieved with multiple k-wires or cannulated screws. At an average follow-up of 59.9 months (range 11–112 months), radiological union of the fusion site was obtained in 19 cases, stable asymptomatic fibrous union in three cases, and definite non-union requiring revision in one case. Complications were few and minor, including pin tract infection and skin burn.²⁸

Surgical treatment options for limited wrist arthritis

Radial styloidectomy

Radial styloidectomy can be performed in isolation for early stages of wrist arthritis (stage 1 SNAC and SLAC) or can be combined with other surgical treatments for more advanced disease if radiocarpal impingement continues to be a problem. To reduce the risk of damage to the important radially based radiocarpal ligaments and subsequent wrist instability with radial styloidectomy, biomechanical studies have recommended against removal of more than 3–4 mm of radial styloid.^{29,30}

Distal pole scaphoid excision

Excision of distal pole of scaphoid is an option both for STT and scaphoid non-union. Various authors have shown good results with this procedure in terms of improvement of pain, range of movement and grip strength as long as less than quarter of the distal scaphoid was excised, there was no capitulate degeneration and SLL was competent.^{31–33}

Proximal row carpectomy

Proximal row carpectomy (PRC) provides excellent outcomes in early cases of SLAC/SNAC wrist (stage 1 and 2) when the articular surfaces of the head of the capitate and lunate facet of the distal radius are well preserved. Though the capitate head has a smaller radius of curvature than the lunate which can cause increased contact loading and translation of capitate in lunate fossa that, in turn, can lead to early degenerative changes between the capitate and lunate fossa, however long-term results have not proven this to be clinically significant. Care must be taken to preserve the radioscapulocapitate ligament during the procedure to prevent postoperative ulnar translocation of the carpus. The purported advantages of the procedure being earlier motion, no hardware and no need for fusion to occur.³⁴

At a minimum follow-up of 10 years (average 13.1 years), Jebson et al. reported an average wrist range of motion of 63% and the average maximal grip strength of 83% compared to the opposite extremity. Two out of their 20 patients required radiocapitate fusion for persistent pain (90% survival rate of PRC). Eighty five percent (85%) were satisfied with their outcome.

Radiocarpitate arthrosis was absent/minimal in 72% patients and moderate/severe in 22% patients. The presence of radiographic changes did not correlate with patient satisfaction or degree of wrist pain.³⁵ Wall et al. reported 65% survival rate of the PRC at a minimum 20 years' follow-up. The flexion-extension arc was 68°, and grip strength was 72% of the contralateral side. The predicted probability of failure revealed a higher risk in patients who underwent PRC at a younger age, which levelled off at age 40 years. They also concluded that there was no correlation between degenerative radiographic changes and satisfaction level.³⁶ Considering these findings, other surgeons have performed PRC for patients with stage 3 SNAC and SLAC wrists and reported favourable early outcomes.^{37–39} In these series surgeons have used modified techniques and added other procedures to PRC such as dorsal capsular interposition,³⁷ or partial capitate excision in line with the hamate with capsular interposition³⁸ or osteochondral resurfacing of capitate using grafts harvested from the resected carpal bones.³⁹ Significant pain relief was achieved in all these groups. In the last group, at an average of follow up of 18 months, arc of motion was 75% and grip strength was 71% of the contralateral side.³⁹

Four-corner fusion

Four-corner fusion involves complete excision of the scaphoid with fusion of the capitate, hamate, lunate, and triquetrum. The original surgical procedure, as described by Watson and Ballet involved replacement of scaphoid with a silicone implant, k-wire fixation of the fusion mass and distal radius bone grafting. The use of silicone implant was abandoned soon afterwards as it became apparent that outcomes were improved and complications (such as dislocations of the implant and osteolysis) minimized if the procedure was performed without the scaphoid replacement. The procedure was performed through two separate transverse incisions, one for the arthrodesis and a second to harvest distal radius bone graft; high-speed burs were not recommended owing to concerns about thermal necrosis. The buried k-wires were removed after 6 weeks.¹³

As the radiolunate joint is rarely involved in SLAC and SNAC wrist degenerative process so this procedure is an option in the majority of these cases. It is also an option in midcarpal degenerative changes secondary to lunotriquetral instability. Arthritis involving the radiolunate joint is a contraindication to the procedure. Most studies report values in the range of 50–60% for the flexion–extension arc and 60–80% for grip strength compared to the contralateral wrist. Pain relief has been reported in 50–90% of patients.⁴⁰ Complications specific to this procedure include non-union, hardware impingement and restriction of movements specially of the dart thrower's as the fusion involves midcarpal joint. Movement restriction also happens in the flexion and extension arc due to lunate malposition, that is, if the lunate is arthrodesed in extension, it impinges on the dorsal lip of the radius and limits extension. Conversely, an overly flexed lunate limits wrist flexion. Ideally, the lunate should be incorporated into the fusion mass in a position of neutral or slight flexion.^{40,41}

Various fixation methods have been used for fixation of fusion including k-wires, headless compression screws, surgical staples and circular fusion plates. Non-union and impingement rates are much higher with the circular plates (26–62%) compared to other methods of fixation (approximately 3–6%). This may be

partly due to the morsalized bone graft from the excised scaphoid used in the circular plate studies rather than distal radius bone graft used with other methods of fixation. Using the second-generation circular plate and distal radius bone graft, Merrell et al. showed complete union of the whole fusion mass in 27 out of 28 patients (96%). There was one case of asymptomatic persistent radiolucency at the luno-triquetral junction. They recommended the use of adequate quantity of autologous cancellous bone graft from distal radius; to denude all the cartilage down to bleeding bone from at least the dorsal two-thirds of the articulations between all four bones; to clear debris of cartilage remnants from the carpal spaces and to use two screws within each of the four bones and the screws need to have good purchase, that is, use of larger screws as primary fixation if required.⁴²

Proximal row carpectomy versus four corner fusion: most papers comparing the results of PRC and four-corner arthrodesis are retrospective series that are too small to make statistically significant conclusions.

A systematic review of 52 articles by Mulford et al. confirmed that both procedures were good options for patients with symptomatic and appropriately staged SLAC or SNAC wrists. Eighty five (85%) of patients with either procedure had good or better pain relief. However 25% of patients with successful results will report some residual pain regardless of the procedure performed and may require occasional use of non-steroidal anti-inflammatory medication. A flexion–extension arc of approximately 60–70% of the opposite wrist can be achieved after either procedure, but the arc is most commonly 10° less in patients having four-corner arthrodesis. Patients achieve grip strength of approximately 80% compared to the opposite side with both procedures. The risk of conversion to total wrist arthrodesis is equal for both procedures at 5%. PRC patients show more radiographic progressive degenerative changes at the lunate fossa however generally this does not correlate with pain or need for further surgery (i.e. total wrist arthrodesis). Only patients having PRC at 35 years of age or younger seem are more likely to request conversions to total wrist arthrodesis over the long term. General complications such as postoperative sepsis and reflex sympathetic dystrophy were the same in both groups however risks specific to four-corner arthrodesis included non-union (5.5%), dorsal impingement (2.6%) and hardware-related problems (3.3%). Based on these findings, four-corner fusion is preferred in patients under 35 years of age and in high-demand patients in their 40s and 50s, with PRC reserved for older or less active patients.^{40,43} A large, randomized, multicenter, prospective study comparing the outcome of these two commonly performed would be of great benefit to guide in informed decision-making.

Radioscapholunate fusion

Radioscapholunate (RSL) fusion is an option for symptomatic focal radiocarpal arthritis, usually secondary to intra-articular distal radius fracture when the midcarpal joints are unaffected. When performed in isolation, the flexion and extension arc achieved is 40–50° (33–40% of normal) and the rate of developing midcarpal arthritis is 35–53% with non-union rates of up to 25%.^{44,45} However when a distal scaphoid excision is



Figure 5 Scaphotrapeziotrapezoid arthritis.

performed in addition to RSL fusion, then the flexion and extension arc increases to 65–70° and the risk of midcarpal arthritis reduced to 12%. Garcia-Elias et al. reported no non-unions in their series using this technique.^{44,46}

Scaphotrapeziotrapezoid arthrodesis

STT arthrodesis is an option to treat isolated STT arthritis and sequel of Kienbock's disease (Figure 5). Better postoperative range of movement is achieved if a radial styloidectomy is also performed. It is important to achieve normal dimensions of the STT joint with the use of adequate bone graft harvested from distal radius.^{47,48}

A range of movement of 60–70% of normal is achieved postoperatively. A non-union rate has been reported as 13%. Radioscaphoid arthritis develops in 23% of patients, likely due to altered wrist biomechanics.^{20,49}

Excision of distal end of scaphoid is another option for isolated STT arthritis. However it should be avoided in the presence of pre-existing carpal instability and only a small amount should be excised to prevent the risk of secondary DISI deformity.⁵⁰

Surgical treatment options for generalized wrist arthritis

Total wrist arthrodesis

Ely performed the first reported case of a wrist arthrodesis in 1910, using an anterior tibial graft that was sutured into place, on a wrist afflicted with tuberculosis.⁵¹ Total wrist fusion has since become a standard surgical treatment for young active patients with severe generalized wrist arthritis. It provides pain relief and a stable base for heavy manual work. To achieve optimal function, the wrist should be fused in 10–15° of extension and slight ulnar deviation. The middle finger carpometacarpal joint needs special attention at the time of surgery as this is a potential site of non union which can subsequently lead to screw loosening. With the use of precontoured dorsal wrist plate, fusion rates of 95–100% have been achieved. It provides effective pain relief (VAS at 2), restores good strength (80–90%) and often allows return to heavy manual work.^{52,53}

Though most patients are satisfied with the overall functional outcome, however they find difficulties with completing certain activities such as perineal care and manipulating the hand in tight spaces where they cannot compensate the lack of wrist movements with shoulder and elbow movements. In cases where bilateral wrist fusion is required, the non dominant hand should

be placed in 5–10° of flexion to better assist in such activities as perineal care.⁵⁴

Total wrist replacement

TWR is a motion preserving alternative to total wrist fusion in lower demand patients with generalized wrist arthritis. It is a particularly good option for patients who have had wrist fusion on one side.⁵⁵

The implant designs have evolved significantly, since the first generation Swanson silastic implants, to address the issues of osteolysis, implant fractures, early loosening and instability. The currently used fourth generation implants are mainly uncemented; they have porous surfaces to enable osteointegration and use ultra-high-molecular-weight polyethylene (UHMWPE) articular interfaces to provide better range of motion and reduce torque. There is also emphasis on bone preservation to achieve better fixation, reduce the chances of instability and preserve the bone stock for possible revision procedures.^{56,57}

TWR maintains about 60° arc of flexion and extension and predictably provides pain relief and improvement of function.⁵⁶ However patients must be counselled about permanent activity restrictions after TWR, particularly avoidance of impact loading of the wrist and infrequent lifting of objects heavier than 10 lb (4.5 kg). This makes the procedure less suitable for young physically active patients.

The survival rate for third-generation implants at 10 years is 78%, whereas that for fourth-generation implants at 4 years is 96% for patient with rheumatoid arthritis and 92% for other indications.⁵⁸ Implant loosening especially on the carpal side remains the most common mode of failure and indication for revision. Complication rates for the fourth-generation implants range from 6% to 47% and include wound-healing issues, infection, tendon damage, stiffness requiring manipulation, dislocations and periprosthetic fractures.^{56,59}

Overall the fourth-generation TWR implants are looking promising in terms of implant survival and functional results however the results are currently only medium term.

Surgical treatment of finger osteoarthritis

Pain is the only real indication for operative treatment of finger osteoarthritis. It is not recommended to operate for deformity alone when the finger function is preserved and there is no significant associated pain. In general, arthroplasty is recommended for metacarpophalangeal joints (MCPJ) and proximal interphalangeal joints (PIPJ) to maintain mobility except for the PIPJ of the index finger where a stable joint is required for a strong pinch grip (where arthrodesis is often recommended). Distal interphalangeal joint (DIPJ) arthritis is commonly treated with arthrodesis.⁶⁰

Arthroplasty

The implant choices used currently for MCPJ and PIPJ arthroplasty range from the constrained silicone (e.g. Swanson) arthroplasty to the unlinked minimally constrained pyrolytic carbon implants (e.g. Ascension PIP PyroCarbon Total Joint) (Ascension Orthopaedics, Inc., Austin, TX).⁶¹

Historically, the hinged metal implants developed by Brannon and Klein in 1950s showed early encouraging results however

late follow-up studies demonstrated problems with implant loosening, bone erosion and implant fractures.

The silicone arthroplasty in the current benchmark for MCPJ and PIPJ arthroplasty as they provide reproducible results with regards to pain relief and improvement of function. Their complications include subsidence, bone overgrowth, bone resorption and implant fracture.

The minimally constrained metal, PIP-SRA (Surface Replacement Arthroplasty) (Small Bone Innovations, Inc., Morrisville, PA) and pyrocarbon, that is, The Ascension PIP PyroCarbon Total Joint (Ascension Orthopaedics, Inc., Austin, TX) have more physiological articulation, reducing stresses at the implant–bone interface and allow better motion and function. However they can only be used in joints with intact ligaments and tendons and no advanced angular deformity.

Arthrodesis

Arthrodesis involves fusion of finger joints in functional position and is an effective way of treating arthritic finger joints with associated gross instability. It is commonly used for DIPJs of all digits and the PIPJ of the index finger—index finger needing more stability for pinch grip. The DIPJs are fused in slight flexion and PIPJs in increasing degrees of flexion from 20–25° at index to 40–45° at little finger. With the exception of thumbs, where stability is paramount, fusion of MCPJs tends to be avoided as it results in significant limitation of hand function. Fusion of PIPJs can also limit function of the digit by up to 50% so the suitability of alternative option, that is, arthroplasty should be considered in middle, ring and little finger PIPJs before contemplating on arthrodesis and patients should be functionally assessed and counselled accordingly. Screw and tension band wire fixation are the commonly used methods for arthrodesis. k-wires, plates and memory staples are other alternatives used by some surgeons.⁶¹ ◆

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