Current Status of Metacarpophalangeal Joint Arthroplasty

Prakash P Kotwal MS, FAMS, FIMSA*, Manish Kumar Varshney MS, DNB, MNAMS, MRCS**

*Professor and Head,  
Department of Orthopaedics, AIIMS, New Delhi.

**Assistant Professor,  
Department of Orthopaedics, LHMC, New Delhi

ABSTRACT

Metacarpophalangeal (MCP) joint arthroplasty is commonly performed for rheumatoid affection of hand. Functional realignment of joint and deformity correction is the principal gain; improving the outcome. Improved understanding of anatomy, pathophysiology and mechanics of MCP joint has provided better insights for patient evaluation and surgical techniques for arthroplasty. Even with high rates of implant failure in long term the clinical impact remains minimal. MCP arthroplasty done for proper indications and with adequate soft tissue reconstruction has a high rate of patient satisfaction.

Keywords: Rheumatoid Arthritis, Metacarpophalangeal joint, Arthroplasty.

INTRODUCTION

Effective surgical treatment of hand deformities in rheumatoid arthritis (RA) can improve patient function and restore independence. A common type of debilitating hand deformity in the rheumatoid hand is ulnar deviation (Figure 1) and volar subluxation of the fingers at the metacarpophalangeal (MCP) joints1. This prevents RA patients from opening their hands to hold objects or to pick up utensils for eating, resulting in a considerable handicap. Cartilage erosion additionally causes chronic pain further hindering hand performance. MCP joint is the commonest involved joint in rheumatoid affection of hand & is particularly crippling leading to functional limitations for the patient 1,2. Instability and pain diminishes hand function so much that surgical reconstruction is often attempted.

Hand function is a predictor of independence in those with rheumatoid arthritis 3 and some 25% surgeries are performed on hand. Even with the availability of advanced pharmaceutical interventions the need for surgery has not diminished4. In most cases the deteriorated MCP joint is removed and replaced by prosthesis. There are a number of designs available mainly providing flexion and extension at MCP joint5. They also aim to reduce pain, by removing the diseased MCP joint and surrounding soft tissues, and to increase stability of the joint so that the patient's own muscles can act naturally upon aligned fingers. Controversy exists between hand surgeons and rheumatologists about the effectiveness of arthroplasty in improving hand function for RA patients with MCP joint disease6,7. Due to delayed referral from rheumatologists, hand surgeons often have a feeling of "too little, too late" as MCP reconstruction is generally
considered to have poor results in late cases. A review is hence essential to evaluate the various advances in our understanding that can be utilized to improve the outcome of MCP arthroplasty.

Anatomical considerations

The MCP joint is very complex and exhibits irregular topological contours with limited symmetry in both the transverse and coronal planes. It appears to be a global joint with three degrees of freedom however it behaves as a universal joint with two degrees of freedom due to restraint of collateral ligaments. There is a change in joint congruence and soft tissue alignment with varying angular position of the joint. The radial condyle of metacarpal head is larger compared to the ulnar condyle and the volar surface is longer than its dorsal surface. These features leads to ulnar slope of MCP joint and a cam effect with tightening of collateral ligaments in MCP flexion. The ulnar sagittal bands are stronger than radial sagittal bands. The ulnar collateral ligament is more nearly parallel with the longitudinal axis of the finger than is the radial collateral ligament which is more oblique. The reconstructed joint is non-anatomic and non-physiologic acting as mere a spacer providing improved alignment. Excision of the MCP joint removes the articular surfaces, investing musculotendinous units and capsuloligamentous structures which are essential for maintaining stability of the joint. Also forces across the normal joint are transmitted by the collateral ligaments to cortical surfaces while across the reconstructed joint forces are directed to endosteal surfaces. Mobility of MCP joint is dependent on tendon and ligament balance which is adversely affected by the underlying disease process and hence the reconstructed joint has reduced mobility. Optimal prosthetic alignment and soft tissue balancing is hence markedly important. The centre of rotation shifts volarly during MCP flexion and there is a combined sliding and rolling movement during range of motion (ROM). This makes it important for accurate placement of the physiological centre of rotation of a prosthetic joint by accurate placement of offset of articular component relative to stem and stem placement in the canal and prosthetic sizing. The prevalent hinge design has the problem of reciprocal displacement adversely changing the moment arm. This produces excessive stress at the implant and consequential failure.

Pathoanatomy

A number of factors have been implicated in the development of ulnar deviation of MCP joint that should be borne in mind for deformity correction:

1. Larger radial condyle
2. Contracture of interossei
3. Attenuation of sagittal radial band
5. Volar subluxation / rupture of extensor mechanism
6. Carpal collapse à radial deviation at wrist à Compensatory ulnar drift
7. Ulnar & volar displacement of flexor sheath

Of these the first two factors require release while third, fourth and fifth should be addressed by soft-tissue balancing and/or reconstruction. Radial deviation of wrist should be looked during preoperative planning and better corrected before operating the MCP joint. Flexor sheath displacement is difficult to correct by surgery and is passively addressed by realigned fingers however a poorly performed surgery would decrease the chances of long-term maintenance of correction.

Surgical considerations

Patient should be critically assessed for reconstructive surgery. Rheumatoid arthritis is a systemic disease hence a complete assessment is required especially cervical spine stability (for preanesthetic work-up). MCP arthroplasty is generally indicated for painful deformity with destruction of joint and fixed deformity that cannot be corrected with soft-tissue reconstruction alone. Specifically joint affection with d” 40° arc of motion and or marked flexion contractures along with significant ulnar drift >30° or joint in poor functional position should be reconstructed. There should be documented radiographic abnormality. MCP replacement is contraindicated in presence of vasculitis, poor skin condition or inadequate bone stock in patients with advanced bone destruction. Appropriate timing of surgery consisting the multiple joint involvement deserves priority assessment for acceptable outcome. For optimum functionality of hand reconstruction of lower extremity and proximal upper extremity procedures should be done before hand surgery. Common axiom for surgery is to start proximally and work distally alternating fusion with motion sparing procedures. Radial deviation at wrist should be specifically assessed as progression and recurrence of ulnar deviation at MCP joint is closely related. Distal radio-ulnar joint instability should be addressed to prevent attritional rupture of extensor apparatus. Proximal interphalangeal (PIP) joint deformity may be addressed either simultaneously or sequentially. PIP reconstruction with either tendon...
reconstruction or arthrodesis is commonly required for good functional outcome. MCP and PIP arthroplasty together is not preferable. Extensor tendon rupture should be repaired with adequate synovectomy 6-8 weeks before MCP arthroplasty as the assessment of adequate tension may not be possible during MCP replacement.

**Surgical technique**

Dorsal transverse incision is made preserving veins to minimize finger swelling. Ulnar hood of extensor apparatus is preferably preserved to expose the MCP joint and radial aspect is incised and later reconstructed. The collateral ligaments are attached to cortical bone by predrilling holes (for patent radial ligaments) or else reconstruction of incompetent ligaments is required. Contracted ulnar intrinsic muscles are released preserving flexor digiti minimi brevis for flexion and 1st palmar interosseous for key pinch. Bone resection is done just distal to origin of collateral ligaments trimming any synovial proliferation. Index finger proximal phalanx (PP) should be reamed in slight supination for better tip pinch while the small finger PP should be reamed in pronation for better grip strength. If adequate space is not available for implant insertion then resect the proximal phalanx at epibasal level. Reconstruct and tension the radial ligament complex before inserting the prosthesis and imbricate radial extensor expansion. Implant should be placed with no-touch technique as scratch may lead to later propagation of surface defects (silicone implants are prone) and early failure.

A capsule forms around the implant during healing phase when positioning and controlled motion of the joint is crucial for ongoing stability and motion. A number of approaches to post-operative healing are practiced but most involve stabilizing the wrist whilst allowing guided flexion and assisted extension of the MCP joints from 1st week onwards. The two most common regimes use (1) static splints which have no moving parts, with the MCP joints in extension alternating between extension and flexion, removed for active range of motion exercises, (2) dynamic MCP extension splinting (Figure 2), which hold the MCP joints suspended in extension with the use of rubber bands, where the patient performs extension and flexion exercises in the splint. Both the regimes are effective in providing the desired stability and movement at reconstructed MCP joint and no superiority has been demonstrated.

**Outcome analysis**

It has been consistently demonstrated that MCP replacement has good acceptability among patients with improved function in properly selected patients. The main aims for surgery are correction of ulnar drift, pain relief, improved extension arc and improved grip strength. The most consistent benefit is correction of ulnar deviation (Figure 3 a & b) with improvement in functionality (Figure 3c) with realignment. However over long term the benefit slowly disappears and some recurrence is usually observed. Goldfarb et al reported that at long term follow up 67% of the implants are broken and there is an average ulnar drift of 10° in patients with intact implant and 20° in patients with broken implant. Recurrent ulnar drift was seen in 43% patients (<10°) while >30° was seen in <10% patients. This is mostly due to failure of implant over time and ongoing disease process with continued destruction of the stabilizing factors. Also there is a loss of motion at reconstructed MCP joint over time from the immediate gain in post-operative movements.

This is also related to recurrence of deformity. Despite

---

Fig. 2: Dynamic splint used for post-operative mobilization.

Fig. 3a: Post-operative correction obtained for a rheumatoid hand with bilateral affection. Fig. 3b: Radiological correction showing good alignment at MCP joint with implant in situ.
these the pain relief that is consistently seen post-operatively is sustained over time and hence the patient satisfaction rates are high even in long term\textsuperscript{13,7,9,12,16}. High rates of implant failure at long term follow-up do not seem to have any relation to patient satisfaction\textsuperscript{9}. Manipulation under anesthesia for improving range of movement has been associated with high rates of implant failure. Addition of metallic titanium grommets at stem condyle junction does not reduce the failure rates.

Large ulnar and volar drift in pre-operative period were postulated to have poor outcomes so surgeons seem to be reluctant in operating patients at advanced degeneration or at least have a pessimistic view with guarded prognosis often take as a support; on the contrary rheumatologist feel that surgery does not benefit until the deformity is sufficiently large. Recently it has been demonstrated that there is no difference in outcome in patients with large early deformities compared to lesser affections of the MCP joint in rheumatoid arthritis. However there is also support to the general view of surgeons that earlier surgery is beneficial before structural deterioration makes it more difficult to realign the fingers and restore functional anatomy.

Most surgeons have found insignificant improvement in the range of motion at replaced MCP joint; however the range of motion shifts to a more extended range considered to be more functional for hand function. The MCP joint requires an average of $61^\circ$ arc of motion to perform 11 different activities of daily living and an average of $72^\circ$ arc of motion to perform power grip\textsuperscript{18}. Insufficient active flexion in the MCP joint of the little finger is of concern following replacement when compared to the other digits as this result in a “reverse cascade” appearance of the hand with flexion diminishing from the radial to ulnar digits rather increasing as in the normal hand. The causes include extended position of the silicone implant and inadvertent release of flexor digiti minimi brevis which should be preserved\textsuperscript{16}.

**SUMMARY**

MCP arthroplasty is an acceptable procedure for reconstruction of rheumatoid hand and has high patient satisfaction rates. Physicians should inform patients that surgical results may not be maintained in the long term but patients should be given the choice as to whether the large improvements seen in the short term justify undergoing this procedure. Subjective outcomes are fair though objective outcomes (metacarpophalangeal joint motion and ulnar drift) worsen. Implant fracture, bone-shortening, and osseous erosions are common. Despite this decline in the results after long-term follow-up, we continue to utilize silicone implants for MCP arthroplasty in patients with rheumatoid arthritis because the implants provide acceptable benefit to patient and no better implants are currently available.

**REFERENCES**


