Postoperative Therapy after Metacarpophalangeal Arthroplasty

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ABSTRACT: A literature review was conducted to determine the most effective postoperative therapy regimens for metacarpophalangeal (MCP) arthroplasty. The main difference between the regimens was the use of passive MCP extension over active extension and splinting in MCP flexion over splinting in extension. One study did not find continuous passive motion to be significantly beneficial for gaining hand strength or MCP motion. No study evaluated the efficacy or suitability of a particular regimen for specific implants or surgical procedures.
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Since the first metacarpophalangeal (MCP) implant arthroplasties in the 1950s,[1] more resurfacing arthroplasties and excisional arthroplasties have become available. Of the excisional arthroplasties, one-piece and two-piece hinge designs, constrained by screws or unconstrained, cemented and noncemented, have been designed.[1] The original one-piece silicone implants have an extended resting position, whereas the more recent designs allow the MCP joint to rest in slight flexion.[1] More than 60 studies have been published about the procedure, from case series and case studies to comparative studies and randomized, controlled trials.

A number of prosthesis designs[2] that allow flexion and extension of the MCP joint are available. At the time of implantation, synovectomy and soft-tissue balancing procedures are often performed to increase lateral joint stability or enhance the biomechanical advantage of the tendons around the MCP joint. These procedures include release of the tendons of abductor digiti minimi and flexor digiti minimi,[3] reconstruction of the radial collateral ligaments,[4] centralization of the extensor digitorum tendon, and transfer of the intrinsic insertions so that they provide radial pull.[5] Six comparative studies evaluated the efficacy of various soft-tissue rebalancing procedures.

The efficacy of postoperative therapy regimens also requires research. Joint stability and hand function are the primary goals of therapy, [6] and regimens include resting the hand, range-of-motion exercises, and a progressive return to activity while incorporating joint protection principles. Despite these common goals and methods, there are wide differences in the splinting, exercises, and time frames between the published regimens. The aim of this review is to determine which postoperative regimen is most effective in achieving these goals, and if any particular regimen is best suited to a specific implant or soft-tissue balancing procedure at the time of surgery.

METHOD

For inclusion in this review, studies had to evaluate the efficacy of a post-MCP arthroplasty regimen for patients who had MCP arthroplasty with one or more implants to the digits but not the thumb. All study designs were accepted but expert opinion papers were excluded. Patients may have received any type of implant and soft-tissue procedure at the time of surgery.

Electronic databases searched were the Cochrane Musculoskeletal Disease Group Register, PedRO, Medline, CINAHL, EMBASE, Dissertations Abstracts, EBM, DARE, Current Contents, and AMED. No time or language limits were imposed.

Studies were appraised as described by the Cochrane Collaboration[7] for sources of methodologic bias that decrease the internal validity of a study. If the study could not be fully appraised from the publication, information was sought by writing to the authors.

RESULTS

Sixty-four studies that described the results of MCP arthroplasty were identified. The history of the studies and their design is illustrated in Figure 1. Of these studies, one randomized, controlled trial, two case series, and two case studies were accepted for this review. Although the remaining 59 studies described outcomes for MCP arthroplasty, they were not focused on the postoperative regimen.

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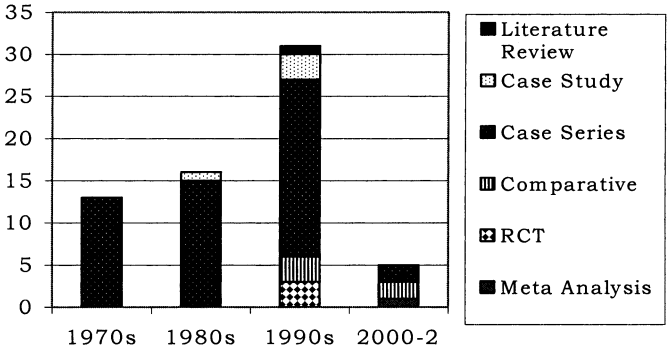

FIGURE 1. *The history of metacarpophalangeal arthroplasty study design. RCT, randomized controlled trial.*

All of the patients in the accepted studies had rheumatoid arthritis; both genders were represented and patients were in their third to seventh decade.

One outcome common of nearly all postoperative patients in every study was the relief of pain once the diseased joint had been removed by surgery. Negative outcomes such as prolonged swelling or implant loosening were not reported.

Features common to all regimens (Table 1) were postoperative avoidance of any hand activity for the first four to six weeks and long-term avoidance of ulnar forces on the fingers. All regimens began between the second and seventh postoperative day.

Regimens could be divided into two main categories with regard to splinting and exercise. Static splint regimens involved removal of the splint for active MCP range-of-motion exercises, and dynamic splint regimens involved active-assisted MCP extension and active MCP flexion exercises within the splint (Table 1).

DISCUSSION

Five studies described the outcome of different postoperative therapy regimes for MCP arthroplasty. Two of these studies compared the efficacy of one regimen over another, one of these being prospective.

Hand therapy for other conditions such as flexor tendon repair also offers multiple postoperative regimens. For example, healing tendons of the hand usually receive motion, but it may be passive, active, or a combination of all of these.[8] The rationale for the various exercise regimens is based on biological healing of the tendon and the strength of the surgical repair, thus its ability to withstand stress without rupturing or forming a gap.[9] These patients usually have normal and similar anatomy preoperatively, leaving few patient variables.

Postoperative therapy regimens for MCP arthroplasty are also based on principles of healing and scar formation,[6] but are not prescribed according to the patient's preoperative hand impairment, the type of implant used, or soft tissue balancing procedures performed. For example, patients having undergone extensor tendon rebalancing and recentralization may benefit from avoidance of passive flexion or avoidance of the extremes of flexion, much like a postoperative extensor tendon repair may be treated. The literature suggests that postoperative therapy for MCP arthroplasty has not been prescribed in this manner; rather, each protocol has been carefully designed and applied to consecutive patients.

To compare the efficacy of a new protocol, many patients would be required for allocation to various postoperative therapy groups. Their outcomes would have to be analyzed according to what protocol they received with the implant, surgery, and preoperative status as variables. The first difficulty in forming control or comparison groups lies in the infrequency of this procedure. Ring et al.[10] took three years to include 25 hands in their study, Pereira and Belcher,[5] took three years for 43 hands and Vahvanen and Viljakka[11] took nine years for 37 hands.

The most common source of bias in the studies was selection bias, which occurs when patients are chosen for treatment or control groups as a result of characteristics that are expected to affect their outcome. Randomization is designed to control the confounding effects of differences between subjects at baseline,[12] and the randomized trial is recommended as the best method of determining treatment efficacy. Here lies the second difficulty in forming control or comparison groups. Patients undergo MCP arthroplasty at all stages of their disease, evidenced by the wide range of motion deficits between the studies of Burr and Pratt,[13] in which the case study patient had nearly normal preoperative MCP motion, and Burr et al.,[14] in which some patients had only 25° of MCP flexion. Measures of pain also varied widely in the latter study, ranging from "zero" to "eight out of ten." These baseline measurements demonstrate the difficulty in obtaining a homogeneous, comparable group of patients with rheumatoid arthritis.

The other three sources of bias described by the Cochrane Collaboration were present in the reviewed studies. Performance bias occurs when patients receive a variation in duration, quality, or quantity of the treatment being studied, which was suspected in the continuous passive motion (CPM) study by Ring et al.[10] Ring et al. describe the application of CPM in detail, except passive forces are described as "low" and treatment quantity is described as "as tolerated." As a result, the reader remains unsure of what amount of passive force is ineffective, as well as what quantity of treatment per day is ineffective.

Detection bias is determined if the timing of assessment, the outcome assessment used, or knowledge of the assessor of the patient's previous state could miss any relevant aspect of the outcome. This may have occurred in the study by Groth et al.,[15] in which some preoperative data were unavailable and

TABLE 1. **Summary of Postoperative Therapy Regimens for Metacarpophalangeal (MCP) Arthroplasty**

Regimen	*Burr et al.*[14]	*Burr and Pratt*[13]	*Ring et al.*[10]	*Groth et al.*[15]	*Gribben et al.*[17]
Design	Case series (n = 15)	Case study (n = 1)	RCT (n = 25)	Retrospective case series (n = 34 patients, 46 hands)	Case study (n = 1)
Started	Day 5–7	Day 5	Day 2–7	Not known	Day 4
Implant	Swanson prostheses	Swanson prostheses	"Silicone arthroplasty"	Not known	Steffee prostheses
Day splint	Two static splints, alternated 24 hourly, with MCP at 0° in one splint and at 60 in the other for 4/52; biofeedback to finger flexors and extensors at 3/52		Dynamic MCP extension splint with RD, 6/52*	Dynamic MCP flexion splint	Dynamic MCP extension and flexion splint, 10/52
Night splint	As above		MCP 0° for 12/52	MCP 20–30° flexion.	Static splint, MCP 0°
Active exercise	Wrist, MCP, and IP ROM, RD ×10 every hour for 4/52	MCP and IP ROM, radial deviation ×10 every hour for the first 4 weeks	MCP and IP ROM ×10 every 2 hours in splint; RD at 4/52	Not known	MCP and IP ROM × 4 daily in splint
Passive exercise		IP ROM , RD ×10 hourly, MCP flexion at 4/52	IP ROM, treatment group received MCP CPM	Not known	MCP and IP ROM
Activity	"Light activity" at 4/52, "normal activities of daily living" at 8/52; return to work 12/52; no function for 4/52, no heavy lifting until 12/52		No pinch for 12/52	Not known	Return to work 10/52; avoid forceful grasps and traction on fingers
Outcome	X MCP flexion unchanged; improvements in pain, MCP extension, and power grip	0–15° MCP extension and 60–70° MCP flexion at 8/52	CPM group did not achieve significant increases in ROM or strength at 5/12‡	Treatment group had significantly more MCP flexion than cohort, but similar MCP extension	Patient had 10° less MCP flexion 5 months post, but reduced pain and paresthsias
Bias	Patient selection, detection of all outcomes	Detection of all outcomes (preoperative data not available)	Patient selection, performance of treatment equally between patients	Patient selection, detection of all outcomes	Patient selection

*For 6/52 = six weeks.
†3/24 = three times daily.
‡5/12 = 5 months.
IP, interphalangeal joints; RD, radial deviation; RCT, randomized controlled trial; ROM, range of motion.

patients were assessed at different postoperative time frames. Detection and comparison of outcomes between studies are only possible when the same outcome measures are used in a standardized manner. The researchers in this review all measured range of motion, but at different time frames (Table 1). Those who measured pain, cosmesis, and function applied different assessments at different time frames. The challenge of outcome measurement in rheumatology has led to the formation of focus groups such as OMERACT (Outcome Measures in Rheumatoid Arthritis Clinical Trials), who have made recommendations for outcome measures to be used in drug trials.[16] OMERACT recommendations are not fully relevant to hand therapy research; however, the process of forming a focus group, and the development of assessment guidelines that allow comparison between homogeneous patients, is possible.

Attrition bias is determined if the loss of patients in the study is significant or varies between the treatment and control groups. This is common in long-term studies involving patients with rheumatoid arthritis, and was experienced by Groth et al.,[15] who were unable to obtain long-term follow-up of the patient group who received their extension protocol. Long-term follow-up is an issue with rheumatoid populations. These patients undergo numerous surgical and drug interventions, while their disease progresses and fluctuates, making the long-term effects of the MCP surgery and therapy difficult to define. Once more, large numbers of patients in each treatment group would be required to decrease the effects of attrition bias and to dilute the effects of subsequent interventions.

The difficulties of past studies guide the planning of future studies. Although the issues of low patient numbers, variable preoperative status, additional surgical and drug interventions, and chronic disease cannot be altered, study designs can. Large randomized trials may not be possible; however, samples of patients, paired according to preoperative status, may be allocated to different treatment protocols. Standardized measurement of pain, cosmesis, impairment, disability, and impact on the patient, made at similar postoperative time frames, would further assist in determining treatment efficacy. Future research by the author endeavors to determine the most relevant outcome measures and time frames for post-MCP arthroplasty patients.

CONCLUSION

This review suggests that all regimens contribute toward an increase in MCP motion and an increase in hand function, but despite the efforts of patients and clinicians, hand therapists remain unaware of the most effective postoperative protocol for MCP arthroplasty or the suitability of each regimen for specific implants and soft-tissue procedures. Difficulties in researching this topic include low patient numbers, highly variable preoperative status, lack of guidelines for outcome measures and time frames, and the effects of subsequent interventions received by the patient. The nature and size of the population with rheumatoid arthritis and MCP arthroplasty do not readily fit the randomized, controlled trial design. Paired sample designs are suggested, as well as the formation of standard outcome measures, for better comparison of results between patients.

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