Silicone-Rubber Implant Arthroplasty of the Metacarpophalangeal Joints for Rheumatoid Arthritis

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ABSTRACT: Forty-six patients with rheumatoid arthritis underwent metacarpophalangeal-joint arthroplasty of the index through little fingers on 210 joints in fifty-five hands using the Swanson-design silicone-rubber spacer. The patients were followed for two to eight years (average, five and one-quarter years). They were evaluated both preoperatively and postoperatively for range of motion, deformity, subjective sense, grip strength, and prehension.

In the initial postoperative evaluation, the majority of patients expressed a strong subjective impression of improvement. Ulnar drift improved from the preoperative average of 25 degrees to less than 5 degrees. The preoperative average extension deficit decreased from 56 to 10 degrees, while the average range of motion increased from 17 to 51 degrees. In the long-term postoperative evaluation, the average ulnar drift had increased to 12 degrees, the average extension deficit had increased to 22 degrees, and the average range of motion had decreased to 39 degrees. Grip strength and prehension did not significantly improve at either evaluation. There were no fractures of the prosthesis and no patient had synovitis. We have found the procedure to be useful for the correction of deformity, increasing range of motion of the fingers, and improving the patient’s sense of well-being.

The metacarpophalangeal joints are those most frequently involved in patients with rheumatoid arthritis. Surgical treatment of these joints has included resection arthroplasty, synovectomy, soft-tissue releases, and joint replacement with a variety of prostheses. Although a number of new prostheses are in the trial stage, the Swanson-design silicone-rubber spacer (Dow Corning; Midland, Michigan) remains widely used.

The rationale of the Swanson design depends on the development of a supporting fibrous capsule to balance the implant after joint resection. The initial stability of the system is most dependent on the ligamentous and intrinsic and extrinsic musculotendinous systems. Both alignment and motion of the joint must be maintained postoperatively while the supporting capsule develops. Dynamic splinting and carefully supervised therapy have long been thought to be essential components of a successful procedure.

Recurrence of the deformity over time and fracture of the prostheses have been concerns. To maintain the balance of motion and stability in the metacarpophalangeal joint also requires stability and alignment in the other joints of the fingers and wrist. The involvement of adjacent joints and tendon forces that were responsible for the initial deformity may nullify the benefits of surgery. Collapse of the wrist, with its associated radial deviation of the metacarpals, leads to ulnar drift of the digits, as does the ulnar dislocation of extensor tendons after destruction of the capsules of the metacarpophalangeal joints. The palmar force of the flexor tendons on the attenuated capsular structures encourages volar subluxation of the metacarpophalangeal joint, and intrinsic-muscle contracture may also contribute to the deformity. The current design of the prosthesis uses a stronger form of silicone rubber that has been reported to be more resistant to fracture.

Materials and Methods

From March 1975 through December 1982, 210 metacarpophalangeal arthroplasties were performed on fifty-five hands in forty-six patients. The preoperative diagnosis was rheumatoid arthritis in forty-three patients; Sjögren’s syndrome in two patients; and a combination of rheumatoid arthritis, Sjögren’s syndrome, and amyotonic dystrophy in one patient. The patients’ ages ranged from nineteen to eighty-six years (mean, fifty-three years). Forty-four of the patients were women. The duration of the disease ranged from two to thirty-five years (average, fourteen years). Twenty-seven of the patients were steroid-dependent at the time of surgery, and thirty-five took steroids during some part of their postoperative course. Twenty-seven patients had either prior or subsequent arthroplasty of other finger joints or the wrist.

The patients were followed for two to eight years (average, five years and three months). For the purposes of this study, the initial postoperative evaluation was performed three to four months after surgery and the final postoperative evaluation was done two to eight years after the operation. Radiographs of the hands were made for all patients at each of the three evaluations. The procedure was performed on four fingers in fifty hands, three fingers in

* This article was accepted for publication prior to July 1, 1985. No conflict-of-interest statement was requested from the authors.
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two hands, two fingers in one hand, and one finger in two hands. Four patients died from unrelated causes during the course of this study.

The indications for surgery were fixed or stiff metacarpophalangeal joints, radiographic evidence of joint destruction, subluxation or dislocation of the joint, ulnar drift that was not correctable by soft-tissue procedures, and extrinsic or intrinsic contractures. All of the patients had either subluxation or dislocation of the metacarpophalangeal joints at the time of surgery. Swanson-design H.P. Silastic (second-generation medical-grade high-performance silicone elastomer) finger joints were used in all patients.

Postoperative management consisted of wearing a volar and dorsal plaster splint for an average of four days, followed by a dynamic outrigger Orthoplast splint for six to eight weeks. Daily therapy sessions were carried out under the supervision of an occupational therapist for the first postoperative week. These were followed by biweekly sessions until use of the splint was discontinued. All patients were familiarized with joint-protection techniques to avoid excessive ulnar-deviation forces.

Measurements of grip strength and range of motion were obtained for all patients preoperatively, during the initial postoperative evaluation at three to four months after surgery, and at the final postoperative evaluation two to eight years after surgery. Measurements of the range of motion represent active motion. Passive motion was not recorded. Grip strength was tested with a Jamar dynamometer on the number-two setting. Prehension (grasping) was tested for fingertip pinch and key pinch (thumb against the radial side of the index proximal phalanx). The patients were asked to evaluate pain, discomfort, function, and appearance (subjective impression) on a scale from zero to five, with five being a normal hand and zero representing a non-functional, painful, and disfigured hand.

Surgical Technique

The surgical technique has been well described previously. In summary, a transverse skin incision is made over the dorsum of the metacarpophalangeal joints, taking care to preserve the dorsal veins of the hand. Access to the joint is obtained by incising the dorsal hood along the radial border of the extensor hood. The ulnar intrinsic tendon is then identified and is incised at the level of the metacarpophalangeal joint for the index, long, and ring fingers. The abductor digiti minimi is also incised.

After resection of the bone and placement of the appropriate prostheses, the radial collateral ligaments are attached, through drill-holes, to the metacarpal shafts of all fingers. Occasionally a reconstruction of the radial collateral ligament had to be performed using a distally based half of the palmar plate. The capsules are then reconstructed, and the extensor tendons are relocated and reeved on the radial side using a horizontal mattress technique with a non-absorbable suture. Regional anesthetic technique was used in operating on forty-two hands and general anesthesia, for the remaining thirteen hands.

Results

Preoperative ulnar drift of the digits (Table 1) ranged from 15 to 45 degrees (average, 25 degrees). There was complete correction of the subluxation or dislocation and almost complete correction of the ulnar drift of the metacarpophalangeal joints (to less than 5 degrees) at the initial postoperative evaluation. However, at final evaluation, twenty-two digits (10 per cent) demonstrated recurrent subluxation, radial deviation (average, 29 degrees) had developed in two digits, and all of the digits had some recurrence of ulnar deviation (average, 12 degrees) (Table 1).

Most of the digits had some loss of extension preoperatively (Table 1), ranging from no loss to 85 degrees (average, 56 degrees) (Fig. 1). The initial postoperative extension deficit averaged 10 degrees (range, 8 to 55 degrees). At the final postoperative evaluation, the average extension deficit (Table 1) had increased to 22 degrees.

The range of flexion of the fingers improved moderately. The preoperative average was 17 degrees (range, zero to 65 degrees), while in the initial postoperative period the average was 51 degrees (range, 30 to 80 degrees) (Fig. 2). The late postoperative evaluation showed an average of 39 degrees. The decrease in flexion between the initial and the final postoperative evaluation is shown in Table 1.

The patients' subjective impression of improvement, rated on a scale from zero to five, improved from the preoperative average of 1.7 to the initial and final postoperative average of 3.9. Pain was listed as a concern on less than 20 per cent of the preoperative evaluations and therefore was thought to contribute only slightly to the improved subjective impression. In contrast, deformity was a preoperative concern for thirty-four patients (74 per cent), and the correction of deformity was considered to be a major cause for the improvement in the sense of well-being.

Despite this positive subjective improvement, there was no significant postoperative change in either grip strength or prehension skills in the twenty-four patients who were so tested.

<table>
<thead>
<tr>
<th></th>
<th>Average (Degrees)</th>
<th>Range (Degrees)</th>
<th>Average by Digit (Degrees)</th>
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<tbody>
<tr>
<td></td>
<td>II</td>
<td>III</td>
<td>IV</td>
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<tr>
<td>Ulnar drift</td>
<td>25</td>
<td>15-45</td>
<td>21</td>
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<tr>
<td>Preop.</td>
<td>&lt;5</td>
<td>0-9</td>
<td>2</td>
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<tr>
<td>Initial postop.</td>
<td>12</td>
<td>5-18</td>
<td>7</td>
</tr>
<tr>
<td>Final postop.</td>
<td>12</td>
<td>5-18</td>
<td>7</td>
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<tr>
<td>Extension deficit</td>
<td>56</td>
<td>0-85</td>
<td>62</td>
</tr>
<tr>
<td>Preop.</td>
<td>10</td>
<td>8-55</td>
<td>6</td>
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<tr>
<td>Initial postop.</td>
<td>22</td>
<td>0-31</td>
<td>18</td>
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<tr>
<td>Flexion</td>
<td>17</td>
<td>0-65</td>
<td>20</td>
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<tr>
<td>Preop.</td>
<td>51</td>
<td>30-80</td>
<td>46</td>
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<tr>
<td>Initial postop.</td>
<td>39</td>
<td>26-72</td>
<td>41</td>
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The table shows the changes in average ulnar drift, extension deficit, and range of motion.
Average extension lag improved from the preoperative 56 degrees to the initial postoperative 10 degrees and the long-term postoperative 22 degrees.

To date, there have been no detectable fractures of the prostheses or any clinically apparent synovitis in the metacarpophalangeal joints that were operated on. Radiographs of the hands of all patients were made at final follow-up, and there was no evidence of cystic changes in the metacarpals or phalanges that were in contact with the prostheses.

Complications

Two patients had a superficial postoperative infection that resolved with wound care and antibiotics. It has not been necessary to revise any of the prostheses.

Discussion

Our findings support the general impression that the silicone-rubber metacarpophalangeal-joint arthroplasty of the second through the fifth digit is a successful method of treatment using the criteria of adequate range of motion, correction of deformity, improvement of stability, and increasing the patient’s subjective sense of well-being. Despite the decrease in measurable improvement over time, in general, the patients continued to feel that they had had a successful result.

Our evaluation differed somewhat from those in previous studies, in that we evaluated both the initial and the late postoperative results. The ranges of motion at the initial postoperative evaluation tended to be greater than has been previously reported by some investigators. Our late postoperative results were more in agreement, although others have reported a better range of motion.

Pain relief was less of a concern to our patients than...
it was to others who were previously evaluated, and appearance was a strong concern.

Most of our patients had diffuse, severe disease, as evidenced by the number who were steroid-dependent and the number of other arthroplasties of the hand and wrist that were done. The loss of correction and motion that occurred between the initial and late postoperative evaluations was highly variable and appeared to be related to the severity and progression of the disease process and the involvement of other joints of the upper extremity rather than a failure of the prosthesis.

In two series, fracture of the prosthesis was reported to occur in 0.88 per cent and 38 per cent of Silastic metacarpophalangeal arthroplasties. A fracture can be difficult to detect clinically or radiographically and repeated examinations may be required. Despite regular evaluation of all of our patients, we have not detected any prosthetic fractures. The absence of such fractures in our patients perhaps relates to their lower activity level because of the generalized disease process or to the fact that our patients received the high-performance Silastic prostheses and not the first-generation Swanson design.

References