SURGICAL TECHNIQUE

SR™ MCP Implant System
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Preoperative Assessment & Anatomy

Record the range of motion (ROM) for all the joints of the hand and wrist and other significant joints. Static deformities, grip strength and pinch strength should also be assessed and recorded.

X-ray examination includes AP, lateral and such special views as may be indicated initially at surgery and at follow-up intervals. Sizing templates with a 3% parallax enlargement are available. Follow-up examinations will include repetition of the above measurement as well as evaluation of positioning, alignment, cement mantle adequacy and evidence of loosening or stem erosion into bone.

Assessment of MCP palmar subluxation, ulnar drift, ulnar intrinsic contracture, extrinsic extensor tendon displacement, swan neck or boutonniere deformity, and flexor tendon displacement should be recorded.
**Incision Options**

Under tourniquet control and adequate anesthesia, incision is made. Two options are recommended (FIGURE 1):

A: a curved longitudinal incision is made over the dorsum of the metacarpophalangeal (MCP joint for single joint involvement),

B: or, through a transverse incision across the dorsum of the MCP with multiple joint involvement.

Dissection is carried down through the subcutaneous tissue to expose the extensor tendons. Retract skin proximally and distally from the incision, with care taken to avoid the dorsal veins passing between the metacarpal heads.

**Capular Exposure**

If the extensor tendon is well centralized, it is split down the central sulcus of the central tendon and both sides are reflected from the underlying capsule (FIGURE 2). In rheumatoid arthritis, the synovial protrusion may have caused the extensor tendon to ulnarily translate and obliterate the radial sagittal band. It is usually possible to dissect the sagittal bands from the capsule and preserve them so that the extensor can be relocated and the sagittal bands imbricated to maintain extensor position.

**Dorsal Synovectomy**

The capsule is then incised longitudinally to expose the joint (FIGURE 3). A dorsal synovectomy is performed. As necessary, collateral ligaments are preserved if the joint can be fully reduced. If not, it may be necessary to release one or both collateral ligaments partially or wholly from their tuberosital origins. The ends of the collateral ligaments should be tagged for later repair to their tuberosital origins.
4 **Metacarpal Articular Head Resection**

The metacarpal head is removed first by a vertical saw cut distal to the collateral ligaments. A second cut at 45° proximovolarly removes the remainder of the metacarpal head (**FIGURES 4A and 4B**). Ligamentous integrity is retained in so far as possible.

5 **Proximal Phalanx Articular Surface Resection**

Remove the base of the proximal phalanx with a minimal slice (**FIGURE 5**). This is to preserve the collateral ligamentous attachments in so far as possible. Marked contracture of the ulnar capsule may require detachment of the ulnar collateral ligament to assure alignment of the finger to the metacarpal.
Trial Preparation
An awl is then inserted in the dorsal aspect of the intramedullary canal of the metacarpal (FIGURE 6A). This is followed by sequential broaching until proper fit has been attained. For the index and long finger the intramedullary preparation is ulnarily displaced slightly (FIGURE 6B). This provides a better moment arm for the radial intrinsic and extrinsic tendons to compensate for the ulnar drift tendency. The same awl and broach procedure is then followed for the proximal phalanx (FIGURE 6C).
Trial Placement
An impactor with a concave surface aids insertion and optimal proximal displacement of the proximal trial component (FIGURE 7A). The tip of the prosthesis should pass the midpoint of the metacarpal. Avoid impaction with metallic instruments which may damage the articular surfaces of the trial components.

A convex impactor is also provided to aid insertion and seating of the distal component (FIGURE 7B). Once the trial components are inserted, check for fit and position, as well as position under the image intensifier.

Trial Reduction/Implant Preparation
The joint is reduced with both the metacarpal and phalangeal trials in place. Static position, ease of passive motion, plane of motion to full extension, and stability is checked. With multiple joints, comparison between finger alignment is checked with the trials in place. Revision trimming may be necessary to correct muscle or soft tissue tightness, and to insure a full range of motion.

If release of the collateral ligaments was previously required, two holes are drilled through the tuberosity at the dorsal lateral and dorsal medial aspect of the remaining metacarpal head for reattachment or imbrication of the ligaments (FIGURE 8). Sutures for repair of the collateral ligament (4-0 Ticron/mersilene) are inserted.

When satisfied with preliminary appearances, the trials are removed using the trial extractor provided in the instrument tray.
Implanting the Components

The intramedullary canal is then irrigated first with saline, then with 0.5% neomycin solution. The medullary cavities are dried. Both the metacarpal and phalangeal prostheses are removed from their sterile packaging and inspected. Polymethylmethacrylate adhesive (PMMA) is injected in a liquid state using a size #14 plastic intracath attached to a 10cc syringe (FIGURE 9).

The distal component is inserted first. Care is taken to position the prosthetic components in proper alignment and rotation. Convex and concave plastic impactors are provided to assist implant insertion. Avoid impaction with metallic instruments which, by compromising the surface finish, may accelerate prosthetic wear.

The joint is then extended and checked under the image intensifier before the cement hardens. Cement fixation of one finger at a time is advisable if the positioning is difficult. If multiple joints are done, it may be easier to do the distal components as a group followed by the proximal components. After the cement has cured, passive range of motion is checked to ensure a full range of motion without impingement of prosthetic binding. If satisfactory, the collateral ligaments are tightened or reattached to the tuberosity of the metacarpal head.

Closure and Centralization

Capsular closure is undertaken after prosthetic fixation. Centralization of the extensor tendon and imbrication of the radial sagittal bands is usually necessary in rheumatoid hands by appropriate closure of the extensor tendon retinacular system. A "pants-over-vest" centralization may be required in cases of moderate-severe ulnar drift along with crossed-intrinsics transfer. Snug repair of the radial collateral ligament helps to also realign the flexor assemblage (See FIGURE A, Page 8).

Reattach radial collateral ligament to the metacarpal bone (FIGURE 10A). Realign the finger before tightening sutures. With finger held in slight over correction, imbricate radial sagittal band over extensor tendon (FIGURE 10B). Complete joint closure by securing radial sagittal band to the extensor apparatus (FIGURE 10C).
Initial Post-Operative Treatment

Postoperative positioning is important and should place the MCP joints in slight flexion and the PIP joints in approximately 45º flexion. If there has been preoperative ulnar deviation, or this appears following closure the fingers should be placed in 5 to 10º radial deviation. These positions must be held while applying a compressive dressing (FIGURE 11).

If there has been a tendency for the fourth and fifth metacarpals to “droop,” the excessive metacarpal arch curvature should also be supported. The dressing is removed at 2 to 4 days and a dynamic splint applied for daytime exercises. A static rest/nocturnal splint capable of holding the fingers in the corrected positions is used at other periods for 4 to 6 weeks.

Rehabilitation

The initial rehabilitation program benefits greatly from close supervision of the physiatrist and hand therapist. The fabrication of the dynamic and static splints requires expert knowledge for correct fit as well as instruction in proper use (FIGURE 12). The first week or two are best carried out with daily or bi-daily supervision followed with repeat reassessment at the scheduled visits.

Follow-up exams should include range of motion (ROM) assessment for all the joints of the hand and wrist and other significant joints. Static deformities, grip strength and pinch strength should also be assessed and recorded. X-ray examination includes AP, lateral and such special views as may also be indicated at follow-up intervals. Assessment of MCP palmar subluxation, ulnar drift, ulnar intrinsic contracture, extrinsic extensor tendon displacement, swan neck or boutonniere deformity, and flexor tendon displacement should also be recorded.
Revision or Removal of MCP Prostheses

Should the SR™ MCP implants loosen, dislocate, suffer infection, or other complication requiring removal, the procedure involves retrieval of the implant under sterile conditions, tourniquet control and adequate anesthesia. The previous dorsal incision (straight or curvilinear) is incised. The soft tissue flaps are reflected down to the extensor tendon system. The extensor tendon is incised longitudinally on the radial side from the proximal phalanx base across the metacarpal head and neck. The sagittal bands are reflected from the capsule (if possible). The capsule of the joint is incised longitudinally and the implants are exposed. Release of collateral ligaments might be necessary to retrieve the implants. The metacarpal prosthesis is removed first. Small 1-2mm osteotomes are used to free the prosthesis and bone cement from within the metacarpal canal. A linear osteotomy of the metacarpal canal may be needed to remove the implant. A fine burr on a high-speed drill is used to remove the cement over the dorsal surface of the proximal component. The distal component may also be drilled out with the high speed burr. The phalangeal components can be tapped from the intramedullary canals or removed with an osteotome.

Salvaging of the joint is by soft tissue volar plate interposition or alternatively silicone interposition joint (no sepsis). Collateral ligament reconstruction and extensor tendon centralization should be performed in revision procedures similar to the index prosthetic insertion procedure. Postoperative physiotherapy is unchanged from other procedures of MCP arthroplasty.

Crossed Intrinsic Transfer Procedure

Crossed intrinsic transfers are often helpful in correcting ulnar deviation. In rheumatoid hands with ulnar capsular contracture it may be necessary to release the ulnar intrinsic and all or part of the ulnar collateral ligament, especially if there is swan neck deformity (FIGURE A).

Release of the ulnar intrinsic lateral band insertion midway onto the proximal phalanx allows transfer onto the radial aspect of the adjacent digit at the close of the soft tissue rebalancing (FIGURE B).
INDICATIONS

> Patient is in need of a revision of failed MCP prosthesis(es) or

> Patient expects to place his/her hands under loading situations, which preclude the use of an alternative implant in the painful osteo-arthritis and post traumatic arthritic MCP joint.

CONTRAINDICATIONS

> Bone, musculature, tendons, or adjacent soft tissue compromised by disease, infection, or prior implantation, which cannot provide adequate support or fixation for the prosthesis.

> Infection.

> Skeletal Immaturity.

WARNINGS AND PRECAUTIONS

Patient Counseling Information (see also Warnings)

In addition to the patient related information contained in the Warnings and Adverse Events sections, the following information should be conveyed to the patient:

> While the expected life of total joint replacements is difficult to estimate, it is finite. These components are made of foreign materials, which are placed within the body for the potential restoration of mobility or reduction of pain. However, due to the many biological, mechanical and physiochemical factors which affect these devices, the components cannot be expected to withstand the activity level and loads of healthy bone for an unlimited period of time.

> Adverse events of this device may necessitate reoperation, revision, or fusion of the involved joint.

Warnings (see Patient Counseling Information Section)

> Patients should be made aware of the increased potential for device failure when excessive demands are made upon it. Strenuous loading, excessive mobility, and articular instability all may lead to accelerated wear and eventual failure by loosening, fracture, or dislocation of the device.

Precautions

> Do not resterilize. The implant is provided sterile in an undamaged package. If either the implant or the package appears damaged, expiration date has been exceeded, or if sterility is questioned for any reason, the implant should not be used.

> Meticulous preparation of the implant and selection of the proper size implant increase the potential for a successful outcome.

> The implant should be removed from its sterile packaging only after the implant site has been prepared and properly sized.

> Implants should be handled without blunt instruments to avoid scratching, cutting, or nicking the device.