

A Case Report of Total Finger Joint Replacement Arthroplasty After Traumatic Amputation

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Abstract

Introduction: Joint reconstruction following trauma at the proximal interphalangeal or metacarpophalangeal levels remain a difficult problem in hand surgery. Function of the injured finger depends on the mobility and stability at these joints. In fingers amputated at these levels with joint destruction, the hand surgeon can perform either an arthrodesis or a replacement arthroplasty (either as an emergency or as a secondary procedure). Arthrodesis will give a stable pain-free joint, but at the cost of sacrificing mobility and even cosmesis. **Clinical Picture:** We report a case of traumatic amputation through the proximal interphalangeal joint (PIPJ) of the right middle finger. Arthrodesis of the PIPJ in extension using Kirschner wires was performed following replantation due to extensive periarticular soft tissue loss, so as to enable repair and healing of the extensor mechanism. This results in poor cosmesis and stiffness of finger interfering with function three months after surgery. **Treatment and Outcome:** A prosthetic total joint replacement of PIPJ was performed as a secondary procedure. Satisfactory hand function and finger movement ensued two years after the procedure, with no loosening or infection of the implant. **Conclusion:** Total interphalangeal joint arthroplasty is a useful secondary procedure, after the initial replantation, for finger amputation with periarticular soft tissue loss.

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Key words: Finger amputation, Finger joint implant, Finger replantation

Case Report

A 41-year-old Chinese man had his dominant thumb, index and middle fingers caught by a wood-cutting machine while at work. He sustained a near-amputation of his middle finger through the proximal interphalangeal joint (PIPJ), with an intra-articular comminuted fracture of the head of the proximal phalanx (Fig. 1a) and the finger connected by only a radial strip of skin. The digital neurovascular bundles, flexor digitorum superficialis and profundus, and extensor digitorum communis tendons, as well as both radial and ulnar collateral ligaments and capsule of the PIPJ were severed. Under intravenous antibiotic cover, wound debridement and fusion of PIPJ of middle finger were performed with parallel intraosseous Kirschner wires, in extension (Fig. 1b). Fusion in extension was performed because it allowed repair of extensor tendon without too much shortening of the bone with reconstruction of the PIPJ being contemplated after healing of wound and extensor mechanism. The flexor digitorum profundus tendon was also repaired. Microsurgical anastomosis of the digital neurovascular bundles was done. The right thumb and index finger also suffered transection of the

ulnar digital neurovascular bundles, which were repaired. Postoperative brachial plexus block and immediate mobilisation with occupational therapy were instituted, together with antibiotics (ampicillin and cloxacillin), and antithrombotics (aspirin and dipyridamole).

At three months post-replantation, his wound had healed well with some sensory recovery, but he complained of painless stiff extended middle finger with ulnar rotational deformity at the PIPJ. There was severe limitation in closing his dominant hand into a fist, due to this "prominently standing" middle finger, which was cosmetically unacceptable.

A secondary procedure was performed. First, an extensor tenolysis was performed via a dorsal incision over the previous scar. The PIPJ was found to be completely ankylosed and was excised. Total prosthetic joint replacement arthroplasty of the PIPJ using a 17.5 x 4.5 mm third-generation isoelastic finger prosthesis (Mydes) was performed (Fig. 1c). There was a crack fracture in the volar cortex of the neck of the proximal phalanx following reaming. The fracture was fixed by tightening a circular interosseous wire around the bone. The proximal component

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Fig. 1a. The patient sustained a near-amputation of the right middle finger through the proximal interphalangeal joint (PIPJ), with an intraarticular comminuted fracture of the head of the proximal phalanx.

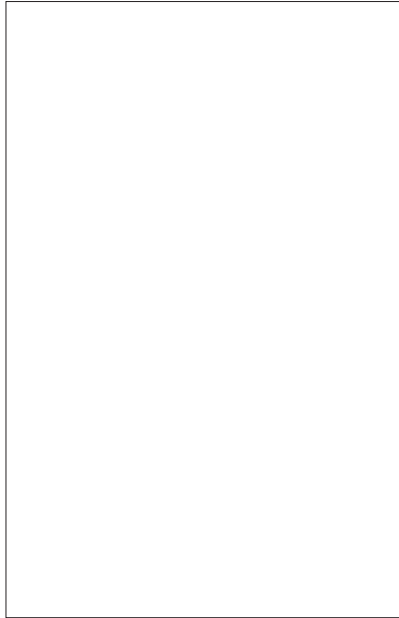


Fig. 1b. Proximal interphalangeal joint of the middle finger was fused in extension with parallel intraosseous Kirschner wires.

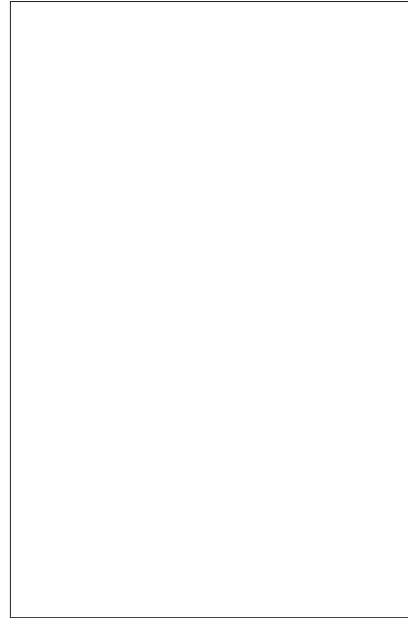


Fig. 1c. Radiographs showed fitting of the proximal component in the bone and tilting of the distal component in the medullary canal surrounded by cement.

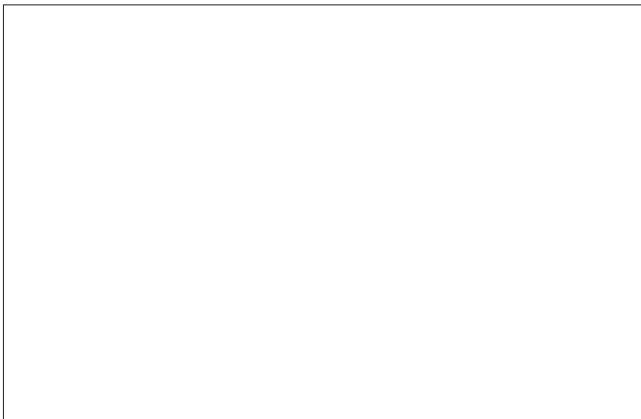


Fig. 2a. There was slight ulnar rotational deformity.

Fig. 2b. There was mild "scissoring" between the middle and ring fingers.

fitted well in the canal following tightening of the screw in the stem of the implant because the stem expanded when the screw was tightened. There was also a crack in the volar cortex of the middle phalanx. It was also fixed by interosseous wiring. The distal component was cemented because it did not fit well in the bone following tightening of the screw. The fingers were put in a fist while allowing the cement to set. Radiographs showed good fitting of the proximal component in the bone and tilting of the distal component in the bone surrounded by cement (Fig. 1c). The wound was closed with full-thickness skin graft to cover the skin defect at full flexion of the PIPJ.

The wound healed without any infection 1 week after arthroplasty, and he began passive and active range of

motion exercises. The fracture united 8 weeks later with commencement of muscle-strengthening exercises. At 2-year post-implantation, the middle finger sensation had recovered partially. The PIPJ movement was 30° to 90° with no pain or lateral instability. There was slight ulnar rotational deformity (Fig. 2a) and mild "scissoring" between his middle and ring fingers (Fig. 2b) without interfering with the hand function. There was clinically and functionally no loosening of the implant or cement. He was able to perform full power grip with his dominant hand and had since returned to work.

Discussion

Destruction of a finger joint poses difficult problems to the hand surgeons. Although arthrodesis provides a strong buttress for pinch grip and relief of pain, the benefits of joint movement are lost. Reconstructive procedures to restore mobility can be divided into three groups: interposition arthroplasty by Swanson spacer¹ or volar plate,² vascularised joint transfer from autologous toes or finger bank,³ and total prosthetic joint replacement arthroplasty.⁴ The type of reconstruction indicated depends on local factors (bone and soft tissue loss), as well as general factors (patient age, occupation, motivation). Despite the numerous techniques available for finger-joint reconstruction in each of these three groups, very few, if any, fulfill the ideal requirements, which are a painless, stable, strong and durable joint with a full range of motion. A report of 61 cases by Foucher G et al⁵ of joint reconstruction following trauma, comparing Swanson

arthroplasty, spacer interposition, toe transfer, and finger bank revealed better results in younger patients with metacarpophalangeal reconstruction, irrespective of the type of operation, with ranges of motion similar in all three groups. In fact, it has shown to be significant that the resultant fixed flexion deformity was much less with arthroplasty than with toe or finger joint transfer.

The first finger prosthesis was implanted for rheumatoid arthritic hand over 40 years ago. Since then, all prostheses that are used for finger-joint are designed to relieve pain, to restore a functional range of motion, to correct existing and prevent further deformity, and to provide cosmetic improvement.⁶ A good functional range for both the PIPJ and MIPJ during activities of daily living is 60°, with useful range of PIPJ in gripping 45° to 90°.⁵

The problems of primary finger joint arthroplasty at the time of replantation are the risk of infection in contaminated amputation and the lack of stability. In addition, arthroplasty also requires the presence of good bone stock, skin cover, and a functioning extensor mechanism, conditions not always present especially in acute mutilating injuries in PIPJ with bone loss and extensor tendon injury.⁵ In a traumatic digital amputation, unlike a primary digital arthroplasty in rheumatoid arthritis, despite adequate debridement, irrigation, antibiotic prophylaxis, good tissue vascularity, and viable soft tissue coverage, the risk of infection is made higher with tissue oedema, devascularisation and the presence of implant as a foreign body for bacterial colonisation. Similarly, the practice of delayed nerve or tendon repair, as well as the contraindication of internal fixation for Grade III compound fractures of long bones, illustrate the need for a clean uncontaminated surgical field for reconstructive work. Just as in an infected total hip or knee arthroplasty, an infected finger joint implant requires removal and arthrodesis, a state any surgeon wishes to prevent. Arthrodesis immediately after a traumatic amputation has lower risk of infection in a contaminated wound, compared to joint reconstruction, but usually results in loss of finger and/or hand function with poor cosmesis. We therefore recommend post-replantation digital implant arthroplasty for traumatic joint destruction as a secondary “salvage” procedure in cases with poor results following arthrodesis, although Kay and Watson⁷ had reported good results in 2 cases with primary implant arthroplasty of metacarpophalangeal joints done during digital replant as an emergency procedure.

Arthrodesis of the finger PIPJ is usually performed with the joint in 40° to 55° flexion (functional position). This patient, however, posed two problems. Firstly, there were extensor tendon, PIPJ soft tissue envelope and collateral ligament loss. Secondly, contaminated wound is “hostile”

to tendon graft/transfer and primary arthroplasty. The finger was thus replanted with the PIPJ fused in extension in order to “bridge” the defect in the extensor mechanism without too much shortening of the bone. The loss of periarticular soft tissue support determined the choice of implant used. Isoelastic prosthesis is a constrained implant that prevents abduction, adduction and rotation moments during movement.

Finger-joint implant is not without complications. A literature review by Foliart and Moraga⁸ of 15,556 silicone Swanson finger-joint implants revealed 2% implant fracture, 4% bone resorption, 1% particulate synovitis and lymphadenitis, 0.7% implant loosening, and 0.6% implant infection. Removal rate is 1% for various reasons (continued pain, infection, implant fracture). The main concern is, however, decreasing range of motion with time, particularly at PIPJ. Good short-term motion results often worsen progressively with time, with increasing extension lag, decreasing movement arc, recurrence of deformities, and ultimate loss of range of motion.⁶ Bone resorption can even “bury” the prosthesis leading to stiffness in extension, a position worse than a good arthrodesis. However, these reviews of clinical results were done for rheumatoid arthritic hands. At present, implantation on patients with rheumatoid arthritis is undertaken at a stage in the disease where the muscles, ligaments and tendons surrounding the joint, as well as the bone, are generally in a poor condition, with surgery being a “salvage” procedure for grossly deformed hand. The initial postoperative arc of motion is increased due to relief of pain, which is the main factor in restricting movement in rheumatoid hands, with gradually decreasing range with time due to continuing disease progress, resulting fibrosis and recurrent deformity. Similarly for post-finger replantation, the result of finger joint replacement depends on the severity of the initial injury — preservation of the extensor mechanism and collateral ligaments are critical in providing a more physiologic articulation after arthroplasty and a more stable joint, particularly to lateral and rotational forces. At best, post-traumatic arthroplasty is still a “salvage” procedure (just as in rheumatoid hand). Until long-term data for post-traumatic finger-joint reconstruction are known, arthroplasty remains to be an option for such patients to enjoy the benefit of an otherwise unattainable movement at these joints.

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