Technical Note The Journal of Hand Surgery (Asian-Pacific Volume) 2023;28(2):297-300 • DOI: 10.1142/S2424835523710029

Proximal Interphalangeal Joint Arthrodesis of the Hand Utilising a Rigid Intramedullary Device

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The proximal interphalangeal joint (PIPJ) is critical for proper finger and hand function. Arthritis of this joint can lead to significant pain and functional impairment. The APEX IP® Extremity Medical fusion device (Extremity Medical, Parsippany, New Jersey, USA) is an interlocking intramedullary screw device that provides a reliable method of hand PIPJ arthrodesis with good patient outcomes. We describe an easily reproducible surgical technique guide for using this device.

Level of Evidence: Level V (Therapeutic)

Keywords: *Intramedullary, Fusion, Arthrodesis, Interphalangeal, Finger*

Received: Jan. 15, 2022; Accepted: Jan. 23, 2023
Published online: Apr. 17, 2023
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INTRODUCTION

The proximal interphalangeal joint (PIPJ) of the finger is a bicondylar joint, which is critical to hand function. Degenerative changes of the PIPJ due to trauma, osteoarthritis or inflammatory arthritis can result in pain, and lead to considerable hand impairment because flexibility and stability of the joint are important in maintaining finger motion and hand function. Osteoarthritis of the hand has been shown to have a prevalence of 67% in women and 54.8% in men aged 55 years or older. PIPJ arthritis is the second leading cause of hand pain after thumb carpometacarpal joint arthritis.[1]

Initial non-surgical management includes splinting and anti-inflammatory medication. When these measures no longer provide relief, operative intervention may be offered to patients.

A number of surgical techniques currently in practice include: oblique Kirchner wire combined with coronal plane interosseous wiring, tension-band wiring, dorsal plate, 90/90 wiring and compression screws.[2] Complications in the literature of PIPJ arthrodesis include nonunion (3%), malunion (1%), hardware prominence (9%) and infection (3.5%).[3] Biomechanical evaluation of PIPJ arthrodesis using the APEX IP® fusion device (Extremity Medical, Parsippany, New Jersey, USA) demonstrate significant increased rigidity of this intramedullary device compared to alternative PIPJ fusion constructs.[4] Although the stiffness required for a successful PIPJ fusion has not been quantified, the authors suggest the APEX intramedullary fusion device will reduce the rate of nonunion and avoid complication of hardware prominence.

TECHNIQUE

Setup: The patient is anaesthetised with general or regional anaesthesia, and positioned supine with a hand table. The operative arm is exsanguinated and operation performed under tourniquet with meticulous haemostasis control.

Exposure: A longitudinal incision is made over the dorsal midline of the affected PIPJ from the midpoint of the proximal phalanx to the midpoint of the middle phalanx. Longitudinal central division and lateral reflection of the extensor tendon is used to expose the joint (Fig. 1).

Procedure: A 0.9-mm guide wire is inserted into the canal of the proximal phalanx under fluoroscopic control. Sizing is performed using an external depth gauge and selection of a 'post' screw by comparison under fluoroscopic imaging. The proximal phalanx is further prepared with cannulated drill and reamer followed by insertion of proximal 'post' implant to a level 1–2 mm below the distal cortical surface. Care is taken to ensure correct rotational alignment of the proximal post implant. Angular preparation of the proximal phalanx is performed to the preoperatively desired angle with hand reaming using specific rasps. A dorsal osseous window is cleared to allow space for lag screw insertion. The authors recommend 30° for the index and middle fingers and 45° for ring and little fingers. A guide wire is then passed into the middle phalanx and cannulated preparation performed (Fig. 2). The lag screw is then

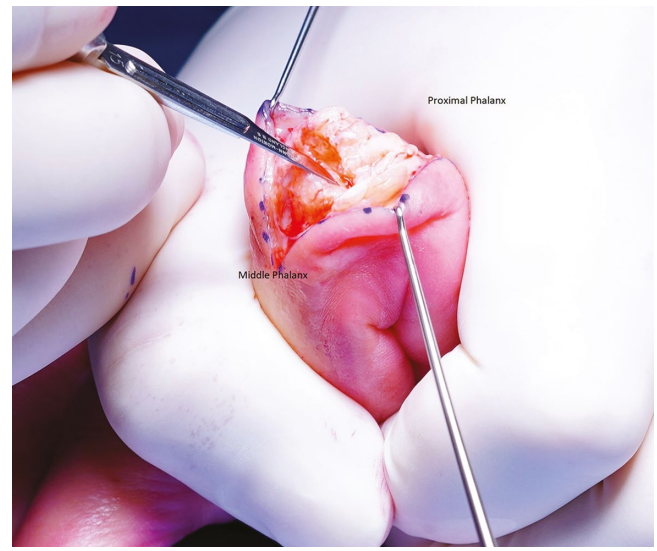

Fig. 1. Extensor tendon reflection.

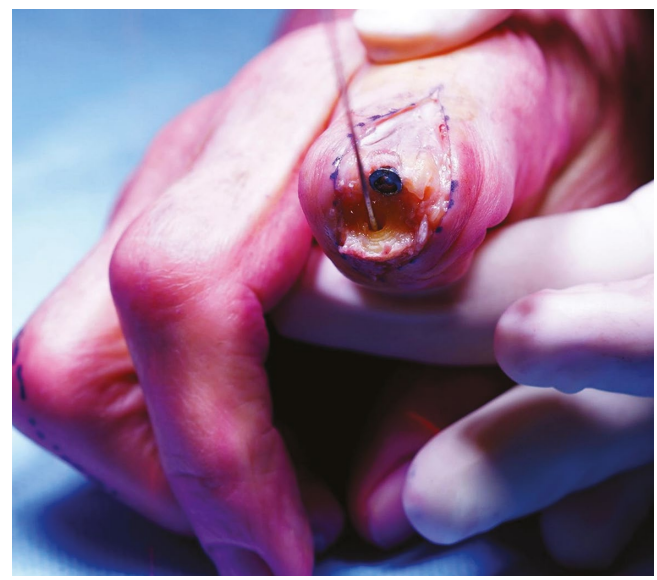

Fig. 2. Guide wire for cannulation of middle phalanx.

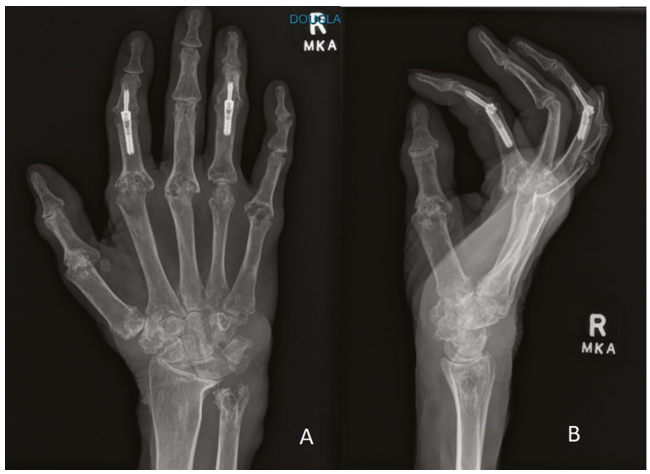

Fig. 3. Postoperative X-ray films of index and middle finger PIPJ fusion utilising APEX IP® Extremity Medical fusion device.

measured and inserted with manual compression until screw compression of the matched prepared joint surfaces is visually and fluoroscopically confirmed. A morse taper is engaged once the lag screw is engaged in the post. Extensor tendon repair is performed using a 4.0 braided non-absorbable suture and running 5.0 nylon suture used for skin closure. A simple finger dressing is applied and due to the rigid nature of the fixation, external splinting is not required but may be provided at surgeon's discretion. Immediate mobilisation is allowed at day 3 supervised by hand therapist. Radiographic confirmation of stable union is performed at 6 weeks postoperatively, at which stage the patient may return to normal duties (Fig. 3).

DISCUSSION

The author's institution has performed 29 PIPJ fusions using this device. Indications for procedure included osteoarthritis, post-traumatic arthritis, failed interphalangeal joint replacement, rheumatoid arthritis and chronic PIPJ dislocation. All patients went onto union and no re-operations were required. The longest follow-up was 3 months with 12 patients discharged at 6 weeks. There was a single superficial infection which resolved with a short course of oral antibiotics and did not require implant removals.

A case series by Novoa-Parra et al of six patients who had PIPJ fusion with the device for severe recurrence of Dupuytren had a mean follow-up of 19.6 months. There were no complications and none of the implants had to be removed. All patients demonstrated radiographic union by 8 weeks and had significant improvement in their pain. All were satisfied with the surgery and would accept it again.[5]

The benefits of this intramedullary device include ease of use, the ability of the fixed angle of the screw to remove the need to spend time meticulously preparing the joint surface angle for fusion, to avoid irritation of the adjacent soft tissue structures and that it does not often require implant removal. The increased rigidity compared to traditional methods of PIPJ fusion are expected to reduce complications of nonunion. The disadvantages of this device include concerns with adjacent metacarpal phalangeal joint disease and the length of the proximal phalanx peg impeding adjacent surgical correction, the smallest implant may not be small enough for a small group of female little fingers, difficulty of removal and concerns for revision options if the need arose and limited options for fusion angle (only 30° and 45°).

We have found that decorticating the sclerotic subchondral bone and cartilage using a rongeur prior to joint preparation with the APEX tools minimises the risk of iatrogenic periprosthetic fracture. It is also important to ensure the proximal phalanx screw is positioned correctly, with the laser line perfectly dorsal, to avoid a subtle rotational deformity. If adequate rotational control is not obtained, a supplementary cerclage wire can be inserted to control the rotation. In osteoporotic bone or a patulous intramedullary canal, local cancellous bone autograft (from the distal radius) can be used to pack the canal and allow a better fit. One must be careful when fusing the little finger PIPJ, particularly in female patients as the implant may be too large. An alternative in this scenario is the Osteomed® hand fusion implant which has the benefit of intramedullary fixation in the middle phalanx, and plate fixation in the proximal phalanx.

In summary, the APEX screw intramedullary fusion device provides a reliable method of PIPJ fusion in the hand and delivers good patient outcomes.

DECLARATIONS

Conflict of Interest: The authors do NOT have any potential conflicts of interest with respect to this manuscript.

Funding: The authors received NO financial support for the preparation, research, authorship and/or publication of this manuscript.

Ethical Approval: Ethical approval was NOT required for this technical note.

Informed Consent: There is NO information (names, initials, hospital identification numbers or photographs) in the submitted manuscript that can be used to identify patients.

Acknowledgements: None.

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