

# PRIMARY ARTHRODESIS OF COMMINUTED FRACTURES WITH INSTABILITY AT THE PROXIMAL INTERPHALANGEAL JOINT OF BORDER FINGERS WITH HEADLESS COMPRESSION SCREW. A PROSPECTIVE CLINICAL AND RADIOLOGICAL STUDY

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## ABSTRACT

*Proximal interphalangeal arthrodesis (PIPA) is a reliable method for relief of pain of the arthritic interphalangeal joints, in acute trauma, reconstruction after chronic injury and for inflammatory arthritides. Stability and compression impart solid arthrodesis. Headless compression screw is a good implant to achieve a very high union rate in a relatively short period. Primary arthrodesis after intra-articular comminuted fractures with instability of the proximal interphalangeal joint (PIPJ) ensures a satisfactory functional outcome with no pain or disability in suitable patients. **Study design:** a prospective study conducted in Banha university hospital. **Patients and methods:** 22 patients aged 45 - 57 years with comminuted intraarticular fractures of the base of the middle phalanx and instability of the proximal interphalangeal joint were treated with primary arthrodesis of the PIPJ with headless compression screw. Follow up period was 12-18 months. **Results:** Clinical results and radiological union were assessed at the final follow up. Solid arthrodesis was achieved in all cases with time to union ranged 7-12 weeks (average 9.5 weeks). Superficial infection in 2 cases and wound dehiscence in 5 cases were reported during the follow up period. **Conclusion:** Primary arthrodesis with headless compression screw for the non-constructible intra-articular injuries of the proximal interphalangeal joint is a reliable option that can achieve a very high union rate and patient satisfaction in mature adults.*

**Keywords:** *arthrodesis, comminuted intra-articular fractures, headless compression screw, interphalangeal instability, proximal interphalangeal joint*

## INTRODUCTION

Fracture dislocations of the proximal interphalangeal joints (PIPJ) are complex disabling injuries in adults. Dorsal fracture dislocations are more common than volar fracture dislocations. Stable injuries often heal with minimal functional disability, while unstable injuries often result in joint incongruity, stiffness, and degenerative joint disease. Multiple surgical techniques have been described to treat these injuries, including open reduction-internal fixation, external fixation, extension block pinning, dynamic traction, volar plate arthroplasty, and arthrodesis by different implants. The results of treatment of volar or dorsal

fracture dislocations of the PIPJ are usually unpredictable. [1-7]

Arthrodesis of the proximal or distal interphalangeal joints is a reliable method to alleviate pain of arthritic joints. Other indications include reconstruction after acute or chronic trauma, chronic mallet finger, unreconstructible flexor tendon defects and after failed arthroplasty. [8-12] Achieving proper bone opposition and compression ensures a solid arthrodesis. Interphalangeal arthrodesis with headless compression screw can achieve 85-100% union rate (0-2% non-union rate) at the PIPJ in published studies. Various methods were used for PIPJ arthrodesis. Kirschner wires, tension band, mini-

plates, and Herbert screws have 21%, 4.5%, 50%, and 0% non-union rates respectively. [1,13-17]

This study evaluated the clinical and radiological results of using the headless compression screw in arthrodesis of comminuted fractures of the base of the proximal phalanx with instability of the PIPJ of the border digits in mature adult patients.

### **PATIENTS AND METHODS**

In this prospective study, twenty-two patients (22 fingers; 10 index fingers and 12 little fingers) with comminuted fractures of the proximal end of the middle phalanx with unstable PIPJ were treated by primary arthrodesis of the PIPJ by headless compression screw in the period from 2008 to December 2014. Surgical technique: through dorsal approach, the joint was exposed and the bone ends were prepared after removal of the articular cartilage. The index fingers were arthrodesed in 30°- 40°, flexion and the little fingers were arthrodesed in 40°- 60°, and rotation was adjusted in regard to the other fingers cascade. The headless compression screws were inserted antegrade through a drill hole in the distal-dorsal cortex of the proximal phalanx after provisional fixation of the joint in the desired position with a small pointed reduction clamp. No bone graft was used in any case. Wounds were thoroughly irrigated and the extensor tendons repositioned.

Postoperative care: a splint was applied to allow for soft tissue healing for 10 days followed by a removable aluminum splint to allow mobilization of the distal interphalangeal and the metacarpophalangeal joints. Patients were followed up clinically and radiologically for 12-18 months.

### **RESULTS**

The study involved 15 males (68%) and 7 females (31.8%), 10 index fingers (45.4%) and 12 little fingers (54.5%), 13 right (59%) and 9 left (40.9%). The mechanism of injury was by axial impaction force in all cases. No cases had an open injury. The follow up period was 12-18 months (average 15 month). Radiological union was achieved in all cases after 7-12 weeks (average 9.5 week). Two cases had superficial infection of the wound that was treated with antibiotics and 5 cases had wound dehiscence that required debridement and reclosure, those 7 cases (31.8%) healed soundly.

The functional outcome was assessed at the final follow up visit using the Michigan Hand Outcome Questionnaire (MHOQ) which evaluates the hand function with daily activities and the patient's satisfaction with treatment. Excellent outcome was reported in 12 cases (54.5%), good in 9 (40.9%), and fair in 1 (4.5%) patient. No patients reported pain at the arthrodesis site. The 7 cases who had soft tissue complications had a good outcome and the patient with fair outcome had a less satisfactory hand functions with daily activities but no pain at the site of arthrodesis.

### **DISCUSSION**

Comminuted fracture dislocation of the proximal interphalangeal joints is challenging to treat with a degree of disability affecting the functional outcome is inevitable. Several methods exist in literature for treatment of these injuries with no general agreement on a standard treatment method. [18]

Arthrodesis of the PIPJ with a crushed articular surface and unstable or dislocated joint is a reliable method for definitive acute treatment to avoid the later complications of chronic pain, deformity,

hand disability, and lately, osteoarthritis. It also allows the patient to have a stable functionally satisfying fingers according to the daily functional activities especially in mature adults above 40 years of age. [19,20]

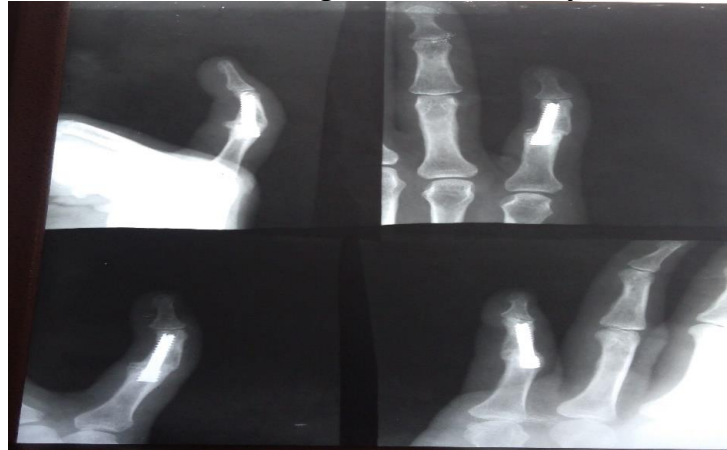
No doubt that proximal interphalangeal arthrodesis could have an impact on the pinch function of the hand. Domalain et al, evaluated the impact of PIPA on the kinematics of index finger-thumb precision pinch. They reported that index finger PIPJ fusion at 30°, 40°, and 50° restricted the maximal index-thumb pinch span by 6%, 10%, and 14% respectively. At the time of pulp contact, PIPJ arthrodesis increased the index finger metacarpophalangeal flexion angle with

the 30° PIPJ fusion while with 50° index PIPJ fusion there will be an increase in the variability of thumb tip location. They concluded that PIPJ fusion at 40°-50° will lead to a more natural precision pinch posture but will restrict aperture and reduces pinch precision. [13] In the present study the PIPJ was arthrodesed in 30°-40° degrees in the 10 index fingers to have less affection on the index-thumb pinch function.

The current study results were 12 excellent, 9 good and one fair according to the Michigan hand outcome score. (Figure-1) The good-to-excellent results (21 cases, 95.4%) were noted in patients who were more satisfied with the final result in regard to their daily activities.



A



B



C



D

**Figure-1: Excellent outcome with little finger PIPJ arthrodesis. A: photo at presentation, B: postoperative X-rays, C: Follow up X-rays (Left) till union (D)-(Right).**

All cases united with no pain; however, the case with fair score had less satisfaction due to difficulties in using the hand in work as an electric technician and household activities due to union with slight ulnar deviation at the arthrodesis site of the index finger. (Figure-2) These results are close to the early study of Ayres et al, [12] who used a Herbert screw and reported 98% union rate in 6 weeks, and the recent study of Leibovic et al, [1] who achieved 100% union rate in comparison

with the other fixation techniques especially Kirschner wires with which non-union rate was higher. Intramedullary fixation with a compression screw that allows for compression in two perpendicular directions at the arthrodesis site is more rigid and permits rapid bone union in weeks. Capo et al, reported that intramedullary linked screw for PIPA resisted more bending moments than all wiring constructs and showed the greatest ultimate strength. [14]



A



B



C



D

**Figure-2: The case with fair outcome. A: photo at time of surgery, B: preoperative X-rays, C: postoperative X-rays (left), D: X-ray at final follow up (Right).**

Several studies reported multiple complications of the PIPJ injuries, more with instability of the joint and comminuted articular surface. Difficulty

in maintaining reduction of articular surface in presence of comminution with tiny articular fragments, the subsequent early finger stiffness, deformity, and the

late development of osteoarthritis causing chronic pain are very common complications. [21-24]

The complications of the present study were temporary and related to the soft tissues, not the fixation method. Two cases had a superficial skin infection that was cleaned and responded well to antibiotics, and 5 cases showed wound dehiscence that required debridement and secondary closure and healed soundly with no functional deficit. There were no non-union cases or prominence of the screw head and all cases united in average of 9.5 weeks.

The weakness points of the current study are the small number of cases and the short period of follow up. The strength points of the study are the early definitive technique of treatment that allowed the patient to use the hand in a short period after injury and not waiting for the unpredictable results of the other treatment methods or to wait for another surgery to treat the subsequent complications.

### CONCLUSION

Proximal interphalangeal joint primary arthrodesis for comminuted intraarticular fractures of the base of the middle phalanx with instability of the joint is a reproducible technique with satisfactory functional and radiological outcomes. Higher evidence studies with larger number of patients are required to highlight this relatively common injury.

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