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## Wrist Arthrodesis : A Salvage Procedure for 15 Months Old Post Traumatic Arthritis of Wrist Joint

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### ABSTRACT

Wrist arthrodesis or wrist fusion is a procedure in which the wrist joint is immobilized by fusion of the radius to the carpal bones. It is considered as a treatment modality for pain relief purposes in conditions such as advanced wrist arthritis following complex communitied wrist fractures, cerebral palsy, brachial plexus injuries, and as a salvage technique after failed implant arthroplasty. Wrist arthrodesis is considered as a last resort when all other treatment options have failed to provide relief to patient's symptoms<sup>1</sup>. Total wrist arthrodesis using a rigid plate with use of bone graft from a local source demonstrates an excellent fusion rate.

**Keywords:** Wrist arthrodesis, Wrist joint, TFCC, Lister tubercle, DRUJ instability, LCDCP plate; Jamar grip strength.

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## INTRODUCTION

For normal hand function, a stable and pain-free wrist is essential. If either of these prerequisites are lost, operative intervention is usually required. Ligament reconstruction, limited intercarpal arthrodesis, and proximal row carpectomy have provided stability and relief of pain<sup>2</sup>. Complete carpal stability is indicated in advanced post-traumatic and inflammatory arthritis and complete loss of carpal support with significant wrist instability. Wrist arthrodesis may involve the entire wrist joint or partial wrist joint. Partial wrist arthrodesis can be achieved by techniques such as scapho-trapezoid fusion, scapho-capitate fusion, scapholunate fusion, four-corner fusion with scaphoid excision, and radio-lunate fusion<sup>3</sup>. The goal of wrist arthrodesis is to provide pain relief and to preserve as much function as possible. Complications such as wound dehiscence, infection, extensor tendon adhesions, and plate impingement, which may require implant removal are common.

The objective of this study is to evaluate the results of wrist arthrodesis using a technique that is simpler, more biological, less expensive, and involving the carpometacarpal joints

### Case Report

A 26-year-old male patient came to Dhiraj Hospital with left side closed distal end radius fracture with distal radio ulnar joint instability, open grade 3b wound over left proximal tibia, left shaft femur fracture with right side Hoffa's fracture and right midshaft tibia fibula fracture. The patient was operated with spanning external fixator over left tibia, left side femur interlock nail, right side tibia interlock nail and radial distractor with Kirschner wire (K wire) for DRUJ instability. Gastrocnemius free flap surgery was done for proximal tibia wound after 1 month of trauma. However, radial distractor was removed after 21 days of surgery elsewhere and passive assisted physiotherapy was started against advice. X-ray was suggestive of wrist subluxation with maluniting distal end radius fracture [Figure 1].



**Figure 1: X-ray of wrist joint after radial extractor removal**

After 12 months, patient came to hospital with complaints of pain, deformity and weakness of grip and pinch strength. Radiographs were taken and findings were suggestive of malunited left distal end radius fracture with dorsal wrist subluxation and DRUJ injury [Figure 2].



**Figure 2: X-ray of wrist joint after 15 months showing arthritic changes with wrist subluxation and DRUJ instability**

After detailed clinical and radiological evaluation, patient was counselled for wrist arthrodesis. After obtaining written and informed consent, supraclavicular & axillary block was given. Patient was made to lie in supine position with arm resting on arm board and forearm pronated. A skin incision was made from the distal two thirds of the forearm, extending between the 3<sup>rd</sup> and 4<sup>th</sup> metacarpal passing through Lister's tubercle [Figure 3].



**Figure 3: Curvilinear skin incision using Lister tubercle as a landmark**

Meticulous dissection was performed taking utmost care of dorsal cutaneous nerve branch of the radial nerve. The extensor pollicis longus tendon was identified and retracted radially. The ulna was inspected. The ulna head and associated TFCC and surrounding soft tissues were removed. Darrach's procedure was performed. The dorsal radiocarpal and dorsal intercarpal ligaments were split longitudinally resulting in detachment of the dorsal capsule from the radius at the level of the styloid process. The articular cartilage from the radiocarpal and intercarpal joint surfaces was denuded. Articular margins of distal end radius, scaphoid and lunate were freshened. Using 1.5 mm Kirschner wire (K wire), multiple drill holes were made into the raw surface of all three bones and fresh bleeding was noted. Ideal position of wrist arthrodesis of 15 degrees of wrist dorsiflexion and 5 degree of ulnar deviation was first held temporarily using radiolunate K wire. Then a pre-counteracted 3.5mm low contact dynamic compression plate [LCDCP] was placed on the dorsal aspect of the radius, lunate and the third metacarpal bone for wrist arthrodesis [Figure 4]. DRUJ injury was fixed using k-wire after reducing dorsal subluxation of ulna [Figure 5 & 6].



**Figure 4: 10 hole LCDCP plate fixation**

The wound was washed thoroughly and closed, starting with the capsule using absorbable sutures. The extensor retinaculum was repaired, and the extensor pollicis longus tendon was transposed subcutaneously. The subcutaneous layer was closed with absorbable sutures and skin was closed with staples. Below elbow volar slab was given.



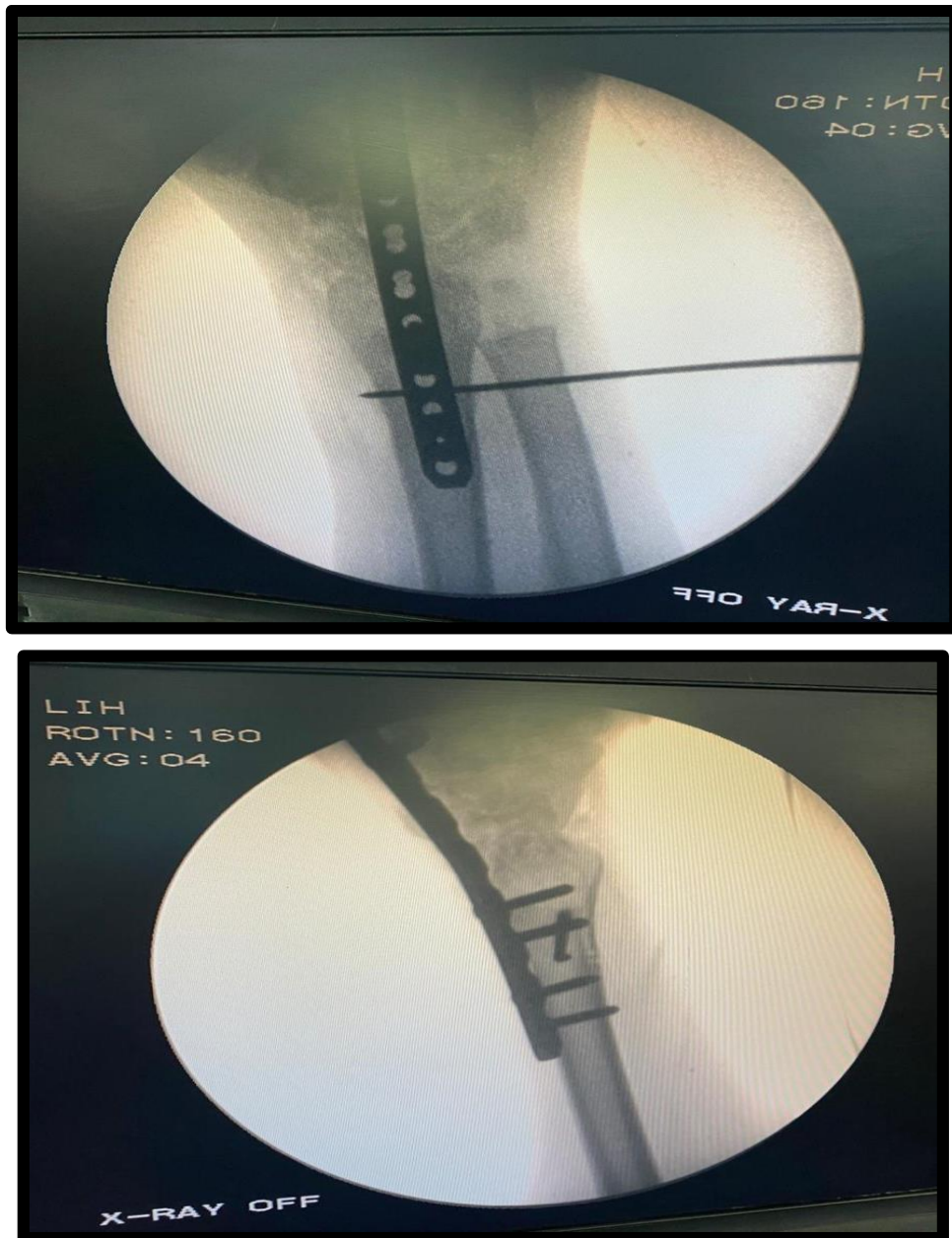


Figure 5 & 6: Intraoperative X-ray (AP & Lateral view)

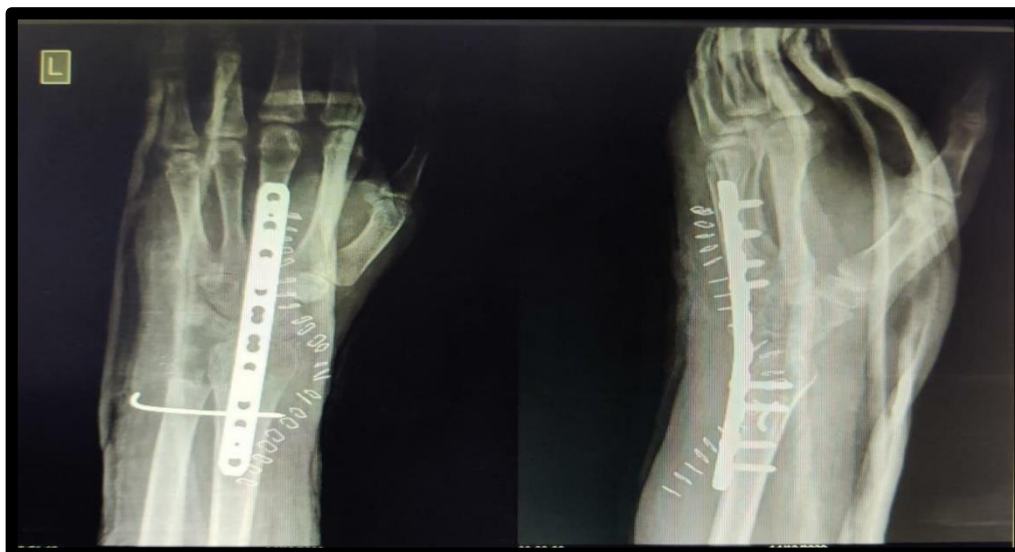
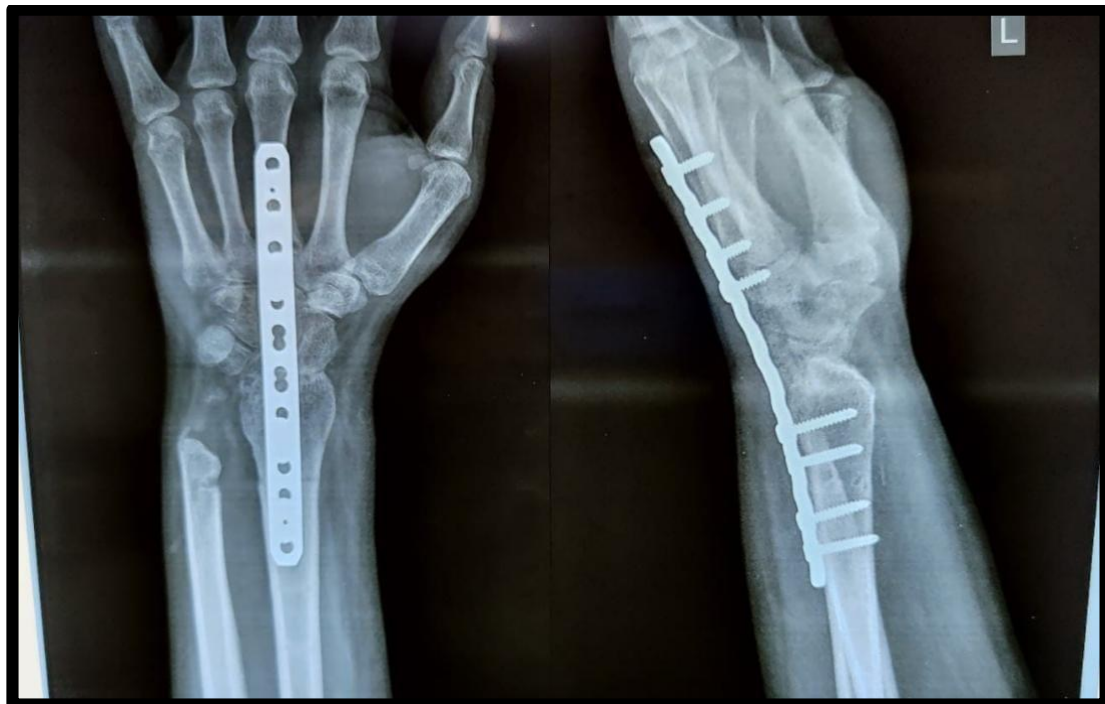


Figure 7: Post-operative X ray of wrist joint

Immediate postoperative gentle finger mobilization was started. Grip and pinch strengthening exercises were started after suture removal. Patient was not allowed to lift weight for 12 weeks following the surgery. Patient was assessed regularly at 1 month interval with final follow-up at 6 months postoperatively. No immediate, early or late complications were encountered. Wound was well healed with primary intention [Figure 8]. Final follow-up x-ray showed stable wrist joint in anatomical position with no dorsal subluxation of ulna [Figure 9]. Jamar dynamometer which consists of a sealed hydraulic system with adjustable hand spacing was used to measure hand grip force in pounds per square inch. On non operative hand, Jamar score was 32 PSI whereas on operative hand, Jamar score was 24 [Figure 10 &11].



**Figure 8: Healed scar mark of incision**

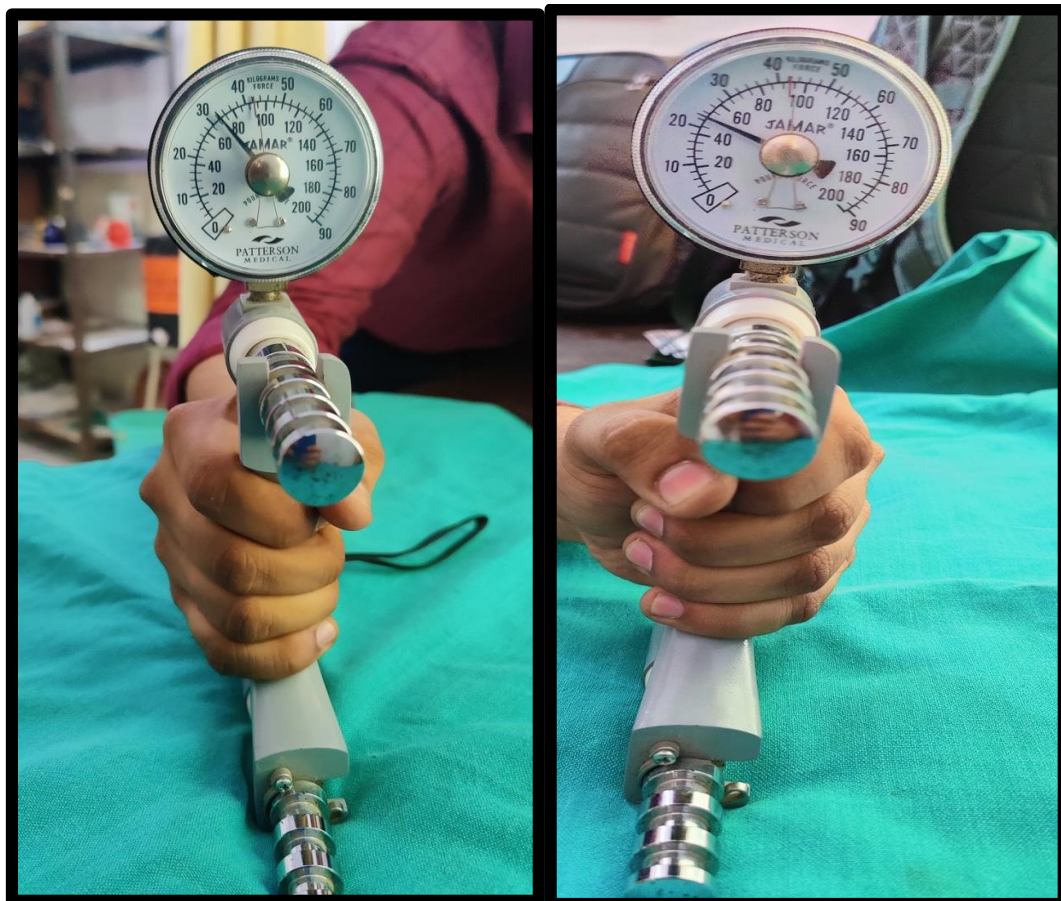


**Figure 9 : Follow up at 6 month**





**Figure 10: Jamar dynamometer**



**Figure 11: Unaffected (left image) & affected (right image) hand**

## DISCUSSION

The wrist joint is formed by the distal radioulnar joint, the radiocarpal joint, and the intercarpal joint. The radiocarpal joint is an ellipsoid joint formed by the proximal row of carpal bones and

distal end of radius. The distal radioulnar joint is a pivot joint which works together with the proximal radio-ulnar joint to produce pronation and supination of the forearm. Lister's tubercle is a bony prominence located on the distal radius which serves as a pulley for the extensor pollicis longus tendon and also as a surgical landmark<sup>6</sup>

There are 8 carpal bones arranged in 2 carpal rows. The proximal row from lateral to medial is represented by the scaphoid, lunate, triquetrum, and pisiform. The pisiform bone does not articulate with the radius. The distal carpal row from lateral to medial is formed by the trapezium, trapezoid, capitate, and hamate. The distal row of carpal bones articulates with the metacarpal bones. The bony anatomy is completed further by ligaments, extensor tendons which pass through 6 extensor compartments on the dorsal aspect of the wrist, flexor tendons passing through the carpal tunnel on the volar aspect of the wrist, the radial and ulnar arteries with their anastomotic arches as well as the radial ulnar and median nerves with their branches<sup>7</sup>. The distal radius contributes to 80% of the load of the wrist joint while the distal ulna bears 20% of the load.

There are three axes of motion within the wrist joint: supination-pronation, flexion-extension and radial-ulnar deviation. Supination- pronation is produced at the proximal and distal radio-ulnar joints. The radial deviation is produced 90% by the mid carpal joint while the ulnar deviation is produced 50% by the radio-carpal joint and 50% by the midcarpal joint. Flexion of wrist occurs 40% by the radiocarpal joint and 60% by the mid carpal joint while extension occurs 66% by the radiocarpal joint and 33% by the mid-carpal joint.<sup>[8]</sup>

Wrist arthrodesis was first demonstrated in the early 1900's. Various techniques for radiocarpal arthrodesis are simple decortication with removal of cartilage and fixation with Kirschner wires, use of a Rush rod from the third metacarpal to the metaphysis of the radius, slippage or rotation of a bone plate from the distal extremity of the radius, fixed distally in the carpal bones<sup>[9]</sup> fixation with a metal plate from the third metacarpal to the radius and grafting and fixation with a bone plate modelled from the iliac crest<sup>10</sup>.

Proponents of intramedullary rods or pins used mostly for inflammatory arthritis and connective tissue disorder have advantages such as decreased operative time, simplicity, lowered cost compared with other implants, and flexibility in positioning the wrist in the desired amount of flexion or extension<sup>11,12</sup>

The advantages of plating with autologous bone grafting include immediate rigidity, thus permitting early postoperative mobilization of metacarpophalangeal and interphalangeal joints, higher fusion rates, lower incidence of complications and lower cost in comparison to arthroplasty.



However, other factors, such as implant cost, patient size, bone quality, and clinical diagnosis, should be considered when selecting the appropriate implant type or method for wrist arthrodesis<sup>13</sup>.

## CONCLUSION

Wrist arthrodesis in dorsiflexion and ulnar deviation after proper denuding of cartilage is considered as a surgical procedure providing salvation when pain, deformity and instability compromise hand function<sup>[7]</sup>. The aim of this study was to present the technique and the results of wrist arthrodesis by using metal plate and close monitoring of wound healing, complications, and overall rehabilitation.

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