OUTCOME OF INTRAMEDULLARY NAILING OF PROXIMAL THIRD RADIUS FRACTURES IN ADULTS USING TALWALKAR SQUARE NAIL.

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Abstract

Background : In the management of Proximal Third Radius Fractures in Adults it is very important to take care of posterior Interosseous nerve, regain the length of the bones, maintaining the radial bow, good apposition, intact fracture haematoma and alignment without any malrotation, early mobilization of wrist and elbow to get good results. Intra medullary nailing of these fractures can be considered as a good alternative method. The aim of the study was to evaluate results of intramedullary nailing using Talwalkar square nails in adult forearm fractures.

Method: It's a prospective multicentric study where we treated 92 adult patients with Proximal Third Radius Fractures, isolated or along with ulna fracture with over the period of four years may 2013 to may 2018 with a follow up for one years.

Result: The average time to complete union was 12.1 (SD +3.2) weeks with cast support for a mean of 8.5 weeks. Union was achieved in 88 out of 92 patients. Using the Grace and Eversmann rating system, 57 patients were excellent, 24 were good, and 7 had an acceptable result. Four patients had non-unions, 2 for the radius and two for the ulna. There were three cases of superficial infection, two had olecranon bursitis. Complication rates associated with the use of square nails were lower compared to plate osteosynthesis and locked intramedullary nails. To control rotation postoperatively, there is a need for application of an above-elbow cast after nailing. There were no incidences of Posterior Interosseous Nerve injury

Conclusion: Use of Talwalkar's design of the square nail has resulted in and continues to result in predictable and good results. Complication rates are lower as compared to plate osteosynthesis, although application of above-elbow cast after nailing is a downside of the procedure. The square nail still has a future in repair of forearm fractures considering its complications rates, cost and acceptable results.

Keywords: Proximal Radius fractures, square nail, Talwalkar Nail, closed intramedullary nailing, radius-ulna nailing.

Introduction

The fractures of the shafts of the forearm bones are the one of the most difficult fractures of the shafts of long bones¹. The shortening, angulation, malunion, malrotation of either of these bones may result in a serious loss of elbow and wrist movements and pronation, supination of the forearm affecting the earning capacity of the individual as well as his day to day activities². The general consensus in the treatment of fractures of both bones of the forearm in adults is for operative treatment; and there are various modes of internal fixations available, the choice of which rests with the treating surgeon³. Closed intra medullary nailing of these fractures can be considered as a good alternative method. The procedure is minimally invasive and preserves the whole biology of fracture healing⁴. Intra medullary nails are load sharing devices and there is

secondary bone healing with good callus⁵, hence may not need cast immobilization after nail removal. The nail removal is also easy and involves small incisions.

The use of intramedullary devices to stabilize fractures is not new. Ivory pins, the Küntscher nail, the Rush nail, and Ender nails have all been in use⁶. Dr. Talwalkar designed and performed fixation of both bones of forearm fractures with flexible square nails⁷. Intramedullary nailing comes with its own sets of advantages and disadvantages. The chances of infection are significantly decreased, as it is a closed procedure and uses the least amount of periosteal stripping. It also has lower refracture rates after implant removal.

The aim of this study was to assess, in adults, the result of closed nailing and to evaluate the anatomical and

functional acceptance of the procedure using Talwalkar square nails.

Materials and Methods

The study was conducted at multiple centres in Mumbai and Solapur. The study was conducted from May 2014 to May 2018 on patients admitted from the emergency department or presenting in the outpatient department of the hospital. We evaluated 92 patients (49 males and 43 females) who met the inclusion and exclusion criteria. The inclusion criteria includes; age more than 18 years, patient not subjected to any other form of treatment, all open and closed fractures without neurovascular deficit, isolated Proximal Radius fracture and Proximal Radius fracture with associated Ulna shaft fracture. While the exclusion criteria were any skeletal immaturity, mid shaft Radius Fracture, lower Third Radius Fracture lower End Radius Fracture, very narrow intramedullary canal and presence of neurovascular deficit. All study participants were followed up for a period of one year.

Implant Design; Stainless steel Talwalkar Square nails were used for all patients for both radius and ulnar fractures. Nail diameters were 2.0mm, 2.5mm, 3.0mm, or 3.5mm, with nail lengths from 16cms to 36 cm for all surgical procedures. For both Radius and Ulna the nail with beveled edge was used for entry point and fracture site negotiation with a 1 cm notch for the tip. This adds to the flexibility and ease of negotiation along the radial bow (Figure 1). The nails have a threaded end for ease of insertion and removal.

Preoperative planning; radiographs were evaluated for each patient for type and location of fractures. (Figure 2a: Preoperative X ray of patient.)

The size of the nails was estimated on the normal limb radiograph. An ulnar nail was placed along the ulnar border of the uninjured forearm to estimate nail size. Alternatively, the length of the ulnar nail was measured from the tip of the olecranon to the ulnar styloid minus 1 cm. The radius nail was measured from the Lister's tubercle to the lateral epicondyle minus 3cm or through the radius styloid process. The length of the radius nail is usually 2 cm shorter than the ulnar nail. The diameter of the nail is also estimated on the pre-op x-ray and verified intraoperatively under the c-arm.

Operative procedure; Under general or regional anaesthesia (axillary block), the patient was positioned supine on the operating table with a radiolucent arm board. The shoulder was abducted and the elbow flexed 90 degree for the nailing of the ulna whereas for the nailing of the radius, the arm was extended. Traction was needed to reduce the fragments. No Tourniquet was used. We nailed the ulna first in case if both bone fractures, thereby providing a more stable forearm for retrograde nailing of

the radius. In case of comminution at fracture site, the less comminuted fractured bone was nailed first to maintain the correct length. The ulna was approached from the radial side of the olecranon tip. An incision of 1cm over the olecranon tip was made deep down to the bone. Entry was made with an awl suited for the radius-ulna nail diameter. The position of the awl was checked under C-arm image intensifier in the anteroposterior and lateral view. No reaming was performed with insertion of the square nails. An ulna nail of appropriate size was selected and loaded over a T-handle. The nail was pushed free hand into the medullary canal of the ulna while the assistant applied traction in the position favouring reduction, depending on the type of fracture. If the nail did get jammed, it was hammered lightly so that it made its way into the medullary canal. The position was checked using the C-arm. The distal end of the nail was usually within 1 cm of the tip of ulna. The end of the nail was buried inside the olecranon. In case of comminution in both bone fractures, the less comminuted bone was fixed first.

The radius was approached through the Lister's tubercle or the styloid process of the radius. A 2 cm incision was made just ulnar to the Lister's Tubercle on the dorsal surface and the soft tissue was divided. The 3rd extensor compartment was opened. The tendon of the extensor pollicis longus (EPL) was identified and retracted toward the ulna, and the radial shaft was in view.

The entry into the medullary canal was made with an awl, 1cm proximal to the articular surface. A radius nail of appropriate size was selected and pre-bent to match the radial contour. The radius nail is loaded over the T-handle with a Jacob's chuck and pushed with the bevelled edge of the radius nail sliding over the volar surface of the radius. The assistant holds and assists in reduction of the fracture. The position of the nail was checked repeatedly under C-arm in both planes during the procedure. We inserted the radial nail up to the radial head. Distally the nail was buried flush with approximately 5 mm left outside the bone for easy removal of the nail later. If in any case the reduction was difficult to achieve, a miniopen reduction was performed. All patients were immobilized with an above elbow slab and asked to perform active finger movements. Movement of the thumb was especially checked for any injury to the EPL tendon during surgery. Patients were discharged on the same day of surgery. Suture removal took place in two weeks and an another above elbow cast was applied.

Patients were evaluated weekly and radiographically at regular intervals. Results were assessed on the basis of the time to union, functional recovery and complications. (Figure 2b: Postoperative X ray of patient, AP and Lateral view). Union was defined as the presence of bridging bone or trabeculae spanning the fracture site. The

patients were also evaluated clinically for fracture site tenderness and pain on rotation. (Figure 3 a,b: complete pronation and complete supination in an operated patient). All patients were prescribed physiotherapy for range of motion and strengthening exercises.

At the last assessment, the degree of forearm rotation was measured with a goniometer. Functional outcome was calculated using the system described by Grace and Eversmann rating system. An excellent rating meant that there was union of the fracture and at least 90% of normal rotation arc of the forearm. A good rating required that the fracture be united and that a minimum of 80% of the rotatory movement are present. For an acceptable result, union of the fracture and a minimum of 60% of normal rotation of the forearm were present. An unacceptable result meant that there was a nonunion or that the patient had less than 60% of normal rotation of the forearm. Patient-rated outcome was assessed with the Disability of the Arm Shoulder Hand questionnaire (DASH)^{8,9}.

Results

The patients were followed up for a minimum of one year postoperatively with a mean age in males of 37.3 years (range, 18- 62 years) and a mean age in the females of 38.7 years (range, 18- 57 years). The right limb was fractured in 53 subjects and the left limb was fractured in 39 subjects. The most common mode of injury (Table 1) was road traffic accidents 48.91% (m=25;47.1%;f=20;51.28%), followed by fall in 25% (m=11=20.7%; f=12=30.7.6%) assault 15.21% (m=9;16.98%;f=5;5.3%), and occupational injuries 10.86% (m=8;15.09% f= 2;5.1%). Short oblique fractures were the most common type of fracture in the present study followed by transverse and comminuted fractures.

Table 1: Mode of fracture

Mode of fracture	Males	Females	Total percentage
Road traffic accident	25	51	48.91
Fall	11	12	25
Assault	09	05	15.21
Occupational injuries	08	02	10.86

There were two cases with open fractures, Gustillo-Anderson type II. These patients were treated with debridement, primary closure and nailing in the same sitting. 66 patients underwent surgery within 24 hours of the accident, 20 patients within 1-3 days and 6 patients were operated within 3-5 days.

No intraoperative complication occurred nor was any nailing converted to some other method of fixation. The average hospital stay was 3 days (range, 2- 5 days). There were three (3.2%) cases with superficial infection at the ulnar entry site that subsided with oral antibiotics for one

week. Two subjects had olecranon bursitis at long term follow-up. The bursa was excised and the implant was removed. The patient was symptomless at the end of 7 months follow-up after implant removal. There was no implant breakage or irritation due to nail or implant back-out.

The average time to union was 12.1 weeks (range, 10-28 weeks). Cast support was maintained for a mean of 8.5 weeks (range, 5- 12 weeks) and continued till radiographic union was seen. There were four cases of delayed union, which subsequently showed radiographic union at 27 weeks. There were four cases of non-union two in the radius and two case of non-union in ulna. These subjects required autologous bone grafting. There was no loss of flexion or extension in any of the patients as compared to the other arm Pronation and supination was restricted in eight patients (8.6%). Four patients (4.3%) had nonunions.

Using the Grace and Eversmann rating system, 57 patients were excellent, 28 were good, and 7 had an acceptable result.

Figure 1: Talwalkar Square nail

Figure 2a: Preoperative X ray of patient.

Figure 2b: Postoperative X ray of patient, AP and Lateral view

Figure 3a: Clinical picture of Complete Pronation of forearm

Figure 3b: Clinical picture of Complete Supination of forearm

Discussion

Plate fixation has been considered the gold standard for fixation of proximal third radius fractures. Several studies have shown good results¹⁰. Droll et al¹¹ compared injured arms to uninjured arms, following internal fixation of the forearm fractures, and found that injured arms had reduced strength of forearm pronation (70%) of that of the normal arm, forearm supination (68%), wrist flexion (84%), wrist extension (63%), and grip (75%). In addition, the injured arms had a significantly reduced active range of forearm supination (90%), forearm pronation (91%) and wrist flexion (82%).

Possible complications include compartmental syndrome¹², delayed union or non-union¹³ and re-fractures after extraction of the plate¹⁴. A high frequency of intraoperative nerve injuries has also been reported¹⁵. The reported incidence of transient dorsal nerve palsy is 7 to 10% of all patients with radius fracture treated by plating¹⁶. Incidence of radio-ulnar synostosis of the plate fixation is reported in the literature is 2% to 9%¹⁷. Though plating for both forearm bones fracture is a sound practice and adheres to the principles of osteosynthesis, a straight plate is unable to maintain and preserve the radial bow, essential for normal rotational movements of the forearm¹⁵.

Closed nailing has many advantages, including early union, low incidence of infection, small scars, less blood loss, and, frequently a relatively short operating time with minimal surgical trauma. In our experience, the main complications

during surgery were due to improper nail size. Another important advantage of intramedullary implants is their stress-sharing behaviour, which facilitates secondary periosteal callus formation¹³. In the present case series, the average operating time and the average fluoroscopy exposure for fixation of both forearm fractures was comparable to other studies¹⁸.

We achieved union in 88 out of 92 patients (95.65%) compared to Street et al who reported a 93% union rate with the use of square nails in forearm fixation¹⁹. Moerman et al, achieved 94% union, using the same evaluation criteria; union time with the intramedullary technique was shorter than with other techniques¹⁶.

Four cases in our series had non-union; all bone grafted and achieved union at 6 months follow up. The cause of non-union in our study was distraction at the fracture site in three cases, two in radius and one in ulna and inadequate immobilization in one subject in the radius. Cast support was given to patients for a mean 8.2 weeks (range 5 to 12 weeks). As most cases were closed procedures and an above elbow (AE) cast was used postoperatively, final functional outcomes were improved²⁰. Implant removal was performed in 6 patients at mean 19 months post operatively and no re-fractures were reported even after an average of 9 months post removal which is lower than those associated with plate removal.²¹

Conclusion: Use of Talwarkar's design of the square nail has resulted in and continues to result in predictable and good results in proximal third radius fractures. Complication rates are lower as compared to plate osteosynthesis and even locked intramedullary nails, although application of above-elbow cast after nailing is a downside of the procedure. The square nail still has a future in repair of forearm fracturing considering its low complication rates, cost and acceptable results.

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