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A retrospective comparative study of plate osteosynthesis and intramedullary nailing in humerus shaft fractures

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Abstract

Fractures of the humeral shaft account for roughly 3% of all fractures, most can be treated non operatively. The range of motion afforded by the shoulder and elbow joints, coupled with a tolerance for small amounts of shortening, allow radiographic imperfections that cause minimal functional deficit and are well tolerated by the patient. In recent times, more and more cases are being operated, in view of the advantages of operative treatment. Operative treatment results in a more predictable alignment and faster healing which makes early mobilisation possible. The advantages, disadvantages, and risks of both nonoperative and operative treatment should be discussed with the patient before a decision is made. We did a retrospective study of 30 cases of fracture shaft of humerus of which 15 were fixed with compression plating and 15 with an interlocking nailing To compare the results of compression plating and interlocking nailing in the treatment of fracture shaft of humerus with reference to 1.the time of healing, 2.functional outcome and 3.complications like infection, failure of implant and neurovascular injuries. If there are no clinical and radiological signs of union by 18 weeks, the fracture was categorized as delayed union and absence of fracture union after 32 weeks after injury was categorized as non-union. The functional outcome was measured by the "Disabilities of Arm, Shoulder and Hand" (DASH) Questionnaire at nine months or at full recovery whichever was earlier. The result was then graded as Excellent (0 to 20 Points), Good (21 to 40 points), Fair (41 to 60 points), Poor (> 60 points). The time taken for healing, the functional outcome and the complications in both groups were then compared. A review of the available relevant literature was also done.

Keywords: humeral shaft fractures, compression plating, interlocking nailing, disabilities of Arm, Shoulder and Hand (DASH) score

Introduction

Fractures of the humeral shaft account for roughly 3% of all fractures, most can be treated non operatively. The range of motion afforded by the shoulder and elbow joints, coupled with a tolerance for small amounts of shortening, allow radiographic imperfections that cause minimal functional deficit and are well tolerated by the patient. In recent times, more and more cases are being operated, in view of the advantages of operative treatment. Operative treatment results in a more predictable alignment and faster healing which makes early mobilisation possible. The advantages, disadvantages, and risks of both nonoperative and operative treatment should be discussed with the patient before a decision is made.

The goal of operative treatment of humeral shaft fractures is to re-establish length, alignment, and rotation with a stable fixation that allows early motion and ideally early weight bearing on the fractured extremity. Options for fixation include plate osteosynthesis, intramedullary nailing, and external fixation.

Plate osteosynthesis remains the "gold standard" of fixation for humeral shaft fractures. Plating can be used for fractures with proximal and distal extension and for open fractures.

The success of intramedullary nailing in the lower extremities led to an initial enthusiasm for intramedullary nailing of the humeral shaft. Although there are many reports in the literature of good results with nailing techniques, problems with insertion site morbidity and union rates have dampened the original enthusiasm for this mode of treatment.

AIM

To compare the results of compression plating and interlocking nailing in the treatment of fracture shaft of humerus with reference to 1.the time of healing, 2.functional outcome and 3.complications like infection, failure of implant and neurovascular injuries

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Materials and Methods

We did a retrospective study of 30 cases of fracture shaft of humerus of which 15 were fixed with compression plating and 15 with an interlocking nailing.

Inclusion Criteria- Failure to obtain and maintain adequate closed reduction (Shortening>3cm Rotation>30degrees Angulation>20degrees) in skeletally mature patients who consented for operative treatment after discussion about the advantages and disadvantages of the operative treatment as well as by continuing with the conservative treatment

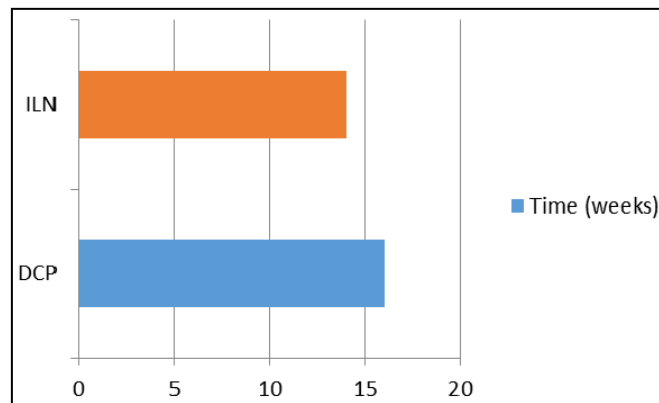
Exclusion criteria-1.Segmental fracture 2.Pathological fracture 3.Intraarticular extension (shoulder joint, elbow joint) 4. Polytrauma patients 5. Head injury patients.

The status of radial nerve preoperative and at follow up was recorded in all the patients.

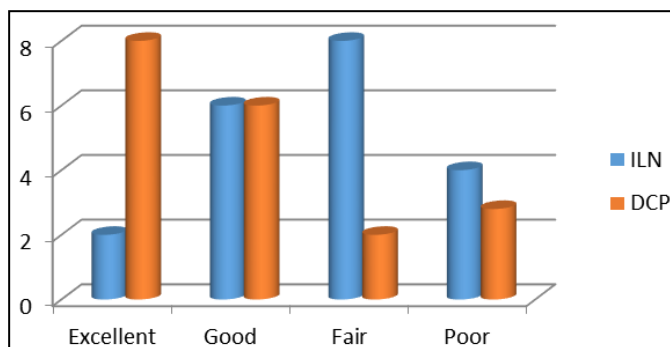
Postoperatively, range of motion of the shoulder and elbow is begun within the first week.

For follow up and evaluation, the time taken for clinical and radiological union was noted. If there are no clinical and radiological signs of union by 18 weeks, the fracture was categorized as delayed union and absence of fracture union after 32 weeks after injury was categorized as non-union. With regards to the radial nerve injury, return of 5/5 power was regarded as complete recovery. The functional outcome was measured by the "Disabilities of Arm, Shoulder and Hand" (DASH) Questionnaire at nine months or at full recovery whichever was earlier. The best possible score being 0 and 100 being the worst possible score. The functional outcome decreases as the score increases. The result was then graded as Excellent (0 to 20 Points), Good (21 to 40 points), Fair (41 to 60 points), Poor (> 60 points).The time taken for healing, the functional outcome and the complications in both groups were then compared. A review of the available relevant literature was also done.

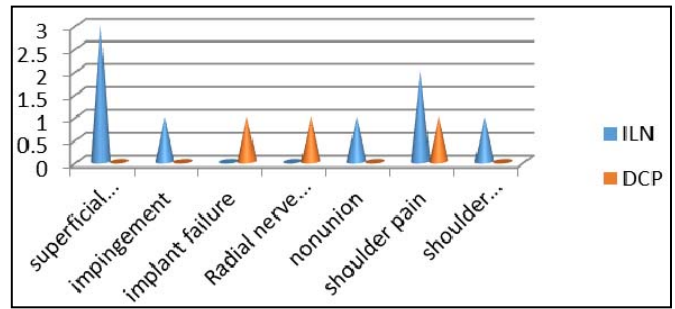
Results



Graph 1: Comparison of Time to Healing



Graph 2: Comparison of Functional Score



Graph 3: Comparison of Complications

The age of our patients varied from 22 years to 65 years, the average age was 35 years. There were 18 males and 12 females. 17 patients had suffered fractures from motor vehicle accidents, 2 were domestic injuries, 10 fell from height and 1 was a sports injury. The right arm was involved in 20 patients and left arm in 10 patients. 3 patients had pre-operative radial nerve palsy, out of which 2 patients recovered completely. The duration from injury to treatment varied from 1 to 15 days (average being 5 days). Among the 15 patients in the DCP group posterior approach was used in 8 patients and an anterolateral approach was used for the remaining 7 patients. Among the 15 patients in the interlocking group, an 8mm nail was used in 11 patients, whereas 7mm nail was used for 4 patients. Only ante grade nailing was done.

We had 2 cases of non-union following nailing. We encountered 3 patients who presented with a concomitant radial nerve palsy were examined at each visit and power was noted.

The time of healing was slightly longer in the plate osteosynthesis group, but this group had more excellent results as per the DASH score. The complications of shoulder pain, shoulder stiffness, impingement, superficial infection and non-union were more in the nailing group, whereas the plate osteosynthesis group had more of implant failure and radial nerve injury.

Discussion and Review of Literature

There are pros and cons of both the methods of fixation. In our study, the time of healing was slightly longer in the plate osteosynthesis group, but this group had more number of excellent results as per the DASH score. The complications of shoulder pain, shoulder stiffness, impingement, superficial infection and non-union were more in the nailing group, whereas the plate osteosynthesis group had more about implant failure and radial nerve injury.

Charnley had stated long back that Shaft of humerus fracture is perhaps the easiest of the major long bones to treat with conservative methods. Historically, methods of conservative treatment have included skeletal traction, abduction casting and splinting, Velpeau dressing, and hanging arm cast, each with its own advantages and disadvantages.

A nonrandomized study by Jawa *et al.* compared outcomes in 21 distal-third diaphyseal fractures treated with functional bracing to those of 19 treated with plate-and-screw fixation. Operative treatment resulted in more predictable alignment and faster healing, but was associated with more complications, such as iatrogenic nerve injury, loss of fixation, and infection.

Options for fixation include plate osteosynthesis, intramedullary nailing, and external fixation. External fixation generally is reserved for high-energy gunshot wounds, fractures with significant soft tissue injuries, and

fractures with massive contamination. Suzuki *et al.* suggested that immediate external fixation with planned conversion to plate fixation within 2 weeks is a safe and effective strategy for treatment of humeral shaft fractures in selected patients with multiple injuries or severe soft tissue injuries that preclude early plate fixation

Plate osteosynthesis provides enough stability to allow early upper extremity weight bearing in polytrauma patients and produces minimal shoulder or elbow morbidity, as shown by Tingstad *et al.* Numerous reports in the literature cite high union rates, low complication rates, and rapid return to function after plate fixation of humeral shaft fractures. Five large series (Foster *et al.*, McKee *et al.*, Vander Griend *et al.*, Bell *et al.*, and Tingstad *et al.*) including 361 fractures had an average union rate of 96.7%. A prospective, randomized comparison of plate fixation and intramedullary nail fixation of humeral shaft fractures found no significant differences in the function of the shoulder and elbow, but shoulder impingement occurred more often with intramedullary nailing and a second surgical procedure was required in more patients with intramedullary nails than with a plate. Another study comparing antegrade intramedullary nailing with plating found that although patients had slightly more shoulder pain after intramedullary nailing than after plating, there was no difference in shoulder joint function except for flexion, which was better in patients with plating. A meta-analysis of the literature that included 155 patients found that reoperation and shoulder impingement were significantly more common after intramedullary nailing than after compression plating. In their updated metaanalysis, Heineman *et al.* concluded that the data were insufficient to show superiority of either technique. As minimally invasive plate osteosynthesis has become popular in other long bones, its use for humeral shaft fractures has been suggested; however, risk of injury to the radial nerve has been a concern. A cadaver study determined that with minimally invasive plate osteosynthesis the plate is 2 to 4.9 mm (average 3.2 mm) from the radial nerve. Pronation of the forearm moves the radial nerve closer to the plate by 3 mm. This technique has not been proved in any large series of patients.

The success of intramedullary nailing in the lower extremities led to an initial enthusiasm for intramedullary nailing of the humeral shaft. Although there are many reports in the literature of good results with nailing techniques, problems with insertion site morbidity and union rates have dampened the original enthusiasm for this mode of treatment. The theoretical advantage of intramedullary nailing included less invasive surgery, an undisturbed fracture hematoma and use of a load sharing device support. Shoulder pain has been reported after antegrade intramedullary nailing in 16% to 37% of patients in more recent studies, and Bhandari *et al.* found that reoperation and shoulder impingement were significantly more common after intramedullary nailing than after plate fixation. Due to the presence of various confounding variables, a large well-controlled trial is needed to come to a definite conclusion. Early flexible nails, such as Rush and Enders, provided little axial or rotational stability and required additional forms of stabilization (cerclage wiring or prolonged immobilization) in comminuted or unstable fractures. The development of locking nails improved stability and rotational control, but results still did not reach the successful outcomes obtained in lower extremity fractures. Newer self-locking expandable nails are reported to be easier to insert, while providing bending and

torsional stiffness equal to that of locked nails. Few clinical studies are available to allow evaluation of these nails. Franck *et al.* described the use of an expandable nail for fixation of 25 unstable humeral shaft fractures in elderly patients with osteoporotic bone; all fractures healed without complications. Stannard *et al.* used a flexible locking nail for fixation of 42 humeral shaft fractures, with healing in 39; 86% had full range of motion, and 90% had no pain. Five complications occurred in four patients: two nonunions, two hardware failures, and one wound infection. All complications occurred in patients whose fractures were fixed with 7.5-mm nails, and the authors recommended that flexible nails should be used with caution in medullary canals with a diameter of 8 mm or less. The technique is technically demanding.

Clinical Photographs



Case 1



Case 2

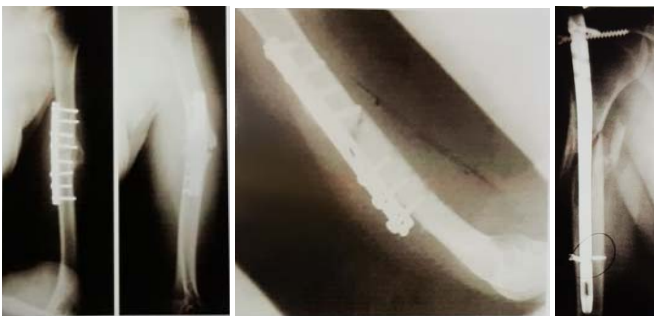




Case 3



Case 4



Implant failure 1

Implant Failure 2

Nonunion

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