



COMPARATIVE STUDY OF FUNCTIONAL OUTCOME OF LIMITED CONTACT DYNAMIC COMPRESSION PLATING AND INTERLOCKING NAILING FOR FRACTURE SHAFT OF HUMERUS IN ADULTS

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ABSTRACT

INTRODUCTION:

Fractures of the humeral shaft are common, accounting 3% of all fractures. They have traditionally been treated conservatively using either a hanging arm cast or a functional brace. However loss of reduction in the plaster cast invariably leads to malunion. Operative treatment for humerus fractures has usually been reserved for open fractures, nonunion, associated forearm fractures, polytrauma, and neurovascular complications. Two surgical techniques under study include intramedullary nailing and dynamic compression plate fixation. The purpose of this study is to compare the outcomes of each method and to analyse statistically significant difference in the results. **METHODOLOGY:** The present comparative study was conducted in patients treated surgically for shaft of humerus fracture from April 2019 to April 2020 centered at FATHER Muller Medical Hospital, Mangalore. Thirty eight patients were taken into the study, out of which 20 underwent LCDCP plating and 18 intramedullary nailing. All were assessed for radiological union, complications and functional outcome at 6weeks, 12weeks and 1 year using DASH questionnaire **RESULTS:** There was no statistically significant difference in the two groups with respect to age, mode of injury, side of injury and AO type. The average age of patients was 40.63years. Road traffic accident was the most common mode of injury. The left side humerus was involved more often. The functional outcome was better in LCDCP group, which was statistically significant (P= 0.015). **CONCLUSION:** We are of the opinion that when surgery is opted as a choice of treatment, both the modalities of treatment i.e.LCDCP Plating and interlocking nailing are good as far as union of the fracture is concerned, but considering the number of complications and functional outcome, we opine that plating offers better result than nailing with respect to function of the shoulder joint.

KEYWORDS

HUMERUS; DIAPHYSEAL HUMERUS FRACTURE; LIMITED CONTACT DYNAMIC COMPRESSION PLATE; INTERLOCKING NAIL; DASH QUESTIONNAIRE

INTRODUCTION

Fractures of the humeral shaft are common and accounts for 3% of all fractures¹. Fractures of humeral shaft have traditionally been treated conservatively with high percentage of primary healing using either a hanging arm cast or a functional brace. However loss of reduction in the plaster cast invariably leads to malunion. Operative treatment for humerus fractures has usually been reserved for open fractures, treatment of nonunion, associated fractures of the forearm, for polytrauma patients, and for those with neurovascular complications. The advantages of operative management are early mobilization and patient comfort². But, surgical management carries the risk of loss of fixation, infections, nerve injuries etc. Most of the studies have used fracture union as the major determinant of the outcome and very few studies have examined the functions at the shoulder and elbow.

Two techniques under study include intramedullary nailing and dynamic compression plate fixation. The optimal method of humeral shaft fracture fixation remains in debate.

Plating provides satisfactory results but requires extensive dissection, and meticulous radial nerve protection. The plate may fail in osteoporotic bone.

With the dynamic success of intramedullary fixation of fractures of the femur and tibia, there was speculation that intramedullary nailing might be more appropriate for humeral shaft fractures than dynamic compression plating.

The theoretical advantage of intramedullary nailing included less invasive surgery, an undisturbed fracture hematoma and use of a load sharing device support.²

However, the success of interlocking nailing in long bones like femur

and tibia is not seen in humerus. According to recent studies the preferred method of fixation of humeral fractures is by dynamic compression plate.

The purpose of this study is to compare the outcomes of each method of fixation (limited contact dynamic compression plating and interlocking nailing) for the fracture shaft of humerus and to analyze statistically significant difference in the results of these two methods.

AIMS AND OBJECTIVES

To compare the results of limited contact dynamic compression plating and interlocking nailing in the treatment of fracture shaft of humerus with respect to

1. Rate of healing
2. Functional outcome and
3. Complications

REVIEW OF LITERATURE

Man was never immune to injury and, even in the neolithic age primitive techniques of bone setting were present. The earliest examples of splinting were seen in mummies found in Egypt.

Hippocrates³ in 460-377 B.C proposed two principles of fracture management.

1. Traction and counter-traction for fracture reduction.
2. Exercise strengthens, inactivity causes wasting of muscles.

Sabancıoğlu a Turkish physician in 15th century described reduction of humerus fracture and maintenance using a wooden splint and bandage from shoulder to the elbow.⁴

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Hansmann⁷ of Hamburg first described the use of plates to fix a fracture. He used a malleable plate, the end of which was bent so as to project out through the skin for later removal. Later Arbuthnot lane advocated the procedure for the management of humeral fractures under certain conditions. Plating was finally popularized by the AO group.

Mast and Colleagues¹⁰ in 1974 reported 5 percent non unions and 15 percent delayed unions in a series of 100 patients with humeral shaft fractures treated with closed techniques (either U slab, hanging arm cast and thoracobrachiastica).

Rush¹¹ brothers advocated intramedullary nailing of the humerus; they used elastic nails in the proximal diaphyseal fractures. The principle of the nail was that it allows for three point fixation in the intramedullary canal.

The first use of compression plating was by Danis¹³ in 1949, who used an axially oriented screw to achieve compression.

The design of the screw holes called for a ramp at the margin of the side of the plate hole which allowed increased compression to be applied to the bone. It is also possible to angulate the screw in the holes thus enabling the placement of an interfragmentary screw through the plate. This was a revolution in treatment of diaphyseal fractures. Good results after plating became the rule rather than the exception.

Perren¹⁷ in 1989 introduced the limited contact dynamic compression plate (LC-DCP). He described the following aims of this new concept.

- Minimal surgical damage to the blood supply
- Maintenance of optimal bone structure near the implant
- Improved healing in the critical zone in contact with the plate
- Minimal damage to the bone lining at plate removal with reduced risk of refracture.

Lin¹⁸ in 1998 conducted a comparative study of treatment of humeral shaft fractures by interlocking nail and plate fixation. He concluded that interlocking nail offered a less invasive surgical technique and more favorable treatment results than plate fixation. He suggested that correct nailing direction, precise surgical techniques, less bulky hardware and stable transfixing screws are the keys to a successful treatment.

Kropflet al¹⁹ in 2000 conducted a study of 111 Humerus fractures stabilized with antegrade interlocking nailing and stated that it is a safe technique regarding consolidation rate with advantages regarding mobilization of the upper limb. Careful suturing of the rotator cuff and counter sinking of proximal nail tip is a prerequisite in avoiding permanent lesions of the rotator cuff and shoulder pain.

Chapman and Colleagues²¹ in a randomized prospective study of 84 patients found that there was no significant difference in shoulder pain, function scores, range of motion and strength following intramedullary nailing and those treated by compression plating. Antegrade insertion of the nail, if carried out properly, is probably not the main reason for shoulder joint impairment after intramedullary nailing.

Niall and colleagues²³ reviewed 49 patients following plate osteosynthesis of humeral shaft fractures. Forty seven fractures (96%) healed radiologically at 14 weeks following surgery. They found no complications as a result of surgery and advocated

plating of humeral shaft fractures as the treatment of choice for non pathological humeral shaft fractures that require operative intervention.

Chen and Andrew²⁴ in 2002 compared fixation stability in 6 matched pairs of human humerus fractures with locked antegrade intramedullary nail or a DCP during cyclic and physiologic loading. They showed that cyclic loading showed no difference between the two groups for average gap displacement or construct stiffness. However, intramedullary fixation has greater failure strength when compared with plate fixation. This may be important for upper extremity partial weight bearing after surgical fixation of diaphyseal

fractures. Putti²⁶ in 2003 compared fixation stability in humeral fractures fixed with intramedullary nail or DCP. In IMN group, no patient had non-union or infection both groups were comparable in terms of functional outcomes and rates of union. The complication rate was higher in IMN group mostly pertaining to shoulder pain.

M.Changulani and colleagues²⁹ in 2006 found that intramedullary interlocking nailing can be considered as a better surgical option for the management of diaphyseal fractures as it offers a short union time and lower incidence of infection. They also found that there was no difference in the rate of union and functional outcome.

Mohsen³⁰ in his study between 2008-2012 found that the risk of shoulder impingement syndrome and restriction of shoulder and elbow joints was observed minimally or not at all as the proper nail length was determined before surgery on the basis of intact limb radiograph and physiotherapy initiated immediately after surgery.

Raghavendra and Haresh³¹ between 2000-2003 in a comparative study of 36 patients underwent compression plating and antegrade interlock nailing. They found no significant difference between plating or nailing in terms of time to union, compression plating is the preferred method in the majority of fractures of the shaft of the humerus as the joint function is better preserved and lesser need for secondary bone grafting

TREATMENT

Management is of two types

1. Non Operative.
2. Operative.

NON OPERATIVE TREATMENT

Humerus is one of the easiest of the long bones to treat by conservative methods. Hence, closed treatment was the initial treatment of choice for most humeral shaft fractures with a union rate of 90 – 100% could be expected.

The humeral shaft is well enveloped by muscle and has robust blood supply. The wide range of motion of the shoulder and the elbow allows for accommodation of certain degrees of angular, axial and rotational malunion³⁷.

The various treatment modalities can be broadly divided into two groups.

1. Dependency traction methods.
2. Thoraco brachial immobilization.

Dependency traction – here gravity reduces the fracture and maintains the reduction as long as the arm is dependent :

1. Hanging arm cast.
2. Coaptation splint or 'U' slab.
3. Functional cast bracing.
4. Skeletal traction.

The types of Thoraco brachial immobilization are

1. Jacksonville sling2 or Stockinette Velpeau shoulder dressing.
2. Sling and swathe.
3. Open Velpeau type cast.
4. Shoulder spica.

OPERATIVE TREATMENT

The goal of operative treatment of humeral shaft fractures is to reestablish length, alignment, and rotation with stable fixation that allows early motion and ideally early weight bearing on the fractured extremity.

Though majority of the simple fracture are managed non operatively³⁷. The indications for operative treatment are.

1. Fracture indications
 - a) Failure to obtain and maintain adequate closed reduction. Shortening greater than 3 centimeter.
 - Angulation greater than 20 degrees.
 - Rotation greater than 30 degrees
- b) Segmental fractures
- c) Pathologic fractures.
- d) Intraarticular extension.

2. Associated injuries.

- a) Open wound.
- b) Vascular injury.
- c) Brachial plexus injury.
- d) Ipsilateral forearm fractures.
- e) Bilateral humeral fractures.
- f) Lower extremity fractures requiring upper extremity weight bearing
- g) Burns.

The main methods for internal fixation of humeral shaft fractures are :

1. Intramedullary nailing.
2. Plate and Screws.
3. External fixation.

MATERIALS AND METHODS

Source of Data

Patients with shaft of humerus fracture operated in Fr. Muller Medical College, Mangalore during April 2019 – April 2020.

Method of Collection

Forty adult patients with fracture shaft humerus treated at Father Muller Medical College will be evaluated pre-operatively and the functional outcome will be assessed post-operatively. The study was initiated after obtaining ethical clearance from the institutions ethical clearance committee.

Inclusion criteria

1. Patient aged 18 years and above.
2. Only the diaphyseal humeral fractures.
3. Closed fractures.

Exclusion Criteria

1. Patients treated conservatively.
2. Patients lost to follow
3. Pathological fractures and
4. Non union
5. Poly trauma

METHOD OF STUDY:

The patients who met the inclusion and exclusion criteria were included in the study after taking informed consent. A thorough history and clinical examination was done.

The humeral shaft fracture was temporarily immobilized with a U-slab and arm pouch.

We used either limited contact dynamic compression plate or interlocking nail for 40 patients between April 2019 and April 2020 admitted at Father Muller Medical College and Hospital, Mangalore for stabilization of fracture of the humeral diaphysis.

Interlocking nailing or plating was done alternatively after pre-operative planning and investigations.

FOLLOW UP AND CRITERIA FOR EVALUATION

The patients were followed up at 6 weeks, 12 weeks and 1 year using DASH questionnaire. At every follow up clinical examination was done to assess status of the surgical wound, pain, tenderness, range of motion of shoulder and elbow. The Dash scoring system is a very useful tool to measure function of the upper limb developed by the American Academy of Orthopaedic Surgeons (AAOS) and has been validated by various studies. (46,47)

The DASH questionnaire has thirty questions the answers of which are graded from one to five points. The functional score is calculated by the formula

DASH DISABILITY / SYMPTOM SCORE = $\{(\text{sum of } n \text{ responses} - 1) \times 25 / N$

Where 'N' is the number of responses. The best possible score is '0' and the worst possible score is '100'. The functional outcome decreases as the score increases.

The result was then graded as Excellent, Good, Fair and Poor as follows

Excellent – 0 to 20 Points.

Good – 21 to 40 points.
Fair – 41 to 60 points.
Poor – Greater than 60 points.

Data- analysis:

Collected data was analyzed by ANOVA for repeated measures, and Chi-Square test

Chi-square/ Fisher Exact test has been used to find the significance of study parameters on categorical scale between two or more groups, Non-parametric setting for Qualitative data analysis. Fisher Exact test used when cell samples are very small.

SAMPLE SIZE CALCULATION

$n = 2(Z \alpha + Z \beta)^2 \times \frac{d^2}{\sigma^2}$
 $Z \alpha = 1.96$ at 95% confidence interval
 $Z \beta = 1.28$ at 90% power
 $\sigma = SD = 0.42$
 $= \text{mean difference} = 0.42$

With 95% confidence interval and 90% power with reference to a study done by Changulani et al 20 in each group.
 $n = 40 (20 \times 2)$.

A sample of size of 40 patients was selected using purposive sampling technique.

20 patients underwent limited contact dynamic compression plating.
 20 patients underwent inter-locking nailing