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ORIGINAL ARTICLE

INTER-LOCKING NAIL-A VIABLE OPTION IN FIXATION OF FRACTURE HUMERUS: OUR EXPERIENCE

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ABSTRACT: BACKGROUND: Fracture Humerus is one of the common injuries in our outpatient departments, and the incidence is on the raise due to increased Road Traffic Accidents. At one time the standard treatment for these injuries is one of conservative but with the advances in the field of orthopedics more and more surgeons are veering round to surgical means to fix these fractures. Out of all the implants which are being used in treating these fractures Inter locking intramedullary nailing is gaining popularity these days. Here in this study we are sharing our experience of using Interlocking nail in the management of diaphyseal fractures of humerus. **MATERIALS & METHODS:** A total of 25 cases of fracture shaft of humerus were selected and were treated by means of Interlocking nail, during a period of two years i.e, from august 2009 to September 2011, in MGM hospital which is attached to Kakatiya Medical College, Warangal. **RESULTS:** Out of the 25 cases which were operated, 1 case was lost for follow up. 18 cases (76%) had excellent results, 4 cases (16%) had moderate results and 2 cases (8%) had poor results. **CONCLUSIONS:** In our experience we found that Interlocking Intramedullary nailing is a viable option in the management of Diaphyseal fractures of humerus and has more advantages over other methods of fixation of these fractures.
KEYWORDS: Inter locking Nail, Fracture Humerus.

INTRODUCTION: Trauma has been the leading cause of morbidity and mortality and is on the rise in the present age. The victim of bony injury faces prolonged immobilization and loss of wages and it's a tough time for the entire family. Besides, the patients often may have to live with the sequelae of stiff joints and functional disability (The fracture disease). Fractures of the shaft of humerus have been treated conservatively since ages, with good results. Sir John Charnley[1] in his treatise "The closed treatment of common fractures "even states" it is perhaps one of the easiest major long bone fractures to treat by conservative methods."

However, conservation treatment cannot be recommended in every case. Prolonged limb immobilization, the need for constant cooperation and repeated hospital visits are the obvious demerits. More ever, unstable (Spiral/long oblique) fractures, comminuted fractures, segmental fractures, pathological fractures, open fractures, fractures with delayed or nonunion and fractures associated with redial nerve injury or major vascular injury are essentially to be treated operatively.

Early restoration of joint motion return to normal physiologic function and minimal morbidity is now regarded as ideal fracture treatment. Though plate fixation has given high rates of union, it requires extensive surgery, with stripping of the soft tissues from bone, increase chances of infection or nerve damages, less secure fixation in osteopenic bone and delayed mobilization of shoulder and elbow. Further, these is stress shielding of bone by the plate and reduced strength of union due to primary osteal healing compared to callus healing seen otherwise. Intramedullary nailing with a conventional "V" nail of Kuntscher, rods of Rush, Enter or Hackethal have been used with varied results.

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These devices however, act merely as internal splints and do not provide rotational stability, so that unrestricted movements cannot be allowed in every patient and external protection in some from or other is needed.

Rigid intramedullary nailing technically avoids these problems. Surgeons are now trying to balance the dis-advantage of conservative and operative management by minimal surgical intervention (Biological fixation by closed intramedullary nailing). Rotatory and torsional stability and alignment are most reliably achieved by transverse locking screws at each end, thus allowing early mobilization and its obvious advantages.

Even shaft fractures with severe comminution, bone loss and pseudoarthrosis can be effectively treated by this method. The availability of image intensifier control has made closed interlocking nailing easily possible in most centers, thus permitting the advantage of closed over open techniques. Ultimately, the best treatment should be determined by thoughtful analysis of the morphology of the fracture, the amount of energy imparted to the extremity by the trauma, the mechanical characteristics of the bone and age of the patient.

The present study attempts to highlight the use of under reamed Interlocking intramedullary nailing of the humerus and evaluate the results and complications related to the procedure.

AIMS AND OBJECTIVES:

1. To study the results of fixation of the shaft of humerus by rigid interlocking intramedullary nailing.
2. To determine whether it is a safe, simple and reliable method in the management of these fractures.
3. To study the effect of this method on shoulder and elbow joint function.
4. To study the operative difficulties encountered.
5. To study the incidence of complication with this method.

MATERIALS AND METHODS: The present study consists of 25 cases of fracture shaft humerus operated at MGMH, Warangal. Twenty five cases of Diaphyseal fractures of humerus in adults were treated by interlocking intramedullary nail during the period from August 2009 to September 2011 in MGM hospital/Kakatiya Medical College, Warangal.

The patient's age group ranging from 20-80 years (avg. 41.3 yrs). (Table & Graph 1).

Age in Years	No. of Cases	Percentage
20-40	4	16.6
41-60	12	33.3
61-80	8	50

Table 1: Age distribution of patients

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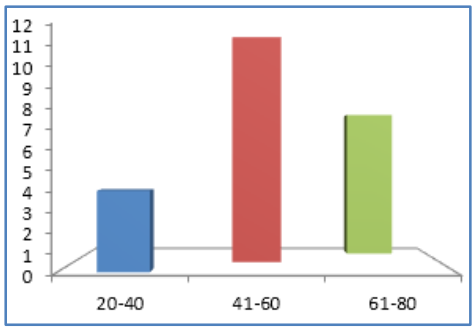
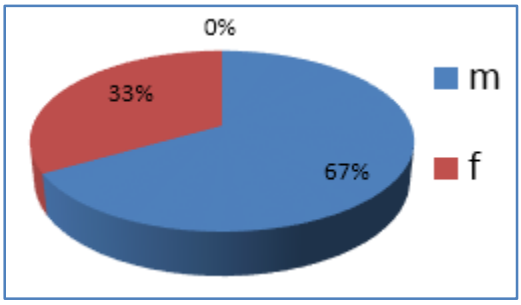


Graph 1: Age distribution of patients

There were 16 males and 8 females (Table & graph 2).

Sex	No. of Cases	%
Males	16	66.6
Females	8	33.3

Table 2: Sex Distribution

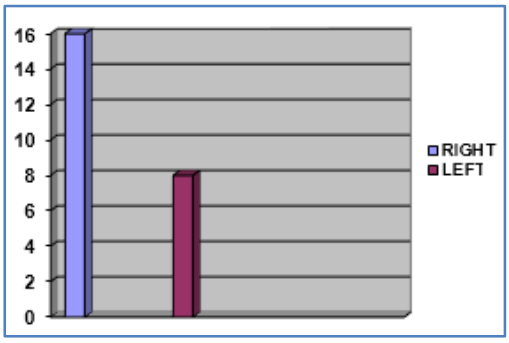


Graph 2: Sex Distribution

16 patients presented with fracture of right arm, and 8 on left arm (Table & Graph 3).

Side	No. of Cases	%
Right	16	66.6
Left	8	33.3

Table 3: Side Affected



Graph 3: Side Affected

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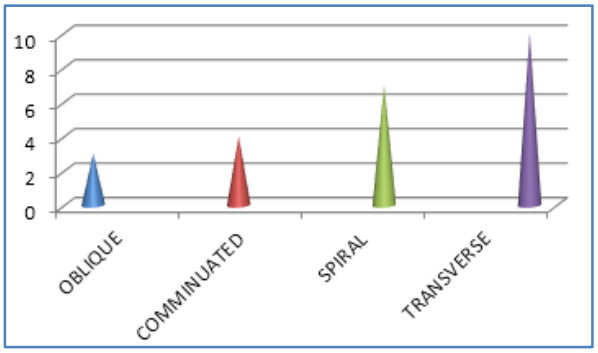
All 20 cases were closed fractures.

Out of 24 cases, there were 19 fresh fractures, 4 nonunion, and 1 pathological fracture.

4 fractures were comminuted, 10 were of transverse type, 7were of spiral type& 3 oblique type (Table & graph 4).

Type of Fracture	No. of Cases	%
Comminuted	4	16.6
Transverse	10	41.6
Spiral	7	29.1
Oblique	3	12.5

Table 4: Type of Fracture According to Morphology

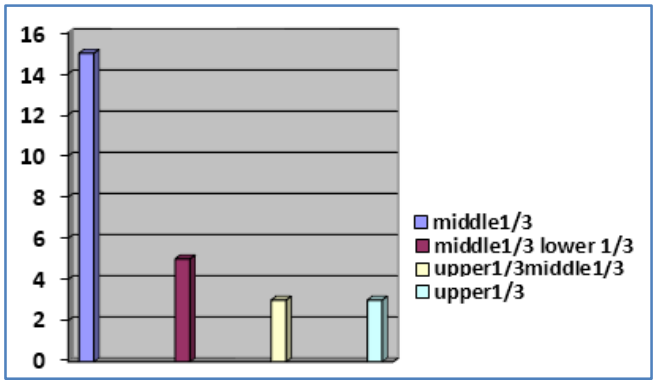


Graph 4: Type of Fracture According To Morphology

13 fractures were located at middle third, 3 were located at upper third, 3 were located at middle to lower third junction& 5 were at upper third middle third junction (Table & Graph 5).

LEVEL	No. of Cases	%
Upper 3rd	3	13
Middle 3rd	13	54
Upper Middle Third	3	13
Middle lower 3rd	5	20

Table 5: Level of Fracture



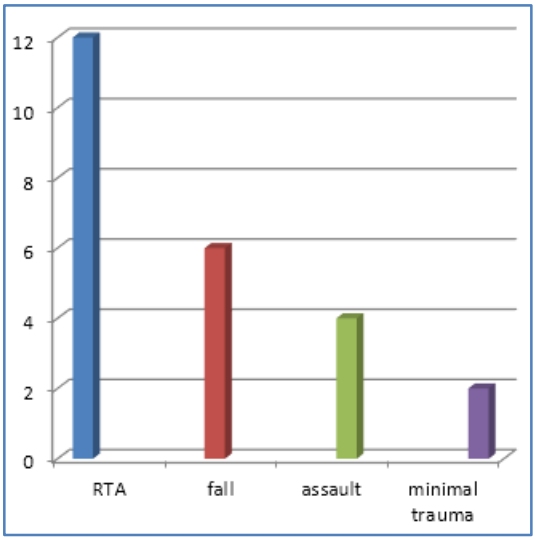
Graph 5: Level of Fracture

DOI: 10.14260/jemds/2015/1470

In 12cases mode of injury was due to RTA and 6 cases was due to fall, 4 cases due to assault/blunt trauma, in 2 cases due to minimal trauma (Table & graph 6).

Mode of Injury	No. of Cases	%
RTA	12	50
Fall	6	25
Assault	4	17
Minimal trauma	2	8

Table 6: Mode Of Injury



Graph 6: Mode of Injury

The time interval between injury and reporting time has ranged from a minimum of 2 hours to a maximum of 48 hours in fresh injuries& in nonunion cases ranged from 4 to 8months.

PROCEDURE: Indications for Interlocking humerus:

1. Multiple trauma.
2. Open fractures.
3. Nerve or vascular injury.
4. Osteoporotic fractures.
5. Segmental fractures.
6. Pathological fractures.

Pre–Operative Estimation of Nail Size: Canal diameter at narrowest point, look for it in the pre-operative roentgenograms in both Antero-posterior and lateral view x-rays. Required length of the nail was assessed as the distance from the tip of the greater tuberosity to3 cms from the upper limit of the olecranon fossa.

Anaesthesia: Operative procedure was performed under general anaesthesia.

DOI: 10.14260/jemds/2015/1470

APPROACH: All cases in this series were operated by the Ante-grade approach using the proximal entry portal:

1. **Positioning of patient:** In supine position, the head was turned to the opposite side to increase exposure of the shoulder. A cloth roll or ring pillow was placed under the scapula so as to achieve 30 degree extension of the shoulder, & the image intensifier was placed on the opposite side of the table and positioned perpendicular to the table
2. **Patient Preparation:** Preoperative scrubbing and Draping was done with sterile sheets.
3. **Incision and Entry Point:** A longitudinal skin incision was made from the most lateral point of the acromion and extended 5 cms distally, centering over the tip of the greater tuberosity. The entry portal was made at a point just medial to the tip of greater tuberosity and 0.5 cms posterior to the bicipital groove using a small curved bone awl & its position was confirmed to be in the center of the canal on image intensifier.
4. **Insertion of Guide Rod and Intraoperative Assessment of Nail length:** A guide rod of 500 mm was used in every case, after withdrawing the curved awl, the 2.4 mm non-beaded (All cases were done without reaming) guide rod was inserted and advanced down the canal, after achieving reduction until the tip was 2 cms proximal to the olecranon fossa, confirmed on the image intensifier. The nail length was estimated by overlapping a second guide rod of same length, proximally from the humeral entry point and subtracting the calculated length of overlapping from 500 mm to determine the precise nail length.
5. **Nail Insertion:** Cannulated nails were passed over the guide rod. Non cannulated nails were inserted only after removing the guide rod. The jig was held pointing away from the patient (Laterally) so the apex of the proximal bend in the nail faced medially. The nail was then gently passed across the fracture to avoid commination and advanced distally after confirming nail position in the distal canal in both AP and lateral views under the image intensifier. The distal limit was confirmed under the image intensifier to be 2cms proximal to the olecranon fossa and proximally the nail was confirmed to be flush with the entry portal or countersunk.
6. **Proximal locking:** The drill barrel was passed through the proximal drill guide along with the trocar and where the skin was dimpled by the trocar, a small 8 mm incision was made and the trocar passed up to bone. The trocar was exchanged for a drill sleeve and using 2.7 or 3.5 mm drill bits respectively, the proximal screw hole was drilled from lateral to medial cortex, while keeping the arm abducted to avoid damage to the brachial artery.

   The depth guage was then inserted through the drill barrel and the required bolt length estimated. The appropriate sized bolt was selected and inserted using the hexagonal screw driver. A washer was used in osteoporotic bone to prevent the screw from being countersunk.
7. **Distal interlocking:** The free hand technique used.
8. **Post-operative Management:** Rehabilitation of the patient began immediately. On the 1st post -op day, the Operated extremity was elevated on a Thomas arm splint or by suspension with abduction and external rotation at shoulder. From the 2nd post-op day, active assisted and passive movements are begun, including pendulum exercises and assisted full forward flexion within the limits of the pain.

   From the 7th post-op day, overhead abduction, external rotation and internal rotation exercises were begun.

DOI: 10.14260/jemds/2015/1470

9. **Follow up Protocol:** The patient was called back for follow up on the 6th, 10th and 16th post-operative week, thereafter depending on the X ray picture at 10 and16weeks, and functional status of the upper limb further follow up, visits were advised.

Advice regarding lifting of weights and heavy work was given based on the X-ray picture and not before 6 post-operative months. A clinical proforma was used to evaluate the patient and keep an accurate follow up record.

Criteria for Assessment of Results: Final Assessment of the patient was done on the basis of following criteria established by Rommen et al. (Table 9)

Result	Loss of Range of Motion	Clinical & Radiological Union
Excellent	< 10%	Good
Moderate	10 – 30%	Good
Poor	> 30%	No signs of union

Table 9: Rommens's Criteria

1. **Excellent:**
   - Good -clinical and radiological union.
   - Less than 10% loss of range of motion.
   - No significant subjective complaints.

2. **Moderate:**
   - Good clinical and radiological union.
   - 10-30% loss of range of motion.
   - Minimum subjective symptoms.

3. **Poor:**
   - No signs of clinical and radiological union.
   - Greater than 30% loss of range of motion.
   - Moderate subjective symptoms.

OBSERVATIONS: Out of 25 patients in our study, 24 returned for clinical and radiological examination. 1 case lost to follow up. Final assessment was done on follow-up. Observations and results are summarized.

The commonest mode of injury was RTA. Males were affected more than females with right side predominance.

The mode of injury was due to RTA in 50% and due to fall in 25%, due to assault/blunt trauma in 17% & due to minimal trauma in 8%.

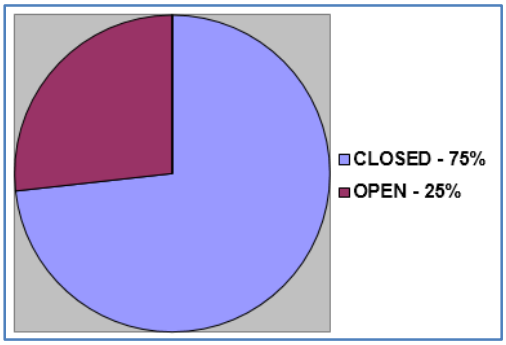
All fractures were of closed type.

Closed nailing was done 75% of cases and 25% of cases required open reduction (Table & graph 7).

DOI: 10.14260/jemds/2015/1470

Type of Operation	No. of Cases	%
Closed	18	75
Open	6	25

Table 7: Type of Operation



Graph 7: Type of Operation

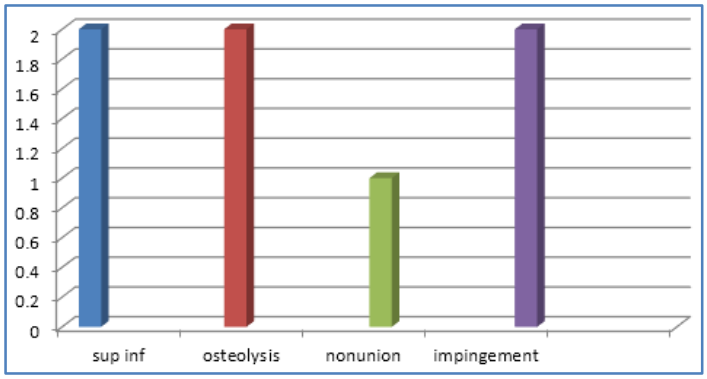
RESULTS: 76% (18 cases) had excellent results, 16% (4 cases) had moderate result and 8% (2case) had poor result.

Out of 24 cases followed up, 2 patients had pain in the shoulder on abduction and forward flexion of shoulder movement after ante grade nailing.

2 cases of autolysis around the implant causing pain and limitation of upper limb function required removal of the implant. Non-union occurred in 1 case (Table & graph 8).

Complication Encountered	No. of cases	%
Infection–superficial	2	8
Impingement syndrome	2	8
Nonunion due to implant failure	1	4
Osteolysis around implant	2	8

Table 8: Postoperative Complications



Graph 8: Postoperative Complications

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The procedure is definitely superior to other modes of operative management of diaphyseal fractures of Humerus due to the following reasons:

1. Closed nailing preserves fracture hematoma thus resulting in circumferential periosteal callus formation and early union, whereas in plate osteosynthesis callus does not form under the plate.
2. Provides good axial and rotational stability particularly in comminuted and segmental fractures.
3. Avoids exposure of the fractures to the exterior there by minimizing the chances of infection. Avoids extensive soft tissue dissection, periosteal stripping and devitalization of bone fragments in comminuted and segmental fractures thereby minimizing the chances of nonunion and morbidity.
4. Closed nailing minimizes the risk of iatrogenic radial nerve injury.
5. Closed interlocking intramedullary nailing reduces the operative time and blood loss, avoiding the need for blood transfusion and its inherent complications.
6. Achieves simultaneous stabilization of multiple fractures in a polytraumatized patient by reducing the operative time.
7. No splintage is required post-operatively except in osteoporotic fractures.
8. Allows immediate postoperative mobilization of shoulder and elbow thereby preventing joint stiffness.

Complications Encountered in Our Study: Immediate: Superficial infection developed in 8% of cases which subsided following higher antibiotic therapy.

Delayed: In our study shoulder dysfunction was noticed in 8% of cases.

1. Case went on for non-union.

DISCUSSION: In our study 24 patients of fracture shaft Humerus of different age groups were selected. The age was 40 years. The sex ratio was 2:1. (M: F).

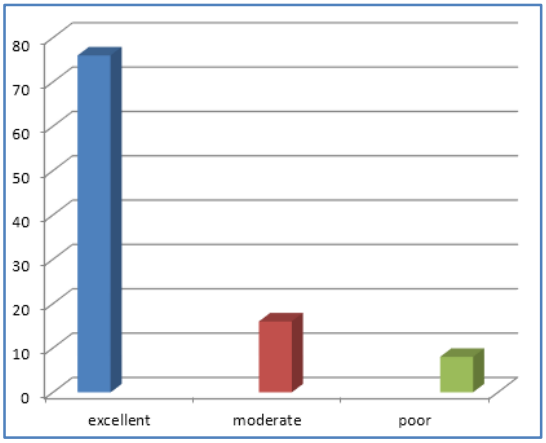
In Rommen et al[2] series average age was 43.8 years and sex ratio was 3:1(M: F) In our study the indications for interlocking intramedullary nailing were comminuted, transverse, spiral fractures and non-unions:

- In Rommen et al series the indications for interlocking intramedullary nailing was transverse, spiral and oblique fractures.
- In our series the average time interval between injury and surgery was 5 days in fresh cases.
- In Rommen et al series the average time interval between injury and surgery was 2 days.
- In our series 18 patients underwent closed nailing and 6 patients required open reduction.
- In Rommen et al series all patients underwent closed nailing.
- In our series static and dynamic locking was done in all cases, average period of union was 4 – 8 months which included non-union cases also.
- In Rommen et al series the average period for union was 13.7 weeks.
- In our study 76% had excellent results, 16% had moderate results and 8% had poor results.
- In Rommen et al series 84.6% had excellent results, 10.3 % had moderate results, and 5% had poor results. (Table 10 & graph 9).

DOI: 10.14260/jemds/2015/1470

Result	No. of cases	%
Excellent	18	76
Moderate	4	16
Poor	2	8

Table 10: Final Results According Rommen"S Criteria



Graph 8: Postoperative Complications

All in all our results compared favorably with the international series.

Radial nerve palsy can also occur in some cases treated with Interlocking nail especially while putting in the distal screw (Mc Carmack),[3] but in our series we have not encountered this problem.

Persistent pain in the shoulder joint can be seen after these cases (Robinson C M),[4] persistent pain and restriction of shoulder movement after ante-grade nailing was noted in 8% of our cases. Haberneck and Orthner[5] reported no impairment of shoulder function at 6 weeks. In our series persistent shoulder pain occurred in 2 cases.

The following are some of the nails being used for the management of humeral shaft fractures,

Hackethal nailing[6] was once popular but gives insufficient stability and the implant may migrate (Henry Link 1988).

The Seidel nail[7] was specifically designed for humeral shaft fractures (Seidel 1989) but was too big for many medullary canals. The insertion may be difficult and can cause fracture. This can be used only by ante-grade technique which damages the rotator cuff and other problems like protrusion, lack of rotational stability, loosening of distal fixation with risk of pseudo-arthrosis may occur.

Russel Taylor humeral nail[8] is smaller in diameter (6 to 9mm) and slightly curved while two locking screws give rotational stability. This can be inserted ante-grade which is totally extra articular.

CONCLUSION Considering the number of cases operated and the good results obtained with surgical treatment of fractures with the interlocking nail humerus it is justifiable to fix with interlocking nail for these fractures as the nail is unique in its dynamicity; complications of open reduction are few.

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Interlocking intramedullary nailing of diaphyseal fractures of the Humerus in adults is a safe and reliable method of treatment.

It is well recommended for multiple fractures, open fractures, nerve or vascular injury, segmental fractures, pathological fractures.

BIBLIOGRAPHY:

1. John Charnley, Closed treatment of common fractures, 4th ed, Cambridge University Press 2003; 99-104.
2. Blum J, Rommens PM, Janzing H. The unreamed humeral nail: a biological osteosynthesis of the upper arm. Acta Cher Belg 1997; 97:184-189.
3. Mc Cormack RG, Brien D, Buckley RE, McKee MD, Powell J. and Schemitsch EH: Fixation of fractures of the shaft of humerus by dynamic compression plate or intramedullary nail, a prospective randomized trail; J Bone J. Surg.(Br); 2000, 82-B:336-39. encountered radial nerve palsy while inserting the ILN and distal screw.
4. Robinson CM, Bell KM, Court-Brown CM. Mc Queen MM; Locked nailing of humeral shaft fractures. Experience in Edin Burgh over a two year period. J. Bone Joint surg. Br.; 1992, 74(4): 558-62.
5. Habernek H, Orthner E. A locking nail for fractures of the humerus J Bone Joint Surg Br 1991; 73:651-653.
6. Henley MB, Chapman JR, Claudi BF. Closed retrograde Hackethal nail stabilization of humeral shaft fractures. J Orthop Trauma 1992; 6:18-24.
7. Siedel H. Humeral locking Nail: A preliminary report. Orthopedics, 1989, 12, 219-226.
8. Ikpreme JO, Intramedullary interlocking nailing for humeral fractures: experiences with the Russel-Taylor humeral nail. Injury 1994; 25:447-455.

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