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ASSESSMENT OF FUNCTIONAL OUTCOME OF SHOULDER HEMIARTHROPLASTY FOR PROXIMAL HUMERAL FRACTURES

Orthopaedics

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ABSTRACT

Aim: to evaluate the clinical and radiological outcome of shoulder hemiarthroplasty in acute humeral head fractures **Methods:** an observational prospective analysis of 40 patients (24 males, 16 females) with a follow-up of minimum 1 year, managed by shoulder hemiarthroplasty for humeral head fracture between August 2022 to March 2024. The outcomes were studied based on the mean constant Murley score, DASH score, and range of movements. **Results:** The mean constant Murley score, Range of movements & DASH score were calculated at postoperative 3, 6, and 12 months showing significant improvement in functional outcome. Mean Constant Murley score at the end of 1 year was 65, the DASH Score at 1 year was 10, and the mean flexion was 100°, internal rotation touching the L3 vertebra, external rotation 40°, and abduction was 100° at the end of 1-year interval. **Conclusion:** Our study concluded that shoulder hemiarthroplasty provides better functional outcomes and a good range of motion in complex humeral head fracture management, with high technical demand, and we can restore the humeral geometry and achieve good functional outcomes.

KEYWORDS

humeral head fracture, shoulder hemiarthroplasty, avascular necrosis humeral head,

INTRODUCTION:

Humeral head fractures are prevalent injuries, particularly in older female patients. These are third common fractures in elderly population, accounting for 4-5 percent of all appendicular skeleton fractures. These injuries usually arise from trivial trauma, like falling on an outstretched arm from height. Over the past three decades, there has been a rise in the occurrence of these fractures. Most proximal humerus fractures can be treated without surgery. Most fractures that do require surgery are treated with shoulder arthroplasty or plate osteosynthesis[1]. Surgical intervention is often necessary for displaced fractures, glenohumeral fracture-dislocations, intra-articular fractures that are displaced, and larger tuberosity displacements exceeding 5 mm in patients under 65 years old who do not show signs of osteopenia. Open reduction and internal fixation(ORIF) are traditionally used to control these patterns. However, Hemiarthroplasty (HA) and Reverse shoulder arthroplasty(RSA) are viable choices when the humeral head cannot be successfully restored or there is uncertainty regarding the viability of the future humeral head reconstruction[2]. There are two types of indications for arthroplasty: fracture characteristics and patient characteristics. For patients to undergo significant surgical procedures and actively engage in their post-operative rehabilitation, they must be medically stable. Fracture characteristics include head-splitting patterns, and displaced three- and four-part fractures that cannot be treated with ORIF using plate osteosynthesis.[3]. The significant failure rates that ORIF has shown in older patients have sparked interest in shoulder arthroplasty. HA might be useful in cases of acute fractures in young patients with unreconstructable patterns, compromised glenoid bone stock that is not suitable for implantation of glenoid components, or sequelae where tuberosity healing is not required or the humeral head remains nonviable (post-traumatic avascular necrosis [AVN])[3].

Methodology And Materials:

This is an observational prospective study of 40 patients managed by shoulder hemiarthroplasty for humeral head fractures. The surgery was within 1 month of the trauma. Follow-up of a minimum of 1 year with series of clinical and radiological examinations at 3, 6, and 12 months was required with the following exceptions- 2 participants had no follow-up.

Inclusion criteria:

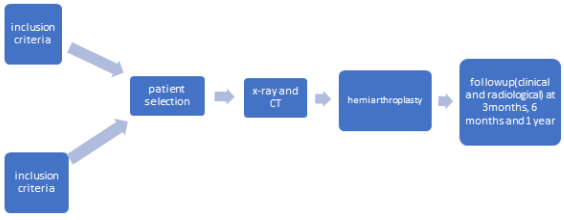
- Medically stable patient and fit enough to undergo anesthesia and the physiologic stress of open surgery.
- Patients aged 20 to 60 years.
- posttraumatic cases with comminuted three or four part proximal humerus fractures.
- Patients with head-splitting fracture or fracture-dislocation.

Exclusion criteria:

- Prior fracture history, previous surgical fixation of shoulder, or segmental fractures
- Patients waited an average of 7.3 to 9.4 days (ranging from 0 to 30 days) from the time of injury to the initial procedure. The average follow-up duration for remaining 38 fractures was 12 months, with a range of 12 to 24 months.
- Rotator cuff injury
- muscular dystrophy or atrophy patients

For each patient, information was gathered regarding patient details, the surgery, the postoperative period, and follow-up stats.

1) Patient details included name, gender, age, mode of injury, comorbidity & nutritional status.
2) Surgical data included classification of fracture, radiological investigation, procedure duration, the timing of the procedure from injury, and anaesthesia.
3) Range of movements at follow-up of 3, 6, and 12 months are the postoperative data



Imaging:

The initial radiography images of the shoulder should be standard views, which include an axillary, a trans scapular Y, and a true AP. A Velpeau view, which is a type of modified axillary view that can be obtained if obtaining the axillary view is problematic because of the patient's discomfort or anxiety. In any situation when we are thinking about doing surgery, we typically need 3-D reconstruction CT scan views. These investigations offer critical information on bone characteristics, fracture pattern, displacement, and the presence of head-splitting component or articular extension. For preoperative planning of arthroplasty, an AP image of the opposite humerus is used to determine the desired height and length of the implant[2].(FIGURE 1,2)

Proximal humerus classification:

The Neer classification system is the most widely used. Proximal humerus fractures can involve four anatomical parts: the humeral head, humeral shaft, greater tuberosity, and lesser tuberosity. For the

greater tuberosity, a displacement of only 0.5 cm is needed, whereas the lesser tuberosity requires 45 degrees of angulation or 1 cm of displacement to be considered significant. The AO classification system focuses on the fracture pattern and its impact on humeral head vascularity. Type C fractures are at the highest risk for AVN, whereas type A fractures are less likely to experience vascular compromise.[4]

NEER'S Classification:
FIGURE 3. This figure describes the original Neer classification for proximal humerus fractures based on the number of displaced parts in addition to the amount of angulation. Reprinted from Neer[5]. Copyright Neer, Lexington, SC. All permission requests for this image should be made to the copyright holder

AO classification:
FIGURE 4: This figure describes the OA classification for proximal humerus fractures. Reprinted from Journal of Orthopaedic Trauma, January 2018, volume 32, number 1.[6]

Surgical Procedure:
Approach: The surgery was performed under general anesthesia with the patient positioned in a beach chair posture at the table's edge, allowing the arm being operated on to hang over the side. The deltopectoral approach is used in all the patients. When it comes to reconstructive shoulder surgery, the deltopectoral method is regarded as the mainstay. Better exposure is obtained by making incision over the clavicle, extending 2 cm lateral to coracoid process, and ending at a point on the anterior midline of the arm, 2 cm distal to the axillary crease. A full-thickness skin flap is then created medially at the proximal end of the incision, extending approximately 1 to 2 cm medial to the coracoid process, to locate the cephalic vein. At this stage, a noticeable triangular area with the clavicle as its base is often observed. The cephalic vein can be easily identified extending distally from this triangle. Due to the greater frequency of lateral tributary veins compared to medial ones, it is generally recommended to retract the cephalic vein laterally when dissecting. For improved exposure when the deltoid needs to be retracted laterally, moving the cephalic vein medially helps prevent its proximal tethering. After establishing the deltopectoral interval, subdeltoid space is located and cleared of any hypertrophic bursal tissue. At this stage, the type of tissue encountered—such as fibrous scar tissue, fracture hematoma, or early callus formation—depends on the time elapsed since the trauma. It is essential to locate the long head of biceps on anterior part of the proximal shaft. Digital palpation can easily identify biceps tendon, which is just medial to tendon insertion of pectoralis major. Nevertheless, the fracture may have damaged the biceps tendon, necessitating a tenodesis to eliminate a potential cause of discomfort[7].

Procedure:
1. Begin by suturing the subscapularis and supraspinatus tendons close to their bone attachments.
2. Temporarily attach the bicipital tendon to the pectoralis major muscle superior border.
3. Tenotomy of biceps long head near rotator interval.
4. Expose the humeral head by carefully cutting through soft tissues and releasing any remaining attachments, taking care not to harm the axillary nerve.
5. Remove loose bone fragments and, if necessary, osteotomise lesser tuberosity from humerus head in 3-part fractures.
6. Stitch the infraspinatus tendon.
7. Measure the posteromedial metaphyseal extension to determine prosthesis placement height.
8. Reattach tuberosities using either sutures or cables.
9. Expose the humeral shaft and prepare the canal for the prosthesis by serial rasping.
10. Retrovert the humeral head approximately 25° relative to the distal humeral epicondylar axis. Insert the prosthesis, ensuring correct placement and using bone cement if needed.
11. Secure tuberosities by passing cables through holes in the prosthesis and tightening them appropriately.
12. Confirm reduction using visual, tactile, and x-ray methods. Close the supraspinatus split and secure the bicipital tendon.
13. Verify the procedure's success with image intensification.[8]

Postoperative period:
Following the surgery, the arm was kept in an immobilizer with 15 degrees of abduction for four weeks. Passive mobilization and pendulum exercises were permitted right away. Active mobilization started in the fifth week, and strengthening exercises began in the eighth week, initially focusing on isometric exercises and later incorporating elastic bands.

The Mean Constant- Murley score was used to calculate the results. It assigns 15 points for pain (subjective components), 20 for function (ADL), 25 for strength (objective components), and 40 for range of motion. A healthy, asymptomatic joint is indicated by a total score of 100; the lowest possible score is 0[9].

Postoperative 1-year Follow-up Clinical Picture
Figure- 7,8,9,10

RESULTS:
The average Constant Murley score was 65(ranging 38 to 76). Pain played a significant role in patient satisfaction, with an average pain score of 14 out of 15. Thirty two patients (80%) reported no pain, while the remaining six experienced occasional mild pain. The average motion score was 27.7 out of 40(ranging 10 to 38). Specifically, active anterior elevation exceeded 150^o in 10 patients, was between 120 and 150^o in 14 patients (average of 106^o), and was less than 120^o in the other 14 patients. The average external rotation was 20^o (ranging 0 to 40^o), and internal rotation was typically at the L3 level. The average ADL score was 18.7/20(ranging 12 to 20); Considering the modest functional demands of these patients—usually relatively elderly—this is a great result.

The most frequent limitations were lifting weights, raising arm above shoulder level, combing hair, and sleeping on affected side. The strength score was quite low, averaging 4.6 out of 25, with a range from 0 to 8.

Constant scores	All 8patients(range)
ADL	18.7(12-20)
ROM	27.7(10-38)
Pain	14.0(10-15)
Strength	4.6(0-8)
Total score	65(38-76)

DISCUSSION:
For humeral head fractures, hemiarthroplasty is a technically demanding treatment that can reliably reduce pain and return shoulder-level function. Accurate tuberosity repair and early surgical intervention within two weeks of the damage were found to have the biggest effects on functional success[10]. Initially, a decade ago idea was early hemiarthroplasty had good functional success compared to delayed hemiarthroplasty. According to Erick M.Marigi et al, There were no statistically significant differences between early Hemiarthroplasty conducted following acute humeral head fractures and late Hemiarthroplasty performed for fracture sequelae in terms of forward flexion, pain, internal rotation, external rotation,ASES scores, satisfaction, reoperations and complications. Even when accounting for death as a confounding variable, there was noticeable trend toward higher rates of reoperation and complications after Hemiarthroplasty for trauma sequelae. However, these differences did not reach substantial significance with the current data.[11]. Patients who can tolerate major surgery, are in good health and can engage in postoperative rehabilitation might consider hemiarthroplasty. ORIF may prevent prosthesis replacement and its associated consequences in younger subjects with proximal humerus displaced fractures and in certain cases with valgus-impacted four-part fractures. In these situations, the tuberosities might be in a better position to be converted into a prosthesis, even if non-union occurs. Neer's classification three and four-part fractures, displaced fractures, head-splitting fractures not amenable to ORIF, bones that are highly osteoporotic, and bone necrosis are among the indications for HA. Furthermore, it is critical to consider the factors that indicate humeral head ischaemia[4]. Krishnan et al identified four criteria that affect the choice of treatment method: fracture pattern, bone quality, patient age and surgical time[12]. While individuals over 70 years of age may be candidates for arthroplasty, other factors such as the patient's activity level, osteoporosis status, and fracture pattern are more significant indicators than age alone. people who are young age, medically unstable, active people, subjects with infections, axillary nerve palsy are contraindications for hemiarthroplasty[9].

Rehabilitation following proximal humeral fractures with prosthetic replacement is still controversial. Neer originally recommended early passive movement as the optimal postoperative treatment. Lannotti

and Naranja suggest vigorous rehabilitation[13], while Boileau et al suggest a more conservative approach to avoid compromising tuberosity fixation[14]. Agorastides et al. conclude in a randomized controlled experiment that delayed mobilization following shoulder hemiarthroplasty is safe as early mobilization[15]. Our patients' recovery was impacted by their class position; adherence to the program consistently had better outcomes, demonstrating the critical need for postoperative rehabilitation after shoulder surgery.

CONCLUSION:

From our study, we concluded that the shoulder hemiarthroplasty provides better functional outcomes and a good range of motion in acute proximal humeral head fracture management, with high technical demand and good surgical skill we can restore the humeral biomechanics and achieve good functional outcomes. However, there is a limitation and a larger sample size is required to understand the study further. Hence referencing further articles and publications is required. And there is a need for follow-up of patients for more time.

Funding Declaration

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Figures:

Figure 1: Preoperative x-ray

NEER's classification:

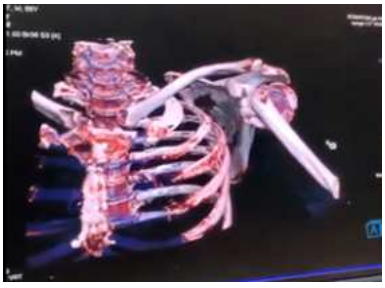


Figure 2: CT left shoulder

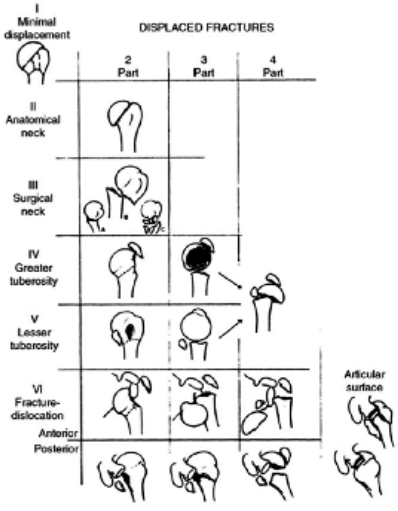


Figure 3. This figure describes the original Neer classification for proximal humerus fractures based on the number of displaced parts in addition to the amount of angulation. Reprinted from Neer[5]. Copyright Neer, Lexington, SC. All permission requests for this image should be made to the copyright holder

AO classification:

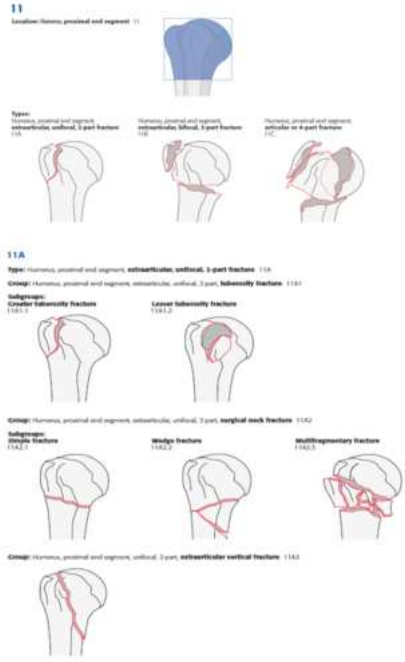
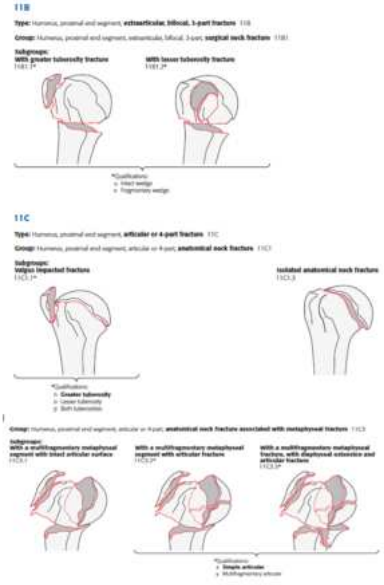


Figure 4:



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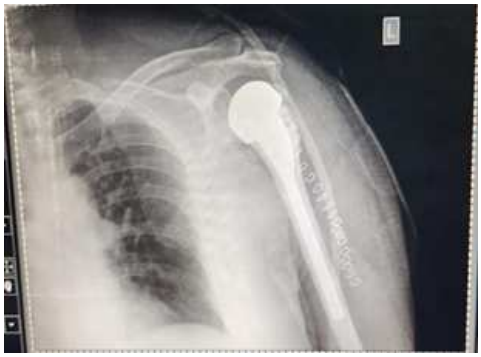

Figure 5: Postoperative X-ray

Figure 6: surgical site wound

Figure 8: external rotation

Figure 9: forward flexion

Figure 10: internal rotation

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