

Original Research Article

Study on the efficiency of locking plate surgery with that of interlocking nail treatment in management of proximal humerus fracture in P. T. Birta City Hospital and Research Center

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ABSTRACT

Background: Proximal humeral fractures (PHFs) commonly exhibit a bimodal distribution based on trauma energy levels, affecting mainly those over 65 through low-energy falls, often indicating osteoporosis. Treatment approaches for displaced PHFs vary, with locking plates offering high stability but posing risks to blood supply and nerves. The efficacy of surgical versus conservative treatments remains debated, especially for complex fractures, with studies linking surgical options like intramedullary nailing and locking plates to mixed outcomes, including possible shoulder limitations. Aims and objectives were to evaluate the efficiency of locking plate surgery with that of interlocking nail in treatment in management of PHF.

Methods: A prospective investigation was carried out on patients who visited our hospital's outpatient department. A general anaesthetic and brachial plexus block were delivered throughout the patients' procedures. Each operation was performed by the same team, which was proficient in both approaches. The study conducted t-test and Chi-square to analyze the data.

Results: The analysis found no significant demographic differences between the two groups ($p > 0.05$). The non-operative group had significantly lower blood loss (71.8 ± 10.5 ml) than the locking plate group (134.2 ± 16.9 ml, $p = 0.000$). Visual analog score (VAS) and Constant-Murley scores indicated greater shoulder function improvements for the locking plate group at three months ($p < 0.001$), although no significant differences were observed at the final follow-up ($p > 0.05$). Postoperative complications did not significantly differ between groups ($p = 0.337$).

Conclusions: Locking plates reduce fractures faster than interlocking intramedullary nails. Both internal fixation techniques for proximal humerus fracture had similar pain and shoulder function scores.

Keywords: Humoral fracture, Stress fracture, Locking plate surgery, Proximal humerus

INTRODUCTION

Regarding their stage and degree of energy, proximal humeral fractures (PHFs) often exhibit a bimodal distribution. Because this bimodal form is so prevalent, doctors should be mindful of the high-energy (like a car

crash in hospitalized children) or low-energy (like an aged participant's state after one floor fall) paradigm in various groups and fracture patterns.¹

Those over 65 are most typically affected by PHFs. In a person with osteoporosis or osteopenia, a PHF brought on

by a low-energy fall is invariably a fragility fracture. Individuals who experience these wounds should be considered osteoporotic already (even without a formal diagnosis by DEXA scan). These injuries typically appear in younger people following elevated trauma, including such motor vehicle accidents (MVs).²

The overuse injury fracture is strongly associated with osteoporosis, and the distant diameter and injury are the next and third highest common fractures in elderly persons, respectively. The vast majority of fractures can be treated without surgery since they have little or no displacement. The most widely accepted for fractures of the proximal humeral is the Neer classification.^{3,4} To classify the disease, the four anatomical parts of the proximal part shaft, femoral neck head, larger and smaller tubercles—as well as the severity of their fracture and displacement—are employed. To be deemed a surgical neck, the bigger or less prominence must be additionally fractured with just a movement of at least ten millimeters and/or a 45° angle angle between the helmet and shaft pieces. 3 parts broken.⁵

Anatomy

The proximal humeral anatomy has four possible "components." These elements were first reported by Neer, and his traditional PHF classification scheme now incorporates them. Among the components of the proximal humerus' anatomy are: greater tuberosity, smaller tuberosity, and surgical neck; other osseous elements crucial to femoral neck morphology include the brachial plexus transect sulcus, anterior calcar, and the places where the lateral, rectus femoris big, and rectus femoris dorsi muscles insert.⁶

There are a variety of neurovascular structures that could be harmed depending on the type of injury. The protein nerve that is injured most frequently is the axillary nerve.⁷ Arterial damage has a 5.2% incidence rate, and elderly individuals have a greater chance to encounter it. These are two typical scenarios for aortic artery injury upon presentation.

Surgical neck fractures that are dislocated or comminuted, as well as subcoracoid humeral dislocation. The humeral head contains the main blood artery that supplies the circulation to the posterior humeral circumflex of the bone. The anterior humeral anteriorly artery's (AHCA's) extensive arterial bifurcation and anastomotic network there in proximal humerus are well known. The long-held belief that the proximal humerus's blood supply is its main source has been disproved. Anterolateral ascend branching and the arcuate artery are the AHCA's two principal branches, with the former providing the larger tuberosity with the majority of its circulatory system.⁸

Three-part fractures make up about 10% of all fractures of the proximal humeral. Operating on premature infants bearing displaced 3-part fractures is not in question. The

main issue is elderly people with varying degrees of osteoporosis and fractures that have shifted after low-energy trauma.⁹ The optimum treatments option for with this patient population is unknown due to a lack of information and consensus.¹⁰

In cases of misplaced PHFs, there are differing views regarding surgical versus conservative treatment. Despite evidence from the "ProFHER trial" showing these breaks can be completely cured semi, many doctors preferred surgical care of displaced PHFs, especially for even more complex three- or 4 fractures. The most popular surgical procedures are open reduction and internal fixation, intramedullary nailing, and reverse shoulder arthroplasty.^{11,12}

The major methods include nonsurgical maintenance, hemiarthroplasty (HA), reversal shoulder arthroplasty, opening reduction external fixation (ORIF), and locking plating. (RSA). The majority of proximal humerus breaks were treated non-operatively, and both non-displaced and displaced fractures had successful outcomes. Contrarily, non-operative treatment may lead to a slower return to functioning, less pain relief, as well as a greater chance of death, per certain studies.¹³

The availability of modern implantable devices, such as locking plates having enhanced purchases in osteoporotic bone, has had an impact on the shift towards more frequent surgical procedures. Internal attachment employing interlock plates and deep reduction may allow the anatomy to be rebuilt in a remarkable way, but there is a potential that the implant or the treatment itself could have difficulties.^{14,15}

A locking plate was employed in the surgical removal and internal fixation (ORIF) technique, which is extensively practised, widely available, and well-liked.¹⁶

Due to its great rigidity, the angular secure system was created largely to handle complex fracture patterns, particularly in patients with low bone quality. After several (10 years) research indicate that this procedure produces acceptable to outstanding clinical results, a sizable complications rate of upwards to 34% has now been noted. Primary issues include medical, trick, including soft tissue-related issues; secondary effects include "biological" and implant-related challenges. Both basic issues and secondary complications exist. Surgical techniques for PHFs have undergone a significant change during the past few decades. The most often done procedures are internal fixation with locking plate osteosynthesis, open reduction, reverse shoulder surgery, shoulder services that help, intramedullary nail fixation, and shoulder hemiarthroplasty.¹⁷

The therapeutic techniques used in displaced PHFs are still up for debate. The locking plate method is seen to be the most effective way to treat PHFs, however multiple studies have linked it to a number of issues. To install the locking

plate, the thick muscles must be severed, which could damage the blood vessels that supply the bone and result in necrosis or nonunion. The axillary nerve is also more prone to injury if somehow the plate is inserted via a percutaneous method. One of the biomechanical benefits of attaching PHFs with intramedullary hammering is a higher resistance to lateral and torsional stress. Scapular tears are a serious possibility and may cause discomfort in the shoulder or functional limitations.¹⁸

It is challenging to accurately assess the overall possibility of adverse events and clinical outcomes due to loyalty, in addition to the various different usage of bone grafts and needle cerclages thus according individual preferences, and the wide array of diverse invasive procedures for approach, fatigue crack repositioning, and other factors. Minkus et al reported an osteosynthesis technique for anatomical reduction, retention, and fixing in 2023. High primary stability anatomical reduction and fixing are both made possible by this reproducible method. Regardless of the type of fracture, degree of displacement, or degree of tuberosity comminution, this standardised, surgical step-by-step procedure was used on all PHF.¹⁹

The study has evaluated the efficiency of locking plate surgery with that of interlocking nail in treatment in management of proximal humerus fracture. The efficiency has been evaluated in terms of VAS and constant-Murley scores and the post-operative complications of both the managements.

METHODS

Study design

A prospective study was conducted on 60 patients, from January 2024 to June 2024, who went to the outpatient department of P. T. Birta City Hospital and Research Centre, Nepal. Throughout the patients' procedures, both general anaesthetic and dorsal plexus block were administered. Every surgery was carried out by the same team, which was skilled in both techniques. Each patient was lying back in a beach chair position on a radiolucent surgery table.

All of the integrated patients' clinical data, including their age, gender, type of injury, contraindications, operation time, length of surgery, blood loss, and Neer classification, was compiled along with their radiographic images. Shoulder function has been assessed using the Constant-Murley index and, in fact, VAS for pain.

Following surgery, management for four weeks, the shoulders were immobilized with an abduction cushion sling.

On the second day after surgery, the shoulder began to move passively. Patients started making active movements about four to six weeks. At one and three months after surgery, two attending orthopaedic doctors did clinical

follow-ups.

Outpatient plain radiographs were taken at each check-up. Acromion impingement, subsurface disease, varus curvature, fat melting, delayed mating, and screw breakage were among other post-operative issues that were reported.

Inclusion and exclusion criteria

The following conditions had to be met in order for someone to be included: they had to be older than 18; have two, three, or four PHFs according to the Neer classification; have a fresh fracture; and not have had ipsilateral humeral surgery in the past.

Exclusion criteria included pathological or open fractures, concurrent neurovascular injury, fractures linked to shoulder dislocation, and mental illnesses.

Statistical analysis

Data entry and statistical analysis were performed using analysis of variance (ANOVA) statistical software. The suitable percentage comparison between several organizations was made using the overall results, measure of dispersion, independent sample t-test, and Chi-square. A significant value of 0.05 was in fact the cutoff for data to be considered significant.

RESULTS

Table 1 displays the demographic data for these two groups. No statistically significant variation existed between the two groups in terms of age, gender, side, damage type, or till classification ($p > 0.05$). In general, the non-operative group underwent surgery more slowly than the locking plate group (83.811.7 versus 102.622.1 ml, $p = 0.000$). In comparison to the internal fixation nail group, the loss of blood inside the clamping plate group was higher (134.216.8 ml, $p = 0.000$) than it was in that group.

Table 2 provides data on the VAS and constant-Murley scores of two groups of patients: the locking plate group and the interlocking non-operative group. The scores are compared at three different time points: 1 month postoperatively, 3 months postoperatively, and final follow-up. The locking plate group had 35 patients, while the non-operative group had 25 patients. The VAS score is a measure of pain, with higher scores indicating more pain. The constant-Murley score is a measure of shoulder function, with higher scores indicating better function.

The study found that, at 1 month postoperatively, both groups had similar VAS scores (4.6 ± 1.2 for the locking plate group versus 4.1 ± 0.8 for the non-operative group), but the non-operative group had a higher constant-Murley score (45.2 ± 9.5 versus 40.6 ± 7.3). The difference in constant-Murley score was statistically significant ($p = 0.023$). At 3 months postoperatively, the locking plate

group had a significantly lower VAS score (2.2 ± 0.5 versus 1.7 ± 0.3 , $p=0.01$) and a higher constant-Murley score (62.2 ± 5.4 versus 70.4 ± 7.8 , $p<0.001$) compared to the non-operative group. At the final follow-up, the locking plate group had a slightly lower VAS score (0.4 ± 0.4 versus 0.5 ± 0.4) and a higher constant-Murley score (85.2 ± 6.5 versus 83.2 ± 5.2), but these differences were not statistically significant.

The locking plate group had worse shoulder function (as measured by the constant-Murley score) at 1 month postoperatively, but significantly better function at 3 months postoperatively compared to the non-operative group. The differences in scores between the two groups were not statistically significant at the final follow-up. The VAS scores were generally low for both groups at the final follow-up, indicating that pain had largely resolved for both groups.

Table 3 shows that there were three patients in the locking plate sample and three patients in the intra - medullary nail group, respectively, with an incidence of general issues of 8.33% and 10.71%, respectively ($p=0.343$). One patient in the locking plate subgroup had fat liquefaction, while the other one had a superficial infection.

One patient in the internal fixation nail category had a varus deformation at the time of the last check-up. In 2 patients with intramedullary nails and 1 patient with locking plates, acromion impingement developed postoperatively.

Table 1: Baseline characteristics between Locking Plate group and interlocking nail group with their respective significant tests.

Variables	Locking plate group (n=35)	Interlocking nail (n=25)	P value
Gender			
Male	16	9	0.614
Female	19	16	
Affected/damaged side			
Left side	21	15	0.715
Right side	16	10	
Age (years)	60.2±13.8	64.7±11.3	0.185
Injury mechanism			
Fell down	20	18	0.521
High fall injury	3	3	
Traffic accident	13	4	
Neer classification			
Two-parts	14	10	0.519
Three-parts	16	14	
Four-parts	5	1	
Surgery time (min)	83.8±11.7	102.6±22.1	0
Blood loss (ml)	134.2±16.9	71.8±10.5	0
Length of stay (days)	12.1±4.2	10.8±3.5	0.103
Follow-up time (months)	8.5±1.6	9.2±1.6	0.15

Table 2: Compares the VAS and constant-Murley scores for groups such as the locking plate group and interlocking nailing group.

Groups	1 month postoperatively		3 month postoperatively		Final follow-up	
	VAS score	Constant-Murley score	VAS score	Constant-Murley score	VAS score	Constant-Murley score
Locking plate group (n=35)	4.6 ± 1.2	40.6 ± 7.3	2.2 ± 0.5	62.2 ± 5.4	0.4 ± 0.4	85.2 ± 6.5
Interlocking nailing group (n=25)	4.1 ± 0.8	45.2 ± 9.5	1.7 ± 0.3	70.4 ± 7.8	0.5 ± 0.4	83.2 ± 5.2
t	1.02	-2.264	2.368	-4.732	1.274	1.854
P value	0.309	0.023	0.01	0	0.213	0.059

Table 3: Postoperative complications in the locking plate and interlocking nailing group.

Variables	Locking plate group (n=35)	Interlocking nailing group (n=25)
Screw breakage	0	0
Superficial infection	1	0
Fat liquefaction	1	0
Varus deformity	0	1
Delayed union	0	0
Acromion impingement	1	2
X²	3.344	
P value	0.337	

DISCUSSION

Here, we conducted a prospective study to evaluate the effectiveness of locking screws against intramedullary nails for managing PHFs. According to our findings, the interlocked nail group's median operation was longer than for the locking board group's, and indeed the locking plate group's intraoperative blood loss was higher than the interlocking nail group's. The VAS and constant-Murley ratings between the two groups did not significantly differ at the last follow-up. Second generation curved intramedullary nails were used in the trial.¹⁹

The greater deltoid muscle was closer to the entry location of the second-generation nail, which raised the possibility of shoulder pain and rotator cuff injury. This study did not uncover any rotator cuff lesions, in contrast to previous ones. Positioning may provide an explanation for the absence of postoperative dysfunction. Following the procedure, the rotator shoulder is rebuilt using tiny sutures, with the tip of the major nail now positioned 2-3 mm beneath the chondro of the femoral shaft. In terms of VAS and constant-Murley ratings at the end of the trial, there were no differences between the nail group and the plate group.²⁰

It is questionable if surgical treatment is preferable to non-surgical treatment for complex proximal humeral fractures (CPHF). There is no consensus on the optimum therapy for CPHFs in elderly patients. The purpose of meta-analysis and randomised controlled trials (RCTs) is to ascertain if corrective surgery for CPHFs is superior than non-surgical care. Surgical procedures in older patients did not significantly improve the functional outcome or quality of life related to health. The risk of postoperative complications, however, increased with surgical therapy for CPHFs.

The use of locking panel technology has increased the frequency of open reduction as well as internal fixation (ORIF) of intraarticular fractures (PHF). By adhering to a few technical recommendations, the frequency of ORIF difficulties can be reduced. These pearls are particularly crucial for individuals over 60, for whom nonoperative treatment and arthroplasty are frequently options. There have not been many substantial, single-center investigations on the current application of this technology. RIF of PHFs with interlocking plates had a 34.4% failure rate and 44.3% postoperative complications in patients older than 60. There was a propensity for a higher failure and risk of complications in geriatric individuals and more challenging fractures. Fixing techniques and indications is necessary to enhance surgical care of PHF.

In a recent study, the 2-year results of senior patients with a misaligned 3-part fracture of the proximal portion who were randomly assigned to non-operative or stabilizing plate therapy were requested. Although it requires a further procedure for 30.2% of patients, the locking plate provides

older patients with misplaced 3-part proximal portion injuries an improved functional outcome and health-related levels of happiness than non-operative treatment.²⁰ The study's objective was to describe, two years following locking plate therapy for simply a displaced two electrode humerus fracture, the results for senior patients. All of this included a patient's health-related happiness being evaluated (HRQoL). Locking plates appear to be a feasible treatment option for elderly patients with such displaced usually containing injuries of a preoperative neck of a proximal portion because of their managed functional status and controllable complication rate.²¹ To prevent screw penetration, nevertheless, extreme caution must be exercised. Despite the fact that the traditional architectural was generally positive, the patients claimed that it significantly decreased their HRQoL.²²

It is still unclear whether or not to treat stable dislocation proximal humeral fractures, specifically in senior patients. Open reduction and internal fixation of proximal humerus fractures were carried out in the comes to believe, multicenter, observational trial with a locking proximal humeral plate in order to assess the functional status and If the proper surgical technique is employed, reconstructive surgery of displacement fractures of the proximal humeral solely with locking femoral neck fractures implant can result in a successful functional outcome.^{23,24} Due to the numerous issues that have been linked to improper surgical technique, it is in the treating dentist's financial best interest to carry out the procedure correctly in order to prevent iatrogenic mishaps. . During surgery, Kirschner wires were utilized as "joysticks" to correct and reduce both larger and smaller tuberosities. After the reduced portions were momentarily fixed with joystick Kirschner wire, a three- and four-part fractures becomes a simple two-part fracture.²⁵

How to treat unstable dislocated neck of femur fractures, primarily in the elderly, is still up for debate. With the use of a locked proximal humeral plate, open reduce and intramedullary of fractures of the proximal humerus was performed in the current prospective, multimodal, observational study with the aim of evaluating the functional status and the frequency of complications.²⁶

Surgical management of displaced fractures in the proximal humerus with the interlocking proximal humeral plate evaluated in the present study can produce a positive functional outcome if the right surgical technique is used. Given that many complications were related to poor surgical technique; it is in the treating surgeon's best interest to perform the treatment appropriately to avoid iatrogenic errors.²⁷

A primary limitation of this study is its retrospective nature, which may introduce bias due to lack of randomization. Additionally, results are specific to a single hospital setting, limiting generalizability. The study also faces constraints in long-term follow-up, potentially

affecting assessment of lasting outcomes and complications.

CONCLUSION

In conclusion with employing locking plates, the method of fracture reduction and repair using interlocking internal fixation nails is less intrusive. However, this method also takes significantly more time. While comparing the two different methods of internal fixation used for the treatment of proximal humerus fractures, there was not a significant difference found in the pain scores or shoulder function ratings. Patients' postoperative happiness can be improved by the creation of tailored surgical plans and enhanced functional exercise guidance when thorough preoperative evaluations and correct intraoperative operations are combined with the clinical experience of orthopedic surgeons.

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