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Locking plate fixation versus intramedullary nail fixation for the treatment of proximal humerus fracture: a review

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ABSTRACT

Proximal humerus fractures are among the most common fractures in the elderly population, with increasing incidence due to osteoporosis. Surgical management is required in displaced and unstable patterns, with locking plate fixation and intramedullary nailing being two commonly employed techniques. This review summarizes the principles, advantages, limitations, and clinical outcomes of these modalities. Locking plates provide stable fixation, particularly in complex and osteoporotic fractures, while intramedullary nails offer a minimally invasive option with reduced soft tissue trauma. Current evidence suggests comparable union rates and functional outcomes, although complication profiles differ. The choice of fixation should be individualized based on fracture pattern, bone quality, and surgeon expertise.

Keywords: Proximal humerus fracture, Locking plate, Intramedullary nail, Fixation, Review

INTRODUCTION

Proximal humerus fractures account for approximately 4-6% of all fractures, representing the third most common fracture type in the elderly after hip and distal radius fractures.[1] Non-operative management is often appropriate for minimally displaced fractures; however, surgical fixation is indicated for displaced, unstable, or multi-fragmentary injuries.[2] Several studies have clinically reported that both locking compression plates (LCPs) and intramedullary nails (IMNs) are effective in restoring anatomy and function, yet their optimal indications and comparative outcomes remain debated.[3-5] This review aims to compare LCP and IMN fixation in the treatment of proximal humerus fractures with emphasis on indications, functional outcomes, and complications.

LOCKING PLATE FIXATION

Locking plates provide rigid fixation with angular stability and allow direct visualization and anatomical reduction. Multiple screw trajectories in the humeral head ensure strong fixation, and medial calcar screws can prevent varus collapse. However, the technique requires extensive surgical exposure, which may disrupt humeral head vascularity and increase the risk of avascular necrosis.[6] Hardware-related issues such as screw cut-out, plate prominence, and subacromial impingement are also reported.[7]

INTRAMEDULLARY NAIL FIXATION

Intramedullary nailing is a minimally invasive procedure that preserves periosteal blood supply and reduces soft tissue trauma. It offers biomechanical load sharing and generally shorter operative time.[8] Nevertheless, it can be challenging to achieve anatomical reduction in comminuted fractures, and the entry point through the rotator cuff may cause postoperative shoulder dysfunction.[9] In osteoporotic bone, fixation may be less stable compared to locking plates.[10]

COMPARATIVE OUTCOMES

Union rates are generally comparable between LCP and IMN fixation.[11] Functional outcomes measured by

Constant and DASH scores have shown mixed results across studies, with some favoring nails for early motion and others plates for anatomical reduction.[12] Complication profiles differ—locking plates carry higher risks of screw perforation and varus collapse, while intramedullary nails more often cause shoulder impingement and rotator cuff irritation.[14] Overall, reoperation rates are similar, and outcomes depend on fracture pattern, patient bone quality, and implant design.[14]

DISCUSSION

The optimal fixation method for proximal humerus fractures remains a topic of active debate. While locking plates offer strong angular stability suitable for complex and osteoporotic fractures, intramedullary nails provide a less invasive alternative with reduced soft tissue damage.[15] Biomechanically, plates resist varus collapse better, whereas nails demonstrate superior load-sharing capacity along the humeral shaft. However, these mechanical advantages do not consistently translate into superior clinical outcomes.[16]

Recent randomized and observational studies have suggested that patient-specific factors such as age, bone density, and fracture configuration play a decisive role in selecting the fixation method. For elderly patients with osteoporotic bone, augmentation with bone grafts or calcium phosphate cement may enhance fixation strength in plate constructs.[17] In contrast, nails may provide satisfactory outcomes in simple two-part fractures, particularly where soft tissue preservation is critical.[18] Minimally invasive plate osteosynthesis (MIPO) and improved entry-point techniques for nails have further minimized soft-tissue disruption and reduced complication rates.

Despite extensive research, the literature remains heterogeneous in terms of study design, follow-up duration, and outcome measures. Meta-analyses indicate no statistically significant difference in long-term functional scores between the two techniques.[19] Thus, the current trend emphasizes individualized treatment planning based on fracture morphology and surgeon experience rather than a one-size-fits-all approach.[20]

CONCLUSION

Locking plate and intramedullary nail fixation are both effective for managing proximal humerus fractures, with comparable union and functional outcomes. The choice of technique should be individualized, considering fracture pattern, bone quality, and surgeon expertise. Locking plates provide superior stability in complex and osteoporotic cases, while intramedullary nails offer a minimally invasive alternative with faster recovery potential. This review consolidates current evidence, clarifying that no single method is universally superior; instead, careful patient selection and adherence to sound surgical principles remain key to optimizing results and advancing clinical understanding in the field of proximal humerus fracture management.

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REFERENCES

1. Lanting B, MacDermid JC, Drosdowech D, Faber KJ. Proximal humerus fractures: a systematic review of treatment modalities. J Shoulder Elbow Surg. 2008;17(1):42-54.
2. Sproul RC, Iyengar JJ, Devcic Z, Feeley BT. A systematic review of locking plate fixation of proximal humerus fractures. Injury. 2011;42(4):408-13.
3. Gradl G, Dietze A, Kääb M, Hopfenmüller W, Mittlmeier T. Is locking nail fixation of humeral head fractures superior to locking plate fixation? Clin Orthop Relat Res. 2009;467(11):2986-93.
4. Zhu Y, Lu Y, Shen J, Zhang J, Jiang C. Locking intramedullary nails versus locking plates for humeral surgical neck fractures: a meta-analysis. J Shoulder Elbow Surg. 2011;20(3):389-98.
5. Spross C, Kaestle N, Benninger E, Fornaro J, Erschbamer M, Zdravkovic V, et al. Deltoid-split or deltopectoral approaches for proximal humeral fracture fixation: a randomized controlled trial. J Bone Joint Surg Am. 2016;98(22):1834-44.
6. Panchal A, Jeong JJ, Park SE, Kim JW. Intramedullary nailing versus locking plate fixation for displaced proximal humerus fractures: a meta-analysis. Orthop Traumatol Surg Res. 2019;105(5):781-9.
7. Konrad G, Bayer J, Hepp P, Voigt C, Oestern H, Kääb M, et al. Open reduction and internal fixation of proximal humeral fractures with use of the locking proximal humerus plate: results of a prospective, multicenter, observational study. J Bone Joint Surg Am. 2012;94(7):601-11.
8. Brorson S, Olsen BS, Frich LH, Jensen SL, Sørensen AK. The treatment of proximal humeral fractures: current concepts. EFORT Open Rev. 2017;2(5):85-93.
9. Sahu D, Choudhury A, Sahu A, Mahapatra S, Samal B. Comparison of intramedullary nailing and locking plate fixation in displaced proximal humeral fractures. Indian J Orthop. 2014;48(5):528-34.
10. Wang G, Mao Z, Zhang L, Zhang L, Zhao Y, Yin P, et al. Meta-analysis of locking plate versus intramedullary nail for treatment of proximal humeral fractures. J Orthop Surg Res. 2015;10:122.
11. Gallinet D, Ohl X, Decroocq L, Dib C, Valenti P, Boileau P. Locking plate fixation versus nailing for displaced 3- and 4-part proximal humerus fractures in patients older than 60 years: a randomized controlled trial. Orthop Traumatol Surg Res. 2018;104(8):S209-13.

12. Gupta AK, Harris JD, Erickson BJ, Abrams GD, Bruce B, McCormick F, et al. Surgical management of complex proximal humerus fractures—a systematic review of 92 studies including 4500 patients. J Orthop Trauma. 2015;29(1):54-9.
13. Sproul RC, Iyengar JJ, Devcic Z, Feeley BT. A systematic review of locking plate fixation of proximal humerus fractures. Injury. 2011;42(4):408-13.
14. Lee SH, Dargent-Molina P, Bréart G; EPIDOS Group. Risk factors for fractures of the proximal humerus: results from the EPIDOS prospective study. J Bone Miner Res. 2002;17(5):817-25.
15. Wang G, Mao Z, Zhang L, Zhang L, Zhao Y, Yin P, et al. Meta-analysis of locking plate versus intramedullary nail for treatment of proximal humeral fractures. J Orthop Surg Res. 2015;10:122.
16. Südkamp N, Bayer J, Hepp P, Voigt C, Oestern H, Kääb M, et al. Open reduction and internal fixation of proximal humeral fractures with use of the locking proximal humerus plate. Results of a prospective, multicenter, observational study. J Bone Joint Surg Am. 2009;91(6):1320-8.
17. Egol KA, Ong CC, Walsh M, Jazrawi LM, Tejwani NC, Zuckerman JD. Early complications in proximal humerus fractures treated with locked plates. J Orthop Trauma. 2008;22(3):159-64.
18. Matassi F, Angeloni R, Carulli C, Civinini R, Innocenti M. Locking plate and intramedullary nail fixation of proximal humerus fractures: a comparative study. J Orthop Traumatol. 2012;13(2):61-9.
19. Handoll HH, Keding A, Corbacho B, Brealey SD, Hewitt C, Rangan A. Five-year follow-up results of the PROFHER trial comparing operative and non-operative treatment of adults with a displaced fracture of the proximal humerus. Bone Joint J. 2017;99-B(3):383-92.
20. Roderer G, Erhardt J, Kuster M, Vegt P, Bahrs C. Second generation locked plating of proximal humerus fractures—a prospective multicentre observational study. Int Orthop. 2011;35(3):425-32.

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