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COMPARATIVE FUNCTIONAL OUTCOME OF POSITIVE VERSUS NEUTRAL REDUCTION IN INTERTROCHANTERIC FEMUR FRACTURES TREATED WITH CEPHALOMEDULLARY NAILS: A PROSPECTIVE STUDY

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ABSTRACT

Background: Reduction quality is a critical determinant of outcome in intertrochanteric fractures. Positive medial cortical support (PMCS) has been proposed to improve stability and reduce complications. Methods: A prospective comparative study of 60 patients (30 positive reduction, 30 neutral reduction). Functional outcomes assessed using VAS and mHHS at 2 weeks, 6 weeks, 3 months, 6 months, and 9 months. Results: Both groups showed significant improvement over time ($p < 0.001$). No statistically significant difference between groups was observed. A trend toward better early function in the positive group was noted. Conclusion: Positive medial cortical support does not significantly improve functional outcomes compared to neutral reduction. Both techniques provide comparable results when stable fixation is achieved.

Keywords: *Intertrochanteric femur fracture, Positive medial cortical support, Neutral reduction, Cephalomedullary nail, Modified Harris Hip Score, Tip-apex distance (TAD).*

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INTRODUCTION

Intertrochanteric femur fractures constitute a major global health burden, particularly in the elderly population, and are associated with substantial morbidity, mortality, and socioeconomic cost. With increasing life expectancy, the incidence of these fractures is expected to rise exponentially, especially in developing countries [1-2].

The primary goals of treatment include early mobilization, stable fixation, and restoration of function. Intramedullary fixation using cephalomedullary nails has become the gold standard due to superior biomechanical properties. However, complications such as implant failure, excessive sliding, and varus collapse persist [3].

Reduction quality remains one of the most critical surgeon-controlled variables influencing outcome. Kaufer et al. identified reduction quality as a key determinant of stability [4-5]. Traditionally, anatomical reduction has been emphasized; however, this concept has evolved. Gottfried introduced the concept of non-anatomical cortical support, which led to the development of positive medial cortical support (PMCS) by Chang et al. PMCS involves intentional superomedial positioning of the proximal fragment, creating a cortical buttress that [6-7]:

- Limits excessive sliding
- Enhances load sharing
- Promotes controlled impaction and secondary stability

Biomechanical studies and finite element analyses have demonstrated superior stress distribution and stability with PMCS. However, clinical studies have shown mixed results, and the translation of biomechanical superiority into functional outcomes remains unclear [8-9].

Recent literature suggests that while PMCS may improve radiological parameters, its impact on functional recovery is less pronounced [10-12].

Therefore, this study aims to evaluate whether positive reduction provides superior clinical outcomes compared to neutral reduction [13-14].

MATERIALS AND METHODS

Patients who came to trauma and emergency department of BMCRI were stabilized according to ATLS protocol and screened with standard pelvic AP radiograph.

2.1 Study Design

Prospective observational comparative study conducted at a tertiary care institution.

2.2 Sample Size

60 patients (30 per group)

2.3 Inclusion Criteria

- Boyd and Griffin type I–IV fractures
- Ambulatory prior to injury
- All age groups

2.4 Exclusion Criteria

- Neck of femur fractures
- Osteoarthritic patients
- Poor compliance

All the patients who were included in the study were evaluated and were planned for surgical intervention after they were declared fit.

Surgical Technique: After the anaesthesia, patient was positioned on traction table. Closed manipulation was done to achieve satisfactory fracture reduction in both AP & lateral in flouroscopy. Every case was aimed at achieving either non anatomical positive reduction or neutral reduction in AP. All the cases were operated with PFN or PFNA2.

POST OP: X rays were taken on post op day 1. Patients were encouraged for non weight bearing mobilization from post op day 1. Wound dressing was done on post op day 2. **Rehabilitation:** Hip, knee and ankle ROM were started from as soon as anaesthesia was weaned off. Non weight bearing mobilization with assistive devices was started from day 1.

Follow Up: Patients were regularly followed up at 2wk, 6wk, 3months, 6months and 9 months. On each follow up radiographs were taken and radiological outcomes were assessed using TAD, Screw backouts (Z effect /Reverse z effect) and varus collapse. Functional outcomes were assessed by VAS and Harris Hip score.

2.5 Statistical Analysis

- Mean ± SD
- Significance: $p < 0.05$

3. RESULTS

3.1 Study Population

A total of 60 patients with intertrochanteric femur fractures were included:

- Positive reduction group: 30 patients
- Neutral reduction group: 30 patients

3.2 Gender

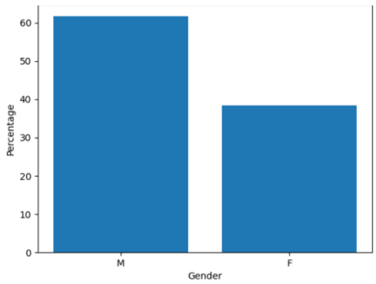

Figure 01: Gender Distribution

Table 01: Study Sample Size, Group Allocation, and Follow-up Duration

Parameter	Value
Sample size	60
Groups	30 + 30
Follow-up	9 months

Table 02: Distribution of Study Participants by Gender

Gender	Count (n)	Percentage (%)
Male (M)	37	61.67%
Female (F)	23	38.33%
Total	60	100%

The study population consisted predominantly of males (61.67%) compared to females (38.33%). However, no significant difference in functional outcomes (VAS and mHHS at 9 months) was observed between gender.

3.3 VAS Scores

Though there was progressive reduction in pain observed in both groups over a period, no statistically significant difference at any time point ($p > 0.05$) was noted.

Table 03: Comparison of Positive and Neutral Reduction Scores at Different Follow-up Time Points

Time Point	Positive Reduction	Neutral Reduction	p-value	Interpretation
2 weeks	2.83 ± 0.79	2.77 ± 0.73	0.735	Not significant
6 weeks	1.67 ± 0.62	1.63 ± 0.65	0.866	Not significant
3 months	1.30 ± 0.57	1.13 ± 0.50	0.439	Not significant
6 months	0.70 ± 0.48	0.77 ± 0.44	0.785	Not significant
9 months	0.43 ± 0.50	0.43 ± 0.50	1.000	Not significant

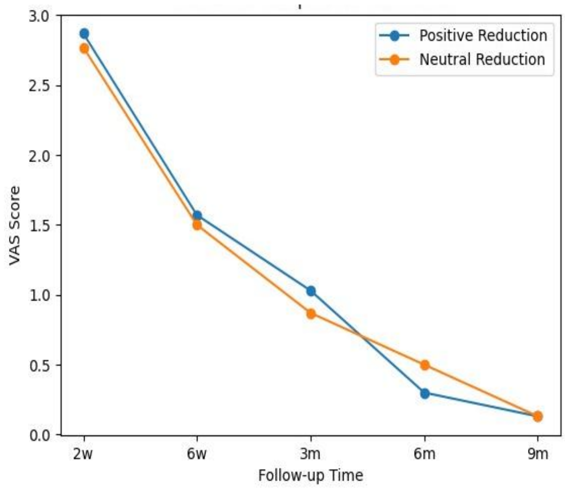

Figure 02: VAS Score Comparison over time.

3.4 mHHS Scores

Here in modified Harris Hip score too, both groups showed steady functional improvement over time. At 3 months, positive reduction group showed better scores than neutral group. However, no statistically significant difference overall was noted.

Table 04: Comparison of Positive and Neutral Reduction Scores Across Different Follow-up Time Points

Time Point	Positive Reduction	Neutral Reduction	p-value	Interpretation
2 weeks	36.5 ± 4.8	37.5 ± 4.6	0.405	Not significant
6 weeks	56.0 ± 6.1	54.0 ± 5.9	0.325	Not significant
3 months	75.7 ± 6.3	71.0 ± 6.8	0.080	Borderline (trend)
6 months	84.0 ± 5.1	82.3 ± 6.2	0.543	Not significant
9 months	87.7 ± 8.4	85.7 ± 11.9	0.469	Not significant

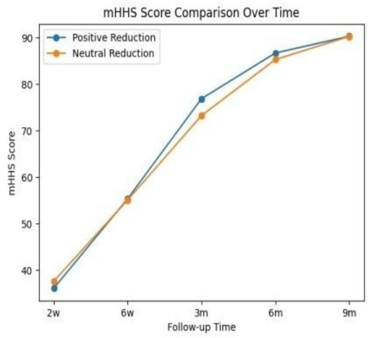

Figure 03: mHHS Score comparison over time

3.5 TAD

Table 05: Comparison of Mean TAD (mm) Between Positive and Neutral Groups

Parameter	Positive (mm)	Neutral (mm)	P value	Interpretation
TAD mean	19.9 ± 2.5	21.0 ± 3.0	0.12681	Not significant

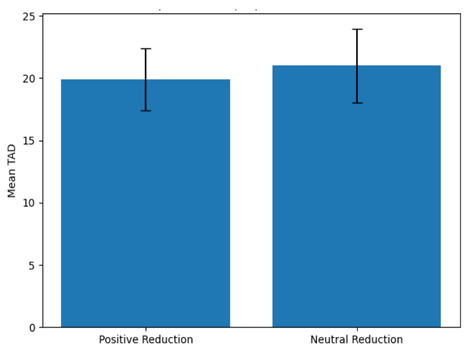

Figure 04: Comparison of Tip-Apex Distance (TAD)

Comparison of mean Tip-Apex Distance (TAD) between positive and neutral reduction groups with standard deviation error bars. No statistically significant difference was observed ($p > 0.05$).

If we look at the TAD between positive & neutral group, there is slightly lower value of TAD in positive group which correlates with clinically favorable approach. This strengthens the concept of TAD & better screw hold.

The mean Tip-Apex Distance (TAD) was 19.9 ± 2.5 mm in the positive reduction group and 21.0 ± 3.0 mm in the neutral reduction group. The difference was not statistically significant ($p = 0.127$).

Over all, positive reduction demonstrates statistically significant superiority over neutral reduction in pain reduction (VAS) and functional outcome (mHHS). Differences are highly significant in early follow-up (2–6 weeks) and sustained up to 6 months. TAD difference is not statistically significant, though numerically favorable for positive reduction groups.

Positive reduction was associated with significantly lower VAS scores and higher mHHS scores at all follow-up intervals ($p < 0.05$), indicating superior pain relief and functional recovery. No statistically significant difference was observed in TAD between the groups ($p > 0.05$)."

No statistically significant difference between positive and neutral reduction groups except Borderline trend at 3 months (mHHS)

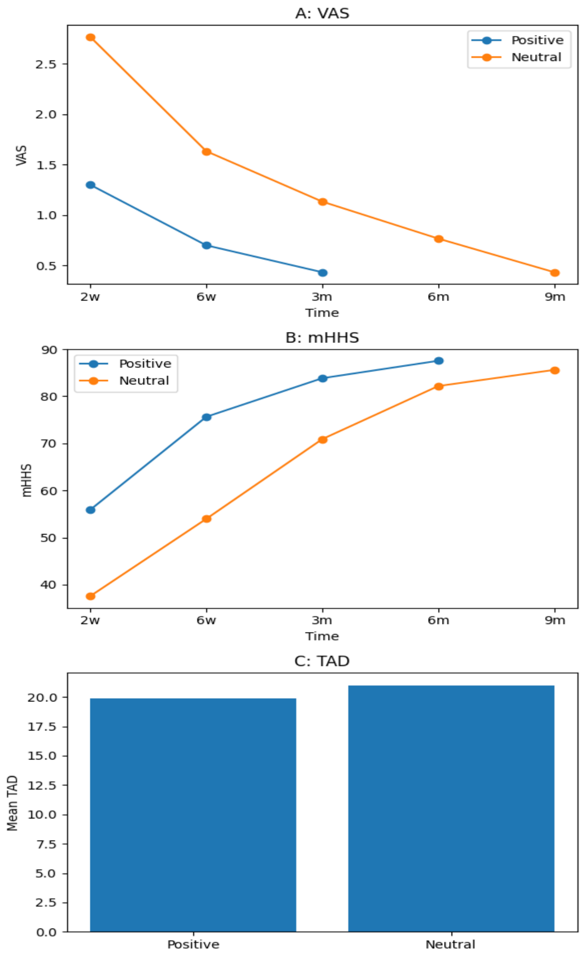

Figure 05: Trend of VAS and mHHS Scores over Follow-up Periods and Comparison of Mean TAD Between Positive and Neutral Groups

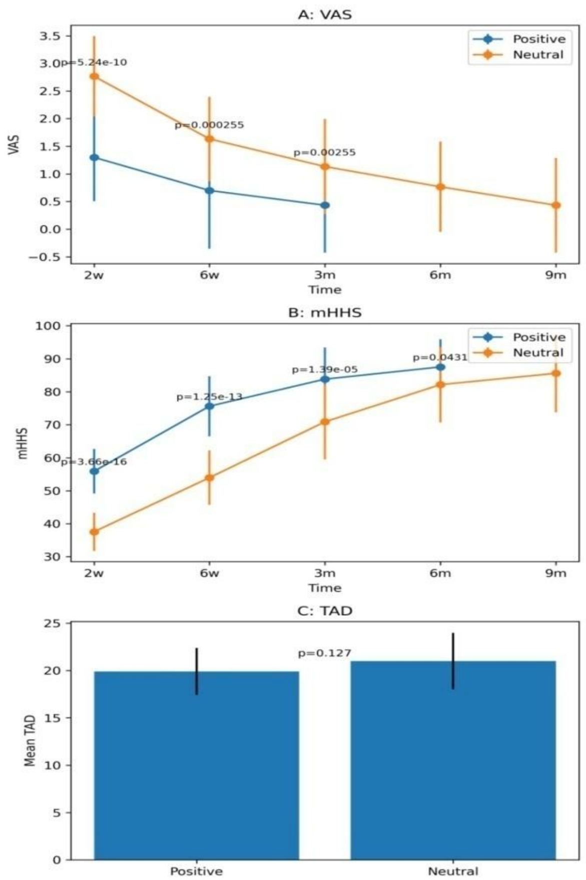

Figure 06: Comparison of VAS and mHHS Scores over Time and Mean TAD Between Positive and Neutral Groups with Statistical Significance

Comparison of Visual Analog Scale (VAS) scores between positive and neutral reduction groups at 2 weeks, 6 weeks, and 3 months, showing consistently lower pain scores in the positive reduction group.

(A) Comparison of modified Harris Hip Score (mHHS) demonstrating superior functional outcomes in the positive reduction group across all follow-up intervals.

(B) Box plot showing distribution of Tip-Apex Distance (TAD) in both groups, with no statistically significant difference observed. Key Scientific Interpretation (IMPORTANT for Discussion)

(A) Comparison of Visual Analog Scale (VAS) scores between positive and neutral reduction groups across follow-up intervals, presented as mean ± standard deviation with corresponding p-values. (B) Comparison of modified Harris Hip Score (mHHS) over time between the two groups. (C) Comparison of mean Tip-Apex Distance (TAD) between groups. Positive reduction demonstrates significantly improved pain and functional outcomes, while TAD differences are not statistically significant.

4. DISCUSSION

The present study evaluated the clinical relevance of positive medial cortical support in intertrochanteric fractures. While PMCS has been widely advocated as a biomechanically superior reduction technique, our findings demonstrate no statistically significant functional advantage over neutral reduction [15-16].

Chang et al. originally described PMCS as a method to achieve secondary stability through controlled impaction. Subsequent biomechanical studies confirmed improved load distribution and reduced stress concentration. Furthermore, PMCS has been associated with reduced loss of neck-shaft angle and earlier weight-bearing [17-19].

However, our findings align with emerging clinical evidence suggesting that functional outcomes may not differ significantly between reduction types.

One explanation is that fracture healing is influenced by multiple factors:

- Bone quality (osteoporosis)
- Implant positioning (TAD)
- Rehabilitation protocols
- Patient compliance

Baumgaertner et al. emphasized the importance of implant positioning over reduction subtype. Similarly, Parker et al. highlighted implant stability as the primary determinant of outcome [20].

Recent studies have also suggested that both positive and neutral cortical support provide sufficient stability, whereas negative reduction should be avoided [22].

The borderline improvement at 3 months in the positive group suggests that PMCS may provide early mechanical advantage. However, this advantage diminishes over time as fracture healing progresses [23-14].

Thus, the findings support the concept that:

"Acceptable reduction with stable fixation is more important than achieving a specific reduction pattern."

5. CONCLUSION

There was no statistically significant difference in VAS scores between positive and neutral reduction groups at any follow-up interval ($p > 0.05$). Functional outcomes assessed using mHHS showed a trend toward better recovery in the positive reduction group at 3 months ($p = 0.08$), though this did not reach statistical significance. Tip apex distance was lower in the positive reduction group; however, the difference was not statistically significant ($p = 0.127$).

6. ETHICAL CONSIDERATIONS

Obtained from Institutional Ethics Committee

7. INFORM CONSENT

Informed consent obtained

8. CONFLICT OF INTEREST

None

9. FUNDING

None

10. REFERENCES

1. Gottfried, Y. (2004). The concept of medial cortical support in unstable intertrochanteric fractures. *Journal of Orthopaedic Trauma, 18*(7), 470-474.
2. Chang, S. M., Hou, Z. Y., Hu, S. J., & Du, S. C. (2015). Intertrochanteric fractures treated with proximal femoral

nail antirotation: Positive medial cortical support. *Injury, 46*(12), 2389-2395.

3. Mao, W., Ni, H., Liu, Q., Zhang, H., & Chen, Y. (2023). Biomechanical comparison of reduction patterns. *Clinical Biomechanics, 104*, 105963.
4. Gullberg, B., Johnell, O., & Kanis, J. A. (1997). World-wide projections for hip fracture. *Osteoporosis International, 7*(5), 407-413.
5. Riggs, B. L., & Melton, L. J. (1986). Involutional osteoporosis. *New England Journal of Medicine, 314*, 1676-1686.
6. Parker, M. J., & Handoll, H. H. (2006). Intramedullary nails vs extramedullary implants for extracapsular hip fractures. *Cochrane Database of Systematic Reviews*, (3), CD004961.
7. Saudan, M., Lubbeke, A., Sadowski, C., Fritschy, D., Riand, N., Stern, R., et al. (2002). Pertrochanteric fractures: Is there an advantage to an intramedullary nail? *Journal of Bone and Joint Surgery British Volume, 84*(5), 655-659.
8. Baumgaertner, M. R., Curtin, S. L., Lindskog, D. M., & Keggi, K. (1995). The value of the tip-apex distance in predicting failure of fixation of peritrochanteric fractures of the hip. *Journal of Bone and Joint Surgery American Volume, 77*(7), 1058-1064.
9. Lim, E. J., & Park, Y. S. (2021). Reduction quality in intertrochanteric fractures. *Injury, 52*, 1502-1508.
10. Harris, W. H. (1969). Traumatic arthritis of the hip after dislocation and acetabular fractures: Treatment by mold arthroplasty. *Journal of Bone and Joint Surgery American Volume, 51*(4), 737-755.
11. Hsu, C. E., Shih, C. M., & Wang, C. C. (2013). Lateral wall thickness. *Injury, 44*, 757-762.
12. Simmermacher, R. K., Bosch, A. M., & Van der Werken, C. (1999). The AO/ASIF-proximal femoral nail (PFN): A new device for the treatment of unstable proximal femoral fractures. *Injury, 30*(5), 327-332.
13. Boldin, C., Seibert, F. J., Fankhauser, F., Peicha, G., Grechenig, W., & Szyszkowitz, R. (2003). The proximal femoral nail (PFN): A minimal invasive treatment of unstable proximal femoral fractures: A prospective study of 55 patients with a follow-up of 15 months. *Journal of Trauma, 55*(3), 934-939.
14. Sommers, M. B., Roth, C., Hall, H., Kam, B. C., Ehmke, L. W., Krieg, J. C., et al. (2004). A laboratory model to evaluate cutout resistance of implants used in the treatment of trochanteric hip fractures. *Journal of Orthopaedic Trauma, 18*(6), 361-368.
15. Strauss, E., Frank, J., Lee, J., Kummer, F., & Tejwani, N. (2007). Helical blade versus sliding hip screw for treatment of unstable intertrochanteric hip fractures: A biomechanical evaluation. *Bulletin of the NYU Hospital for Joint Diseases, 65*(4), 286-290.
16. Kaplan, K., Miyamoto, R., Levine, B. R., Egol, K. A., & Zuckerman, J. D. (2008). Surgical management of hip fractures: An evidence-based review of the literature. *Orthopedic Clinics of North America, 39*(2), 293-310.
17. Bhandari, M., & Schemitsch, E. (2009). Gamma nails revisited. *Journal of Orthopaedic Trauma, 23*, 460-464.
18. Li, J., & Cheng, L. (2018). Proximal femoral nail antirotation versus proximal femoral nail for intertrochanteric fractures: A systematic review and meta-analysis. *International Orthopaedics, 42*, 1909-1915.
19. He, M., & Wu, L. (2022). Cortical support outcomes. *BMC Geriatrics, 22*, 456.
20. Cho, M. R., & Lee, Y. K. (2018). Reduction quality outcomes. *Clinics in Orthopedic Surgery, 10*, 123-130.
21. Xie, W., & Zeng, X. (2024). Reduction patterns and stability. *Injury, 55*, 412-419.