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Functional and Clinical Outcomes of Middle Third Clavicle Fracture Treated with Reconstruction Plate: A Retrospective Cross-Sectional Study

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ABSTRACT

Background: *Midshaft (middle third) clavicle fractures form the majority of clavicular injuries and are frequently displaced, risking malunion, non-union, and functional deficits when treated non-operatively. Plate fixation offers stable reduction and early mobilization; reconstruction plates remain widely used, especially in resource-limited settings.*

Methods: *Retrospective cross-sectional study of 24 adults (18–60 years) with displaced midshaft clavicle fractures treated with open reduction and internal fixation using a reconstruction plate (August 2023–July 2024). Outcomes: Visual Analogue Scale (VAS) and Disabilities of the Arm, Shoulder and Hand (DASH) at 6, 12, and 24 weeks; radiological union at 12 and 24 weeks; complications. Statistics: mean±SD, paired t-tests (6↔12, 12↔24, 6↔24 weeks), McNemar test for paired union proportions; $p<0.05$ significant.*

Results: *Mean age 36.54±11.45 years; 83.3% male; mean displacement 2.79±0.51 cm. VAS improved from 4.29±0.46 (6w) to 2.88±0.45 (12w) to 1.83±0.38 (24w); all pairwise comparisons $p<0.001$. DASH improved from 44.04±2.76 to 29.75±3.15 to 15.88±3.15; all pairwise $p<0.001$. Radiological union: 12 weeks 14/24 (58.3%); 24 weeks 22/24 (91.7%); McNemar $\chi^2=2.25$, $p=0.134$. Complications: infection 5/24 (20.8%), delayed union 3/24 (12.5%), implant failure 1/24 (4.2%).*

Conclusion: *Reconstruction plate fixation yielded significant pain and functional improvements with high overall union by 24 weeks and acceptable complication rates, supporting its role as a reliable fixation strategy for displaced midshaft clavicle fractures.*

Key words: *clavicle fracture; midshaft; reconstruction plate; VAS; DASH; radiological union; complications*

INTRODUCTION:

Clavicle fractures comprise 2.5–10% of adult fractures, with the middle third accounting for ~70–80%.[1,2] Midshaft clavicle fractures are highly relevant in orthopaedic practice due to their frequency and tendency for displacement, especially in active adults. Mechanisms often include high-energy trauma, such as road traffic accidents and falls onto the shoulder, leading to significant functional impairment.

While traditional nonoperative management can be effective for undisplaced fractures, recent data highlight increased risks of malunion, non-union, persistent pain, and limited shoulder function when managing displaced midshaft injuries nonoperatively. This has led to a move toward operative strategies, particularly for those with considerable displacement, cosmetic concerns, or high-activity demands.Displaced midshaft injuries treated non-operatively have higher risks of symptomatic malunion, non-union, persistent pain, and functional limitation.[3-7] Surgical fixation can restore length and alignment, enabling early rehabilitation and improved outcomes.[3,8]

Fixation options include intramedullary devices and plates.Among various fixation options, the reconstruction plate is notable for its versatility, ease of anatomical contouring, and widespread availability, making it particularly crucial in low-resource settings where advanced locked implants may not be accessible. Plate fixation offers rigid stability and anatomical reduction in comminuted patterns; reconstruction plates remain commonplace due to contourability and availability, despite the popularity of precontoured locking plates.[8–10] Biomechanical work has explored relative strengths of plate types, while clinical series report good union and function with both locking and reconstruction constructs.[10-13] .We report functional and clinical outcomes after reconstruction plate fixation for displaced midshaft clavicle fractures at a South Indian tertiary center.

MATERIALS AND METHODS

Design & Setting: Retrospective cross-sectional study at R.L. Jalappa Hospital, Tamaka, Kolar (August 2023–July 2024). Ethical approval was obtained from the Institutional Ethics Committee (Sri Devaraj Urs Medical College).

Sample size: 24 patients (a priori calculation based on reoperation prevalence as per parent literature).[8]

Inclusion criteria: Adults 18–60 years; radiographically confirmed displaced midshaft fractures; skin tenting.

Exclusion criteria: Prior clavicle injury; established non-union; proximal/distal third fractures; pathological fractures.

Surgical technique & follow-up: Open reduction and internal fixation using superior reconstruction plate; standard postoperative protocols. Patients were reviewed at 6, 12, and 24 weeks. Union was defined clinically (absence of pain/tenderness) and radiographically (bridging callus/trabeculations across fracture line).

Outcome measures:

Pain: VAS (0–10) at 6, 12, 24 weeks.

Function: DASH at 6, 12, 24 weeks.

Radiological union at 12 and 24 weeks (binary).

Complications: infection, implant failure, delayed union.

Statistics: Continuous variables are mean±SD; categorical variables as n (%). Paired t-tests compared repeated measures (6↔12, 12↔24, 6↔24 weeks) for VAS and DASH. Paired change in union proportions (12w vs 24w) tested with McNemar's test (continuity correction). $p<0.05$ was significant. Analyses were performed on the full cohort (n=24).

RESULTS

Table 1. Demographics and baseline characteristics (n=24)

Variable	Value
Age (years)	**36.54 ± 11.45**
Gender (M/F)	**20 (83.3%) / 4 (16.7%)**
Displacement (cm)	**2.79 ± 0.51**

Table 1 presents the age, gender, and fracture displacement of the study cohort. The mean age of the study participants is **36.54 ± 11.45 years.**Most patients were young males (83.3%) with significant displacement, which is typical of high-energy injuries suitable for surgical fixation. The mean displacement was **2.79 ± 0.51cms.**

Table 2. VAS scores over time (mean ± SD)

Time point	VAS (mean ± SD)
6 weeks	**4.29 ± 0.46**
12 weeks	**2.88 ± 0.45**
24 weeks	**1.83 ± 0.38**

Table 2 details mean pain scores at 6, 12, and 24 weeks post-surgery. The mean VAS score at 6 weeks is 4.29 ± 0.46, at 12 weeks is 2.88 ± 0.45 and at 24 weeks is 1.83 ± 0.38. There is a clear decrease in pain at each follow-up, demonstrating the effectiveness of reconstruction plating in reducing pain during recovery.

Table 3. DASH scores over time (mean ± SD)

Time point	DASH (mean ± SD)
6 weeks	**44.04 ± 2.76**
12 weeks	**29.75 ± 3.15**
24 weeks	**15.88 ± 3.15**

Table 3 shows functional outcomes using the DASH score at the same intervals. The mean DASH score at 6 weeks is 44.04 ± 2.76, at 12 weeks is 29.75 ± 3.15 and at 24 weeks is 15.88 ± 3.15. Substantial decreases over 24 weeks indicate marked improvement in shoulder and arm function after surgery, reflecting successful rehabilitation.

Table 4. Paired comparisons for VAS and DASH

Measure	Comparison	n pairs	t	p-value
VAS	6w vs 12w	24	−12.63	**<0.001**
VAS	12w vs 24w	24	−11.64	**<0.001**
VAS	6w vs 24w	24	−29.36	**<0.001**
DASH	6w vs 12w	24	−25.27	**<0.001**
DASH	12w vs 24w	24	−22.34	**<0.001**
DASH	6w vs 24w	24	−42.73	**<0.001**

Description: Pain and disability improved significantly at each interval, with large effect sizes (all $p<0.001$). These results align with literature supporting early recovery after plate fixation.
Note: t values are directionally negative because later scores are lower (improved) than earlier ones.
Table 4 provides statistical validation of pain and function improvement, showing all changes are highly significant ($p<0.001$). The consistently negative t-values confirm reductions in pain and disability at each interval.

Table 5. Radiological union at 12 and 24 weeks

Time point	United (n, %)	Non-united (n, %)
12 weeks	**14 (58.3%)**	**10 (41.7%)**
24 weeks	**22 (91.7%)**	**2 (8.3%)**

Paired test: McNemar $\chi^2=2.25$; **p=0.134** (with continuity correction).
Description: Substantial increase in union by 24 weeks (≈92%). The paired test was not statistically significant at $\alpha=0.05$, likely reflecting limited power with small discordant pairs; nonetheless, the absolute improvement is clinically meaningful and consistent with prior plate-fixation series.
Table 5 tracks bone healing at specified intervals. The union rate increases from 58.3% at 12 weeks to 91.7% at 24 weeks, demonstrating reliable fracture healing with this technique. The observed improvement is clinically meaningful, even if the statistical test was not significant due to sample size.

Table 6. Postoperative complications (n=24)

Complication	Frequency (n, %)
Infection	**5 (20.8%)**
Delayed union	**3 (12.5%)**
Implant failure	**1 (4.2%)**

Description: Overall complication profile is comparable to published reconstruction plate cohorts, where superficial infection and delayed union are reported in single-digit to low-teens percentages, and hardware failure is uncommon.
Table 6 summarizes complications like infection, delayed union, and implant failure.9 patients had complications.Among those 5 patients (20.8%) had infection,3 patients (12.5%) had delayed union,and 1 patient (4.2%) had implant failure .While infection rates were slightly elevated, overall complication frequencies remain consistent with published data on midshaft clavicle plate fixation.

DISCUSSION

In this single-center series of displaced midshaft clavicle fractures treated with reconstruction plates, we observed marked improvements in pain (VAS) and function (DASH) between 6→12→24 weeks, with high union at 24 weeks (91.7%) and low mechanical failure (4.2%). These findings support reconstruction plates as a pragmatic and effective option.
Comparison with literature: Our functional improvements mirror reports that operative fixation surpasses non-operative care in pain relief and functional recovery for displaced midshaft fractures.[3-7] In direct comparisons of plate types, Gan et al.[3] reported comparable or favorable outcomes with reconstruction plates against locking plates, while Kingsly et al.[9] found both plate types yield significant DASH improvements. Cho et al.[12] noted satisfactory results for both reconstruction and reconstruction

locking plates, suggesting construct selection may be guided by fracture pattern, bone quality, and implant availability.

Union: Our 24-week union of 91.7% sits within the broad range reported for plate fixation.[9,12,14] Dhoju et al.[11] achieved ~95% union with superior reconstruction plates, and Woltz et al.[4] also documented high healing rates in a retrospective cohort. The non-significant McNemar test likely reflects a small number of discordant pairs and limited sample size; clinically, the transition from 58% at 12 weeks to 92% at 24 weeks is substantial and aligns with expected healing trajectories after stable fixation.[2,14]

Complications: Infection (20.8%) in our cohort is on the higher edge of published plate-fixation series, which often report lower superficial infection rates; factors such as soft-tissue handling, wound care, and patient comorbidities may contribute.[12-15] Implant failure (4.2%) and delayed union (12.5%) are within reported ranges for midshaft clavicle plate fixation.[9,12,14] Biomechanical data indicate that while locking plates may offer greater stiffness, reconstruction plates can achieve adequate stability when anatomically contoured and applied with sound technique.[10-11]

Implications: In regions where implant cost and availability influence practice, reconstruction plates remain a valid and effective solution offering early pain relief, rapid functional gains, and reliable union.[3,8,9,12,14]

Strengths and limitations: Strengths include standardized time-point assessments and complete follow-up to 24 weeks. Limitations encompass retrospective design, modest sample size limiting inferential power (especially for union and complications), and the absence of a concurrent locking-plate control group.

Future directions: Prospective comparative studies with larger samples, patient-reported outcomes beyond 24 weeks, and cost-effectiveness analyses (implant and reoperation costs) would refine implant selection pathways.[3]

CONCLUSION

Reconstruction plate fixation for displaced midshaft clavicle fractures produced significant, stepwise improvements in VAS and DASH through 24 weeks, with high union and low mechanical complications. Reconstruction plate fixation for displaced midshaft clavicle fractures delivers significant benefits, as highlighted by stepwise reductions in pain and functional disability over 24 weeks, high radiological union rates, and few mechanical complications. Despite the prevalence of advanced locked implants, the reconstruction plate remains invaluable in resource-limited environments because of its versatility, affordability, and excellent clinical outcomes. These findings reinforce its utility as a dependable fixation strategy for midshaft clavicle fractures, with results comparable to the best available evidence. Further research should address longer-term patient outcomes, direct implant comparisons, and cost-effectiveness to continue refining best practices in this common orthopedic challenge. In our setting, reconstruction plates represent a dependable, accessible fixation strategy with outcomes comparable to contemporary literature.

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