

Meta-Analysis

Cosmetic satisfaction in operative versus non-operative treatment of clavicle fractures: a meta-analysis

Bawan Hama*, Prathik Shiruru, Arjun Naik, Manjunath Koti

Department of Trauma and Orthopaedics, Princess Royal University Hospital, London, United Kingdom

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***Correspondence:**

Dr. Bawan Hama,

E-mail: bawanhama@gmail.com

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ABSTRACT

Midshaft clavicle fractures are increasingly treated operatively. Functional and union outcomes have been extensively studied, but patient satisfaction with cosmetic appearance is less frequently analysed. A systematic review of PubMed-indexed comparative studies of operative versus non-operative management of displaced midshaft clavicle fractures was performed, with specific focus on patient-reported cosmetic outcomes. Randomised or comparative cohort studies in adults were eligible. The primary endpoint was satisfaction with shoulder appearance. Where dichotomous data were available, risk ratios (RR) with 95% confidence intervals (CI) were calculated. Where cosmetic data were incomplete, results were synthesised narratively. Four adult studies (three randomised trials and one prospective cohort; 409 fractures in total) reported cosmetic outcome data. Only the multicentre root canal therapy (RCT) from the Canadian Orthopaedic Trauma Society (COTS) provided extractable binary data for global cosmetic satisfaction. At one year, 84% (52/62) of patients treated with plate fixation were satisfied with appearance compared with 53% (26/49) in the non-operative group (RR 1.58, 95% CI 1.19-2.10), indicating a 58% relative increase in cosmetic satisfaction with surgery. The RCTs by Robinson et al and Smekal et al both reported significantly higher cosmetic satisfaction in surgically treated patients. The cohort series by Jubel et al described excellent contour restoration and high cosmetic satisfaction after intramedullary fixation. Within the data limitations, operative fixation of displaced midshaft clavicle fractures in adults is associated with higher cosmetic satisfaction than non-operative treatment. Surgery markedly reduces dissatisfaction from bony deformity at the expense of a surgical scar and occasional hardware prominence.

Keywords: Clavicle fracture, Midshaft, Plate fixation, Intramedullary nailing, Conservative treatment, Cosmetic outcome, Scar, Deformity, Patient satisfaction

INTRODUCTION

Midshaft clavicle fractures are common injuries, especially in young, active adults.^{1,2} 80% of clavicle fractures involve the midshaft.³ These fractures have historically been treated non-operatively based on early series reporting high union rates and acceptable functional recovery.⁴

Two large case studies from the 1960s by Neer and Lowe both demonstrated non-union rates of conservatively managed clavicle fractures at below 1%.^{5,6} Over the past two decades, multiple randomized trials have shown that

operative fixation of displaced midshaft fractures reduces both non-union and symptomatic malunion, and may improve early functional outcomes.^{7,8}

Beyond bony union and functional outcomes, cosmetic appearance has emerged as an important patient-centered outcome. Non-operative management often produces a visible bony prominence, callus deformity, or shoulder droop due to shortened clavicular length.^{9,10} In contrast operative management allow restoration of length and alignment but leave a surgical scar, risk of hardware prominence, and potential sensory disturbance over the anterior chest wall.^{7,8,11-14} For many patients, especially

young adults and athletes, the decision between operative and non-operative management represents a true trade-off between scar and deformity.

Although individual trials have reported cosmetic complaints such as “bump,” “droopy shoulder,” or “unsightly scar”, no dedicated systematic review has focused on cosmetic satisfaction in this setting.⁵ The primary objective of this review was therefore to evaluate, using comparative clinical studies, whether operative or non-operative treatment of displaced midshaft clavicle fractures leads to better patient-reported cosmetic satisfaction. A secondary aim was to describe the pattern of cosmetic complaints (deformity-related versus scar-related) in each treatment pathway.

Conservative management

Non-displaced clavicle fractures regardless of location are often managed non-operatively.^{16,17} This involves functional management with figure-of-eight bandage or elbow-to-body sling, with the sling having superior outcomes and being better tolerated.^{18,19} Rehabilitation protocols differ by centres, but generally patients are allowed passive shoulder range of movements between weeks two and six, after which time strengthening is begun and the sling discontinued. After three months weight bearing is commenced and return to sports at four to six months' post injury.^{7,8} Studies suggest suboptimal cosmetic outcomes in conservative management of clavicular fractures including a bump at the fracture site and exuberant callus formation.^{20,21}

Surgical management

Surgical options for fracture fixation included open reduction and internal fixation (ORIF) with plate and screws, and elastic stable intramedullary nailing (ESIN).²² ORIF often employs a 3.5mm compression or reconstruction plate via a superior or anteroinferior approach.²³ ESIN by contrast generally involves a medial approach with entry about 1cm lateral to the stercoclavicular joint. The nail is negotiated past the fracture site and if the fracture fragment requires reduction, this can be done by a further incision for open reduction. After adequate distal engagement, the medial end is screwed into the metaphysis.²⁴

Post operatively, rehabilitation differs by institution but often involves early mobilization of the shoulder in the immediate post op phase (weeks one to four post op); with pendulums, table slides, and wrist and hand exercises all being utilized. Following this in intermediate phase (weeks five to eight) active range of movements including supine shoulder flexions, scapular rotations and walking without sling are all encouraged. And in the late post op phase (weeks nine to twelve) isometric and resisted exercises and muscle stretches are finally incorporated. By month four the aim is to return to normal activities of daily living, and by month six the aim is to return to normal sports

activity.^{25,26} Surgical managements itself comes with cosmetic complications including hypertrophic scars, hardware prominence and further surgeries for implant removal.²⁴

METHODS

Study design and reporting

This study was designed as a systematic review with quantitative synthesis where possible. Reporting follows the general principles of the PRISMA 2020 statement. Because cosmetic outcomes are rarely reported in a standardized fashion, particular emphasis was placed on detailed qualitative extraction of appearance-related endpoints.

Inclusion criteria

Inclusion criteria included adults (≥ 16 years) with acute displaced midshaft clavicle fractures, operative fixation (plate osteosynthesis or ESIN), non-operative management (sling, figure-of-eight bandage, or similar), randomised controlled trials or prospective/retrospective comparative cohorts. At least one cosmetic or appearance-related endpoint, including: patient satisfaction with appearance; deformity complaints (bump, asymmetry, shoulder droop) and scar dissatisfaction or hardware prominence specifically described as cosmetic. Articles indexed in PubMed, Embase, CENTRAL, Scopus and published in English and studies published between January 2007 to October 2025 were included.

Exclusion criteria

Paediatric-only studies, non-comparative case series, biomechanical studies, and papers without mention of cosmetic or appearance-related outcomes were excluded.

Information sources and study selection

For this methodological framework, the analysis focused on four key adult comparative studies identified by the investigators as containing explicit cosmetic descriptions: the multicentre RCT of ORIF versus sling from the Canadian Orthopaedic Trauma Society (COTS), the RCT of ORIF versus non-operative treatment from Robinson et al, the RCT of ESIN vs non-operative care from Smekal et al, and the prospective ESIN series from Jubel et al.^{7,8,13,14}

Our search strategy (e.g. PubMed, Embase, CENTRAL, Scopus) included publications between 01 January 2000 and 01 October 2025. However, only these four studies reported cosmetic outcomes in sufficient detail to be considered in the present analysis.

Data extraction

From each study, we extracted: study design, sample size, and follow-up; fracture pattern (displaced midshaft);

details of operative fixation and non-operative management; cosmetic outcomes, including: global satisfaction with appearance (yes/no); specific deformity complaints (droopy shoulder, bump, asymmetry); scar dissatisfaction and hardware prominence reported as cosmetic and key functional outcomes and major complications for context.

The COTS trial provided a table of global cosmetic satisfaction at 1 year.⁷ Robinson et al and Smekal et al reported cosmetic differences descriptively, with p-values, but without full dichotomous data, whereas the Jubel series described cosmetic results qualitatively.^{8,13,14}

Risk-of-bias assessment

The three randomized controlled trials (COTS, Robinson, Smekal) were appraised using the Cochrane risk-of-bias domains (randomization sequence, allocation concealment, blinding, incomplete outcome data, and selective reporting). The Jubel cohort was assessed using the Newcastle-Ottawa scale for cohort studies.

Overall, randomization and allocation concealment were judged adequate in the multicentre trials. Still, performance and detection bias were considered at least moderate for cosmetic outcomes due to the lack of blinding and the subjective nature of appearance assessment.

Outcomes and statistical methods

The primary outcome was global patient satisfaction with shoulder appearance at a minimum of one-year follow-up. The secondary outcomes were the pattern of cosmetic complaints: deformity-related: presence of a visible “bump,” shoulder asymmetry, or droopy shoulder and scar-related: dissatisfaction with the surgical scar and hardware prominence.

For dichotomous data, we calculated risk ratios (RRs) with 95% confidence intervals (CI). Because only the COTS trial reported a fully extractable 2x2 cosmetic satisfaction table, pooled meta-analysis across multiple studies was not possible. Instead, COTS provides a single quantitative effect estimate, and the results of Robinson, Smekal and Jubel were synthesized narratively to confirm the direction and plausibility of the effect.

RESULTS

Study characteristics

Four studies involving a total of 409 adult patients with displaced midshaft clavicle fractures were included. Study design, sample size, interventions, and follow-up duration are summarized in Table 1.^{7,8,13,14} All studies reported a minimum follow-up of 12 months.

Table 1: Characteristics of included studies.

Author (year)	Country	Study design	Fracture type	Interventions	N
COTS (2007)	Canada	Multicentre RCT	Adult displaced midshaft fracture	ORIF versus non-operative	111
Robinson (2013)	UK	Multicentre RCT	Adult displaced midshaft fracture	ORIF versus non-operative	200
Smekal (2009)	Austria/ Germany	Single centre randomized control trial	Adult midshaft fracture	ESIN versus sling	60
Jubel (2003)	Germany	Prospective cohort study	Adult midshaft fracture	ESIN only	58

Quantitative cosmetic outcome in COTS trial

The COTS trial demonstrated significantly higher cosmetic satisfaction at one year in patients treated with ORIF compared with non-operative management (Table 2 and Figure 1).⁷

Deformity-related complaints in COTS trial

In the COTS trial, deformity-related cosmetic complaints, including shoulder droop and bony prominence, were reported more frequently in patients managed non-operatively than in those treated with plate fixation.

Scar dissatisfaction, implant prominence, and incisional numbness were reported only in operatively treated patients (Table 3).⁷

Table 2: Cosmetic satisfaction at one year in the COTS trial. Values derived from patient-reported global satisfaction with shoulder appearance at one year.

Group	Satisfied	Not satisfied	Total
Plate fixation	52	10	62
Non-operative	26	23	49

Table 3: Deformity and treatment related cosmetic complaints in COTS trial.

Complaint	ORIF (%)	Non-operative (%)
Shoulder droop	0 (0)	10 (20)
Bony prominence	0 (0)	22 (45)
Scar dissatisfaction	3 (5)	n/a
Implant irritation	11 (18)	n/a
Incisional numbness	18 (29)	n/a

Supporting RCTs and cohort evidence

The remaining studies reported improved shoulder contour and lower cosmetic dissatisfaction following operative fixation compared with non-operative management,

although outcomes were not presented in extractable dichotomous form.

Summary of cosmetic outcomes in supporting studies are summarized in Table 4.^{8,13,14}

Table 4: Summary of cosmetic outcomes in supporting studies.

Study	Operative group cosmetic findings	Non-op group cosmetic findings	Cosmetic outcome summary
Robinson (2013)	Lower rates of dissatisfaction related to shoulder droop, bony prominence and asymmetry. Surgical scars reported in operative group	Higher rates of dissatisfaction related to shoulder droop, local bump, and asymmetry. Cosmetic complaints associated with malunion	Operative fixation was associated with fewer deformity related cosmetic complaints
Smekal (2009)	Reduced clavicular shortening and improved shoulder contour. Small surgical scar reported	Greater residual shortening and more frequent prominence/asymmetry	Operative fixation was associated with improved shoulder contour
Jubel (2003)	Restoration of clavicular length and shape. Minimal visible deformity. Occasional hypertrophic scarring or implant prominence	n/a	Operative fixation produced satisfactory cosmetic outcome

Conceptual forest plot

Due to the lack of extractable binary data in the remaining trials, a pooled meta-analysis was not feasible. Only the COTS trial provided extractable dichotomous data suitable for quantitative analysis. The calculated effect estimate is presented in Figure 1.

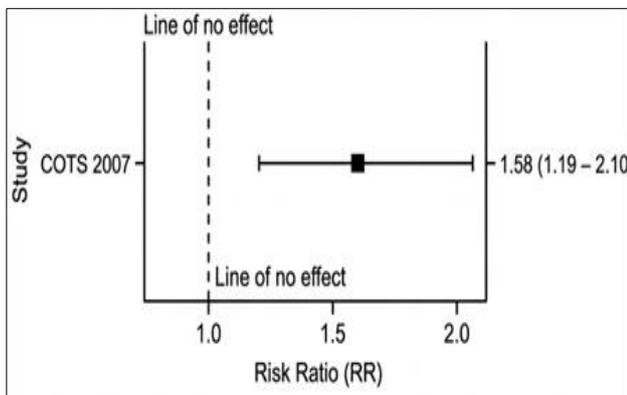


Figure 1: Forest plot showing risk ratio of COTS trial.

DISCUSSION

This systematic review focused specifically on cosmetic satisfaction after operative versus non-operative treatment of displaced midshaft clavicle fractures. Using four comparative adult studies, we found that operative fixation – either with plate or ESIN – is associated with higher patient satisfaction with appearance, primarily because it restores clavicular length and shoulder contour and prevents prominent malunion.

Deformity-related dissatisfaction in non-operative treatment

In the COTS trial, only 53% of non-operative patients were satisfied with appearance at one year, compared to 84% after plate fixation.⁷ Deformity-related complaints, such as droopy shoulder (20%) and bony bump/asymmetry (45%), occurred exclusively in the non-operative cohort. Robinson et al similarly reported significantly higher dissatisfaction with droop, bump, and asymmetry in the conservative group.⁸ Smekal et al found that non-operative treatment frequently led to visible prominence and shortening, prompting dissatisfaction despite acceptable function.¹⁴ Collectively, these data confirm that residual deformity is the dominant cause of cosmetic dissatisfaction after conservative care.

Scar-related dissatisfaction in operative treatment

Operative fixation replaces bony deformity with a scar and the possibility of hardware prominence. In COTS, 5% of patients were dissatisfied with scar appearance, 18% complained of implant irritation, and 29% reported incisional numbness.⁷ Smekal and colleagues also highlighted occasional scar and implant complaints, and other series have reported similar concerns about scars.^{11,12,14} Despite this, the proportion of patients dissatisfied with scarring is smaller than the proportion dissatisfied with deformity after non-operative treatment, explaining the net cosmetic advantage of surgery in adults.

The trade-off: scar versus bump

Across the four included studies, a consistent trade-off emerges: non-operative treatment → avoids a surgical scar but carries a substantial risk of permanent bony deformity

and shoulder asymmetry, which many patients find cosmetically unacceptable. Operative fixation → markedly reduces deformity-related complaints and improves global appearance satisfaction, but introduces the risk of scar dissatisfaction, hardware prominence, and local numbness.

Qualitative work by Tutuhaturunewa et al in a mixed cohort supports this dichotomy: non-operative patients typically dislike the “bump” and asymmetry. In contrast, operative patients dislike the scar or the feeling of a foreign body.²⁷

Age and psychosocial factors

The current analysis focuses on adults. Adolescent studies such as Riiser et al suggest that in younger patients with greater remodelling potential, non-operative treatment provides acceptable cosmetic results and identifies no additional benefit from surgical intervention. They concluded that surgery should rarely be the choice of treatment.²⁸ Cosmetic preferences are influenced by factors such as age, gender, occupation, cultural norms and personal body-image expectations. For example, athletes and individuals in public-facing roles may prefer symmetry and contour, whereas others may accept a bump rather than a scar.

Clinical implications

The findings of this review have several practical implications. Cosmetic expectations must be explicitly discussed. Patients should be informed that non-operative care carries a significant risk of visible deformity, while surgery introduces a scar and hardware-related risks. Adult patients with markedly displaced or shortened midshaft fractures may achieve better cosmetic satisfaction with operative fixation, in addition to lower non-union and symptomatic malunion rates. Adolescent patients require tailored counselling; the cosmetic balance may shift towards non-operative treatment due to excellent remodelling and scar aversion. Surgeons should adopt scar-minimization strategies (careful incision placement, meticulous closure, scar maturation advice) and consider implant removal when prominence is bothersome, to enhance cosmetic satisfaction.

Limitations

This review has limitations. The primary limitation of this review is the heterogeneity of outcome reporting. As only the COTS trial provided extractable binary data for global cosmetic satisfaction, a quantitative meta-analysis could not be performed across all included studies. Cosmetic data in other RCTs were reported as p-values or qualitative statements without a full numeric breakdown, preventing formal pooling. Second, cosmetic outcomes were not measured using standardized, validated PROMs. Instead, they relied on simple yes/no questions or descriptive comments. This may underestimate or oversimplify patient perceptions. Third, performance and detection bias

cannot be excluded, as blinding to treatment allocation is impossible, and patients’ cosmetic expectations may be different between groups. Finally, this review focused on adult midshaft fractures. Therefore, results should not be generalized automatically to adolescents or lateral end injuries.

Despite these constraints, the consistency of findings across multiple studies strengthens the conclusion that operative fixation improves cosmetic satisfaction in adults.

CONCLUSION

Operative fixation of displaced midshaft clavicle fractures in adults is associated with higher patient satisfaction with cosmetic appearance than non-operative treatment. Surgery largely eliminates deformity-related complaints such as a bony bump and shoulder droop but introduces the risk of scar dissatisfaction and hardware prominence. The choice between operative and non-operative pathways involves a genuine aesthetic trade-off and should be explicitly addressed in shared decision-making.

Future trials should incorporate validated cosmetic PROMs, report scar and deformity domains separately, and explore how age, gender and psychosocial factors influence cosmetic preference.

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REFERENCES

1. Postacchini F, Gumina S, De Santis P, Albo F. Epidemiology of clavicle fractures. *J Shoulder Elbow Surg.* 2002;11(5):452-6.
2. Wiesel BB, Nagda S, Mehta S, Churchill RW. Management of midshaft clavicle fractures in adults. *J Am Acad Orthop Surg.* 2018;26(22):e468-76.
3. Robinson CM. Fractures of the clavicle in the adult: epidemiology and classification. *J Bone Joint Surg Br.* 1998;80(3):476-84.
4. Song HS, Kim H. Current concepts in the treatment of midshaft clavicle fractures in adults. *Clin Shoulder Elb.* 2021;24(3):189-98.
5. Neer CS II. Nonunion of the clavicle. *JAMA.* 1960;172(10):1006-11.
6. Rowe CR. An atlas of anatomy and treatment of midclavicular fractures. Baltimore: Williams & Wilkins. 1968.
7. Canadian Orthopaedic Trauma Society. Non-operative treatment compared with plate fixation of displaced midshaft clavicular fractures: a multicenter, randomized clinical trial. *J Bone Joint Surg Am.* 2007;89(1):1-10.
8. Robinson CM, Goudie EB, Murray IR, Jenkins PJ, Ahktar MA, Read EO, et al. Open reduction and plate fixation versus nonoperative treatment for displaced midshaft clavicular fractures: a multicenter,

- randomized, controlled trial. *J Bone Joint Surg Am.* 2013;95(17):1576-84.
9. McKee MD, Wild LM, Schemitsch EH. Midshaft malunions of the clavicle. *J Bone Joint Surg Am.* 2003;85(5):790-7.
 10. Waldmann S, Benninger E, Meier C. Nonoperative treatment of midshaft clavicle fractures in adults. *Open Orthop J.* 2018;12:1-6.
 11. Virtanen KJ, Malmivaara AOV, Remes VM, Paavola MP. Operative and nonoperative treatment of clavicle fractures in adults: a systematic review. *Acta Orthop.* 2012;83(1):65-73.
 12. Andrade-Silva FB, Kojima KE, Joeris A, Santos Silva J, Mattar R Jr. Single, superiorly placed reconstruction plate compared with flexible intramedullary nailing for midshaft clavicular fractures: a prospective, randomized controlled trial. *J Bone Joint Surg Am.* 2015;97(8):620-6.
 13. Jubel A, Andermahr J, Bergmann H, Prokop A, Rehm KE. Elastic stable intramedullary nailing of midclavicular fractures in athletes. *Br J Sports Med.* 2003;37(6):480-3.
 14. Smekal V, Irenberger A, Struve P, Wambacher M, Krappinger D, Kralinger FS. Elastic stable intramedullary nailing versus nonoperative treatment of displaced midshaft clavicular fractures: a randomized, controlled, clinical trial. *J Orthop Trauma.* 2009;23(2):106-12.
 15. Ahrens PM, Garlick NI, Barber J, Tims EM; Clavicle Trial Collaborative Group. The Clavicle Trial: a multicenter randomized controlled trial comparing operative with nonoperative treatment of displaced midshaft clavicle fractures. *J Bone Joint Surg Am.* 2017;99(16):1345-54.
 16. van der Meijden OA, Gaskill TR, Millett PJ. Treatment of clavicle fractures: current concepts review. *J Shoulder Elbow Surg.* 2012;21(3):423-9.
 17. Lazarides S, Zafiroopoulos G. Conservative treatment of fractures at the middle third of the clavicle: the relevance of shortening and clinical outcome. *J Shoulder Elbow Surg.* 2006;15(2):191-4.
 18. Andersen K, Jensen PO, Lauritzen J. Treatment of clavicular fractures: figure-of-eight bandage versus a simple sling. *Acta Orthop Scand.* 1987;58(1):71-4.
 19. Ropars M, Thomazeau H, Hutten D. Clavicle fractures. *Orthop Traumatol Surg Res.* 2017;103:S53-9.
 20. Hill JM, McGuire MH, Crosby LA. Closed treatment of displaced middle-third fractures of the clavicle gives poor results. *J Bone Joint Surg Am.* 1997;79(4):537-8.
 21. McKee RC, Whelan DB, Schemitsch EH, McKee MD. Operative versus nonoperative care of displaced midshaft clavicular fractures: a meta-analysis of randomized clinical trials. *J Bone Joint Surg Am.* 2012;94(8):675-84.
 22. Martin JR, Saunders PE, Phillips M, Mitchell SM, McKee MD, Schemitsch EH, et al. Comparative effectiveness of treatment options for displaced midshaft clavicle fractures: a systematic review and network meta-analysis. *Bone Jt Open.* 2021;2(8):646-54.
 23. Rivera-Saldívar G, Manrique-Ávila JA. Superior versus anteroinferior plating for mid-shaft clavicle fractures: a randomized clinical trial. *Cir Cir.* 2024;92(2):141-9.
 24. Gadegone WM, Lokhande V. Screw intramedullary elastic nail fixation in midshaft clavicle fractures: a clinical outcome in 36 patients. *Indian J Orthop.* 2018;52(3):322-7.
 25. Massachusetts General Hospital Sports Medicine Physical Therapy. Rehabilitation protocol for clavicle open reduction and internal fixation (ORIF). Boston (MA): Massachusetts General Hospital. 2023. Available at: <https://www.massgeneral.org/assets/mgh/pdf/orthopaedics/sports-medicine/physical-therapy/rehabilitation-protocol-for-clavicle-orif.pdf>. Accessed on 08 November 2025.
 26. Royal Berkshire NHS Foundation Trust. Clavicle fracture open reduction internal fixation (ORIF): advice and exercises. Reading (UK): Royal Berkshire NHS Foundation Trust. 2023. Available at: https://www.royalberkshire.nhs.uk/media/scipacg2/clavicle-fracture-open-reduction-internal-fixation-advice-and-exercises_jun23.pdf. Accessed on 08 November 2025.
 27. Tutuhatunewa ED, Stevens M, Dams OC, van Son J, Louhanepessy RD, Krabbe PFM, et al. Exploring patient satisfaction after operative and nonoperative treatment for midshaft clavicle fractures: a focus group analysis. *BMC Musculoskelet Disord.* 2020;21(1):560.
 28. Riiser MO, Molund M. Long-term functional outcomes and complications in operative versus nonoperative treatment for displaced midshaft clavicle fractures in adolescents: a retrospective comparative study. *J Pediatr Orthop.* 2021;41(5):279-83.

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