

IN BRIEF

Comparisons of Routine Initial Operative Fracture Treatment and Later Reconstructive Treatment are not Interesting

Tarek Salibi, MD; David Ring, MD, PhD; Michel P.J. van den Bekerom, MD, PhD

Research performed at Dell Medical School--The University of Texas at Austin, Texas, USA

Received: 24 August 2023

Accepted: 28 August 2023

Abstract

Studies that compare routine immediate operative treatment of fractures with selective later reconstructive surgery for malunion or nonunion may be misleading because it discounts the people who did well with nonoperative treatment. We identified 20 studies comparing routine operative fracture treatment and later reconstruction in the hip, clavicle, proximal humerus, elbow, and distal radius. Fifteen of 20 studies favored immediate operative treatment on the basis of lower reoperation rates, fewer complications, better patient reported outcome scores, and higher satisfaction. Five studies were neutral, and none favored delayed reconstruction for malunion or nonunion. These findings emphasize the potential benefits of routine early surgery and raise questions about the validity of studies comparing different timings of fracture treatment.

Level of evidence: N/A

Keywords: Clavicle, Delayed, Early, Hip, Proximal humerus, Surgery, Wrist

Introduction

For diaphyseal clavicle fractures, proximal humerus fractures, and other fractures for which the role of operative treatment is debated, a strategy of routine operative treatment can be compared to a strategy of routine initial nonoperative treatment with later selective operative treatment of malunion or nonunion.¹ Studies that compare the results of acute fracture surgery compared to later surgery for nonunion or malunion are used to support routine initial operative treatment. But this is a false comparison, because it is unlikely that a person requesting surgery for malunion or nonunion is representative of the average person with that fracture treated nonoperatively.

First, the evidence is clear that many people accommodate clavicle nonunion and clavicle and proximal humerus malalignment well with relatively little discomfort or incapability.^{2,3} Given the evidence that levels of discomfort and incapability are associated more with mindset and circumstances than with severity of pathophysiology, people requesting delayed reconstruction may be a relative disadvantage in their interpretation and distress regarding symptoms, which may diminish their outcomes. Second, a

person requesting reconstructive surgery for nonunion or malunion may have worse initial fracture pathophysiology (displacement, fragmentation, etc.) and different medical comorbidities than the average patient with the fracture under consideration.

Given these, and likely other, considerations, when we compare acute fracture treatment with later reconstruction for dissatisfaction with symptoms, we can assume that dissatisfaction with symptoms will be greater on average in the group that remains in or returns to care and requests a reconstructive procedure.^{4,5} The only valid study design is one that accounts for everyone initially treated nonoperatively, preferably in a randomized trial with every effort to manage patient, surgeon, and evaluator bias.

We reviewed studies that compare routine initial operative treatment to delay reconstruction to test the hypothesis that such comparisons can be assumed, a priori, to always or nearly always favor routine early surgery. Such a finding would indicate that such studies are misleading and should not be performed or published.

Corresponding Author: David Ring, Department of Surgery and Perioperative Care, Dell Medical School--The University of Texas at Austin, Texas, USA

Email: david.ring@austin.utexas.edu



THE ONLINE VERSION OF THIS ARTICLE
ABJS.MUMS.AC.IR

Materials and Methods

We searched used three search engines (PubMed, Embase, Google) to identify studies comparing routine immediate operative fracture treatment (<4 weeks) to later reconstructive surgery (>4 weeks) for malunion or nonunion in the upper and lower extremity up to July 2023. Inclusion criteria were adult patients, studies of fracture treatment, and comparison of routine immediate operative treatment versus reconstructive operative treatment. Exclusion criteria were systematic reviews or meta-analysis, studies that are not in English.

Among the 561 articles in the initial search, 32 articles were selected for full review after review of the abstract. Among those studies, 12 were excluded because they addressed different timings of acute fracture treatment rather than initial operative treatment compared to later reconstructive surgery. This resulted in a total of 20 articles [Appendix 1] for review: three on hip fractures, six on diaphyseal fracture of the clavicle, nine on proximal

humerus fractures,⁶ one on elbow fractures, and one on distal radius fractures.

The following outcomes were tracked: active range of motion, pain intensity, reoperations, complications, and patient reported outcome measures.

Results

Fifteen studies favored immediate operative treatment, five were neutral, and none favored delayed reconstruction for malunion or nonunion. Specific factors that favored immediate operative treatment included lower reoperation rate in 10 studies, fewer complications in nine, better Constant score in five studies, better (lower) DASH score in two, and higher EQ-5D score, higher UCLA score, greater satisfaction with treatment, higher SANE score, and earlier return, higher SSV score, higher Constant score in one each, with some studies finding more than one advantage to immediate operative treatment [Table 1].

Table 1. Factors That Favored Acute Treatment

	Worse in Acute	Better in Acute	No Difference	Not reported
Complication Rates	0	9	5	6
Reoperation rate	0	10	1	9
DASH score	0	2	1	17
SANE score	0	1	0	19
Return to work time	0	1	3	16
Constant score	0	5	2	13
Satisfaction	0	1	1	18
UCLA score	0	1	2	17
EQ-5D score	0	1	0	19
SSV score	0	1	0	19

Discussion

The finding that surgery for nonunion and malunion is nearly always associated with less favorable outcomes than routine immediate operative treatment is no surprise.⁷ This is a foregone conclusion. First, the motivation to seek out care and accept an offer of operative treatment for malunion and nonunion is almost certainly associated with both relatively less adaptive thoughts and feelings and worse fractures in more infirm people. Many people accommodate malunion and nonunion of the clavicle and malunion of the proximal humerus, and nonunion is associated with fracture complexity and medical comorbidities. In other words, the person that has reconstructive fracture surgery is not representative of the average person with that fracture nor are they representative of the average person with nonunion or that degree of malalignment. Even if delayed treatment results in a slightly inferior outcome, this outcome has to be balanced by the number of patients who avoided surgery altogether. This is similar to the number needed to treat: how many acute surgeries are justified to avoid one late surgery with a possible inferior outcome.

Because comparisons of routine initial fracture surgery

with later reconstructive surgery for nonunion or malunion can be expected to favor routine early surgery, this study design is misleading and should be abandoned. The only meaningful comparison is between routine immediate operative treatment versus routine nonoperative treatment followed by selective reconstruction, preferably in a prospective randomized trial.

Acknowledgement

Not applicable

Conflict of interest: None

Funding: None

Tarek Salibi MD ¹
David Ring MD, PhD ¹
Michel Van Den Bekerom MD ^{2,3}

¹ The University of Texas at Austin, Austin, Texas, USA

² Shoulder and Elbow Unit, Joint Research, Department of Orthopedic Surgery, OLVG, Amsterdam, The Netherlands

³ Shoulder and Elbow Unit, Joint Research, Department of Orthopaedic Surgery, OLVG, Amsterdam, The Netherlands

References

1. Shu R, Crijs T, Ring D, Fatehi A. Surgeons Consider Initial Nonoperative Treatment With Potential for Future Conversion to Reverse Arthroplasty a Reasonable Option for Older, Relatively Infirm, and Less-Active Patients. *J Orthop Trauma*. 2022; 36(5):265-270. doi:10.1097/BOT.0000000000002278.
2. 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):383-392. doi:10.1302/0301-620X.99B3.BJJ-2016-1028.
3. Woltz S, Krijnen P, Schipper IB. Plate Fixation Versus Nonoperative Treatment for Displaced Midshaft Clavicular Fractures: A Meta-Analysis of Randomized Controlled Trials. *J Bone Joint Surg Am*. 2017; 99(12):1051-1057. doi:10.2106/JBJS.16.01068.
4. Potter JM, Jones C, Wild LM, Schemitsch EH, McKee MD. Does delay matter? The restoration of objectively measured shoulder strength and patient-oriented outcome after immediate fixation versus delayed reconstruction of displaced midshaft fractures of the clavicle. *J Shoulder Elbow Surg*. 2007; 16(5):514-518. doi:10.1016/j.jse.2007.01.001.
5. Colasanti CA, Anil U, Adams J, Pennacchio C, Zuckerman JD, Egol KA. Primary versus conversion reverse total shoulder arthroplasty for complex proximal humeral fractures in elderly patients: a retrospective comparative study. *J Shoulder Elbow Surg*. 2023; 32(8):e396-e407. doi:10.1016/J.JSE.2023.01.019.
6. Seidl A, Sholder D, Warrender W, et al. Early Versus Late Reverse Shoulder Arthroplasty for Proximal Humerus Fractures: Does It Matter? *Arch Bone Jt Surg*. 2017; 5(4):213. doi:10.22038/abjs.2017.20040.1522.
7. Nayar SK, Marrache M, Bressner JA, Raad M, Shafiq B, Srikumaran U. Temporal Trends in Hip Fractures: How Has Time-to-Surgery Changed? *Arch Bone Jt Surg*. 2021; 9(2):224. doi:10.22038/ABJS.2020.46195.2268.

Appendix 1. References List

- | | |
|---|---|
| 1 | Gracia, G., Laumonerie, P., Tibbo, M. E., Cavaignac, E., Chiron, P., & Reina, N. (2023). Outcomes of acute versus delayed total hip arthroplasty following acetabular fracture. <i>European Journal of Orthopaedic Surgery & Traumatology : Orthopedie Traumatologie</i> , 33(1), 51–60. https://doi.org/10.1007/S00590-021-03157-Z |
| 2 | Colasanti, C. A., Anil, U., Adams, J., Pennacchio, C., Zuckerman, J. D., & Egol, K. A. (2023). Primary versus conversion reverse total shoulder arthroplasty for complex proximal humeral fractures in elderly patients: a retrospective comparative study. <i>Journal of Shoulder and Elbow Surgery</i> , 32(8), e396–e407. https://doi.org/10.1016/J.JSE.2023.01.019 |
| 3 | Panagopoulos, G. N., Pugliese, M., Leonidou, A., Butt, F., Jaibaji, M., Megaloikonomos, P. D., Consigliere, P., Sforza, G., Atoun, E., & Levy, O. (2022). Acute versus delayed reverse total shoulder arthroplasty for proximal humeral fractures: a consecutive cohort study. <i>Journal of Shoulder and Elbow Surgery</i> , 31(2), 276–285. https://doi.org/10.1016/J.JSE.2021.07.003 |
| 4 | Nieboer, M. J., Austin, D. C., Uvodich, M. E., Rogers, T. H., Barlow, J. D., Sanchez-Sotelo, J., O'Driscoll, S. W., & Morrey, M. E. (2022). Acute versus delayed radial head arthroplasty for the treatment of radial head fractures. <i>Journal of Shoulder and Elbow Surgery</i> , 31(12), 2506–2513. https://doi.org/10.1016/J.JSE.2022.07.031 |
| 5 | Gouk, C., Bairstow, M., Thomas, M., Tan, E., Taylor, F., & Bindra, R. (2022). A comparison of early fixation of distal radius fractures versus late corrective osteotomy of distal radius malunion. <i>ANZ Journal of Surgery</i> , 92(12), 3319–3324. https://doi.org/10.1111/ANS.18122 |
| 6 | Nicol, G. M., Sanders, E. B., Kim, P. R., Beaulé, P. E., Gofton, W. T., & Grammatopoulos, G. (2021). Outcomes of Total Hip Arthroplasty After Acetabular Open Reduction and Internal Fixation in the Elderly—Acute vs Delayed Total Hip Arthroplasty. <i>The Journal of Arthroplasty</i> , 36(2), 605–611. https://doi.org/10.1016/J.ARTH.2020.08.022 |
| 7 | Barger, J., Stenquist, D. S., Mohamadi, A., Weaver, M. J., Dyer, G. S. M., & von Keudell, A. (2021). Acute versus delayed reverse total shoulder Arthroplasty for the management of Proximal Humerus Fractures. <i>Injury</i> , 52(8), 2272–2278. https://doi.org/10.1016/J.INJURY.2021.05.040 |
| 8 | Seidel, H. D., Bhattacharjee, S., Koh, J. L., Strelzow, J. A., & Shi, L. L. (2021). Acute Versus Delayed Reverse Shoulder Arthroplasty for the Primary Treatment of Proximal Humeral Fractures. <i>Journal of the American Academy of Orthopaedic Surgeons</i> , 29(19), 832–839. https://doi.org/10.5435/JAAOS-D-20-01375 |
| 9 | Kluijffhout, W. P., Tutuhatunewa, E. D., & van Olden, G. D. J. (2020). Plate fixation of clavicle fractures: comparison between early and delayed surgery. <i>Journal of Shoulder and Elbow Surgery</i> , 29(2), 266–272. https://doi.org/10.1016/J.JSE.2019.06.022 |

Appendix 1. Continued

- 10 Kuhlmann, N. A., Taylor, K. A., Roche, C. P., Franovic, S., Chen, C., Carofino, B. C., Flurin, P. H., Wright, T. W., Schoch, B. S., Zuckerman, J. D., & Muh, S. J. (2020). Acute versus delayed reverse total shoulder arthroplasty for proximal humerus fractures in the elderly: Mid-term outcomes. *Seminars in Arthroplasty: JSES*, 30(2), 89–95. <https://doi.org/10.1053/J.SART.2020.05.007>
- 11 Marsalli, M., Rojas, J. T., & Barahona, M. (2019). Acute Surgery vs. Non-union Surgery of Displaced Midshaft Clavicle Fractures: A Case-control Study. <https://doi.org/10.7759/cureus.5480>
- 12 Nowak, L. L., Hall, J., McKee, M. D., & Schemitsch, E. H. (2019). A higher reoperation rate following arthroplasty for failed fixation versus primary arthroplasty for the treatment of proximal humeral fractures: a retrospective population-based study. *The Bone & Joint Journal*, 101-B (10), 1272–1279. <https://doi.org/10.1302/0301-620X.101B10.BJJ-2019-0142.R2>
- 13 Sawalha, S., & Guisasola, I. (2018). Complications associated with plate fixation of acute midshaft clavicle fractures versus non-unions. *European Journal of Orthopaedic Surgery & Traumatology : Orthopedie Traumatologie*, 28(6), 1059–1064. <https://doi.org/10.1007/S00590-018-2174-2>
- 14 Lädemann, A., Abrassart, S., Denard, P. J., Tirefort, J., Nowak, A., & Schwitzguebel, A. J. (2017). Functional recovery following early mobilization after middle third clavicle osteosynthesis for acute fractures or nonunion: A case-control study. *Orthopaedics & Traumatology: Surgery & Research*, 103(6), 885–889. <https://doi.org/10.1016/J.OTSR.2017.03.021>
- 15 Seidl, A., Sholder, D., Warrender, W., Livesey, M., Williams, G., Abboud, J., & Namdari, S. (2017). Early Versus Late Reverse Shoulder Arthroplasty for Proximal Humerus Fractures: Does It Matter? *Archives of Bone and Joint Surgery*, 5(4), 213. <https://doi.org/10.22038/abjs.2017.20040.1522>
- 16 Sebastia-Forcada, E., Lizaur-Utrilla, A., Cebrian-Gomez, R., Miralles-Muñoz, F. A., & Lopez-Prats, F. A. (2017). Outcomes of Reverse Total Shoulder Arthroplasty for Proximal Humeral Fractures: Primary Arthroplasty Versus Secondary Arthroplasty After Failed Proximal Humeral Locking Plate Fixation. *Journal of Orthopaedic Trauma*, 31(8), e236–e240. <https://doi.org/10.1097/BOT.0000000000000858>
- 17 McKnight, B., Heckmann, N., Hill, J. R., Pannell, W. C., Mostofi, A., Omid, R., & Hatch, G. F. "Rick." (2016). Surgical management of midshaft clavicle nonunions is associated with a higher rate of short-term complications compared with acute fractures. *Journal of Shoulder and Elbow Surgery*, 25(9), 1412–1417. <https://doi.org/10.1016/J.JSE.2016.01.028>
- 18 Dezfuli, B., King, J. J., Farmer, K. W., Struk, A. M., & Wright, T. W. (2016). Outcomes of reverse total shoulder arthroplasty as primary versus revision procedure for proximal humerus fractures. *Journal of Shoulder and Elbow Surgery*, 25(7), 1133–1137. <https://doi.org/10.1016/J.JSE.2015.12.002>
- 19 Yang, Z., Liu, H., Xie, X., Tan, Z., Qin, T., & Kang, P. (2015). Total Hip Arthroplasty for Failed Internal Fixation After Femoral Neck Fracture Versus That for Acute Displaced Femoral Neck Fracture: A Comparative Study. *The Journal of Arthroplasty*, 30(8), 1378–1383. <https://doi.org/10.1016/J.ARTH.2015.02.037>
- 20 Potter, J. M., Jones, C., Wild, L. M., Schemitsch, E. H., & McKee, M. D. (2007). Does delay matter? The restoration of objectively measured shoulder strength and patient-oriented outcome after immediate fixation versus delayed reconstruction of displaced midshaft fractures of the clavicle. *Journal of Shoulder and Elbow Surgery*, 16(5), 514–518. <https://doi.org/10.1016/J.JSE.2007.01.001>