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Case Report

Supporting the medial hinge in proximal humerus fractures with an intramedullary plate

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ABSTRACT

Proximal humerus fractures are common and approximately 20% of displaced fractures may benefit from surgery. A lack of medial support is found to be a predictor of failure after surgical fixation of proximal humerus fractures. The optimal technique for restoring the medial hinge is unclear. We describe two cases of patients with a dislocated 4-part humerus fracture treated with a locking plate and an additional small intramedullary plate to support the medial hinge. This technique is simple and allows for an enhanced stability of the medial hinge during and after surgery.

Introduction

Fractures of the proximal humerus are common and account for approximately 5% of all fractures and 79% of all humerus fractures in adults [1,2]. The majority of these fractures occur in patients over 60 years of age and are caused by a simple fall. This suggests age-related risk factors such as osteoporosis to be an underlying mechanism [2]. Proximal humerus fractures also occur in younger patients, more likely to be the result of a high energetic trauma. These types of trauma are associated with a higher risk of fracture-displacement [3].

Most patients can be treated non-operatively, approximately 20% of displaced proximal humerus fractures may benefit from surgery [4]. Although literature provides no consensus on a particular surgical technique to be the standard of care [4–6], plate osteosynthesis is considered the golden standard [7]. Loss of reduction is one of the most common causes of revision surgery [8]. A lack of medial support is found to be a predictor of failure after surgical fixation of proximal humerus fractures [9–12]. Gardner et al. also concluded medial support to be important for maintaining fracture reduction in locked plating of proximal humerus fractures [13]. A few articles suggest the use of a separate plate to reconstruct the medial hinge if disrupted [4,14,15].

Addressing the importance of the medial hinge for a successful fixation of proximal humerus fractures, we will describe a technique with an intramedullary plate to reconstruct a disrupted medial hinge.

Case report

A 52-year old male (patient A) fell on his right shoulder during skiing and a 55-year old female (patient B) fell from standing height. Both patients sustained a displaced, four-part proximal humerus fracture (Fig. 1). Operative treatment consisting of open reduction and

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internal (plate) fixation was chosen.

Surgical technique. Under general endotracheal anesthesia, the patients were placed in the beach-chair position. The fractured arm and shoulder were prepared and draped in a sterile fashion and 1 g of cefazolin was administered intravenously as antibiotic prophylaxis.

The deltopectoral approach was used to approach the proximal humerus. The fracture was debrided and three Ticron® 5 sutures (Covidien, Zaltbommel, Netherlands) were used at a cranial, dorsal and ventral position in the rotator cuff, at the location of the greater and lesser tubercles. Subsequently, the medially displaced humeral shaft was reduced towards the humeral head, which was reduced from its varus position with a K-wire joystick. The medial hinge proved unstable, leading to easy dislocation. Therefore, it was decided to secure the medial hinge with a two-hole 2.4 mm intramedullary plate in patient A (DePuySynthes, Amersfoort, Netherlands) with two locking screws (Fig. 2). The 2-hole plate was created by cutting a 5-hole distal radius radial column plate. In patient B a 12 holes 2.0 mm locking plate (DePuySynthes, Amersfoort, Netherlands) was cut to the length of 4 holes and subsequently fixed with 2 locking screws. For intra-operative photo, see Fig. 3.

Then, with a stable medial hinge and an adequate reduction of the head to the shaft, a five-hole PHILOS plate (DePuySynthes, Amersfoort, Netherlands) was used to secure the head to the shaft after the cuff stitches were attached to the plate. Two screws were placed over the calcar to enhance medial support, screws were placed in the head and three screws were placed in the shaft. The reduction and fixation were considered adequate and proved stable after testing. The wound was closed in a standard fashion.

Follow-up. The post-operative course in both patients was uneventfully. The fractures healed in an anatomic position (Fig. 4). Patient A was lost to follow-up after 12 months. The last known function was an elevation over 100 degrees with nearly normal endorotation and exorotation. Patient B recovered very well and reported a QuickDash score of 2.3 at 24 months of follow-up, the optional module for work revealed a score was 0 (both excellent).

Discussion

Loss of reduction and subsequent cut-out are the most common implant related complications and causes of revision surgery in patients with proximal humerus fractures treated with locking plates [8]. While an overall loss of reduction of 12.2% is reported, rates can be as high as 28.6% in older patients with a 3 or 4-part humerus fracture [16].

Jung et al. showed with a multivariable regression analysis that medial comminution and insufficient medial support are independent risk factors for loss of reduction [10]. Several other studies report lack of medial support to be a predictor of failure after surgical fixation of proximal humerus fractures, resulting in poor radiographic outcomes [9,11,12,17]. The importance of the medial hinge in offering mechanical support during and after fracture reduction is also demonstrated in biomechanical studies using cadavers and synthetic humeri [18–20].

It can be difficult to gain sufficient medial support and to retain this after surgery. Studies have been published addressing this problem using additional medial support screws, an additional medial blade in lock plating or a fibula bone graft [21–25]. He et al. compared fracture stability in lateral lock plating alone or combined with a medial locking plate. The combination with enhanced support to the medial hinge was proven to be the most stable construction [26].

The technique of ‘the medial hinge plate’ used in this patient is simple and allows for greater stability of the medial hinge during and after surgery. No additional incision has to be made for placement of the intramedullary plate through the opening of the original fracture and extra stability is provided where it is needed: at the medial hinge.

There are some limitations to this technique. It can only be used in patients with a fracture pattern enabling the intramedullary

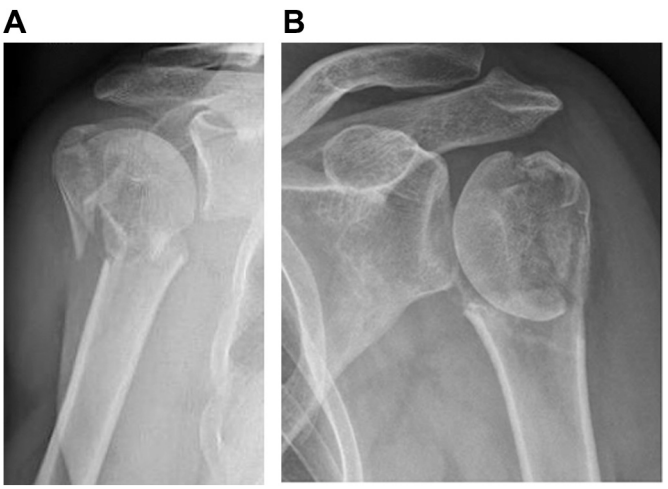

Fig. 1. The preoperative image of the displaced, four-part proximal humerus.
Fracture of patient A (left) and patient B (right).

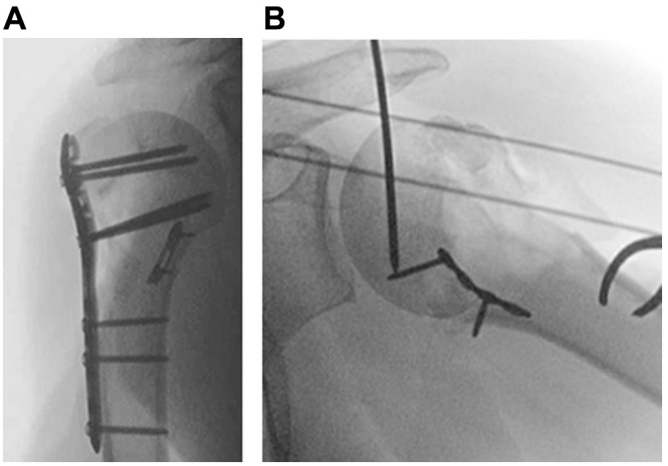

Fig. 2. The peroperative image with the placement of a two-hole 2.4 mm intramedullary plate to reconstruct the medial hinge in patient A (left) and patient B (right).

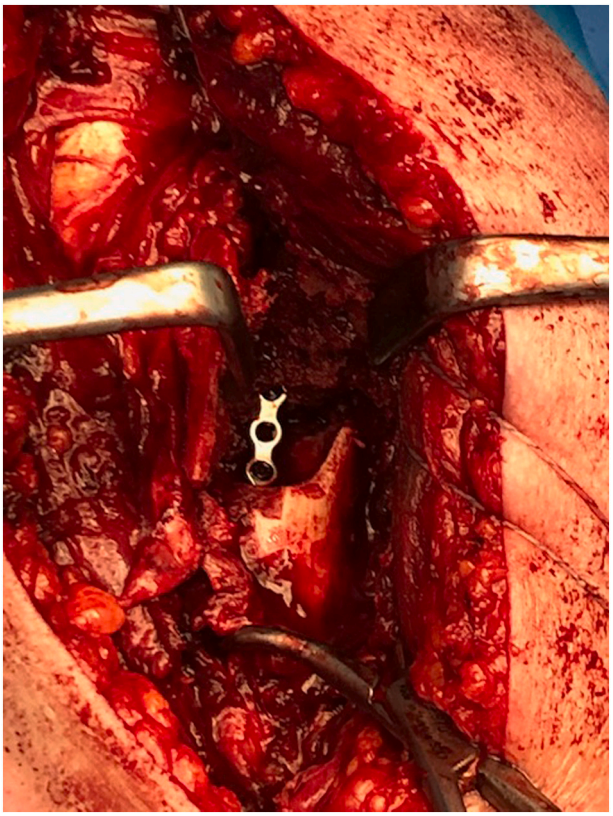

Fig. 3. Intra-operative photo of patient B showing the medial hinge plate (2.0 mm).

plate to be inserted. Furthermore, whereas the majority of proximal humerus fractures occur in elderly in whom osteoporosis can be an underlying mechanism, our patients were only 52 and 55 years of age with an assumed better bone quality.

Conclusion

In a dislocated 4-part humerus fracture treated with a locking plate an additional intramedullary plate can be placed to support the medial hinge. This simple technique allows for an enhanced stability of the medial hinge during and after surgery.

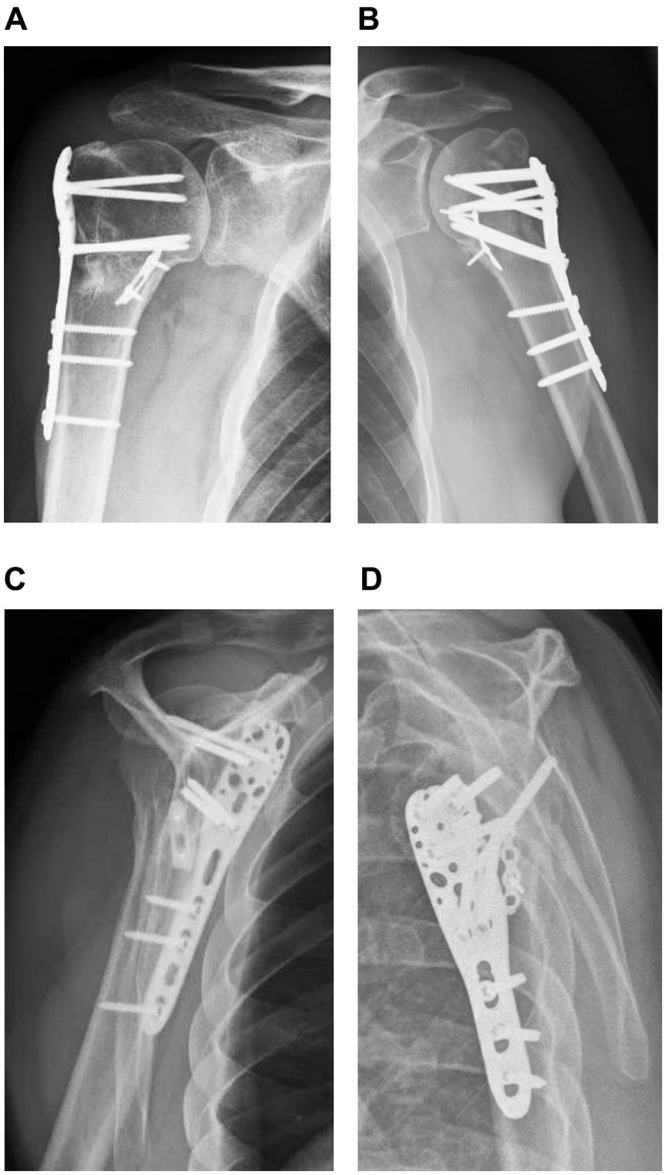

Fig. 4. Postoperative images of patient A and patient B.

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Declaration of competing interest

The authors declare that there is no conflict of interest.

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References

[1] C.M. Court-Brown, B. Caesar, Epidemiology of adult fractures: a review, Injury 37 (2006) 691–697.

[2] C. Bergdahl, C. Ekholm, D. Wennergren, F. Nilsson, M. Moller, Epidemiology and patho-anatomical pattern of 2,011 humeral fractures: data from the Swedish Fracture Register, BMC Musculoskelet. Disord. 17 (2016) 159.
[3] P. Boileau, S.D. Pennington, G. Alami, Proximal humeral fractures in younger patients: fixation techniques and arthroplasty, J. Shoulder Elb. Surg. 20 (2011) S47–S60.
[4] S.J. Nho, R.H. Brophy, J.U. Barker, C.N. Cornell, J.D. MacGillivray, Management of proximal humeral fractures based on current literature, J. Bone Joint Surg. Am. 89 (Suppl. 3) (2007) 44–58.
[5] I.R. Murray, A.K. Amin, T.O. White, C.M. Robinson, Proximal humeral fractures: current concepts in classification, treatment and outcomes, J. Bone Joint Surg. (Br.) 93 (2011) 1–11.
[6] D. Maier, M. Jaeger, K. Izadpanah, P.C. Strohm, N.P. Suedkamp, Proximal humeral fracture treatment in adults, J. Bone Joint Surg. Am. 96 (2014) 251–261.
[7] G. Roderer, J. Erhardt, M. Graf, L. Kinzl, F. Gebhard, Clinical results for minimally invasive locked plating of proximal humerus fractures, J. Orthop. Trauma 24 (2010) 400–406.
[8] C. Thanasas, G. Kontakis, A. Angoules, D. Limb, P. Giannoudis, Treatment of proximal humerus fractures with locking plates: a systematic review, J. Shoulder Elb. Surg. 18 (2009) 837–844.
[9] D. Krappinger, N. Bizzotto, S. Riedmann, C. Kammerlander, C. Hengg, F.S. Kralinger, Predicting failure after surgical fixation of proximal humerus fractures, Injury 42 (2011) 1283–1288.
[10] S.W. Jung, S.B. Shim, H.M. Kim, J.H. Lee, H.S. Lim, Factors that influence reduction loss in proximal humerus fracture surgery, J. Orthop. Trauma 29 (2015) 276–282.
[11] W.B. Jung, E.S. Moon, S.K. Kim, D. Kovacevic, M.S. Kim, Does medial support decrease major complications of unstable proximal humerus fractures treated with locking plate? BMC Musculoskelet. Disord. 14 (2013) 102.
[12] C.W. Lee, S.J. Shin, Prognostic factors for unstable proximal humeral fractures treated with locking-plate fixation, J. Shoulder Elb. Surg. 18 (2009) 83–88.
[13] M.J. Gardner, Y. Weil, J.U. Barker, B.T. Kelly, D.L. Helfet, D.G. Lorich, The importance of medial support in locked plating of proximal humerus fractures, J. Orthop. Trauma 21 (2007) 185–191.
[14] J.W. Sperling, F. Cuomo, J.D. Hill, R. Hertel, C. Chuinard, P. Boileau, The difficult proximal humerus fracture: tips and techniques to avoid complications and improve results, Instr. Course Lect. 56 (2007) 45–57.
[15] R. Hertel, Fractures of the proximal humerus in osteoporotic bone, Osteoporos. Int. 16 (Suppl. 2) (2005) S65–S72.
[16] B.D. Solberg, C.N. Moon, D.P. Franco, G.D. Paiement, Locked plating of 3- and 4-part proximal humerus fractures in older patients: the effect of initial fracture pattern on outcome, J. Orthop. Trauma 23 (2009) 113–119.
[17] S.J. Lin, Y.H. Tsai, T.Y. Yang, S.H. Shen, K.C. Huang, M.S. Lee, Medial calcar support and radiographic outcomes of plate fixation for proximal humeral fractures, Biomed. Res. Int. 2015 (2015), 170283.
[18] F. Kralinger, S. Unger, M. Wambacher, V. Smekal, W. Schmoelz, The medial periosteal hinge, a key structure in fractures of the proximal humerus: a biomechanical cadaver study of its mechanical properties, J. Bone Joint Surg. (Br.) 91 (2009) 973–976.
[19] B.A. Ponce, K.J. Thompson, P. Raghava, A.W. Eberhardt, J.P. Tate, D.A. Volgas, et al., The role of medial comminution and calcar restoration in varus collapse of proximal humeral fractures treated with locking plates, J. Bone Joint Surg. Am. 95 (2013), e113 (1-7).
[20] J. Lescheid, R. Zdero, S. Shah, P.R. Kuzyk, E.H. Schemitsch, The biomechanics of locked plating for repairing proximal humerus fractures with or without medial cortical support, J. Trauma 69 (2010) 1235–1242.
[21] L. Zhang, J. Zheng, W. Wang, G. Lin, Y. Huang, J. Zheng, et al., The clinical benefit of medial support screws in locking plating of proximal humerus fractures: a prospective randomized study, Int. Orthop. 35 (2011) 1655–1661.
[22] M. Beirer, M. Cronlein, A.J. Venjakob, T. Saier, M. Schmitt-Sody, S. Huber-Wagner, et al., Additional calcar support using a blade device reduces secondary varus displacement following reconstruction of the proximal humerus: a prospective study, Eur. J. Med. Res. 20 (2015) 82.
[23] G. Osterhoff, D. Baumgartner, P. Favre, G.A. Wanner, H. Gerber, H.P. Simmen, et al., Medial support by fibula bone graft in angular stable plate fixation of proximal humeral fractures: an in vitro study with synthetic bone, J. Shoulder Elb. Surg. 20 (2011) 740–746.
[24] N. Biermann, W.C. Prall, W. Bocker, H.O. Mayr, F. Haasters, Augmentation of plate osteosynthesis for proximal humeral fractures: a systematic review of current biomechanical and clinical studies, Arch. Orthop. Trauma Surg. 139 (8) (2019) 1075–1099, https://doi.org/10.1007/s00402-019-03162-2. Epub 2019 Mar 22.
[25] C.J. Laux, F. Grubhofer, C.M.L. Werner, H.P. Simmen, G. Osterhoff, Current concepts in locking plate fixation of proximal humerus fractures, J. Orthop. Surg. Res. 12 (2017) 137.
[26] Y. He, J. He, F. Wang, D. Zhou, Y. Wang, B. Wang, et al., Application of additional medial plate in treatment of proximal humeral fractures with unstable medial column: a finite element study and clinical practice, Medicine (Baltimore) 94 (2015), e1775.