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A new technique for olecranon osteotomy in the treatment of distal humeral fractures

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Background: Olecranon osteotomy is a commonly used method for obtaining adequate exposure of the articular surface in complex distal humeral fractures. We describe a new technique whereby a precontoured olecranon plate is first fixed to the olecranon, and a Gigli saw is used to perform the osteotomy while the plate is in place.

Methods: By use of a standard posterior approach, a precontoured olecranon plate is applied to the olecranon and affixed with screws both proximally and distally to the planned osteotomy site. A Gigli saw is passed anterior to the olecranon and is used to create an osteotomy through the bare area of the sigmoid notch. The plate is removed from the distal fragment. The proximal olecranon fragment, plate, and extensor mechanism are retracted proximally en bloc to expose the articular surface. After fracture repair, the osteotomy fragments are reapproximated, and the plate is reattached to the distal fragment. QuickDASH (short version of the Disabilities of the Arm, Shoulder and Hand questionnaire) and Veterans RAND 12-Item Health Survey (VR-12) scores for patients treated with this technique were compared with those of patients treated with the standard chevron osteotomy method.

Results: All patients achieved radiographic and clinical union of the osteotomy site. QuickDASH, VR-12 physical, and VR-12 mental scores were not significantly different from those of patients in the chevron osteotomy group ($P = .93$, $P = .79$, and $P = .68$, respectively; t test).

Conclusion: The described method provides excellent visualization of the joint, is less technically challenging than the standard chevron osteotomy, and reduces operative time. Osteotomy union was attained in all 5 cases, with functional outcomes comparable with those attained with the chevron technique.

Open reduction–internal fixation of complex intra-articular distal humeral fractures presents a challenge because of inherently poor visualization of the joint. This can hinder the ability to achieve anatomic reduction of the articular surface in these injuries. Several techniques have been described using elevation of the extensor mechanism.[1,6] Although it is generally thought that preservation of the olecranon is desirable, an olecranon osteotomy is often necessary and has been shown to yield greater visualization of the articular surface than other non-osteotomy techniques.[2,9] Multiple types of tension-band wiring and plate fixation of the osteotomy at the end of the case have been described.[3,4,7] The chevron technique is promoted because it offers a large bony surface area for healing and provides some inherent stability owing to the post-osteotomy olecranon portion fitting into the wedge of the proximal ulna cut. This technique is effective but time-consuming and somewhat technically challenging.

We describe a new technique whereby a precontoured olecranon plate is first fixed to the olecranon and ulnar shaft, and a Gigli saw is used to perform the osteotomy while the plate is in place. This technique is efficient, takes minimal operating room time to perform, and is less technically challenging and has a shorter learning curve than a chevron osteotomy. It is important to note that this technique allows for the osteotomy to be performed while the plate is in place, ensuring anatomic reduction of the post-osteotomy fragments. All patients treated with this technique went on to clinical and radiographic healing of the osteotomy site and achieved functional outcomes comparable with fractures treated using the classic chevron osteotomy.

This study was approved by the Oregon Health and Science University Institutional Review Board (study No. 17468).

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Figure 1 A precontoured olecranon plate is affixed to the olecranon.

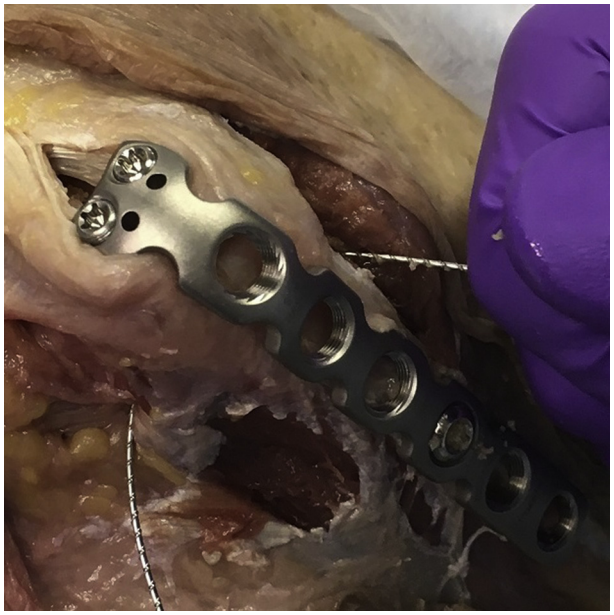

Figure 3 The osteotomy is created by directing the Gigli saw distally, and the cut is made posteriorly.

Materials and methods

Surgical technique

The patient is placed in the lateral decubitus position with the operative arm placed over an arm holder. A straight posterior incision is made over the olecranon and distal humerus and continued through the subcutaneous tissues. Full-thickness medial and lateral flaps are raised. The ulnar nerve is identified and dissected within the cubital tunnel, wrapped with a vessel loop, and protected at all times. A precontoured olecranon plate is then applied to the olecranon and affixed with screws both proximally and distally to the planned osteotomy site (Fig. 1). Medial and lateral capsular dissection is performed around the olecranon to gain entry into the ulnohumeral joint, and a curved hemostat is introduced anterior to the olecranon and used to pass a Gigli saw (Fig. 2). The saw is used to create the osteotomy through the bare area of the sigmoid notch (Fig. 3). The saw is pulled distally during the cut to create an oblique osteotomy. At this point, the screws fixing the plate distally are removed. The proximal olecranon fragment with the plate attached is retracted proximally with the extensor mechanism to expose the distal humeral fracture (Fig. 4).

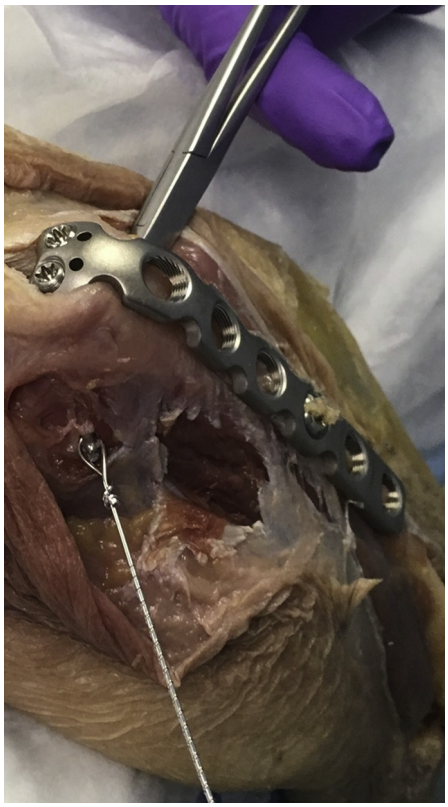

Figure 2 A Gigli saw is passed anterior to the olecranon using a curved hemostat.

After repair of the distal humerus itself, the olecranon osteotomy fragments are reapproximated and the plate is fixed to the distal fragment using standard small fragment screws and the preexisting screw holes. Use of these same holes ensures anatomic reduction of the osteotomy, which is confirmed by intraoperative fluoroscopy. The wound is closed in a standard fashion, and rehabilitation is initiated based on surgeon preference and confidence in the distal humeral fixation.

Outcome measurements

Osteotomy union was evaluated at 2- and 6-week follow-up clinic visits. QuickDASH (short version of the Disabilities of the Arm, Shoulder and Hand questionnaire) and Veterans RAND 12-Item Health Survey (VR-12) scores were collected for all patients at their most recent follow-up.[5,8] Outcome data for the 5 patients most recently treated with the standard chevron osteotomy were also collected for comparison.

Results

Five distal humeral fracture patients were treated with the described technique. Patient demographic characteristics are

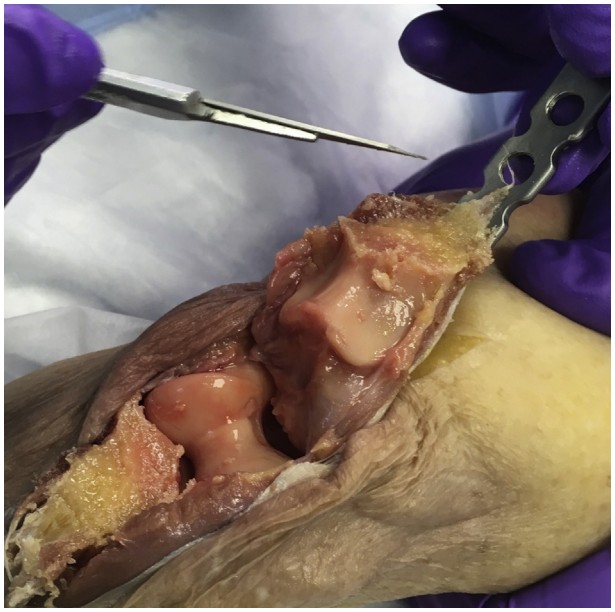

Figure 4 The plate, proximal olecranon fragment, and extensor mechanism are retracted en bloc.

shown in Table I. Two patients had isolated injuries from low-energy falls. One patient had a Gustilo-Anderson grade 2 open fracture with transection of the radial nerve at the level of the brachioradialis, one had an open ipsilateral humeral shaft fracture, and one had ipsilateral distal ulnar and radial fractures. The mean length of follow-up after surgery was 6.6 months (range, 4.5-12 months).

In all 5 cases, union of the olecranon osteotomy was achieved. The average final elbow range of motion was 26.0° (range, 10°-65°) of extension, 114.6° (range, 80°-138°) of flexion, 81.0° (range, 70°-90°) of pronation, and 73.6° (range, 45°-90°) of supination (Table I).

The mean QuickDASH scores for the Gigli saw and chevron osteotomy groups were 35.0 and 33.3, respectively, and were not significantly different ($P = .93$, t test). The VR-12 physical component summary and mental component summary scores were 42.8 and 51.7, respectively, for patients treated with the Gigli saw osteotomy and 40.8 and 47.4, respectively, for those treated with the chevron osteotomy. Neither the physical component summary scores nor the mental component summary scores for the 2 techniques differed significantly ($P = .79$ and $P = .68$, respectively; t test).

In the patient with an open fracture, a postoperative infection developed that required débridement, removal of hardware, and flap coverage 1 month after the initial fixation. When the olecranon hardware was removed 4 weeks after the index surgical procedure, union had been achieved at the osteotomy site. Because of his radial nerve injury, he required tendon transfers to restore extension of the wrist, thumb, and fingers. No other patients required removal of hardware or had other complications. Anteroposterior and lateral radiographs at 6 months after surgery for patient 1 are shown in Figure 5.

Discussion

An olecranon osteotomy provides the best visualization of the articular surface in complex distal humeral fractures compared with triceps-sparing or triceps-splitting approaches.[9] The commonly used chevron osteotomy can be technically challenging and requires fixation at the end of the case. The technique described in this report is technically straightforward and has a shorter learning curve than the chevron osteotomy. It further guarantees anatomic reduction as the plate is placed before the osteotomy is performed. Osteotomy union has been attained in all cases with this technique, and the functional outcome scores (QuickDASH and VR-12) were comparable with those attained with the chevron technique.

One criticism of this technique is that the Gigli saw kerf removes a 0.7-mm width of articular cartilage and bone, whereas the chevron technique uses an osteotome to crack, rather than remove, the cartilage itself. However, because the Gigli saw technique ensures anatomic reduction, there will be no articular step-off, and preservation of the arc of curvature of the olecranon is ensured. By contrast, despite having minimal cartilage loss, the chevron technique has a higher chance of articular incongruity due to nonanatomic reduction, and achieving anatomic reduction is more time-consuming and challenging.

As a variation on the described technique, one has the option of supplementing fixation with a locking screw across the osteotomy site itself. The success with respect to union thus far suggests that this is likely not needed, but it is an option if desired.

A final note is that the Gigli saw technique creates a flat surface osteotomy that has a smaller surface area and a smaller olecranon fragment than the chevron technique. There is a theoretical chance of this increasing the likelihood of nonunion. To mitigate this, the Gigli saw is pulled distally as it is pulled posteriorly toward the plate. This creates a broad, oblique cut with a large olecranon fragment and an excellent metaphyseal bleeding surface (Fig. 4).

Table I
Patient characteristics, final range of motion at follow-up, and subjective outcome measures (VR-12 and QuickDASH scores) for 5 consecutive patients treated with Gigli saw method and 5 traditional chevron osteotomy patients

Patient No.	Group	Sex	Age, yr	Laterality	Mechanism of injury	Follow-up, mo	Union	Final range of motion,°		VR-12 score		QuickDASH score
								Extension/flexion	Pronation/supination	PCS	MCS	
1	Gigli saw	M	49	L	Ground-level fall	14.9	Yes	15/120	90/90	46.97	63.36	11.84
2	Gigli saw	M	26	R	Pedestrian vs automobile	6.0	Yes	20/80	90/90	39.06	43.84	25.00
3	Gigli saw	M	65	R	Fall from ladder	4.5	Yes	20/138	85/73	51.18	58.00	6.82
4	Gigli saw	M	30	L	Motor vehicle collision	12.1	Yes	10/125	70/45	38.25	52.38	63.33
5	Gigli saw	M	64	L	Tractor rollover	8.1	Yes	30/110	70/70	38.39	41.06	50.00
6	Chevron	M	20	L	Ground-level fall	23.5	Yes	10/130	77/75	54.40	59.48	3.95
7	Chevron	M	32	R	Fall from roof	5.1	Yes	20/110	90/90	46.43	57.98	23.68
8	Chevron	M	55	R	Fall from ladder	2.8	Yes	30/90	90/90	52.18	40.79	0.00
9	Chevron	M	17	L	Ground-level fall	3.7	Yes	0/140	80/80	26.61	40.43	75.00
10	Chevron	F	51	L	Motor vehicle collision	6.7	Yes	0/110	70/70	24.43	47.43	56.82

VR-12, Veterans RAND 12-Item Health Survey; *QuickDASH*, short version of Disabilities of Arm, Shoulder and Hand questionnaire; *PCS*, physical component summary; *MCS*, mental component summary; *M*, male; *L*, left; *R*, right; *F*, female.

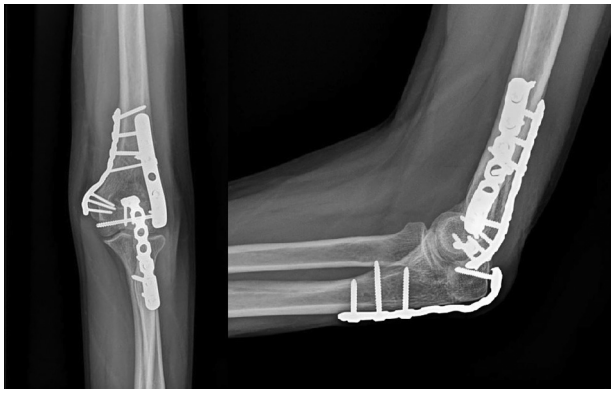

Figure 5 Anteroposterior and lateral radiographs showing anatomic union of osteotomy site at 6 months postoperatively.

In this series, our sample size was small and the follow-up period was only 6 months, but within this period, all osteotomy sites healed and a there were no complications related to this osteotomy technique.

Conclusion

The described technique appears to reduce operative time and is technically easier than chevron osteotomy while producing similar radiographic and functional outcomes.

Disclaimer

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References

1. Bryan RS, Morrey BF. Extensive posterior exposure of the elbow. A triceps-sparing approach. Clin Orthop Relat Res 1982;(166):188–92.
2. Cassebaum WH. Operative treatment of T and Y fractures of the lower end of the humerus. Am J Surg 1952;83:265–70.
3. Chin K. Double tension-band fixation of the olecranon. Tech Shoulder Elbow Surg 2000;1:61–6.
4. Coles CP, Barei DP, Nork SE, Taitsman LA, Hanel DP, Bradford Henley M. The olecranon osteotomy: a six-year experience in the treatment of intraarticular fractures of the distal humerus. J Orthop Trauma 2006;20:164–71. https://doi.org/10.1097/00005131-200603000-00002.
5. Gummesson C, Ward MM, Atroshi I. The shortened disabilities of the arm, shoulder and hand questionnaire (QuickDASH): validity and reliability based on responses within the full-length DASH. BMC Musculoskelet Disord 2006;7:44. https://doi.org/10.1186/1471-2474-7-44.
6. McKee MD, Kim J, Kebaish K, Stephen DJ, Kreder HJ, Schemitsch EH. Functional outcome after open supracondylar fractures of the humerus. The effect of the surgical approach. J Bone Joint Surg Br 2000;82:646–51.
7. Ring D, Gulotta L, Chin K, Jupiter JB. Olecranon osteotomy for exposure of fractures and nonunions of the distal humerus. J Orthop Trauma 2004;18:446–9. https://doi.org/10.1097/00005131-200408000-00010.
8. Selim AJ, Rogers W, Fleishman JA, Qian SX, Fincke BG, Rothendler JA, et al. Updated U.S. population standard for the Veterans RAND 12-item Health Survey (VR-12). Qual Life Res 2009;18:43–52. https://doi.org/10.1007/s11136-008-9418-2.
9. Wilkinson JM, Stanley D. Posterior surgical approaches to the elbow: a comparative anatomic study. J Shoulder Elbow Surg 2001;10:380–2.