Original Article

Articular Exposure between Triceps Reflecting Anconeus Pedicle (TRAP) Approach and Olecranon Osteotomy Approach

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Abstract

OBJECTIVES: To compare percentage of articular exposure of distal humerus between triceps-reflecting anconeus pedicle (TRAP) approach and olecranon osteotomy approach.

MATERIAL AND METHODS: 10 fresh cadaveric elbows were randomly allocated into 2 groups. Group 1 (5 elbows) was assigned for olecranon osteotomy approach. Group 2 (5 elbows) was assigned for TRAP approach. After surgical exposures were done, the visible articular surface of distal humerus was painted with oil-based yellow color. Subsequently, all dissected elbows were disarticulated. The remaining invisible articular area was painted with oil-based blue color. A square mesh net was firmly wrapped around the painted articular surface. The number of squares was counted and calculated into percentage of articular exposure. Median was calculated and compared among both groups.

RESULT: The olecranon osteotomy exposure group offers median of articular exposure at 57.69%. TRAP exposure group offers 47.45% with statistical significance in the difference between two approaches (Mann-Whitney U test, $p = 0.028$, 95% CI = 2.1 to 15.9)

CONCLUSION: The olecranon osteotomy exposure offers more articular visualization compared with the TRAP approach with statistical significance.

Keywords: olecranon osteotomy approach, triceps reflecting anconeus pedicle approach, TRAP, distal humerus articular exposure, elbow

Comminuted intraarticular fracture of distal humerus (AO/OTA 13 C2, C3) is a difficult fracture. Adequate articular exposure is mandatory for anatomical reduction of the distal humeral joint surface.[1] There are various approaches for treating comminuted intraarticular fracture including olecranon osteotomy approach, the triceps splitting approach, the triceps-sparing approach[2], triceps-reflecting anconeus pedicle approach[3]. Olecranon osteotomy provides excellent exposure of the distal humerus, being a straightforward procedure. It is also associated with limited complications. The potential for complications related to the creation and repair of the osteotomy include migration or prominence of the hardware[4], separation of the osteotomy, delayed union, and nonunion. Osteotomy also denervates the anconeus muscle which is dynamic elbow stabilizer[5]. The triceps-reflecting anconeus pedicle approach (TRAP) is another commonly used approach for treatment of comminuted intraarticular fracture of distal humerus. The TRAP approach does not denervate the anconeus muscle and there is no risk of olecranon nonunion.[6] Sachdev et al.,[7] found the triceps-reflecting anconeus pedicle approach had less complications, and a lower rate of reoperation and better post-operative elbow motion.

The objective of this study is to compare articular exposure of olecranon osteotomy approach and the triceps reflecting anconeus pedicle approach of distal humerus.

Materials and Methods

Ten elbows from five fresh frozen cadavers were obtained from the Department of Anatomy, Faculty of Medicine, Chiang Mai University. The study protocol was approved by the Institutional Ethical Committee Board,

Faculty of Medicine, Chiang Mai University. All of the cadavers had no upper extremity deformity, pre-existing surgery, no joint ankylosis or limitation of elbow ROM. Ten elbows were randomly and equally divided into 2 groups, the olecranon osteotomy exposure (Figure 1) and the triceps reflecting anconeus pedicle exposure (Figure 2). Olecranon osteotomy was performed as described by Ring D, et al.[4]TRAP exposure was performed as described by O'Driscoll, SW.[5] After completing the surgical exposure of each elbow, visualized articular surface was painted with an oil-based yellow color. Subsequently, each elbow was disarticulated. The remaining articular area which was not seen by the surgical exposure was painted with an oil-based blue color (Figure 3).The technique to measure in this paper use the same technique described by Dakouré P, et al.[2] The results are similar to those of Wilkinson and Stanley. A mesh net, sized 5 mm x 5mm, was then firmly wrapped around the elbow. Numbers of squares covering the yellow and blue areas were counted. The same operator took the measurements, as in Figure 4. Percentage of articular exposure was then calculated by following formula.

$$S = 100 \times \frac{Ny}{Ny + Nb}$$

S = percentage of the surgically exposed articular surface
Ny = number of squares covering yellow area
Nb = number of squares covering blue area

Analysis of collected data was done by the SPSS software (IBM Corp. Released 2011. IBM SPSS Statistics for Windows, Version 20.0. Armonk, NY: IBM Corp.). Comparison of difference was performed using Mann-Whitney U test.)

Results

As the results demonstrated in Table 1, the median percentage of articular exposure by olecranon osteotomy is 57.69% (min-max, 50.0-61.3%). The median percentage of articular exposure by TRAP approach is 46.87% (min-max, 42.3-53.6%). Comparing to TRAP approach, the olecranon osteotomy provided greater visualization of articular surface area with statistical difference (Mann-Whitney U test, p = 0.028, 95%CI = 2.1 to 15.9). The olecranon osteotomy provided more articular surface area on Trochlea (medial condyle).

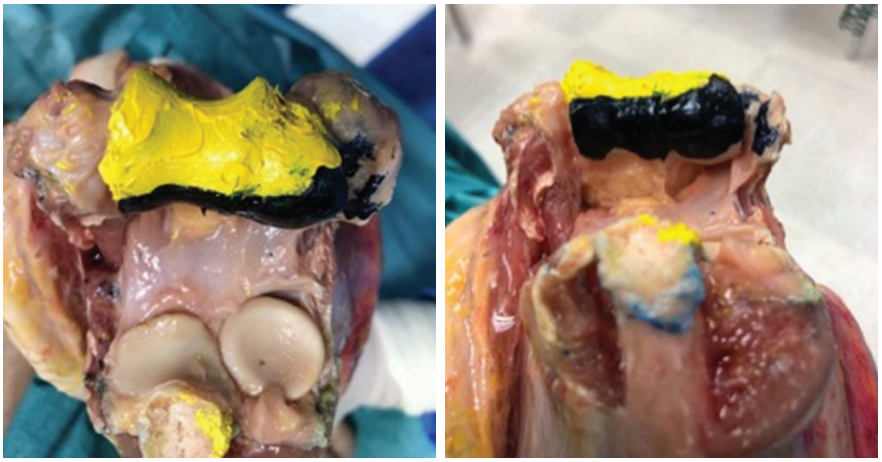

Figure 1: Shows distal humerus articular exposure by olecranon osteotomy

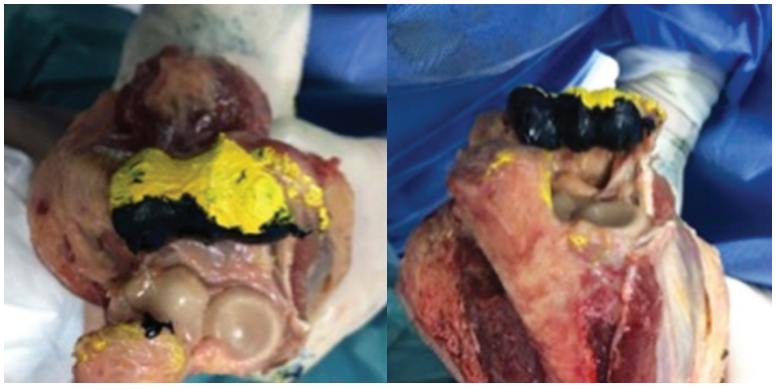

Figure 2: Shows distal humerus articular exposure by TRAP
The yellow color is the area that can be seen from exposure.
The blue color is the area that can be seen from exposure.

Figure 3: Shows the mesh method to measure percentage of articular area

Table 1: Percentage of distal humerus articular exposure of each elbow according to exposure.

% of articular in olecranon osteotomy	% of articular in TRAP
50	46.87
61.29	48.38
51.85	46.15
57.69	42.30
60.71	53.57

Discussion

Surgery of comminuted fracture of distal humerus needs adequate articular visualization to achieve anatomical reduction. Various approaches have been proposed for the treatment of distal humerus fracture. Olecranon osteotomy[4], being one of the most commonly performed approaches, has been associated with reported complications which may require re-operation such as nonunion or delayed union of osteotomy site, implant impingement, and denervation of anconeus muscle.[7]Another common posterior approach to the elbow is the triceps splitting approach[8], and triceps-sparing (Bryan-Morrey) approach.[9]

According to a comparative anatomical study by Wilkinson JM and Stanley D[1], the triceps splitting approach provided poorer articular exposure, when compared with olecranon osteotomy. Therefore, the triceps splitting approach may not be a good surgical approach in dealing with comminuted articular fractures. The triceps-sparing approach, proposed by Bryan RS and Morrey BF[8] was also another common approach for distal humerus fracture. However, this approach still requires an extra-articular olecranon-tip osteotomy to provide an access to the distal humerus.

In 2000, O'Driscoll SW[5] proposed the TRAP approach to distal humerus which permits adequate exposure, while fulfilling prerequisites of ideal surgical exposure to distal humerus. Complications of TRAP approach include triceps muscle weakness and ulnar nerve paresthesia.[7] Nevertheless, Sachdev S, et al.[7] reported that elbow motion and post-operative rehabilitation was much better in TRAP technique. Due to its advantage, TRAP approach has subsequently gained popularity and has been studied in many publications. However, there is still a limitation of data demonstrating articular exposure of TRAP approach. To our knowledge, the current study is the first anatomical study comparing articular exposure achieved by olecranon osteotomy and TRAP approaches.

The current study attempted to compare the articular exposure of both exposures by simple method (net mesh) to identify articular visualization of TRAP comparing with standard olecranon osteotomy. The study results demonstrated median percentage of articular exposure in TRAP group at 46.87% and the olecranon osteotomy at 57.69%. Statistical analysis revealed that olecranon osteotomy provided greater exposure than TRAP with statistical significance (Mann-Whitney U test, p = 0.028, 95%CI = 2.1 to 15.9). Meanwhile, the TRAP approach offered fewer complications and better post-operative range of motion.[7]

For clinical application, the olecranon osteotomy shows more articular area of capitulum than the TRAP approach, so in cases in need of more capitulum assessment, the preferred option is olecranon osteotomy.

Conclusion

The olecranon osteotomy exposure offers more articular visualization compared with the TRAP approach with statistical significance.

References

1. Wilkinson JM, Stanley D. Posterior surgical approaches to the elbow: a comparative anatomic study. *J Shoulder Elbow Surg* 2001;10(4):380-2.
2. Dakouré PW, Ndiaye A, Ndoye JM, et al. Posterior surgical approaches to the elbow: a simple method of comparison of the articular exposure. *Surg Radiol Anat*2007;29(8):671-4.
3. Pollock JW, Athwal GS, Steinmann SP. Surgical exposures for distal humerus fractures: a review. *Clin Anat* 2008;21(8):757-68.
4. Ring D, Gulotta L, Chin K, et al. Olecranon osteotomy for exposure of fractures and nonunions of the distal humerus. *J Orthop Trauma* 2004;18(7):446-9.
5. O'Driscoll SW. The triceps-reflecting anconeus pedicle (TRAP) approach for distal humeral fractures and nonunions. *Orthop Clin North Am* 2000;31(1):91-101.
6. Özer H, Solak S, Turanli S, et al. Intercondylar fractures of the distal humerus treated with the triceps-reflecting anconeus pedicle approach. *Arch Orthop Trauma Surg* 2005;125(7):469-74.
7. Sachdev S, Shah K, Mehta M, et al. The comparison of triceps reflecting anconeus pedicle and olecranon osteotomy approaches in the treatment of intercondylar fractures of the humerus. *Indian J Orthop Surg* 2017;3(3):294-300.
8. Bryan RS, Morrey BF. Extensive posterior exposure of the elbow. A triceps-sparing approach. *Clin Orthop* 1982;166:188-92.
9. Van Gorder GW. Surgical approach in supracondylar "T" fractures of the humerus requiring open reduction. *J Bone Joint Surg Am* 1940;22:278-92.

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