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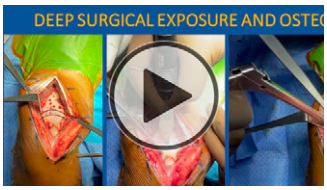
KEY PROCEDURES

Shortening Dome Osteotomy for the Correction of Coronal Plane Elbow Deformities

Sumit Arora, MS(Ortho), DNB(Ortho), MRCPS, Prajwal Gupta, MS(Ortho), Shahrukh Khan, MS(Ortho), DNB(Ortho), Rahul Garg, MS(Ortho), Anant Krishna, MS(Ortho), Abhishek Kashyap, MS(Ortho)

Published outcomes of this procedure can be found at: *Arch Orthop Trauma Surg*. 2023 Mar; 143(3):1371-8.

Investigation performed at the Department of Orthopaedic Surgery, Lok Nayak Hospital, Maulana Azad Medical College, New Delhi, India



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Abstract

Background: Severe elbow deformities are common in developing countries because of neglect or as a result of prior treatment that achieved poor reduction. Various osteotomy techniques have been defined for the surgical correction of elbow deformities[1-9]. However, severe elbow deformities (>30°) pose a substantial challenge for surgeons because limited surgical options with high complication rates have been described in the literature. Shortening dome osteotomy is a useful method of correcting moderate-to-severe deformities and offers all of the advantages of previously described dome osteotomy without causing an undue stretching of neurovascular structures[8,9].

Description: The anesthetized patient is placed in a lateral decubitus position under tourniquet control with the operative limb up, the elbow in 90° of flexion, and the forearm draped free to hang over a bolster kept between the chest and the forearm. A posterior midline approach is utilized, with the incision extending from 6 cm proximal to the tip of the olecranon to 2 cm distal. The ulnar nerve is identified and protected during the entire surgical procedure. In case of severe (>30°) and long-standing cubitus varus deformity, anterior transposition of the ulnar nerve is additionally performed to prevent nerve stretching after the deformity correction. A midline triceps-splitting approach is utilized along with subperiosteal dissection to expose the metaphyseodiaphyseal region of the distal humerus. Alternatively, the operating surgeon may choose to utilize a triceps-sparing approach. Hohmann retractors are placed at the medial and lateral aspects of distal humerus to protect the anterior neurovascular structures. Careful extraperiosteal dissection and a transverse incision over the anterior periosteum are performed to facilitate rotation of the distal fragment, as the anterior periosteum is usually thickened in cases of long-standing deformities. The posterior midline axis of the humerus is marked on the skin. The dome of the olecranon fossa is identified, and the distal osteotomy line is made just proximal and almost parallel to the dome. The proximal osteotomy line is made parallel and 5 to 8 mm proximal to the distal osteotomy line, as any further larger shortening may affect the muscle length-tension relationship. The posterior cortices of

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both domes and of the medial and lateral supracondylar ridges are osteotomized with use of an ultrasonic bone scalpel (Misonix), which was set at 70% amplitude control and 80% irrigation control. Alternatively, the osteotomy may be made by making multiple drill holes and connecting them with a 5-mm sharp osteotome or with use of a small-blade oscillating saw. The osteotomy of the anterior cortex is completed under direct vision with use of a Kerrison upcutting rongeur, after the subperiosteal separation of bone in order to protect the surrounding soft tissues. Kirschner wires are inserted in the distal fragment, and can be used like joysticks to manipulate the distal fragment to facilitate correction. Often, the anterior periosteum is found thickened and resists the free rotation of the distal fragment. In that case, a careful anterior extraperiosteal dissection is performed to protect the neurovascular structures, and this thickened periosteum may need to be incised transversely to facilitate deformity correction. Correction is achieved by rotating the distal fragment about the proximal fragment along the line of the parallel dome cuts, as per the preoperative planning, and correction may be verified intraoperatively using an image intensifier. Once the desired correction is obtained, the osteotomy site is provisionally fixed with Kirschner wires. Internal fixation is achieved with the help of a locking reconstruction or anatomically contoured posterolateral distal humerus locking plate plate applied over the posterolateral aspect of the distal humerus. Alternatively, the osteotomy site may be fixed with use of crossed-column screws. The osteotomy site may be grafted with small bone chips harvested from the excised curved bone fragment.

Alternatives: Closing-wedge osteotomy is a simple technique for deformity correction. However, this procedure requires removal of a large wedge[1] in cases of severe deformities, which leads to the generation of high displacing forces at the osteotomy site and at the prominence of the lateral condyle, as well as associated stretching of the ulnar nerve in cubitus varus correction. Other osteotomies like a step-cut osteotomy[3], pentalateral osteotomy[4], and 3D osteotomy[5] are viable options for severe deformities; however, these techniques are difficult to reproduce because of their complex intraoperative templating, poor precision, and difficulty in maintaining fixation for higher degrees of deformity. Conventional dome osteotomy is a simple and reproducible method for the correction of severe deformities, but is associated with a large valgus moment and nerve stretching[2]. Shortening dome osteotomy offers all the advantages of conventional dome osteotomy, along with the added benefit of decreased tension in the neurovascular bundle[8,9].

Rationale: Removal of a concentric curved piece of the bone enables the surgeon to correct even a severe deformity with greater ease and precision, without causing any undue stretching of the ulnar nerve. The surface area of the proximal dome (concave) is less than that of distal dome (convex) because of the natural distal humeral flare. The deformity correction involves additional medial translation of the distal fragment that prevents lateral condylar prominence.

Expected Outcomes: In a study of 18 patients with a mean age of 7.5 years (range, 5 years to 11 years), Singh et al.[8] reported that the mean radiographic ulnohumeral angle improved from 26.1° varus (range, 22° to 34°) preoperatively to 7.3° valgus (range, 2° to 12°) postoperatively ($p < 0.001$). The mean lateral condylar prominence index was −2.4° (range, +4.7° to −10.5°) preoperatively compared with −1.7° (range, +4.5° to −5.1°) postoperatively ($p = 0.595$). Radiographic healing was observed in all of the patients at a mean of 7.1 weeks (range, 5 to 9 weeks). All patients regained their preoperative range of elbow motion within 6 months postoperatively.

Important Tips:

- The dome of the olecranon fossa is identified, and the distal osteotomy line is made just proximal and parallel to the dome. The proximal osteotomy line is made parallel and 5 to 8 mm proximal to the distal osteotomy line.
- The posterior midline axis of the humerus is marked on the skin, as measuring displacement at this mark will help assess the magnitude of correction achieved.
- The posterior cortices of both of the domes are osteotomized with use of an ultrasonic bone scalpel. The osteotomy of the anterior cortex is completed under direct vision with use of a Kerrison upcutting rongeur, after the subperiosteal separation of bone in order to protect the surrounding soft tissues.

- Careful extraperiosteal dissection and a transverse incision over the anterior periosteum are performed to facilitate rotation of the distal fragment, as the anterior periosteum is usually thickened in cases of long-standing deformities.

Acronyms and Abbreviations:

- K-wire = Kirschner wire

Sumit Arora, MS(Ortho), DNB(Ortho), MRCPS[1]
Prajwal Gupta, MS(Ortho)[1]
Shahrukh Khan, MS(Ortho), DNB(Ortho)[1]
Rahul Garg, MS(Ortho)[1]
Anant Krishna, MS(Ortho)[1]
Abhishek Kashyap, MS(Ortho)[1]
[1]Department of Orthopaedic Surgery, Lok Nayak Hospital, Maulana Azad Medical College, New Delhi, India

Email for corresponding author: mamc_309@yahoo.co.in

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