

Supracondylar Subtraction Wedge Osteotomy for the Treatment of Adult Cubitus Valgus

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ABSTRACT

Objective: to report the results of a series of adult patients with a valgus malunion of the elbow treated with a supracondylar subtractive monoplanar wedge osteotomy. **Materials and methods:** 5 patients were included. The surgical technique consisted of a posterior paratricipital approach, with resection of a subtractive wedge and the anterior transposition of the ulnar nerve. The average follow-up was 17 months. **Results:** 4 patients were men and 1 was a woman with an average age of 27 years. The preoperative range of motion was 138°-7° and the postoperative range of motion was 138-6°. Pain according to VAS was 4 and 1, MEPS was 71 and 97, and DASH 6 was 26 and 8, respectively. The preoperative radiological evaluation showed an average valgus of 30° with a contralateral valgus of 11°. The final valgus obtained was 13°. The final correction was, on average, 2° less than the contralateral side. All osteotomies healed and the medial prominence was on average 32% more than before surgery. According to the Oppenheim scale, the results were excellent in 4 patients and good in 1. Personal satisfaction was, on average, 8.6. **Conclusions:** Supracondylar subtractive wedge osteotomy is a good option for the treatment of adult cubitus valgus, with a recovery of angular values similar to the contralateral side and a high satisfaction rate. As it is a simpler technique, compared to the multiplanar osteotomies, it is our treatment of choice for adult cubitus valgus.

Keywords: Cubitus valgus; osteotomy; subtractive wedge; malunion; supracondylar humeral fracture.

Level of Evidence: IV

Osteotomía en cuña sustractiva supracondílea para el tratamiento del codo valgo del adulto

RESUMEN

Objetivo: Comunicar los resultados de una serie de adultos con consolidaciones en valgo del codo tratados con una osteotomía en cuña sustractiva monoplanar. **Materiales y Métodos:** Se incluyeron 5 pacientes. Se describe la técnica quirúrgica que consistió en un abordaje posterior paratricipital, resección en cuña sustractiva y transposición anterior del nervio cubital. El seguimiento promedio fue de 17 meses. **Resultados:** Se trató a 4 hombres y una mujer, con una edad promedio de 27 años. La movilidad preoperatoria promedio fue de 138°-7° y la posoperatoria, de 138-6°, el puntaje de dolor en la EAV fue de 4 y 1, el MEPS de 71 y 97, y el DASH de 26 y 8, respectivamente. La evaluación radiográfica preoperatoria arrojó un valgo promedio de 30° con un valgo contralateral de 11°. La corrección radiográfica demostró un valgo de 13°. Se obtuvo una corrección promedio de 2° menos que del otro lado. Todas las osteotomías consolidaron, y la medición de la prominencia medial fue, en promedio, un 32% mayor que en el preoperatorio. Según la escala de Oppenheim, el resultado fue excelente en 4 pacientes y bueno en uno. La satisfacción personal fue, en promedio, de 8,6. **Conclusiones:** La osteotomía en cuña sustractiva para tratar un codo valgo es una buena opción terapéutica, con recuperación de valores angulares comparables con el lado contralateral, y alta tasa de satisfacción de los pacientes. Como es una técnica menos compleja que las osteotomías multiplanares, es nuestra elección ante una consolidación viciosa en valgo del codo del adulto.

Palabras clave: Codo valgo; osteotomía; cuña sustractiva; consolidación viciosa; fractura supracondílea de codo.

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INTRODUCTION

Angular deformities of the elbow are common complications of supracondylar fractures in children. These alter joint orientation in a mono or multiplanar manner.¹ Cubitus varus is the most frequent complication, it has an average incidence of 30% (range 0-60%).²⁻⁴ In contrast, cubitus valgus, caused by a nonunion of the lateral humeral condyle or premature physal closure, is rare.⁵

This valgus deformity rarely compromises the function of the elbow, it presents as an aesthetic alteration. In many cases, it goes unnoticed, because it implies an increase in the physiological position of the elbow. However, there may be medial instability and irritation of the ulnar nerve induced by its stretching in complex cases.³

There are different types of osteotomies for the treatment of the cubitus valgus.⁶⁻⁸ However, there is no consensus on which one achieves the best final outcome. Therefore, the choice of the surgical technique depends on the surgeon's preference.

Monoplanar osteotomy is a controversial procedure because it does not allow a multiplanar correction that often accompanies valgus deformity.

The objective of this study is to report the results of a series of adult patients with valgus consolidations of the elbow treated with a monoplanar subtractive wedge varizing osteotomy.

MATERIALS AND METHODS

A retrospective observational study was designed that included all patients who had undergone a corrective elbow osteotomy to correct a deformity, at our institution, between 2007 and 2019. 10 patients were identified. The inclusion criteria were: patients >18 years of age (skeletally mature), with vicious consolidations of the distal humerus with pathological valgus deviation (> 20°),⁷ treated with a medial subtractive wedge varizing osteotomy, with complete pre and postoperative radiological studies and a follow-up >1 year.

The final group encompassed five patients. The remaining five were excluded because they had varus consolidations (3 cases) and their age was <18 years (2 cases).

All preoperative and postoperative evaluations were carried out by one of the authors (GG).

The radiographic evaluation was performed in the regular anteroposterior and profile elbow views of both upper extremities, and they were analyzed comparatively.

To measure the deformity, the humerus-elbow-wrist angle⁸ was used in the anteroposterior projection with the elbow extended and in maximum supination, drawing two transverse lines perpendicular to the humeral axis (one proximal and one distal) and two lines perpendicular to the axis of the forearm (one proximal and one distal). Then a line was drawn perpendicular to the midpoint of the humeral lines and another connecting the midpoint of the forearm lines. The intersection between these two lines forms the humerus-elbow-wrist angle. The necessary correction angle was determined using the healthy contralateral side as a guiding parameter.

Medial prominence was measured with the Wohn scale⁹ (Figure 1).

Four patients had a history of a supracondylar fracture in childhood. One (Case 3) had suffered a posterolateral dislocation of the elbow at the age of 11 and, three years before our surgery, suffered a new trauma with dislocation. From that moment on, he had multiple episodes of subluxation.

Two patients had a nonunion of the humeral condyle due to a type 2 fracture of the Milch classification.¹⁰ Two patients had paresthesias in the ulnar territory and one (Case 1) had undergone a tendon transfer due to ulnar paralysis and anterior nerve transposition.

All were operated on by the same surgeon (GG).

Surgical technique

The patients were placed in the prone position with the arm resting on a radiolucent surgical table. A posterior approach was performed and the ulnar nerve was identified and transposed anteriorly and in the subcutaneous plane in four of the five cases. The remaining patient was the one who had already undergone surgery. In the osteotomy surgery, the nerve was only identified, no surgical gesture was performed on it.

The paratricipital approach was used in all cases. The wedge to be resected had been previously measured and made in a plastic template and, with it, the osteotomy was performed. Previously, a hole had been created in the apex of the wedge 2 mm from the external cortex of the humerus to try to make the osteotomy incomplete and facilitate compression. It was temporarily fixed with two 2 mm Steinmann nails and then definitive osteosynthesis was carried out with two locking plates.



Figure 1. Medial prominence index measurement (%) = $(CB - BA)/CA \times 100$.

One of the patients had posterolateral elbow instability so the distal approach was prolonged and, through the interval between the anconeus and the posterior ulna, the joint capsule was accessed and reconstruction of the lateral ligament was carried out with a triceps slice.

The closure was performed with a drain in all cases and postoperative immobilization was carried out with a plaster cast at 90° for one week. In the case of ligament reconstruction, immobilization lasted for six weeks.

The final clinical evaluation consisted of an objective examination measuring the range of motion with a goniometer and a subjective one using the DASH (*Disabilities of the Arm, Shoulder and Elbow*),¹¹ MEPS (*Mayo Elbow Performance Score*)¹² and visual analog scale (VAS) scores for pain in activity and patient satisfaction.

To analyze the clinical outcomes of the correction of the deformity, the Oppenheim criteria scale¹³ was used, based on the measurement of the humerus-elbow-wrist angle, the active range of motion and the presence of complications. The result is considered excellent if the humerus-elbow-wrist angle correction has a difference <5° with respect to the contralateral side, the loss of range of motion is <5° and there are no complications; good if the difference of the humerus-elbow-wrist angle is 6° to 10° and the loss of the range of mobility is <6°-10° with respect to the contralateral elbow, accompanied by slight deformity, and poor if the difference is > 10° and the loss of the range of mobility is > 10° in relation to the contralateral elbow.

The average follow-up was 19 months (range 12–37).

FINDINGS

The group consisted of four men and one woman, with an average age of 27 years (range 18-42) (Table 1). The right side was affected in four cases and the dominant limb in another four. The average preoperative range of motion was 138-7° whereas the postoperative one was 138-6°, the pain score according to the VAS was 4 and 1, the MEPS score was 71 and 97, and the DASH was 26 and 8, respectively (Table 2).

In two patients with ulnar paresthesias, the symptoms reappeared.

Table 1. Demographic data

Patient	Age	Sex	Associated lesions	Valgus (°)	Valgus Contralateral (°)	Resected Wedge (°)	Final valgus (°)	Correc-tion (°)	Medial prominence			Follow-up (months)
									Preop.	Postop.	%	
1	23	M	Pseudocondyle	29	6	23	8	-2	22	34	54	37
2	42	M	No	34	15	19	19	-4	52	59	13	16
3	20	F	Posterolateral instability	40	20	20	20	0	46	54	17	12
4	18	M	No	22	5	17	6	-1	50	61	22	13
5	34	M	Pseudocondyle	25	8	17	11	-3	24	37	54	18
Average	27			30	11	19	13	-2	39	50	32	19

M = male, F = female.

Table 2. Findings

Patient	Flexion-exten-sion (°)		MEPS		DASH		Pain		Satis-faction	Oppenhei-men scale	Complications
	Preop.	Postop.	Preop.	Postop.	Preop.	Postop.	Preop.	Postop.			
1	145-0	145-5	65	100	24	2	5	0	9	Good	Ulnar neuritis and implant extraction
2	135-10	135-10	70	100	34	5	5	1	9	Excellent	No
3	135-0	135-0	65	85	34	13	5	2	9	Excellent	No
4	140-10	140-10	85	100	9	6	2	1	8	Excellent	No
5	135-15	135-5	70	100	27	12	3	1	8	Excellent	No
Average	138-7	138-6	71	97	26	8	4	1	8.6%		

MEPS = Mayo Elbow Performance Score, DASH = Disabilities of the Arm, Shoulder and Elbow.

The preoperative radiographic evaluation showed an average valgus of 30° (range 22-40°), with a contralateral valgus of 11° (range 5-20°). Radiographic correction showed a valgus of 13°. Therefore, the correction obtained was, on average, 2° less than on the contralateral side. All osteotomies healed and the medial prominence measurement was, on average, 32% (range 13-54%) higher than preoperatively (Figures 2 and 3).

According to the Oppenheim scale, the results were excellent (4 cases) and good (1 case). Personal satisfaction with the outcome was, on average, 8.6 (range 8-9).



Figure 2. **A.** Patient with cubitus valgus (Case 1). **B** and **C.** Anteroposterior and lateral radiograph of the elbow, showing humeral condyle nonunion and a valgus deviation of 29°. **D.** Paratricipital approach. **E.** Subtraction wedge osteotomy. **F.** Osteotomy osteosynthesis. **G.** Radiograph showing an 8° postoperative valgus. **H-J.** Final range of motion.



Figure 3. A. Patient with valgus deviation (Case 4). B. Intraoperative image of the subtraction wedge. C. Final range of motion.

DISCUSSION

We reported the results of monoplanar wedge osteotomy for the treatment of elbow valgus and have obtained good functional outcomes. This type of osteotomy is widely criticized in the literature, because the deformity is often multiplanar, which is why, for many authors, so should be its correction. The osteotomy that we present is monoplanar, and it would not allow correction in all planes.^{6,7,14,15} Weaknesses of this osteotomy include: that it does not allow a rotary correction, it provides less stability because it is a linear osteotomy, and it increases medial prominence, since it does not allow the translation of the distal fragment.

The three most frequently published osteotomies are the closing wedge, the step-cut “V”, and the dome-shaped. The step cut osteotomy has some advantages, such as providing intrinsic stability from the V-shape of the cuts and allowing multiplanar correction. Kin et al.⁸ published the results of 13 patients treated with this technique. They achieved good angular correction, with an average final valgus of 9.1° and an improvement in medial prominence. However, four patients required an additional osteotomy to correct a flexion contracture.

The dome-shaped osteotomy is less complex than the previous one, but the correction, in our opinion, is less precise than with the resection of a wedge. Hahn et al.⁸ reported 13 patients who underwent this osteotomy, with a valgus correction from 24° to 11°, with improvement in functional clinical scores and medial prominence.

Although these types of osteotomies would have the advantage of multiplanar correction, no published studies compare the results with monoplanar osteotomies. In our series, the increase in medial prominence was 32%. Although this is one of the criticisms of this technique, the clinical satisfaction of the patients has been high and none reported discomfort regarding this point.

Therefore, we consider that, except in exceptional cases, such as with a very marked deformity in other planes, in addition to the coronal one, monoplanar correction allows achieving similar results to those of other multiplanar techniques and with a simpler technique.

Humeral condyle nonunions were not treated because they were not symptomatic. Although some authors recommend osteosynthesis for nonunions,^{14,16} others have obtained good results without surgical treatment.¹⁷

This study has many limitations. First of all, its retrospective nature. Second, the series consisted of a small number of patients with limited follow-up. Third, the final functional evaluation was done by the surgeon in charge. However, this type of deformity is a poorly reported condition in our literature and vindicates this often-criticized type of osteotomy.

The subtractive wedge varizing osteotomy for the treatment of adult cubitus valgus is a good therapeutic option, the angular values achieved are comparable with those of the contralateral side, and the patient satisfaction rate is high. As it is a less complex technique than multiplanar osteotomy, it emerges as our choice when faced with a valgus malunion of the elbow.

Conflict of interests: The authors declare they do not have any conflict of interests.

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