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Comparison of two medial epicondylectomy techniques in cubital tunnel syndrome

Kübital tünel sendromunda iki medial epikondilektomi tekniğinin karşılaştırılması

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ABSTRACT

Objectives: This study aims to compare partial medial epicondylectomy (PMe) and distal medial epicondylectomy (DMe) techniques in terms of sensory and motor improvements, functional results and complications.

Patients and methods: The study included a total of 59 cubital tunnel syndrome patients (37 males, 22 females; mean age 42.3 years; range 23 to 80 years). Of the patients, DMe was applied on 30 and PMe was applied on 29. Patients were evaluated with Wilson Krout scores, Semmes-Weinstein Monofilament (SWM) test, and grip and pinch strength measurements preoperatively and at postoperative third, sixth, and 12th months. Both groups' pre- and postoperative intragroup and intergroup results were compared.

Results: Wilson Krout scores in postoperative checks were better with DMe compared to PMe. The improvement in SWM test scores was statistically significant for only DMe. The improvement in grip strength, lateral pinch and terminal pinch measurements in DMe group was significant at postoperative third month. In PMe group, significant improvement for these measurements was obtained at postoperative sixth month. The only complication observed with DMe was tenderness developing over the medial epicondyle. Painful subluxation of the nerve associated with paresthesia was detected in four patients in PMe group.

Conclusion: Compared to PMe, DMe offers more satisfactory subjective results. Motor functional recovery occurs earlier with DMe. DMe appears to have lower complication rates.

Keywords: Cubital tunnel; medial epicondylectomy; ulnar nerve.

ÖZ

Amaç: Bu çalışmada parsiyel medial epikondilektomi (PMe) ve distal medial epikondilektomi (DMe) teknikleri duyusal ve motor düzelme, fonksiyonel sonuçlar ve komplikasyonlar açısından karşılaştırıldı.

Hastalar ve yöntemler: Çalışmaya toplam 59 kübital tünel sendromu hastası (37 erkek, 22 kadın, ort. yaş 42,3 yıl; dağılım 23-80 yıl) dahil edildi. Hastaların 30'una DMe, 29'una PMe uygulandı. Hastalar ameliyat öncesinde ve ameliyat sonrası üç, altı ve 12. aylarda Wilson Krout skorları, Semmes-Weinstein Monofilaman (SWM) testi ve kaba kavrama ve ince kavrama gücü ölçümleri ile değerlendirildi. Her iki grubun ameliyat öncesi ve sonrası grup içi ve gruplar arası sonuçları karşılaştırıldı.

Bulgular: Ameliyat sonrası kontrollerde Wilson Krout skorları PMe'ye kıyasla DMe ile daha iyi idi. SWM testi skorlarındaki düzelme sadece DMe için istatistiksel olarak anlamlı idi. DMe grubunda kavrama, lateral ve terminal çimdikleme ölçümlerindeki düzelme ameliyat sonrası üçüncü ayda anlamlı idi. PMe grubunda bu ölçümler için anlamlı düzelme ameliyat sonrası altıncı ayda elde edildi. DMe ile görülen tek komplikasyon medial epikondil üzerinde ortaya çıkan hassasiyet idi. PMe grubunda dört hastada parestezinin eşlik ettiği ağrılı sinir subluksasyonu saptandı.

Sonuç: PMe ile karşılaştırıldığında DMe daha tatmin edici sübjektif sonuçlar ortaya koymaktadır. DMe ile motor fonksiyonel iyileşme daha erken ortaya çıkmaktadır. DMe daha düşük komplikasyon oranlarına sahip görünmektedir.

Anahtar sözcükler: Kübital tünel; medial epikondilektomi; ulnar sinir.

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Cubital tunnel syndrome (CuTS), the compression neuropathy of the ulnar nerve at the elbow, is a common compression neuropathy of the upper extremity like carpal tunnel syndrome.[1] Medial epicondyle (ME) is one of the sides of compression for the ulnar nerve in addition to the arcade of Struthers, medial intermuscular septum, cubital tunnel and flexor pronator aponeurosis.[2] The role of ME in pathogenesis of CuTS is reported as a tension neuropathy caused by traction and stretching of the nerve by the fulcrum effect it causes with elbow flexion.[3,4]

In situ decompression, anterior transposition of the nerve and medial epicondylectomy techniques are applied surgical decompression options for ulnar nerve at the level of elbow. Medial epicondylectomy techniques described in the literature with satisfactory clinical results are total excision,[5] partial excision of the tip[6] and minimal epicondylectomy.[7,8] However, medial elbow pain, painful nerve subluxation, elbow instability, flexor pronator weakness, flexion contracture at the elbow were reported complications of these techniques.[6,9,10] Distal medial epicondylectomy (DMe) was reported as a modification of partial medial epicondylectomy (PMe) which creates a significant change in ulnar nerve strain with encouraging preliminary clinical results.[2,11]

In this study, we aimed to compare PMe and DMe in terms of sensory and motor improvements, functional results and complications.

PATIENTS AND METHODS

This prospective randomized study was conducted at the Kirikkale University School of Medicine between January 2009 and November 2013 and included a total of 59 patients (37 males, 22 females; mean age 42.3 years; range 23 to 80 years) who were clinically diagnosed as cubital tunnel syndrome with symptoms of paresthesia and/or tingling in their last two digits and who attended to postoperative 12th month checks. In addition to clinical symptoms, all patients had positive Tinel's sign and positive cubital tunnel stress test performed by full flexion of the elbow associated with extension of the wrist and fingers.[9] The diagnosis was confirmed with electroneuromyography (ENMG) in all patients, with decreased motor nerve conduction velocity at the elbow segment of the ulnar nerve. Another inclusion criterion was a history of conservative treatment without any symptomatic relief. All patients had significant ulnar nerve compression against the medial epicondyle after in situ decompression was completed. The exclusion criteria were history of previous surgery for cubital tunnel or ulnar tunnel syndrome, diagnosis of polyneuropathy, loss of elbow range of motion, previous elbow surgery, elbow instability and elbow osteoarthritis or any form of inflammatory arthritis and preoperative subluxation of the nerve. Also, patients with abnormal laboratory findings for liver and renal functions and uncontrolled blood glucose levels were not operated due to anesthetic issues and were excluded. The study protocol was approved by the Kirikkale University School of Medicine Ethics Committee. A written informed consent was obtained from each patient. The study was conducted in accordance with the principles of the Declaration of Helsinki.

Patients were randomly divided into two groups by the method of block randomization as those who were performed DMe (group A; 20 males, 10 females; mean age 44.9 years; range 23 to 80 years) and those who were performed PMe (group B; 17 males, 12 females; mean age 39.8 years; range 23 to 70 years) (Table I). The average duration of symptoms was 9.4 months (range 4-17 months) in group A and 9.8 months (range 5-16 months) in group B. Three patients in group A and four patients in group B had bilateral CuTS. Two

TABLE I

Patient demographics

	DMe group Group A (n=30)			PMe group Group B (n=29)		
Patient demographic	n	Mean	Range	n	Mean	Range
Age (year)		44.9	23-80		39.8	23-70
Gender						
Female	10			12		
Male	20			17		
Mean duration of symptoms (month)		9.4	4-17		9.8	5-16

DMe: Distal medial epicondylectomy; PMe: Partial medial epicondylectomy.

Figure 1. Osteotomy line for distal medial epicondylectomy. D: Distal; P: Proximal.

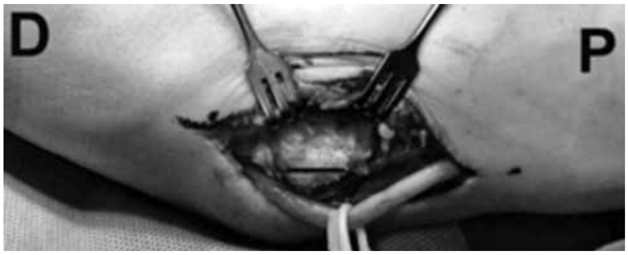

Figure 2. Osteotomy line for partial medial epicondylectomy. D: Distal; P: Proximal.

different surgical medial epicondylectomy techniques were applied for each group.

All patients were operated at the same clinic by one of the senior authors under regional block anesthesia with tourniquet control. Distal medial epicondylectomy, which removes the distal half of the medial epicondyle subperiosteally, was performed in group A, after in situ decompression of the ulnar nerve from medial intermuscular septum to first motor branch to flexor pronator mass as defined by Cirpar et al.[2] (Figure 1). Standard PMe removing the medial half described by Kaempffe and Farbach[6] was performed in group B, after in situ decompression (Figure 2). Distal and medial halves of the medial epicondyle were measured with a simple sterile ruler and the osteotomy lines were drawn with a cautery. The osteotomies were performed with a micro oscillating saw of 0.51 mm blade thickness. Medial intermuscular septum was released in all patients at its insertion on the medial epicondyle. After release of the tourniquet and control of hemorrhage, the wounds were closed in usual fashion.

Elbow anteroposterior and lateral radiographies were obtained preoperatively to rule out any signs of previous elbow trauma, fracture or osteoarthritis. The radiographies were obtained postoperatively to examine the osteotomy sites. Last radiographic checks were performed at sixth month (Figure 3). The patients were clinically assessed preoperatively and at postoperative third, sixth and 12th months. On pre- and postoperative checks, the patients were clinically examined for Tinel's sign on cubital tunnel, local tenderness over the medial epicondyle, nerve subluxation with elbow motion, varus-valgus and total joint instability. Objective assessment was performed with Goldberg's modification[12] of McGowan grading system[13] (Table II) and Wilson Krout Scores (WKS).[14] Sensory status of the patients was assessed with Semmes-Weinstein monofilament (SWM) test. Motor function of the ulnar nerve was evaluated with grip strength (GS) and pinch strength measurements of terminal pinch (TP), tripod grip (TG), lateral or key pinch (LP) (Baseline Hydraulic Hand Dynamometer and Baseline Hydraulic Pinch Meter, Fabrication Enterprises Inc., Irvington, NY, USA) in comparison to other normal side only for unilateral cases.

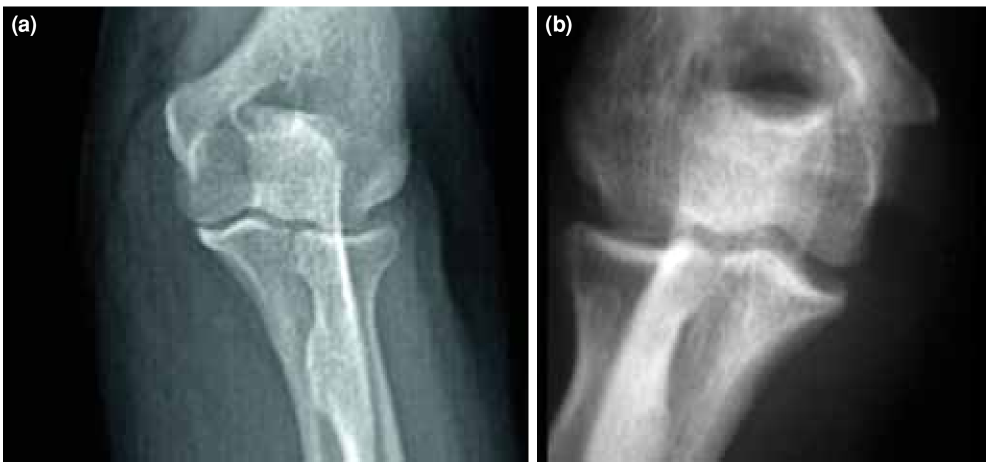

Figure 3. Postoperative sixth month anteroposterior radiography of patients. **(a)** Partial medial epicondylectomy group, **(b)** distal medial epicondylectomy group.

TABLE II

McGowan grading system for cubital tunnel syndrome

Grade I
Subjective symptoms, no objective findings
Grade II
(A) Sensory, motor weakness, good intrinsic strength
(B) Sensory loss, intrinsic atrophy
Grade III
Profound sensory and motor loss
Marked atrophy
Clawing of the last two digits

Statistical analysis

The statistical analyses were performed using IBM SPSS version 23.0 software (IBM Corp., Armonk, NY, USA). Pre- and postoperative McGowan and WKS of groups were compared with Pearson chi-square test for homogeneity. Wilcoxon signed rank test was used for statistical analysis of the difference in each group between pre- and postoperative scaled variables. Mann-Whitney U test was used to compare scaled variables between groups. The statistical significance level was set at $p<0.05$.

RESULTS

In postoperative checks, none of the patients in group A complained of paresthesia or tingling. Four patients in group B had a complaint of paresthesia. These four patients also had tenderness over the medial epicondyle and painful subluxation of the nerve with elbow flexion. The symptoms of paresthesia and tenderness resolved at second check at sixth month. However, painful nerve subluxation continued and three of the patients refused to undergo a second intervention to treat this complication. Anterior subcutaneous transposition was performed for the remaining patient at second year. Two patients had tenderness over the medial epicondyle in group A at third postoperative month, which resolved in both patients by the sixth month check.

All patients in both groups had full range of motion at all checks. There was no patient in any group having positive varus or valgus instability both under fluoroscopy control in the operating room or during postoperative checks. The cubital tunnel stress test was positive in 23 patients (76.6%) in group A and 21 patients (72.4%) in group B in preoperative examination. However, none of the patients in neither group had positive stress test in postoperative evaluations. There were no surgery related complications in any of the groups.

According to preoperative evaluations for McGowan grading system for CuTS, 76.6% (n=23) of patients were grade IIA and 23.4% (n=7) were grade IIB in group A. In group B, 6.8% of patients (n=2) were grade I, 79.3% (n=23) were grade IIA, and 13.7% (n=4) were grade IIB. The difference between preoperative McGowan scores was not statistically significant ($p=0.342$).

On postoperative evaluation at third month, 50% of the patients had good and 50% had excellent WKS in group A. The rate of excellent scores improved to 83.3% at sixth month and to 93.3% at one-year checks. At first postoperative check, 41.4% of patients had fair and 58.6% had good WKS in group B. At next check at sixth month, only two patients demonstrated improvement from fair to good scores,

TABLE III

Postoperative Wilson-Krout scores

	Number of patients											
	3rd month				6th month				12th month			
	DMe		PMe		DMe		PMe		DMe		PMe	
	n	%	n	%	n	%	n	%	n	%	n	%
Excellent (normal function, minimal sensory/motor symptoms, no pain)	15	50	-	-	25	83.3	-	-	28	93.3	-	-
Good (improved, mild sensory motor symptoms, occasional pain)	15	50	17	58.6	5	16.7	19	65.5	2	6.7	19	65.5
Fair (better to moderate sensory/motor symptoms/weakness	-	-	12	41.4	-	-	10	34.5	-	-	10	34.5
Poor (no improvement or worse)	-	-	-	-	-	-	-	-	-	-	-	-

DMe: Distal medial epicondylectomy; PMe: Partial medial epicondylectomy.

and these scores remained unchanged at one-year check. The difference for WKS between two groups was statistically significant (p<0.001), with group A patients having higher scores (Table III).

Mean preoperative SWM scores of 3.28 (range 2.44-4.08) in group A improved to 2.90 at third month and to 2.77 at sixth and 12th month checks demonstrating normal sensory function. The difference between pre- and postoperative checks were statistically significant (p=0.026 and p=0.004, respectively). In group B, mean preoperative SWM score was 3.06 (range 2.44-4.08), which was measured as 2.85 at all postoperative checks. The improvement in SWM score in group B was not statistically significant (p=0.66). However, this score demonstrated normal sensory function for this group. The difference for SWM scores between two groups was not statistically significant for pre- and postoperative measurements (p=0.648 for preoperative measurements, 0.367 for postoperative third month and p=0.056 for postoperative sixth and 12th month checks).

On preoperative dynamometric measurements, mean GS was 76% and 74.4% in groups A and B, respectively. Mean TG score was 61.7% and 61.3% in groups A and B, respectively. Mean LP score was 71% and 68.2% in groups A and B, respectively. Mean TP was 66.7% and 65.4% in groups A and B, respectively. The difference for these measurements was not statistically significant (p=0.107 for GS, 0.1 for TG, 0.132 for LP and 0.196 for TP). Results of grip and pinch strength measurements were listed in Table IV.

For GS measurements, statistically significant improvement was obtained in group A beginning from the first check at third month (p<0.001). However, statistically significant improvement was obtained at second check at sixth month in group B (p<0.001). The improvement in GS at first check was not statistically significant in this group (p=0.107). The difference between two groups was statistically significant at third postoperative month check (p<0.001). At sixth and 12th month checks, GS value was not statistically significantly different between two groups (p=0.497).

The improvement in TG values for both groups was statistically significant beginning from the third month check (p<0.001). However, there was a statistically significant improvement in group A when compared with group B at first check (p<0.001).

The differences for all postoperative LP measurements between two groups were statistically significant (p<0.001). Statistically significant improvement was achieved at third postoperative month in group A (p<0.001). However, the improvement was not statistically significant in group B at third postoperative month check with a p value of 0.274. The statistically significant improvement was achieved at sixth postoperative month check for this group (p<0.001).

TABLE IV

Results of grip and pinch strength measurement in both groups

	Grip strength		Tripod grip		LP		Terminal pinch	
	%	Range	%	Range	%	Range	%	Range
Preoperative								
DMe	75	66-82	61.7	60-63	71	66-78	66.7	63-70
PMe	74.4	66-80	61.3	60-64	68.2	59-79	65.4	59-69
p	=0.568		=0.1		=0.132		=0.196	
Third month								
DMe	90.3		79.1		81.9		76.8	
PMe	76.13		70.2		71.2		68.4	
p	<0.001		<0.001		<0.001		<0.001	
Sixth month								
DMe	90.3		82.1		87.2		80	
PMe	90.03		81.02		79.1		76.1	
p	=0.497		=0.09		<0.001		<0.001	
Twelfth month								
DMe	90.3		83.8		89.9		84.2	
PMe	90.03		83.2		82.03		82	
p	=0.497		=0.08		<0.001		=0.196	

DMe: Distal medial epicondylectomy; PMe: Partial medial epicondylectomy.

The patients in group A achieved a statistically significant improvement when compared with the preoperative value (p<0.001) at third month check. However, the improvement of TP was not significant in group B in first postoperative check (p=0.237). The difference between two groups was also statistically significant at this first postoperative check (p<0.001). Statistically significant improvement in TP in group B was achieved at sixth postoperative month (p<0.001). The difference between two groups was significant at sixth month check (p<0.001). At last check, patients in both groups had similar TP measurements (p=0.196).

DISCUSSION

Cubital tunnel syndrome is the second most common compression neuropathy of the upper extremity.[1] However, controversy still exists about surgical treatment of this clinical entity. Simple decompression and anterior transposition of the ulnar nerve are claimed to be the most commonly applied surgical treatment options for CuTS.[15,16] However, it is well-documented that the medial epicondyle plays an important role in pathophysiology of CuTS by causing traction and stretching of the nerve.[4,10,17] Satisfactory clinical results have been reported in the literature for simple in situ decompression of the ulnar nerve for CuTS.[16,18,19] The main clinical problem of this technique seems to be the recurrence of the symptoms and limited improvement in Wilson-Krout scores especially in grade IIB and III patients.[20,21] Of revision surgery, the 19% in Krogue's[22] series and about 50% worsening or persistent two-point discrimination test in Song's[23] series support the relatively low effectiveness of simple in situ decompression. In our opinion, these problems occur due to continuing traction effect of medial epicondyle on ulnar nerve with in situ decompression. This is supported by the finding of failure of reduction of intraneural pressures by in situ decompression in cadaver studies.[24] Anterior transposition has also been reported to reveal significant improvement in clinical signs and symptoms. However, in some studies, this technique was reported to have less favorable results and increased risk of complications when compared with both in situ decompression and medial epicondylectomy.[18-21,25] These drawbacks of transposition techniques are related to compromised vascularity and intraneural microcirculation of the ulnar nerve.[25,26]

Medial epicondylectomy has been shown to decrease ulnar nerve strain at the elbow which is accepted as a cause of CuTS.[3,11,27] To address the tethering effect of this anatomical structure on ulnar nerve, different types of medial epicondylectomy techniques have been described with satisfactory clinical results.[2,5-7] Distal medial epicondylectomy was reported as a modification of PMe with encouraging preliminary clinical results.[2,11] In this study, we aimed to clinically compare DMe with the widely applied PMe technique described by Kaempffe and Farbach.[6]

There are studies reporting on the clinical comparison of different types of medial epicondylectomy techniques in the literature. In Amako's series,[8] minimal medial epicondylectomy and partial epicondylectomy demonstrated similar clinical results for Yasutake scores and motor conduction scores. However, they did not recommend large excision of the medial epicondyle due to valgus instability observed in their medial epicondylectomy patients. In our series, the patients operated by excision of the distal part of the medial epicondyle had better Wilson-Krout scores in all postoperative checks when compared with PMe. In PMe group, our patients had only 65% of good scores at one year check. In contrast, Schnabl et al.[31] reported approximately 68%, while Efstathopoulos[9] reported 76% excellent and good scores in their series with PMe. The rate of good and excellent WKS was 100% for DMe patients in our study. The reported rates of improvement in WKS for minimal medial epicondylectomy were between 73%-94%, which were higher than PMe and comparable with DMe.[28,29] Muerman's and De Smet[30] reported inverse relationship with preoperative neuropathy grade and chance of recovery. However, in our series, the distribution of patients in both groups was similar with regard to preoperative McGowan scores. Thus, the clinical difference we observed may be related with paresthesia, tenderness over the medial epicondyle and painful subluxation of the ulnar nerve encountered in PMe patients. The persistence of paresthesia may be due to limited effect of partial epicondylectomy on ulnar nerve strain as shown by Cirpar[11] and Mitchell.[27]

In this study, we used quantitative parameters of SWM test, grip strength and pinch strengths to objectively evaluate the difference between distal and partial ME techniques. Postoperative mean SWM scores for both techniques were in range of normal sensory function, when compared with preoperative values of 3.28 in DMe and 3.06 in PMe group. The improvement in SWM scores was statistically significant for only DMe. In contrast, against comparable postoperative mean SWM results with the non-operated side, these postoperative measurements were still in range of diminished sensory function with PMe in Schnabl's series.[31] In many studies dealing with CuTS, the SWM test was not used for clinical evaluation of treatment alternatives.[6,7,9,16,20,28] It was demonstrated that the SWM test is a valuable quantitative test for assessing sensations in different types of compression neuropathies and there is a significant relationship between sensory nerve conduction studies and this test.[32] Thus, the use of SWM test strengthens the clinical outcomes of our study and we believe that it must be used for clinical follow-up of neural recovery, not only in peripheral nerve injuries, but also in compression neuropathies of the peripheral nerves.

In order to evaluate both preoperative loss and recovery rate of motor function, we performed grip and pinch strength measurements on all patients. The improvement in GS, LP and TP measurements in DMe patients was significant at about third postoperative month. In contrast, statistically significant improvement for these measurements was encountered at about sixth postoperative month in PMe patients. This difference indicates that motor recovery can be gained earlier with DMe. However, after six months of time, both techniques seemed to produce significant improvements in motor functional recovery. The last measurements in both groups revealed that none of the patients gained 100% of the strength of the contralateral side. We think that each technique resulted in a loss in strength measurements at about the same level. These final losses of strength were compatible with reports of LP and GS loss in Heithoff et al.'s,[33] Kaempffe and Farbach[6] and Muermans and De Smet's[30] series. Thus, both techniques seemed to reveal significant improvement both in extrinsic and intrinsic motor functions. However, this improvement occurred earlier in patients operated by DMe. Final loss of strength may be related by the degree and duration of compromise of the ulnar nerve.

Medial elbow pain,[7,9,20] painful nerve subluxation,[6] elbow instability,[6,30] flexor pronator weakness and flexion contracture at the elbow[6,8-10] were reported complications of medial epicondylectomy techniques. Although we did not observe valgus instability in any of our patients, the potential of damage of anterior bundle of the medial collateral ligament complex was present for each medial epicondylectomy techniques. In DMe, the subperiosteal dissection and repair of both the periosteum and flexor pronator aponeurosis may be the preventing factor for this complication as reported by Cirpar et al.[2] Limited or minimal epicondylectomy techniques described by Amako et al.[8] and Yoon et al.[7] also seemed to be free of this complication, because the osteotomy line lies medial to insertion of the anterior bundle as advised by Baek et al.[34] The only encountered complication with DMe in our series was tenderness over the medial epicondyle. However, four patients had painful subluxation of the nerve associated with paresthesia, which necessitated additional surgical intervention in PMe group. In DMe, the protection of the height of the medial epicondyle prevents the nerve to subluxate anteriorly, which is what may cause frictional neuritis with persistence of symptoms and medial tenderness. The overall rate of complications in our series reveals that DMe is a more reliable technique when compared with PMe.

The limitations of our study are the relatively small number of patients, lack of postoperative ENMG evaluation of the patients and lack of late postoperative radiographic evaluation to identify if any osteophyte, calcification or new bone formation is present due to osteotomy or minor instability.

In conclusion, DMe offers more satisfactory subjective results in McGowan grade II to III patients. In addition, the motor functional recovery occurs earlier with DMe when compared with PMe. The DMe technique seems to have low rate of complications including medial elbow tenderness or painful nerve subluxation. However, the technique needs to be evaluated on larger numbers of patients and compared with other surgical treatment options for CuTS to reach a more precise conclusion.

Declaration of conflicting interests

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