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Microneurolysis Versus Microneurolysis and Hypothenar Fat Flap for Management of Recurrent Carpal Tunnel Syndrome: Comparative Study

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ABSTRACT

Background: Recurrent carpal tunnel syndrome represents challenge for hand surgeons, multiple techniques were described for its management varied from simple nerurolysis to microvascular free flaps. The hypothenar fat flap represents one of the common methods for treatment of such difficult situation. The purpose of this study is to compare effectiveness of simple neurolysis and early mobilization versus neurolysis combined with fat flap in management of this problem.

Patients and Methods: Twenty one patients with recurrent carpal tunnel syndrome were treated by simple neurolysis (ten patients) and neurolysis combined with hypothenar fat flap (eleven patients). Patients were followed for 50.09±19.28 months in simple neurolysis group and for 52.9±19.22 months in flap group and the outcomes of both techniques were compared.

Results: Early postoperative results showed overall improvement in both groups with no significant difference between the two techniques, at late postoperative period the cases managed by neurolysis combined with fat flap showed better results, but the differences between both groups were noted to be insignificant.

Conclusion: Both techniques are effective in the treatment of recalcitrant carpal tunnel syndrome. Flap coverage of median nerve is not mandatory in the first recurrence, and it should be reserved for cases with multiple recurrences.

INTRODUCTION

Carpal tunnel syndrome represents the most common type of entrapment neuropathy with incidence ranging from 2.7-5.8% **[1-5]**. Although surgical decompression is considered an effective method for treatment, but it may be followed by a recurrence which is varied from less than 1% up to 32% **[6-15]**. The commonest cause of recurrence of symptom is perineural scarring **[16]** which leads to nerve ischemia, mechanical constriction, and impairment of its gliding property. This scarring is difficult to be treated as its excision and neurolysis is followed by more scarring **[17]**. Efforts were spent to prevent this scarring including wrapping the nerve with vein graft **[18,19]**, local and even sophisticated free flaps **[20-22]**. Among these options the hypothenar fat flap (HTFPF) was considered to be simple solution for recurrent cases **[23]**.

On the otherhand, some studies have shown that neurolysis alone with early mobilization can restore normal gliding of the nerve and prevents adhesions around it, and there is no need to complicate the procedure by flap coverage **[6,24]**.

Up to our knowledge, there is no study compared the effectiveness of neurolysis with early mobilization as against neurolysis combined with the hypothenar fat flap in the treatment of recurrent carpal tunnel syndrome. In this study we are comparing the outcome of both techniques.

PATIENTS AND METHODS

This prospective study was conducted in the Department of Plastic Surgery, Zagazig University from June 2002 through August 2008 after it has been proved by the University Review Committee.

Twenty one patients with recurrent carpal tunnel syndrome were included in this study. Patients were randomly divided into two groups. (A) group: Patients who had odd numbers were submitted to neurolysis combined with fat flaps (eleven patients with fifteen flaps) and (B) group: Patients with even numbers underwent neurolysis only (ten patients with five bilateral cases). According to Raimbeau all patients in this study had three months or more of symptoms free period after the first surgery to be defined as a recurrent case **[25]**. Cases with persistent symptoms after initial surgery without a symptom free period, those with new symptoms that were not present before the first surgery (painful hypertrophic scar, pain and para-

esthesia at territory of palmer cutaneous branch, and pisotriquetral syndrome [26]), as well as cases with incomplete release of flexor retinaculum and those with nerve injury that discovered at exploration were excluded from this study. Diagnosis was confirmed by nerve conduction velocity studies (NCV) in all cases. Table (1) shows demographic data of these patients.

Table (1): Demographic data of patients.

	Group A				
	Age (years)	Intervals between surgeries (month)	Follow-up (month)	Sex	Laterality
Maximum	57	80	75	3♂	7 unilateral
Minimum	39	18	25	8♀	4 bilateral
Mean	46.09±6.57	53.7 ±19.50	50.09± 19.28		
	Group B				
	Age (years)	Intervals between surgeries (month)	Follow-up (month)	Sex	Laterality
Maximum	57	76	75	4♂	5 unilateral
Minimum	33	19	24	7♀	5 bilateral
Mean	47.2±7.4	53±18.71	52.9±19.22		

All patients did not respond to the initial trial of non-operative treatment before re-exploration.

Informed consent was taken from the patient after thorough explanation of the whole procedure and possible complications.

Surgical techniques: All surgeries were done by the same surgeon and under magnification using 5.5X Keeler loupe. Skin incision was designed to include the previous scar from wrist crease proximally and to the proximal palmar flexion crease distally for both groups. For flaps group, incision was extended proximally so as to make triangular flap with its apex directed to the ulnar side. A stepwise neurolysis of the median nerve was performed from surrounding scarring down to normal fascicular architecture. Procedure followed was according to as described by Mazal (i.e. external neurolysis alone until healthy fascicle appears, if healthy fascicle not seen, then surgeon proceeded to epifascicular epineuriotomy, if still fails to expose healthy fascicles, then epifascicular epineuriectomy or interfascicular epineuriectomy was considered) [27]. This neurolysis was extended proximally till virgin untouched tissue and antibrachial fascia was released, distally neurolysis extended as far as taking off median nerve branches.

For group (B), careful hemostasis was observed and wound was closed without drain, and wrist was not splinted.

For group (A), fat flap was harvested using technique described by Giunta, so dissection of flaps was continued through the subcutaneous fatty tissue immediately below the skin directed to ulnar side till the fascia of the abductor digiti minimi, at this point the under surface of the flap, including the Palmaris brevis muscle, is dissected in a radial direction as far as Guyon's canal. Care was taken to prevent the damage of the palmar branch of the ulnar nerve and the palmar digital nerves, which pass through the fat, also the fine end branches of the ulnar artery over Guyon's canal were preserved to ensure the blood supply of the flap.

After that this 3x4cm flap was stitched with absorbable sutures to the radial wall of the carpal tunnel over the median nerve [28]. Wound was closed with drain in situ and wrist splint was applied for one week in neutral position.

Patients in both groups were asked to move their fingers from the first post operative day to full range of movement. Physiotherapy of wrist joint started after two weeks Figs. (1-4).

Follow-up was done for all patients at regular intervals: (Every two months) for the first two years, then every six months thereafter. Evaluation of patients was done both subjectively and objectively.

Boston carpal tunnel questionnaire (BCTQ) was used for subjective assessment of symptomatic and functional status of the hand; symptoms severity score "(sss)" section is composed of eleven questions to assess the severity of symptoms like

pain and numbness, a score from one (no symptom) to five (sever symptom) is chosen. The functional status score "(FSS)" section is used to assess the functional status through choosing the appropriate answer that best described the ability of the hand to do every item of selected eight hand functions, again a score is ranged from one (no difficulty) to five (sever difficulty) **[29,30]**.

Objective evaluations of different components of sensibility were tested.

Semmes-Weinstein monofilament (SWMFs) for light touch (normal sensation if handle marking of monofilament is 2.83; diminished sensation if the marking is 3.61; diminished but protective sensation if the marking is 4.31 and loss of protective sensation if the marking is 4.56) **[31]**.

Disk-Criminator was used for two point's discrimination (2PD) (<5mm means normal; 6-10mm means fair; 11-15mm poor; one point means protective sensation; no point means anesthetic) **[32]**.

Both tests were performed for radial side of thumb, and middle fingers, the mean readings were taken. All tests were carried out preoperatively to determine basal values. Results were analyzed using SPSS for windows. Paired *t*-test was used to compare numeric data and chi-square for ordinal data (SWMFs), the significant level was set at 0.01.

Fig. (1): Subcutaneous dissection.

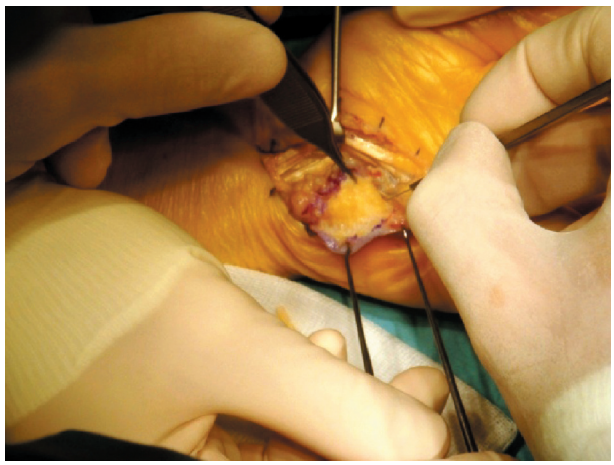

Fig. (2): Flap elevation.

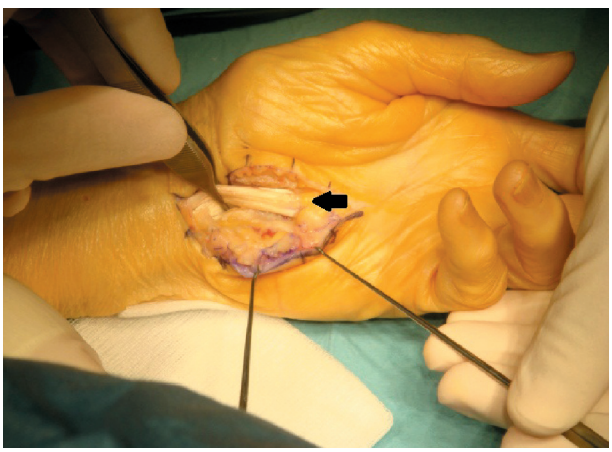

Fig. (3): Adhesolysis of median nerve.

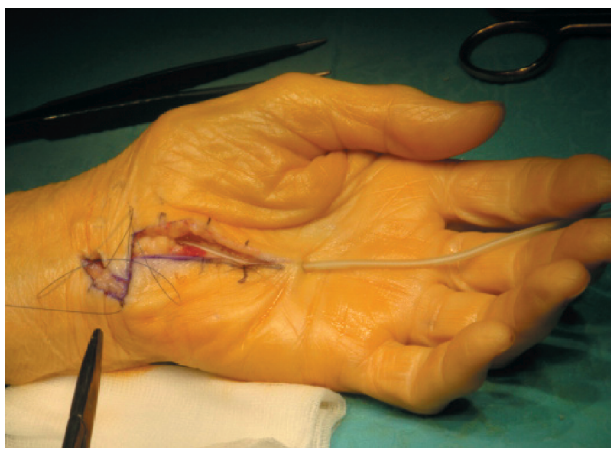

Fig. (4): Closure over drain.

RESULTS

All our patients recovered well with minimal postoperative complications; one patient in group A had delayed wound healing followed by hypertrophic scar (7%).

In both group it was observed that there was an overall significant improvement in clinical tests and relief of symptoms, this improvement was noted to be progressive until it reached the optimum at eight months-postoperatively (early post operative results).

In flap group (A) symptoms such as pain, tingling, weakness and sensitivity of the hand improved. Inference observed by change of mean value of symptoms severity score (SSS) from 3.35±

0.44 preoperatively to 1.30±0.24 post operatively, paired *t*-test revealed that change was statistically significant ($p<0.001$).

Functional status score (FSS) also revealed same improvement from 3.52±0.42 preoperatively to 1.32±0.28 postoperatively, and *p*-value was less than 0.001.

The mean preoperative 2PD was 8.9±2.58mm which dropped to 5.1±0.83mm after surgery. This change was statistically significant ($p<0.001$).

Chi square analysis of pre- and postoperative values of Semmes-Weinstein monofilament test also showed statistically significant improvement ($X^2 = 9.5$, $p<0.008$) (Table 2 & Diagram 1).

Tinel sign was presented in all patients preoperatively as well as Phalan sign. Tinel sign disappeared after surgery in all except two hands (14%) who had a long history of complaints and worst preoperative tests readings. But all cases were negative for Phalan sign.

Preoperative nerve conduction study was impaired in all patients; the mean median nerve distal motor latency (DML) was 6.5±1.8 milliseconds. Postoperatively Nerve conduction returned to normal values in eleven hands 78.5%, while the mean postoperative DML was 4.7±0.91.

Patients in group B had a significant improvement approximately equal to that of group A; BCTQ-sss, BCTQ-fss and 2PD changed from 3.39±0.42, 3.5±0.42 and 9.33±2.43mm preoperative to 1.36±0.23, 1.35±0.26 and 5.33±0.81mm postoperative respectively, a gain paired *t*-test revealed that this changes were statistically significant.

Chi square analysis reveals significant improvement in SWMFs test postoperatively (Table 3 & Diagram 2). Nerve conduction velocity improved in 64.2% of cases after surgery, the mean DML was changed from 6.72±0.74 preoperatively to 4.85±0.98. Tinel sign was positive in three wrists postoperatively, but Phalen sign was negative in all patients.

When postoperative results of both groups were compared, it was observed that there was no statistical difference (Table 4). Regarding late postoperative period one case (7%) in B group complained from the recurrence of symptoms after nineteen months following surgery. These symptoms progressively got worse over the period of six months in spite of immobilization (BCTQ-sss=2.9, BCTQ-fss=3). The patient was forty seven years old with no relevant co-morbidity. After this trial of conservative treatment, it was decided to explore. Upon exploration it was noted that there was marked fibrosis, this case was managed by the same method as of A group, after that the patient had uneventful recovery.

Except for this case in all other cases it was observed that there was no significant differences between the two groups at late postoperative period (two years postoperatively) (Table 5).

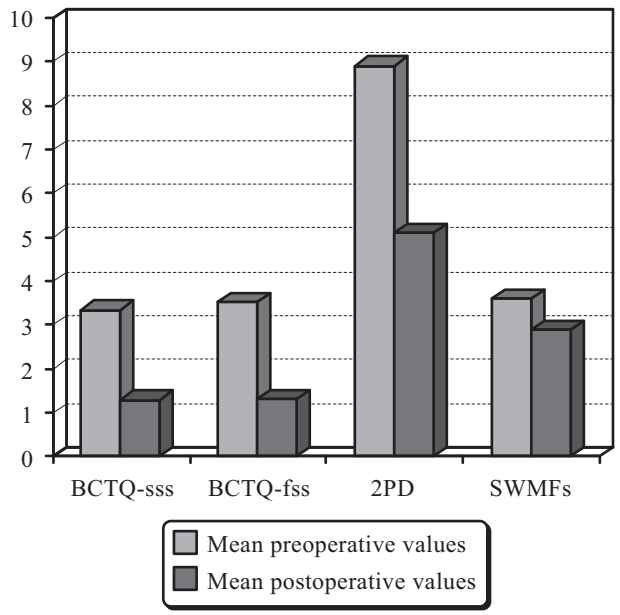

Diagram (1): Difference between pre and early postoperative in group A.

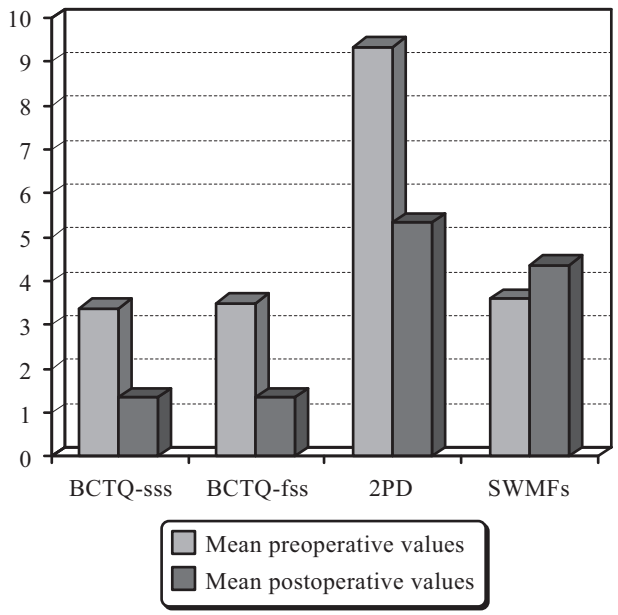

Diagram (2): Difference between pre and early postoperative in group B.

Table (2): Pre and early (eight months) postoperative values in group A.

	BCTQ-sss	BCTQ-fss	2PD	SWMFs
Mean preoperative values	3.35±0.44	3.52±0.42	8.9±2.58mm	3.6479
Mean postoperative values	1.30±0.24	1.32±0.28	5.1±0.83mm	2.9964
Paired *t*-test (99% Confidenc Interval of the Difference)	$p<0.01$	$p<0.01$	$p<0.01$	$X^2 = 9.5$, $p<0.008$

Table (3): Pre and early (eight months) postoperative values in group B.

	BCTQ-sss	BCTQ-fss	2PD	SWMFs
Mean preoperative values	3.39±0.42	3.5±0.42	9.33±2.43mm	3.59
Mean postoperative values	1.36±0.23	1.35±0.26	5.33±0.81mm	4.37
Paired *t*-test (99% Confidenc Interval of the Difference)	$p<0.01$	$p<0.01$	$p<0.01$	$X^2 = 14.6$, $p<0.002$

Table (4): Early (eight months) postoperative results of A and B group.

	BCTQ-sss	BCTQ-fss	2PD
Mean postoperative results in A group	1.30±0.24	1.32±0.28	5.1±0.83mm
Mean postoperative results in B group	1.36±0.23	1.35±0.26	5.33±0.81mm
Paired *t*-test (99% Confidence Interval of the Difference)	$p>0.01$	$p>0.01$	$p>0.01$

Table (5): Late postoperative results (twenty four months).

	BCTQ-sss	BCTQ-fss	2PD
Mean postoperative results in A group	1.30±0.25	1.32±0.28	5.13±0.83
Mean postoperative results in B group	1.38±0.25	1.40±0.28	5.53±0.74
Paired *t*-test (99% Confidence Interval of the Difference)	$p>0.01$	$p>0.01$	$p>0.01$

DISCUSSION

Recurrent carpal tunnel syndrome represents a great challenge to hand surgeons **[34-40]**. Many studies had concluded that simple scar excision and neurolysis is insufficient to prevent recurrence and maintain sufficient excursion of the nerve, **[10,16,41-43]** and the key to prevent the recurrence is to interpose a well vascularzied tissue around the nerve to prevent further adhesion **[19-21]**.

Many techniques were described to provide this tissue interposition includes: Synovial flap **[44,45]**, abductor digiti minimi flap **[46]**, pronator quadratus muscle flap **[47]**, palmaris brevis muscle flap **[20]**, reverse radial artery fascial flap **[48]** or even free flap **[49]**.

In 1985 Cramer descried the usage of the hypothenar fat flap to provide this vascularized tissue **[50]**. His technique was refined by Strickland et al. **[16]** and eventually by Mathoulin and associates **[23]**.

Other studies concluded that complete carful neurolysis with early mobilization is sufficient to prevent recurrence and maintain normal nerve excursion **[6,24,51]**.

Pizzillo stated that the vascularized flap should only be considered in case of failure of neurolysis

to resolve the condition or if there is residual symptom, and it should not be the first choice **[52]**.

This study includes twenty one patients with Recalcitrant Carpal tunnel Syndrome; all patients fulfilling Strickland criteria of recurrence **[16]**.

In order to evaluate the efficiency of the tested techniques for prevention of fibrosis and recurrence, we had excluded two groups; those with incomplete release of the retinaculum, because in this group the symptoms might not have appeared if the first surgery were to have been done correctly. However the incidence of this group may reach 54% in one study **[53]**.

Other excluded patients were those with iatrogenic nerve injury in the first surgery as the prognosis is poor in such group whatever the techniques used **[26]**.

In all patients we started the procedures with neurolysis which was done in step wise manner; while Rydevik in his experimental work noticed that internal neurolysis leads to excessive scar formation due to nerve ischemia that developed after disruption of blood-nerve barrier **[54]**.

Mazal state that if internal neurolysis is done by skilful microsurgeon it will be beneficial rather than hazardous **[27]**.

Scopel studied different methods for drainage of intraneural hematomas and found that there was neither functional nor histomorpholometric difference between epineurotomy and interfascicular neurolysis **[55]**.

From our finding we believe that both techniques are safe if has been done by expert surgeon.

Only one wound (7%) had a healing problem in flap group. This low morbidity of hypothenar fat flap as painful scar, donor site presthesia or pigmentation and postoperative edema was observed in other series **[28,56,57,58]**.

Although it was stated that the results of the second surgery for carpal tunnel syndrome are unsatisfactory with up to 95% residual symptoms and 40% poor results, **[59,60]** our study had revealed better results in both groups.

The success rate in flap group was approximately as same as to other series: Fusetti et al., report disappearance of pain and paresthesia in 85% in their patients while 95% of them were satisfied by operation **[61]**.

Craft and associate report improvement in pain of 93%, numbness completely disappeared in 42% of patients, average subjective improvement in numbness was 82.9% **[62]**.

In their study Mathoulin and others had reported that pain disappeared in 89% of cases. While in 4% there was mild tingling **[23]**.

Neurolysis group also had approximate success rate to previous group and comparable to the study of Duclos who had achieved complete disappearance of pain in 75% of his patient and partial improvement in 17% **[51]**.

During early postoperative period there was no significant difference between two techniques either in relief of the symptoms or the results of diagnostic tests. Although there was difference at late postoperative period as in 7% of cases in B group (one case) the symptoms recurred, but the difference is not statistically significant and does not justify to shifting patient from simple procedure to more complex one.

Conclusion:

The results of our study concluded that both neurolysis alone and neurolysis combined with the hypothenar fat flap had similar success rate. The flap application after neurolysis is not mandatory in the first instance, however due to small sample size our preliminary results should be supported by other studies with more patients.

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