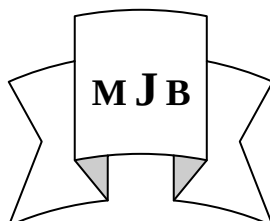


Clinical Comparative Study of Open Surgical Treatments of Carpal Tunnel Syndrome: Mini Open versus Classical Open Incision

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Abstract

Background: Carpal tunnel syndrome is the commonest and the most important entrapment neuropathy that affects median nerve at wrist region more commonly in middle age females, resulting in certain sensory and/or motor dysfunction of median nerve.

Patients and methods: 40 patients with a carpal tunnel syndrome were individually randomized into the trial (mini-open incision CTR) (n=20) and control group (classical technique CTR) (n=20). We followed up the patients of 2 groups for period of 6 months, observation has been done at third week , third month and 6month postoperatively, the patients were asked about symptomatic pain relief and functional status of the hand (including pinch and grip functional activities) and scored according to Boston Carpal Tunnel Questionnaire (BCTQ) score , and examined for palmar tenderness, esthetic outcome of scar and operation time were measure

Results:

- 1) The mean symptom severity scores of BCTQ in both group decreased (improved) significantly within 3 weeks postoperatively.
- 2) The mean functional status scores of BCTQ is decrease earlier (in third month postoperatively) in the trial group where the difference is significant , where as at sixth month the difference in mean of 2 group become not significant statistically.
- 3) The operation time is shorter in trial group.
- 4) The esthetic outcome and pillar tenderness is significantly better in trial group.

Conclusion

- 1) mini-open technique is associated with significant minimal scar tenderness, esthetic outcome, significant improvements in overall hand function and shorter in operation time than classical technique.
- 2) The symptoms (pain, numbness and parasthesia) in both mini-open technique and classical technique will relief early and significantly within 3weeks postoperatively.
- 3) The mini-open carpal tunnel release via a small palmar incision is a relatively simple and effective procedure

Keyword

CTS, mini-open CTR technique, classical CTR technique, Boston Carpal Tunnel Questionnaire (BCTQ) score

دراسه سريرييه مقارنه في الجراحه المفتوحه لمعالجه متلازمه النفق الرسغ (بين عمليه الشق الجراحي المصغر والشق الجراحي النمطي)

الخلاصة

الخلفية: تعتبر متلازمة النفق الرسغي النمط الأكثر شيوعا والأهم من أنماط انضغاط الأعصاب المحيطة عند الإنسان والتي تصيب العصب الوسطي في منطقة الرسغ ، في النساء المتوسطات الأعمار عادة، وينتج عنها اضطرابات محددة في الوظائف الحسية والحركية للعصب الوسطي.

المرضى والطريقة: دراسة مقارنة شملت ٤٠ مريضاً لمتلازمة النفق الرسغي تم تقسيمهم إلى مجموعتين، مجموعة الاختبار وتشمل ٢٠ مريضاً أجريت لهم عملية الشق الجراحي المصغر ومجموعة القياس وتشمل ٢٠ مريضاً أجريت لهم عملية الشق الجراحي النمطي. تمت متابعة المرضى المجموعتين لمدة ستة أشهر وتمت معاينة المرضى عند الأسبوع الثالث والشهر الثالث والشهر السادس بعد العملية. تمت معاينة المرضى من خلال اختفاء أعراض الألم ورجوع وظيفة اليد للفعاليات الحياتية وتمت تسجيل النقاط حسب مقياس بوستن الاستثنائي لمتلازمة النفق الرسغي (Boston Carpal Tunnel Questionnaire (BCTQ) score). وتمت معاينة الوقت الذي استغرقته العملية في كلا المجموعتين ومعاينة اثر الندبة الناتجة عن العملية.

النتائج:

- (١) معدل قياس شدة الأعراض حسب مقياس بوستن انخفض في كلا المجموعتين خلال ثلاثة أسابيع بعد العملية.
- (٢) معدل قياس وظيفة اليد حسب مقياس بوستن انخفض أكثر وفي وقت أبكر في المجموعة الاختبارية عند الشهر الثالث.
- (٣) معدل وقت العملية اقصر بمعدل ١.٦ في المجموعة الاختبارية.
- (٤) الندبة الناتجة عن الشق الجراحي وحساسية ألم الجرح أفضل في المجموعة الاختبارية، % ٧.٥ في المجموعة الاختبارية و % 22.5 في المجموعة القياسية.

الاستنتاج:

- (١) طريقة الشق الجراحي المصغر ينتج عنها ندبة اصغر حجماً وأقل حساسية للألم مع تحسن هام في وظائف اليد العامة بالإضافة إلى قصر الوقت لأجراء العملية.
- (٢) الأعراض (الألم، الخدر، الإحساس الغريب) في كلا المجموعتين تتحسن بصورة هامة خلال ثلاثة أسابيع بعد العملية.
- (٣) تحرير العصب بطريقة الشق الجراحي المصغر إجراء سهل وفعال .

Introduction

Carpal tunnel syndrome (CTS) is one of the most common upper limb compression neuropathies [1]. CTS account for approximately 90% of all entrapment neuropathies. Sir James Paget described it in 1854 (tardy median palsy). The lesion has been well established as a clinical entity during the past by the article of Phalen in the 1950s [2].

It is due to an entrapment of the median nerve in the carpal tunnel at the wrist.

The incidence and prevalence

Varies, 0.125% - 1% and 5 -16%, depending upon the criteria used for the diagnosis[3]. It is a condition of middle-aged individuals and affects females more often than males. Several studies have reported marked female preponderance and a peak incidence around 55 to 60 years [3]. The mean age at diagnosis was 50 years for men and 51 years for women [4]. It is one of the most widely recognized occupational health conditions;

particularly in industries where work involves high force/pressure and the repetitive use of vibrating tools.

Pathophysiology

The exact pathogenesis of CTS is not clear. Several theories have been put forward to explain the symptoms and impaired nerve conduction studies. The most popular ones are

- 1) Mechanical compression
symptoms of CTS are due to compression of the median nerve in the carpal tunnel. The major drawback of this theory is that it explains the consequences of compression of the nerve but does not explain the underlying etiology of mechanical compression. Brain and colleagues attributed the symptoms of CTS to spontaneous median nerve compression in the carpal tunnel. The term 'spontaneous' was used due to lack of clear association between wrist joint deformities and symptoms. The compression was believed to be mediated by several factors such as exertion strain, overuse, hyperfunction,

repeated or prolonged wrist extension, prolonged grasping of tools, and unaccustomed manual work[5].

2) Micro-vascular insufficiency, proposes that the lack of blood supply leads to depletion of nutrients and oxygen to the nerve causing it to slowly lose its ability to transmit nerve impulses. Scar and fibrous tissue eventually develop within the nerve. Depending on the severity of injury, changes in the nerve and muscles may be permanent. The characteristic symptoms of CTS, particularly tingling, numbness and acute pain, along with acute and reversible loss nerve conduction are thought to be secondary to ischemia of the affected nerve segment

Seiler *et al* showed (by laser Doppler flowmetry) how normal pulsatile blood flow within the median nerve was restored within 1 min of transverse carpal ligament release. The authors concluded that ischemia likely plays a significant role in the etiology of CTS [6].

Kiernan *et al* found that the conduction slowing in the median nerve can be explained by ischemic compression alone and may not always be attributable to disturbed myelination[7].

3) Vibration theories.

the symptoms of CTS could be due to the effects of long-term use of vibrating tools on the median nerve in the carpal tunnel. Lundborg *et al* noted epineural oedema in the median nerve within days following exposure to

vibrating hand-held tools. Furthermore, the authors also noted similar change following mechanical, ischemic, and chemical trauma. Interestingly, the authors also report animal studies that show a temporary accumulation of smooth axoplasmic structures and deranged axoplasmic structures following a short exposure to a vibrating force [8].

Small palmar incision — Open carpal tunnel release can be performed through a small palmar (or "limited") incision [9] (**fig.1**). This permits better exposure to avoid complications and keeps the incision out of the painful portion of the palm .

Carpal tunnel release through a small palmar incision uses a longitudinal palmar incision that starts just proximal to Kaplan's cardinal line and moves proximally for 1.5 to 2 cm. This allows visualization of the transverse carpal ligament; the more proximal portion of the ligament can be identified by elevating the tissue proximally above and below it. Then, under direct vision, the ligament can be incised or cut with a tenatome knife (no.15 scalpel).

The improved exposure with this technique decreases the risk of injury to vital structures and avoids a longer scar at the base of the palm that increases morbidity. Furthermore, the palmar fascia is left intact over the proximal portion of the transverse carpal ligament, reducing postoperative incision pain [9]

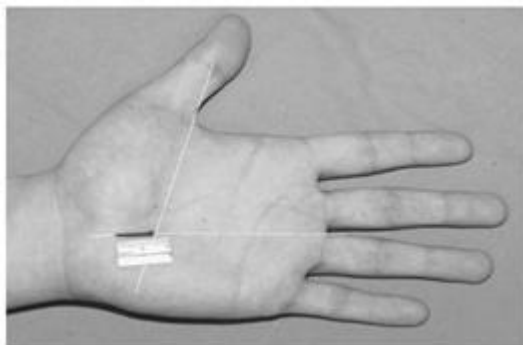


Fig 1 incision for limited mini-open carpal tunnel release

Patients and Methods

This study included 40 patients (40 hands) presented to the orthopedic department at specialized surgical teaching hospital in Baghdad city and Al-Sadar teaching hospital in Al-najaf city during the period extending from November 2008, to October 2010.

The criteria used to include the patients in the study were:

- 1) Female.
- 2) Housewives.
- 3) Dominant hand.
- 4) Age between 30 and 40 years.
- 5) Unilateral involvement.
- 6) Idiopathic causes only.
- 7) Positive electrodiagnostic study findings with moderate degree.

There were 36 right hand dominant patients, and 4 left hand dominant patients. The duration of patients symptoms ranged from 6 months to 18 months (mean, 12 months).

The diagnosis of CTS was based on a history of hand numbness and physical examination with the Phalen flexion test and Tinel sign. To confirm the diagnosis, nerve conduction studies were performed in all patients, and only patients with positive electrodiagnostic study findings with moderate degree were included in the study.

Cervical spine x-ray has been done to all patient complaining from these

symptoms. The patients with positive x-ray finding were excluded from study. Laboratory investigations include: complete blood picture, ESR, blood chemistry and virology screening tests for HIV, HBV, HCV have been done.

Exclusion criteria were patients :

- 1) structural abnormalities.
- 2) previous carpal tunnel release.
- 3) associated conditions .
- 4) postoperative complicated cases.
- 5) sever thener wasting.
- 6) Moderate to sever cervical vertebral spondylosis.

The period of follow-up of patients was 6 months .

The patients divided into 2 groups; the trial (mini-open technique CTR) (n=20) and control group (traditional technique CTR) (n=20). Postoperative follow-up assessments were performed at 3rd week, 3rd month and 6th month after the procedure in all patients.

The evaluations consisted of determination of symptom relief and functional status of the hand depending on Boston Carpal Tunnel Questionnaire (BCTQ) score(**fig 3**) and assessments of subjective complaints of scar hypersensitivity(esthetic outcomes grades [10] (**table 2**), pillar tenderness and operative time.

Table 1 data of 40 patient with idiopathic CTS

Data	Total No.
Patients	40
Hands	40
Female	40
Male	None
Dominant right hand affected	36
Dominant left hand affected	4
The mean duration of symptoms	12 months
The mean duration of follow up	6 months

Table 2 grades for assessment of esthetic outcomes

Grade	Result
1	Unsatisfactory
2	Fair
3	Good
4	Very good
5	Excellent

ANNEX 1

SELF-EVALUATION PROTOCOL – BOSTON PROTOCOL

Name: sex
 age Hand: () Right () Left
 Evaluation Date: Surgery Date:

THE FOLLOWING QUESTIONS REFER TO YOUR SYMPTOMS WITHIN A TYPICAL PERIOD OF 24 HOURS, DURING THE LAST TWO WEEKS.
 (Choose one answer in each question)

1) How strong is the pain on your hand or wrist at night?
 1- I feel no pain on hand or wrist at night.
 2- little pain
 3- moderate pain
 4- intense pain
 5- severe pain

2) How many times did your hand or wrist pain wake you up in a typical night for the last two weeks?
 1- never
 2- once
 3- twice or three times
 4- four to five times
 5- more than five times

3) Do you usually feel hand or wrist pain during the day?
 1- I never feel pain during the day
 2- I feel little pain during the day
 3- I feel moderate pain during the day
 4- I feel intense pain during the day
 5- I feel severe pain during the day

4) How often do you feel hand or wrist pain during the day?
 1- never
 2- once or twice a day
 3- three to five times a day
 4- more than five times a day
 5- constant pain

5) In average, how long do daytime pain episodes last?
 1- I never feel pain during the day
 2- less than 10 minutes
 3- from 10 to 60 minutes
 4- more than 60 minutes
 5- I feel constant pain during the day

6) Do you feel your hand dormant (lost sensitiveness)?
 1- no
 2- I feel little dormancy
 3- I feel moderate dormancy
 4- I feel intense dormancy
 5- I feel severe dormancy

7) Do you feel weakness on your hand or wrist?
 1- no weakness
 2- little weakness
 3- moderate weakness
 4- intense weakness
 5- severe weakness

8) Do you feel a tingling sensation on your hand?
 1- no tingling sensation
 2- little tingling sensation
 3- moderate tingling sensation
 4- intense tingling sensation
 5- severe tingling sensation

9) How strong is dormancy (lost sensitivity) or tingling sensation at night?
 1- I never feel dormancy or tingling sensation at night
 2- little
 3- moderate
 4- intense
 5- severe

10) How often did dormancy or tingling sensation wake you up during a typical night for the last two weeks?
 1- never
 2- once
 3- twice to three times
 4- four to five times
 5- more than five times

11) How difficult do you feel in taking and using small objects, such as keys or pens?
 1- not difficult
 2- a little difficult
 3- moderately difficult
 4- very difficult
 5- severely difficult

IN A TYPICAL DAY FOR THE LAST TWO WEEKS, HAVE YOUR HAND OR WRIST SYMPTOMS BROUGHT ANY DIFFICULTY IN PERFORMING THE ACTIVITIES LISTED BELOW?
 Please, circle the number that best describes your ability to perform the activity.

ACTIVITY	DEGREE OF DIFFICULTY				
Writing	1	2	3	4	5
Buttoning clothes	1	2	3	4	5
Holding a book while reading	1	2	3	4	5
Holding the telephone hang	1	2	3	4	5
Housekeeping	1	2	3	4	5
Opening a glass vial cap	1	2	3	4	5
Carrying market bags	1	2	3	4	5
Bathing and dressing	1	2	3	4	5

No difficulty 1
 Little difficulty 2
 Moderate difficulty 3
 Intense difficulty 4
 Cannot perform the activity at all due to hands and wrists symptoms 5

Investigator's opinion:

Fig 3 Boston Carpal Tunnel Questionnaire (BCTQ) score

Operative technique of mini-opening

All operations were performed using an upper-arm tourniquet and beir's block anesthesia . The 1.5- to 2 cm incision (**fig 4**) was placed at the proximal palm along the "life line", beginning distally at the intersection of Kaplan's cardinal line drawn with the thumb radially abducted and a line drawn along the radial border of the ring finger metacarpal (**Fig. 5**).

After the skin incision(**fig 6**), the subcutaneous tissue was dissected with curved mosquito forceps (**fig.7**) and self retaining retractor was positioned to separate the edges of the incision (**fig 8**).

The palmar fascia was divided, and the transverse carpal ligament was identified. A no. 15 scalpel was used to incise the carpal ligament. The incision was started at the distal end of the ligament for identification of possible vulnerable key structures, including the recurrent motor branch of median nerve.

After making a small window, the transverse carpal ligament was divided proximally while protecting the nerve using a freer retractor located beneath

the ligament. After division of the distal ligament, proximal ligament division was easier, using retractor; a subcutaneous tunnel was formed that guided the division, under direct observation, up to and including the distal forearm fascia.

Confirmation of the complete division was performed by direct observation and hyperextend the wrist to become the median nerve more anterior and probing of the proximal and distal aspects of the carpal ligament(**fig9**). Then the tourniquet was released and meticulous hemostasis was performed. The wound was closed with interrupted or continuous 3-0 nylon sutures(**fig 10**).

Betadine was then applied to the wound, followed by a soft bulky dressing and a light compressive bandage.

Postoperative splints were not used and the patients were encouraged to use their hands normally. Heavy activities were avoided for the first 3 weeks. The original dressing was removed after 2 days, and the stitches were removed 14 days after surgery.

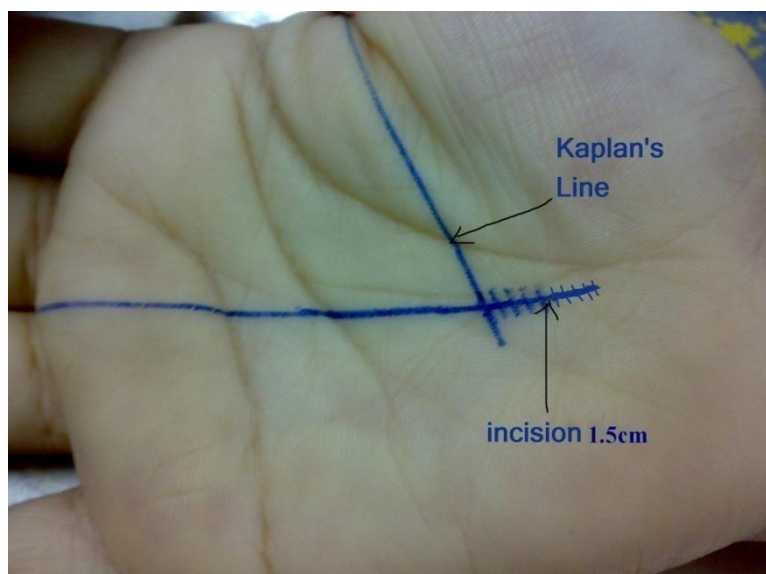


fig 5 line of incision

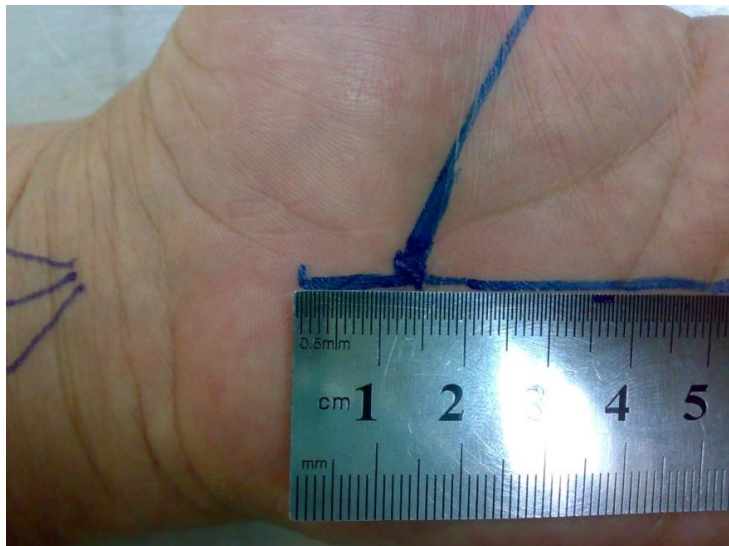


Fig 4 length of incision



Fig 6 the incision



Fig 7 dissected with curved mosquito forceps



Fig 8 application of self retaining retractor

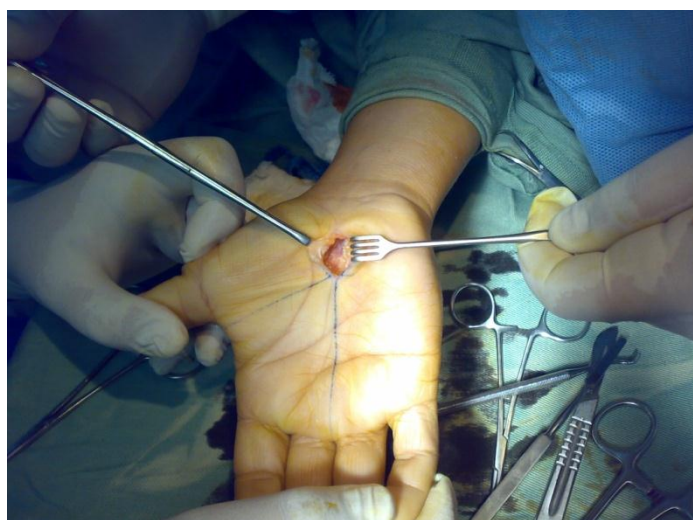


Fig 9 median nerve after cutting transverse carpal ligament and hyperextend wrist

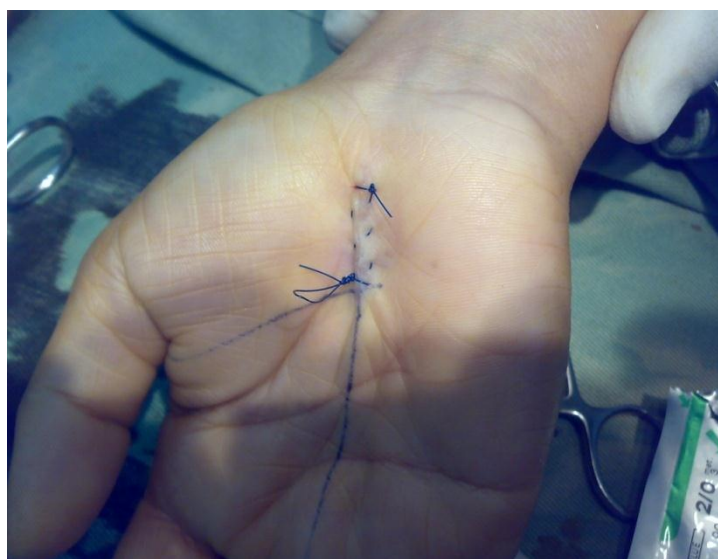


Fig 10 suturing of skin

Results

In this intervention clinical therapeutic trial study, patient were divided into 2 groups according to operative technique has been done.

1) Trial group: 20 patients with mini-opening technique, 19 dominant right hands and one dominant left handed with unilateral involvement, females, and housewives.

2) Control group: 20 patients with classical technique, 17 patients with right dominant hand and 3 left dominant hands, all with unilateral involvement, females and housewives.

All patients were assessed at 3rd weeks, 3rd month and 6th month postoperatively .A physical examination was done.

Patients' satisfaction and adjustment to daily activities were recorded, based on the Boston Questionnaire. Scores of symptom severity and functional status were obtained both pre- and postoperatively, and were analyzed statistically (**table 3 and 4**). We compared the results of 2 groups statistically using t-test , we take the mean of the collecting data of scores of each patient for both group and take the SD of each group and then by using t-test ,the p value appear to know if the difference in the scores of patient of 2 groups is significant or no.

We used t-test because the number of patients of each group is less than 30.

In the trial group The mean symptom severity score decreased (improved) from 36.8 (SD 3.29) to 13.2(SD 1.39) within 3weeks post-operation and the mean Functional Status score

decreased (improved) from 26.9(SD2.78) to 12.2 (SD1.31) on the third month postoperatively.

There is mild increased in the mean functional score within 3weeks post-operation from 26.9(SD2.78) to 27.2(SD3.91).

In the control group The mean symptom severity score decreased (improved) from 37.3 (SD 4.99) to 14.7(SD 1.88) within 3weeks post-operation and the mean Functional Status score decreased (improved) from 26.5(SD 4.06) to 14.6(SD2.67) on the third month postoperatively.

There is mild increased in the mean functional score within 3weeks post-operation from 26.5(SD 4.06) to 27.9(SD 4.99).

we found there is no significant difference between 2 groups in scores of symptoms severity in all post operative periods of follow up ,also there is no significant difference between 2 groups in scores of functional status within 3week and at sixth months post-operation follow up time .

The only significant difference between 2 groups has been noted in the scores of functional status at third months (p value ≤ 0.05),where the mean Functional Status score decreased (improved) from 26.9(SD2.78) to 12.2 (SD1.31) for the trial group (mini open technique) and the mean Functional Status score decreased (improved) from 26.5(SD 4.06) to 14.6(SD2.67) for control group (classical technique) on the third month postoperatively.

Table 3 result of Boston Questionnaire scores of symptom severity

Period	Mean of trial group	Mean of control group	t-test	P value	significance
Within 2weeks preoperative	36.8 SD(3.29)	37.3 SD(4.99)	-----	-----	-----
3weeks post.op.	13.2 SD(1.39)	14.7 SD(1.88)	2.045	> 0.5	Not significant
3months post.op.	11.6 SD(0.51)	11.8 SD(0.63)	0.769	> 0.1	Not significant
6months post.op.	11.3 SD(0.48)	11.1 SD(0.31)	1.087	> 0.1	Not significant

Table 4 result of Boston Questionnaire scores functional status

Period	Mean of trial group	Mean of control group	t-test	P value	significance
Within 2weeks preoperative	26.9 SD(2.78)	26.5 SD(4.06)	-----	-----	-----
3weeks post.op.	27.2 SD(3.91)	27.9 SD(4.99)	0.348	> 0.5	Not significant
3months post.op.	12.2 SD(1.31)	14.6 SD(2.67)	2.553	≤ 0.05	significant
6months post.op.	10.8 SD(1.4)	10.2 SD(1.23)	1.034	> 0.1	Not significant

Postoperative scars in the patients operated by traditional open technique for carpal tunnel release were significantly longer (about 5 cm) than the scars in the patients operated mini open incision technique (about 1.5 cm). Thus, esthetic outcomes at third month were better in the group operated by mini open incision technique than in traditional technique group where the mean of esthetic outcome grades in trial group was 5 and in the control group was 4 and the p value of 2 groups was 0.036 so there is significant difference (**Table 5**)(**fig 3 and 4**).

Three (15%) patients in the trial group and 9(45%) patients in the control group complained of scar or pillar tenderness (there is significant difference, p 0.006) at third month of follow up, however the tenderness disappeared at 6 month of follow up in both groups.

The mean Operation time was 9.5 min.(SD 1.1) in trial group and 11.1min.(SD 1.2) in control group, so it on average 1.6 min shorter in the trial group (there is significant difference, p 0.001) (**Table 6**).



Fig 12 At 3rd month postoperative scar in mini open technique



Fig 13 At 3rd month postoperative scar in classical technique

Table 5 cosmetic results

<i>At third month follow up</i>	<i>Mini-open</i>	<i>P value</i>	<i>classical</i>
esthetic outcome /1-5	5 (3-5)	0.036	4 (2-5)
Tenderness	3/20 (15%)	0.006	9/20 (45%)

Table 6 operation time results

	<i>Mini-open</i>	<i>P value</i>	<i>classical</i>
Operation time (min)	9.5 ± 1.1	0.001	11.1 ± 1.2

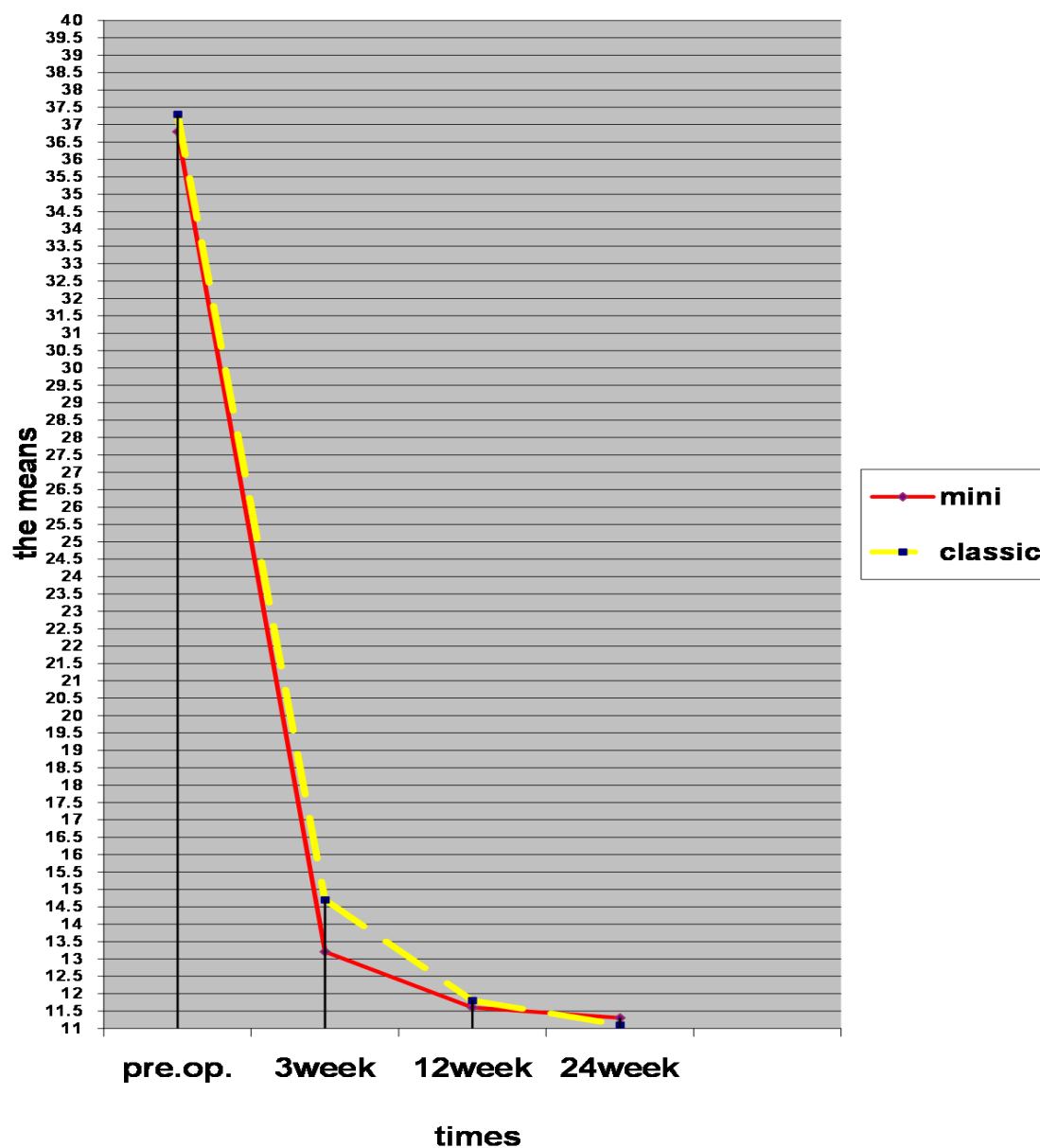


Fig 14 curve line improvement of the BCTQ scores of symptom severity

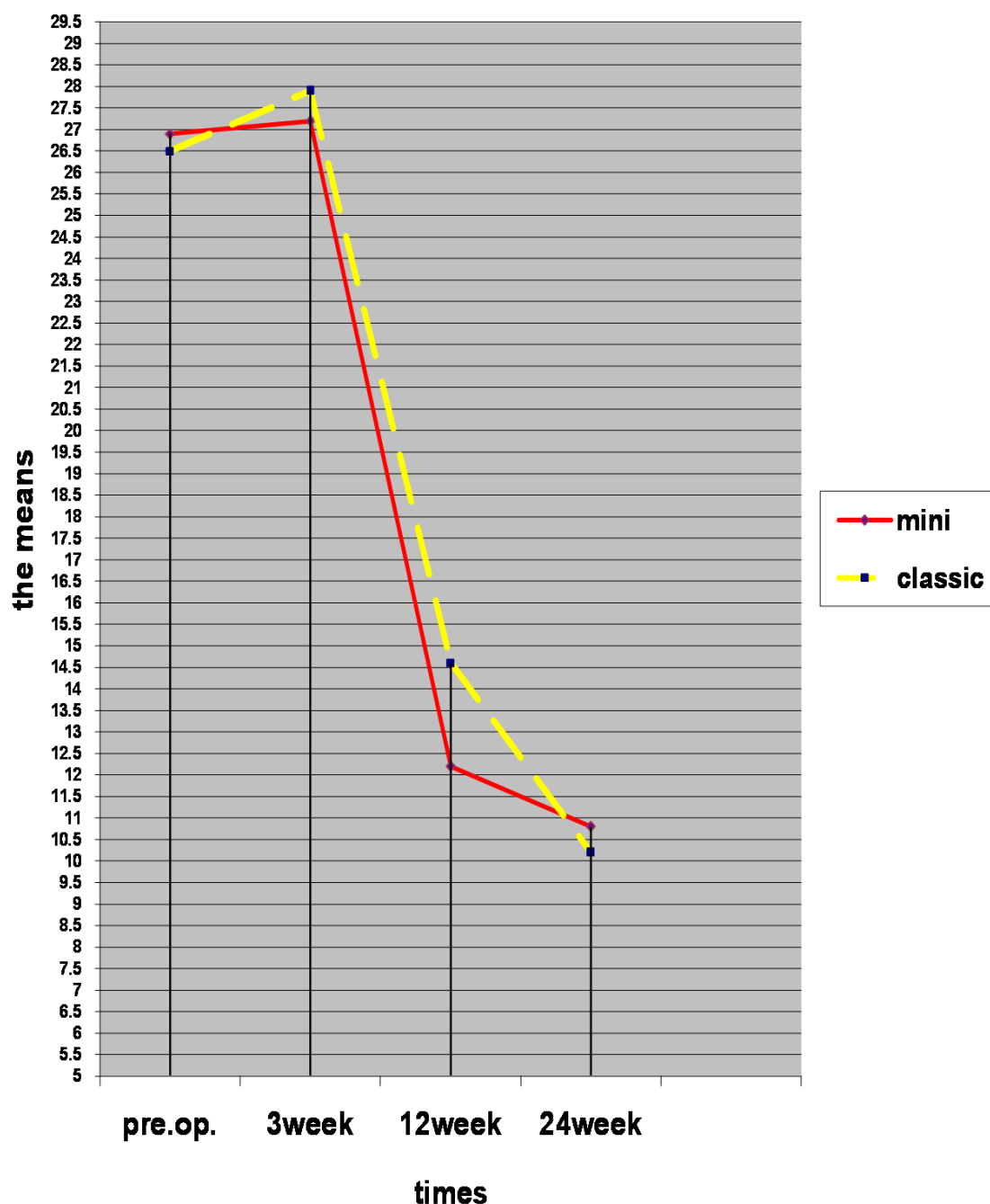


Fig 15 curve line improvement of the BCTQ scores of functional status

Discussion

The objective of carpal tunnel release is to decompress median nerve impingement. Many different methods have been used for surgical carpal tunnel release, including the classic open technique, the endoscopic technique, and, recently, the limited mini-open technique.

Lee and Strickland[9] introduced a limited palmar incision technique to preserve a fascial convergence between

the thenar and the hypothenar and to avoid skin incision crossing wrist crease. These two anatomical structures are the most important for quick postoperative recovery.

They used a skin incision up to 1.5 cm in length over the distal part of the carpal ligament. The division of the distal part of the carpal ligament is performed under direct vision, whereas the proximal part of the ligament is blindly divided.

All of the above techniques have been successful in improving the symptoms of carpal tunnel syndrome, and each has strengths and weaknesses.

In this study, we performed a mini-open carpal tunnel release to divide the transverse carpal ligament beginning distally, combining the advantages of direct structural identification, of the classic open approach, with the advantages of minimal incisions used in the endoscopic approach.

In the classic open approach with a larger-incision, the overlying skin, subcutaneous fat, and palmar fascia are incised with the transverse carpal ligament. This results in incision pain, which is probably related to the division of many sensory fibers along the palm. The pillar pain can decrease hand strength and delay regaining normal activities of daily living[11].

Decreased postoperative morbidity has been reported as the primary advantage of endoscopic techniques when compared to open release procedures[8]. The patients who had endoscopic procedures had less scar tenderness and better preservation of grip and pinch strength at various time intervals and returned earlier to activities of daily living and to work.

However, endoscopic carpal tunnel release may lead to complications including incomplete retinaculum division and neurovascular injury due to the limited visual field[12].

To overcome the limitations of the endoscopic approach, while maintaining the advantages of the technique, various limited incision approaches have been devised since the early 1990s[13,14,15].

A mini-open carpal tunnel decompression can be performed by proximal or distal mini open techniques. The proximal mini open release can be performed through a transverse incision at the wrist[6]. However, the superficial palmar arch,

which lies a few millimeters beyond the distal end of the flexor retinaculum, the motor recurrent branch of median nerve [17], and the communicating branch of the ulnar nerves may be cut accidentally[18], or the flexor retinaculum release may be incomplete due to limited visualization distally.

The advantage of the distal open technique, as used in this study, is easy identification of these vulnerable distal structures and their protection, as well as the skin incision along "life line", which results in a relatively acceptable surgical scar.

The distal open technique frequently uses a specially designed knife to minimize the skin incision [14].

The technique described in this study used a retractor forming a proximal subcutaneous tunnel, which was a distal open technique that does not require special devices and because a commonly available retractor was used, the technique was simple and economic. In addition, the skin incision (1.5-2 cm) was comparable with that (1-1.5 cm) of the technique using a special knife(**fig 2**).

The cadaver studies appeared the safety of the distal mini-open incision, despite their vicinity and all their possible anatomic variations, the risk of structural damage to components such as ulnar and digital nerves, palmar cutaneous and recurrent branch of the median nerve, median nerve, flexor tendons and palmar arterial arch is very low in short-incision carpal tunnel release [19].

In this study, we compared the traditional open technique as a gold standard with a mini-open incision technique. Postoperative follow-up assessments were performed at 3rd week, 3rd month and 6th month after the procedure in all patients of 2 groups.

The evaluations consisted of determination of symptom relief and

functional status of the hand depending on Boston Carpal Tunnel Questionnaire (BCTQ) score and assessments of subjective complaints of scar hypersensitivity (esthetic outcomes grades), pillar tenderness and operative time.

The BCTQ questionnaire was first introduced in 1993[20].

BCTQ is a carpal tunnel syndrome specific outcome assessment questionnaire. It assesses not only the severity of symptoms but also the functional status patients who have undergone carpal tunnel release.

The BCTQ questionnaire has two components. The first part a Symptom Severity Scale with 11 questions. The second Functional Status Scale with 8 items that are rated for degree of difficulty on a five-point scale. Each scale generates a final score that ranges from 1 to 5, with a higher score indicating a greater disability.

BCTQ has been used extensively as outcome measure following CTS treatment, because it has following criteria:

- 1) reproducible.
- 2) internally consistent.
- 3) responsive to clinical change.
- 4) valid.

It has been indicated that severity of symptoms and functional disability cannot be estimated by sensibility or nerve-conduction testing. If symptoms and function are the outcomes of interest, they must be assessed directly, so we used BCTQ [20].

In our study we used criteria to include the patient in this study to decrease the bias which happen from differences in the patient age, occupations, sex, daily activities, difference in pathology and found of associated conditions which may affect the result of operation.

In our series we found that both groups showed no significant difference in BCTQ scores of symptom

severity during all follow up period postoperatively, where both groups showed identical symptomatic relief outcome (**table 3**) (there is significant improvement of BCTQ scores of symptom severity within 3 weeks postoperatively) (**fig 12**).

We found The patients in this study of both groups also had mild worsening of BCTQ scores of functional status 3 weeks after surgery, and this comparable with study has been done by Department of General and Hand Surgery, Pomeranian Medical University in Szczecin used other type of questionnaire called Patient Evaluation Measure (PEM) showed Over a half-year follow-up, the sensation improved statistically significantly during the first month after operation. Power of the hand decreased initially comparing to baseline values, following by further gradual increasing throughout the follow-up; PEM scores showed continuous improvement of the hand status at each assessment [21].

Other studies suggested that postoperative worsening of the functional status of the hand (within 3 to 6 weeks postoperatively) was due to alterations of biomechanics caused by expansion of carpal tunnel rather than the loss of continuity of the flexor retinaculum [22,23].

In our study we found that there is good improvement by 6 months postoperatively in the control group, but there is good improvement by 3 months in trail group, where there is significant difference between 2 groups in the BCTQ scores of functional status at third month of follow up ($p < 0.05$) (**fig 12**), so there is early return of functional status of the hand with mini-open technique compares with classical technique, and this has been found in many articles [9,14,15,24].

We compared the result of our study with study by Sudqi A. Hame, Falah Z.

Harfoushi[25], in their study they showed improvement of symptom severity of BCTQ scores from 34 preoperatively to 21 at 3rd week and 16 at twelfth week postoperatively; and their study showed also improvement in functional status of BCTQ scores from 31 preoperatively to 16 at twelfth week postoperatively. Other study has been done by Avni Dayican[26] showed that The symptom severity score improved from 38 to 16 and the mean Functional Status score improved from 39 to 20 at the third month postoperatively. Significant recovery of the patients was noted both functionally ($p < 0.001$) and symptomatically ($p < 0.001$).

These results is comparable with results of our study with some not significant differences in numbers of scores because the BCTQ score is subjective not objective. Postoperative scars in the patients operated by traditional open technique for carpal tunnel release were significantly longer (about 5 cm) than the scars in the patients operated by mini-open incision technique (about 1.5cm) (**Table 5**). Thus, esthetic outcomes were better in the group operated by mini-open incision technique than in traditional technique group (significant difference $p = 0.036$) (**Table 5**). The short length of the incision decreases time to return to work. Every 1 cm increase the length of the incision prolongs the time to return to work by nearly 5 days. [24]. Three patients (15%) in the trial group and 9 (45%) patients in the control group complained of scar or pillar tenderness (significant difference $p = 0.006$). Operation time was on average 1.6 min shorter in the trial group, where there is significant difference between 2 groups ($p = 0.001$) (**Table 6**). These findings regarding postoperative incision and pillar tenderness for mini open CTR were comparable with those in prior

published series of endoscopic carpal tunnel release, where A PROSPECTIVE, RANDOMISED STUDY OF ENDOSCOPIC VERSUS LIMITED-OPEN METHODS has been done by K. C. Wong, L. K. Hung, P. C. Ho, J. M. W. Wong *From the Prince of Wales Hospital, Hong Kong*, showed that The mean operating time was 12.9 ± 4.9 minutes for ECTR and 12.9 ± 5.1 minutes for mini open CTR ($p = 0.96$); The mean length of the wound was 14.6 ± 2.1 mm and 15.4 ± 1.7 mm, respectively ($p = 0.16$). Also showed that pillar pain was also less in the mini open CTR group. At eight weeks, (53%) in the ECTR group and (27%) in the mini open CTR group had pillar pain and (53%) and (33%), respectively [27]; These results is comparably similar to our study results.

Study of Carpal Tunnel Release by Limited Palmar Incision vs Traditional Open Technique has been done by Izabela Jugovac in *Division of Neurosurgery, Pula General Hospital* showed that 8% patients in the limited palmar incision and 22% patients in the Traditional Open Technique complained of scar or pillar tenderness[10]; these result is different from our results where its lower, this because the incision of skin in this mini open approach is did at proximal edge of TCL (there is no opening of skin of palm so the results cosmetically relatively better but disadvantage of this incision is not see the recurrent motor branch of median nerve and superficial palmar arch so they may subject to injury, but our approach permit us to see these structures.

Conclusions

- The mini-open carpal tunnel release via a small palmar incision is a relatively simple and effective procedure, no specialized equipment is

needed for this procedure, and costs are relatively low.

- The mini-open carpal tunnel release can preserve most structures necessary for rapid postoperative recovery.
- A mid-palm incision allows for direct visualization of susceptible neurovascular structures to prevent injury.
- The mini-open carpal tunnel release is associated with significant symptom relief, minimal scar tenderness, and significant improvements in overall hand function .
- The mini-open carpal tunnel release is associated with early return of hand function than classical technique.
- The mini-open carpal tunnel release is shorter in the operative time from classical technique.
- The symptoms (pain, numbness and parasthesia) in both mini-open technique and classical technique will relief early and significantly within 3weeks postoperatively.
- The functional status (include the pinch and grip function) will deteriorate slightly within 3-6 weeks post operatively and improve more earlier (at 3rd month) in mini-open technique but then will be equal in both groups at sixth month.

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