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Comparing the Results of Limited Incision Technique and Standard Longitudinal Incision Technique for Carpal Tunnel Decompression by Numerical Grading System

Karpal Tünel Dekompresyonunda Uygulanan Sınırlı İnsizyon Tekniği ile Açık Teknik Cerrahisi Sonuçlarının Sayısal Değerlendirme Sistemi ile Karşılaştırılması

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ABSTRACT

The carpal tunnel syndrome is the most common nerve entrapment syndrome. Many different methods have been described for treatment. We performed a novel method to release the carpal tunnel. Subsequently, we compared the surgery results of this novel limited incision technique and the standard longitudinal incision technique by using a 'Numerical Grading System'. There is no reported study about the use of 'Numerical Grading System' for assessment of carpal tunnel syndrome in the literature. The novel technique is simple and effective, employs inexpensive instruments, and has a low complication rate. The aim of this paper is to record a novel limited incision technique and a new assessment method for the carpal tunnel syndrome.

KEYWORDS: Carpal tunnel syndrome, Limited incision technique, Numerical grading system, Pressure specified sensory device, Pillar pain

ÖZ

Karpal tünel sendromu, üst ekstremitede görülen en sık tuzak nöropati sendromudur. Karpal tünelin cerrahi dekompresyonu için açık ve sınırlı kesi teknikleri mevcuttur. Bu çalışmanın amacı, karpal tünelin dekompresyonunda açık teknik ile modifiye ettiğimiz sınırlı kesi tekniklerinin duyu ve motor düzelme sonuçlarını ilk kez 'Sayısal Değerlendirme Sistemi' ile değerlendirerek karşılaştırmaktır. Çalışmaya dahil olan tüm hastaların 'Grip' ve 'Pinch' kuvvetleri, duyusal sensitiviteleri ve insizyon hattındaki skar hassassiyeti değerlendirildi. Çıkan sonuçlar, uygulamış olduğumuz sınırlı kesi tekniğinin açık teknik kadar güvenli ve etkili olduğunu gösterdi.

ANAHTAR SÖZCÜKLER: Karpal tünel sendromu, Sayısal Değerlendirme Sistemi, Sınırlı insizyon tekniği

INTRODUCTION

The carpal tunnel syndrome is the most frequent nerve compression disorder. It affects 1% and 5% of the general and working population using their hands and wrists in daily life.1 A variety of techniques have been described for the treatment of carpal tunnel syndrome. The first open carpal tunnel release was performed in 1924 by. Mackinnon et al. in Mayo Clinic and popularized later by Phalen et al.2 Today, open carpal tunnel release through an interthenar incision is the standard procedure of choice for many surgeons.

The open incision technique has some disadvantages related to the procedure including an unsightly and tender scar, pillar pain, a long healing period and flexor tendon bowstringing 3-5 A well-designed incision using an endoscopic limited incision may overcome the majority of those problems related to the classical open release for carpal tunnel and have been developed in principle to decrease the drawbacks of open release.6-8

In 1989, a computer-based device [Pressure-Specified Sensory Device (PSSD), Sensory Management Services, Baltimore, MD] was developed by A. Lee Dellon. (Figure 1) The continuous cutaneous pressure can be measured with PSSD using a hemispheric probe attached to the force transducer which enables one-point static (Merkel cell-neurite complexes, Ruffini complexes), one-point moving (Pacinian and Meissner corpuscles), and moving and static two-point (innervations density) discriminations.9

Figure 1: *Pressure-Specified Sensory Device.*

In this study, we performed a limited incision for decompression of the carpal tunnel and compared the results with those of the standard longitudinal incision technique by using a "Numerical Grading system"10 We aimed to describe a novel limited incision technique and to assess a new grading system for the patients with carpal tunnel disorder.

PATIENTS AND METHODS

Fifty-six patients (20 male, 36 female, age 23-67; mean 50.7) with isolated carpal tunnel syndrome were enrolled to the study. The final diagnosis was based on the history of hand dysesthesia, paraesthesia, numbness in the median nerve distribution, a positive Phalen's flexion test finding and/or a positive Tinel's sign. All patients also underwent nerve conduction tests and had positive electrodiagnostic study findings.

A total of 63 wrists (bilateral in 7 cases, 43 right and 20 left-sided wrists) underwent carpal tunnel decompression with a standard longitudinal incision technique (Group 1) while 31 hands had decompression using the novel limited incision technique (Group II). The patients were followed-up for 8 to 14 months (mean; 11). The sensory, grip strength, pinch strength and scar hypersensitivity were assessed in all patients at the incision line both before surgery and after the follow-up period. Incision scar hypersensitivity and pain were evaluated with the 'Visual Analog Scale' which is a straight line with the left end of the line representing no pain (number 0) and the right end of the line representing the worst pain (number 10). Patients were asked to mark on the line the level of the pain they felt..

Grip strength - key pinch and sensorial evaluations were performed in all patients by one examiner using the Pressure-Specified Sensory Device (Figure 2). All patients were seated in a reclining chair and were asked to close their eyes so that they could not see the computer screen or the hand being tested. A button linked to the computer was placed in the hand opposite to the hand being tested, and subjects were instructed to press the button to indicate perception of the test stimulus. These data obtained from the measurements were put into the 'Numerical Grading System' using a ten-point scale (Table I). The scores presented for the carpal tunnel syndrome at the wrist level a minimum score of 0 and a maximum of 10. The Mann Whitney-

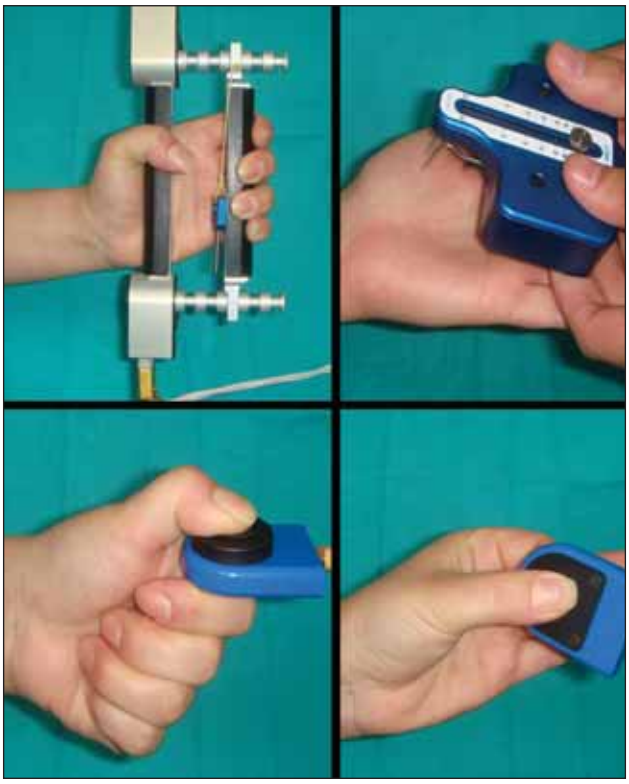


Figure 2: *The evaluation of grip strength - key pinch and sensory.*

U test was used for statistical analysis and assessed a significant difference between the groups. The recovery of grip and pinch strength percentages were expressed in mean ±SD (standard deviation) and p values <0.05 were accepted as statistically significant.

SURGICAL TECHNIQUE

The standard longitudinal incision and the limited incision technique were performed after local anesthesia with a upper- arm pneumatic tourniquet by the same surgeon. Patients in Group I had carpal tunnel decompression by open technique. For the standard technique, a curved longitudinal incision was made parallel to the thenar crease crossing the wrist crease obliquely in an ulnar direction at a point in line with the long axis of flexed ring finger or just on the ulnar side of the palmaris longus tendon.

Patients in Group II had carpal tunnel decompression with the limited incision technique. The 1-cm first incision was marked in the palm, beginning at the intersection of Kaplan's cardinal line and a line drawn along the radial border of the third web. After skin incision, the subcutaneous tissue was incised with a no. 15 blade and two

Table I: 'Numerical Grading System' applied to the median nerve at the wrist level.

Numerical Score		
Sensory	Motor	Description of Impairment
0	0	None
1		Paresthesia, intermittent
2		Abnormal threshold : pressure, Semmes –Weinstein filament marking 3.22 -3.61, Pressure-Specified Sensory Device > 1 g/mm^2 vibration, biothesiometer 3 – 10 μg
	3	Weakness, thenar muscles
4		Abnormal threshold : pressure, Semmes –Weinstein filament marking 3.84 -4.34, Pressure-Specified Sensory Device > 16.1 g/mm^2 vibration, biothesiometer 11 – 20 μg
5		Paresthesia, persistent
6		Abnormal 2PD – Index finger : s2PD 7-10 mm : m2PD 4 – 6 mm
	7	Muscle wasting (1/4 – 2/4)
8		Abnormal 2PD – Index finger : s2PD 11 mm : m2PD > 7 mm
9		Anesthesia
	10	Muscle wasting (3/4 – 4/4)

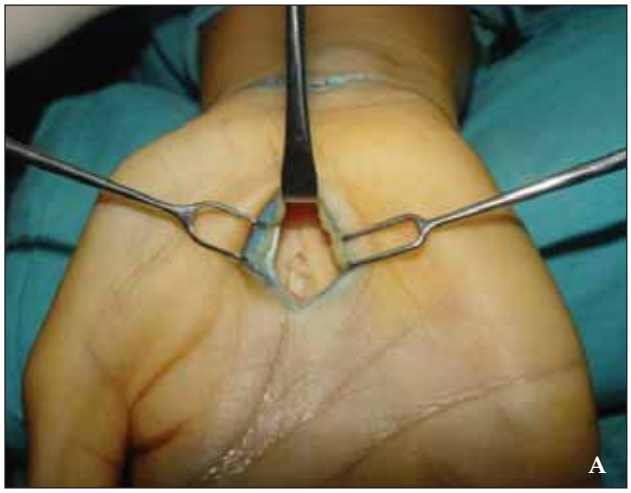
Note:

- 2PD = Two point discrimination
- Adapted from ' Numerical Grading Scale for Peripheral Nerve Function' by A. L. Dellon, 1993, Journal of Hand Therapy

retractors were positioned to separate the edges of the incision. The palmar fascia was divided by blunt dissections. The distal edge of flexor retinaculum and median nerve was lateralized (Figure 3A -3B) and the variations of motor branch of median nerve were visualized

A 1.5 cm second skin incision was made on a line between palmaris longus and the flexor carpi ulnaris tendons, at the wrist level. The proximal edge of the flexor retinaculum and median nerve was identified (Figure 4). Then, a scalpel handle was pushed proximally from the first incision to second incision which passed through the carpal tunnel (Figure 5). Thus, this scapel handle was inserted between the median nerve and the flexor retinaculum. Later on a no. 15 blade was passed and placed superficial to the flexor retinaculum (Figure 6). This blade gently

Figure 4: *The second skin incision side on a line between palmaris longus and the flexor carpi ulnaris tendons. The proximal edge of the flexor retinaculum and median nerve.*



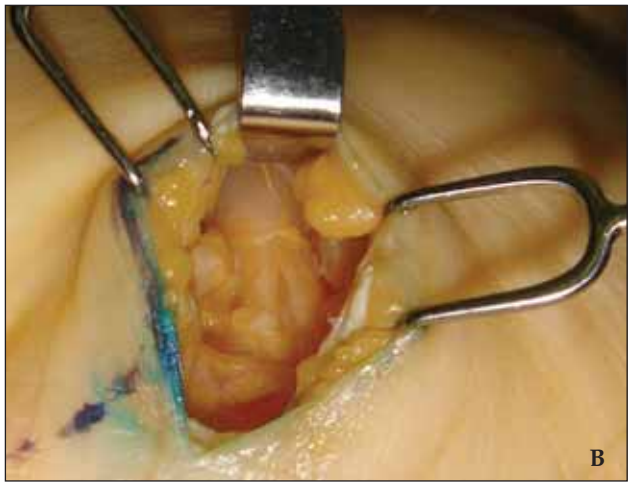


Figure 3A,B: *The first skin incision on the intersection of Kaplan's cardinal line and a line drawn along the radial border of the third web. The distal edge of flexor retinaculum and median nerve.*

Figure 5: *The scalpel under the carpal tunnel.*

Figure 6: *A no. 15 blade, below the flexor retinaculum and above the scalpel.*

pushed toward distally to divide the flexor retinaculum, above the first scalpel which placed between median nerve and flexor retinaculum (Figure 7). The flexor retinaculum between the blade and handle was completely divided in this way.

The incisions were closed with interrupted 4-0 nylon sutures and a pressure bandage was applied. The tourniquet was then released. No splint was used, and the patients were encouraged to move their hands and fingers in the immediate postoperative period. The original dressing was removed after 5 days, and the stitches were removed after 10 days.

Figure 7: *Release of the fexor retinaculum with using the scalpel.*

RESULTS

In this study, a total of 63 hands underwent carpal tunnel release. In the follow-up period, no recurrence and injury to the neurovasculature structures in Group I and II was noted.

There was no significant difference between the two surgical procedures for the recovery of grip and pinch strength ($p>0.05$). Significant differences were observed in either grip strength or pinch strength between the pre and postoperative period ($p<0.05$). The preoperative and post-operative grip and pinch strength scores are shown in (Table II).

The changes in scores were assessed for hand functions according to the Numerical Grading System in preoperative and postoperative periods (Table III). The scar hypersensitivity at the incision sites was also evaluated with 'Visual Analog Scale' after a postoperative period of 8 to 14 months and a statistically significant difference in the scar tenderness was noted ($p<0.05$). There was excessive hypersensitivity in group I patients compared to group II patients as indicated in (Table IV).

DISCUSSION

Carpal tunnel decompression surgery has evolved over the years to decrease the complications and side effects associated with the surgical procedures. The standard longitudinal incision technique has been the optimal treatment procedure for surgical decompression of the median nerve, though it is still controversial. This technique has the advantage of direct visualization of the structures within the carpal tunnel11, but it may be associated with certain complications such as a painful scar with an incidence of 19% to 61%.12 Other complaints include superficial sensory nerve pain, neuromas, and "pillar" pain which may possibly result from small neuromas in the subcutaneous tissue. The pillar pain may decrease hand strength and delay activities of daily living. The major disadvantage of the limited incision technique is limited visualization, but a well-designed incision and proficiently executed surgical procedure may help to overcome this problem. For this reason, we suggested a limited incision technique to release the carpal tunnel using the blade handles only and need no extra equipment.

Table II: Pre and postoperative scores for grip strength and pinch strength.

	GRIP (g / mm²) (mean ± standard deviation)		**PINCH (g / mm²)** (mean ± standard deviation)	
	Preoperative	Postoperative	Preoperative	Postoperative
GROUP I (N=32) Standart longitudinal incision technique	16.4 ± 3.54	22.4 ± 3.21	3.2 ± 3.14	6.4 ± 2.20
GROUP II (N=31) Limited incision technique	16.2 ± 2.14	22.0 ± 2.54	2.8 ± 2.70	6.2 ± 1.84

Table III: Preoperative and postoperative scores for the 'Numerical Grading System'.

	Preoperative Scores (mean ± standard deviation)	**Preoperative Scores** (mean ± standard deviation)
GROUP I (N=32) Standart longitudinal incision technique	8 ± 2.4	3 ± 1.2
GROUP II (N=31) Limited incision technique	7 ± 1.3	5 ± 1.3

Table IV: The scores of incision scar hypersensitivity according to the 'Visual Analog Scale'.

Patients	**Visual Analog Scale** (mean ± standard deviation)
GROUP I (N=32) Standart longitudinal incision technique	7 ± 2.24
GROUP II (N=31) Limited incision technique	3 ± 1.16

In this study, we compared patient outcomes after the standard longitudinal incision and limited incision technique. The scores of grip strength - key pinch and sensorial evaluations were defined in all patients before and after the surgery by using the PSSD. The findings were evaluated by a 'Numerical Grading System' because the nerve conduction studies may be either false positive or negative for diagnosing and evaluating the surgical results. However, scoring systems like the Boston Questionnaire and the Patient Evaluation Measure (PEM) may evaluate the results obtained from the surgical procedures. However these systems, do not seem to be valuable tools for the evaluation of symptomatic and functional conditions of patients in carpal tunnel syndrome treatment. The sensitivity and specificity of the questionnaire systems are insufficient because these systems are subjective.

Neurosensory testing with PSSD offers advantages over traditional electrodiagnostic studies. The PSSD will identify the earliest stages of nerve compression and neuropathy at a time when traditional electrodiagnostic testing will not be able to detect a change in peripheral nerve function, and therefore the PSSD will correlate better with patient symptoms.13,14 The obtained motor and sensory measurements by using PSSD, may be evaluated by a 'Numerical Grading System' applied to the median nerve at the wrist level for the carpal tunnel syndrome. 9,10 PSSD is also a painless and a noninvasive test and tolerable for the majority of patients. It may therefore be used to follow-up serially the progression or improvement of carpal tunnel surgery outcomes.

The limited technique is safe and effective as it offers direct visualization of the structures within the carpal tunnel. Thus, the risk for the potential complications and injury to nerve, artery, or tendon decreases remarkably. The ligament of the carpal tunnel can be divided more proficiently under direct vision. The only sign of operation is a small scar similar to that of endoscopic carpal tunnel release and less scar tenderness and pillar pain. is noted. Thereby, there has been almost no need for supplementary treatment such as physiotherapy and anti-inflammatory medication and the patients return to activities of daily living and work soon.

In our series, there was no complication related to the surgical intervention of any injury to nerve, artery, or tendon structures. The carpal tunnel decompression by dividing the transverse carpal ligament can be made with the use of the limited incision technique which has been safe and simple and can be performed with the standard surgical equipment. The patient tolerance is reasonably high and the procedure is compatible with the current trend in surgery, minimal invasive surgical intervention. PSSD and 'Numerical Grading system' have been useful for both the diagnosis and assessment of carpal tunnel syndrome.

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