

# Carpal Tunnel Syndrome Surgery Anti-Adhesion Gel Is Effective?

## Chirurgické léčení syndromu karpálního tunelu – je antiadhezivní gel efektivní?

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### ABSTRACT

#### PURPOSE OF THE STUDY

The purpose of the current study is to assess the efficacy of anti-adhesion gel on the symptom severity and functional outcomes after mini incision open surgery for carpal tunnel syndrome (CTS).

#### MATERIAL AND METHODS

A total of 200 CTS patients (154 women, 46 men) were included in this study. Group I (n = 100; 78 women, 22 men) did not receive local administration of anti-adhesion gel, while anti-adhesion gel consisting of hyaluronic acid-carboxymethylcellulose (Seprafilm®, SanofiBiosurgery, Bridgewater, NJ, USA) was locally applied to patients in Group II (n = 100; 76 women, 24 men). All patients recruited in this study had received conservative treatment comprised of non-steroidal anti-inflammatory drugs, steroid injection, replacement of vitamin B and stabilization with splints. Cases that did not benefit from these therapeutic options during one year were assigned as candidates for surgical treatment.

#### RESULTS

There was no significant difference between two groups in terms of mean age, gender distribution, preoperative and postoperative Boston questionnaire (BQ) scores, difference of BQ scores after the operation, and the presence of the disease on the left or right side. According to postoperative 1. Year results, there was no significant difference between two groups.

#### CONCLUSIONS

Results of the current study demonstrated that use of anti-adhesion gel during mini incision open surgery for CTS did not bring about significant advantages in terms of functional or symptomatic outcomes. Further, controlled trials on larger series are warranted to understand the beneficial effects of anti-adhesive materials during the surgical treatment of CTS.

**Key words:** anti-adhesion gel, Boston questionnaire, carpal tunnel syndrome.

### INTRODUCTION

Peripheral nerve entrapment neuropathy occurs as a result of the long term and persistent pressure on the nerve. It is a common disease which is characterized with pain, numbness and muscle fatigue and it deteriorates the daily life and the quality of the sleep. Carpal tunnel syndrome is a common entrapment neuropathy that is observed in older ages in women. When there are symptoms such as numbness, tingling and pain in the sensory part of the median nerve, it can be easily diagnosed with provocative tests and electrodiagnostic studies. The nonsurgical treatment approaches are limited and the recovery is generally ensured by surgically or endoscopically loosening the transverse carpal ligament (4, 6, 15, 18).

Recently, the reasons of the carpal tunnel syndrome have been known and its surgical treatment is commonly performed. Therefore, it is important for health expenditures. The most common treatment method is to decompress the carpal tunnel surgically. There are various applications in terms of the length of the skin incision. Various complications have been reported in different surgical methods. These complications can be the damage in the median nerve branches, hypertrophic scar formation, pain in the place of incision depending on the perineural adhesions, arterial injury, insufficient release, tendon adhesions, infection, hematoma, joint stiffness, and recurrences. The recurrence of the carpal tunnel syndrome is reported between 7% and 20% (2, 15).

One of the common complications of the primary surgery is the carpal tunnel recurrence which can occur because of the nerve tissue adhesions. In these cases, the nerve decompression operation should be repeated and the clearance of the perineural adhesions should be performed. However, the success of this operation is not as high as the primary cases. Some surgeons recommend the external or internal neurolysis in case of the median nerve. Some other surgeons recommend that some tissues should be dressed by synthetic materials in order to prevent the scar formation. The clinical applications of the topical use of the various anti-adhesion materials have been searched in the recurrence experimental and vertebrae surgery (3, 13, 16). There is no study that is conducted about the use of these materials in carpal tunnel recurrence or as a protective method in primary cases.

The Boston questionnaire (BQ) is self-administered and is a well-recognized, validated outcome instrument specific for use in CTS (8). It has been compared with many different outcome measures. It involves two sections, one assessing symptoms such as pain and paraesthesia, and the second analyzing function terms of eight day-to-day tasks. Eventually, a mean score for both symptom severity and functional status is given (5).

Functional recovery after peripheral nerve injuries or surgical interventions can be unsatisfactory due to incomplete recovery. One of the underlying causes of such a failure can be attributed to scar formation. Scarring may be due to intraoperative neural injury, hemorrhage in the surgical field or manipulation of the nerve. Intraneural scarring may constitute a mechanical barrier against axonal regeneration, while extraneural scarring may cause chronic compression or tethering of the nerve to the surrounding tissue, which may in turn result in traction injury and vasospasm of the intraneural vessel. Subsequently, ischemia of the nerve may lead to the irreversible injury of the nerve. Intraneural and extraneural scarring and perineural adhesion of nerves may present with chronic persistent neurologic symptoms. Therefore, adhesion has become an important complication of peripheral nerve surgery. From this point of view, hyaluronic acid, a natural component of the extracellular matrix, can play an important role within the matrix in wound healing. Hyaluronic acid may not only reduce perineural scarring and postoperative adhesion, but also peripheral nerve regeneration may be improved. Carboxymethylcellulose is a biocompatible polysaccharide that serves as a physical barrier, which may diminish peripheral nerve adhesion and epidural fibrosis at spine surgery. Mixture of hyaluronic acid with carboxymethylcellulose both delays the absorption of hyaluronic acid and prolongs the duration of its anti-adhesive effect (10).

The aim of the current study is to assess the efficacy of anti-adhesion gel on the symptom severity and functional outcomes after mini incision open surgery for CTS.

## MATERIAL AND METHODS

The permission was obtained from the ethical committee of our hospital. This study was planned in line with the Declaration of Helsinki. It was understood from the patient recordings that this retrospective cohort study was conducted in Orthopedics and Traumatology clinics of our hospital between 2012 and 2015. Unilateral CTS surgery was performed in 305 patients. Totally 12 patients were excluded from the study because of the exclusion criteria. It was learnt that anti-adhesion gel was used in 112 patients and it was not used in 181 patients. In order to evaluate the data of the study, 100 patients who used anti-adhesion gel (Group I) and another 100 patient who did not use anti-adhesion gel (Group II) were randomly selected. Totally 200 CTS patients were included in the study (46 male, 154 female). The mean age of the study group was  $46.96 \pm 12.94$  years. The frequency of the disease that is in the right side ( $n = 117$ , 58.5%) was higher compared to the frequency of the disease that is in the left side ( $n = 83$ , 41.5%). All patients were diagnosed with unilateral CTS.

All patients were evaluated in detail with emphasis to symptomatology, history and physical examination findings. Patients with complaints on the neck and shoulders that may mimic the symptoms of CTS as well as patients with prior diagnoses of systemic diseases such as diabetes mellitus and rheumatoid arthritis were excluded from the study. All patients suffered from paresthesia of the hand on the innervation zone of median nerve and this complaint was more remarkable nocturnally. Moreover, patients complained of pain of variable intensity radiating towards the forearm and hand. All patients recruited in this study had received conservative treatment comprised of non-steroidal anti-inflammatory drugs, replacement of vitamin B and stabilization with splints. Cases that did not benefit from these therapeutic options during 6 months were assigned as candidates for surgical treatment. Electroneuromyographic evaluation was routinely performed for all patients and classification was made according to the system defined by Stevens and our series consisted of severe CTS cases with respect to this classification (11).

Boston survey results, the recurrence rates of the patient, and postoperative one year Electroneuromyographic results were recorded and these findings of two groups were compared to each other.

### Surgical technique

All surgical procedures were carried out under axillary block anesthesia and tourniquet. Distal mini open incision was located at the intersection of the line on the long axis of the 3<sup>rd</sup> web space and Kaplan's line (Fig. 1).

Soft tissues were dissected and superficial palmar arc was exposed. Transverse carpal ligament was dissected from the volar and dorsal soft tissues and median nerve. At this stage, identification of the motor branch of the median nerve is advised to avoid complications related

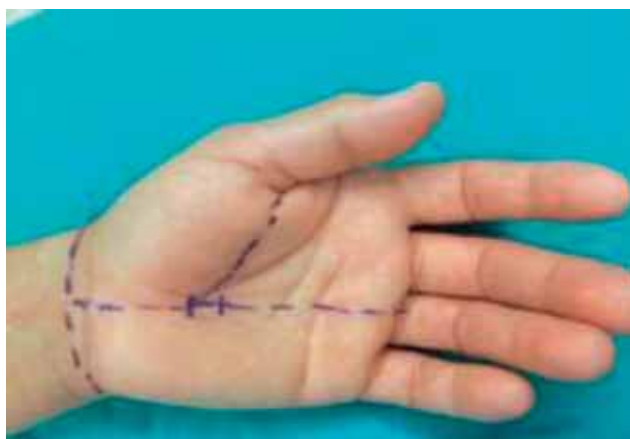


Figure 1.



Figure 2.



Figure 3.

to the anatomical variations. Distal part of the carpal ligament was sectioned with scissors after visualization by soft tissue retraction, whereas proximal part was cut under direct visualization at the 30° flexion of the wrist. No additional surgical interventions were implemented in any patients. There were no noteworthy complications were encountered intraoperatively or in the early postoperative period (Fig. 2).

In the group receiving anti-adhesive gel, operation field was coated with anti-adhesion gel consisting of hyaluronic acid-carboxy-methylcellulose (Seprafilm®, Sanofi Biosurgery, Bridgewater, NJ, USA) after surgical goals were accomplished (Fig. 3).

Patients were discharged the next day after surgery and tendon-gliding exercises were instructed. Routine controls were made on 1<sup>st</sup>, 3<sup>rd</sup>, 6<sup>th</sup> and 12<sup>th</sup> months after the operation.

Evaluation of preoperative patients symptomatic and functional and 12<sup>th</sup> months controls the severity of symptoms and functional capacity scale was applied to the Boston. In addition, all patients evaluated in terms of the emerging issues in the last control complications noted. 12<sup>th</sup> months EMG monitoring. Cosmetic appearances of the mini-incision were satisfactory at the end of first year postoperatively.

### Statistical analysis

Analysis of data was performed by means of "IBM SPSS Statistics 20" program. Normal distribution of variables was assessed with Kolmogorov-Smirnov test. Variables with normal distribution were analyzed with parametric methods, while non-parametric were used for variables without normal distribution. Two independent groups were compared with either Independent-Samples T test or Mann-Whitney U test. Categorical variables were compared via Pearson Chi-Square test. Quantitative data were expressed with mean, standard deviation, minimum, maximum, median and interquartile range (IQR). Confidence interval was 95% and p value less than 0.05 was considered as statistically significant.

### RESULTS

Comparison of two groups with respect to average age, gender distribution, preoperative and postoperative BQ scores, difference in BQ scores after operation and involvement of right or left sides is shown in Table 1.

Table 1. Overview of descriptive, clinical, symptomatic and functional characteristics of CTS patients treated surgically with open mini-incision technique with and without anti-adhesion gel.

Variable	Groups		p Value
	AA (-)	AA (+)	
Age (mean SD)	47.0 12.9	46.4 12.4	0.76
Gender (M/F)	22/78	24/76	0.74
Preoperative BQ score	40.0–8.0	40.0–6.5	0.54
Postoperative BQ score	13.0–5.0	12.0–6.0	0.23
Difference between preoperative & postoperative BQ scores	26.0 5.1	27.1 5.6	0.14
Side of involvement (R/L)	61/39	56/44	0.47

Abbreviations: AA: anti-adhesion gel; F: female; M: male; BQ: Boston questionnaire; R: right; L: left; SD: standard deviation.

As it can be seen, none of the variables under investigation displayed remarkable difference between two groups.

Similarly, recurrence was detected in three patients (3%) in both groups at the end of first year.

## DISCUSSION

In this study, we attempted to evaluate whether there was a functional or symptomatic difference between CTS patients treated surgically with or without use of anti-adhesive gel. Our results indicated there was no noteworthy difference in terms of postoperative functional and symptomatic profiles between two patient groups treated with open mini incision surgery. To the best of our knowledge, this is the first trial assessing the efficacy of anti-adhesion gel in the surgical treatment of CTS and we hope our results will pioneer implementation of further trials on the improvement of surgical outcomes with use of anti-adhesion materials.

There have efforts to minimize scarring and perineural adhesion after surgery for peripheral nerves. In this purpose, various surgical techniques such as microsurgical technique, free fat grafts, vein wrapping or silicone cuffing have been used. However, postoperative perineural scarring and adhesion are sometimes inevitable despite the use of meticulous surgical techniques. In addition, pharmacologic agents such as cis-hydroxyproline, anti-transforming growth factor-1 antibody, citicoline and doxorubicin have been utilized to reduce scar formation in peripheral nerve surgery (14). Even though these agents possess favourable effects in experimental setting, their efficacy has not been fully documented clinically. Hyaluronic acid and its derivatives reduce scar formation and optimize the extracellular matrix (17).

As a major component of the extracellular matrix, hyaluronic acid has an important role in the early wound healing process. It stimulates endogenous release of interleukin-1 production, which in turn elicits proliferation of fibroblasts, and production of collagenase. It also regulates motility of leukocytes and processes such as adhesion and phagocytosis. Therefore, it may suppress the formation of scar via diminishing the infiltration of inflammatory cells to damaged tissues. Coating the surgical field with hyaluronic acid may be useful for reduction of scar formation (7). Hyaluronic acid may promote the regeneration of damaged nerve by realignment of the fibrin matrix and by establishing a suitable environment for axonal growth (14).

Adanali et al. demonstrated that hyaluronic acid-carboxymethylcellulose resulted in increased thickness of myelin sheath and axonal diameter after nerve injury

(1). Despite these promising results in experimental model, we did not observe any favorable effects of anti-adhesion gel in surgery for CTS.

Consistent with this, the present study focused on investigation of the effects of Seprafilm, a commercially-available hyaluronic acid carboxymethylcellulose derivative after open mini-incision surgery for CTS. However, our results did not demonstrate any beneficial effects of anti-adhesive material use in terms of recurrence rates and functional or symptomatic outcomes after surgery for CTS. Even though previous publications have supported the use of anti-adhesion substances in abdominal, pelvic and tendon surgeries, we could not document any additional advantages during mini-open surgery for CTS (1, 9). This may ensue from patient selection criteria, efficacy of mini-incision technique or subjectivity of BQ scores. Moreover, hyaluronic acid carboxymethylcellulose has a relatively rigid texture compared to nerves and this brings about a physical restriction on its use with nerves (7). Application of different forms such as solution may improve availability and augment the efficacy of the anti-adhesion material. Notably, we did not come across any adverse outcomes with the use of these substances. In the literature, some anti-adhesion agents were reported to cause delay of wound healing and enhancement of inflammatory reaction (12). Importantly, our model has demonstrated the biocompatibility and safety of anti-adhesion gel.

Main restrictions of the current study include retrospective design and data derived from the experience of a single institution. Moreover, impacts of social, environmental, ethnic and genetic factors must not be ignored during interpretation of our results. Lack of histopathological and morphometric evaluation of the impact of anti-adhesion gel is another remarkable limitation of this study.

## CONCLUSIONS

In conclusion, results of the current study demonstrated that use of anti-adhesion gel during mini incision open surgery for CTS did not bring about significant advantages in terms of functional or symptomatic outcomes. Further, controlled trials on larger series are warranted to understand the beneficial effects of anti-adhesive materials during the surgical treatment of CTS.

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