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Surgical treatment of the carpal tunnel syndrome using endoscopic control and electrophysiologic monitoring

Abstract

Carpal tunnel syndrome is a variant of tunnel neuropathy developing because of the median nerve compression by hypertrophic flexor retinaculum. Due to long compression, the ischemic processes progress in the nerve causing a pain syndrome and gradual loss of function. Conservative methods address to resolve edema and to improve nutrition, but, in case of severe compression of the flexor retinaculum by dense tissue, the fast, sufficient and long effect cannot be achieved in each case. Surgical treatment includes dissection of the flexor retinaculum and followed nerve decompression, fast pain alleviation, and termination of neurologic deficit progression. General complications of the operation occurred nowadays are insufficient dissection of the flexor retinaculum and/or postoperative expanded cicatrical adhesion process that, in its turn, can cause repeated nerve compression. The search of a way to minimize a surgical intervention preserving radicality is being conducting to reduce occurrence of the complications.

Keywords: carpal syndrome, tunnel neuropathy, neuromonitoring, endoscopic control

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Introduction

Tunnel syndromes in upper extemities have higher prevalence rate in modern days. Main causes are long, unvaried hand work, i.e. chronic trauma of radiocapal joints. Persons who work with the computers, employed in manufacture, artists and musicians are more tend to suffer this disease. Basic ethiopathogenesis of the disease is thickening and ossification of the carpal ligament causing the median nerve compression. Pathologic processes in compessed nerve lead to compessive neuropathy and sensitive and motor disturbances, as consequences. Sensitive disturbances include pain in the radiocarpal joint, palm, I-III fingers, neuopathic pain and/or dullness in I-III fingers. Motor disturbances include palsy in I-III fingers, impairment of fine motor skills. All these neurologic disturbances cause permanent incapacity to work, and in some cases–to disability. Estimating the syndrome prevalance, it is important to note that about 20000 inhabitants of Moscow suffer from this pathology. Modern methods of diagnistic identify this disease reliably but low level of outpatient diagnostic makes the patients to go by long way till the correct diagnosis will be established, and the results of open surgery do not allow them to return to work shortly. Domestic developments in endoscopic visualization are developing, but the process of improvement is on the way to improve the existing one, and not to introduce new directions in surgery.

The history of the carpal tunnel syndrome and its treatment began from 1913 when Marie and Foix recommended a decompression of the median nerves after the autopsy of cadaver with hypotrophy of the tenor muscle.[1] In 1930, Learmoth described his first experience of surgical treatment the carpal tunnel syndrome.[2] In 1966, Phalen published the first big series of the clinical cases of 439 patients with the carpal tunnel syndrome who underwent 654 surgeries.[3] Further, variety of surgical methods were developed (Figure1).[3,4] Many authors described the complications of that operations.[5–7] In 1977, based on own surgical experience, Lanz U.[7] described different variants of location of the median neve.[8] Further development of surgical treatment divided into three branches: improvement of classic methods, development of closed methods, and introducing endoscopic technologies.

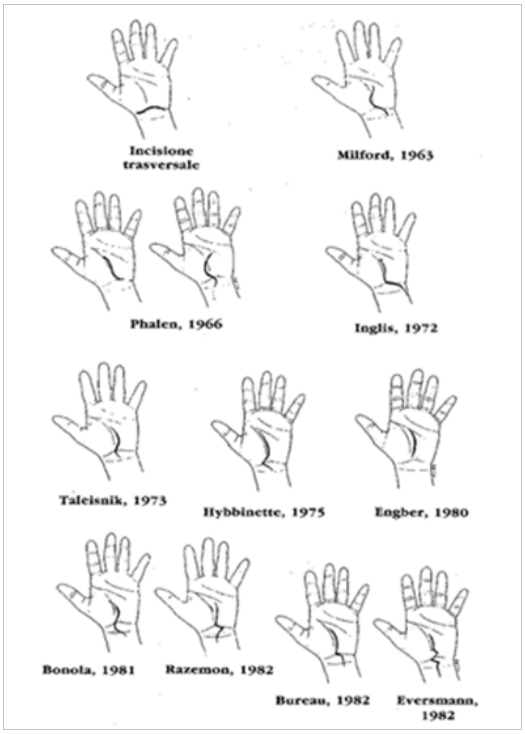

Figure 1 Basic surgical techniques for the carpal tunnel syndrome.

Materials and methods

During the study in 2015-2016, 72 operations using new combined technique were done due to the carpal tunnel syndrome in patients without improvement after consevative treatment. Following criteria were chosen to estimate the effectiveness of proposed method:

i. Progression of the wrist pain syndrome (VAS)

ii. Progression of the wrist sensory disturbances

iii. Incidence rate of the intraoperation surgical complications

iv. Incidence rate of insufficient decompression of the median nerve

v. Duration of hospitalization

vi. Duration of temporary incapacity for work

vii. Incidence rate of symptomatic compression of the median nerve with cicatricial tissue.

We developed and detailed the surgical treatment, defined an optimal technique of the median nerve decompression.

Method description

Surgical access is performed by the skin fold of the radiocarpal joint in the projection of the median nerve entrance into the carpal canal. Anatomic landmarks: for the skin incision, the guide is the skin fold formed when I and V fingers are confronted (corresponds to the projection of the passage of the median nerve in the carpal canal). Incision is performed transversely to the carpal canal, the length is 10-15mm. Visualization of the flexor retinaculum and the exact place of its dissection is performed guiding by the tendon of the flexor of the second finger. If the access is correct, the median nerve is visualized when the tendon is displaced laterally and the carpal ligament is dissected (Figure 2).

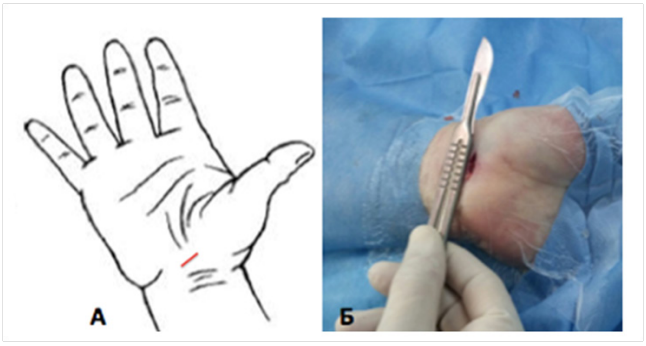

Figure 2 А – topography of the surgical access; Б-Intraoperational view of the access.

The stage of decompression begins from a forming of tunnels above the flexor retinaculum in proximal and distal directions using a surgical scissors with blunt ends. The tunnel is formed bluntly, pushing soft tissues. This manipulation allows to reduce pain postoperatively and to minimize the risk to damage surrounding blood vessels when the ligament is dissected. Dissection of the ligament is performed consequently proximally and distally using the surgical scissors with blunt ends strictly along the projection of the course of the median nerve (Figure 3).

To dissect the ligament in the distal direction, it is important to determine the projection of the palmar arch, which corresponds to the distal edge of the tenor. Closed manipulation without visualization of the dissection distal to this line threatens damage to the palmar arch and developing profuse bleeding, which is practically impossible to stop with this access.

Figure 3 Stage of carpal ligament dissection.

Endoscopic visualization in this technique is the stage of control of completeness of decompression and determining the location of large blood vessels. A rigid endoscope with 0 degree optics and a diameter of 3mm is used. Working insert with a channel for irrigation improves visualization dramatically. This technique allows visualizing the median nerve in details all along the carpal canal, to assess its condition, completeness of decompression, hemostasis (Figure 4).

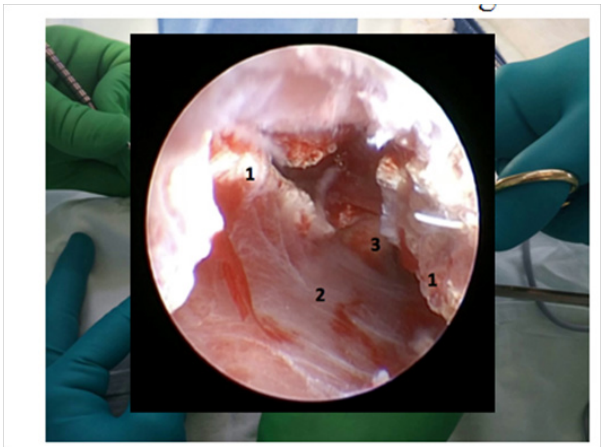

Figure 4 Video endoscopic imaging.

1-carpal ligament

2-median nerve

3-region of the neve split

Monitoring is conducted using intraoperative EMG using the free run mode throughout the surgical procedure and the direct stimulation mode at the stage of the median nerve exposure and after complete the carpal ligament dissection (Figure 5).

A significant difference in M-responses at the stage of visualization and at the end of dissection of the carpal ligament indicates complete decompression of the nerve and improvement of its conductive function (Figure 6).

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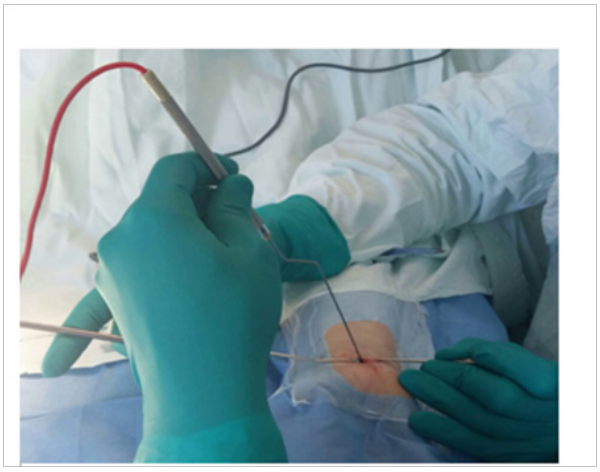

Figure 5 The stage of direct stimulation of the median nerve.

Figure 6 Intraoperative snapshots of the screen of electrophysiologic monitor

А – M-response at the stage of the median nerve visualization

Б – M-response after complete dissection of the carpal ligament

Results and discussion: Evaluation of the pain syndrome changes showed its significant decrease already in firstday after operation and preserving the result for 6months. Average level of the wrist pain by VAS was 6 preoperatively [3;7]; the value deceased to 2 in the first postoperative day [1;3], and it was associated mainly with minor pain in the area of the postoperative wound. During long term follow-up, the average value was 1[0; 2].

Evaluation of the superficial pain perception changes showed moderate decrease from 3[2;4] to 2[2; 3] in the first postoperative day and significant restore of the sensitivity in 6 months to 1[0; 2]. During the studied surgical procedures, significant intraoperative complications were not noted (N=0). US evaluation of the median nerves in 6 months after the surgery showed no cases of insufficient decompression and incomplete dissection of the carpal ligament (N=0).

Average period of staying in hospital was 16days [12;24] due to reduced extent of operation, the lack of need of external sutures (the absorbable sutures were used in subcutaneous fat with and the adhesive composition was applied to the skin), minimal postoperative edema, minimal risk of wound infection.

The assessment of temporary incapacity for work at the control consultation showed no long-term temporary incapacity for work after the surgical treatment, and the average values were 7[5;12]. Ultrasound evaluation of the postoperative cicatrical adhesion process showed a presence of the mass compromising the median nerve in 8.7% of cases, but comparison this diagnostic finding with clinical presentations showed absence of significance in 100% of cases.

All existing and described in the world literature methods can be divided into three types, as mentioned above. Open technique does not allow reduce markedly a surgical trauma, closed technique does not provide visualization, endoscopic method increases expenses for big number of operations due to delicate instruments and complicated sterilization. Offered technique is the combination of endoscopic control and closed decompression. Extent of intraoperative exposure of the median nerve and restore of the conductive function are recorded reliably using intraoperative EMG. Combination of closed decompression, endoscopic control and electrophysiologic monitoring allows minimizing the extent of surgical procedure, risks of postoperative complications (N=0) and insufficient decompression (N=0), period of staying in hospital (average period after operation was 16hours [12;24]), expenses for treatment (cost saving by reduced duration of hospitalization and postoperative analgesia), postoperative cicatrical adhesion process (number of cases of repeated nerve compression with cicatrical tissue was N=0), and rehabilitation period (average period of temporary incapacity for work 7days [5;12]).

Conclusion

i. Combined surgical treatment using endoscopic control and electrophysiologic monitoring reduces significantly the pain syndrome and sensory impairment in early and long-term periods.

ii. Developed technique allows achieving sufficient decompression of the median nerve with minimal risk of intraoperative complications and surgical trauma.

iii. Comparing to the existing methods, application of the described technique provides a possibility to decrease duration of staying in hospital, temporary incapacity for work and long-term postoperative complications.

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Conflicts of interest

The author declares no conflicts of interest.

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