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ORIGINAL ARTICLES

MINI-OPEN CARPAL TUNNEL RELEASE TECHNIQUE

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ABSTRACT

Introduction/Aim: Carpal tunnel syndrome (CST) is the most common cause of upper extremity compressive neuropathy. Until the introduction of endoscopy, the dominant surgical method was classic open surgery. The objective of the paper is to examine the efficacy, safety and economic value of the mini-open carpal tunnel release technique using a longitudinal 2 cm long incision in the carpal region.

Methods: The diagnosis was made based on clinical examination, followed by an ENMG. The study includes only patients with idiopathic CTS, while those who have developed CTS as a result of secondary causes have been excluded from the study. All patients were operated on under local anaesthesia, WALANT, without the use of a tourniquet. A longitudinal incision 2 cm long is made in the line of the radial edge of the ring finger, 2-3 cm distal to the wrist flexion crease, immediately proximal of the Caplan cardinal line and ulnar to the thenar crease. Upon cutting through the skin and subcutaneous soft tissue, the superficial fascia is identified and then cut with the same scalpel in the same direction and the same length. The transversal ligament is then identified and carefully incised with a scalpel enough to allow further decompression with the use of scissors. Using standard surgical scissors for the hand, the ligament is cut proximally to the forearm fascia and then distally until a faint crackling sound is heard, which means that the ligament had been completely cut. This must be checked by inserting the Freer elevator proximally and distally to the edge of the ligament. Now it is possible to identify the nerve and accompanying hand flexor tendons. Sutures are placed only on the skin and a roll of gauze is fixed to the wound with an elastic bandage to provide compression. The first check-up is on the very next day and the patient is advised to start doing hand exercises. The sutures are removed 10-14 days after surgery.

Results: From January 2018 to December 2019, 35 carpal tunnel decompressions were performed on 30 patients using the mini-open decompression technique and standard surgical scissors. The surgery was performed on 22 patients in the operating room and 8 patients in the infirmary. There were no intraoperative complications. All patients reported no night pain from the very first day after surgery. Pillar pain, incision pain and hand weakness were progressively becoming less pronounced during the next 12 weeks. At the final check-up, only one patient still had pronounced symptoms that required a reintervention. The rest of the patients had completely recovered. Even though the endoscopic procedure for carpal tunnel decompression is constantly evolving, the classic open method and newly developed mini-open carpal tunnel release technique remain the treatments of choice.

Conclusion. Our research shows that the mini-open carpal tunnel release technique is a quick, efficient, safe and cheap surgical technique for treating carpal tunnel compressive neuropathy.

Keywords: carpal tunnel syndrome, mini-open release technique, the endoscopic procedure

INTRODUCTION

Carpal tunnel syndrome (CTS) is the most common cause of upper extremity compressive neuropathy. It is two to three times more common in the female population, usually occurring at middle age. It is a serious medical and socio-economic problem since 10% of the population of the USA will develop the syndrome during their lifetime. The treatment costs over 4 billion dollars a year and it can significantly reduce the patient's ability to work. Carpal tunnel syndrome is most commonly idiopathic and the cause is unknown in 90% of the cases. In a smaller percentage, it occurs as a result of a badly set distal radius fracture, inadequate immobilisation of distal radius fracture, in systemic diseases (rheumatoid arthritis, amyloidosis, Raynaud syndrome…), diabetes mellitus, obesity and pregnancy. It can develop as a consequence of tumours inside the carpal tunnel, infection or scarring due to injury in the vicinity of the tunnel. The syndrome is diagnosed based on the patient's complaints (paresthesia in the innervation zone of the median nerve, grip weakness, dropping of objects, hand and finger pain, night pain, numb fingers and in advanced cases hypotrophy of the thenar region and complete disruption of sensibility in the innervation zone of the median nerve), clinical examination which is

most commonly enough to make the diagnosis (positive Phalen's, Durkan's, Semmes-Weinstein and Tinel's test), ENMG testing and occasional ultrasound, CT and MRI diagnostics [1-3].

Idiopathic CTS with mild complaints can be treated conservatively by applying nighttime orthosis and instillation of corticosteroids. In more advanced and serious forms of disease that persist longer, operative treatment is necessary. Learmonth was the first person to describe surgical decompression of the carpal tunnel on a patient with an advanced compressive neuropathy syndrome developed after injury in 1933. Cannon and Love described the nature of idiopathic CTS in 1946. Brain and associates explained the pathophysiology of CTS and described surgical decompression on 6 patients in 1950. During the following years, Phalen and associates published several articles describing the nature of idiopathic CTS and the surgical treatment technique [4]. From this moment on, surgery became the dominant treatment modality for CTS. Up to 1987, open decompression of the carpal tunnel was the only surgical technique available, but that year Okutsu described the endoscopic method of decompressing the canal [5,6]. The popularization of the endoscopic method during the 90s led to a controversy about which method of operative treatment is more efficient, safe and economical. Many articles were published on the subject, some of which prefered the open surgical method and others the endoscopic method. This led surgeons to work on perfecting both of the techniques, further developing the endoscopic procedure, but it also led to the creation and development of the mini-open technique. Today, we can say that three methods of surgical treatment exist: the classic open method, the mini-open technique (with or without the application of guides) and the endoscopic method. Regardless of the advantages and disadvantages of these techniques, research has shown that there is no significant difference in efficacy and that the choice of the method lays only on the surgeon. Even with the development of the endoscopic and mini-open surgical techniques, as well as surgical equipment advances, 30% of the surgeons still prefer the classic open surgical method of decompression. According to the American Academy of Orthopedic Surgeons (AAOS), the key point of surgical treatment success is the adequate visualization of the transverse ligament and median nerve followed by a complete ligament resection [7,8], which is exactly why 30% of the surgeons still prefer the classic open decompression technique [5,9].

OBJECTIVE

To examine the efficacy, safety and economic value of the mini-open carpal tunnel decompression technique performed through a 2cm longitudinal incision in the carpal region.

METHODS

From January 2018 to December 2019, 35 carpal tunnel decompressions were performed on 30 patients using the mini-open decompression technique and standard surgical scissors. The diagnosis was made based on clinical examination, followed by an ENMG. The study only includes patients with idiopathic CTS, while those who have developed CTS as a result of secondary causes have been excluded from the study. All patients were operated on under local anaesthesia, WALANT, without the use of a tourniquet. A standardised anaesthetic solution was used: lidocaine 1% (10 mg/ml) combined with 0.0005 mg/ml epinephrine and 8.4% sodium bicarbonate. The surgery was performed on 22 patients in the operating room and 8 patients in the infirmary.

While preparing for surgery, all patients were taught hand exercises that they would be required to do after the surgery.

SURGICAL TECHNIQUE

The hand is placed in a supine position on the operating table. The surgical field is prepared and 3-5ml of local anaesthetic is applied to the incision region. A longitudinal incision 2cm long is made in the line of the radial edge of the ring finger, 2-3cm distal to the wrist flexion crease, immediately proximal of the Caplan cardinal line and ulnar to the thenar crease [Image 1]. Upon cutting through the skin and subcutaneous soft tissue, the superficial fascia is identified and then cut with the same scalpel in the same direction and the same length [Image 2]. The transversal ligament is then identified and carefully incised with a scalpel enough to allow further decompression with the use of scissors [Image 3,4]. With a blunt Freer elevator, the superficial fascia is raised to visualize the ligament in its entirety, first proximally and then distally. Using standard surgical scissors for the hand, the ligament is cut proximally to the forearm fascia and then distally until a faint crackling sound is heard, which means that the ligament had been completely cut. This must be checked by inserting the Freer elevator proximally and distally to the edge of the ligament. If there is no resistance, the ligament is completely cut. Now it is possible to identify the nerve and accompanying hand flexor tendons [Image 5]. We do not perform nerve neurolysis. Sutures are placed only on the skin and a roll of gauze is fixed to the wound with an elastic bandage to provide compression. The first check-up is on the very next day when the wound is dressed and the patient is advised to start doing hand exercises. The sutures are removed 10-14 days after surgery.

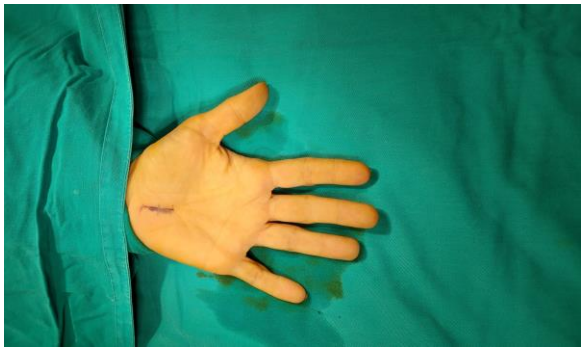

Image 1. Location and length of the incision

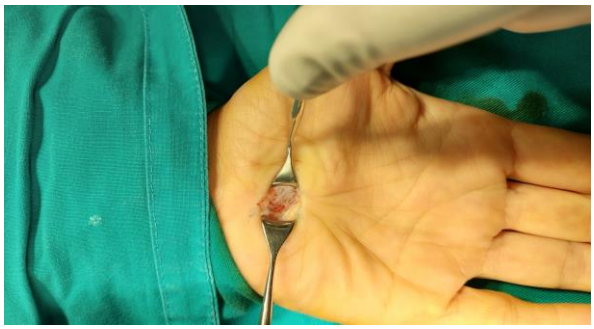

Image 2. Superficial fascia

Image 3. Cutting the transversal ligament with scissors

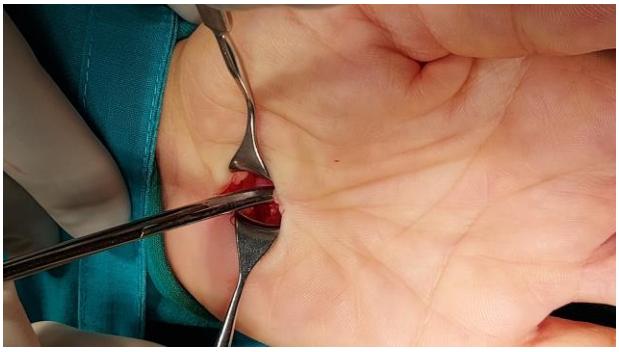

Image 4. Cutting the transversal ligament with scissors

Image 5. The transversal ligament is completely resected, the median nerve is visualized

DISCUSSION

Medium and severe cases of CTS have been successfully treated using different surgical procedures for the last 70 years. Operative treatment enables the patient's quick and safe recovery with a speedy return to usual life activities. Since 10% of the population in the USA have some form of CTS and 500 000 patients are operatively treated annually with the cost of over 4 billion dollars, it is hardly surprising that a lot of research is aimed towards the development and advancement of surgical techniques in treating CTS [10].

Ever since the mid-20th century and articles published by Phalen and associates, surgical treatment has had a dominant role in treating CTS, as most of the patients recover and return to usual life activity in three months.

Until 1987, when Okutsu introduced the endoscopic method, the classic open method was the only surgical technique available. It enables a direct view of the entire length of the transverse ligament and the median nerve, the orientation of the sensory branch of the median nerve and the recurring motor branch, vascular structures and possible anatomic malformations of all structures mentioned. This ensures a safe approach to canal decompression without the risk of damaging some of the vital neurovascular structures of the carpal region. On the other hand, about 10.2% of the patients experienced a complication, most commonly pillar pain (pain in the region of the thenar and hypothenar eminences), pain in the region of the scar, scar hypertrophy or grip weakness [11,12]. With the popularization of the endoscopic procedure, it was noticed that the minimally invasive procedure leads to fewer complications. Pillar pain, scar pain and grip weakness were significantly less pronounced and of shorter duration, which led to a speedier recovery of the patient. It had also been noted that the mini-incision approach in endoscopic procedures usually did not result in hypertrophic or painful scarring. It is thought that the classic open method leads to such complications because the incision goes all the way across the wrist crease and the carpal region, which is rich in small sensory branches. The branches become injured and result in long-lasting pain. The endoscopic procedure also protects the superficial fascia which many consider to be crucial for grip strength preservation, but which must be cut when approaching the transversal ligament during the open procedure. The negative aspect of the endoscopic procedure is the higher level of median nerve paraesthesia after the procedure, which is, however, transitory. It is thought that pushing the endoscope into the canal causes additional trauma and compression of the nerve, which intensifies the patient's symptoms for a short time after the procedure. A small number of cases of direct injury to the median nerve, its motor and sensory branches and digital nerves during the procedure have been reported.

These are very serious complications that leave long-lasting consequences and require reintervention. A reintervention is more common due to an uncomplete transversal ligament resection as well.

These are rare complications of the endoscopic procedure, but they are more common than with the classic open procedure. The downside of the endoscopic procedure is also that it requires very expensive equipment, a long process of educating the surgeon and a significantly higher cost of each procedure due to very expensive consumables that are used [5,7,13-15].

Because of the advantages and disadvantages of both procedures, the mini-open carpal tunnel release technique is developed. It's a procedure that combines aspects of both previously described techniques. On one side, it enables visualization of the transverse ligament and the median nerve just like the classic open method. The canal is approached through a mini-incision, placed longitudinally in the carpal region or transversely at the level of the proximal canal entrance, or through two transverse incisions placed at both the proximal and the distal canal entrances. On the other hand, the mini-incision approach and using a guide are characteristics of the endoscopic procedure. Research has shown that the complications of this procedure are similar to the endoscopic method complications, that they are rarer and less pronounced than with the classic open method, but also that the neurovascular structures are more frequently injured.

Many articles have been published comparing the endoscopic and mini-open techniques [16-18]. Some showed significant advantages of the endoscopic procedure, others the advantages of the mini-open procedure. All in all, based on meta-analyses and cohort studies, it had been concluded that patients treated with the endoscopic method have less pronounced postoperative pain, rarer and less pronounced incidences of pillar pain and scar pain and quicker early recovery. On the other hand, early recovery in mini-open procedures is not as quick, there is more postoperative pain and discomfort, but over time these complaints reduce and the rate of recovery equalizes with the endoscopic procedure. Analysing the condition of patients 3 months postoperatively, studies have shown that there is no difference in the recovery or the presence and severity of the complications. Ho-Jung Kang and associates compared the satisfaction of patients after operations on both hands, one with the endoscopic procedure and the other with the mini-open procedure. They showed that patients prefer the endoscopic procedure because of less postoperative pain and a smaller scar, but do not report a difference in functional recovery [15]. The American Association for Hand Surgery (AAHS) conducted an inquiry among hand surgeons that showed that, regardless of the endoscopic procedure advantages mentioned above, 34% of the surgeons still prefer the classic open method and 46% prefer the mini-open procedure. This means that the potential advantages are not enough to decisively proclaim that the endoscopic procedure is better.

The American Academy of Orthopaedic Surgeons (AAOS) published guidelines in 2016 for treating CTS, emphasizing adequate transversal ligament and median nerve visualization during decompression as well as complete transversal ligament resection [7,8]. This does create a foundation for proclaiming that the open methods are better because the endoscopic method is not yet able to produce such results, which is why reinterventions are more common.

In our department, we treated 30 patients, two-thirds of which were women with complaints more often in the dominant hand, which corresponds with epidemiological research results in published studies. The surgery itself was conducted under local anaesthesia using standard surgical instruments, which significantly reduced the cost of treatment. We didn't use expensive endoscopic equipment, guides for canal decompression or general or regional anaesthesia, which all raise the cost of the procedure, the required time to do the procedure and perioperative recovery. Eight patients were operated on in the infirmary, which additionally lowered the cost of organizing and preparing the operating room. The results of treatment correspond with the results in published studies. We had no intraoperative complications. All patients declared the very next day that they were night-pain free. The largest number of patients had recovered completely 6 weeks postoperatively. We had one reintervention, a painful scar revision, which was the result of sensory nerve endings damage at the level of the incision.

CONCLUSION

Based on all available facts, we can conclude that the mini-open carpal tunnel release technique is a quick, safe and cheap method for treating CTS, which enables the patients a speedy return to their usual life activities.

Conflict of interest: none declared.

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ORIGINALNI RAD

MINI-INCIZIONA TEHNIKA U ZBRINJAVANJU SINDROMA KARPALNOG TUNELA

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SAŽETAK

Uvod/Cilj Sindrom karpalnog tunela (SKT) je najčešći oblik kompresivne neuropatije gornjeg ekstremiteta. Sve do uvođenja endoskopske procedure, klasična otvorena metoda je bila dominantan oblik lečenja. Cilj našeg rada je da se ispita efikasnost, bezbednost i ekonomičnost mini-incizionog pristupa u dekompresiji karpalnog tunela vertikalnim rezom dužine do 2cm u nivou karpalne regije.

Metod rada: Dijagnoza postavljena na osnovu kliničkog pregleda, je potvrđena ENMG ispitivanjem. U studiju su uključeni samo pacijenti sa idiopatskim SKT, dok su oni sa sekundarnim uzročnicima isključeni iz studije. Pacijenti su operisani u uslovima lokalne anestezije, WALANT, bez turnikea. Uzdužni rez dužine 2cm se prostirao u pravcu radijalne ivice domalog prsta, 2-3cm distalno od prevoja ručja, a neposredno proksimalno od Kaplanove kardinalne linije i ulnarno od brazde tenarnog uzvišenja. Po isecanju kože i potkožnog mekog tkiva identifikuje se površna fascija, koja se istim nožem preseca u istom pravcu i dužini. Potom se identifikuje transverzalni ligament, koji se oprezno otvara nožem u dužini koja dozvoljava dalji nastavak dekompresije makazama. Zatim se standarnim hiruškim makazama za šaku pristupa presecanju ligamenta proksimalno do fascije podlaktice, a potom distalno dok se ne čuje blago pucketanje, koje označava da je ligament u potpunosti prekinut. Obavezno se proveri da li je ligament u potpunosti prekinut uvlačenjem Freer elevatora proksimalno i distalno do ivica ligamenta. Sada se može identifikovati nerv i prateće tetive fleksora šake. Po postavljanju sutura na koži, preko rane se stavi gaza u obliku rolne, koja se fiksira elastičnim zavojem radi kompresije operisanog mesta. Prva kontrola je narednog dana i tada se savetuje sprovođenje preporučenih vežbi za šaku, dok se konci uklanjaju 10-14. postoperativnog dana.

Rezultati Od januara 2018. godine do decembra 2019. godine na našem odeljenju je urađeno 35 dekompresija karpalnog tunela kod 30 pacijenata koristeći mini-incizioni pristup i standardne hiruške makaze. U operacionoj sali operacionog bloka bolnice su operisana 22 pacijenta, dok je ostalih 8 pacijenata operisano u ambulatnim uslovima. Nismo imali ni jednu intraoperativnu komplikaciju. Svi pacijenti već prvog postoperativnog dana nisu imali noćne tegobe. Bol u pilarnoj regiji, regiji operativnog reza i slabost hvata se progresivno smanjivao tokom perioda od 12 nedelja, da bi na poslednjoj kontroli samo jedan pacijent i dalje imao intezivne tegobe koje su zahtevale reintervenciju. Svi ostali pacijenti su se u potpunosti oporavili.

Zaključak Bez obzira na razvoj i usavršavanje endoskopske procedure dekompresije karpalnog tunela, dominantni oblici operativnog lečenja su i dalje klasična otvorena metoda i novorazvijene mini-incizione metode dekompresije. Na našoj seriji smo pokazali da je mini-inciziona metoda brza, efikasna, bezbedna i ekonomična metoda operativnog lečenja kompresivne neuropatije karpalnog tunela.

Ključne reči: sindrom karpalnog tunela, mini-inciziona tehnika, endoskopska tehnika