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Association between stenosing tenosynovitis and carpal tunnel syndrome: retrospective case series study

Mantas Fomkinas[1], Aurimas Dobilinskas[1], Ernest Zacharevskij[1], Kęstutis Braziulis[1], Rytis Rimdeika[1]

[1]Hospital of Lithuanian University of Health Sciences Kaunas Clinics, Department of Plastic and Reconstructive Surgery, Kaunas, Lithuania

Abstract

Background and aim. To evaluate the relationship of stenosing tenosynovitis (ST) and carpal tunnel syndrome (CTS), including development of these conditions after surgery for the other.

Materials and methods. A case series analysis reviewed subjects with ST and CTS treated surgically. All patients included were over the age of 18 and had annulotomy or retinaculotomy performed. Patients with recurrent disease were excluded. Data collection and analysis accounted for the type of procedure performed, time period of these conditions development. Data analysis was performed using IBM SPSS software. Results with values of $p < 0,05$ were considered statistically significant.

Results. There was a total of 1858 patients (mean age 60.05, SD 13.57) – 400 men (21.5%) and 1458 women (78.5%). 1406 patients were diagnosed with CTS, 345 – ST and 107 – both pathologies. It was found that the rate of development of CTS after annulotomy (4.1%) was statistically significantly higher ($p < 0.05$) than the rate of development of ST after retinaculotomy (1.6%) ($p > 0.05$). The CTS after annulotomy most commonly occurs after more than 12 months ($p = 0.003$), while ST after retinaculotomy – after 6 – 12 months ($p > 0.05$).

Conclusion. ST and CTS are often diagnosed concomitantly, although tend to develop after the surgical treatment for each other. The rate of development of CTS after annulotomy is significantly higher than the rate of development of ST after retinaculotomy. The CTS after annulotomy most commonly occurs after more than 12 months, while ST after retinaculotomy – after 6 – 12 months.

Keywords: carpal tunnel syndrome, stenosing tenosynovitis, trigger digit, carpal tunnel release, retinaculotomy, annulotomy.

Ryšys tarp stenozuojančio tenosinovito ir riešo kanalo tunelinio sindromo: retrospektyvinis atvejų grupės tyrimas

Mantas Fomkinas[1], Aurimas Dobilinskas[1], Ernest Zacharevskij[2], Kęstutis Braziulis[1], Rytis Rimdeika[1]

[1]Lietuvos sveikatos mokslų universiteto ligoninė Kauno klinikos, Plastinės ir rekonstrukcinės chirurgijos klinika, Kaunas, Lietuva

Santrauka

Tikslas. Nustatyti retinakulotomijos ar anulotomijos įtaką stenozuojančio tenosinovito (ST) ar riešo kanalo tunelinio sindromo (RKTS) išsivystymui.

Tyrimo metodai. Atliktas retrospektyvinis tiriamasis darbas Lietuvos sveikatos mokslų universiteto ligoninėje Kauno Klinikose Plastinės ir rekonstrukcinės chirurgijos klinikoje. Į tyrimą įtraukti 2012 – 2017 metais dėl RKTS ir ST operuoti pacientai. Pacientų įtraukimo kriterijai: amžius daugiau negu 18 metų ir atlikta operacija dėl RKTS arba ST toje pačioje rankoje. Pacientai, kuriems atliktos abi operacijos skirtingose plaštakose ar po operacijos pasireiškė ligos atsikartojimas, tyrime nedalyvavo. Išanalizavus duomenis, nustatytas atliktos operacijos tipas ir laikotarpis tarp abiejų ligų pasireiškimo vienam pacientui. Statistinė duomenų analizė atlikta naudojant SPSS programą. Statistiškai reikšmingi skirtumai nustatyti, kai $p < 0,05$.

Rezultatai. Į tyrimą įtraukti 1858 pacientai (vidutinis amžius 60,05 ± 13,57) – 400 vyrų (21,5%) ir 1458 moterų (78,5%). 1406 pacientams nustatytas tik RKTS, 345 – tik ST ir 107 pacientams – nustatytos abi patologijos. Nustatytas statistiškai reikšmingas skirtumas ($p < 0,05$), kad RKTS po anulotomijos atsiranda dažniau (4,1%), negu ST atsiradimas po retinakulotomijos (1,6%) ($p > 0,05$). RKTS po anulotomijos dažniausiai atsiranda po daugiau nei 12 mėnesių ($p = 0,003$), o ST po retinakulotomijos dažniausiai atsiranda po 6 – 12 mėnesių ($p > 0,05$).

Išvados. ST ir RKTS dažnai diagnozuojami kartu, nors dažnai išsivysto po taikyto chirurginio gydymo. RKTS po anulotomijos atsiranda reikšmingai dažniau, negu ST po retinakulotomijos. RKTS po anulotomijos dažniausiai išsivysto praėjus daugiau nei 12 mėnesių po operacijos, tuo tarpu ST po retinakulotomijos išsivysto praėjus 6 – 12 mėnesių.

Raktažodžiai: riešo kanalo tunelinis sindromas, stenozuojantis tenosinovitas, retinakulotomija, anulotomija.

1. Introduction

Carpal tunnel syndrome (CTS) and stenosing tenosynovitis (ST) are one of the most common disorders, treated by Hand or Plastic and Reconstructive surgeons [1]. Some studies have suggested that carpal tunnel syndrome is associated with the occurrence of stenosing tenosynovitis in the same patient or that these two conditions may present simultaneously [2]. It has been observed and reported that symptoms and clinical signs of stenosing tenosynovitis occur several weeks or months after surgery of carpal tunnel release. Herada et al. (2005) study found that the incidence of stenosing tenosynovitis after carpal tunnel release surgical procedure was 5.9% [3].

Carpal tunnel syndrome is a chronic compressive hand neuropathy caused by compression of the median nerve in the carpal tunnel, characterized by pain, numbness and the arm weakness [4]. The incidence of carpal tunnel syndrome in the general population ranges from 2.7 to 5.8% [5-7]. Women have been reported to be 2 – 3 times more likely to be affected than men [5, 8], especially after the fifth decade of life [6]. The carpal tunnel is a narrow canal in the palmar side of the wrist that is bounded on all sides. The carpal tunnel protects ten structures – median nerve, tendon of the flexor pollicis longus, four tendons of the flexor digitorum superficialis and four tendons of the flexor digitorum profundus [9]. Carpal tunnel syndrome usually occurs when the pressure in the carpal canal increases for various reasons, causing irritation, ischemia and damage of the median nerve [8-10]. Inflammation of any of these nine tendons can cause it to thicken. Likewise anatomical compression can result in the formation of non-inflammatory fibrosis, which limits the flexor tendons [8].

Stenosing tenosynovitis is the result of compression of a tendon with a fibrin ligament. It is associated with irritation and inflammatory process as well as disruption of smooth tendon movements. Disprepancies in tendon and canal thickness can become painful. Finger catching or locking occurs when a stiffened tendon enters a narrower space bounded by A1 pulley [11-14]. The lifetime risk of stenosing tenosynovitis in the general population is estimated at 2.6%, which is several times higher in patients with diabetes [15, 16]. Analyzing the epidemiology and etiology of this disease, two peaks of morbidity are observed. The first peak is up to 8 years old (usually 1 – 4 years old), which is equally common in boys and girls [12, 17]. The second peak is between 45 and 60 years old, 3 times more common in women [15]. Stenosing tenosynovitis most commonly occur in the tendon sheath, which includes the tendons of the abductor pollicis longus and the extensor pollicis brevis. It also frequently affects the tendons of the flexor digitorum superficialis and profundus of the two middle fingers. It is less common in the tendon of the flexor pollicis longus muscle and metacarpophalangeal joints. [18] Stenosing tenosyvitis, which involved the tendons of the abductor pollicis longus and the extensor pollicis brevis muscle, was described by a Swiss surgeon de Quervain in 1895 and was named after him – de Quervain syndrome (disease) [19]. Stenosing tenosynovitis is usually associated with prolonged flexion and extension of the thumb and other fingers resulting in hardening of the tendons sheaths and increased friction. In cases of prolonged disease, the tendon sheath thickens and increases in size for 3 – 4 times [20, 21].

One of the causes of carpal tunnel syndrome and stenosing tenosynovitis is the inflammatory process. Therefore it is believed that these two pathologies are related [22]. The incidence of carpal tunnel syndrome in general population ranges from 2.7 to 5.8% [5-7], of which, from 7.7

to 23% are affected by stenosing tenosynovitis [1]. In both cases, the diseases are most prevalent in persons between the age of 40 – 60 and more often occurs in women than in men [7]. Diseases are similar in nature and share common characteristics and risk factors. These are spontaneous nonspecific disorders in which symptoms result from changes in pressure in the cannals. Flexor tendons sheaths or flexor retinaculum thickening is significant for the development of the carpal tunnel syndrome, whereas flexor tendons or A1 pulley thickening is important in the pathophysiology of stenosing tenosynovitis. The inflammatory reaction of the tendons sheaths is likewise observed in both diseases [1]. Disease development is induced by repetitive occupational microtraumas or by working with vibrating devices, especially at low ambient temperatures, prolonged wrist or palm pressure, prolonged extension or flexion of the hand [23, 24]. Endocrine and metabolic disorders, particularly in the presence of diabetes mellitus or hypothyroidism, have been found to influence the co-existence of both pathologies [7, 25]. Carpal tunnel syndrome may occur with stenosing tenosynovitis due to inflammatory process of flexor tendons [2, 3, 7].

Therefore our study objective is to evaluate the relationship of stenosing tenosynovitis and carpal tunnel syndrome, development of these conditions after annulotomy and carpal tunnel release (retinaculotomy).

2. Materials and methods

A case series analysis has enrolled 1858 patients admitted to the department of Plastic and Reconstructive Surgery in Hospital of Lithuanian University of Health Sciences Kaunas Clinics due to the need of elective surgical care for carpal tunnel syndrome (CTS) and/or stenosing tenosynovitis (ST) in 2012 – 2017. The research related to the use of patients medical documentation has been complied with all the relevant national regulations, institutional policies and in accordance the tenets of the Helsinki Declaration, and has been approved by the authors' institutional review board or equivalent committee.

The main diagnosis was determined from medical documentation based on data of clinical signs and physical examination. Carpal tunnel syndrome was diagnosed by numbness or tingling in the innervated area of the median nerve, soreness and numbness during night-time sleep, Tinel's and Phalen's positive tests. All patients with carpal tunnel syndrome have undergone nerve conduction testing and electroneuromyography. Stenosing tenosynovitis has been diagnosed by physical examination. Patient inclusion criteria: age over 18 and performed surgery for CTS and/or ST. Patients with recurrence of the disease after surgery were excluded from the study.

The age, sex, type of surgery performed and the time to onset of both diseases per patient were determined after analyzing the data. Data was analyzed using IBM SPSS (Statistical Package for Social Sciences) version 25 statistical package and methods of descriptive statistics. Chi square criterion ($\chi 2$) was used to estimate statistically significant difference between different groups of patients. For hypothesis testing significance level of $p < 0,05$ was chosen.

3. Results

The study has included 1858 patients (mean age 60.05, SD 13.57). Study sample consisted of 400 men (21.5%) and 1458 women (78.5%). Carpal tunnel syndrome was diagnosed for 1406 patients, stenosing tenosynovitis – 345 patients and both pathologies – 107 patients. The distribution of men and women by pathology is presented in Figure 1.

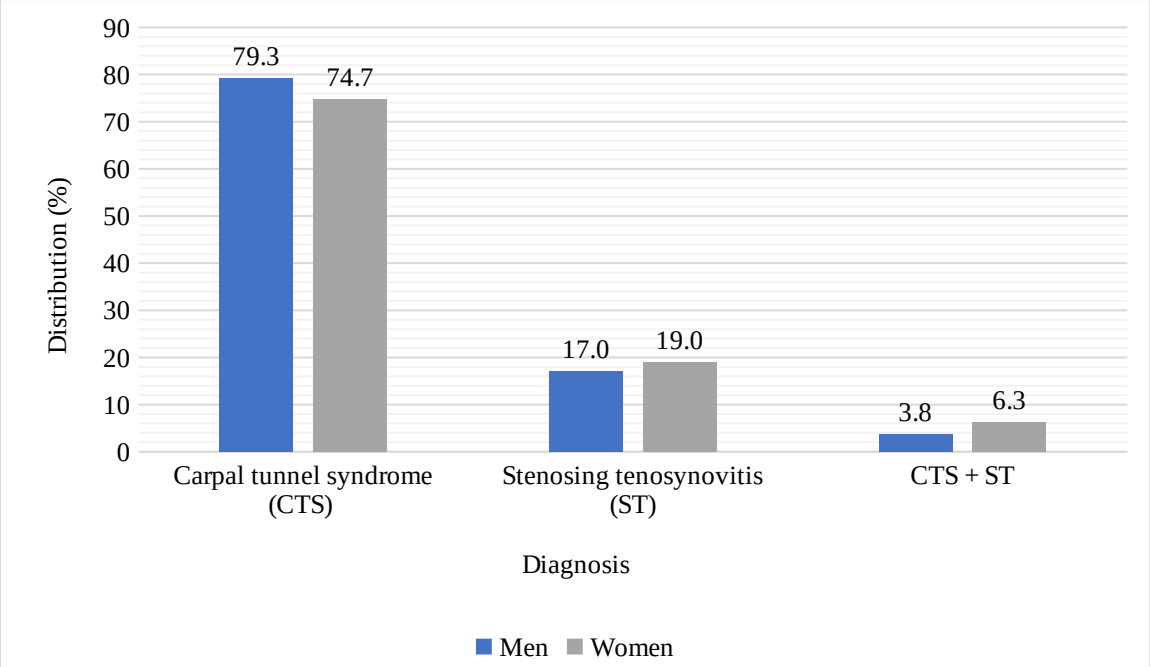


Figure 1. Study sample distribution by gender and pathology

317 (79.3%) men underwent surgical treatment for CTS, 68 (17.0%) for ST and 15 (3.8%) for both disorders. 1089 (74.7%) females underwent surgical treatment for CTS, 277 (19.0%) for ST and 92 (6.3%) for both disorders (Table 1). Female patients were more likely than male to have both conditions, although no statistically significant difference was found (p = 0.077).

Table 1. Study sample distribution by pathology

	In total		**ST**		**CTS**		**ST + CTS**	
	N	**%**	**N**	**%**	**N**	**%**	**N**	**%**
Males	400	21,5	68	17,0	317	79.2	15	3.8
Females	1458	78,5	277	19.0	1089	74.2	92	6.3
All patients	1858	100.0	345	18.6	1406	74.7	107	5.8

ST – stenosing tenosynovitis, CTS – carpal tunnel syndrome, N - number of individuals, % - percentage of individuals.

The mean age of patients treated for ST was 57.90 (SD 13.23), for CTS – 60.52 (SD 13.78) and for both pathologies – 60.84 (SD 11.13). A statistically significant difference was found between men and women with stenosing tenosynovitis respectively at 57.38 (SD 14.89) and 57.43 (SD 13.87) years, compared with patients with carpal tunnel syndrome respectively at 62.36 (SD 14.26) and 59.96 (SD 13.59) years (< 0.05). The mean age of patients with both disorders accordingly was 62.47 (SD 10.25) and 60.11 (SD 12.79) years (Figure 2).

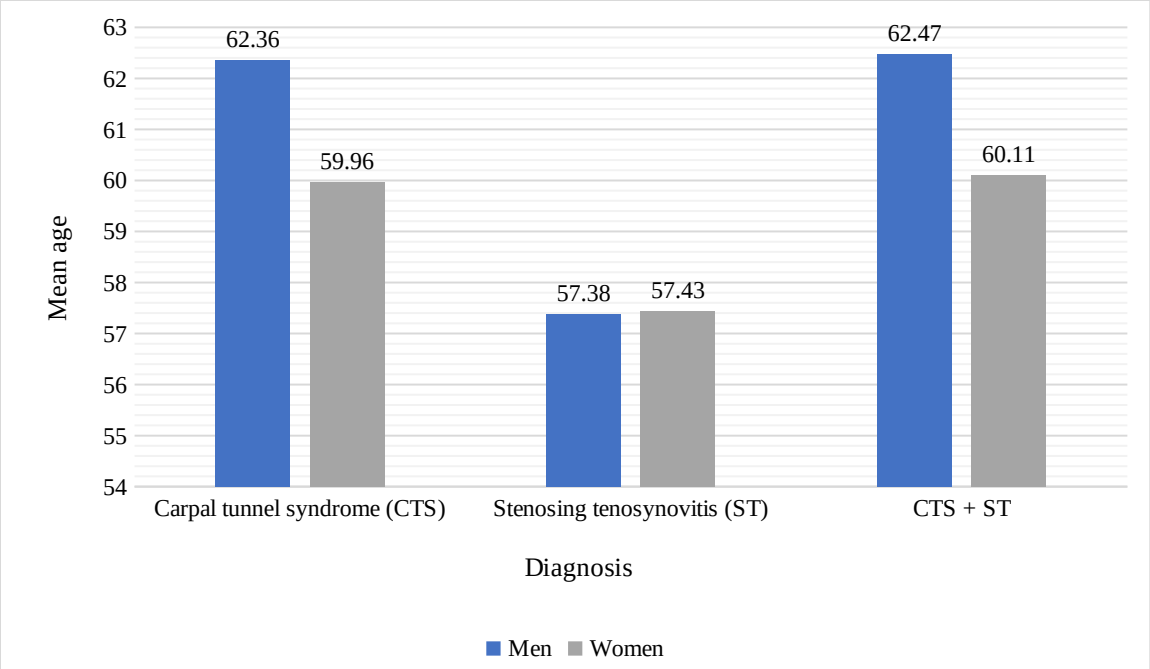


Figure 2. Study sample distribution by age, gender and pathology

A statistically significant difference ($p < 0.05$) was found in the incidence of carpal tunnel syndrome following stenosing tenosynovitis surgical treatment – annulotomy (4.1%), compared to the occurrence of stenosing tenosynovitis after carpal tunnel release surgical procedure (1.6%) (Table 2).

Table 2. The incidence of disease after surgical treatment

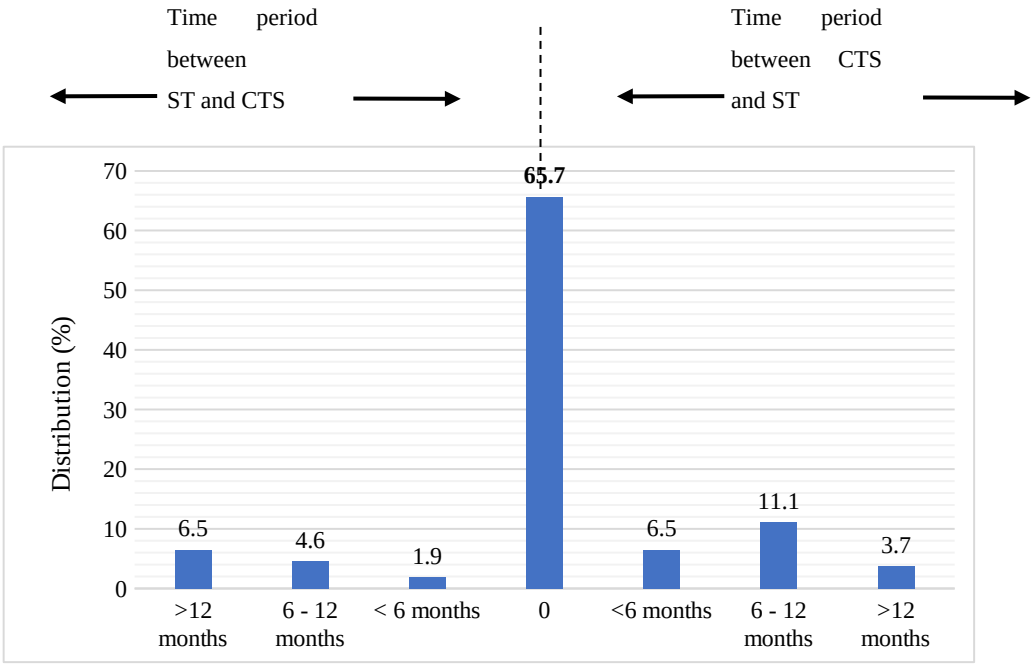
	CTS		**ST**		***χ2***	***df***	***p***
	N	**%**	**N**	**%**			
In total	1406	98,4	345	95.9	7,401	1	0.011
Another pathology occurrence after surgical treatment	23	1.6	14	4.1			

ST – stenosing tenosynovitis, CTS – carpal tunnel syndrome, N - number of individuals, % - percentage of individuals, χ2 – chi square criterion, df – degrees of freedom, p – significance level.

Carpal tunnel syndrome usually occurs afterwards more than 12 months after annulotomy ($p = 0.003$) and stenosing tenosynovitis usually occurs afterwards 6 – 12 months after carpal tunnel release surgery ($p > 0\ 05$) (Figure 3).

Stenosing tenosynovitis have affected both hands in 48.8% of the cases, while both pathologies have affected both hands simultaneously in 4.7% of the cases. The right hand was the most frequently affected by carpal tunnel syndrome (77.1%) ($p < 0.05$). Generally, both hands most commonly have been affected in women ($p < 0.05$).

Figure 3. Time periods between surgical treatment of hand pathologies – carpal tunnel syndrome (CTS) and stenosing tenosynovitis (ST)



4. Discussion

Our study has demonstrated association between carpal tunnel syndrome (CTS) and stenosing tenosynovitis (ST) and an increased risk of development after the surgery. We found that after surgical treatment of ST, carpal tunnel syndrome has developed in 4.1% of the cases and stenosing tenosynovitis after surgical treatment of CTS in 1.6% cases. Similar results have been observed in other authors' published researches. Harada et al. (2005) study found that 11.5% of 875 patients have developed stenosing tenosynovitis within three years after carpal tunnel release surgery, which resulted in another surgical procedure (annulotomy). It has been reported in the literature that the incidence of stenosing tenosynovitis as a complication of carpal tunnel release surgical treatment is from 5.9 to 25% [3]. Goshtasby et al. (2010) conducted a study which found the incidence of stenosing tenosynovitis after carpal tunnel release to be 6.3% [7]. Lin et al. (2017) executed a cohort study comparing the incidence of stenosing tenosynovitis in patients who were surgically treated for CTS. It was determined that patients had the risk of stenosing tenosynovitis increased 3.7 fold after CTS surgical treatment [26].

Kutsumi et al. (2005) have reported that during flexion or extension of the wrist, friction between the tendons and the transverse carpal ligament is increased. At higher angles between them, the friction increases accordingly. Excessive friction can cause damage to the tendons or ligament surface, which cause inflammation of the tendons sheaths. Inflammatory factors are formed and breaks down the glycoproteins on the surface of the tendons and transverse carpal ligament, which in addition increase friction. Due to these reasons, permanent repetitive damage to these anatomical structures occur. Stenosing tenosynovitis after surgery of CTS can be explained by volar migration of the flexor tendons. This alteration results in greater friction between the tendons of flexor digitorum superficialis and the A1 pulley.

Consequently of these transitions, the flexor tendons with its sheaths catches or locks in the relatively narrower A1 pulley [22, 27].

In our study, carpal tunnel syndrome most commonly occured more than 12 months after surgical treatment for ST (p =0 003), and stenosing tenosynovitis after 6 – 12 months after surgical treatment for CTS. Lin et al. (2017) study have shown a 9.65 times higher relative risk for stenosing tenosynovitis development in the first 6 months after CTS surgical treatment [26]. Wessel et al. (2012) have described the time periods between patients undergoing surgery for both pathologies. The authors found that carpal tunnel syndrome usually develops after more than 18 months after annulotomy and stenosing tenosynovitis develops during the first 6 months after carpal tunnel release [1]. Based on the available data, we can conclude that stenosing tenosynovitis develops more rapidly following carpal tunnel release surgery. We believe that surgical treatment of CTS may influence the onset of stenosing tenosynovitis. However, we cannot claim that the surgical outcome of stenosing tenosynovitis is CTS. Both pathologies can occur in the same patient due to predisposition to the inflammatory process. The results obtained in our study and in other authors studies are similar and show a dependence on the development of stenosing tenosynovitis after surgical treatment of the carpal tunnel syndrome.

It is important to keep in mind the possible errors and evaluate the results with caution whereas we have only examined the relationship between ST and CTS surgical treatment and have no data on the usage of conservative treatment and the time from diagnosis to surgery. Knowing that both pathologies have common risk factors in observed population and both are associated with inflammatory process, therefore spontaneous onset of diseases in the same patient is common and does not necessarily have a specific causative relationship to the performed surgical procedure. However, while being cautious about the limitations of our study, it should be emphasized that stenosing tenosynovitis after CTS surgical treatment, as mentioned in the studies cited above, occurs after 6 months and may be explained by postoperative inflammatory changes. Unlike the occurrence of stenosing tenosynovitis after CTS surgical treatment, the development of carpal tunnel syndrome after ST surgical treatment is not specifically mentioned in the literature. The results in our study are not statistically significant and the time from annulotomy to carpal tunnel release was usually more than 12 months, therefore in the absence of any possible pathophysiological explanation this case should be ruled out as potential causative relationship of CTS.

5. Conclusions

1. The rate of development of carpal tunnel syndrome after surgical treatment for stenosing tenosynovitis is statistically higher than the rate of development of stenosing tenosynovitis after carpal tunnel syndrome surgery.
2. The carpal tunnel syndrome after stenosing tenosynovitis surgical treatment most commonly occurs after more than 12 months, while stenosing tenosynovitis after carpal tunnel syndrome surgical treatment most commonly occurs after 6 – 12 months.

6. Statements and declarations

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No funds, grants or other support was received for conducting this study.

Competing interests

All authors certify that they have no affiliations with or involvement in any organization or entity

with any financial interest or non-financial interest in the subject matter or materials discussed in this manuscript.

Ethics approval

Ethical approval was received by the local Bioethics Center of Lithuanian University of Health Sciences. This research study was conducted retrospectively from data obtained for clinical purposes and all the procedures being performed were part of the routine medical care.

Consent to participate and publish

This research study was conducted retrospectively from data obtained for clinical purposes. We consulted extensively with the Bioethics Center of Lithuanian University of Health Sciences who determined that our study did not need informed consent regarding participation and publishing of this research because data was depersonalized, encoded and data of patients who signed to not be included in educational and scientific processes was excluded.

Data availability

Research data is not publicly available because of patient healthcare data protection.

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