

Outcomes of surgery for giant cell tumors of the tendon sheath within the hand

Authors' Contribution:

A – Study Design
B – Data Collection
C – Statistical Analysis
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Andrzej Żyluk^{ABCDEF}, Ada Owczarska^B

Department of General and Hand Surgery, Pomeranian Medical University in Szczecin, Poland;
Head: prof. Andrzej Żyluk MD PhD

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ABSTRACT:

Introduction: Giant cell tumor of the tendon sheath is the most common benign proliferative lesion involving the upper limb, characterized by relatively high recurrence rate after surgery.

Aim: The objective of the study was a retrospective analysis of outcomes of the operative treatment of these tumors, in a long-term (a mean of 4,2 year) follow-up.

Material and methods: Preoperative examination was performed in 58 patients, 36 females (62%) and 22 males (38%), in a mean age of 41 years, and treatment outcomes were assessed in 47 persons (81% of the operated patients), at a mean of 4.2-year follow-up. The final assessment was performed in a form of phone interview.

Results: The most common site of the tumors was the fingers – 42 cases (72%). In 31 patients (53%) the lesion had a well-defined capsule, and in 11 (19%) a satellite nodule was found around the main tumor. A total of 9 relapses (21%) occurred, all within the first 2 years following surgery. Two patients had a next episode of recurrence after the second operation. In 8 out of the 9 patients with a recurrence, the primary lesion did not have a well-defined capsule. In 38 patients who had no relapse, 31 were completely symptom-free, whereas 7 complained of mild pain of the scar and/or numbness of a part of the involved finger.

Conclusions: The main factor that impacted the high rate of recurrence was incomplete tumor excision, which resulted from inadequately accurate surgery and the tumor morphology (having no well-defend capsule). The role of operating with the use of magnifying devices and keeping a greater surgical margin at resection of the non-capsulated lesions was emphasized, as it could translate into reducing the recurrence rate.

KEYWORDS:

giant cell tumor of the tendon sheath, hand tumor, soft tissue tumor, tendon sheath

INTRODUCTION

Giant cell tumor of the tendon sheath is the most common proliferative lesion in the upper extremities. Another older name for this tumor found in the literature is “villonodular synovitis”.

Giant cell tumor belongs to the family of benign hyperplastic lesions that originate in the synovial membrane, tendon sheath or synovial bursa [1–7]. The reason behind giant cell tumor is reactive or regenerative hypertrophy of synovial membrane in the tendon, accompanied by a mildly severe inflammatory component [7–9]. In histological examination, the tumor has a heterogeneous structure and consists of:

- polynuclear osteoclast-like giant cells,
- histiocytes,
- xanthine cells containing yellow-colored lipid deposits,
- deposits of fibrin and hemosiderin, which give the cross-section a yellow-brown color.

Giant cell tumors of the tendon sheath have a mixed structure, malignant and inflammatory. This tumor involves both sexes at any age, but it is more common in women aged 40–60 years [1–8]. In a clinical setting, the condition appears as a slow-growing mass located on the finger and, more rarely, on the metacarpus or wrist.

Most giant cell tumors are asymptomatic, but in some patients they can cause pain or impair mobility of the fingers. The main nodule may be accompanied by satellite nodules, spaced at a distance of a few or several millimeters. These nodules can be characterized as benign and there is no risk of malignant transformation with a longer growth rate or larger sizes [9–11].

Diagnosis is made on the basis of clinical examination and in most cases, it does not require imaging examinations. In rare instances, when the tumor compresses the phalanx, it can create an impression on the cortex, visible in the X-ray image. Ultrasound allows to confirm a solid hyperplastic lesion within the finger, and magnetic resonance imaging shows the precise ratio of tumor tissue to the neighboring structures, such as joints, nerves or vessels [12–14].

Ultrasonography and magnetic resonance tomography, as well as biopsy, are rarely used in the diagnosis of hand nodules, because the vast majority of these nodules are benign changes and can be radically excised during the first operation. The Al-Qattan classification distinguishes between 2 types of tumor:

- type 1 involves a single lesion surrounded by a capsule of different thickness,
- type 2 involves the existence of several nodules that do not have a well-developed connective tissue membrane (Tab. I.) [15].

No work has been published in the Polish literature on the results of treatment of these frequent hyperplastic changes in the hand, which has prompted the authors to write this article.

The aim of this retrospective study was to analyze the results of surgical treatment of giant-cell tumors of the tendon sheath in the hand, after a relatively long (on average 4-year) follow-up.

MATERIAL AND METHODS

In 2013–2014, 58 patients, i.e. 36 women (62%) and 22 men (38%), aged 41 years (range 31–55) with nodules, underwent surgery at the Department of General and Hand Surgery of the Pomeranian Medical University in Szczecin; histopathological examination revealed giant cell tumors of the tendon sheath. The diagnosis was made on the basis of clinical symptoms, i.e. a visible nodule on the hand. Twelve patients had ultrasound examination done in their own scope. Ultrasonography confirmed the presence of a solid nodule within the finger or hand, without a specified relationship with a concrete tissue, e.g. a tendon or joint capsule. X-rays were not routinely taken before surgery. All patients were operated on; finger lesions were excised under local anesthesia and ischemia in the form of a rubber ring fixed on the base of the finger. Nodules on the metacarpus and wrist were excised in the brachial plexus block and with a tourniquet fixed over the shoulder. Attempts were made to excise whole tumors, and if the tumors had a capsule – to enucleate them. Magnification devices (magnifier loupes) were not routinely used during the operation, although some of the operators did reach for them. The post-operative wound was closed with sutures. The excised tumors were sent for histopathological examination. The inclusion criteria of patients included a histopathological result confirming the diagnosis of giant cell tumor of the tendon sheath. Patients were followed up after on average 4.2 years of surgery (range 3–5 years). There was a telephone interview follow-up, in which patients were asked about: recurrence of nodules, symptoms in the operated site and possible hand dysfunction. Follow-up examination was carried out in 47 patients (81%) from the operated group.

RESULTS

The most common location of the nodules was the fingers – 42 cases (72%), the dorsal side in 25 patients (43%) and the palmar side in 17 (29%) patients. In 9 patients (16%) the nodules were located on the wrist, and in 7 (12%) on the palmar side of the metacarpus. The most frequently involved was the index finger – 13 cases (31%) and the middle finger – 10 (24%), followed by the thumb – 8 (19%), the ring finger – 6 (14%) and the little finger – 5 (12%) cases. The mean duration between observance of lesion to surgery was 14 months (range 4–56). The nodules were asymptomatic in the vast majority of cases; only 8 patients (14%) experienced a slight pain when grasping objects when the tumor was located on the palmar side of the finger. It was noted intraoperatively whether the nodule had a well-developed capsule and whether it had satellite nodules. In 31 patients (53%), the nodule was encapsulated (Fig. 1.), while 27 (47%) patients did not have a developed capsule (Fig. 2A.–C.), and 11 (19%) had 1 to 3 satellite nodules, which were excised together with the main lesion. In one patient, the nodule on the wrist was of considerable size (2.5 x 2 cm), which is unique for this type of disease (Fig. 3A., B.). The postoperative course was uneventful in 51 patients,



Fig. 1. Intraoperative image of enucleation of a well-encapsulated giant cell tumor of the tendon sheath on the little finger.

and in 7 (12%) there was an inflammatory response in wound healing, which required a few days of antibiotic therapy. In 3 persons (5%) the wound was suppurating and stayed “open” while healing. In all patients, the wound ultimately healed.

A follow-up telephone interview was carried out in 47 patients (81%). During the average 4.2-year follow-up, there were 9 recurrences (21%), which required a second operation. All recurrences took place within the first 2 years after surgery (range 7–24 months): 5 on the operated finger, 2 on the metacarpus and 2 on the wrist. Two patients had next relapse after the second operation. In 8 of the 9 patients who experienced a recurrence, the tumor resected at the first operation had not well-defined capsule. Of the 38 patients with no recurrence, 31 were asymptomatic and 7 (18%) complained of minor pain of the scar at the site of surgery and/or finger numbness, which did not impair hand function in any of the patients.

DISCUSSION

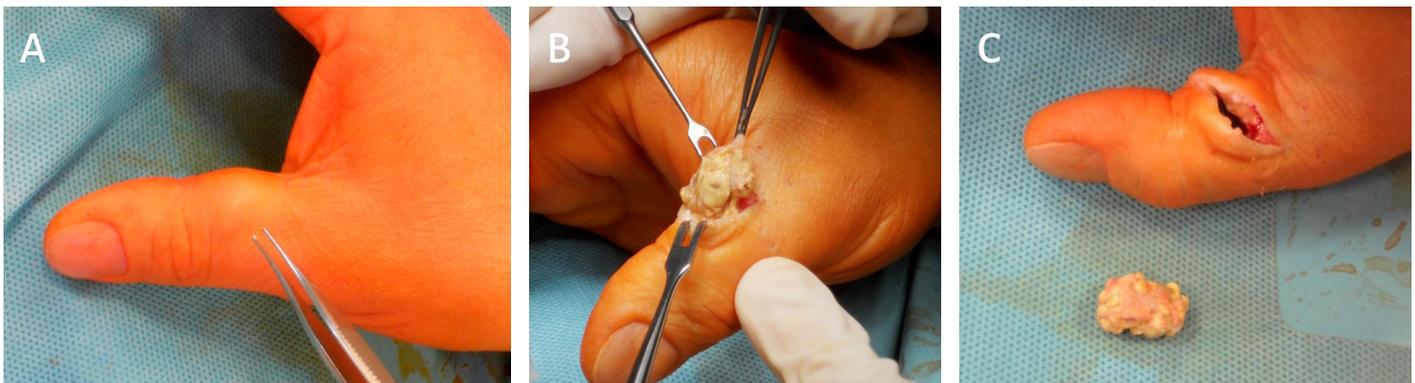
The presented outcomes in the treatment of giant cell tumors of the tendon sheath in the hand indicate that it is a moderately common disease in surgical practice; one that is associated with relatively high recurrence. Nine cases of a recurrence (21%) are relatively high compared to the findings from the literature in the last 10 years (Tab. II.). There may be several reasons for such results but according to the authors, the most important was the lack of due care in the operation, i.e. excision of nodules without an adequate margin, sometimes in fragments, and the performance of surgery in most cases without magnifying devices. All these factors pose a risk of incomplete excision of the nodule, especially when it does not have a well-developed capsule or when it is accompanied by satellite nodules. Admittedly, the operations were performed with a standard technique but it seems that in cases of suspected giant cell nodule of the tendon sheath in the hand, the lesion should be excised as accurately as possible. Another factor that could be of importance was the lack of a well-developed capsule at the first operation in 8 of the 9 patients who had a recurrence. The authors did not evaluate the tumors on the Al-Qattan scale, but the absence of a capsule represents one of the type 2 attributes of this classification.

Tab. I. Al Qattan classification of tendon sheath giant cell tumors.**TYPE I: THE ENTIRE NODULE IS SURROUNDED BY A CAPSULE OF VARYING THICKNESS**

- a. Solitary nodule surrounded by a well-defined and relatively thick capsule,
- b. Solitary nodule surrounded by a relatively thin capsule,
- c. Lobar nodule with a common capsule.

TYPE II: THE ENTIRE NODULE IS NOT SURROUNDED BY A CAPSULE

- a. The main nodule has a capsule but is accompanied by a separate satellite lesion without a capsule,
- b. Widespread type: several side-by-side nodules without a capsule,
- c. Polycentric type: several separate nodules in the same finger.

**Fig. 2.** (A) Nodule located on the medial surface of thumb; (B) intraoperative image of excision of capsule-free tumor; (C) visible “cluster-like” texture of excised nodule and a cavity in thumb after excision.

It should also be noted that the follow-up examination was performed only in 81% of all operated patients. It can be safely assumed that the patients who could not be located did not have a recurrence because they would have reported the problem to the authors' clinic which is a reference center for the treatment of hand injuries and diseases for 3 voivodships. Assuming such a scenario, the recurrence rate would be significantly lower – 9/58 (15%).

FACTORS AFFECTING THE INCREASED RECURRENCE RATE AFTER SURGICAL TREATMENT OF GIANT CELL TUMORS OF THE TENDON SHEATH

The frequency of postoperative recurrences reported in the literature is relatively high: from 4% to 27%. This is influenced by several factors, the most important of which is incomplete tumor excision [3, 4, 7, 8]. As it was already mentioned, only some of the lesions are surrounded by a well-formed connective tissue capsule, which allows for enucleation of the tumor in whole. In tumors without a capsule, one is not able to easily distinguish healthy tissue from diseased one, and therefore it is relatively common that tumor fragments remain within the incision, which is an obvious reason for recurrence [3, 7]. Also, the presence of satellite nodules, which are easy to omit when removing the underlying lesion, promotes relapse.

Other contributing factors reported in the literature are listed in Tab. III. Except for the incomplete excision, the actual significance of the remaining factors on the recurrence rate remains uncertain, also because the postoperative follow-up period is quite varied: from 6 months to even 10 years (Tab. II.). The significance of this factor for a reliable assessment of the frequency of recurrences is stressed: notable is that in publications with a follow-up period of less than 1 year, the frequency

of relapses is lower compared to those with longer-term results. For this reason, the optimal time for assessing the recurrence frequency after surgery should be at least 3 years [3, 4, 7, 10]. The presented paper meets this criterion.

REVIEW OF CERTAIN PUBLICATIONS ON THE OUTCOMES OF SURGICAL TREATMENT FOR GIANT CELL TUMORS OF THE TENDON SHEATH

Williams et al. (2010) presented the results of surgical treatment in 186 patients, in an equal proportion of men and women, with a mean age of 45 years, with giant cell tumors of the tendon sheath, with an average follow-up period of 5 years. Most nodules were localized: on the proximal phalanges – 50 (27%) and on the middle fingers – 37 (20%), on the metacarpus – 27 (14%) and on the thumb – 33 (18%). The nodules were located more often on the dorsal than the palmar side, in a ratio of 1.3:1. Forty-two patients (22%) had changes visible on X-rays, usually a discrete erosion of the bone in the place corresponding to the site of the nodule or degenerative changes in a neighboring joint. The authors noted 27 recurrences (14%) over the 5-year follow-up period and examined factors that influenced the greater risk of relapse. These factors included: involvement of tendon (extensor or flexor) and the joint capsule; the risk of recurrence with association with these tissues was 32% (21/66) compared with the risk of 4% (6/147) when they were not occupied by the tumor. Postoperative complications occurred in 46 patients (25%). The majority of patients (n = 44) had transient sensory disturbance on the operated finger. The changes in the phalanges visible in radiographic examination did not increase the risk of recurrences. The authors observed that approx. 1/3 of recurrences occurred between the 3rd and 5th year after surgery [4].

Di Grazia et al. (2013) reported outcomes of surgical treatment in 64 patients, 40 women and 26 men, aged on average 45 years

Tab. II. The frequency of recurrences after resection of giant cell tumors of the tendon sheath reported in the literature.

AUTHOR AND YEAR	NUMBER OF PATIENTS	FREQUENCY OF RECURRENCES	MEAN PERIOD AND SCOPE OF OBSERVATION (MONTHS)
Byers et al. (1968)	26	27%	88 (36–240)
Fyfe et al. (1980)	51	19%	906–240
Grover et al. (1998)	52	15%	79 (7–174)
Reilly et al. (1999)	70	26%	40 (7–138)
Kotwal et al. (2000)*	48	4%	52 (24–132)
Al-Qattan (2001)	30	12%	48 (24–72)
Ozalp et al. (2004)	134	14%	42 (6–132)
Lowyck et al. (2006)	43	16%	68 (15–136)
Williams et al. (2010)	186	14%	52 (36–86)
Di Grazia et al. (2013)	64	5%	? (2–153)
Koutserimpas et al. (2018)	36	11%	21 (?)
Ozben et al. (2019)	50	6%	84 (38–173)
Żyluk et al. (2020)	47	21%	50 (38–64)

*Surgical treatment with postoperative radiotherapy

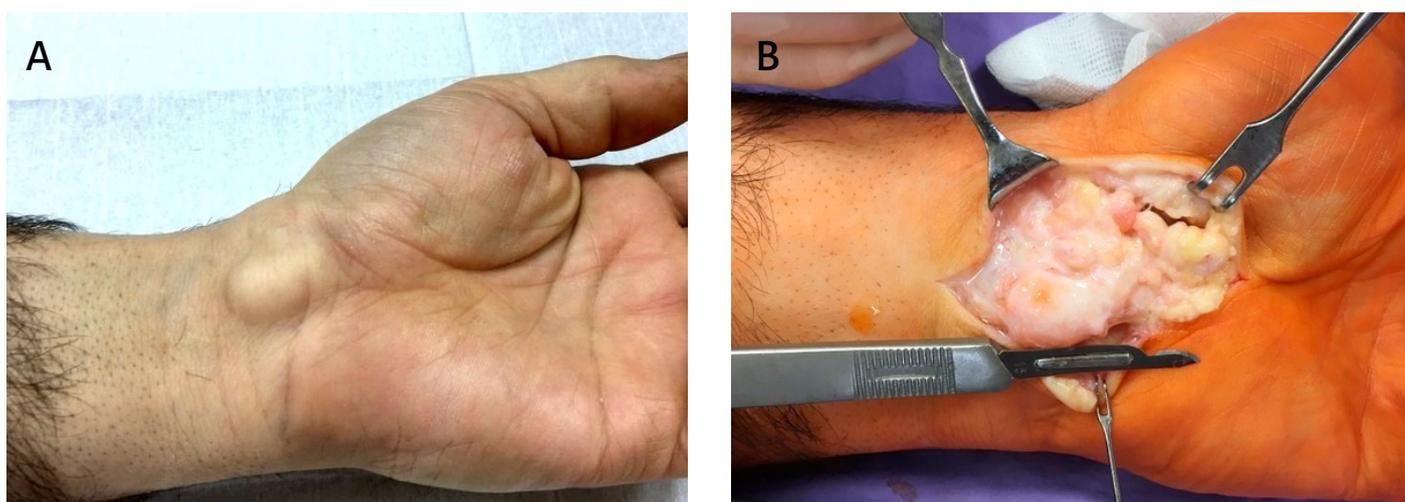


Fig. 3. (A) Seemingly small nodule on the palmar side of wrist; (B) intraoperative view of excised tumor with removed capsule.

old with giant cell tumors of the tendon sheath. The lesions were most often located on the middle finger, thumb, index and metacarpus, in about 20% of cases. Operations were performed under magnification, with the use of magnifier loupe or an operating microscope. The authors reported 3 cases of relapse (5%). Also in 3 patients, X-rays showed cortical erosions on the phalanx, in the site corresponding to the location of the nodule. In 7 patients (11%) the tumors were located in the vicinity of the neurovascular bundle and in 7 (11%) they remained in relation to the tendons, but none of these factors influenced the frequency of recurrence [7].

Ozben et al. (2019) presented the results of surgical treatment in 50 patients, 34 women and 16 men, aged on average 44 years (range 18–69) with giant cell tumors of the tendon sheath. The most common site of the lesions was: long fingers – 34 cases (68%), thumb – 15 (30%), and only 1 on the metacarpus (2%). The most common location on the fingers concerned the distal phalanges and distal interphalangeal (DIP) joints – 15

cases (45%), the middle phalanges and proximal interphalangeal (PIP) joints – 12 (35%) and the proximal phalanges – 7 (20%). Operations were performed under magnification, using a magnifier loupe or an operating microscope. Results were assessed at a mean of 7 years after surgery. The authors noted 3 recurrences (6%), 2 after 1.5 year, and 1 after 4 years after surgery. In all cases, the nodules were located near the interphalangeal joints, which led the authors to conclude that the relationship between the lesion and the articular capsule is a significant risk factor for recurrence [3].

Fotiadis et al. (2011) conducted a meta-analysis of the literature on the treatment outcomes of giant cell tumors of the tendon sheath. The analysis covered 21 publications from the period of 30 years (1980–2009), which contained data on a total of 605 patients aged 32–51 years. The disease was more common in women in a ratio of 1.5:1, which was a statistically significant difference. The most common site of tumor was the index finger – 30% and the middle finger

Tab.III. Factors associated with greater risk of recurrence after excision of giant cell tumors of the tendon sheath.

FACTOR CONTRIBUTING TO RECURRENCE
Incomplete tumor excision
Cortical erosions of the phalanx visible on X-ray
Location near the interphalangeal joint
Degenerative changes in the joint, near which the tumor is located, visible on X-ray
Type 2 tumor according to Al Qattan classification
Increased mitotic activity in histological assessment
Location near the neurovascular bundle of the finger

– 25%. In 85% of patients, the tumor was asymptomatic and in 15% it caused slight pain or numbness of the finger. The average growth time until consultation (surgery) was 2.5 years. In 28% of cases, X-rays showed cortical erosion of the bone above the nodule. 5% had a history of trauma in the site where the nodule would appear later. The size of the excised lesions ranged from 0.5 to 5 cm. Type 1 in the Al Qattan classification was more frequent (79%) than type II (21%). The recurrence rates ranged from 0 to 50%, and the factors that significantly increased the risk of recurrence were the same as those listed in Tab. III. The authors conclude that the most important factor that limits the risk of recurrence is radical excision of the lesion with the use of magnifying optical devices. Also, morphological type 1 tumor in the Al Qattan classification is associated with significantly lower recurrence rate [10]. Although surgery is the primary method of treatment, radiotherapy has been attempted to reduce the frequency of recurrences in the surgical site. The authors of one study reported only 4% of recurrences after using this adjuvant therapy [16].

However, later publications did not conclusively confirm the benefits of radiotherapy in preventing recurrences after surgery and – due to its harmfulness and costs – it is not used [10].

CONCLUSION

In conclusion, giant cell tumors of the tendon sheath are the most common benign lesions found in the upper extremities, mainly on the fingers. The primary method of treatment is excision, but the frequency of recurrences after surgery is relatively high, which is due to several reasons, the most important of which is incomplete resection. Both the results of this study and the findings from literature show the need for greater care at operation these lesions, i.e. use of magnifying devices and excision of the non-capsulated nodules with a greater margin. Of course, surgeries should be performed in a bloodless operating field.

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Corresponding author: prof. Andrzej Żyłuk MD PhD; Department of General and Hand Surgery, Pomeranian Medical University in Szczecin, Poland; Unii Lubelskiej street 1, 71-252 Szczecin, Poland; E-mail: azyluk@hotmail.com

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