



Twelve-year Experience for Tenosynovial Giant Cell Tumors of Tendon Sheath: A Review of 95 Cases from A Single Institution

Tendon Kılıfının Tenosinovyal Dev Hücreli Tümörlerinde 12 Yıllık Deneyim: Tek Bir Kurumdan 95 Olgunun Gözden Geçirilmesi

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Abstract

Objective: We aimed to present our 12-year experiences for tenosynovial giant cell tumors (TGCTs) of tendon sheath by summarizing the demographic characteristics and clinicopathological features of 95 cases who underwent excision of localized TGCT in a single institution to investigate the factors associated with gender and tumor location among the patients.

Method: The medical records of 95 patients with TGCT were reviewed. Demographic characteristics and clinicopathological findings were collected and compared according to gender and tumor location.

Results: Females were predominantly involved (78.95%). The mean age was 41.09±14.26 years. The majority of patients had TGCT in their hands (75.79%) and most predominantly involved tumors in D1 and D2 (n=21 and 25, respectively). The tumor invaded into the bone/joint of 5 patients (5.26%), and 4 recurrences (4.21%) were determined over the mean follow-up period of 84.3 months (range: 14-136). No significant difference was found in demographics and clinicopathological features between two genders (p>0.05). However, there was a significant increase in the median tumor size of male patients compared with that of females (p=0.011). There was also no significant difference in demographics and clinicopathological features among digits of hands (p>0.05).

Conclusion: Our study provides a comprehensive analysis of 95 patients who underwent surgical resection for localized TGCTs over 12 years at a single tertiary care hospital. TGCTs pose unique challenges in management because of their diverse clinical presentations and variable recurrence rates. Despite being predominantly benign, TGCTs exhibit recurrence and bone/joint invasion, necessitating meticulous follow-up and evaluation.

Keywords: Gender, recurrence, tenosynovial giant cell tumors, tumor location

Öz

Amaç: Tendon kılıfının tenosinovyal dev hücreli tümörlerinde (TGCT) 12 yıllık deneyimimizi, tek bir kurumda lokalize TGCT eksizyonu yapılan 95 olgunun demografik özelliklerini ve klinikopatolojik özelliklerini özetleyerek sunmayı ve hastalar arasında cinsiyet ve tümör yerleşimi ile ilişkili faktörleri araştırmayı amaçladık.

Yöntem: TGCT'li 95 hastanın tıbbi kayıtları gözden geçirildi. Demografik özellikler ve klinikopatolojik bulgular toplandı ve cinsiyet ve tümör yerleşimine göre karşılaştırıldı.

Bulgular: Kadınların çoğunlukta olduğu görüldü (%78,95). Ortalama yaş 41,09±14,26 yıl idi. Hastaların çoğunluğu ellerde TGCT'ye sahipti (%75,79) ve en sık D1 ve D2'de tümör tutulumu vardı (sırasıyla n=21 ve 25). Ortalama 84,3 aylık (aralık: 14-136) takip süresi boyunca 5 hastada (%5,26) tümör kemiğe/ekleme invaze olmuş ve toplam 4 nüks (%4,21) tespit edilmiştir. İki cinsiyet arasında demografik ve klinikopatolojik özellikler açısından anlamlı bir fark bulunmamıştır (p>0,05). Bununla birlikte, erkek hastaların medyan tümör boyutunda kadınlara göre anlamlı bir artış vardı (p=0,011). El parmakları arasında da demografik ve klinikopatolojik özellikler açısından anlamlı bir fark yoktu (p>0,05).

Sonuç: Çalışmamız, bir üçüncü basamak hastanede 12 yıllık süre boyunca lokalize TGCT'ler için cerrahi rezeksiyon uygulanan 95 hastanın kapsamlı bir analizini sunmaktadır. TGCT'ler, çeşitli klinik tabloları ve değişken nüks oranları nedeniyle tedavide benzersiz zorluklar oluşturmaktadır. Çoğunlukla benign olmalarına rağmen, nüks ve kemik/eklem invazyonu sergileyen TGCT'ler titiz takip ve değerlendirme gerektirir.

Anahtar kelimeler: Cinsiyet, nüks, tenosinovyal dev hücreli tümörler, tümör yerleşimi



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Introduction

According to the World Health Organization classification of tumors, tenosynovial giant cell tumors (TGCTs) are a group of benign soft tissue tumors with neoplastic, inflammatory, trauma-related, immune-mediated, or abnormal lipid metabolism. TGCTs originate from the synovial cells of the tendon sheath, synovium of joints or bursae (1). TGCT is the most common tumor in the foot and the second most common tumor in the hand following the ganglion cysts (1,2).

TGCT is classified into two different types, localized and diffuse, according to their growth characteristics (3). The diffuse type, also known as pigmented villonodular synovitis, tends to be multinodular and intraarticular, presenting an aggressive clinical course, and recurrence rates are crucially high among patients (4). The localized type tends to be less aggressive, often involving the tendon sheaths as a single nodular lesion (5). A surgical resection is the standard treatment modality in the localized type, whereas the ideal treatment modality in the diffuse type is controversial (6).

Although TGCT is typically non-cancerous, recurrence rates can reach as high as 15% (7). Several factors associated with elevated recurrence rates have been identified in the literature, including the diffuse type (8), bone erosion, joint arthritis (9,10), involvement of neurovascular structures (11), incomplete resection (12), tumor invasion beyond the capsule (13), and lesion size exceeding 2 cm (14). However, the available literature lacks sufficient clarity on the factors that are most influential in causing recurrence. Many studies included in the literature did not adhere to a standardized surgical protocol, and there are limited data comparing findings based on gender. Additionally, recurrence rates varied among studies due to differences in follow-up periods and a significant number of lost patients, making comparisons challenging (5,7,9-14). Therefore, we aimed to present our 12-year experience with TGCTs by presenting the demographic characteristics and clinicopathological features of 95 cases who underwent excision of localized TGCT in a single institution to investigate the factors associated with gender and tumor location among the patients.

Materials and Methods

Patient Selection

The data of 95 patients who underwent surgical procedures at our orthopedics and traumatology clinic and were

diagnosed with TGCT between 2010 and 2022 were retrospectively reviewed using hospital records and subsequently incorporated into the study. The investigation was conducted at a single tertiary care hospital, with the research protocol receiving approval from an Institutional Review Board of University of Health Sciences Turkey, İstanbul Bağcilar Training and Research Hospital (ethics committee protocol number: 2023/09/13/056). Inclusion criteria comprised patients aged 18 years or older, with a histologically confirmed diagnosis of localized tendon sheath tumor, and a minimum follow-up duration of 2 years. Patients lacking adequate follow-up documentation or exhibiting suspicious pathological diagnoses were excluded from the study. Initially, a pool of 108 potentially eligible patients was identified from hospital records. However, five patients were lost to clinical follow-up, records for three patients' last examinations were unavailable, and five patients were omitted because of diagnostic ambiguities. Consequently, the final cohort consisted of 95 patients diagnosed with TGCT, all of whom underwent surgery by a single surgeon within the orthopedic clinic of the aforementioned tertiary care hospital and had undergone clinical follow-up.

Data Collection

A standardized database sheet including the demographics, preoperative radiological findings, detailed operative notes and physical examination of the lesion was created using hospital records. The records included the age, gender, anatomical localization of the tumour, its relationship with structures such as bone and nerve, invasion to the bone/joint and preoperative duration after the onset of symptoms, postoperative complication as recurrence.

Operation

All patients were operated on by the same surgeon. Incisions on the relevant anatomical region of the lesion were made during surgery according to the principles of oncological surgery. The masses were removed in one piece with maximum attention to the adjacent important structures, ensuring that there were no satellite lesions, and were preserved for pathological examination.

Pathology

Pathological examination of lesions was performed by a single pathologist. The maximum diameter and appearance of the masses were recorded macroscopically. Routine tissue preparation techniques, hematoxylin & eosin staining and immunohistochemical studies were applied to the tissues, and the diagnosis of TGCT was confirmed microscopically. Data were included in the records.

Follow-up

Following the surgeries, passive movement initiation started within the first week, with active movement initiation following pain alleviation in the second week. Sutures were removed after a 14-day period, and patients were scheduled for subsequent follow-up appointments. During these appointments, complications including recurrence, joint motion restriction, neurovascular assessments, and wound site issues were documented. The follow-up duration for the patients ranged from 14 to 136 months.

Statistical Analysis

Statistical analysis was performed using the GraphPad InStat ver. 3.06 (GraphPad Inc, CA, USA) computer program. The distribution of the variables was tested using Kolmogorov-Smirnov test. Normally distributed two continuous variables were compared using the unpaired t-test, and more than two variables were compared using One-Way Analysis of Variance. Not normally distributed two continuous variables were compared by Mann-Whitney U test and more than two variables by Kruskal-Wallis test. Categorical variables were compared using the chi-square test or chi-squared test for Independence. The statistical significance level was $p < 0.05$.

Results

A total of 95 patients underwent surgical resection of localized TGCTs in our tertiary hospital between 2010 and 2022. The demographics and clinicopathological features of all patients are presented in Table 1. The mean age of all patients at the time of operation was 41.09 ± 14.26 years

(range: 18-68 years). 21.05% of patients were male. Of the total, 72 patients had tumors in the hand (75.79%), 13 had tumors in the foot (13.68%), 6 in the joint (6.31%), and 4 in the knee (4.21%). The right side was involved in 56.84% of patients ($n=54$). The surgeries were performed at mean 12 months (range: 3-60 months) after the onset of symptoms. The median largest dimension of the tumors was 1.7 cm (range: 0.5-8.5 cm). The tumor invaded the bone/joint of 5 patients (5.26%), and 4 recurrences (4.21%) were determined over the mean follow-up period of 84.3 months (range: 14-136 months) (Figures 1-3).

The demographics and clinicopathological features of patients were compared according to gender, and the results are presented in Table 2. No significant difference was found in the mean age, median preoperative duration, distribution of tumor location, side, and frequencies of bone invasion and recurrence between two genders ($p > 0.05$). However, there was a significant increase in the median tumor size of male patients compared with that of females ($p = 0.011$).

The demographics and clinicopathological features of patients were also compared according to the anatomic location of tumors in the hands, and the results are presented in Table 3. Twenty-one patients had TGCT in the D1 digit of the hand, 25 patients had TGCT in D2, 14 patients had one in D3, 7 patients in D4, and 5 patients in D5. No significant difference was found in the mean age, median preoperative duration and tumor size, distribution of gender, side of tumor location, and frequencies of bone invasion and recurrence among digits of hands ($p > 0.05$).

Table 1. Demographics and clinicopathological features of the patients

		Total (n=95)
Age, mean \pm SD	Year	41.09 \pm 14.26
Gender, n (%)	Male	20 (21.05)
	Female	75 (78.95)
Tumor location, n (%)	Hand	72 (75.79)
	Knee	4 (4.21)
	Foot	13 (13.68)
	Joint	6 (6.31)
Side, n (%)	Left	41 (43.16)
	Right	54 (56.84)
Tumor size, median [range]	Largest dimension (cm)	1.7 [0.5-8.5]
Bone invasion, n (%)		5 (5.26)
Preoperative duration, median [range]	Months	12 [3-60]
Recurrence, n (%)		4 (4.21)

SD: Standard deviation

Table 2. Comparison of demographics and clinicopathological features of patients according to gender

		Male (n=20)	Female (n=75)	p-value
Age, mean ± SD	Year	43.05±14.92	40.47±14.14	0.235
Tumor location, n (%)	Hand	14 (70.0)	58 (77.33)	0.867
	Knee	1 (5.0)	3 (4.0)	
	Foot	3 (15.0)	10 (13.33)	
	Joint	2 (10.0)	4 (5.33)	
Side, n (%)	Left	7 (35.0)	34 (45.33)	0.565
	Right	13 (65.0)	41 (54.67)	
Tumor size, median [range]	Largest dimension (cm)	2.5 [1.0-8.5]	1.5 [0.50-8.0]	0.011
Bone invasion, n (%)		2 (10.0)	3 (4.0)	0.614
Preoperative duration, median [range]	Months	12 [3-30]	12 [3-60]	0.982
Recurrence, n (%)		1 (5.0)	3 (4.0)	0.843

SD: Standard deviation



Figure 1. Bone erosion. Anteroposterior radiograph of fifth finger showing TGCT

TGCT: Tenosynovial giant cell tumor

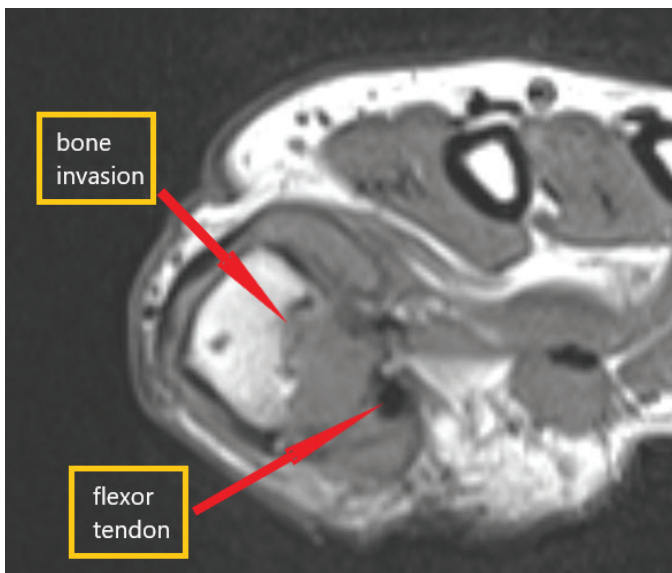


Figure 2. Intraosseous invasion. Magnetic resonance images of the thumb

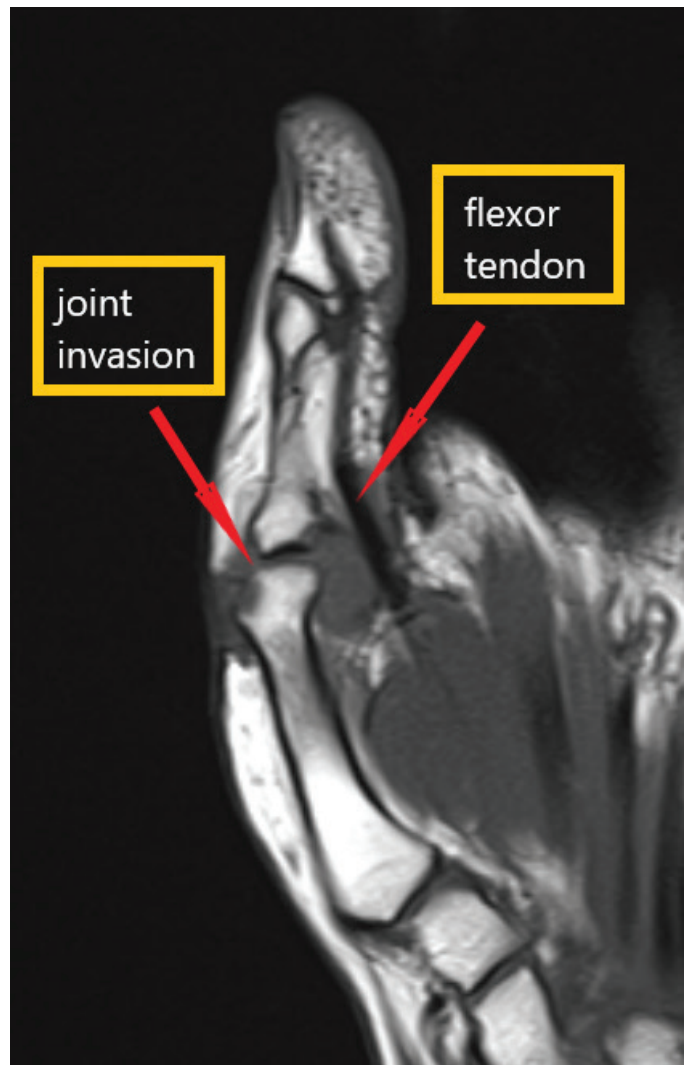


Figure 3. Joint invasion. Magnetic resonance images of thumb metacarpophalangeal joint

Table 3. Comparison of demographics and clinicopathological features of patients according to the anatomic location of tumors in hands

		D1 (n=21)	D2 (n=25)	D3 (n=14)	D4 (n=7)	D5 (n=5)	p-value
Age, mean ± SD	Year	46.9±9.9	38.8±14.5	46.2±12.0	43.3±9.9	50.0±12.4	0.135
Gender, n (%)	Male	2 (9.5)	7 (28.0)	1 (7.1)	2 (28.6)	2 (40.0)	0.234
	Female	19 (90.5)	18 (72.0)	13 (92.9)	5 (71.4)	3 (60.0)	
Side, n (%)	Left	10 (47.6)	13 (52.0)	6 (42.9)	1 (14.3)	2 (40.0)	0.510
	Right	11 (52.4)	12 (48.0)	8 (57.1)	6 (85.7)	3 (60.0)	
Tumor size, median [range]	Largest dimension (cm)	1.7 [0.9-8.0]	1.7 [0.5-3.0]	1.5 [1.0-2.6]	2.3 [1.0-3.0]	1.8 [1.0-2.5]	0.752
Bone invasion, n (%)		2 (9.5)	0 (0)	0 (0)	1 (14.3)	1 (20.0)	0.205
Preoperative duration, median [range]	Months	11 [4-60]	10 [3-24]	10.5 [3-26]	9 [5-48]	15 [9-24]	0.608
Recurrence, n (%)		1 (4.8)	0 (0)	0 (0)	0 (0)	1 (20.0)	0.130

SD: Standard deviation

Discussion

Despite the extensive literature on TGCTs of the tendon sheath, their treatment remains challenging for orthopedists. These tumors, which originate from synovial cells, can infiltrate nearby structures such as joints, bone cortices, tendon sheaths, and neurovascular tissues. Achieving a balance between complete tumor removal and preservation of vital tissues presents a significant challenge. In this study, we shared our institutional experience spanning 12 years with TGCTs of the tendon sheath and summarized the demographic characteristics and clinicopathological features of 95 cases who underwent localized TGCT excision. Our findings revealed an overall recurrence rate of 4.21%, with tumor size demonstrating variation based on gender, suggesting a potential risk factor for tumor growth in males.

There are various case series and case reports of benign and malignant soft tissue tumors (15). The literature presents several recurrence rates for TGCTs, from as low as 2% to as high as 24% (2,11,16,17). In our study, we attribute our relatively low recurrence rate of 4.21% to adherence to the principles of tumor surgery, frequent encounters with such cases in our tertiary center, and the expertise of our surgeons.

In line with previous studies (11,16), our observations regarding the anatomical distribution of TGCTs in the hand corroborate the existing literature, with a higher incidence noted in the first two fingers compared with others. While some studies have reported increased recurrence rates in specific joints, such as the distal interphalangeal and

thumb interphalangeal joints (16), we did not observe such a relationship in our cohort.

Several studies have investigated the impact of the involvement of important structures on recurrence (18,19). Kitagawa et al. (18) reported an association between tumor proximity to neurovascular structures and recurrence, whereas Williams et al. (19) found that joint capsule involvement increased the recurrence rate to 32%. In our study, although we observed bone and joint invasion in one patient with recurrence, we did not find a statistically significant association.

According to multiple studies, TGCTs exhibit female gender predominance (20). Consistent with existing literature, our patient series also demonstrated a high proportion of female patients. However, while previous research indicates no significant correlation between tumor size and gender, our analysis revealed a significantly larger tumor size among male patients, despite comparable preoperative durations for both genders. Although our study did not yield explanatory data, we hypothesize that this discrepancy may be attributed to inherent differences in extremity dimensions between genders.

Our findings underscore the importance of standardized surgical approaches and consistent follow-up protocols for elucidating factors associated with recurrence and outcomes. Notably, although several factors have been implicated in TGCT recurrence, including tumor size, invasion of adjacent structures, and incomplete resection (21), our study did not identify a significant association between gender or anatomical location and

recurrence. Furthermore, our investigation highlights the heterogeneity in TGCT presentation across different anatomical locations within the hand, emphasizing the need for tailored management strategies based on tumor localization. However, further studies with larger sample sizes are warranted to validate these findings and elucidate additional factors influencing TGCT recurrence and clinical outcomes.

Conclusion

Our comprehensive analysis of 95 cases of localized TGCTs spanning 12 years provides valuable insights into the demographic characteristics and clinicopathological features of this condition. Our study revealed a low recurrence rate of 4.21%, which is likely attributable to meticulous surgical techniques and the extensive experience of our surgical team. Although our findings corroborate previous literature regarding the anatomical distribution of TGCTs in the hand, with a predilection for the first two digits, we did not observe a significant association between tumor location and recurrence. In addition, while involvement of important structures such as neurovascular elements and joint capsules has been implicated in recurrence in some studies, our analysis did not reveal a statistically significant relationship. Interestingly, we observed a significant difference in tumor size based on gender, with male patients presenting with larger tumors than females, highlighting a potential area for further investigation regarding the underlying factors contributing to this disparity. Our study underscores the importance of standardized surgical approaches and consistent follow-up protocols in elucidating factors associated with TGCT recurrence and outcomes. However, further research with larger sample sizes is warranted to validate these findings and identify additional factors influencing TGCT recurrence and clinical outcomes. Ultimately, our study contributes to ongoing efforts to optimize management strategies for TGCTs and improve patient outcomes.

Ethics

Ethics Committee Approval: The research protocol receiving approval from an Institutional Review Board of University of Health Sciences Turkey, İstanbul Bağcilar Training and Research Hospital (ethics committee protocol number: 2023/09/13/056).

Informed Consent: N/A.

Authorship Contributions

Surgical and Medical Practices: M.U., Concept: M.U., Design: M.U., M.F.D., O.B., Data Collection or Processing: N.Y.E., Analysis or Interpretation: N.Y.E., Literature Search: N.Y.E., M.F.D., O.B., Writing: M.F.D., O.B.

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