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# Testicular Sparing Surgery in Small Testicular Lesions: Functional and Oncological Outcomes

## Küçük Testiküler Lezyonlarda Testis Koruyucu Cerrahi: Fonksiyonel ve Onkolojik Sonuçlar

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**ÖZET**

**Amaç:** Testiküler germ hücreli tümörler, dünya çapında artış eğilimi gösteren, 20-34 yaş arası erkek popülasyonunda en sık görülen solid tümörlerdir. Testis kitlelerinde altın standart birinci basamak tedavi radikal orşiektomidir. Ancak radikal orşiektomi özellikle genç hastalarda beden imajı bozukluklarına, cinsel işlev bozukluklarına ve infertiliteye neden olabilir. Avrupa Üroloji Derneği kılavuzlarında tümör belirteçleri negatif olan küçük testiküler kitlelerde aşırı tedaviyi önlemek ve testis fonksiyonlarını korumak için testis koruyucu cerrahinin ( TKC) uygulanabileceği belirtilmektedir. Çalışmamızda kliniğimizdeki testis koruyucu cerrahi deneyimlerimizi değerlendirmeyi, onkolojik ve fonksiyonel sonuçları özetlemeyi amaçladık.
**Gereçler ve Yöntemler:** Kliniğimizde 2008-2023 yılları arasında testis tümörü nedeniyle TKC uygulanan hastalar çalışmaya dahil edildi. Çalışmaya tek testiste tümörü, iki taraflı testis tümörü olan hastalar ile karşı testisi normal olan ve tümörü 2 cm'den az veya testis hacminin %30'undan az olan hastalar dahil edildi. Hastaların demografik verileri, tümör özellikleri ve takip verileri toplandı ve istatistiksel olarak analiz edildi.
**Bulgular:** TKC uygulanan toplam 26 hasta değerlendirildi. Dokuz hastada Germ Hücreli Tümör (GHT ), 17 hastada ise benign testiküler kitle tespit edildi. Ortalama hasta yaşı 25±6.1 (18-69) yıldı. Ortalama tümör boyutu 12.9±4.4 (7-24) mm idi. GHT'li hastalar ortalama 21.8±7.8 (10-36) ay takip edildi. Bir hastada takipte lokal nüks görüldü ve radikal orşiektomi uygulandı. Takip süresince diğer hastalarda nüks veya metastaz görülmedi. Benign lezyonlar 21.5±9.3 (10-38) ay süreyle takip edildi. Lokal nüks gözlenmedi. Ameliyat sonrası testosteron düzeylerinde anlamlı bir azalma olmadı (p=0.3).
**Sonuç:** Bu çalışmada TKC ile benign testiküler tümörler için mükemmel klinik sonuçlar elde edildi. Ayrıca germ hücreli tümörü olan hastalarda TKC güvenli ve etkin bir tedavi seçeneği olarak önerilebilir. Ancak TKC'nin potansiyel riskleri ve yararları konusunda daha geniş hasta verilerini içeren daha fazla seriye ihtiyaç vardır.

**Anahtar Kelimeler:** Bilateral testis tümörü, germ hücreli tümör, soliter testis, testis koruyucu cerrahi

**ABSTRACT**

**Objective:** To evaluate our testis-sparing surgery ( TSS) experiences in our clinic and outline its oncological and functional outcomes.
**Materials and Methods:** Patients who underwent TSS due to testicular mass in our clinic between 2008 and 2023 were included in the study. Patients with a mass in solitary testis, bilateral testicular mass as well as patients with a normal contralateral testis and a mass of less than 2 cm or less than 30% of the testicular volume were included in the study. Patient demographics, tumor characteristics, and follow-up data were collected and analyzed statistically.
**Results:** A total of 26 patients who underwent TSS were evaluated. Germ Cell Tumor (GCT ) was detected in 9 patients, and benign testicular mass was detected in 17 patients. The mean patient age was 25±6.1 (18-69) years. The mean tumor size was 12.9±4.4 (range 7-24) mm in all patients. Patients with GCTs were followed up for a mean of 21.8±7.8 (10-36) months. Local recurrence was observed in one patient during follow-up, and radical orchiectomy was performed. No recurrence or metastasis was observed in other patients during the follow-up period. Benign lesions were followed up for 21.5±9.3 (10-38) months. Recurrence was not observed. There was no significant decrease in testosterone levels after surgery (p=0.3).
**Conclusions:** Excellent outcomes for benign tumors using TSS were obtained in the present study. TSS could be suggested as a safe and effective treatment option in patients with germ cell tumors, as in the present study. However, more data regarding the potential risks and benefits of TSS with a larger patient series is needed.

**Keywords:** Bilateral testicular tumor, germ cell tumor, solitary testis, testis sparing surgery

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## INTRODUCTION

Annually, three to ten novel cases in 100,000 men are diagnosed with germ cell testicular cancer (GCT), representing 1% of all male neoplasms and 5% of all urologic tumors (1). It is the most widely seen solid tumor in the male population between 20-34 years of age, with a globally rising tendency (2). Testicular cancer is usually determined as a unilateral testicular scrotal mass by the patient or incidentally during an ultrasound (US) imaging. Small asymptomatic testicular masses have increased due to increased rates of self-examination and the use of ultrasound (3). 60-70% of palpable and non-palpable small testicular masses are benign lesions (4-6). However, the pathological nature of small testicular masses cannot be clearly distinguished by pre-operative imaging and physical examinations.

The gold standard first-line treatment in testicular masses is radical orchiectomy (RO) (7). The treatment algorithm is arranged together with the evaluation of testicular histopathology, tumor markers, and imaging examination. Radical orchiectomy may lead to disorders concerning body image, sexual dysfunction, and infertility, especially in younger patients (8).

According to European Association of Urology (EAU) guidelines, testicular sparing surgery (TSS) in testicular cancer should be performed in patients with single testis to preserve fertility and hormonal function (7). In small masses with negative tumor markers, TSS is recommended in selected cases to prevent over-treatment and protect testicular functions. Currently, there is no evidence supporting any size cut-off for a testicular lesion to be safely followed up (9). EAU recommends histopathological evaluation due to the risk of malignancy (7). Most clinicians agree that TSS should be considered first in bilateral testicular tumor or solitary testicular tumor. The latest American Urological Association (AUA) guidelines indicate that it will be an alternative in highly selected patients with regular contralateral testis, testicular mass <2 cm, tumor markers negative, and equivocal ultrasound/physical exam findings (10).

In recent years, small series of TSS results with normal contralateral testis have been published (4, 11-14). Generally, oncological and functional short-term results have been reported as promising.

In our study, we recommended TSS for all patients with bilateral testicular masses or solitary testes as well as for patients with small testicular masses with normal contralateral testis. This study aims to evaluate our testis-sparing surgery experiences in our clinic and to outline outcomes regarding the course of cancer and the function of the testes post surgically.

## MATERIALS AND METHODS

The study included patients who had undergone TSS due to testicular mass in our clinic between 2008 and 2023. Patients with a mass in solitary testis, bilateral testicular mass, and normal contralateral testis and a mass of less than 2 cm or less than 30% of the testicular volume were included in the study.

We did not include patients classified as high risk according to EAU guidelines (testicular volume<12 ml, history of cryptorchidism, and age<40) in our study. Therefore, testicular biopsy from normal parenchyma was not performed in any patient for the diagnosis of GCNIS. In addition, patients with multiple (concurrent or recurrent) testicular lesions were not included in the study.

TSS patients' data were analyzed retrospectively. Patient demographics, tumor characteristics, and follow-up data were collected. TSS was performed under general anesthesia with the inguinal incision. First, the spermatic cord was suspended with a rubber tourniquet to prevent vascular invasion; then the testis was mobilized and removed from the scrotum. Tunica vaginalis was opened, and the mass was palpated and excised together with the surrounding parenchyma. If the mass could not be evaluated clearly by palpation, intraoperative ultrasound was used. After the lesion site was marked, the lesion was sharply excised with the surrounding parenchyma tissue and tunica albuginea. Frozen section examination (FSE) biopsy was conducted on the tumor base in patients with high tumor markers and suspicion of malignancy over 1 cm tumors. A biopsy was not performed on the remaining testicular parenchyma. After hemostasis was achieved, the tunica albuginea was closed. The tourniquet was released, and the testicle was placed in the scrotum. Dartos muscle and skin were covered in two layers.

All patients were dismissed on the first postoperative day. After TSS, all patients underwent standardized protocol follow-ups according to pathology results and stages. Physical examination was performed at all follow-up visits of the ipsilateral testis, and ultrasound was performed periodically. In testicular cancers, if there is no problem in the follow-

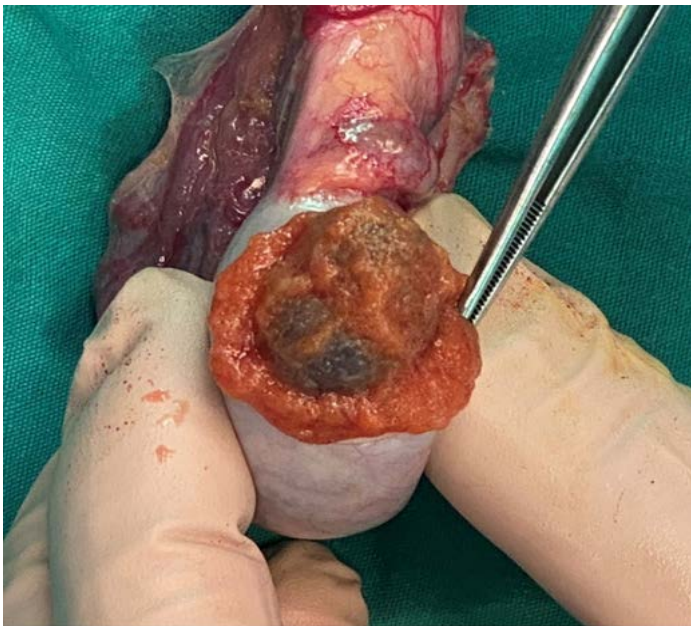

**Figure 1.** Intraoperative Germ Cell Tumor

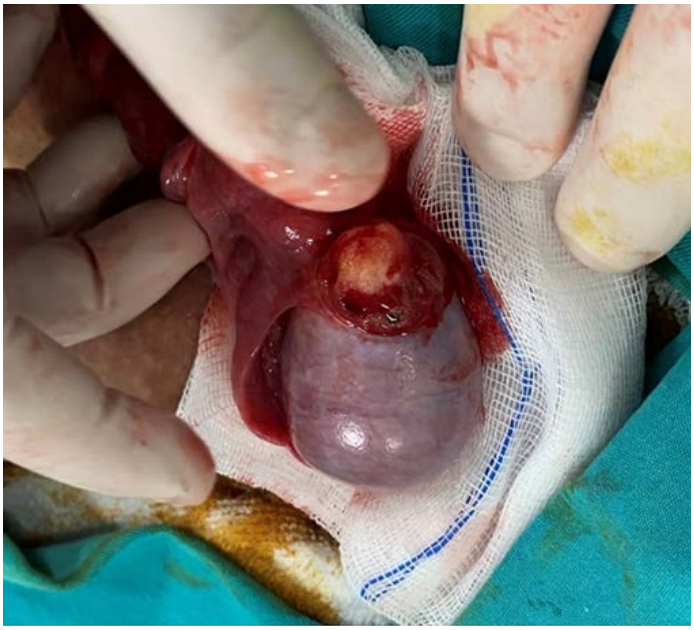

**Figure 2.** Intraoperative Leydig Cell Tumor

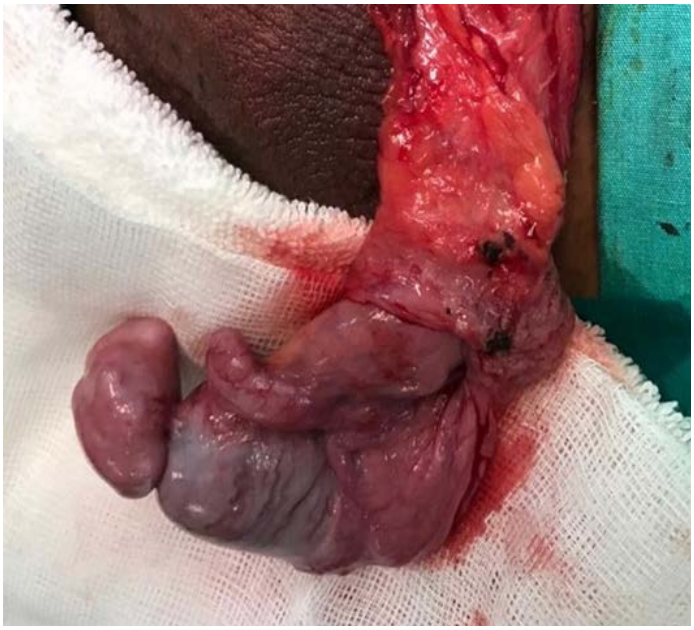

**Figure 3.** Intraoperative Paratesticular Pseudotumor

up (residual or recurrent mass), the first year is followed by ultrasound 4 times, the second year 3-4 times, and up to 5 years twice a year. In benign lesions, a 3rd-month control ultrasound was performed, only repeat ultrasound if new clinical concern and followed up once a year.

***Statistical Analysis:***

SPSS, v.23.0 statistical software (SPSS, Inc., Chicago, IL, USA) package program was utilized for statistical analysis. Descriptive analysis was used to define quantitative variables. The mean and minimum-maximum values were provided. Shapiro Wilk test was applied to evaluate whether the data conformed to normal distribution. Wilcoxon test was applied to compare data in the dependent group.

***Ethics and Consent to Participate:***

All procedures performed in this study were conducted by the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards. Ethics Committee approval was obtained before starting the study, in line with the Declaration of Helsinki (No: 2024/4774).

## RESULTS

A total of 26 patients who underwent TSS were evaluated. GCT was detected in 9 patients, and benign testicular mass was detected in 17 patients. The mean patient age was 25±6.1 (18-69) years. Nine (34.6%) patients had left testicular tumors, and 17 (65.4%) patients had right testicular tumors. The mean tumor size was 12.9±4.4 (range 7-24) mm all of the patients. The mean tumor size was 12.2±4.6 (7-24) mm in benign masses. In those with GCT, the mean tumor size was 14.3±3.7 (10-20) mm. In 19 cases, the mass was palpable. Six cases had non-palpable mass. In these cases, perioperative ultrasound was performed. Testicular pain was present in 6 patients. Only 3 of the patients had limited tumor marker elevation. FSE was obtained from 12 patients from the tumor bed, and the results were negative. In 10 of the 12 patients in whom we performed FSE, the final pathology was similar.

After the final pathological examination, GCT was detected in 9 patients (34.6%). In addition, 5 benign Leydig cell tumors, 4 fibrosis, 2 adrenal rest tumors, 2 paratesticular pseudotumor, 2 paratesticular adenomatoid tumors, 1 epidermoid cyst, and 1 angiomyolipoma were detected. There were 2 seminomas, 5 non-seminomatous germ cell tumors (NSGCT) and, 2 Intratesticular germ cell neoplasia (ITGCN) in GCT patients. Surgical margins were not positive in any of our patients.

Indication and demographic data of patients who underwent testicular sparing surgery are given in Table 1. Twenty-two (84.6%) patients had a small mass with normal contralateral testis, 2 (7.7%) had bilateral testicular mass, and 2 (7.7%) had a mass in solitary testis. Two patients with solitary testis had previously undergone radical orchiectomy for GCT.

Patients with GCTs were followed up for a mean of 21.8±7.8 (10-36) months. Local recurrence was determined in one patient during follow-up, and radical orchiectomy was performed. None of the remaining patients had recurrence or metastasis during the follow-up period. Benign lesions were followed up for 21.5±9.3 (10-38) months without any recurrence.

For patients undergoing partial orchiectomy, testosterone levels were examined before and 3 months after the operation. Whereas average testosterone level was determined as benign pathology patients 360±91 (184-540) ng/dl before surgical intervention, it was determined as 358±90 (190-533)

**Table 1.** Patient's Data

| TSS İndications | Age (Years) | Size (mm) | Side (L/R) | Tumor Markers | Malign/ Benign | Histopathology (M/B) | Preoperative Testosteron Levels (ng/dl) | Postoperative Testosteron Levels (ng/dl) | Follow-Up (months) | Local Recurrence | Management | Status |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Small Mass | 22 | 10 | R | Normal | M | Seminoma | 378 | 375 | 26 | no | Surveillance | Disease Free |
| Small Mass | 38 | 10 | R | Normal | B | Leydig Cell Tumor | 254 | 256 | 32 | no | Surveillance | Disease Free |
| Small Mass | 40 | 20 | L | Normal | B | Leydig Cell Tumor | 320 | 317 | 36 | no | Surveillance | Disease Free |
| Small Mass | 30 | 7 | R | Normal | B | Leydig Cell Tumor | 385 | 386 | 19 | no | Surveillance | Disease Free |
| Small Mass | 21 | 17 | R | Normal | B | Adrenal Rest Tumor | 489 | 490 | 28 | no | Surveillance | Disease Free |
| Small Mass | 22 | 11 | L | Normal | M | NSGCT | 365 | 357 | 24 | no | Surveillance | Disease Free |
| Small Mass | 39 | 20 | R | Normal | M | ITGCN | 387 | 390 | 36 | no | Surveillance | Disease Free |
| Small Mass | 28 | 10 | R | Normal | B | Leydig Cell Tumor | 380 | 375 | 38 | no | Surveillance | Disease Free |
| Bilateral Mass | 35 | 15 | L | Normal | M | Seminoma | 190 | 188 | 22 | no | CHT | Disease Free |
| Small Mass | 18 | 10 | R | Normal | B | Fibrosis | 445 | 432 | 36 | no | Surveillance | Disease Free |
| Small Mass | 18 | 7 | L | Normal | B | Adrenal Rest Tumor | 385 | 390 | 12 | no | Surveillance | Disease Free |
| Small Mass | 35 | 12 | L | Normal | B | Leydig Cell Tumor | 290 | 293 | 24 | no | Surveillance | Disease Free |
| Small Mass | 23 | 14 | R | Normal | B | Adenomatoid tumor | 395 | 410 | 12 | no | Surveillance | Disease Free |
| Solitary Testicular Mass | 21 | 15 | R | Elevated | M | NSGCT | 188 | 190 | 10 | no | CHT | Disease Free |
| Small Mass | 38 | 9 | L | Normal | B | Fibrosis | 411 | 407 | 10 | no | Surveillance | Disease Free |
| Small Mass | 34 | 14 | L | Normal | B | Angiomyolipoma | 184 | 190 | 16 | no | Surveillance | Disease Free |
| Small Mass | 35 | 24 | R | Normal | B | Paratesticular Pseudotumour | 540 | 533 | 18 | no | Surveillance | Disease Free |
| Small Mass | 69 | 12 | R | Normal | B | Paratesticular Pseudotumour | 240 | 232 | 18 | no | Surveillance | Disease Free |
| Small Mass | 54 | 10 | R | Normal | B | Epidermoid Cycst | 285 | 280 | 20 | no | Surveillance | Disease Free |
| Small Mass | 25 | 10 | R | Normal | M | Teratoma | 360 | 364 | 15 | no | Surveillance | Disease Free |
| Small Mass | 24 | 15 | L | Normal | B | Adenomatoid tumor | 345 | 321 | 21 | no | Surveillance | Disease Free |
| Small Mass | 30 | 10 | R | Normal | B | Fibrosis | 385 | 387 | 16 | no | Surveillance | Disease Free |
| Small Mass | 19 | 7 | L | Normal | B | Fibrosis | 403 | 400 | 10 | no | Surveillance | Disease Free |
| Small Mass | 37 | 18 | R | Normal | M | ITGCN | 328 | 347 | 18 | no | Surveillance | Disease Free |
| Solitary Testicular Mass | 22 | 16 | R | Elevated | M | NSGCT | 190 | 182 | 24 | yes | CHT | Disease Free |
| Bilateral Mass | 27 | 20 | R | Elevated | M | NSGCT | 228 | 200 | 8 | no | CHT | Disease Free |

(CHT: Chemotherapy, ITGCN: Intratubuler Germ Cell Neoplasia, NSGCT: Non-Seminomatous Germ Cell Tumor, TSS: Testis Sparing Surgery)

ng/dl postoperatively. There was no significant decrease in testosterone values (p=0.3). In patients with GCT, pre-operative testosterone was 298±91 (188-387) ng/dl, and post-operative testosterone was 299±93 (182-390) ng/dl (p=0.78).

## DISCUSSION

Testicular sparing surgery will certainly play an important role in testicular masses in the following years. Testis-sparing surgery is recommended in special cases according to existing guidelines (7, 10). In our current series, apart from being testicular masses, small masses, synchronous masses, and small masses in the solitary testicle have TSS oncological acceptable results in testicular cancer.

In recent years, especially with the increase in US use, there has been an increase in the frequency of testicular small masses determined. The general opinion about small testicular masses is that most of them are benign (4, 5, 9, 15). 80% of non-palpable masses were considered as benign (9, 16). In palpable lesions whereas Shilo et al. reported in their recent study (6) 69% (11/16) of testicular masses under 25 mm as benign (both palpable and non-palpable), Gentile et al. (5) reported 86.7% of the masses (13/15) as of benign pathology. Ates et al. recently reported in their study that 93.3% of all cases smaller than 25 mm as of benign pathology (14/15) (17). Considering the mass dimensions, Keske M et al. reported in a multicenter study with 212 participants that whereas 54.3% of the masses below 1 cm were benign, between 2.1 cm and 3.0 cm, 14,4% were considered benign (18). Scandura et al. They stated that 69% (81/56) of small testicular masses under 10 mm were benign (9). In our study, patients with GCT had larger tumors than patients with benign lesions. Most of the testicular masses smaller than 10 mm in our study were not malignant.

Definitive differentiation of small testicular masses in terms of malignity cannot be made clinically. The imaging features of benign solid testicular lesions vary largely and mostly mimic malignant lesions (i.e., intra-testicular lesions; there is no definitive feature that distinguishes malignant and benign lesions by ultrasound.) (19). Therefore, in many benign masses, futile radical orchiectomy is performed. One of the frequently used methods for benign-malign differentiation is perioperative FSE (20). However, FSE can be difficult and the pathologist's personal experience is the major determinant for a meaningful FSE of testicular masses (21). In their study, Bianjiang Liu et al. conducted TSS with 11 patients with testicular mass of benign characteristics defined with intraoperative FSE (22). They stated that they had similar results with the final pathology. Nason et al. It is one of the largest partial orchiectomy studies in the literature, and they did not recommend FSE because of its high false negative rate (14).

In recent years, studies have been published in the opposite direction, advocating the necessity of performing FSE. Connolly et al. reported a 94.2% positive predictive value and 92.6%

**Table 2.** Publications About Testis Sparing Surgery

| Author: | Year | N | TSS Indications | Tumor Size (mm) | Bening Testicular Mass (N) | Malign Testicular Mass (N) | Complementary Orchiectomy | Local Recurrence | Treatment of Local Recurrence | Adjuvan Radiotherapy for Testis | RPNLD | Adjuvant CHT | Preoperative Testosteron Levels (ng/dl) | Postoperative Testosteron Levels (ng/dl) | Disease Free | Follow-Up (months) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Gaosi (15) | 2016 | 28 | small lesion | 9.3 | 22 | 6 Seminoma | 6 | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| Gentile (5) | 2013 | 15 | small lesion | 9.5 | 14 | 1 Seminoma | 2 | NA | NA | NA | NA | NA | NA | NA | NA | 19 |
| Ferrelti (29) | 2014 | 25 | bilateral lesion/solitary testis | 11.4 | 5 | 11 Seminoma, 9 NSGCT | No | 3 | RO | 5 | NA | 1 | 361 | 346 | AS | 42.2 |
| Shio (6) | 2009 | 16 | small lesion/ bilateral lesion | 8-25 | 11 | 3 Seminoma, 2 NSGCT | 5 | No | No | NA | NA | 1 | NA | NA | AS | 48 |
| Lawrentsch (27) | 2011 | 27 | solitary testis | 12 | 10 | 9 Seminoma, 5 NSGCT | No | 2 | RO | 1 | 1 | 1 | NA | NA | AS | 67 |
| Heidenreich (13) | 2001 | 73 | bilateral lesion/ solitary testis | 15 | 0 | 42 Seminoma, 31 NSGCT | No | 4 | RO | 42 | NA | 3 | 400-450 | 300-350 | AS / 1 dead | 91 |
| Bojanic (11) | 2014 | 26 | bilateral lesion/ solitary testis | <20 | 0 | 16 Seminoma, 7 NSGCT | No | 7 | RO | NA | 1 | 10 | NA | NA | NA | 54 |
| Bojanic (12) | 2017 | 28 | small lesion | 11.4 | 18 | 6 Seminoma, 4 NSGCT | 1 | 1 | RO | NA | NA | NA | NA | NA | AS | 40.9 |
| Keske (18) | 2019 | 13 | bilateral lesion/ solitary testis/ small lesion | 14.6 | 9 | 1 Seminoma, 3 NSGCT | No | 1 | RO | 1 | NA | 1 | 3 | 2 | AS | 47.2 |
| Nason (14) | 2019 | 77 | bilateral lesion/ solitary testis/ small lesion | 15 | 41 | 28 Seminoma, 15 NSGCT | 6 | 10 | RO | 1 | 2 | 1 | 209 | 273 | AS / 3 dead | 43.5 |
| Our Study | 2024 | 26 | bilateral lesion/ solitary testis/ small lesion | 12.9 | 17 | 2 Seminoma, 5 NSGCT 2ITGCN | 1 | 1 | RO | 0 | NA | 4 | 329 | 302 | AS | 21.6 |

AS: Active Surveillance, CHT: Chemotherapy, ITGCN: Intratesticular germ cell neoplasia, NSGCT: Non-Seminomatous Germ Cell Tumor, RO: Radical Orchiectomy, RPLND: Retroperitoneal Lymph Node Dissection, TSS: Testis Sparing Surgery

negative predictive value for malignancy in 80 patients (23). Matei D.V. et al. reported from 144 patients that the sensitivity and specificity of FSA were 93% and 98%, respectively, for malignant tumors and 90% and 99%, respectively, for benign tumors (24). In our study, the FSE result obtained from 12 patients was compatible with the final pathology in 10 of them. In our opinion, FSE should be removed if it will affect the surgical method. Especially in cases with high tumor markers and large testicular masses, the frozen biopsies we performed from the tumor base were negative for the tumor.

The standard treatment for suspected malignancy in testicular masses is radical orchiectomy. The reason why TSS is not considered in the first place is the high recurrence rate with accompanying Intratesticular germ cell neoplasia (ITGCN). The multifocality rate in tumors smaller than 4 cm increases up to 26% (21). Secondly, the presence of ITGCN is almost invariably present in the precursor lesion of the GCT, which is evident in 80% of the normal-appearing testicular tissues surrounding the germ cell tumor mass (13). However, data presented recently suggest the prevalence of ITGCN could be decreased if a tumor lesion is smaller than 1 cm (21). Heinrich et al. In their study, they proposed 16 Gy radiotherapy to the testis in the presence of intratesticular neoplasia in bilateral testicular tumors, solitary testicles, tumor bed and resection area biopsy, and normal parenchyma biopsy results (13). Bojacis et al. In the study, local recurrence after TSS indicated that ITGCN had a worse prognosis, but they mentioned that radiotherapy might be delayed to the testis in patients who want to become a father (12).

Bojanic et al. reported a 29% local recurrence rate (7/26) subsequent to TSS in bilateral or solitary testis tumors. All patients with local recurrence had ITGCN and had poor prognosis criteria. Moreover, they underwent further TSS or RO with only 1 developing metastasis (retroperitoneal nodes). The rate of survival was 100% (12). A 5.5% local recurrence rate was determined by Heidenreich et al. in a series of partial orchiectomy in patients with bilateral tumors or a solitary testis and all were salvaged successfully with RO (13). Bojanic et al. In another study, 10 of 28 patients with normal contralateral testis and TSS had GCT, and only 1 patient reported local recurrence at 39 months (11). In the present study, GCT was detected in 8 patients. The mean follow-up period of GCT patients was 21.8±7.8 (10-36) months without metastasis.

Table 2 presents a list of selected published TSS series. One of the publications with a high number of malignant patients in the current literature is Bojacis et al. In their study, 37.5% of

patients had GCT, and stromal tumors and various lesions were found in 64.3% of patients (12). Neither contralateral tumors nor distant metastases were observed in any of the patients in their cohort. Overall survival was achieved in all patients. (11). In line with the findings of the present study, benign testicular tumors were observed in 18 patients. In the present study, 8 of 25 cases (32%) were GCT, other 17 patients (68%) had stromal tumors and various lesions. Nason et al. have reported a large series of TSS in the Canadian population. They performed TSS on 77 patients, of which 25 had benign lesions (32.5%), 28 (36.4%) had malignant lesions, seminomas, 15 (19.5%) had non-seminomas, and 9 (11.7%) had sex-cord stromal tumor with a median follow-up was 43.5 months (range 1–258) (14). The overall local recurrence rate reported was 12.9% (n = 10) who underwent salvage RO. 6 of the patients who underwent RO were followed up. Only three received systemic chemotherapy. All patients became disease-free. In their study, three of the follow-up patients died, two due to testicular cancer. Both of them initially presented with widespread metastatic disease. However, our series has many strengths, especially because we provide information about the long-term oncological outcomes of testicular cancer with small testicular mass. The present study reports the entire experience of TSS, whereas other series have focused on bilateral lesions, solitary testis, and small lesions independently or confirmed stromal tumors (Table 2).

Nason and Bojanic studies had similar oncologic results between radical orchiectomy and TSS (12,14). In our study, the oncological results of TSS in GCT can be accepted. Hence, TSS could be established as a feasible method without compromising survival rates and with potential benefits. In the present study, no distant metastases were observed in the patients in the long-term follow-up period. Local recurrence was observed in one patient during local follow-up, and radical orchiectomy was performed. Nevertheless, the present study has determined a recurrence-free period of at least 38 months with all of the potential benefits of the preserved testis.

Preserving testicular function is an important issue. Out of the long-term testicular cancer survivors, up to 17% report changes in body image (5,25) that are independently associated with sexual dysfunction. Hence, TSS is most likely to improve body image and sexuality in testicular cancer (26). Moreover, in a large-scale Norwegian study comparing the general population with patients who underwent TSS, the 10-year paternity rate among TSSs is reduced by 30% (8).
Testicular tissue preservation could improve these rates. In the study of Nason et al., no statistical difference was found in the comparison of pre and post-operative testosterone (14). Bojanic et al. reported normal testosterone levels in all TSS patients along with a successful conception in a proportion (11). The testosterone levels of the participants in the present study were also followed up. No statistically significant change was observed in the postoperative period compared to the preoperative period.

However, almost one-third of TCSs report fear of cancer recurrence (FoR), and elevated levels of emotional distress were associated with elevated FoR rates with statistical significance (27). As the high local recurrence rate after TSS is widely accepted, FoR can be expected in these patients. Although frequent follow-up visits, in line with the protocol established, provide safety from an oncologic perspective, these lead to increased follow-up visit-associated anxiety.

Although Leydig cell tumors (LCT) are very rare, these constitute the most widely spread form of testicular stromal tumors, representing 1–3% of all adult testicular tumors (1). The EAU guidelines recommend abstention from immediate radical orchiectomy for the sake of organ-sparing procedures in small intraparenchymal lesions and the obtainment of a pathological diagnosis, especially in patients with symptoms of gynecomastia or hormonal disorders in which a non-germ cell tumor should be considered (7).In the literature, local and metastatic relapse was not observed in LCT patients who underwent TSS (28). However, Florian Laclergerie et al. reported in their study comparing radical orchiectomy with 35 patients and TSS with 21 patients that two out of 56 patients had local recurrence and no distant metastasis(27). Benign lesions have no recurrence risk (5, 6). Hence, TSS is a safe modality in these types of tumors. Organ-sparing surgery is a reasonable and reliable alternate modality for testicular tumors with benign tendencies (29,30). In our study, we did not detect local recurrence at 21.5±9.3 (10-38) months in non-germ cell testicular masses.

Our study is retrospective and has some limitations. Small testicular masses do not have a standard treatment in the literature. Many factors, such as patient age, size of the testicular mass, environmental factors, patient's desire, and especially the preference of the urologist, affect testicular sparing surgery. In addition, our series includes all forms of testicular lesions. When evaluated together with other series, TSS has many advantages, such as long-term survival advantage, protection of testicular functions, and psychological and cosmetic factors. However, TSS as an alternative surgical approach is to be performed by experienced urologists in centers with large series of cases.

## CONCLUSIONS

Excellent outcomes for benign tumors using TSS were obtained in the present study. TSS could be suggested as a safe and effective treatment modality in patients with germ cell tumors as in the present study. However, more data with larger patient series is needed regarding the potential risks and benefits of TSS.

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