Testicular torsion in adults: Demographics and 30-day outcomes after orchiopexy or orchiectomy

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Abstract

Background: Most often studied in the pediatric population, testicular torsion also affects the adult male population. Little data exists on demographics, patient risk factors, and associated outcomes for the surgical management of testicular torsion. This study sought to describe differences in demographics and outcomes for those patients requiring orchiopexy or orchiectomy.

Materials and methods: An analysis of the American College of Surgeons National Surgical Quality Improvement Program database (2015–2018) was performed, capturing patients with a postoperative diagnosis of testicular torsion. Patients were stratified into 2 groups if they received orchiopexy or orchiectomy. Demographics, perioperative variables, surgeon specialty, and outcomes were analyzed.

Results: A total of 769 patients undergoing surgical treatment of testicular torsion were captured. Most of these patients were White (46.81%) and young adults (28.33 ± 12.04 years) and 28.8% required orchiectomy. Those undergoing orchiectomy were more likely to be older, have more comorbidities, and have a systemic inflammatory response syndrome. Mean operative time was longer in the orchiectomy group (48 ± 23 vs. 44 ± 20 minutes, \(p < 0.0124\)). There were no deaths at 30 days. Length of stay and rate of superficial wound infection were higher in the orchiectomy group and discharge to home was more likely in the orchiectomy group.

Conclusions: Adult testicular torsion should be considered in an acute scrotum differential. Adult patients requiring orchiectomy for testicular torsion are more likely to have confounding medical conditions compared to those undergoing orchiopexy. Clinically, rates of complications between the 2 procedures are small, making the decision to perform orchiopexy or orchiectomy based on the scenario.

Keywords: Orchiectomy; Orchiopexy; Testicular torsion

1. Introduction

Testicular torsion is a condition that is traditionally seen in the pediatric population, but can occur at any age\textsuperscript{[1]} While it most commonly affects young males in a bimodal fashion with peaks in the perinatal and pubertal ages, its prevalence in adults is higher than previously believed\textsuperscript{[1,2,3]}

Testicular torsion occurs when the spermatic cord twists around its own axis which impedes blood flow to the testicle leading to ischemia. The severity of testicular torsion is dependent on the duration of torsion and extent of rotation, which is typically between 180° and 720°. The more extensive the spermatic cord rotation the quicker onset of ischemia\textsuperscript{[1]}. The management of testicular torsion is based on the viability of the testicle\textsuperscript{[1,4]} If the testicle is not detorsed in an appropriate amount of time, it can undergo irreversible damage and injury inducing atrophy and loss of function\textsuperscript{[3,5]}

Adults with testicular torsion have variable salvage rates and may have a higher likelihood of undergoing orchiectomy over orchiopexy. The salvage rates in adults, as in children, have been shown to be primarily time dependent\textsuperscript{[1,2,6-8]}. The differing outcomes between adults and pediatrics are secondary to longer time to initial presentation, greater degree of twist, poor history and physical, as well as the assumed knowledge that testicular torsion in adults is overwhelmingly rare\textsuperscript{[1,2,5]}. Additionally, there are numerous factors that have been studied to determine the reason for non-salvageable testicles resulting orchiectomy such as social determinants of health. A few studies have shown that this may play a role in orchiectomy\textsuperscript{[9,10]}. But this data is exclusively found within the pediatric population and has not been demonstrated ubiquitously\textsuperscript{[11]}. The objective of this study was to identify demographics, perioperative variables, and outcomes for a national population of adult patients who suffered from testicular torsion while distinguishing risks factors for patients requiring orchiectomy versus orchiopexy.

2. Materials and methods

Data was utilized from the American College of Surgeons National Surgical Quality Improvement Program (ACS NSQIP) database (2015–2018)\textsuperscript{[12]}. This database contains patient-level, aggregate data, and is Health Insurance Portability and Accountability Act compliant as it does not identify hospitals, physicians, or patients. This data is free to ACS NSQIP participating hospitals. The benefit of this particular dataset is
a national dataset that collects more granular data of specific pre-
and postoperative risk factors and outcomes. The Institutional
Review Board of the University of Kansas Medical Center
approved this study as non-human subjects research and protocol
exempt.

An analysis of the ACS NSQIP database from 2015 to 2018 was
performed, capturing patients with a postoperative diagnosis of
testicular torsion. Patients were stratified into 2 groups based on if
they received orchiopexy or orchiectomy. The age, sex, race,
comorbidities, perioperative variables, elective operation, wound
class, preoperative laboratory values, admission quarter, mortality,
length of operation, length of stay, discharge destination, surgeon
specialty, and postoperative outcomes such as readmission and
return to the operating room, as well as complications such as deep
vein thrombosis or wound infection, were included in the analysis as
available in NSQIP. Not captured within this database are insurance
status, urban–rural dwelling, education level of the patient, or
preoperative exam findings or imaging findings. Degree of torsion or
operative details are not captured either.

Statistical analysis and data management were performed
using SPSS (IBM Corp. Released 2015, IBM SPSS Statistics for
Windows, Version 23.0. Armonk, NY, IBM Corp.) and Excel
(Microsoft version 16.32). Chi-square test and Satterthwaite or
Pooled t test were used where appropriate. Multivariate
regression analysis was not carried out due to the low population
size. Significance is indicated by $p < 0.05$.

3. Results

A total of 769 patients undergoing surgical treatment of testicular
torsion were captured (Table 1). A majority of these patients were
White (46.81%) young adults (28.33 ± 12.04 years). Orchiopexy
was completed more often than orchiectomy (71.13% vs.
28.87%). Those undergoing orchiectomy were more likely to
be older (34.02 ± 15.55 vs. 26.01 ± 12.04 years, $p < 0.001$), be of
Hispanic ethnicity (13.96% vs. 8.41%, $p = 0.02$), have diabetes
(5.41% vs. 1.10%, $p < 0.001$), have hypertension (12.16% vs.
4.2%, $p < 0.001$), and have a systemic inflammatory response
syndrome (SIRS) (12.61% vs. 4.75%, $p < 0.001$).

Table 2 describes perioperative variables. In the evaluation and
comparison of preoperative labs, there was a statistically
significant finding of increased white blood cell count (12.0 vs.
9.9 × 10^9/L, $p < 0.01$) in the orchietomy population. A statisti-
cally significant difference was observed in the orchietomy
population, but still within normal laboratory parameters, in a
lower hematocrit (42% vs. 44%, $p < 0.01$), higher platelets (253
vs. 238 × 10^9/L, $p < 0.01$), elevated alkaline phosphatase (90.6
vs. 75.3 μL, $p < 0.01$), and lower creatinine (0.9 vs. 1.0mg/L,
$p < 0.01$). These were classified as emergency operations in
68.27% of the entire population. There were no variations
among admission quarter and most procedures were done under
general anesthesia. Table 3 describes that 98.57% of procedures
were done by urologists while 11 cases (1.43%) were done by
general surgeons.

Mean operative time was longer in the orchietomy group (48
± 23 vs. 44 ± 20 minutes, $p = 0.0124$) (Table 4). There were no
deaths at 30 days. Length of stay and rate of superficial wound
infection were higher in the orchietomy group (3.15% vs.
0.73%, $p =0.0167$) and length of stay was longer in those
requiring orchietomy (0.41 vs. 1.06 days, $p < 0.01$). Readmis-
sion, return to the operating room, and postoperative compli-
cations were otherwise similar between groups.

4. Discussion

Adult testicular torsion has been primarily investigated through
institutional case series. To the best of our knowledge, there are
no database reviews of adult testicular torsion that delineate
patients who have received orchiopexy or orchietomy. Smaller
studies have investigated risk factors, but there remains minimal
nationwide data on comorbid factors that may impact the need
for orchietomy especially in adults.[1]

It is well known that time from torsion to treatment plays a
fundamental role in improving salvage in both adults and

### Table 1
Baseline demographics and comorbidities of adults with testicular torsion.

| Characteristic | Total (n = 769, 100%) | Orchiopexy (n = 547, 71.13%) | Orchietomy (n = 222, 28.87%) | $p$ |
|----------------|---------------------|-----------------------------|-----------------------------|-----|
| Age, yr        | 28.33 ± 12.04       | 26.01 ± 9.36                | 34.02 ± 15.55               | <0.0001 |
| Race, n (%)    |                     |                             |                             |     |
| White          | 360 (46.81%)        | 259 (47.35%)                | 101 (45.50%)                | 0.6406 |
| Black          | 233 (30.30%)        | 159 (29.07%)                | 74 (33.33%)                 | 0.2434 |
| Hispanic       | 77 (10.01%)         | 46 (8.41%)                  | 31 (13.96%)                 | 0.0201 |
| Not reported   | 141 (18.34%)        | 105 (19.20%)                | 36 (16.22%)                 | 0.3333 |
| Comorbidities, n (%) |            |                             |                             |     |
| Diabetes       | 18 (2.34%)          | 6 (1.10%)                   | 12 (5.41%)                  | 0.0003 |
| Current smoker | 187 (24.32%)        | 126 (23.03%)                | 61 (27.48%)                 | 0.1931 |
| No dyspnea     | 766 (99.61%)        | 545 (99.63%)                | 221 (99.55%)                | 0.8642 |
| COPD           | 2 (0.26%)           | 2 (0.37%)                   | 0 (0.00%)                   | 1.0000 |
| Hypertension   | 50 (6.50%)          | 23 (4.20%)                  | 27 (12.16%)                 | 0.0001 |
| Weight loss    | 0 (0.00%)           | 0 (0.00%)                   | 0 (0.00%)                   | 1.0000 |
| Steroid use    | 3 (0.39%)           | 3 (0.55%)                   | 0 (0.00%)                   | 0.5609 |
| Independent    | 749 (97.40%)        | 537 (98.17%)                | 212 (95.50%)                | 0.0346 |
| Body mass index, kg/m² | 25.98 ± 6.34       | 25.84 ± 6.25                | 26.32 ± 25.98               | 0.3906 |
| ASA 3 or greater | 70 (9.10%)         | 33 (6.03%)                  | 37 (16.67%)                 | <0.0001 |
| Preoperative SIRS | 54 (7.02%)         | 26 (4.75%)                  | 28 (12.61%)                 | 0.0001 |

Values are mean (SD) or n (%). ASA = American Society of Anesthesiologists; COPD = chronic obstructive pulmonary disease; SIRS = systemic inflammatory response syndrome.
pediatrics. However, the overall testicular salvage rate is widely variable, ranging from poor to moderate and is worse in the adult population when compared to pediatrics.

In our 769 patients, we found that 28.8% of adults who had testicular torsion required orchiectomy. This percentage is lower in the pediatric population. Patients older than 21 years had 41% salvage versus 70.3% in the younger population. They found that the time to detorsion (102 vs. 11 hours) and the degree of torsion (30° vs. 431°) played a statistically significant role in their ability to salvage. They concluded that the salvage rates were poorer in adults potentially due to the extent of twist in the cord.

We found that patients with increased age, Hispanic ethnicity, presence of comorbid conditions including diabetes, hypertension, American Society of Anesthesiologists of 3 or greater, and preoperative SIRS were statistically higher in those receiving orchiectomy. Additionally, laboratory statistical differences seen in the orchiectomy population including increased white blood cell counts, lower hematocrit, elevated platelets, elevated alkaline

Table 2
Perioperative variables of adults with testicular torsion.

| Variables                   | Total (n=769, 100%) | Orchiopexy (n=547, 71.13%) | Orchiectomy (n=222, 28.87%) | p     |
|-----------------------------|---------------------|-----------------------------|-----------------------------|-------|
| Elective operation, n (%)   | 163 (21.20%)        | 130 (23.77%)                | 33 (14.86%)                 | 0.0652|
| Emergency operation, n (%)  | 525 (68.27%)        | 373 (68.19%)                | 152 (68.47%)                | 0.9401|
| Admission quarter, n (%)    |                     |                             |                             |       |
| 1                           | 200 (26.01%)        | 139 (25.41%)                | 61 (27.48%)                 | 0.5539|
| 2                           | 176 (23.15%)        | 133 (24.31%)                | 45 (20.27%)                 | 0.2292|
| 3                           | 160 (20.81%)        | 110 (20.11%)                | 50 (22.52%)                 | 0.4551|
| 4                           | 231 (30.34%)        | 165 (30.16%)                | 66 (29.73%)                 | 0.9051|
| Wound class, n (%)          |                     |                             |                             |       |
| Clean                       | 402 (52.28%)        | 308 (56.31%)                | 94 (42.34%)                 | 0.0004|
| Contaminated                 | 323 (42.00%)        | 233 (42.60%)                | 90 (40.54%)                 | 0.6808|
| Contaminated                 | 34 (4.42%)          | 5 (0.91%)                   | 29 (13.06%)                 | <0.0001|
| Dirty/Infected              | 10 (1.30%)          | 1 (0.18%)                   | 9 (4.05%)                   | 0.0001|
| General anesthesia, n (%)   | 753 (97.92%)        | 535 (97.81%)                | 218 (98.20%)                | 0.7300|
| Preoperative labs           |                     |                             |                             |       |
| Sodium, mEq/L               | 139.1 ± 2.6         | 139.2 ± 2.5                 | 138.8 ± 2.8                 | 0.8029|
| BUN, mmol/L                 | 13.8 ± 4.6          | 14.1 ± 4.3                  | 13.4 ± 5.2                  | 0.1320|
| Creatinine, mg/dL           | 1.0 ± 0.2           | 1.0 ± 0.2                   | 0.9 ± 0.2                   | 0.0002|
| Albumin, g/dL               | 4.2 ± 0.6           | 4.4 ± 0.4                   | 4.0 ± 0.7                   | 0.0000|
| Bilirubin, mg/dL            | 0.7 ± 0.5           | 0.7 ± 0.4                   | 0.7 ± 0.6                   | 0.6589|
| AST, u/L                    | 27.1 ± 21.5         | 26.5 ± 24.5                 | 24.8 ± 15.3                 | 0.1386|
| ALP, u/L                    | 81.0 ± 32.0         | 75.3 ± 22.2                 | 90.6 ± 42.4                 | 0.0015|
| WBC, × 10^9/L              | 10.6 ± 4.0          | 9.9 ± 3.5                   | 12.0 ± 4.5                  | <0.0001|
| HCT, %                      | 43.4 ± 3.9          | 44.0 ± 3.3                  | 42.2 ± 4.6                  | <0.0001|
| PLT, K/L                    | 243.4 ± 66.6        | 238.6 ± 59.2                | 253.4 ± 78.8                | 0.0248|
| PTT, s                      | 29.6 ± 7.7          | 26.7 ± 4.5                  | 31.3 ± 11.4                 | 0.1208|
| INR                         | 1.1 ± 0.1           | 1.1 ± 0.1                   | 1.1 ± 0.2                   | 0.1626|

Values are mean (SD) or n (%). ALP = alkaline phosphatase; AST = aspartate aminotransferase; BUN = blood urea nitrogen; HCT = hematocrit; INR = international normalized ratio; PLT = platelets; PTT = partial thromboplastin time; WBC = white blood cells.

Table 3
Surgeon specialty of adults with testicular torsion.

| Surgeon specialty, n (%) | Total (n=769, 100%) | Orchiopexy (n=547, 71.13%) | Orchiectomy (n=222, 28.87%) | p     |
|--------------------------|---------------------|-----------------------------|-----------------------------|-------|
| Urologic surgery         | 758 (96.57%)        | 540 (98.72%)                | 218 (98.20%)                | 0.5806|
| General surgery          | 11 (1.43%)          | 7 (1.28%)                   | 4 (1.80%)                   | 0.5806|

Values are mean (SD) or n (%).
Table 4
Perioperative outcomes of adults with testicular torsion.

| Characteristic                                                                 | Total (n = 769, 100%) | Orchiopexy (n = 547, 71.13%) | Orchiectomy (n = 222, 28.87%) | p     |
|-------------------------------------------------------------------------------|-----------------------|------------------------------|--------------------------------|-------|
| Hospital days to operation, d                                                 | 0.12 ± 1.16           | 0.10 ± 1.34                  | 0.16 ± 0.44                    | 0.3946|
| Hospital length of stay, d                                                    | 0.60 ± 2.06           | 0.41 ± 1.48                  | 1.06 ± 2.99                    | 0.0023|
| 30-Day mortality, n (%)                                                       | 0 (0.00%)             | 0 (0.00%)                    | 0 (0.00%)                      | 1.0000|
| Operative time, min                                                           | 45 ± 21               | 44 ± 20                      | 48 ± 23                        | 0.0124|
| Discharge destination (home), n (%)                                           | 701 (91.16%)          | 521 (95.25%)                 | 180 (81.08%)                   | 0.0011|
| Complication, n (%)                                                           |                       |                              |                                |       |
| Readmission                                                                  | 0 (1.17%)             | 4 (0.73%)                    | 5 (2.25%)                      | 0.1300|
| Related to operation                                                          | 6 (0.78%)             | 3 (0.55%)                    | 3 (1.35%)                      | 0.3629|
| Return to operating room                                                      | 6 (0.78%)             | 2 (0.37%)                    | 4 (1.80%)                      | 0.0611|
| Related to operation                                                          | 4 (0.52%)             | 2 (0.37%)                    | 2 (0.90%)                      | 0.3282|
| Orchiectomy                                                                  | 1 (0.13%)             | 1 (0.18%)                    | 1 (0.45%)                      | 0.1777|
| Unplanned intubation                                                          | 0 (0.00%)             | 0 (0.00%)                    | 0 (0.00%)                      | 1.0000|
| On ventilator > 48 hr                                                         | 0 (0.00%)             | 0 (0.00%)                    | 0 (0.00%)                      | 1.0000|
| Wound infection (superficial)                                                 | 11 (1.43%)            | 4 (0.73%)                    | 7 (3.15%)                      | 0.0167|
| Wound infection (deep)                                                        | 0 (0.00%)             | 0 (0.00%)                    | 0 (0.00%)                      | 1.0000|
| Organ/space surgical site infection                                            | 0 (0.00%)             | 0 (0.00%)                    | 0 (0.00%)                      | 1.0000|
| Wound dehiscence                                                             | 4 (0.52%)             | 2 (0.37%)                    | 2 (0.90%)                      | 0.1477|
| Pneumonia                                                                    | 2 (0.26%)             | 2 (0.37%)                    | 2 (0.90%)                      | 0.0831|
| Urinary tract infection                                                       | 0 (0.00%)             | 0 (0.00%)                    | 0 (0.00%)                      | 1.0000|
| Deep vein thrombosis                                                          | 1 (0.13%)             | 0 (0.00%)                    | 1 (0.45%)                      | 0.2887|
| Pulmonary embolism                                                            | 0 (0.00%)             | 0 (0.00%)                    | 0 (0.00%)                      | 1.0000|
| Cardiac arrest requiring cardiopulmonary resuscitation                       | 0 (0.00%)             | 0 (0.00%)                    | 0 (0.00%)                      | 1.0000|
| Myocardial infarction                                                         | 1 (0.13%)             | 1 (0.18%)                    | 0 (0.00%)                      | 1.0000|
| Sepsis                                                                       | 2 (0.26%)             | 2 (0.37%)                    | 2 (0.90%)                      | 0.0831|
| Shock                                                                        | 1 (0.13%)             | 1 (0.18%)                    | 1 (0.45%)                      | 0.2887|
| Bleeding transfusion                                                          | 0 (0.00%)             | 0 (0.00%)                    | 0 (0.00%)                      | 1.0000|
| Renal complications                                                           | 1 (0.13%)             | 0 (0.00%)                    | 1 (0.45%)                      | 0.2887|

Values are mean (SD) or n (%).

phosphatase, and lower creatinine, though only white blood cell count was elevated and other values were within normal ranges.

Little is described in the literature concerning patient comorbid conditions in adult testicular torsion. Tanaka et al.[18] have examined clinical predictors in children with testicular torsion and found that torse testicles were able to be salvaged in 60.5% of cases. Interestingly, they also found that along with duration and degree or torsion, C-reactive protein (CRP) was significantly higher in the non-salvageable testis group. The predictive factor of non-salvageable tests was a CRP level > 10 mg/dL.

Systemic illness, diabetes, and hypertension all have been shown to increase inflammatory markers, which can lead to vascular compromise and microvascular dysfunction in other organs.[19] In our patients that required orchietomy, patients with diabetes and hypertension were found to have an increasing risk of non-salvageable testicles. In sepsis, or patients meeting SIRS criteria, there is damage to the endothelium resulting in tissue hypoperfusion potentially leading to end-organ failure.[20]

The vascular damage seen in other organ systems due to diabetes and hypertension as well as the effects of sepsis may be insightful for explanation as to the cause of this as organs are more tenuous as a result of their comorbidity. There have been others who have attempted to identify hematologic parameters for the diagnosis of testicular torsion. Since neutrophils play a vital role in the inflammatory processes, the neutrophil to lymphocyte ratio (NLR) has been shown to be predictive of prognosis of both acute and chronic inflammatory diseases. Günes et al.[23] found that NLR was 84% sensitivity and 92% specificity in identifying testicular torsion and was related to the duration of symptoms. Interestingly, in another study, the NLR was also shown to be equally as sensitive and specific as doppler ultrasonography for testicular torsion.[24]

There was also a statistically significant increase in platelet count. While the values may be clinically insignificant, the statistical significance may be indicative of a larger overall inflammatory process that is seen in non-salvageable testicles. Palmer et al.[25] demonstrated that an increase in platelet activating factor, which is a biochemical marker of ischemic injury, leads to testicular ischemia in rats. It appears reasonable that patients that are systemically ill, with a prior elevation of inflammatory markers, may yield a higher propensity to develop ischemia requiring more frequent management with orchietomy.

The increased orchietomy rate based on race is not a novel concept. We found that in adults, Hispanics were more likely to undergo orchietomy. In 2 prior data base reviews in the pediatric population, both Cost et al.[9] and Zhao et al.[10] demonstrated that insurance type and race were shown to be independent predictors of orchietomy. However, Zhao et al.[10] found this to be in African American males with an odds ratio 1.33 (95% CI 1.04–1.71) and Cost et al.[9] saw 37.6% vs. 28.1% (p < 0.0001) in comparing Black and White children. Not captured within this
study were variables such as delays in care or language barriers which may play a role in delays to treatment.

One limitation of this study, similar to other national database reviews, is that the total length of time of torsion is unknown. The time to operation is a substantial component for salvage, but extrapolating this data, it could account for delayed time for Hispanic patients due to limited access to care and a language barrier delaying care. Gold et al. demonstrated that every minute is valuable in management, and found that the time from arrival to the emergency department to treatment was an independent risk factor for testis survival.

We affirm that orchietomy does not have benign consequences. Orchietomy patients postoperatively had increased hospital stay and superficial wound infection. We hypothesize that these factors may both be related to patients being systemically ill at the time of orchietomy and inherently having poorer blood supply either due to comorbid or concurrent conditions. In addition to immediate complications, a unilateral orchietomy has been shown to decrease fertility. All of these components should be discussed with the patient and family preoperatively in all torsion cases in the chance that they require orchietomy.

Our study has several other limitations that are inherent to the nature of a retrospective study and limitations of a database. The ACS NSQIP database acknowledges several limitations inherent to their database. Generic variables are collected, patient follow-up is only 30 days, data is only from participating hospitals, and some variables are not present for each case. Additionally, information regarding each individual case and the complex circumstance is not available including time to operation, torsion to operative time length, which all remain an important factor for decision making. Additionally, with such short follow-up, there is no ability to describe long-term outcomes or recurrence postoperatively. The ACS NSQIP has attempted to eliminate sampling error, but complete removal of bias is not possible without randomly generated assignment of cases. A regression analysis of the data may be able to pinpoint risk factors, but the population we analyzed with the data available to us did not allow for a statistically sound model or regression.

5. Conclusion

Adult testicular torsion should be considered in an acute scrotum differential as it can occur at all ages. Adult patients requiring orchietomy for testicular torsion are more likely to have confounding medical conditions compared to those undergoing orchioepxy. Clinically, rates of complications between the 2 procedures are small, making the decision to perform orchioepxy or orchietomy based on the scenario, but the risk and possibility of orchietomy should be discussed with patient preoperatively.

Acknowledgments

The authors would like to acknowledge the Department of Surgery at the University of Kansas for their support and enthusiasm for resident and student research endeavors.

Statement of ethics

This study was designated “Non-Human Subjects Research” by the Human Subjects Committee at the University of Kansas School of Medicine. Thus, the participants’ consent was not required.

Conflicts of interest statement

The authors have no disclosures or conflicts of interest.

“American College of Surgeons National Surgical Quality Improvement Program and the hospitals participating in the ACS NSQIP are the source of the data used herein; they have not verified and are not responsible for the statistical validity of the data analysis or the conclusions derived by the authors.”

Funding source

No funding was used in the creation of this manuscript.

Author contributions

All authors contributed equally to the writing and creation of the manuscript. Dr. Brungardt devised the study and performed statistical analysis.

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**How to cite this article:** Brungardt JG, McLeay MT, Schropp KP. Testicular torsion in adults: Demographics and 30-day outcomes after orchiopexy or orchiectomy. *Curr Urol* 2021;15(4):219–224. doi: 10.1097/CU9.0000000000000032