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A comparison of distal triceps tendon repair outcomes by surgical technique

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Background: Distal triceps tendon ruptures are an uncommon injury with several reported repair techniques. Outcomes research between the repair techniques is complicated by the rarity of the injury as most published materials are based on small sample sizes and specific surgical techniques. This study compared surgical complications, reoperations, and range of motion between all suture transosseous tunnel only (TT), suture anchor only (SA), and transosseous tunnel plus suture anchor (TTSA) repair techniques.

Methods: We retrospectively identified patients who underwent a distal triceps repair at our tertiary-care institution from 2011 to 2021. The electronic medical record was reviewed for patient demographics, triceps rupture characteristics, repair technique, and postoperative complications.

Results: This study includes 199 patients who underwent a repair by TT (82), SA (69), or TTSA (48) techniques. No differences were identified between groups with regards to demographics and medical comorbidities. Patients treated by SA technique were more likely to have a loss of elbow extension (SA: 14 [26.4%], TT: 6 [8.57%], TTSA: 4 [10.0%], $P = .014$) postoperatively with an average loss of 9° for the patients in all groups. However, no differences were identified between the groups with regards to postoperative complications (TT: 15.9%, SA: 17.4%, TTSA: 18.8%, $P = .911$), including triceps rerupture (TT: 6.10%, SA: 4.35%, TTSA: 12.5%, $P = .260$), and reoperation (TT: 11.0%, SA: 11.6%, TTSA: 14.6%, $P = .822$) rates.

Conclusion: Regardless of repair technique, distal triceps tendon repair surgery has a relatively high complication and reoperation rate. However, given the similarities between the various methods of repair, surgeons can be confident in repairing this type of injury by whichever modality they deem appropriate.

Distal triceps tendon ruptures account for <1% of all muscle and tendon injuries and typically occur as a result of an avulsion off the olecranon during muscular contraction with an eccentric load or direct trauma to the posterior elbow.[3,34] Treatment of these injuries depends on the severity of the rupture, functional status of the patient, and the patient's goals of care. Nonoperative management may be successful for partial ruptures, especially those with preserved strength and ruptures involving less than 50% of the tendon. However, not all partial ruptures are equivalent and nonoperative care has been associated with a high rate of subsequent operative intervention for residual pain and weakness.[22,28] Surgery can yield good outcomes for partial ruptures in the setting of reduced strength.[6,7,18,31]

Operative treatment of distal triceps ruptures is associated with high rates of patient satisfaction, pain reduction, and improved elbow extension strength.[1,21] It is the preferred treatment modality for patients with high-grade partial ruptures and complete ruptures.[27,31,34] Despite the success of operative repair, it is also associated with a relatively high complication rate with reports as high as 22% with common complications of rerupture, infection, and ulnar neuropathy.[4,19,23,32] However, recent systematic review suggests a lower complication rate of 14.9% with the highest rates found in direct repair (29.2%) and the lowest rates found in suture anchor repair (7.7%).[2] To optimize outcomes following operative

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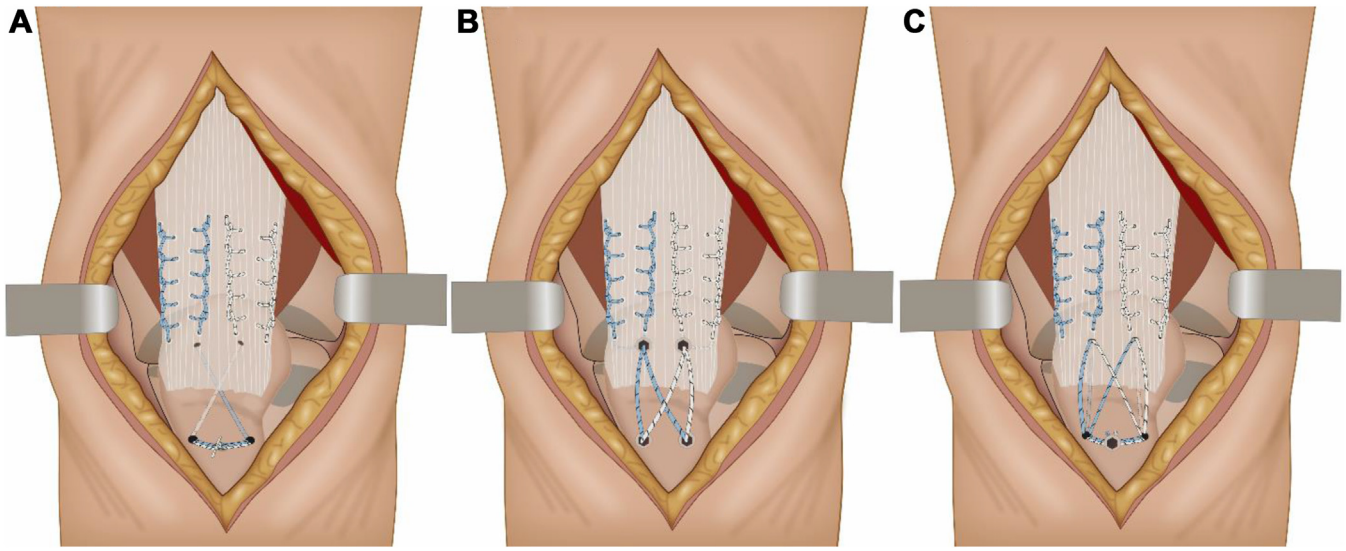

Figure 1 Illustrated examples of the (**A**) transosseous only, (**B**) suture anchor only, and (**C**) transosseous plus suture anchor repair techniques.

intervention, surgeons have evaluated outcomes by repair technique between transosseous tunnels and suture anchor repair techniques. One large cohort study found a suture anchor approach to be associated with lower rerupture rates, but this finding was not substantiated on systematic review.[2,23] However, these prior studies do not include repair techniques that combine suture anchor repair with transosseous tunnels. In light of this limitation, the paucity of published material on this topic, and the mixed results regarding the superiority of one technique to another, this study was initiated to investigate and report our institutional experience with these various technique options.

Materials and methods

We retrospectively identified patients who underwent distal triceps repair from 2011 to 2021 at a single tertiary-care institution through a medical record query with the current procedural terminology code 24342 for repair of the distal biceps or triceps tendons. The operative notes of these patients were reviewed to determine if a biceps or triceps repair had been performed. Patients who had undergone a primary triceps repair were included in this study. Exclusion criteria included patients with prior total elbow arthroplasty, those with allograft supplemented repairs, direct suture-only repairs (without tranosseous tunnel) for partial tears, prior olecranon hardware, and those associated with large intra-articular or comminuted olecranon fractures requiring repair.

The electronic medical record was reviewed to collect patient demographics, comorbidities, mechanism and timing of injury, elbow range of motion (ROM) before and after surgery, and post-operative complications. Injury timing was categorized as either injury within 90 days of surgery or injury beyond 90 days from surgery to provide comparable results to the prior work by Mirzayan et al.[23] Elbow ROM was observed for the presence of full active extension or not in both the preoperative and final post-operative time periods as qualitative measures were not available in all patients upon chart review. Loss of active elbow extension in the postoperative period was only considered positive if the patient had at least 90 days of follow-up after the surgery. Patients were separately identified if they had complete elbow extension preoperatively but were found to have incomplete elbow extension postoperatively. Operative technique and triceps rupture completeness was determined by review of operative notes. Ruptures were categorized as partial or complete. Patients were separated into 3 groups: suture-only transosseous tunnel (TT) repair, suture anchor (SA)—only repair, and transosseous tunnel plus suture anchor (TTSA) repair (Fig. 1). Postoperative complications, reoperations, and ROM data were evaluated for 1 year after surgery. Specifically, we tracked postoperative complications for triceps reruptures, wound complications, ulnar neuropathy, and events leading to reoperation. The operative surgeons were categorized by their fellowship subspecialty training as either hand and wrist, sports medicine, or shoulder and elbow surgeons.

A bivariate analysis was performed comparing the groups by triceps repair technique. A chi-squared test was performed for categorical variables and an analysis of variance or Kruskal–Wallis H-test were performed for continuous variables. Direct comparisons between groups were performed when the analysis between the 3 groups yielded a significant P value. A multivariate linear regress was performed with dependent variables of triceps rerupture and postoperative loss of elbow extension. A P value less than .05 was considered statistically significant. All statistical analyses were performed using R Studio Version 4.0.2 (Boston, MA, USA).

Results

After application of inclusion criteria, we identified 233 patients. Eighteen patients were excluded for having received a direct suture only repair, 8 for graft augmentation of the repair, 4 for prior total elbow arthroplasty, 2 for prior olecranon hardware, 1 for a comminuted olecranon fracture, and 1 patient for having a prior ipsilateral triceps repair at an outside institution. The remaining 199 patients were comprised of 82 TT, 69 SA repairs, and 48 TTSA repairs. Overall, there were 94 full and 105 partial tear patients included in this study. Of the partial tears repaired, the SA technique was the most commonly performed (41.9%). The most commonly used technique for full tear injuries was a TT repair (48.9%).

The 3 groups analyzed (TT, SA, and TTSA) were similar with regards to all baseline demographics and medical comorbidities (Table I). More patients in the TTSA group recalled a traumatic mechanism of injury for their triceps ruptures (TT: 50 [61.0%], SA: 42 [60.9%], TTSA: 41 [85.4%], $P = .007$). The TTSA group also had a

Table I
Patient demographics and comorbidities.

	Total data	Transosseous only	Suture anchor only	Transosseous + suture anchor	*P* value
	N = 199	N = 82	N = 69	N = 48	
Age	51.7 (12.4)	51.1 (12.0)	52.5 (12.5)	51.6 (13.2)	.807
Sex: male	184 (92.5%)	77 (93.9%)	62 (89.9%)	45 (93.8%)	.586
Race					.594
White	149 (74.9%)	58 (70.7%)	52 (75.4%)	39 (81.2%)	
Black	30 (15.1%)	15 (18.3%)	9 (13.0%)	6 (12.5%)	
Asian	2 (1.01%)	0 (0.00%)	2 (2.90%)	0 (0.00%)	
Other	18 (9.05%)	9 (11.0%)	6 (8.70%)	3 (6.25%)	
Ethnicity: Hispanic	9 (4.52%)	5 (6.10%)	2 (2.90%)	2 (4.17%)	.695
Hand dominance					.783
Right	140 (87.0%)	61 (84.7%)	43 (91.5%)	36 (85.7%)	
Left	19 (11.8%)	10 (13.9%)	4 (8.51%)	5 (11.9%)	
Ambidextrous	2 (1.24%)	1 (1.39%)	0 (0.00%)	1 (2.38%)	
Smoking status					.117
Nonsmoker	154 (78.2%)	62 (76.5%)	49 (72.1%)	43 (89.6%)	
Former smoker	21 (10.7%)	7 (8.64%)	11 (16.2%)	3 (6.25%)	
Current smoker	22 (11.2%)	12 (14.8%)	8 (11.8%)	2 (4.17%)	
Alcohol use					.072
None	60 (31.6%)	22 (28.2%)	16 (24.6%)	22 (46.8%)	
Occasional	90 (47.4%)	34 (43.6%)	39 (60.0%)	17 (36.2%)	
Weekly	32 (16.8%)	18 (23.1%)	8 (12.3%)	6 (12.8%)	
Daily	8 (4.21%)	4 (5.13%)	2 (3.08%)	2 (4.26%)	
Diabetes					.237
Nondiabetic	186 (93.9%)	77 (93.9%)	66 (97.1%)	43 (89.6%)	
NIDDM	8 (4.04%)	2 (2.44%)	2 (2.94%)	4 (8.33%)	
IDDM	4 (2.02%)	3 (3.66%)	0 (0.00%)	1 (2.08%)	
Inflammatory arthropathy	18 (9.09%)	8 (9.76%)	6 (8.82%)	4 (8.33%)	1.000
BMI	30.2 (5.02)	30.0 (4.98)	31.0 (5.61)	29.5 (4.04)	.479
CCI	1.24 (1.24)	1.22 (1.21)	1.26 (1.23)	1.25 (1.34)	.935

NIDDM, non–insulin-dependent diabetes mellitus; *IDDM*, insulin-dependent diabetes mellitus; *BMI*, body mass index; *CCI*, Charlson comorbidity index.

nonsignificant lower percentage of patients with symptoms for greater than 90 days before surgery (TT: 25 [30.5%], SA: 20 [29.0%], TTSA: 7 [14.6%], $P = .110$) (Table II).

The SA group was found to have fewer patients with full preoperative elbow extension than the TT group (TT: 27.1% vs. SA: 8.93%, $P = .055$) and the TTSA group (SA: 8.93% vs. TTSA: 27.0%, $P = .063$) (Table III) but neither comparison met statistical significance. Postoperatively, the SA group was found to have more patients with a loss of full elbow extension than the TT group (SA: 26.4% vs. TT: 8.57%, $P = .048$) but not the TTSA group (SA: 26.4% vs. TTSA: 10.0%, $P = .129$). However, of patients who did not have full elbow extension, the degree of ROM loss was similar between the groups (TT: 15.0°, SA: 6.93°, TTSA: 7.5°, $P = .193$) and 0 patients in these 3 groups had a loss of elbow extension greater than 30°. The SA group was found to have more patients with incomplete postoperative elbow extension that also had full elbow extension before surgery, but these findings were not statistically significant on head-to-head comparison (TT: 5.71% vs. SA: 20.8%; $P = .074$ and SA: 20.8% vs. TTSA: 7.5%; $P = .210$). The 3 groups were found to have a similar length of follow-up for all patients. In patients with incomplete elbow extension, the median follow-up was 5.6 months with an interquartile range of 4.5 to 8.6 months.

The overall rate of symptomatic rerupture was 7.04% at a mean of 80.6 days (range: 10-182) after surgery. There was no difference between the 3 groups with regards to triceps rerupture rate (TT: 6.10%, SA: 4.35%, TTSA: 12.5%, $P = .245$). Similarly, there were no differences with regards to reoperation for any reason (TT: 11.0%, SA: 11.6%, TTSA: 14.6%, $P = .822$). Reoperations outside of revision triceps repairs consisted of (4) irrigation and débridement procedures for concern of infection, (2) cubital tunnel releases, (2) débridement procedures for elbow stiffness, (1) removal calcified suture granuloma, and (1) excision of infected olecranon bursa. The overall complication rate was 17.1%. The rate was similar between the 3 groups (TT: 15.9%, SA: 17.4%, TTSA: 18.8%, $P = .911$) (Table IV).

This study includes operations from 41 different surgeon across 3 subspecialties with 49 operations performed by hand and wrist surgeons, 71 by sports medicine surgeons, and 79 by shoulder and elbow surgeons. The 3 groups were found to utilize TT, SA, and TTSA techniques at different rates ($P = .005$) (Table V). Shoulder and elbow surgeons used a TT repair technique (54.4% of cases) more frequently than hand and wrist (32.7% of cases) and sports medicine (32.4% of cases) surgeons. Sports medicine physicians frequently performed SA repairs (47.9% of cases) while hand and wrist surgeons evenly used all 3 techniques (TT: 16, SA: 16, TTSA: 17).

On linear regression analysis, former (odds ratio [OR]: 1.12, confidence interval [CI]: 0.997-1.26, $P = .058$) and current (OR: 1.17, CI: 1.04-1.31, $P = .009$) smoking statuses were associated with triceps rerupture with current smoking being the only statistically significant factor. Repair technique by TT (reference), TTSA (OR: 1.09; CI: 0.99-1.19; $P = .078$), and SA (OR: 0.98; CI: 0.90-1.06; $P = .608$ were not found to be associated with triceps rerupture. A separate linear regression was performed with the presence of a postoperative loss of full elbow extension as the dependent variable. Triceps repair by SA technique (OR: 1.21, CI: 1.07-1.66, $P = .003$) and an associated extraarticular avulsion fracture (OR: 1.28, CI: 1.07-1.55, $P = .009$) were associated with a postoperative loss of full elbow extension (Table VI).

Discussion

Repair technique was not found to have an impact on triceps rupture or postoperative complication rates, but the SA repair technique was associated with a higher likelihood of having a postoperative loss of elbow extension. In addition, patients sustaining avulsion fracture were also more likely to have a postoperative loss of elbow extension, and patients with a smoking history were more likely to suffer a triceps rerupture.

Table II
Triceps tear characteristics.

	Total data	Transosseous only	Suture anchor only	Transosseous + suture anchor	*P* value
Complete rupture	94 (47.2%)	46 (56.1%)	25 (36.2%)	23 (47.9%)	.051
Traumatic injury	133 (66.8%)	50 (61.0%)	42 (60.9%)	41 (85.4%)	**.007**
Open injury	8 (4.02%)	3 (3.66%)	3 (4.35%)	2 (4.17%)	1.000
Avulsion fracture	22 (11.1%)	6 (7.32%)	7 (10.1%)	9 (18.8%)	.128
Prior steroid injection	5 (2.51%)	1 (1.22%)	3 (4.35%)	1 (2.08%)	.454
Rupture laterality: right	98 (49.2%)	39 (47.6%)	37 (53.6%)	22 (45.8%)	.655
Dominant-sided injury	84 (55.2%)	37 (51.4%)	24 (51.1%)	23 (54.8%)	.926
Symptom duration >90 d	52 (26.1%)	25 (30.5%)	20 (29.0%)	7 (14.6%)	.110

Bold text indicate statistical significance ($P < .05$).

Table III
Elbow range of motion.

	Total data	Transosseous only	Suture anchor only	Transosseous + suture anchor	*P* value
Preoperative limited extension	34 (20.9%)	19 (27.1%)	5 (8.93%)	10 (27.0%)	**.025**
Postoperative limited extension	24 (14.7%)	6 (8.57%)	14 (26.4%)	4 (10.0%)	**.014**
Developed limited extension after surgery	18 (11.0%)	4 (5.71%)	11 (20.8%)	3 (7.5%)	**.028**
Degrees of missing extension (°)	9.0 (8.5)	15.0 (11.4)	6.9 (7.0)	7.5 (5.0)	.569
Length of follow-up: Total	147 (113)	146 (124)	150 (109)	144 (9.0)	.478

Bold text indicates statistical significance ($P < .05$).

Table IV
Postoperative complications.

	Total data	Transosseous only	Suture anchor only	Transosseous + suture anchor	*P* value
Total complication	34 (17.1%)	13 (15.9%)	12 (17.4%)	9 (18.8%)	.911
Triceps rerupture	14 (7.04%)	5 (6.10%)	3 (4.35%)	6 (12.5%)	.245
Ulnar neuropathy	13 (6.53%)	5 (6.10%)	6 (8.70%)	2 (4.17%)	.672
Wound complication	6 (3.02%)	2 (2.44%)	3 (4.35%)	1 (2.08%)	.765
All reoperations	24 (12.1%)	9 (11.0%)	8 (11.6%)	7 (14.6%)	.822
Revision triceps repair	14 (7.04%)	5 (6.10%)	3 (4.35%)	6 (12.5%)	.245

Table V
Triceps tendon repair technique by subspecialty training.

	Hand and wrist	Sports medicine	Shoulder and elbow	*P* value
TT repair	16 (32.7%)	23 (32.4%)	43 (54.4%)	**.005**
SA repair	16 (32.7%)	34 (47.9%)	19 (24.1%)	
TTSA repair	17 (34.7%)	14 (19.7%)	17 (21.5%)	

TT, transosseous only; *TTSA*, transosseous plus suture anchor; *SA*, suture anchor only.
Bold text indicate statistical significance ($P < .05$).

Prior publications on distal triceps ruptures inconsistently report rerupture rates and are primarily composed of several small case series.[12,15,22,28,30] In the 2 most recent systematic reviews, cases from an included multicenter study comprised the majority of the available rerupture data.[2,13,23,24] The included multicenter study is one of the best available reports on postoperative complications after triceps tendon repair surgery, but their comparison between repair techniques is limited by a relatively short-term follow-up (3-4 months). Their final study ultimately found the SA repair to be a superior technique with a 0% rerupture rate compared to 6.7% rerupture rate in TT repairs.[23] Our study differs in that rerupture rates were followed for 1 year after surgery and were similar between groups (TT: 6.10%, SA: 4.35%, TTSA: 12.5%, $P = .260$). In addition, we included patients who underwent TTSA repair and found these patients experienced the highest rate of rerupture. Regression analysis showed the TTSA repair group was positively associated with tendon rerupture at an odds ratio of 1.09 but a nonsignificant *P* value of .078. As the TTSA group included fewer patients than the other 2 groups assessed, this study is likely underpowered to make any assertion regarding differences between this technique and TT or SA repairs. Overall, our regression analysis does not suggest any repair technique to be independently associated with tendon rerupture. However, a positive smoking history was found to be independently associated with tendon rerupture with a statistically significant result for current smokers (OR: 1.17; $P = .009$).

Our findings are supported by biomechanical analyses of TT and SA repair techniques as these show similar tendon strength when tested with cyclic loading.[8,11] Regarding the impact of smoking history, our data indicated that former and current tobacco smoking patients tended to be at higher risk for rerupture with odds ratios of 1.12 and 1.17, respectively, but this was not statistically significant. This calculation is also likely underpowered as former smokers comprise only 10.7% of our total cohort. Despite these limitations, the odds ratio is substantial and suggests an association between the 2 variables. This association is further supported by clinical studies and in animal models that have demonstrated impaired tendon integrity with tobacco/nicotine consumption.[9,26,35]

Patients treated by SA in this study were found to experience a higher rate of postoperative loss of elbow extension. This finding was substantiated by linear regression with an odds ratio of 1.21. We hypothesize this difference could be attributed to the additional proximal ulna bone disruption required by a suture anchor repair with anchors up to 4.75 mm in size compared to the 2.0-mm drill holes commonly used in transosseous-only techniques. Additionally, the suture anchor repair may be associated with decreased extension due to scar tissue and alteration of the joint capsule leading to more substantial tightness. Although these patients were

Table VI
Multivariate linear regression with dependent outcomes of triceps rerupture and the loss of full elbow extension.

Predictors	Rerupture			Postoperative extension loss		
	Odds ratio	CI	*P* value	Odds ratio	CI	*P* value
Nonsmoker	Reference			-	-	-
Former smoker	1.12	0.997-1.26	.058	-	-	-
Current smoker	1.17	1.04-1.31	**.009**	-	-	-
TT repair	Reference			Reference		
TTSA repair	1.09	0.99-1.19	.078	0.98	−0.86 to 1.12	.796
SA repair	0.98	0.90-1.06	.608	1.21	1.07-1.66	**.003**
Avulsion fracture	-	-	-	1.28	1.07-1.55	**.009**

CI, confidence interval; *TT*, transosseous only; *TTSA*, transosseous plus suture anchor; *SA*, suture anchor only.
Bold text indicates statistical significance ($P < .05$).

more likely to have a loss of elbow extension after surgery, the degree of extension loss did not place patients outside of a previously reported functional ROM for the elbow and averaged only 8° of loss of full elbow extension in this group.[25,29] It is important to note that while our results fall into the normal functional ranges needed common activities of daily living, distal triceps ruptures more often occur in younger, more active individuals[16] and therefore these smaller ROM limitations may still play a role in their functional status and quality of life. In this study, we also identified patients who had incomplete elbow extension in the preoperative period to account for any preoperative contractures. From this frame of reference, we found that 20.8% of patients receiving a SA repair who demonstrated full preoperative elbow ROM developed limited extension after surgery. This is a higher percentage than the TT repair (5.71%) and the TTSA repair (7.50%) groups, but the result was not found to be statistically significant on head-to-head comparison. Given that limited postoperative elbow extension only occurred in 24 (14.7%) of patients, this result is also likely underpowered to detect a significant difference.

Rehabilitation after triceps surgery typically consists of removal of a brace to allow for full ROM 6 weeks after surgery with a steady increase in loading beyond 12 weeks.[20] Thus, our length of follow-up (median 5.6 months for those with incomplete extension) was likely adequate to determine the majority of ROM improvements these patients were expected to obtain. In addition to the differences by SA repair, an associated avulsion fracture with a triceps rupture was an independent risk factor for a postoperative loss of full-elbow extension with an odds ratio of 1.28. Olecranon fractures have previously been reported to be associated with elbow stiffness including severe stiffness with a ROM arc between 30° and 60° at an odds ratio of 1.92.[33,36] Our finding would suggest that patients with avulsion fractures and those being repaired by SA techniques should be counseled preoperatively of this increased possibility and followed closely by therapy services to work on improving their ROM.

The total complication rate in this study is 17.1% which is similar to the complication rate described in the recent systematic review of 14.9%. However, unlike the systematic review which reported complication rates of 15.2% in TT repairs and 7.7% in SA repairs, our complications were similar between all repair technique groups.[2] The higher complication rate reported in our study for the SA technique is likely secondary to our increased follow-up time in this group. In addition, while many complications in the review were unspecified, our complications were most commonly a subsequent triceps rerupture and postoperative ulnar neuropathy. Although we report a high rate of postoperative ulnar neuropathy (6.53%), only 2 of these 13 patients ultimately required surgical intervention. However, most complications outside of ulnar neuropathy (ie, triceps rerupture and wound complications) required reoperation with an overall reoperation rate of 12.1% that was similar between groups (TT: 11.0%, SA: 11.6%, TTSA: 14.6%, $P = .822$). This reoperation rate is higher than the comparative study by Mirzayan et al, but we anticipate these differences are due to our longer follow-up and increased rerupture rates as well.[23] Moreover, the study by Mirzayan et al included only acute injuries defined as less than 90 days, while 26.1% of the patients in our study had a more chronic injury.

The explanation for differences in repair techniques between surgeon subspecialty training is likely multifactorial. One of our hypotheses regarding techniques is that the differences are related to educational material and research within the subspecialty societies. Sports medicine surgeons, with minimally invasive expertise, and their corresponding societies likely gravitated towards SA repair while hand and wrist surgeons helped to popularize TTSA techniques.[5,10,14,34] Ultimately, surgeons typically learn their techniques while in training or through continuing education often with their subspecialty societies. In this study, surgeons from each training category performed repairs by all 3 techniques with only modest differences between the groups. This suggests that each training path adequately educates surgeons to perform a variety of techniques.

Prior studies suggested that a SA repair technique was associated with a lower complication and rerupture rate.[2,24] However, our study suggests these rates are similar between SA and TT repair techniques. These differences in findings are particularly important given the added cost associated with the use of implants with triceps rupture repair.[17] Previous data may have encouraged surgeons to perform a more costly procedure in hopes for improved postoperative outcomes. However, our report suggests surgeons should not be discouraged from a cost-effective TT repair technique as the outcomes compared to SA and TTSA techniques are similar at 1 year after surgery.

This study is not without limitations. Our methodology as a retrospective review is limited by the amount and quality of information that was documented in the medical record, and we may not have identified all patients receiving a distal triceps rupture leading to an unknown selection bias. Our representation of ROM was limited to a qualitative scale as degree representations were not available on every patient. However, all patients with a loss of full elbow extension had a documented severity of their deficit but this deficit was not always depicted as an extension lag or a flexion contracture. Our follow-up is limited to 1 year which misses late complications and any continued improvements in elbow ROM. We group partial and complete injuries as well as traumatic and atraumatic injuries together for our statistical analysis, but this heterogeneous population is also addressed by regression analysis. Additionally, there were many surgeons included who may have different levels of vigilance with assessing and documenting ROM and complications. This may have introduced a reporting bias where surgeons who use a SA technique are more likely to report motion loss. The high number of surgeons in this study likely

includes a variety of postoperative protocols that could account for differences in ROM and complication rates. Lastly, we do not include any representation of patient-reported outcome measures after surgery. Although, previous reports with small sample sizes do not describe significant differences in patient-reported outcomes between repair techniques.[19,32] Further research should be conducted with larger patient populations with additional evaluation of patient-reported outcome measures.

Conclusions

Surgical repair of a distal triceps rupture by TT, SA, or TTSA technique results in similar complication, rerupture, and reoperation rates. Interestingly, patients with a smoking history were more likely to suffer a rerupture regardless of repair technique utilized. These results suggest that surgeons can repair a distal triceps rupture by whichever technique they feel is appropriate or are the most experienced with, as no technique appears to offer a lower risk of complications or reoperation.

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