Review

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Triceps Tendon Ruptures: A Systematic Review

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Abstract

Background: Triceps tendon ruptures (TTR) are an uncommon injury. The aim of this systematic review was to classify diagnostic signs, report outcomes and rerupture rates, and identify potential predisposing risk factors in all reported cases of surgical treated TTR. **Methods:** A literature search collecting surgical treated cases of TTR was performed, identifying 175 articles, 40 of which met inclusion criteria, accounting for 262 patients. Data were pooled and analyzed focusing on medical comorbidities, presence of a fleck fracture on the preoperative lateral elbow x-ray film (Dunn-Kusnezov Sign [DKS]), outcomes, and rerupture rates. **Results:** The average age of injury was 45.6 years. The average time from injury to day of surgery was 24 days while 10 patients had a delay in diagnosis of more than 1 month. Renal disease (10%) and anabolic steroid use (7%) were the 2 most common medical comorbidities. The DKS was present in 61% to 88% of cases on the lateral x-ray film. Postoperatively, 89% of patients returned to preinjury level of activity, and there was a 6% rerupture rate at an average follow-up of 34.6 months. The vast majority (81%) of the patients in this review underwent repair via suture fixation. **Conclusions:** TTR is an uncommon injury. Risks factors for rupture include renal disease and anabolic steroid use. Lateral elbow radiographs should be scrutinized for the DKS in patients with extension weakness. Outcomes are excellent following repair, and rates of rerupture are low.

Keywords: triceps tendon, rupture, avulsion, steroid, renal disease

Introduction

Spontaneous triceps tendon ruptures (TTR) are uncommon, accounting for less than 2% of all tendon injuries.[1,40] Published reports of TTR are primarily contained within a few small case series. In addition to the infrequent description of this injury pattern, the diagnosis is difficult, misdiagnosis is common, often delayed.[3,14-16,35,39,40] A number of medical comorbidities have been described as potential predisposing risk factors for TTR, including anabolic steroid use, local steroid injection for bursitis, oral steroid, renal disease, diabetes, and familial tendinopathy.[3,5,9,10,13,19,20,22,25,26,32,34,36,37,42] However, the degree to which these factors contribute to TTR is unknown. The purpose of this systematic review is to (1) identify medical conditions which can be associated with TTR, (2) determine the prevalence of the Dunn-Kusnezov Sign (DKS) associated with TTR, and (3) highlight outcomes of surgical repair and rerupture rates following surgical intervention of TTR.

Materials and Methods

The present study is reported following the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-analyses) guidelines.[38] There was no source of funding for this analysis.

Eligibility

The inclusion criteria for the present analysis incorporated articles that: (1) reviewed results of treatment of patients with TTR; (2) adult patients; and (3) patients who were treated with surgical intervention. Finally, (4) only studies written in the English language were considered.

Studies were excluded if they: (1) were a technique description, therapy article, biomechanical analysis, or a review; (2) analyzed only nonoperative treatment; (3) were a letter to the editor; (4) were not written in the English language; (5) reviewed only partial tears; (6) involved a total elbow replacement; (7) involved patella cubiti; (8) were published in a non-American or non-European journal; (9)

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were published more than 30 years ago; and (10) reviewed pediatric patients only. In addition, (11) we excluded pediatric patients in series.[41] Finally, (12) those reports lacking adequate orthopedic follow-up were excluded. Cases in the latter typically were in medical, as opposed to surgical journals, and only mentioned a triceps injury in passing and did not report any outcome measures.

Variables of Interest

The primary data points obtained were the rates of (1) presence of fleck fracture, DKS, on the lateral x-ray film; (2) return to full preoperative function; (3) time to surgery; (4) delayed diagnosis, subjectively defined to be greater than a month in the majority of the articles; (5) medical comorbidity; and (6) repair technique. The prevalence of the DKS was reported both with and without the 2 largest series.[21,35]

Search Strategy and Selection of Studies

A systematic review was performed for all articles published on the treatment of TTR through PubMed, MEDLINE, and EMBASE between the years 1985 and 2015. Search terms included *triceps* tendon* rupture**.

The abstracts generated by the search were individually assessed for relevance by 2 primary authors. Full articles were reviewed independently according to the inclusion and exclusion criteria. All analysis was verified by J.C.D.

Assessment of Methodological Quality and Data Collection

The GRADE (Grading of Recommendations Assessment, Development and Evaluation Working Group) criteria is an assessment template used to evaluate the quality of methods used in published studies.[2] Using this template, the quality of the selected studies was independently assessed by the 2 primary authors. Disagreement concerning study quality was moderated by the senior author.

Data Pooling Across Studies and Data Analysis

Demographic data and outcome measures were collected and pooled. No clear sources of bias were identified among the articles included. Outcome measures were compiled and compared.

Results

The search resulted in 175 potentially eligible studies, while 40 met inclusion and exclusion criteria (Figure 1). There were 29 case reports and 11 case series included, accounting for 262 patients. Analysis of the included case series (Tables 1 and 2) and the included case reports (Table 3) is depicted.

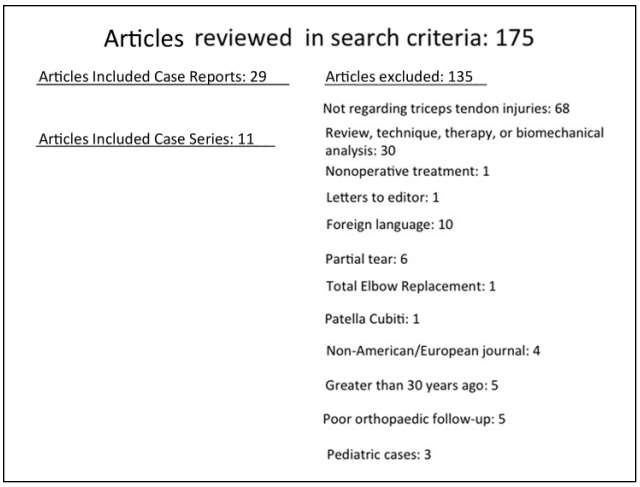

Figure 1. Systematic review process of identification, inclusion, and exclusion of studies, as well as reasons for exclusion.

The average age was 45.6 years (range, 17-61 years), and average follow-up was 34.6 months (range, 1.5-264 months). Upon presentation, 61% of patients had a fleck fracture present on the lateral x-ray film—the DKS. Nearly 90% of patients returned to preinjury level of activity while only 7% experienced a rerupture. The average time to surgery was 24 days while 10 patients in our series had a significant delay in diagnosis (Table 4).

The most common medical comorbidity contributing to TTR was renal disease (10%) followed by anabolic steroid use (7%) and neuromuscular disease (3.2%). The vast majority of repairs were conducted with suture repair only (81%) while a minority used suture anchors (17%). Mechanism of injury can be seen in Table 3 but was not analyzed in Table 4, as mechanism of injury was inconsistently reported in the case series.

Discussion

TTR are an uncommon injury, and descriptions of the injury are contained within small case series and a collection of case reports. The aim of the present systematic review was to combine all known data to better understand TTR. The 3 main findings of the current review were as follows: (1) renal disease (10%) and anabolic steroid use (7%) were the most common medical comorbidities; (2) at presentation, the DKS was present in 61% of cases on the lateral x-ray film; and (3) after surgical intervention, 89% of patients returned to preinjury level of activity while there was only a 6% rerupture rate.

Renal disease (10%) was the most common medical comorbidity in this TTR cohort. Renal disease is known to

Table 1. Case Series: Surgical Volume, Follow-up, Time to Surgery, Findings, and Complications.

Author	Repairs	Mean follow-up (range), mo	Average age, y	Study findings	Complications
van Riet et al[35]	23	93 (7-264)	47	Peak strength of 82% as compared with contralateral side (range, 75%-106%) ROM, 10°-136° All patients had 4-5/5 strength testing	3 (13%) reruptures 1 patient had olecranon avulsion, ulnar neuropathy, and required HWR Average 10° loss ROM
Mirzayan et al[21]	150	NR	49	Neither outcome scores, strength, nor ROM	BT fixation: anchor fixation Reoperation rate (2.1% vs 9.4%)* Infection rate (0% vs. 5.2%)*
Mair et al[19]	11	36 (NR)	29	All regained full ROM without weakness 10/11 returned to professional football	1 (9%) rerupture
Bava et al[4]	5	32 (18-49)	47	Postoperative: DASH: 1.4 ASES: 99.2 Mayo Elbow: 95.8 Oxford Elbow (pain), 96; (function), 100; (social), 96	NR
Kokkalis et al[17]	11	21 (12-40)	53	Preoperative → postoperative VAS: 8.5 → 2.4 Preoperative → postoperative strength:1.6 → 4.8 Postoperative arc of motion: 136° 9/11 patients "very satisfied" and returned to full work	Loss of 7° arc of motion 1/11 (9%) had postoperative pain over suture knot
Farrar and Lippert (1981)[12]	3	10 (9-12)	48	3/4 (75%) had 4/5 strength 1/4 (25%) had 5/5 strength	NR
Sierra et al[29]	11	17 (7-168)	50	10/11 (91%) in follow-up returned to preinjury activity 2/11 (18%) had 4/5 strength 9/11 (82%) had 5/5 strength	1 (6%) rerupture 1 (6%) radial nerve palsy 1 (6%) ulnar neuropathy
Sollender et al[31]	4	NR	42	1 patient suture repair 3 patients—NR 4/4 patients were weight lifters using anabolic steroids 2/4 patients had local steroid injection	1 (25%) rerupture—early return to aggressive weight lifting 1 (25%) contralateral triceps rupture
Kose et al[18]	8	19 (12-26)	25	All patients satisfied; all returned to previous level of function 6/8 (75%) excellent Mayo, 2/8 (25%) good Mayo 5/5 strength in all	1 (13%) ulnar nerve entrapment, required release 1 (13%) PIN palsy
Yoon et al[41]	2	19 (5-60)	21	3/4 (75%) had ROM 0°-140° with full strength	1 (25%) 10° loss of extension
Neumann et al[24]	7	12 (NR)	49	Mean DASH, 10.3 6/7 (83%) had full ROM	1 (14%) had loss of flexion (110°)

Note. ROM = range of motion; HWR = hardware removal; NR = not reported; BT = bone tunnel; DASH = Disabilities of the Arm, Shoulder and Hand; ASES = American Shoulder and Elbow Surgeons; Mayo = Mayo Elbow Score; VAS = Visual Analog Scale; PIN = posterior interosseous nerve.
*Not statistically significant.

cause tendinopathy.[16,40] The increase in parathyroid hormone frequently seen in renal disease depolymerizes bone, weakening tendon insertions, and may lead to tendon ruptures.[11,27] The largest case series included was a multicenter, multisurgeon report published as an abstract only, including 150 TTR. Although 66% had medical comorbidities, the specifics of these comorbidities were not well delineated and were left out of present prevalence.

Anabolic steroid use (7%), local steroid injection (5.3%), and oral corticosteroid were also found to be associated with TTR. Sollender et al[31] reported on 4 middle-aged weight lifters who used anabolic steroid and sustained a

Table 2. Case Series: Mean Time to Surgery, Radiographic Evidence of Fracture, Medical Comorbidity, and Surgical Technique.

Author	Mean time to surgery (range), d	Radiographic evidence?	Medical comorbidity contributing to injury?	Technique
van Riet et al[35]	63	Yes: 5/23	1—local infection 3—poliomyelitis	14 suture repair 9 reconstruction with augmentation
Mirzayan et al[21]	19	Yes: 58.4%[a]	2.7%—anabolic steroid[a]	Both suture anchor and suture with bone tunnel
Mair et al[19]	NR	NR	1—anabolic steroid 6—steroid injection for bursitis	Suture without augmentation
Bava et al[4]	NR	NR	NR	Suture anchor (×2)
Kokkalis et al[17]	NR (8-21)	Yes: 8/11	None	Suture repair
Farrar and Lippert (1981)[12]	NR	Yes: 3/3	1—renal disease	Suture repair
Sierra et al[29]	12 (1-45)	NR	1—steroid use	Suture repair
Sollender et al[31]	NR	1/1 3—NR	4—anabolic steroid 2—local steroid injection	Suture repair
Kose et al[18]	12 (1-75)	Yes: 8/8	1—anabolic steroid use	Suture repair
Yoon et al[41]	NR	Yes: 4/4	4—associated radial head, MCL	1 suture repair with tension band wire 1 suture repair with anchor (×1) 2 suture repair
Neumann et al[24]	NR	NR	NR	6 suture repair 1 suture anchor repair

Note. Mirzayan et al[21] also reported percentages—the data for which were extrapolated given their patient population. NR = not reported; MCL = medial collateral ligament.
[a]Mirzayan et al[21] reported percentages.
[b]Two patients from Yoon et al[41] were excluded for being pediatric cases; 3 patients were excluded from Sollender et al[31] as they were listed as "middle aged."

Table 3. Case Reports by Medical Comorbidity.

Author	Age, y	Mechanism	Radiographic evidence?	Repair and outcomes	Notes
Anabolic steroid use					
Nikolaidou et al[25]	28	Weight lifting	NR	Suture anchor repair At 18 mo: full ROM and strength	Long-term anabolic steroid use
Duchow et al[10]	31	Fight	Yes: 1/1	Suture repair Hematoma evacuation and suture repair At 12 wk: full ROM, no ulnar nerve symptoms	Ulnar nerve compression attributed to forming hematoma History of local steroid injections Long-term use of anabolic steroids and competitive power lifting
Bach et al[3]	33	Weight lifting (snatch 325 lbs)	NR	Suture repair At 9 mo: full ROM, benched 375 lbs, cleaned 407 lbs	Anabolic steroid use Olympic weight lifter Delayed presentation (28 mo)
Bunshah et al[5]	40	Weight lifting	Yes: 1/1	Suture repair At 1 y: Mayo Elbow Score, 85; strength 5/5	Anabolic steroid use Powerlifter
Local steroid injection					
Weistroffer et al (2003)[37]	49	Prior bilateral BKA; injured while landing ATV	No: 0/1	Suture repair with augmentation At 2 y: ROM, 5°-140°, 5/5 strength 6% side-side difference on isokinetic testing Return to competitive motorcycle racing	Had prior triceps suture repair Described repair with hamstring autograft augmentation
Stannard and Bucknell[32]	35	Bench pressing 315 lbs	NR	Suture repair At 9 mo: ROM, 0°-140° and able to bench greater than 300 lbs	Six injections for olecranon bursitis (last injection 3 wk prior to rupture) History of anabolic steroid use (12-wk cycles for 4 y—last cycle 6 mo prior)

(continued)

Table 3. (continued)

Author	Age, y	Mechanism	Radiographic evidence?	Repair and outcomes	Notes
Oral steroid medication					
Pina et al[26]	43	Fall, 1 m	Yes: 1/1	3 suture anchors At 1 y: full painless ROM Complete strength	History of oral steroid for asthma
Renal disease					
de Waal Malefijt et al[9]	66	Avulsion	Yes: 1/1	Suture repair At 6 mo: ROM, 5°-140°	Tuberculosis-induced renal insufficiency Parathyroid glands removed 3 wk prior for secondary hyperparathyroidism
Zaidenberg et al (2015)[42]	36 (B)	Fall	Yes: 2/2	Suture repair At 12 mo: full ROM, 5/5 strength DASH: 6	Renal transplant secondary to acute glomerulonephritis Required hemodialysis
Gupta and Murthi[13]	48	Fall	Yes: 1/1	Suture repair with ORIF of distal humerus At 36 mo: ROM 10°-120°	Renal transplant requiring hemodialysis and oral steroids
Tsourvakas et al[34]	27 (B)	Fall	Yes: 2/2	Suture repair At 3 mo: full ROM	CKD from acute glomerulonephritis requiring hemodialysis
Mont et al[22]	22 (B)	Seizure	No: 0/2	Suture repair At 1 y: ROM, 0°-120°	Glomerulonephritis with end-stage renal disease Hypocalcemic-induced tetany causing bilateral triceps/quadriceps tendon ruptures
Diabetes mellitus					
Wagner and Cooney[36]	61	Roller skating fall	Yes: 1/1	Suture repair Follow-up: NR 5/5 strength ROM, 20°-130° Return to work as mechanism	Poorly controlled, insulin-dependent DM Associated nephrolithiasis and essential HTN 5 mo
Isolated trauma					
Tarallo et al (2015)[33]	40	Car accident	Yes: 1/1	Suture repair At 30 d: full ROM	No medical problems
Naito et al[23]	17	Football	Yes: 1/1	Suture repair At 9 mo: full ROM and strength	No medical problems Associated radial head/trochlear fractures
Daglar et al (2009)[7]	39	Fall	Yes: 1/1	Suture repair At 10 mo: 10°-140°	No medical problems
Singh and Pooley[30]	31	Ice hockey	NR	Suture repair At 6 mo: return to professional hockey	MRI was negative but surgical exploration demonstrated complete intramuscular rupture of all 3 heads
Rajasekhar et al. (2002)[28]	42	Fell 3 ft	Yes: 1/1	Suture repair with tension band At 1 y: full ROM and strength	K-wires removed at 3 mo
Dev et al (1999)[8]	53	Fell	Yes: 1/1	Steel wire repair At 6 wk: 0°-110°	Injury included avulsion of triceps origin as well which was treated conservatively
Yazdi et al[39]	27	Fall	Yes: 1/1	Suture repair with VY-plasty technique	Comorbidities not recorded
	24	Fall	NR	At 2 y: Both patients had full elbow strength and ROM and had returned to work	Both were delayed presentation (4 mo)
Naito et al[23]	18	Football	Yes: 1/1	Suture repair At 2 mo: full ROM and return to football	Comorbidities not recorded
Herrick and Herrick[14]	32	Unknown	Yes: 1/1	Unknown repair technique At 1 y: able to bench press 215 kg	Significant delay to presentation Cubital tunnel syndrome Powerlifter
Inhofe and Moneim[15]	19	Fall	Yes: 1/1	Suture repair At 3 mo: 10°-135°, resumed recreational activities	Delay in presentation (9 mo) No medical comorbidities
Familial					
McCulloch et al[20]	19	Football	Yes: 1/1	Suture repair At 6 mo: full ROM and strength	No medical problems Father: bilateral triceps rupture

Note. NR = not reported; ROM = range of motion; BKA = below knee amputation; ATV = all-terrain vehicle; DASH = Disabilities of the Arm, Shoulder and Hand; ORIF = open reduction internal fixation; CKD = chronic kidney disease; DM = diabetes mellitus; HTN = hypertension; (B) = bilateral; MRI = magnetic resonance imaging.

Table 4. Weighted Averages and Prevalence of Study Characteristics.

Characteristic	n	Value
Total TTR	262	262
Average age, y	262	45.6 y (range, 17-61 y)
Average follow-up, mo	107	34.6 mo (range, 1.5-264 mo)
% of DKS	223	137 (61.4%)
% of DKS (without Mirzayan et al[21] and van Riet et al[35])	50	44 (88%)
% return to preoperative function	79	71 (89.0%)
% rerupture	101	6 (5.9%)
Average time to surgery	192	23.6 d
% delay diagnosis >1 mo	10	[a]
Medical comorbidity		
Anabolic steroid	219	16 (7.3%)
Steroid injection	219	11 (5%)
Oral steroid medication	219	1 (<1%)
Renal disease	95	12 (10%)
Diabetes	95	1 (<1%)
Infection	95	1 (<1%)
Neuromuscular disease	95	3 (3.2%)
Repair technique		
Suture repair	108	88 (81%)
Suture anchor	108	17 (17%)
Other	108	3 (3%)

Note. TTR = triceps tendon rupture; DKS = Dunn-Kusnezov Sign.
[a]Time to diagnosis was inconsistently reported, and a percentage was not calculated.

TTR. In addition, 2 patients had received local steroid injection and tendinopathy. The authors hypothesized that age- and activity-related tendinopathy, in concert with anabolic steroids, lead to the TTR. In addition, patients involved in heavy lifting who present with triceps tendinopathy may be at risk for future rupture.

The DKS, present on the lateral x-ray film, has previously been described as pathognomonic for TTR.[6] Although many other reports have described its presence, no large report has determined its prevalence among TTR. Our analysis has determined that the DKS is present in 61% of TTR. If the largest series, a published abstract, and the second largest series are removed from the analysis, the prevalence of the DKS increases to 88%.[21,35] Combined, these 2 retrospective reviews accumulated data from 14 different centers. These large multicenter retrospective reviews are subject to a degree of reporting error, so the prevalence may be higher in TTR. Regardless, providers should be aware of this radiographic finding, present in roughly 61% to 88% of patients, which may help reduce misdiagnoses and eliminate the diagnostic odyssey.

The surgical outcomes following TTR are generally excellent with 89% returning to preinjury activity level. Because the body of the systematic review is comprised of discontinuous case reports and short series, outcome measures are varied. After 32 months, Bava et al[4] reported that 5 patients after surgical repair of TTR had an average Disabilities of the Arm, Shoulder and Hand (DASH) of 1.4, American Shoulder and Elbow Surgeons (ASES) of 99.2, and Mayo Elbow Score of 95.8. Furthermore, the vast majority of patients had full strength and range of motion following surgical repair.[17,18,24,41] Other patients were able to return to heavy weight lifting. After repairing TTR, Bach et al[3] reported their patient was able to bench 375 lbs and power clean 407 lbs, whereas Naito et al[23] reported that their patient was able to bench 215 kg at 2 months postoperatively. Furthermore, other patients returned to competitive motorcycle racing, professional football, and professional hockey after TTR repair.[19,30,37]

There were 6 reruptures (5.9%). Three reruptures occurred in the second largest series of 23 TTR.[35] One was a routine primary rerupture, whereas a second may have been precipitated by an infection. The third patient actually had 2 reruptures after traumatic episodes. Mair et al[19] reported having a rerupture sustained during rehabilitation exercises in a professional football player 6 weeks after the initial repair. In the analysis of middle-aged bodybuilders using anabolic steroids by Sollender et al[31], one patient sustained a rerupture during early aggressive weight lifting and another patient had a contralateral rupture in the postoperative period. The 2 other reruptures were due to direct trauma.[29]

The vast majority (81%) of the patients in this review underwent repair via suture fixation. Mirzayan et al[21] compared suture repair with suture anchor fixation following TTR and found no difference in terms of infection rate, reoperation rate, or rerupture rate. However, the authors did note that those repaired with suture anchors were released from medical care sooner. Given the limited data on comparison of surgical technique, the authors do not believe one technique is superior to the other.

There are 3 primary limitations to this study. First, the findings of this review are subject to the bias and error inherent to retrospective data collection. Second, the interpretation of outcomes is limited by their heterogeneity from report to report. Third, 2 case series account for 173 TTR, or 66% of the cases in this systematic review.[21,35] The reporting of outcomes, presence of DKS, and complications may be skewed toward these authors reporting.

Despite these limitations, this study represents one of the first systematic reviews of the literature. The 3 key findings were as follows: (1) Renal disease (10%) and anabolic steroid use (7%) were the 2 most prevalent medical comorbidities; (2) the DKS was present in 61% to 88% of TTR on the lateral x-ray film; and (3) 89% of patients returned to preinjury level of activity postoperatively. TTR is a rare and frequently misdiagnosed injury because the vague signs and symptoms associated with it include ecchymosis, pain, and lack of active extension. However, with careful evaluation

of potential medical risk factors, scrutiny of the lateral x-ray film for the DKS, early referral to an orthopedist, and better physical exam techniques, patients may expect a positive outcome following surgical repair of TTR. Future research should be directed toward creating a large series with uniform, validated outcome measures.

Ethical Approval

This study was approved by our institutional review board.

Statement of Human and Animal Rights

This article does not contain any studies with human or animal subjects.

Statement of Informed Consent

Informed consent was obtained when necessary.

Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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References

1. Anzel SH, Covey KW, Weiner AD, Lipscomb PR. Disruption of muscles and tendons: an analysis of 1,014 cases. *Surgery*. 1959;45:406-414.
2. Atkins D, Best D, Briss PA, et al; GRADE Working Group. Grading quality of evidence and strength of recommendations. *BMJ*. 2004;328:1490.
3. Bach BR Jr, Warren RF, Wickiewicz TL. Triceps rupture. A case report and literature review. *Am J Sports Med*. 1987;15(3):285-289.
4. Bava ED, Barber FA, Lund ER. Clinical outcome after suture anchor repair for complete traumatic rupture of the distal triceps tendon. *Arthroscopy*. 2012;28(8):1058-1063.
5. Bunshah JJ, Raghuwanshi S, Sharma D, Pandita A. Triceps tendon rupture: an uncommon orthopaedic condition [published online ahead of print March 12, 2015]. *BMJ Case Rep*. doi:10.1136/bcr-2014-206446.
6. Carpentier E, Tourne Y. Avulsion traumatique du tendon tricipital brachial. A propos d'un cas. *Ann Chir Main Memb Super*. 1992;11:163-165.
7. Daglar B, Delialioglu OM, Ceyhan E, Altas O, Bayrakci K, Gunel U. Combined surgical treatment for missed rupture of triceps tendon associated with avulsion of the ulnar collateral ligament and flexor-pronator muscle mass. *Strategies Trauma Limb Reconstr*. 2009;4(1):35-39.
8. Dev S, Jimulia T, Pusey RJ. Rupture of the triceps muscle at its attachments. *Injury*. 1999;30(1):70-71.
9. de Waal Malefijt MC, Beeker TW. Avulsion of the triceps tendon in secondary hyperparathyroidism. A case report. *Acta Orthop Scand*. 1987;58:434-435.
10. Duchow J, Kelm J, Kohn D. Acute ulnar nerve compression syndrome in a powerlifter with triceps tendon rupture—a case report. *Int J Sports Med*. 2000;21(4):308-310.
11. Engel MB. Mobilization of muco-protein by parathyroid extract. *Ann Pathol*. 1952;53:339-351.
12. Farrar EL III, Lippert FG III. Avulsion of the triceps tendon. *Clin Orthop Relat Res*. 1981;161:242-246.
13. Gupta RR, Murthi AM. Distal humeral fracture with associated triceps tendon avulsion in a renal transplant recipient. *Orthopedics*. 2010;10:204–207. doi:10.3928/014774 47-20100129-26.
14. Herrick RT, Herrick S. Ruptured triceps in a powerlifter presenting as cubital tunnel syndrome. A case report. *Am J Sports Med*. 1987;15(5):514-516.
15. Inhofe PD, Moneim MS. Late presentation of triceps rupture. A case report and review of the literature. *Am J Orthop (Belle Mead NJ)*. 1996;25(11):790-792.
16. Keener JD, Sethi PM. Distal triceps tendon injuries. *Hand Clin*. 2015;31(4):641-650.
17. Kokkalis ZT, Mavrogenis AF, Spyridonos S, Papagelopoulos PJ, Weiser RW, Sotereanos DG. Triceps brachii distal tendon reattachment with a double-row technique. *Orthopedics*. 2013;36(2):110-116.
18. Kose O, Kilicaslan OF, Guler F, Acar B, Yuksel HY. Functional outcomes and complications after surgical repair of triceps tendon rupture. *Eur J Orthop Surg Traumatol*. 2015;7:1131-1139.
19. Mair SD, Isbell WM, Gill TJ. Triceps tendon ruptures in professional football players. *Am J Sports Med*. 2004;32(2):431-434.
20. McCulloch PC, Spellman J, Bach BR. Familial triceps tendon ruptures. *Orthopedics*. 2008;31(6):600-602.
21. Mirzayan R, Singh A, Acevedo DC, Sodl JF, Yian E, Navarro RA. Surgical treatment of 150 acute distal triceps tendon ruptures. *J Shoulder Elbow Surg*. 2015;24:e120.
22. Mont MA, Torres J, Tsao AK. Hypocalcemic-induced tetany that causes triceps and bilateral quadriceps tendon ruptures. *Orthop Rev*. 1994;23(1):57-60.
23. Naito K, Homma Y, Morita M, Mogami A, Obayashi O. Triceps tendon avulsion: a case report and discussion about the olecranon ossification nucleus. *Eur J Orthop Surg Traumatol*. 2013;2:S193-S196.
24. Neumann H, Schulz AP, Breer S, Faschingbauer M, Kienast B. Traumatic rupture of the distal triceps tendon (a series of 7 cases). *Open Orthop J*. 2015;9:536-541.
25. Nikolaidou ME, Banke IJ, Laios T, Petsogiannis K, Mourikis A. Synthetic augmented suture anchor reconstruction for a complete traumatic distal triceps tendon rupture in a male professional bodybuilder with postoperative biomechanical assessment. *Case Rep Orthop*. 2014;2014:962930.
26. Pina A, Garcia I, Sabater M. Traumatic avulsion of the triceps brachii. *J Orthop Trauma*. 2002;16(4):273-276.
27. Preston ET. Avulsion of both quadriceps tendons in hyperparathyroidism. *JAMA*. 1972;221:406-407.
28. Rajasekhar C, Kakarkapudi TK, Bhrama MS. Avulsion of the triceps tendon. *Emerg Med J*. 2002;19:271-272.
29. Sierra RJ, Weiss NG, Shrader MW, Steinmann SP. Acute triceps ruptures: case report and retrospective chart review. *J Shoulder Elbow Surg*. 2006;15(1):130-134.

30. Singh RK, Pooley J. Complete rupture of the triceps brachii muscle. *Br J Sports Med*. 2002;36(6):467-469.
31. Sollender JL, Rayan GM, Barden GA. Triceps tendon rupture in weight lifters. *J Shoulder Elbow Surg*. 1998;7:151-153.
32. Stannard JP, Bucknell AL. Rupture of the triceps tendon associated with steroid injections. *Am J Sports Med*. 1993;21:482-485.
33. Tarallo L, Zambianchi F, Mugnai R, Costanzini CA, Catani F. Distal triceps tendon repair using Krakow whipstitches, K wires, tension band and double drilling technique: a case report. *J Med Case Rep*. 2015;9(1):36.
34. Tsourvakas S, Gouvalas K, Gimtsas C, Tsianas N, Founta P, Ameridis N. Bilateral and simultaneous rupture of the triceps tendons in chronic renal failure and secondary hyperparathyroidism. *Arch Orthop Trauma Surg*. 2004;124(4):278-280.
35. van Riet RP, Morrey BF, Ho E, O'Driscoll SW. Surgical treatment of distal triceps ruptures. *J Bone Joint Surg Am*. 2003;85(10):1961-1967.
36. Wagner JR, Cooney WP. Rupture of the triceps muscle at the musculotendinous junction: a case report. *J Hand Surg Am*. 1997;22:341-343.
37. Weistroffer JK, Mills WJ, Shin AY. Recurrent rupture of the triceps tendon repaired with hamstring tendon autograft augmentation: a case report and repair technique. *J Shoulder Elbow Surg*. 2003;12:193-196.
38. Welch V, Petticrew M, Tugwell P, et al; PRISMA-Equity Bellagio Group. PRISMA-Equity 2012 extension: reporting guidelines for systematic reviews with a focus on health equity. *PLoS Med*. 2012;9(10):e1001333.
39. Yazdi HR, Zomashi I, Ghorban HM. Neglected triceps tendon avulsion: case report, literature review, and a new repair method. *Am J Orthop (Belle Mead NJ)*. 2012;41(7):E98-E99.
40. Yeh PC, Dodds SD, Smart LR, Mazzocca AD, Sethi P. Distal triceps ruptures. *J Am Acad Orthop Surg*. 2010;18(1):31-40.
41. Yoon MY, Koris MJ, Ortiz JA, Papandrea RF. Triceps avulsion, radial head fracture, and medial collateral ligament rupture about the elbow: a report of 4 cases. *J Shoulder Elbow Surg*. 2012;21(2):e12-e17.
42. Zaidenberg EE, Gallucci GL, Boretto JG, De Carli P. Simultaneous bilateral rupture of the triceps tendon in a renal transplant patient. *Case Rep Orthop*. 2015;2015:903690.