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Distal triceps tendinopathies

Tendinopathy of the triceps tendon is the rarest tendinopathy of the elbow [1]. An evaluation of 801 magnetic resonance images of elbows and upper extremities of 740 patients with elbow pain showed triceps pathologies in 9.9% of the images evaluated [24]. Signal alterations in the triceps tendon without a visible disruption were seen in 6% of the images while triceps tendon lesions were visible in 3.8% of the images, of which more than 50% were partial ruptures. The average age of patients with triceps tendon pathologies was 47 years.

» Triceps tendon ruptures affect men twice as often as women

Triceps tendon ruptures affect men twice as often as women [9]. While case reports exist for patients of all age groups, adolescents with incompletely or recently closed growth plates are particularly affected. Triceps ruptures are also particularly common among weightlifters and American football players. General risk factors include cortisone intake, anabolic steroid abuse, internal diseases such as chronic kidney failure, hyperparathyroidism and type 1 diabetes, hypocalcemic tetany, Marfan syndrome, osteogenesis imperfecta, rheumatoid arthritis, and chronic olecranon bursitis [9, 10, 12].

Anatomy, histology, and pathogenesis

The triceps tendon attaches approximately 12–14 mm distal to the olecranon tip, where it has a width of approx. 40 mm [29]. The bony footprint is ap-

prox. 460 mm² with an average length of approx. 21 mm and a width of 23 mm. The caput longum and mediale converge distally and form the superficial part of the triceps tendon, which attaches directly to the medial aspect of the olecranon and laterally partially converges with the superficial fascia of the anconeus muscle [9]. The exact anatomy of the deep portion of the triceps tendon remains disputed. Masen et al. describe a separate lower insertion tendon of the caput mediale [16], while Keener et al. depict histologically a confluence of the medial tendon parts with the central tendon [12]. Ruptures can start both from the medial or the lateral part of the tendon [9]. The typical injury mechanism is described as an eccentric force on the contracting muscle, for example, due to a fall on the outstretched arm, during weight-lifting, or due to a direct trauma to the elbow [9, 12, 16, 27]. Ruptures occur in particular near the insertion of the tendon onto the olecranon, less often at the myotendinous junction.

» The exact anatomy of the deep portion of the triceps tendon remains disputed

Histologically, tendinopathy show cell activation and proliferation, matrix changes including disorganization of collagen and neovascularization [20]. Since this remodeling process is often not painful, tendinopathies mostly become noticeable or symptomatic only when the tendon is ruptured. There are also differences in gene expression and histological parameters in different tendon regions and at different times during the healing process [6].

Symptoms, clinical signs, and diagnostics

Diagnosis is often delayed due to misdiagnosis [26]. If tendinopathy of the triceps tendon is suspected, risk factors and traumatic events including the accident circumstances should be inquired at first. Clinically, tendinopathy of the triceps tendon manifests in stress-related posterior pain, which increases with forced extension against resistance [9, 15]. If the triceps tendon is ruptured, swelling, ecchymosis, loss of strength in extension, and a palpable gap along the course of the tendon can also occur [15, 19]. However, the latter can be difficult to see due to swelling of the soft tissue. The inability of full extension can be considered as a sign of complete rupture. A weaker extension in comparison between the healthy and the affected side can still be possible by compensation from the anconeus muscle or remaining parts of the triceps muscle. [15]. Tendinopathies often occur bilaterally. For example, rupture of the opposite extremity is almost 200 times more common in patients with Achilles tendon rupture [3]. Bilateral clinical improvement can often be observed after unilateral surgical treatment, although the exact mechanisms have not yet been fully elucidated [2]. Bilateral ruptures have also been described regarding the triceps tendon [11].

Viegas proposed the modified Thompson test as a clinical examination sign for ruptures of the triceps tendon [27]. For this test, the patient's elbow is placed on the edge of the examination table. The muscle is compressed manually, which leads to a passive extension against gravity with tendon integrity or partial rupture, with no extension in complete ruptures



Fig. 1 ◀ Thompson test modified according to Viegas



Fig. 2 ▲ Extension test against resistance in the overhead position

(◼ Fig. 1). However, the test is difficult to perform due to the large lever arm of the forearm and the relatively small muscle of the triceps muscle, and it is often difficult to interpret because of pain and swelling [19]. In everyday clinical practice, the extension test against resistance in the overhead position has prevailed (◼ Fig. 2; [14, 15]). With the shoulder elevated at 180° and the elbow flexed, the patient is asked to extend the arm against gravity or against resistance. If elbow extension is not feasible, this suggests a complete rupture of the triceps tendon. In partial ruptures, it is often still possible to extend against gravity, but only with significantly reduced extension force against resistance in comparison with the unaffected side. However, information on sensitivity and specificity of this test is still unavailable.

» Tendinopathies often occur bilaterally

X-rays should always be acquired to detect bony avulsion injuries at the insertion area of the triceps tendon [10]. This so-called flake of bone sign (proximalization of the torn-out fragment) can be seen in 61–88% of triceps tendon ruptures (◼ Fig. 3).

In the sonographic examination, the superficial parts of the triceps tendon can be seen better compared with its deep parts (◼ Fig. 4; [25]). The dynamic examination of the tendon is advantageous; the tension of tendon parts can be ex-

amined with extension against resistance and, in the case of a bony rupture, the proximalization of the fragment can be visualized during muscle contraction.

Magnetic resonance imaging (MRI) diagnostics are suitable for assessing the extent of injury, possible tendon retraction, changes in muscle quality, and accompanying injuries, since both the superficial and deep areas of the tendon and its surrounding structures can be assessed well (◼ Fig. 5; [9, 14]). Tendinopathies show abnormal signal intensities in liquid-sensitive sequences, while with ruptures a wavy triceps tendon is seen as an indication of a lack of tension [9].

Treatment

Conservative management

Conservative treatment approaches can be used for tendinopathies and partial tendon ruptures [9, 10]. The elbow is first immobilized in a brace and flexion is limited to 30° for 4 weeks [14]. In principle, it is important that the immobilization phase is as short as possible in order to minimize the risk of joint stiffness. Range of motion is then successively released in a movable brace after initial movement limitation. Unrestricted range of movement, which should be reached after 12 weeks at the latest, is required in order to start active training of extension strength. Full extension strength should be restored after a period of 6–9 months [14, 30].

Publications on conservative treatment are limited to a few case reports. Mair et al. [17] retrospectively describe a case series of 10 partial ruptures of 19 National Football League players, six of whom were successfully treated conservatively. Overall, the majority of patients showed good clinical outcome with no signs of dysfunction or loss of strength. However, three of the patients treated conservatively showed a lack of strength and pain at the end of the season. A complete triceps tendon rupture occurred in one player, after which treatment was switched to a surgical approach.

With regard to the limited data available, it is currently difficult to make recommendations for further conservative treatment options, so that in many respects, conservative treatment approaches of other tendinopathies should be considered. Nonsteroidal anti-inflammatory drugs (NSAIDs) can be used preferably topically, although positive effects have not been demonstrated for various kinds of tendinopathy [28].

Cortisone injections—as with tendinopathies of other locations—represent a clear risk factor for ruptures [10, 12], which is why they should be used with extreme caution.

The injection of platelet-rich plasma (PRP) shows good results for the treatment of elbow tendinopathies in individual studies [13]. However, there is a high degree of heterogeneity in the methods used to produce PRP, which makes it difficult to make a definitive statement about

the effectiveness of PRP injections. For the distal triceps tendon, there is only one case report of a partial distal triceps tendon rupture in the current literature, which was treated with PRP injection and physiotherapy [7]. At 2 weeks after the injection and before the start of the physiotherapy, a reduction in pain was found in a follow-up examination, and 4 weeks after the injection, an increase in elbow strength from 3/5 to 4/5 was seen.

Recommendations regarding physiotherapy and physical therapy for tendinopathies in general include eccentric training, cross-friction, and cryotherapy [28]. In this regard, however, there are no explicit recommendations for tendinopathy of the distal triceps tendon.

Reports of extracorporeal shock wave therapy (ESWT) in tendinopathies of the elbow show good results, but this is usually related to the treatment of epicondylitis [28]. There are currently no data available on the treatment of triceps tendon tendinopathies with ESWT.

Donaldson et al. [9] recommend regular check-ups during conservative treatment of partial ruptures in order to detect an enlargement of the rupture at an early stage. If symptoms persist after 6 months of conservative treatment, surgical treatment should be discussed. The patient's age, comorbidities, and activity level must be taken into account when making this decision [14].

Surgical treatment

Surgical treatment consists of debridement of the insertion region with subsequent anatomical refixation. Surgical reconstruction is indicated for complete ruptures. There is no uniform recommendation for the operative treatment of partial ruptures. Depending on the source, surgical refixation is recommended for partial tendon ruptures of 50–75%, with a relevant strength deficit compared with the healthy opposite side [9, 21].

The most widespread refixation technique is transosseous triceps tendon fixation, which, however, has disadvantages regarding primary stability and footprint coverage due to the inexact anatomical

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Distal triceps tendinopathies

Abstract

Tendinopathy of the distal triceps represents a rare pathology in the upper extremity. Although there is scant scientific evidence published to date, the association with risk factors such as internal diseases or steroid use is commonly described in various reports. Due to traumatic incidents or sporting overuse, partial or complete ruptures can occur. Clinically, stress-related posterior elbow pain, swelling, ecchymosis, loss of strength in extension, and a palpable gap in the tendon can be seen. Physical examination shows reduced extension force and increasing pain with forced extension against resistance. Ten-

dinopathies and resulting partial or complete ruptures can be detected by ultrasound and magnetic resonance imaging. Conservative therapy with temporary immobilization is recommended for tendinopathies or minor ruptures of the triceps tendon. Complete ruptures or larger partial ruptures should be treated surgically with anatomical refixation of the tendon.

Keywords

Elbow · Tendon injuries · Rupture · Triceps insufficiency · Pain

Tendinopathien der distalen Trizepssehne

Zusammenfassung

Die Tendinopathie der distalen Trizepssehne ist ein seltenes Krankheitsbild, das wissenschaftlich bisher nur wenig beleuchtet wurde. Die Trizepssehnentendinopathie ist häufig mit Risikofaktoren wie internistischen Erkrankungen oder Einnahme von Steroiden assoziiert und kann sich in Form einer Partial- oder Komplettruptur aggravierend. Diese Rupturen treten insbesondere bei traumatischen Ereignissen oder in starken Belastungssituationen auf. Klinisch können stressbedingte posteriore Ellenbogenschmerzen, Schwellung, Ekchymosen, Kraftverlust in der Extension und eine tastbare Dellenbildung im Verlauf der Sehne vorkommen. Die körperliche Untersuchung zeigt eine verringerte Streckkraft und eine Zunahme der Schmerzen bei forcierter

Extension gegen Widerstand. Tendinopathien und daraus resultierende Partial- oder Komplettrupturen können sonographisch und MRT-morphologisch nachgewiesen werden. Nativradiologisch ist in einigen Fällen eine knöcherne Avulsion zu erkennen. Bei Tendinopathien oder kleineren Teilrupturen der Trizepssehne ist die konservative Therapie mit temporärer Immobilisierung empfehlenswert. Bei vollständigen Rupturen oder größeren Partialrupturen ist die operative Therapie zur anatomischen Refixation der Sehne indiziert.

Schlüsselwörter

Ellenbogen · Sehnenverletzungen · Ruptur · Trizepsinsuffizienz · Schmerz

reinsertion [14]. The “knotless suture-bridge repair” technique—adopted from shoulder surgery—includes a double-row, crossing anchor fixation of the triceps tendon [8]. Thanks to an almost anatomical reconstruction, high biomechanical primary stability can be achieved. On this basis, the modified V-shaped double-row triceps tendon reconstruction was developed in our group, which has improved biomechanical primary stability compared with the suture-bridge technique and is associated with less tendon dislocation [23]. An example of a surgically treated rup-

ture of the distal triceps tendon using the V-shaped double row reconstruction [22] is shown in **Fig. 6**. With this technique, two double-hinged anchors are placed medially and laterally at the proximal insertion area of the triceps tendon. The distal triceps tendon is then secured medially, laterally, and centrally with four sutures over a length of at least 3 cm. Approximately 4 cm distal to the olecranon tip, a monocortical borehole is made at a 45 ° angle in a proximal direction to the ulna shaft. The free thread ends are threaded into a button and this is inserted transcortically. The button is

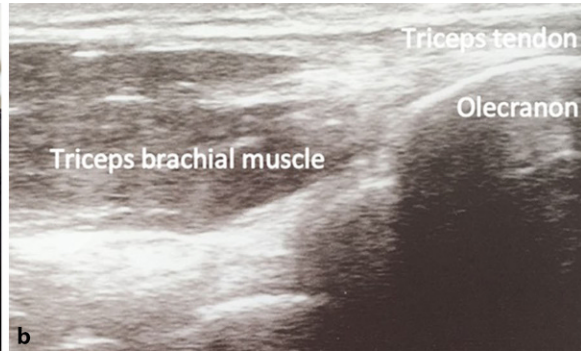


Fig. 3 ◀ For the sonographic examination of the triceps tendon, the patient rests their palm on the examination table and flexes the elbow at 90° (a). The triceps tendon can now be assessed with its insertion to the olecranon in longitudinal section (b) and in cross section



Fig. 4 ▲ “Flake of Bone”: typical sign on lateral X-ray image for triceps avulsion injuries

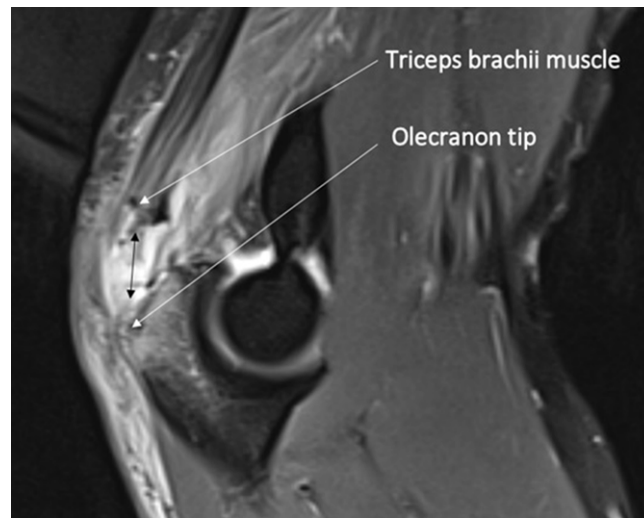


Fig. 5 ◀ Complete rupture of the triceps tendon on magnetic resonance imaging



Fig. 6 ▲ Postoperative X-ray image of the surgically treated complete rupture of the distal triceps tendon using a V-shaped double-row reconstruction [23]

then flipped in an intramedullary fashion by pulling on the ends of the threads and the tendon pressure is adjusted by tensioning the threads (■ Fig. 6).

Postoperatively, the elbow is immobilized in 90° flexion in a posterior cast for 3–4 days [14]. The patient is then switched to a movable brace with flexion being limited to 90° for 6 weeks. The pas-

sive and active-assisted exercise begins on the first postoperative day with a restriction of active extension for 6 weeks postoperatively. Sporting activities are prohibited for at least 12 weeks.

Athwal et al. [4] also describe the possibility of arthroscopic refixation of the triceps tendon and were able to report good clinical results in two cases.

Overall, few case series and case reports describe good postoperative results, with 89% of the operated patients being able to return to the pre-traumatic activity level [10]. In the described cases, however, traumatic events are usually described as the cause of the rupture without predisposing tendinopathy. Bava et al. [5] reported good results from five surgically treated patients 32 months postoperatively, with the vast majority of the patients regaining full strength and a full range of motion. Other cases are described in which operated patients could bench press weights of more than 200 kg [18] or return to competitive motorcycle races, professional football, or professional hockey [10]. Van Riet et al. [26] report 23 interventions on 22 patients with eight complete and 15 partial ruptures. Good clinical results were shown with an average extension loss of 10° and an average flexion of 136°. Manual strength tests showed a strength level of at least 4/5 and the isokinetic peak

strength averaged 82% of the unaffected arm. In ten patients the ruptures were initially not recognized, and thus there was a delay between injury and diagnosis. Although the results were comparable to those receiving early care, the recovery process of patients with delayed diagnosis was overall slower; therefore, early surgical treatment within 3 weeks is recommended as the treatment of choice after post-traumatic treatment.

» Surgical reconstruction is indicated for complete ruptures

Postoperative complications include secondary olecranon bursitis and a persistent flexion deficit of up to 20°. The re-rupture rate is low at 6% and mostly associated with renewed trauma [9]. Van Riet describes results that are as good for surgically treated ruptures as for primary interventions [26].

Practical conclusion

- Tendinopathy of the triceps tendon shows reduced extension force and an increase in pain with forced extension against resistance.
- Ruptures occur especially after traumatic events or strong, sudden loads of extension.
- Clinical examination and magnetic resonance imaging are the gold standard for diagnosis, while ultrasound and X-rays can provide additional information.
- In the case of complete ruptures and larger partial ruptures, surgical treatment with anatomical fixation of the tendon is indicated.

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Compliance with ethical guidelines

Conflict of interest. S. Lappen, S. Geyer, B. Scheiderer, A.B. Imhoff and S. Siebenlist declare that they have no competing interests.

For this article no studies with human participants or animals were performed by any of the authors. All studies performed were in accordance with the ethical standards indicated in each case.

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