19 Evaluation of Common Tendinopathies of the Elbow

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19.1 Introduction

Elbow tendinopathies represent a common cause of pain and disability, mainly in manual workers or athletes in their 35–55 years. Based on the location, elbow tendinopathies can be classified as lateral (affecting the common extensor origin), medial (affecting the flexor-pronator muscles origin), anterior (affecting the biceps tendon insertion), and posterior (affecting the triceps tendon insertion). Tendinopathies include *traumatic forms*, usually with acute onset, presenting some degree of tendon tears (from partial to complete lesion) and *degenerative forms,* usually with chronic onset, where the tendon is generally continuous, but shows more or less severe degrees of degeneration. Usually, both acute or traumatic forms can be diagnosed through the patient medical history and the execution of specific provocative examination manoeuvres, without a systematic need of imaging.

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19.1.1 Medical History

In elbow tendinopathies, it is important to take an accurate medical history that needs to investigate

- *Patient features*: age, working, sporting and recreational activities, dominant side, compensation claims.
- *Past medical history*: rheumatic diseases, metabolic disorders, drugs use (anabolic hormones, steroids, fluoroquinolones).
- *Characteristic of the pain*: onset (traumatic or insidious), mechanism of injury (if present), type of pain (sharp or dull), unilateral or bilateral elbow involvement, time lasting, pain severity, clinical impairments, activities triggering pain, pain relief modalities and response to medical therapy, evolution of the symptoms over time (Table 19.1).

19.1.2 Clinical Examination

With clinical examination we need to evaluate

- Local conditions: swelling, bruises, anatomical shape modification, precise pain localization and its irradiation, presence of specific trigger points, elbow range of motion and strength. The comparison with the contralateral limb is always recommended.

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Table 19.1 Five useful questions to investigate the diagnosis of elbow tendinopathies

How?	How did the pain start? How was the injury mechanism?
Where?	Where does it hurt? Can you point to the exact spot that hurts?
When?	When did the pain begin? Does it come and go or is it constant?
How much?	How much is the pain? Does it prevent you from participating in your normal activities?
What?	What activities make your pain worse? What medications or treatments make it better?

- Elbow stability, range of motion, strength testing, and neurovascular function
- Conditions in adjacent joints: to detect causes of irradiated pain (like cervical radiculopathy) or predisposing conditions causing elbow tendinopathy (like shoulder stiffness).
- Specific evocative tests: these tests are a keypoint for elbow tendinopathies diagnosis. They have been developed to evoke pain in the specific muscle-tendon unit under investigation, through its specific active contraction or with its selective passive stretching. The comparison with the contralateral limb is always useful.

The stronger is the agreement among medical history, physical examination, and evocative tests, more reliable is the diagnosis of elbow tendinopathy.

Even if in most cases imaging, as plain X-ray, ultrasonography, and magnetic resonance imaging, is not usually required for the diagnosis, it is often requested especially in atypical or persistent cases for diagnosis confirmation, to rule out concomitant causes of elbow pain, to evaluate the severity of the lesion, and to follow up its evolution over time.

Table 19.2 Etiologies of the pain caused by common elbow tendinopathies, with their possible differential diagnosis

Pain location	Common tendinopathies	Differential diagnosis
Lateral	Lateral epicondylitis (tennis elbow)	• Cervical radiculopathy • Radiocapitellar arthrosis • Radial tunnel syndrome • Posterolateral rotatory instability • Synovial plica • OCD capitulum humeri • Panner disease
Medial	Medial epicondylitis (golfer's elbow)	• Medial instability • Cubital tunnel syndrome • Snapping triceps syndrome • Ulnar collateral ligament tear
Posterior	Triceps tendon injury	• Olecranon bursitis
Anterior	Distal biceps tendon injury	• Bicipitoradial bursitis

Elbow tendinopathies are the most common causes of elbow pain; however, we should not forget other possible etiologies (Table 19.2).

19.2 Lateral Epicondylitis (Tennis Elbow)

Lateral epicondylitis (LE) is the most common cause of lateral elbow pain. It consists of a symptomatic tendinosis of the short carpal radial extensor (ERBC) and of the aponeurosis of the common finger extensor at the level of the lateral epicondyle of the elbow.

19.2.1 Clinical Presentation

The typical patient is a middle age person subjected to repetitive movements, hand-arm vibration and awkward postures, as manual workers or recreational athletes. There is an equal gender distribution and the dominant extremity is more frequently affected.

Patients with lateral epicondylitis present pain at or around the bony prominence of the lateral epicondyle that often radiates down to the forearm in line with the common extensor muscle mass, especially during activities involving forearm supination and wrist extension.

The pain can vary in each patient from an intermittent and mild ache to a constant, severe, and sharp pain, causing a disturbance in sleep and limiting the grip strength and sometimes the last degrees of the elbow extension during daily activities.

Usually, lateral epicondylitis starts with insidious onset and gradual progression of the pain.

19.2.2 Physical Examination

It is important to perform a physical examination of the entire upper extremities, beginning from a cervical spine evaluation, moving to the shoulder, then elbow, wrist and hand, followed by comparison with the unaffected, contralateral extremity.

Examination typically reveals localized soreness over the common extensor origin 0* palpation of the lateral epicondyle, especially just anterior and distal to the lateral epicondyle—at the origin of the extensor carpi radialis brevis (ECRB)—elicits pain that often radiates along with the extensor muscle mass.

Sometimes skin hypopigmentation and soft tissue atrophy can be evident on the lateral epicondyle if multiple cortisone injections have been previously performed.

Other diagnoses should be considered if the patient is younger than 25 years or older than 65 years of age, or the onset of the pain is clearly due to an acute traumatic event, or pain is referred at the soft spot level or more distally along the forearm instead of at the lateral epicondyle, or, if during forearm rotation, a crepitus can be detected.

19.2.3 Specific Examination Manoeuvres

To evaluate lateral epicondylitis many specific physical examination manoeuvres have been described. The tests are better performed with the patient comfortably seated with both arms exposed.

- **Cozen's test**: The patient is positioned with the arm forward, the elbow fully extended, the wrist extended, the forearm pronated. The examiner resists to the dorsal flexion of the wrist. This test stresses the whole of the common extensor origin [1]. If the patient holds the wrist in radial deviation, the extensor carpi radialis brevis and longus are selectively activated and the test is even more accurate (Fig. 19.1).

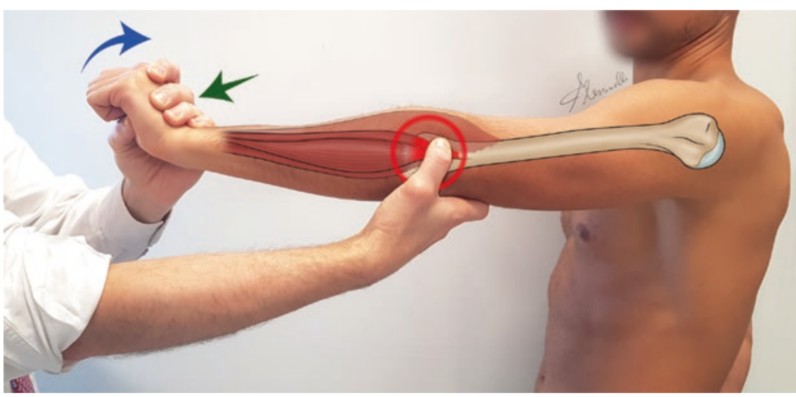

Fig. 19.1 Cozen's test: the resisted wrist extension with radial deviation and full pronation can be considered one of the best tests to confirm the diagnosis of LE. The pain is typically exacerbated by gentle pressure over the lateral epicondyle

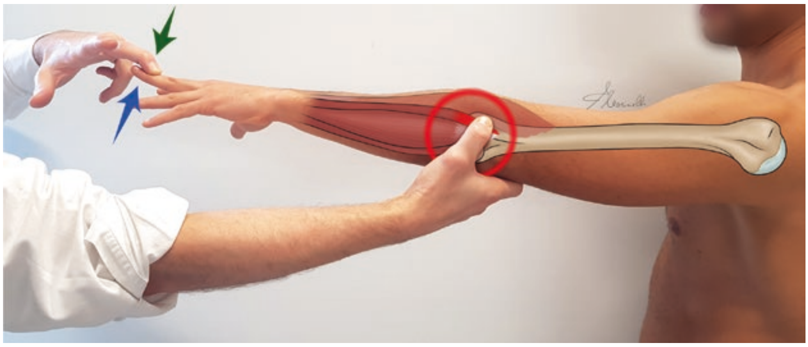

Fig. 19.2 Maudsley's test: the resisted middle finger extension causes pain at the lateral epicondyle in case of LE. The pain is exacerbated by a gentle local pressure over the lateral epicondyle. In case of radial tunnel syndrome, the pain is typically located some centimetres more distal

- **Maudsley's test** (or **resisted middle finger extension test**): The patient is positioned with the arm forward, the elbow extended, the wrist in neutral position, the forearm pronated. The examiner resists to the dorsal flexion of the middle finger: the test elicits pain on the ECRB tendon (Fig. 19.2) and it is particularly painful if a radial tunnel syndrome is associated [2].
- **Mill's test:** The patient is positioned with the arm along the body, the elbow extended with the forearm in full pronation. The examiner flexes the patient's wrist. The onset of pain over the lateral epicondyle suggests ECRB tendinosis [3] (Fig. 19.3).
- **Polk's test**: The patient is asked to grab an object (about 2.5 kg) with the elbow flexed to 100° and forearm pronated [4]. The test is called Laptop test if the raised object is a notebook computer (Fig. 19.4).
- **Chair pick up test**: The patient is asked to lift a chair, placed in front of him/her, with the forearm pronated and a partially extended elbow, using the first three fingers [5] (Fig. 19.5).
- A loss of grip strength has also been described as a diagnostic test for lateral epicondylitis and the use of a dynamometer permits to quantify the relative impairment:
- **Grip strength test** (*sens. 80%; spec. 85%*): The patient is asked to squeeze the dynamometer as strong as possible. Maximal grip strength can be reduced to almost 50% if the test is performed with the elbow in full extension; however, just a reduction in strength of approximately 8% between flexion and extension is considered indicative of lateral epicondylitis [6].

Fig. 19.3 Mill's test: in case of LE, a passive wrist flexion movement causes pain at the lateral epicondyle. The pain is exacerbated by a gentle local pressure

19.2.4 Possible Associated Symptoms

Lateral epicondylitis is often associated with other clinical disorders, like radial tunnel syn-

Fig. 19.4 Polk's test for LE: grasping a relatively heavy object (2–3 kg) with the elbow flexed and the forearm pronated, the extensors of the wrist are stressed. In case of L.E. this test causes pain at the lateral epicondyle

Fig. 19.5 Chair pick up test: in case of LE, lifting the back of a chair with a three-finger pinch (thumb, index, and long fingers) and the elbow fully extended elicits pain at the lateral epicondyle

drome (entrapment of the posterior interosseous nerve) or, cervical radiculopathy, homolateral shoulder stiffness or scapular dyskinesis, which affecting elbow kinematics, can cause elbow over-use.

19.3 Medial Epicondylitis (Golfer's Elbow)

Medial epicondylitis (ME) is a degenerative tendinopathy of the flexor-pronator muscles origin at the level of the medial epicondyle.

19.3.1 Clinical Presentation

Medial epicondylitis usually affects middle aged athletes or workers involved in repetitive wrist flexion and forearm pronation activities.

Patients with medial epicondylitis typically present a subtle onset of pain at the medial aspect of the elbow that often radiates down to the forearm, especially during activities involving forearm pronation and wrist flexion. The pain varies in each patient from a mild and intermittent ache to constant and severe sharp pain.

19.3.2 Physical Examination

Examination typically reveals localized tenderness at the origin of the flexor-pronator mass on the medial epicondyle, exacerbated by resisted wrist flexion performed with the elbow extended and forearm supinated.

19.3.3 Specific Examination Manoeuvres

Several tests have been described to elicit pain in case of medial epicondylitis. These tests are performed with the patient comfortably seated with both arms exposed.

- **Reverse Mill's test**: The patient is positioned with the arm forward, the elbow extended, and the forearm supinated. The examiner passively moves the wrist in dorsal flexion (Fig. 19.6).

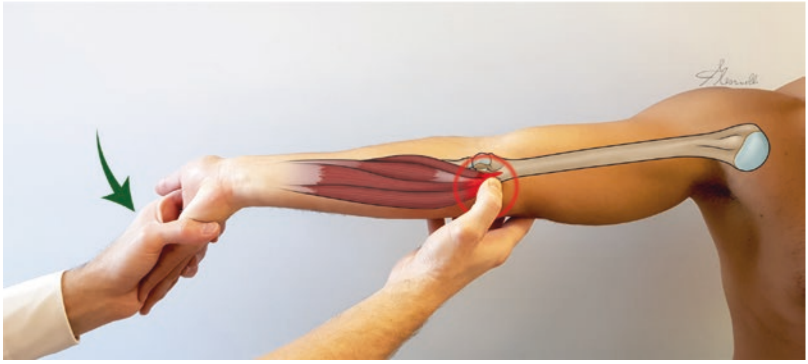

Fig. 19.6 Reverse Mill's test: in case of ME the passive wrist extension, performed with elbow extended and forearm supinated, causes pain at the medial epicondyle, exacerbated by gentle local pressure

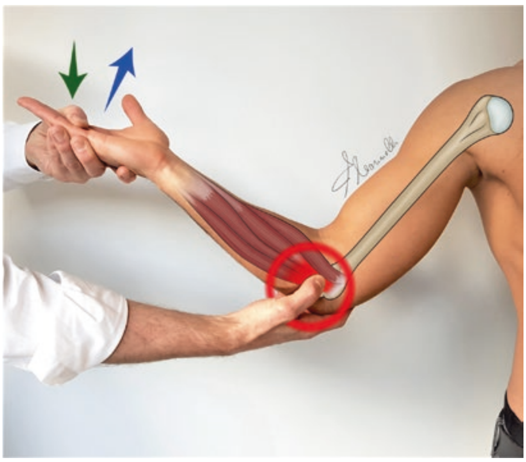

Fig. 19.7 Resisted wrist flexion test: in case of ME the active resisted wrist flexion performed with elbow and wrist partially extended, elicits pain at the medial epicondyle, exacerbated by gentle local pressure

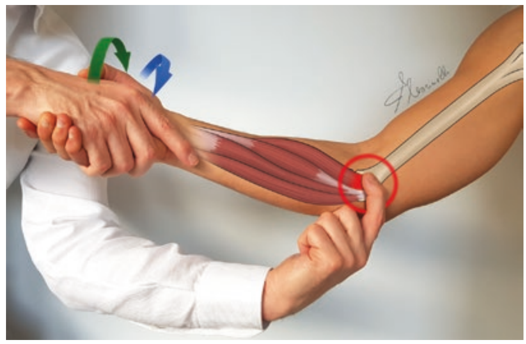

Fig. 19.8 Resisted forearm pronation test: in case of ME, the active resisted forearm pronation performed with elbow and wrist partially extended elicits pain at the pronator teres tendon insertion. The pain is increased if during the test a gentle local pressure is applied by the examiner over the tendon's insertion

- **Resisted wrist flexion test:** The patient is positioned with the arm forward, the elbow and wrist extended and forearm supinated. The patient is asked to actively flex the wrist, against the resistance of the examiner who, in the meanwhile, palpate with his/her thumb the insertion of the patient's flexors mass (Fig. 19.7).
- **Resisted forearm pronation**: The patient is positioned with elbow in 90° of flexion. The examiner hand grasps the patient's hand in a handshake position, while the index finger of the opposite hand rests over the medial part of the tendon insertion on the medial epicondyle. The patient is asked to actively pronate the forearm while the examiner holds resistance, maintaining the hand in neutral position. If this test, that selectively activates the pronator teres muscle, is more painful than the resisted wrist flexion test, it indicates a greater pronator teres involvement (Fig. 19.8).
- **Polk's test**: The patient is asked to grab an object (about 2.5 kg), in front of him/her, with a flexed elbow and forearm supination [4] (Fig. 19.9).
- **Cheek test:** The patient is asked to press his own cheeks with their fingers, keeping shoulders abducted. The pain at the medial epicondyle is caused by the contraction of the flexor-pronator mass [7] (Fig. 19.10).

19.3.4 Possible Associated Symptoms

Medial epicondylitis symptoms can be associated to lateral epicondylitis or to cubital tunnel

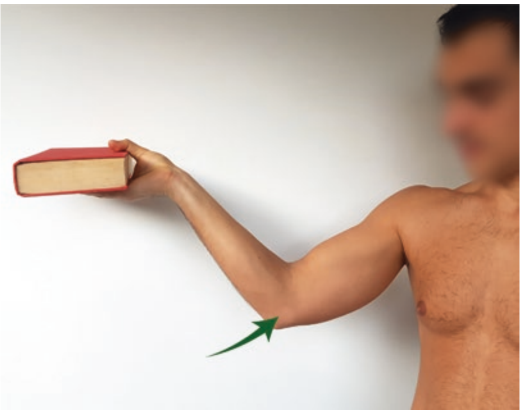

Fig. 19.9 Polk's test for ME: grasping a relatively heavy object (2–3 kg) with the elbow flexed and the forearm supinated puts under stress the wrist flexors muscles, causing pain at the medial epicondyle in case of ME

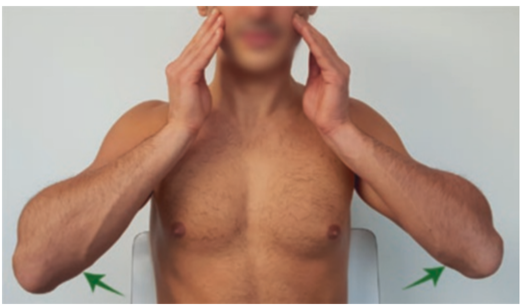

Fig. 19.10 Pressing own cheeks, while keeping the shoulder partially abducted, causes contraction of the flexor-pronator mass and elicits pain at the medial epicondyle

syndrome. Tinel's sign and a full neurological examination, including sensory and motor assessment, permit to rule out ulnar nerve neuropathy. Ulnar collateral stability should also be assessed.

19.4 Distal Biceps Tendinopathy

Injuries to the distal biceps tendon are relatively common and are usually due to traumatic or micro-traumatic lesions, more or less severe, of the tendon at its bone insertion.

The most common lesions are traumatic and acute complete tendon tears, with or without a lacertus fibrosus rupture. Less frequently, the tendon presents a partial thickness that can be insertional or intrasubstance.

19.4.1 Clinical Presentation

Patients with complete distal biceps tear are typically muscular and middle-aged men, between 35 and 55 years, reporting an uncontrolled eccentric load that has led to a forced elbow extension while the bicep was actively contracting. Patients usually report a sudden, painful "pop" at the time of injury followed by the development of a dull ache. The diagnosis of complete distal biceps tendon tear can usually be established only based on patient history and physical examination. However, an intact lacertus fibrosus can make the proximal migration of the muscle belly less evident, an excellent strength conservation in very muscular patients can make difficult the perception of flexion weakness, the absence of significant pain or visible hematoma can hide the severity of the tendon lesion. On the other hand, great attention should be given to avoid missed or delayed diagnoses because late surgery makes reinsertion more difficult, with a higher complication rate.

19.4.2 Physical Examination

A patient with complete tendon rupture typically presents a "Popeye" deformity that is a visible flattening of the distal muscle contour of the arm due to the proximal retraction of the biceps muscle belly. When not easily noticeable, the crease-to-biceps distance between the elbow flexion crease and the round biceps muscle belly can be compared with the opposite arm to confirm the diagnosis.

The presence of ecchymosis in the distal arm and proximal forearm suggests an acute and complete injury although sometimes it does not appear until days after the insult. In partial ruptures and tears, usually ecchymosis may never develop due to confinement of the hematoma by an intact bicipital aponeurosis.

ROM and strength should be assessed compared to the contralateral extremity. Typically, the patient complains of pain in the affected arm at the antecubital fossa during full extension and supination.

Reduction of strength and pain are typically noticed with resisted elbow flexion and even more with forearm supination.

19.4.3 Specific Examination Manoeuvres

- **Hook test:** The patient is asked to look at the palm of his/her hand on the affected side keeping the forearm in active supination, with the shoulder elevated and the elbow flexed at 90°. An intact distal bicep tendon allows the examiner to hook his/her finger around the lateral side of the distal biceps tendon of the patient. If the bicep is torn, the examiner cannot hook his/her finger around any anterior structures [8] (Fig. 19.11). The absence of the tendon compared to the contralateral arm is a reported to have 80/100% of sensibility and 100% of specificity for complete biceps tendon tear.
- However, care must be taken during direct palpation of the tendon in the antecubital fossa as an intact bicipital aponeurosis may be misleading. The presence of a cord-like structure cannot exclude a partial tendon tear.
- **Passive forearm rotation test:** The elbow of the patient is flexed at 90°, relaxed on the patient's side. The examiner with one hand rotates the forearm, while with the other hand palpates the biceps muscle: the absence of proximal excursion during supination and distal excursion during pronation is a positive test for total distal biceps rupture, with a reported sensibility of 95% and specificity of 100% [9].
- **Active forearm rotation test:** The examiner asks the patient to actively rotate the forearm with the elbow flexed at 60°–70°. Lack of the biceps belly migration is a positive test for total distal biceps rupture, with a reported sensibility of 100% (Fig. 19.12).
- **Lag Sign:** The patient is seated with the arm over a table. At first the examiner holds the patient's forearm in full supination and asks the patient to hold this position. Then the examiner releases the forearm and assesses if some degrees of pronation occur. If this happens, it means that the pronation forces exceed the supination forces, as a result of biceps tendon lesion [10].
- **Bicipital crease interval (BCI):** The distance between the antecubital fossa (elbow at 90° of flexion) and the start of the muscle belly is calculated (normal value is 6 cm). A BCI greater than 6 cm indicates a total distal biceps rupture [11]. It has been reported that this test presents a 90% of sensibility and from 50 to 100% of specificity.

Fig. 19.11 Hook test: the index of the examiner is used to hook the distal insertion of the biceps tendon of the patient, while the patient actively supinates the forearm. If the distal biceps tendon of the patient is intact, a strong cord-like structure can be easily palpated

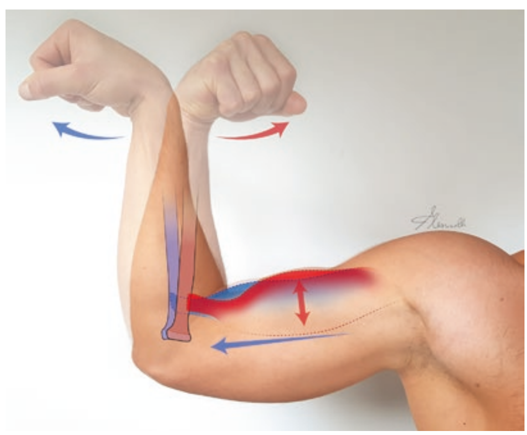

Fig. 19.12 Active forearm rotation test: if the distal biceps tendon is intact, keeping the elbow flexed and rotating the forearm, the arm changes its contour. During the forearm rotation, due to the relative movement of the radial tuberosity, the biceps muscle belly gets longer and stretched with forearm pronation and gets shorter and dumpy in supination

- **Bicipital crease ratio (BCR)** The ratio between the BCI in both arms is calculated. The normal value from 1 to 1.2. A BCR value greater than 1.2 indicates a total distal biceps rupture. This test presents a 96% of sensibility and 80% of specificity.
- **The biceps squeeze test** is similar to the Thompson test for Achilles tendon ruptures. The patient is seated and the forearm rests on a table, slightly pronated and elbow flexed to 60°–80°. The clinician squeezes the distal part of the belly biceps brachii. The lack of forearm supination suggests complete rupture [12]. This test, even if it has been reported to present a good sensitivity, in our experience is not very reliable.
- **Bicipital Aponeurosis Flex Test:** the bicipital aponeurosis, if present, can be felt on the medial side of the elbow while the patient flexes the elbow at around 75°, flexes the wrist, supinates the forearm, and with the hand closed into a fist isometrically contracts the biceps [13].

19.5 Triceps Tendinopathies

Triceps tendinopathy, that generally occurrs in male muscular athletes or manual workers, represents the least common type of elbow tendinopathies.

Triceps tendinopathies are a spectrum of lesion, going from chronic tendinosis to acute tendon rupture.

Triceps tendinosis is an enthesopathy, secondary to overuse caused by repetitive and resisted elbow extension activities, causing degenerative process at the tendon to bone insertion.

Patients with symptomatic tendinosis present recurrent or persistent pain at the olecranon insertion, that increases with resisted elbow extension.

Triceps tendon rupture is usually acute and traumatic, caused by a sudden eccentric load applied to a contracting triceps muscle. Traumatic tendon rupture can be partial or complete.

19.5.1 Clinical Presentation

Patients typically report a sudden, painful “pop” at the time of injury followed by the development of a dull ache and swelling at the posterior elbow.

19.5.2 Physical Examination

On physical examination, the posterior elbow is examined for signs of direct trauma, swelling, ecchymosis, and visible defects. Elbow range of motion and elbow extension strength is compared to the contralateral limb. Tenderness at the olecranon insertion as well as increased pain with resisted elbow extension can be present, with different degrees of severity, in both acute and chronic triceps tendinopathies. In case of complete tendon rupture, a palpable defect may be present but soft tissue swelling and body habitus may limit the clinician’s ability to accurately identify the defect; a significant reduction in extension strength is normally present, but the inability to actively keep the forearm in extension against gravity is seen in a minority of cases. In fact, the presence of an intact lateral expansion of the tendon may allow active extension (albeit weak), even in complete ruptures. This may lead to misdiagnosis, or delayed diagnosis of the rupture.

19.5.3 Specific Examination Manoeuvres

- **Fall down triceps test**: The test can be performed in supine position, the shoulder elevated, and the elbow partially extended. The examiner pushes the forearm to flex the elbow, while the patient tries to maintain the elbow extended (Fig. 19.13). In case of tendon lesion, the patient shows weakness extension. However, not all complete triceps tendon tears result in total loss of active elbow extension: an intact lateral expansion

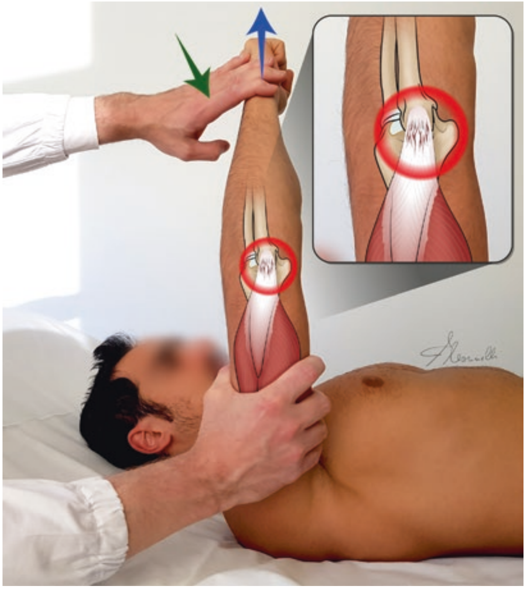

Fig. 19.13 Fall down triceps test: the examiner pushes the forearm to flex the elbow, while the patient tries to maintain the elbow extended: the inability to actively keep the forearm in extension against gravity is a sign of complete rupture

Fig. 19.14 Triceps squeeze test: the triceps muscle belly is squeezed in a patient in prone position over the edge of the examination table, with the shoulder abducted and the elbow flexed 90°. If the triceps tendon is intact, the test will produce some degrees of elbow extension. In case of a complete tear, triceps squeezing is not able to produce elbow extension

or compensating anconeus may still provide some degree of active elbow extension, albeit the test is painful and the strength weaker.

- **Triceps squeeze test**: This test it is the adaptation of the Thompson test for the triceps tendon. It can be performed on a prone patient with the shoulder abducted and the elbow flexed 90° over the edge of the examination table. In a patient with complete tear of the triceps tendon, squeezing the triceps muscle belly is not able to produce an extension [14] (Fig. 19.14).

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