11 Clinical Presentation and Diagnosis of Cubital Tunnel Syndrome

Claudius D. Jarrett

Introduction

Since the early description of Cubital tunnel syndrome, the diagnosis remains primarily based on the history of the present illness and the physical examination. Recent advances in research have provided additional information into demographic risk factors, occupational and recreational hazards, as well as subtleties in presentation that adds clarity in ones diagnosis. The physical examination can delve deep from the surface when provocative examination are utilized and weighted to their strengths. The value of imaging studies continues to evolve. Numerous studies have been performed to provide insight on the utility of elctrodiagnostic studies, ultrasound, and magnetic resonance images (MRIs). When used appropriately, these tools can supplement the surgeon's examination, treatment, as well as discussion of prognosis with patients. This chapter will discuss classic and novel aspects of the presentation and diagnosis of Cubital tunnel syndrome that the clinician can bring to their daily practice.

C. D. Jarrett (✉)
Division of Orthopaedic Surgery, Wilmington Health Associates, Wilmington, NC, USA

Presentation

Patients with Cubital tunnel syndrome classically present with painful paresthesias radiating from the medial elbow down the forearm into the ulnar one and a half digits. A substantial portion of patients may also describe weakness in their grip strength. Some may complain of their small finger getting caught while attempting to place their hand in their pants pocket. The length of symptoms can range from weeks to years. Clarifying whether a patient's symptoms are constant or intermittent is an important aspect of the history [1]. Intermittent symptoms can be a sign of transient nerve ischemia that can help guide type and prognosis of treatment. At times, patients will present with purely motor complaints of hand weakness, loss of dexterity, and subtle ulnar sided digital clawing deformity. This unique patient population presents an ominous prognostic dilemma, as intrinsic muscle atrophy can be rather severe without any antecedent sensory complaints.

One should inquire about specific occupational demands and recreational activities. Repetitive or protracted elbow hyperflexion, whether performed at work or in the gym, can be associated with exacerbation of symptoms. Some patients also report prolonged use of vibratory tools at work. Occasionally, patients may describe an antecedent traumatic event to the medial elbow as well.

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Nighttime symptoms are common. The clinician should ask about positional sleeping habits. Typically, paresthesias are more prominent at night, as a result of unintentional elbow flexion, but can progress resulting in dense daytime numbness. Exacerbating factors can include elevated cellphone use, prolonged driving, and reading. Some may describe worsening symptoms with weight lifting such as overhead triceps extensions, closed fist bench press, and triceps pull-down.

Physical Examination

The physical exam should begin with assessing the overall appearance of symptomatic arm. The clinician should observe how the patient moves and uses the arm during conversation, writing, shaking hands, as well as the normal resting position and tone. One should assess for the presence of muscle atrophy in comparison to the contralateral arm. The presence of intrinsic muscle atrophy should be noted as it likely reveals a more advanced form of the disease process (Fig. 11.1). The clinician should evaluate for masses, swelling, wounds, and/or prior incisions. One should document the range of both active and passive motion in the shoulders, elbows, wrists, and hands. Motor function should be assessed by grading resisted digital flexion as well as intrinsic strength. In comparison to the intrinsic muscles, the fascicles innervating the flexor digitorum profundus to the ring and small fingers are more centrally located within the ulnar nerve and unlikely to be involved until the later stages of the disease process. Sensory testing should be performed, at the minimum, by assessing light touch as well as both static and dynamic two-point discrimination. During early stages of neuropathy, the Semmes Weinstein monofilament test and vibratory testing can be effective in detecting sensory impairment. Alternation of normal sensation along the dorsal ulnar hand (i.e. dorsal sensory branch of the ulnar nerve) can help distinguish between pathologic ulnar nerve compression at the elbow versus at the wrist. Additionally, ulnar nerve compression at the wrist typically does not lead to weakness of the ring and small finger flexor digitorum profundus. Digital perfusion and distal pulses should also be evaluated. Evidence of perfusion abnormalities (i.e. loss of radial pulse) may hint towards a different etiology such as thoracic outlet syndrome.

Fig. 11.1 Patient with advanced Cubital tunnel syndrome with evidence of intrinsic atrophy (arrow)

The presence of Wartenberg and/or Froment sign also correlates with motor weakness in patients with Cubital tunnel syndrome. Wartenberg sign occurs when the patient is unable to fully adduct the small finger secondary to the weakened interosseous muscles and the overpowering pull of the small finger extensors (Fig. 11.2a). Froment sign results secondary to weakness of the intrinsic muscle adductor pollicis. The sign is positive when a patient is unable to hold a piece of paper between the thumb and index finger without flexing the thumb at the interphalangeal joint (Fig. 11.2b).

Several provocative maneuvers remain the core of the physical examination and allow distinguishing Cubital tunnel syndrome from other sites of nerve compression (i.e. C8 radiculopathy) [2] (Table 11.1). A Tinel's test, direct compression test, or placement of the elbow in a position of hyperflexion test (i.e. elbow flexion test) may all reproduce the patient's symptoms. The Tinel's test is performed by repeatedly tapping or percussing over the Cubital tunnel. The direct compression test is executed simply applying direct continuous pressure over the Cubital tunnel. The elbow flexion test is completed by

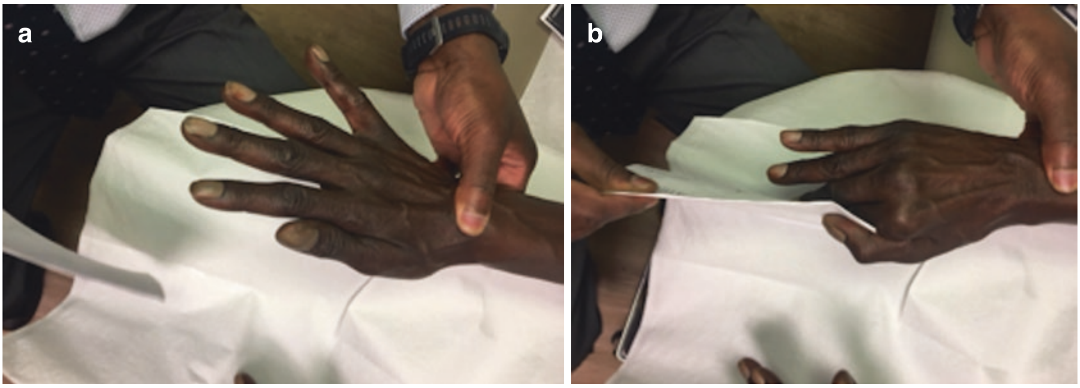

Fig. 11.2 (**a**) Patient with a positive Wartenberg's sign. He is unable to fully adduct the small finger secondary to the weakened interosseous muscles and the overpowering pull of the small finger extensors. (**b**) Patient with a positive Froment's sign. He is unable to hold a piece of paper between the thumb and index finger without flexing the thumb at the interphalangeal joint

Table 11.1 Reported sensitivity and specificity of commonly applied provocative maneuvers for Cubital tunnel syndrome

Name	Examination maneuver	Sensitivity/ specificity
Tinel's	4–6 taps on the ulnar nerve just proximal to the cubital tunnel	70%/98% [3]
Elbow Flexion	Elbow placed in maximum flexion with forearm supinated and wrist in neutral	75%/99% [3]
Direct Pressure	Place index and middle finger directly on subject's ulnar nerve proximal to cubital tunnel with elbow in 90° of flexion	89%/98% [3]
Combined Elbow flexion – Direct Pressure	Elbow placed in maximum flexion while directly pressing on ulnar nerve just proximal to cubital tunnel	98%/95% [3]
Elbow flexion-shoulder abduction/internal rotation	Elbow in hyperflexion with shoulder abducted to 90° and in maximum internal rotation	58%/100% [4, 5]
Modified elbow flexion-shoulder abduction/internal rotation	Elbow in hyperflexion, shoulder abducted to 90° and internally rotated, forearm supinated, and wrist extended	87%/98% [4, 5]

The sensitivity and specificity may vary based on length of duration of exam [3–5]

passively flexing the elbow to the maximum angle for 1–3 min. The sensitivity and specificity of these tests do vary in the literature (Table 11.1) [3–5]. The clinician should remain cognizant of the varying rates of false positives for these tests published in the literature. The author recommends limiting the duration of provocation to no more than 1 min as longer time periods may lead to positive findings in asymptomatic controls [3, 6–9]. Rayan et al and Kuschner et al reported a positive percussion test in approximately 24% and 34% of normal volunteers, respectively [6, 7]. Combining or slightly modifying these exams may increase their sensitivity and specificity (Fig. 11.3a, b). A combination of the elbow flexion test with the direct pressure while adding additional tension to the ulnar nerve by shoulder abduction/internal rotation, forearm supination, and wrist extension has been found by investigators to do such that. By doing this, Ochi and colleagues increased the sensitivity and specificity of the elbow flexion test to 85% and 98%, respectively [5]. However, one must be aware that these additions may also increase the false-positive results of the provocative maneuver.

The scratch collapse test is another described provocative maneuver for Cubital tunnel syndrome. The exam is done by first placing the patient's flexed elbow at their side and acquiring a baseline their shoulder external rotation strength. Next, the clinician lightly scratches over the Cubital tunnel then re-evaluates the patient's

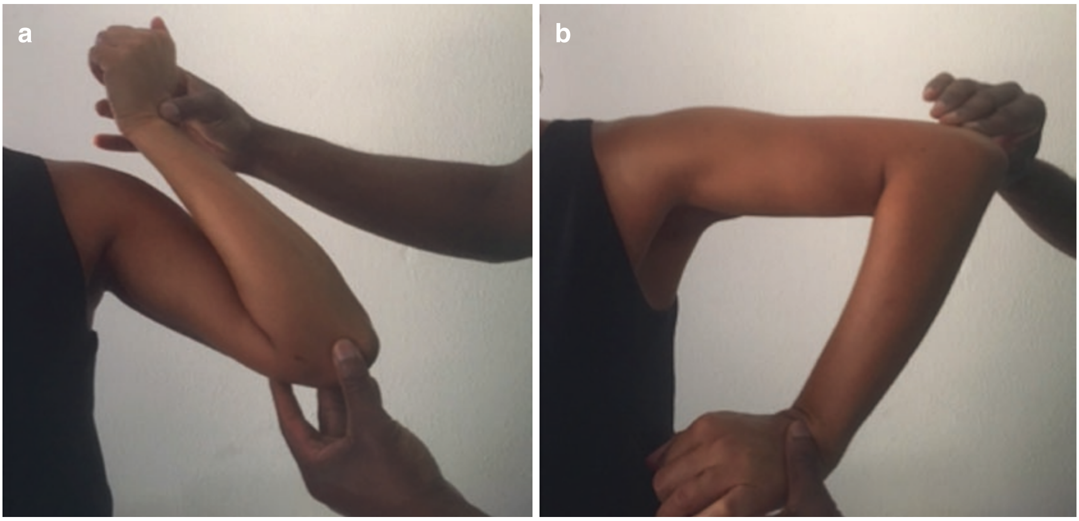

Fig. 11.3 (**a**) Example of the combined elbow flexion and direct pressure test (**b**) Example of modified elbow flexion test including shoulder internal rotation, elbow flexion, wrist extension, and direct pressure test

shoulder external rotation strength. In patients with Cubital tunnel syndrome, a positive test will produce temporary diminished shoulder external rotation strength. Investigators have reported a 69% sensitivity and 99% specificity for Cubital tunnel syndrome [8].

The ulnar nerve should also be assessed for stability. This can be assessed by placing one or two fingers on the medial epicondyle and taking the elbow from full extension to full flexion. The ulnar nerve will slide underneath ones fingers if unstable. This assessment should be performed on both sides as up to approximately a third of patients have physiologic subluxation on exam [6, 10, 11].

The physical exam should be completed by full examination of cervical spine and shoulder girdle to rule out other potential sites of nerve compression or injury.

Classification

Cubital tunnel syndrome is commonly categorized based on the physical examination by the McGowan classification system [12]. Patients with McGowan Grade I Cubital tunnel syndrome present with sensory changes but no objective motor weakness on exam. Grade II is delineated by the presence of motor weakness. Patients are considered Grade IIa if the motor weakness is mild and Grade IIb if moderate (i.e. 3 out of 5). Patients with McGowan Grade III present with profound motor weakness and intrinsic atrophy upon examination. Dellon later modified the McGowan classification to include the severity of sensory changes [13]. Based on the Dellon modification, patients with mild Cubital tunnel syndrome have intermittent paresthesias. Moderate Cubital tunnel syndrome results in a decrease to vibratory sensation on exam. Severe Cubital tunnel syndrome is marked by abnormal two-point discrimination.

Electrodiagnostic Studies

Electrodiagnostic studies continue to be used as a supplemental tool to confirm the diagnosis of Cubital tunnel syndrome [1]. However, innate limitations including patient discomfort, precise localization, detection of structural abnormalities, as well as risk of false-negatives prevent it broad utilization [14–16]. Current criteria used to confirm pathologic nerve conduction at the elbow include a ulnar nerve conduction velocity <50 m/s, a 10-m/s difference from the contralateral side, and/or a 20% reduction in amplitude in comparison to the contralateral side [1, 17]. Electrodiagnostic testing can reliably confirm abnormal nerve conduction in patients with moderate to severe (e.g. McGowan II or III) Cubital tunnel syndrome. However, these tests can be unpredictable in patients with mild disease (e.g. McGowan I) [15, 18]. Hence, the results of electrodiagnostic testing should not take precedence over ones history and physical examination.

Imaging

Plain Radiographs

The acquisition of plain radiographs should not be routine but dictated by history, examination, and planned surgical approach. A history of trauma, limited elbow range of motion, an abnormal carrying angle, and/or presence of elbow swelling are just some of the clinical findings that warrant acquisition of plain x-rays of the elbow. Three views of the elbow (anteroposterior [AP], oblique, and lateral) are typically sufficient. When surgical intervention is anticipated, preoperative radiographs should be acquired to evaluate the bony anatomy, alignment, presence or absence of arthritis, post-traumatic changes, and articular congruency.

Ultrasound

The exact role of ultrasonography for the diagnosis of ulnar neuropathy at the elbow continues to be refined [19]. Technological advances have allowed for improved the visualization of structural abnormalities. The inexpensive nature and ability to perform dynamic evaluation are some of its unique touted advantages. However, consistent correlation with clinically significant disease remains variable [14, 20–22]. This may be in part secondary to the technician dependency of the study. Most ultrasound studies provide estimates on the appearance and size of the ulnar nerve in and around the Cubital tunnel. The cross sectional area (CSA) and largest diameter on transverse scans are frequently documented exam findings (Fig. 11.4a, b) [14, 19, 23–25]. Substantial nerve enlargement on ultrasound has been shown to coincide with electrodiagnostic studies and clinical symptoms by some investigators [25, 26]. Volpe et al prospectively compared the CSA and electrodiagnostic studies in 50 elbows with Cubital tunnel syndrome to 50 controls. The authors reported an 88% sensitivity and specificity for diagnosing electrodiagnostic confirmed Cubital tunnel syndrome using ultrasound when using a cut-off of ≥10 mm^2 CSA [27]. However, there remains no standard guideline on what is considered significant enlargement and the ideal location to measure it [14, 21–25].

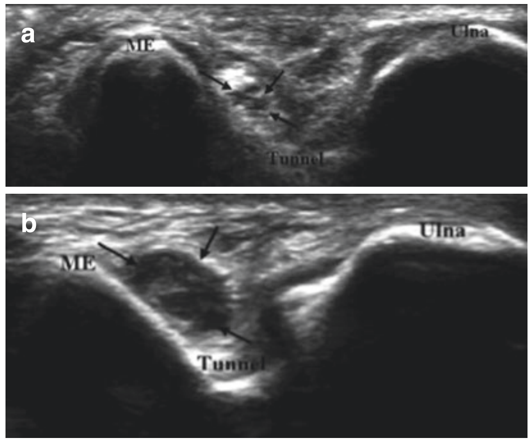

Fig. 11.4 (**a**) Ultrasound of the elbow in an asymptomatic volunteer with an ulnar nerve cross-sectional area of 0.08 cm^2. The cross-section of the ulnar nerve is depicted by arrows outlining its periphery. ME, medial epicondyle; Tunnel, ulnar tunnel. (**b**) Ultrasound of the elbow in a patient with Cubital tunnel syndrome with an ulnar nerve cross-sectional area of 0.29 cm^2. Similarly, the cross-section of the ulnar nerve is depicted by arrows outlining its periphery. (From Wiesler et al. [19] with permission)

MRI

Magnetic resonance imaging (MRI) continues to be investigated as a potentially attractive noninvasive alternative to assist in the diagnosis of Cubital tunnel syndrome. The improved resolution of modern 3 Tesla scans allows a clearer detection of morphological changes of the ulnar nerve. The technique for acquisition of the MRI should be performed with care. The elbow ought be held in extension during the scan, and the ulnar nerve should be to be aligned within 10^0 relative to the direction of the main magnetic field B_0. This precaution minimizes the artificial contribution to the T2 signal by the magic angle effect [28, 29]. On MRI scans, the ulnar nerve is most visibly seen on axial slices posterior to the medial epicondyle. A normal nerve should appear as a round hypointense structure surrounded by fat [30]. Increased signal of as well as increase in caliber of the ulnar nerve within the Cubital tunnel on T2-weighted or Diffusion weighted images can correlate with clinical diagnosis and electrophysiological testing [30–34]. The longitudinal extension of the increased signal as seen on several axial slices proximally and distally improves the clinical relevance. Altun and colleagues compared traditional MRI scans and diffusion weighted – MRI scans in patients with 24 symptomatic elbows with 26 controls. Electrophysiological testing and clinical criteria for the diagnosis for Cubital tunnel syndrome were used to assess both cohorts. All 24 elbows with Cubital tunnel syndrome had increased pathologic signaling on diffusion-weighted imaging and 20 of the 24 elbows had increased signal on T2-weighted imaging. None of the controls had pathologic signaling on their MRI scans [33]. In a similar study, Iba et al compared traditional MRI scans and diffusion weighted – MRI scans in 11 elbows with clinically diagnosed Cubital tunnel syndrome to 6 normal controls. Again, none of the normal elbows were found to have pathologic signally within the ulnar nerve. Diffusion-weighted MRI revealed positive signals in all 11 elbows and T2-weighted imaging revealed high signal intensity in 8 of the 11 elbows [32]. However, caution must remain on relying to heavily on imaging alone. Others have reported up to 60% of asymptomatic elbows may how increased signal on MRI [35].

Conclusion

The diagnosis of Cubital tunnel syndrome will continue to heavily rely on a thorough inquiry and a detailed physical examination. Secondary to varieties in presentation, the diagnosis can be difficult to confirm. An array of provocative maneuvers arms the clinician with several ways to clarify the diagnosis. Advances in electrodiagnostic studies and imaging can provide supplemental tools for selective patients. An appreciation of the important aspects of the history of the presenting illness as well as a firm grasp on the physical examination will continue to direct timely diagnosis, prognosis, and treatment of Cubital tunnel syndrome.

References

1. Palmer BA, Hughes TB. Cubital tunnel syndrome. J Hand Surg WB Saunders. 2010;35(1):153–63.
2. Jarrett CD, Papatheodorou LK, Sotereanos DG. Cubital tunnel syndrome. Instr Course Lect. 2017;66:91–101.
3. Novak CB, Lee GW, Mackinnon SE, Lay L. Provocative testing for cubital tunnel syndrome. J Hand Surg Elsevier. 1994;19(5):817–20.
4. Ochi K, Horiuchi Y, Tanabe A, Morita K, Takeda K, Ninomiya K. Comparison of shoulder internal rotation test with the elbow flexion test in the diagnosis of cubital tunnel syndrome. J Hand Surg Am. 2011;36(5):782–7.
5. Ochi K, Horiuchi Y, Tanabe A, Waseda M, Kaneko Y, Koyanagi T. Shoulder internal rotation elbow flexion test for diagnosing cubital tunnel syndrome. J Shoulder Elb Surg. 2012;21(6):777–81.
6. Rayan GM, Jensen C, Duke J. Elbow flexion test in the normal population. J Hand Surg. 1992;17(1):86–9.
7. Kuschner SH, Ebramzadeh E, Mitchell S. Evaluation of elbow flexion and linel tests for cubital tunnel syndrome in asymptomatic individuals. Orthopedics. 2006;29(4):305–8.
8. Cheng CJ, Mackinnon-Patterson B, Beck JL, Mackinnon SE. Scratch collapse test for evaluation of carpal and cubital tunnel syndrome. J Hand Surg Am. 2008;33(9):1518–24.
9. Beekman R, Schreuder AHCML, Rozeman CAM, Koehler PJ, Uitdehaag BMJ. The diagnostic value of provocative clinical tests in ulnar neuropathy at the elbow is marginal. J Neurol Neurosurg Psychiatry BMJ Publishing Group Ltd. 2009;80(12):1369–74.
10. Childress HM. Recurrent ulnar-nerve dislocation at the elbow. Clin Orthop Relat Res. 1975;108:168–73.
11. Calfee RP, Manske PR, Gelberman RH, Van Steyn MO, Steffen J, Goldfarb CA. Clinical assessment of the ulnar nerve at the elbow: reliability of instability testing and the association of hypermobility with clinical symptoms. J Bone Joint Surg Am Journal of Bone and Joint Surgery, Inc. 2010;92(17):2801–8.
12. McGOWAN AJ. The results of transposition of the ulnar nerve for traumatic ulnar neuritis. J Bone Joint Surg Br. 1950;32-B(3):293–301.

13. Dellon AL. Review of treatment results for ulnar nerve entrapment at the elbow. J Hand Surg. 1989;14(4):688–700.
14. Cho C-H, Lee Y-H, Song K-S, Lee K-J, Lee S-W, Lee S-M. Accuracy of preoperative ultrasonography for cubital tunnel syndrome: a comparison with intraoperative findings. Clin Orthop Surg. 2018;10(3):352–7.
15. Greenwald D, Blum LCI, Adams D, Mercantonio C, Moffit M, Cooper B. Effective surgical treatment of cubital tunnel syndrome based on provocative clinical testing without electrodiagnostics. Plast Reconstr Surg. 2006;117(5):87e–91e.
16. Yoon JS, Walker FO, Cartwright MS. Ulnar neuropathy with normal electrodiagnosis and abnormal nerve ultrasound. Arch Phys Med Rehabil WB Saunders. 2010;91(2):318–20.
17. Hutchison RL, Rayan G. Diagnosis of cubital tunnel syndrome. J Hand Surg Elsevier. 2011;36(9):1519–21.
18. Tomaino MM, Brach PJ, Vansickle DP. The rationale for and efficacy of surgical intervention for electrodiagnostic-negative cubital tunnel syndrome. J Hand Surg W.B. Saunders. 2001;26(6):1077–81.
19. Wiesler ER, Chloros GD, Cartwright MS, Shin HW, Walker FO. Ultrasound in the diagnosis of ulnar neuropathy at the cubital tunnel. J Hand Surg. 2006;31(7):1088–93.
20. Beekman R, Visser LH, Verhagen WI. Ultrasonography in ulnar neuropathy at the elbow: a critical review. Muscle Nerve Wiley-Blackwell. 2011;43(5):627–35.
21. Mondelli M, Filippou G, Frediani B, Aretini A. Ultrasonography in ulnar neuropathy at the elbow: relationships to clinical and electrophysiological findings. Neurophysiol Clin. 2008;38(4):217–26.
22. Gruber H, Glodny B, Peer S. The validity of ultrasonographic assessment in cubital tunnel syndrome: the value of a cubital-to-humeral nerve area ratio (CHR) combined with morphologic features. Ultrasound Med Biol. 2010;36(3):376–82.
23. Bayrak AO, Bayrak IK, Turker H, Elmali M, Nural MS. Ultrasonography in patients with ulnar neuropathy at the elbow: comparison of cross-sectional area and swelling ratio with electrophysiological severity. Muscle Nerve Wiley-Blackwell. 2010;41(5):661–6.
24. Ozturk E, Sonmez G, Çolak A, Sildiroglu HO, Mutlu H, Senol MG, et al. Sonographic appearances of the normal ulnar nerve in the cubital tunnel. J Clin Ultrasound. 2008;36(6):325–9.
25. Yoon JS, Hong S-J, Kim B-J, Kim SJ, Kim JM, Walker FO, et al. Ulnar nerve and cubital tunnel ultrasound in ulnar neuropathy at the elbow. Arch Phys Med Rehabil. 2008;89(5):887–9.
26. Zhong W, Zhang W, Zheng X, Li S, Shi J. The high-resolution ultrasonography and electrophysiological studies in nerve decompression for ulnar nerve entrapment at the elbow. J Reconstr Microsurg Thieme Medical Publishers. 2012;28(5):345–8.
27. Volpe A, Rossato G, Bottanelli M, Marchetta A, Caramaschi P, Bambara LM, et al. Ultrasound evaluation of ulnar neuropathy at the elbow: correlation with electrophysiological studies. Rheumatology (Oxford) Oxford University Press. 2009;48(9):1098–101.
28. Chappell KE, Robson MD, Stonebridge-Foster A, Glover A, Allsop JM, Williams AD, et al. Magic angle effects in MR neurography. AJNR Am J Neuroradiol. 2004;25(3):431–40.
29. Kästel T, Heiland S, Bäumer P, Bartsch AJ, Bendszus M, Pham M. Magic angle effect: a relevant artifact in MR neurography at 3T? AJNR Am J Neuroradiol. 2011;32(5):821–7.
30. Andreisek G, Crook DW, Burg D, Marincek B, Weishaupt D. Peripheral neuropathies of the median, radial, and ulnar nerves: MR imaging features. Radiographics. 2006;26(5):1267–87.
31. Bäumer P, Dombert T, Staub F, Kaestel T, Bartsch AJ, Heiland S, et al. Ulnar neuropathy at the elbow: MR neurography—Nerve T2 signal increase and caliber. Radiology Radiological Society of North America, Inc. 2011;260(1):199–206.
32. Iba K, Wada T, Tamakawa M, Aoki M, Yamashita T. Diffusion-weighted magnetic resonance imaging of the ulnar nerve in cubital tunnel syndrome. Hand Surg World Scientific Publishing Company. 2010;15(1):11–5.
33. Altun Y, Aygun MS, Cevik MU, Acar A, Varol S, Arıkanoglu A, et al. Relation between electrophysiological findings and diffusion weighted magnetic resonance imaging in ulnar neuropathy at the elbow. J Neuroradiol Elsevier Masson. 2013;40(4):260–6.
34. Breitenseher JB, Kranz G, Hold A, Berzaczy D, Nemec SF, Sycha T, et al. MR neurography of ulnar nerve entrapment at the cubital tunnel: a diffusion tensor imaging study. Eur Radiol Springer Berlin Heidelberg. 2015;25(7):1911–8.
35. Husarik DB, Saupe N, Pfirrmann CWA, Jost B, Hodler J, Zanetti M. Elbow nerves: MR findings in 60 asymptomatic subjects—Normal anatomy, variants, and pitfalls. Radiology Radiological Society of North America. 2009;252(1):148–56.