CQ HAND + UPPER LIMB
SPECIALIST ORTHOPAEDIC SURGEON

EVIDENCE SUMMARY

Carpal Tunnel Syndrome

title: “Carpal Tunnel Syndrome” slug: carpal-tunnel-and-nerve-compression region: wrist audience: patient mesh_terms: [“Carpal Tunnel Syndrome”, “Median Nerve”, “Decompression, Surgical”, “Neural Conduction”, “Electrodiagnosis”, “Wrist”, “Severity of Illness Index”, “Surveys and Questionnaires”] article_count: 888 model_used: Qwen3.6-35B-A3B-Q8_0.gguf generated_at: ‘2026-06-16T19:28:38+00:00’ key_articles: - title: “Outcomes of Mini-Open Carpal Tunnel Release in Patients With Unrecordable Preoperative Nerve Conduction Potentials at a Minimum of 5 Years” ref_num: 1 evidence_tier: paper evidence_level: 4 doi: 10.1177/1558944719857815 year: 2019 - title: “What’s new in carpal tunnel syndrome? Commentary and personal opinions” ref_num: 3 evidence_tier: paper evidence_level: 5 doi: 10.1177/17531934221080631 year: 2022 - title: “Hand Pain and Sensory Deficits: Carpal Tunnel Syndrome” ref_num: 4 evidence_tier: paper doi: 10.2519/jospt.2019.0301 year: 2019 - title: “A 6-year outcome of patients who cancelled carpal tunnel surgery” ref_num: 5 evidence_tier: paper evidence_level: 3 doi: 10.1177/1753193411410155 year: 2011 - title: “Carpal Tunnel Syndrome: The Correlation between Outcome, Symptoms and Nerve Conduction Study Findings” ref_num: 7 evidence_tier: paper evidence_level: 3 doi: 10.1054/jhsb.2001.0616 year: 2001 - title: “AAOS Appropriate Use Criteria: Management of Carpal Tunnel Syndrome” ref_num: 8 evidence_tier: paper evidence_level: 5 doi: 10.5435/jaaos-d-17-00454 year: 2018 - title: “Carpal Tunnel Syndrome” ref_num: 9 evidence_tier: paper doi: 10.1016/b978-0-12-385157-4.00652-7 year: 2014 - title: “Management of Carpal Tunnel Syndrome” ref_num: 10 evidence_tier: paper evidence_level: 5 doi: 10.5435/jaaos-d-17-00451 year: 2018 - title: “Practice parameter: Electrodiagnostic studies in carpal tunnel syndrome [RETIRED]” ref_num: 11 evidence_tier: paper evidence_level: 1 doi: 10.1212/wnl.58.11.1589 year: 2002 - title: “The long-term follow-up of treatment with corticosteroid injections in patients with carpal tunnel syndrome. When are multiple injections indicated?” ref_num: 12 evidence_tier: paper evidence_level: 3 doi: 10.1177/1753193412469580 year: 2012 - title: “COMPLICATIONS OF NONOPERATIVE AND OPERATIVE TREATMENT OF CARPAL TUNNEL SYNDROME” ref_num: 13 evidence_tier: paper evidence_level: 5 doi: 10.1016/s0749-0712(21)00316-4 year: 1996 - title: “Carpal Tunnel Syndrome Surgery: What You Should Know” ref_num: 14 evidence_tier: paper evidence_level: 4 doi: 10.1097/gox.0000000000002692 year: 2020 - title: “Carpal tunnel syndrome and work” ref_num: 15 evidence_tier: paper evidence_level: 4 doi: 10.1016/j.berh.2015.04.026 year: 2015 - title: “Carpal Tunnel Syndrome Diagnosis” ref_num: 16 evidence_tier: paper evidence_level: 5 doi: 10.1016/j.pmr.2014.01.004 year: 2014 - title: “Carpal tunnel syndrome” ref_num: 17 evidence_tier: paper evidence_level: 4 doi: 10.1136/bmj.g6437 year: 2014 - title: “Variation in Interpretation of Provocative Tests for Carpal Tunnel Syndrome” ref_num: 18 evidence_tier: paper evidence_level: 4 doi: 10.1016/j.jhsa.2024.07.004 year: 2025 - title: “Carpal Tunnel Syndrome: A Potential Early, Red-Flag Sign of

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Amyloidosis" ref_num: 20 evidence_tier: paper evidence_level: 5 doi: 10.1016/j.jhsa.2025.07.017 year: 2025 - title: "Diagnosis of Carpal Tunnel Syndrome" ref_num: 21 evidence_tier: paper evidence_level: 5 doi: 10.1016/j.jhsa.2009.12.034 year: 2010 - title: "Elongated muscle belly of the flexor digitorum superficial causing carpal tunnel syndrome" ref_num: 22 evidence_tier: paper evidence_level: 5 doi: 10.1007/s11552-012-9435-z year: 2012 - title: "Outcome Metrics in the Treatment of Carpal Tunnel Syndrome: A Systematic Review" ref_num: 23 evidence_tier: paper evidence_level: 1 doi: 10.1177/1558944720949951 year: 2020 - title: "In Justification of Nonsurgical Treatment for Carpal Tunnel Syndrome" ref_num: 24 evidence_tier: paper evidence_level: 5 doi: 10.1016/j.jhsa.2009.05.009 year: 2009 - title: "Long-term outcome of carpal tunnel release surgery in patients with severe carpal tunnel syndrome" ref_num: 26 evidence_tier: paper evidence_level: 3 doi: 10.1302/0301-620x.99b10.bjj-2016-0587.r2 year: 2017 - title: "Carpal Tunnel Release in Patients With Diabetes: A 5-Year Follow-Up With Matched Controls" ref_num: 28 evidence_tier: paper evidence_level: 2 doi: 10.1016/j.jhsa.2014.01.012 year: 2014 - title: "Ultrasound and MRI in Carpal Tunnel Syndrome: The Dilemma of Simplifying the Approach to a Complex Disease or Making Complex Assessments of a Simple Problem" ref_num: 30 evidence_tier: paper evidence_level: 5 doi: 10.1016/j.jhsa.2012.07.041 year: 2012 - title: "Minimally Invasive Ultrasound-Guided Carpal Tunnel Release Improves Long-Term Clinical Outcomes in Carpal Tunnel Syndrome" ref_num: 31 evidence_tier: paper evidence_level: 4 doi: 10.2214/ajr.20.24383 year: 2021 - title: "Carpal Tunnel Release by the Agee Endoscopic Technique" ref_num: 32 evidence_tier: paper evidence_level: 4 doi: 10.1054/jhsb.1999.0226 year: 1999 - title: "Ultrasonographic assessment of longitudinal median nerve and hand flexor tendon dynamics in carpal tunnel syndrome" ref_num: 34 evidence_tier: paper evidence_level: 4 doi: 10.1002/mus.23246 year: 2012 - title: "Re: Becker SJE, Makanji HS and Ring D. Changes in treatment plan for carpal tunnel syndrome based on electrodignostic test results. J Hand Surg Eur. 2014, 39: 187–93" ref_num: 36 evidence_tier: paper evidence_level: 5 doi: 10.1177/1753193414526674 year: 2014 - title: "Carpal Tunnel Syndrome and Distal Radius Fractures" ref_num: 37 evidence_tier: paper evidence_level: 5 doi: 10.1016/j.hcl.2017.09.003 year: 2018 - title: "Correspondence between clinical presentation and electrophysiological testing for potential carpal tunnel syndrome" ref_num: 39 evidence_tier: paper evidence_level: 2 doi: 10.1177/1753193412461860 year: 2012 - title: "CORR Insights®: Diagnosis of Mild-to-moderate Idiopathic Median Neuropathy at the Carpal Tunnel Based on Signs and Symptoms is Discordant From Diagnosis Based on Electrodiagnostic Studies and Ultrasound" ref_num: 40 evidence_tier: paper evidence_level: 5 doi: 10.1097/corr.0000000000002822 year: 2023 - title: "Carpal tunnel syndrome caused by an interosseous ganglion of the lunate" ref_num: 41 evidence_tier: paper evidence_level: 4 doi: 10.1177/17531934241227809 year: 2024 - title: "Carpal tunnel syndrome" ref_num: 42 evidence_tier: paper evidence_level: 4 doi: 10.1136/bmj.39282.623553.ad year: 2007 - title: "How to Differentiate Pronator Syndrome from Carpal Tunnel Syndrome: A Comprehensive Clinical Comparison" ref_num: 43 evidence_tier: paper evidence_level: 4 doi: 10.3390/diagnostics12102433 year: 2022 - title: "Intraindividual comparison between open and endoscopic release in bilateral carpal tunnel syndrome: a meta-analysis of randomized controlled trials" ref_num: 44 evidence_tier: paper evidence_level: 1 doi: 10.1002/brb3.439 year: 2016 - title: "Management of Recalcitrant Carpal Tunnel Syndrome" ref_num: 45 evidence_tier: paper evidence_level: 5 doi: 10.5435/jaaos-d-18-00004 year: 2019 - title: "Carpal Tunnel Syndrome" ref_num: 46 evidence_tier: paper doi: 10.1016/j.ocl.2017.11.009 year: 2018 - title: "Is surgical intervention more effective than non-surgical treatment for carpal tunnel syndrome? a systematic review" ref_num: 47 evidence_tier: paper evidence_level: 1 doi: 10.1186/1749-799x-6-17 year: 2011 - title: "Efficacy of Combined Ultrasound-Guided Steroid Injection and Splinting in Patients With Carpal Tunnel Syndrome" ref_num: 48 evidence_tier: paper evidence_level: 1

doi: 10.1016/j.apmr.2017.01.018 year: 2017 - title: “Cross-Sectional Area of the Median Nerve as a Prognostic Indicator in Carpal Tunnel Syndrome Treated With Local Steroid Injection” ref_num: 49 evidence_tier: paper evidence_level: 4 doi: 10.1016/j.jhsa.2021.09.022 year: 2023 - title: “Outcomes of endoscopic surgery compared with open surgery for carpal tunnel syndrome among employed patients: randomised controlled trial” ref_num: 50 evidence_tier: paper evidence_level: 1 doi: 10.1136/bmj.38863.632789.1f year: 2006 - title: “The Comparative Effectiveness of Combined Lumbrical Muscle Splints and Stretches on Symptoms and Function in Carpal Tunnel Syndrome” ref_num: 52 evidence_tier: paper evidence_level: 2 doi: 10.1016/j.apmr.2011.08.013 year: 2012 - title: “Corticosteroid Injection for Carpal Tunnel Syndrome” ref_num: 54 evidence_tier: paper evidence_level: 5 doi: 10.1016/j.jhsa.2008.06.023 year: 2008 - title: “Grading severity of carpal tunnel syndrome in electrodiagnostic reports: Why grading is recommended” ref_num: 56 evidence_tier: paper evidence_level: 5 doi: 10.1002/mus.23824 year: 2013 - title: “Decompression for recurrent carpal tunnel syndrome provides significant functional improvement and patient satisfaction” ref_num: 59 evidence_tier: paper evidence_level: 4 doi: 10.1177/1753193419875945 year: 2019 - title: “An Alternative Solution for the Diagnosis of Carpal Tunnel Syndrome” ref_num: 61 evidence_tier: paper evidence_level: 5 doi: 10.2106/jbjs.o.01067 year: 2015 - title: “Carpal Tunnel Syndrome: Reconciling “Demand Management” with Clinical Need” ref_num: 62 evidence_tier: paper evidence_level: 5 doi: 10.1054/jhsb.1999.0328 year: 2000 - title: “Pedicled Fat Flap Coverage of the Median Nerve after Failed Carpal Tunnel Decompression” ref_num: 63 evidence_tier: paper evidence_level: 4 doi: 10.1054/jhsb.2002.0780 year: 2002 - title: “Scientific study of the extent of transverse movement of the median nerve at the wrist during active wrist extension in static positions of the upper limb tension test one” ref_num: 64 evidence_tier: paper evidence_level: 4 doi: 10.1258/ht.2011.011017 year: 2011 - title: “Magnetic Resonance Imaging After Endoscopic Carpal Tunnel Release” ref_num: 65 evidence_tier: paper evidence_level: 2 doi: 10.1016/j.jhsa.2012.11.013 year: 2013 - title: “Diagnostic potential of ultrasound in carpal tunnel syndrome with different etiologies: correlation of sonographic median nerve measures with electrodiagnostic severity” ref_num: 66 evidence_tier: paper evidence_level: 3 doi: 10.1186/s12891-019-3010-5 year: 2019 - title: “Median nerve deformation in differential finger motions: Ultrasonographic comparison of carpal tunnel syndrome patients and healthy controls” ref_num: 67 evidence_tier: paper evidence_level: 3 doi: 10.1002/jor.21562 year: 2011 - title: “Carpal Tunnel Syndrome: A Case–Control Study Evaluating Its Relationship with Body Mass Index and Hand and Wrist Measurements” ref_num: 68 evidence_tier: paper evidence_level: 3 doi: 10.1177/1753193408090142 year: 2008 - title: “Mycobacterium marinum and Carpal Tunnel Syndrome: Three Case Reports” ref_num: 69 evidence_tier: paper evidence_level: 4 doi: 10.1016/j.jhsa.2017.05.027 year: 2017 - title: “Carpal Tunnel Syndrome Due to Hydroxyapatite Crystal Deposition Disease” ref_num: 70 evidence_tier: paper evidence_level: 5 doi: 10.1007/s12593-012-0076-9 year: 2013 - title: “Clinical, Radiological, and Electrodiagnostic Diagnosis of Pronator Syndrome Concurrent With Carpal Tunnel Syndrome” ref_num: 71 evidence_tier: paper evidence_level: 4 doi: 10.1016/j.jhsa.2020.06.006 year: 2020 - title: “Diagnosing carpal tunnel syndrome—clinical criteria and ancillary tests” ref_num: 72 evidence_tier: paper evidence_level: 4 doi: 10.1038/ncpneuro0216 year: 2006 - title: “Diagnosing Systemic Amyloidosis Presenting as Carpal Tunnel Syndrome” ref_num: 73 evidence_tier: paper evidence_level: 4 doi: 10.2106/jbjs.20.02093 year: 2021 - title: “Carpal Tunnel Syndrome Secondary to Ganglion Cyst in a Child” ref_num: 74 evidence_tier: paper evidence_level: 5 doi: 10.1177/0883073810387299 year: 2011 - title: “The Reversed Palmaris Longus: Sonographic Findings and Anatomical Correlation With Implications for Carpal Tunnel Syndrome Diagnosis and Management” ref_num: 75 evidence_tier: paper evidence_level: 4 doi: 10.1016/j.jhsg.2025.100903 year: 2026 - title: “Carpal Tunnel Syndrome Caused by Space Occupying Lesions” ref_num: 77 evidence_tier: paper

evidence_level: 4 doi: 10.3349/ymj.2009.50.2.257 year: 2009 - title: “High wrist ratio is a risk factor for carpal tunnel syndrome” ref_num: 79 evidence_tier: paper evidence_level: 4 doi: 10.1002/ca.23198 year: 2018 - title: “Unusual causes of carpal tunnel syndrome: space occupying lesions” ref_num: 80 evidence_tier: paper evidence_level: 4 doi: 10.1177/1753193411414352 year: 2011 - title: “The Usefulness of Ultrasonography in the Diagnosis of Carpal Tunnel Syndrome” ref_num: 81 evidence_tier: paper evidence_level: 3 doi: 10.1177/1753193408090396 year: 2008 - title: “Assessment of grip-motion characteristics in carpal tunnel syndrome patients using a novel finger grip dynamometer system” ref_num: 82 evidence_tier: paper evidence_level: 4 doi: 10.1186/s13018-020-01773-9 year: 2020 - title: “Role of Anthropometric Characteristics in Idiopathic Carpal Tunnel Syndrome” ref_num: 83 evidence_tier: paper evidence_level: 3 doi: 10.1016/j.apmr.2012.11.017 year: 2013 - title: “Differences in risk factors for neurophysiologically confirmed carpal tunnel syndrome and illness with similar symptoms but normal median nerve function: a case–control study” ref_num: 84 evidence_tier: paper evidence_level: 3 doi: 10.1186/1471-2474-14-240 year: 2013 - title: “Position of the wrist associated with the lowest carpal-tunnel pressure” ref_num: 85 evidence_tier: paper evidence_level: 4 doi: 10.2106/00004623-199511000-00008 year: 1995 - title: “The biomechanics of subsynovial connective tissue in health and its role in carpal tunnel syndrome” ref_num: 86 evidence_tier: paper evidence_level: 5 doi: 10.1016/j.jelekin.2017.10.007 year: 2018 - title: “Intrarater and interrater reliability of a hand-held dynamometric technique to quantify palmar thumb abduction strength in individuals with and without carpal tunnel syndrome” ref_num: 87 evidence_tier: paper evidence_level: 3 doi: 10.1016/j.jht.2017.08.005 year: 2018 - title: “Variability of Precision Pinch Movements Caused by Carpal Tunnel Syndrome” ref_num: 88 evidence_tier: paper evidence_level: 3 doi: 10.1016/j.jhsa.2008.02.030 year: 2008 - title: “The Quality and Strength of Evidence for Etiology: Example of Carpal Tunnel Syndrome” ref_num: 89 evidence_tier: paper evidence_level: 3 doi: 10.1016/j.jhsa.2008.01.004 year: 2008 - title: “Reduced Longitudinal Excursion of the Median Nerve in Carpal Tunnel Syndrome” ref_num: 90 evidence_tier: paper evidence_level: 3 doi: 10.1016/j.apmr.2007.02.015 year: 2007 - title: “Clinical relevance commentary in response to: Intrarater and inter-rater reliability of a handheld dynamometric technique to quantify palmar thumb abduction strength in individuals with and without carpal tunnel syndrome” ref_num: 91 evidence_tier: paper evidence_level: 5 doi: 10.1016/j.jht.2018.09.010 year: 2018 - title: “Pre-operative electrodiagnostic testing predicts time to resolution of symptoms after carpal tunnel release” ref_num: 92 evidence_tier: paper evidence_level: 4 doi: 10.1177/1753193415576248 year: 2015 - title: “Predicting Clinical Outcome After Surgical Treatment in Patients With Carpal Tunnel Syndrome” ref_num: 93 evidence_tier: paper evidence_level: 2 doi: 10.1016/j.jhsa.2018.05.017 year: 2018 - title: “REOPERATION FOR CARPAL TUNNEL SYNDROME” ref_num: 94 evidence_tier: paper evidence_level: 4 doi: 10.1016/s0749-0712(21)00315-2 year: 1996 - title: “Topographical Assessment of Symptom Resolution Following Open Carpal Tunnel Release” ref_num: 95 evidence_tier: paper evidence_level: 4 doi: 10.1016/j.jhsa.2009.04.024 year: 2009 - title: “The Benefit of Carpal Tunnel Release in Patients With Electrophysiologically Moderate and Severe Disease” ref_num: 96 evidence_tier: paper evidence_level: 3 doi: 10.1016/j.jhsa.2014.12.012 year: 2015 synthesis_version: “v2” verifier_status: skipped

Overview

- Patients with end-stage carpal tunnel syndrome do not have worse long-term patient-reported outcomes after carpal tunnel release compared with the general population [1].
- The utility of diagnostic tests, outcome measurement standardization, and cost-effectiveness calculations remain topics of ongoing debate in the diagnosis and management of carpal tunnel syndrome [3].
- High-quality research is needed to resolve ongoing debates regarding the diagnosis and management of carpal tunnel syndrome [3].
- Carpal tunnel decompression surgery is safe and effective, with 97% of patients experiencing complete or partial relief [7].
- The AAOS Appropriate Use Criteria provide guidance on diagnostic and treatment options for carpal tunnel syndrome [8].
- The AAOS Appropriate Use Criteria specify scenarios where electrodiagnostic studies are or are not necessary [8].
- The AAOS Appropriate Use Criteria address the appropriateness of surgical versus nonsurgical interventions [8].
- The AAOS developed Appropriate Use Criteria to help determine the appropriateness of treatments for carpal tunnel syndrome by synthesizing evidence with expert opinion [10].
- Standards, guidelines, and options for electrodiagnostic (EDX) studies of carpal tunnel syndrome are defined based on a critical review of the literature [11].
- A rational plan of therapy is available for each category of complications of carpal tunnel syndrome [13].
- Successful treatment of carpal tunnel syndrome is commonly defined based on a patient-reported outcome measure (PROM) [23].
- Recent efforts in carpal tunnel syndrome treatment emphasize measuring outcomes from the patient's perspective [23].
- Nonsurgical methods for mild to moderate carpal tunnel syndrome are effective and underused [24].
- Conservative treatment of carpal tunnel syndrome has slight complications compared to surgical risks [24].
- Patient choice is emphasized in the management of mild to moderate carpal tunnel syndrome [24].
- Universal acceptance of diagnostic criteria for carpal tunnel syndrome remains elusive without prospective controlled studies verifying improved performance [30].
- Evidence available to purchasers and clinicians attempting to manage demand for carpal tunnel decompression is usually sparse and rarely comprehensive [62].
- Universally applied and validated measures for hand surgery outcomes are rarely available [62].
- The outcome of carpal tunnel decompression syndrome is good in the majority of cases [63].
- Open and endoscopic techniques for carpal tunnel decompression provide similar results [63].

Anatomy & Pathophysiology

- Altered hand dynamics in carpal tunnel syndrome patients may have implications for the pathophysiology and clinical evaluation of the condition [34].
- Ultrasound-based classification models may support the diagnosis of carpal tunnel syndrome [34].
- Transverse movement of the median nerve is most marked with forearm supination, irrespective of other changes in the kinetic chain [64].
- Median nerve deformation parameters during differential finger motions may be useful as an additional tool for diagnosing or assessing the biomechanics of carpal tunnel syndrome [67].
- Wrist morphometry, as measured by the wrist index, has a causative association with carpal tunnel syndrome, but the difference is too small to be of diagnostic value in clinical or epidemiological practice [68].
- A high wrist ratio is a risk factor for carpal tunnel syndrome and was the only significant predictor in logistic regression analysis [79].
- A novel finger grip dynamometer system can quantify patient symptoms easily and objectively by measuring each finger's grip strength at one time and recording the time course of grip motion, contributing to the evaluation of hand function [82].
- Simple external hand or wrist measurements could be used for screening purposes to predict the tendency for carpal tunnel syndrome [83].
- Obesity, diabetes, use of hand-held vibratory tools, and repeated forceful movements of the wrist and hand are causes of impaired median nerve function [84].
- Splints that immobilize the wrist in a functional position of extension do not minimize carpal tunnel pressure [85].
- The subsynovial connective tissue (SSCT) is an anatomical structure that contributes biomechanically to the carpal tunnel and has a relation with the surrounding tendons and nerve [86].
- Hand-held dynamometry reliably quantifies palmar thumb abduction strength in individuals with and without carpal tunnel syndrome, but is more reliable with the same rater than with different raters [87].
- Carpal tunnel syndrome impairs the performance of precision pinch movement, indicated by increased variability [88].
- The etiology of carpal tunnel syndrome is largely structural, genetic, and biological, with environmental and occupational factors such as repetitive hand use playing a minor and more debatable role [89].
- Reduced longitudinal excursion of the median nerve at the carpal tunnel is observed in carpal tunnel syndrome patients [90].
- Palmar thumb abduction strength measurement is a repeatable technique with excellent nonparametric reliability, though large differences between raters and a lack of variability in the sample limit clinical utility [91].

Classification

- Carpal tunnel syndrome involves a classification and diagnosis of the condition [15].
- The diagnosis of carpal tunnel syndrome should shift from a dichotomous, all-or-none approach to one that considers probabilities of disease [21].
- Tools such as the hand diagram and CTS 6 are used to form baseline probabilities for carpal tunnel syndrome [21].
- Management of carpal tunnel syndrome is guided by estimated probability and severity [21].
- Ultrasound-based classification models may support the diagnosis of carpal tunnel syndrome [34].
- Grading severity in electrodiagnostic reports refers to the degree of median neuropathy pathology, not the syndrome itself [56].

Clinical Presentation

- Carpal tunnel syndrome is characterized by hand pain and sensory deficits [4].
- The clinical presentation of carpal tunnel syndrome includes specific symptoms and signs that are used for classification and diagnosis [15].
- Carpal tunnel syndrome is extremely common and is seen in both community and hospital practice [17].
- Carpal tunnel syndrome is the commonest peripheral nerve problem in the United Kingdom [42].
- Specialists do not consider pain without paresthesia or a noncharacteristic symptom distribution as characteristic of carpal tunnel syndrome [18].
- Symptoms and signs characteristic of carpal tunnel syndrome significantly, but incompletely, coincided with electrophysiological testing [39].
- There is a severe discordance between the estimated prevalence of mild-to-moderate carpal tunnel syndrome based on clinical signs and symptoms (73%) versus electrodiagnostic studies and ultrasound (51%) [40].
- Carpal tunnel syndrome can be an early manifestation of systemic amyloidosis [20].
- Ultrasonography is useful in the diagnostic evaluation of carpal tunnel syndrome, especially in cases with an atypical clinical presentation [22].
- Uncommon aetiologies should be considered in patients with atypical symptoms of carpal tunnel syndrome [41].
- The diagnostic process to differentiate pronator syndrome from carpal tunnel syndrome is challenging due to overlapping symptoms [43].
- The diagnosis of carpal tunnel syndrome should shift from a dichotomous, all-or-none approach to one that considers probabilities of disease, utilizing tools like the hand diagram and CTS 6 [21].

Investigations

- Carpal tunnel syndrome is generally not considered difficult to diagnose, although the method of diagnosis may vary among clinicians [16].
- Electrodiagnostic studies are used to determine scenarios where they are necessary or unnecessary in the management of carpal tunnel syndrome [8].
- Ultrasonography is a useful method for the diagnostic evaluation of carpal tunnel syndrome, capable of discovering the cause of median nerve compression, especially in cases with atypical clinical presentation [22].
- There is sufficient evidence for orthopaedic and hand surgeons to consider using ultrasound as the first-line confirmatory diagnostic tool for carpal tunnel syndrome [61].
- High-resolution ultrasound is a valid and accurate diagnostic modality in carpal tunnel syndrome and correlates with CTS severity [66].
- Ultrasonography can be used as an ancillary diagnostic modality in patients with suspected CTS, with the cross-sectional area of the median nerve at the tunnel inlet being the most useful diagnostic criterion [81].
- Routine sonographic assessment is valuable when evaluating patients with carpal tunnel syndrome [75].
- An ultrasound examination can confirm the diagnosis of carpal tunnel syndrome and uncover underlying etiology, though nerve conduction studies may still be required [74].
- Imaging tests such as ultrasound and MRI have lower diagnostic accuracy than nerve conduction studies but are useful for explaining persistence of symptoms following surgical relief [72].
- MRI of patients 3 months after successful endoscopic carpal tunnel release does not demonstrate a discrete gap or separation in the flexor retinaculum overlying the median nerve but may be useful for evaluating median nerve morphology [65].
- Space-occupying lesions of the carpal tunnel may be easily missed, and a carpal tunnel view and ultrasound scanning are mandatory in suspected cases [70].
- In cases with swelling or tenderness on the area of wrist flexion creases, it is important to obtain a carpal tunnel view, and MRI and/or CT should be supplemented to rule out space-occupying lesions around the carpal tunnel if necessary [77].
- Carpal tunnel syndrome caused by a space-occupying lesion is rare and more complicated than idiopathic carpal tunnel syndrome [80].
- Electrodiagnostic, ultrasound, and MRI tests are not helpful in making a diagnosis of pronator syndrome concurrent with carpal tunnel syndrome when clinical evaluation is the reference standard [71].
- Amyloidosis diagnosis after carpal tunnel release is rare but is associated with poor outcomes [73].

Treatment

NON-OPERATIVE MANAGEMENT

- Patients with early carpal tunnel syndrome can be managed with conservative treatment [9].
- Carpal tunnel release should be recommended to patients who have failed nonsurgical treatment [9].
- Nonsurgical methods for mild to moderate carpal tunnel syndrome are effective and underused [24].
- Conservative treatment has slight complications compared to surgical risks [24].
- Initial treatment for carpal tunnel syndrome generally is nonoperative [46].
- The strongest evidence for nonoperative treatment supports bracing/splinting [46].
- One-third of patients with carpal tunnel syndrome had a long-term beneficial effect from corticosteroid injection, especially when they had a good initial response [12].
- Local steroid injection for carpal tunnel syndrome has an overall success rate of 45% after a mean follow-up of 16 months [49].
- Steroid injection combined with splinting resulted in modestly greater reduction of symptoms, functional recovery, and improvement of nerve function at 12-week follow-up compared to steroid injection alone [48].
- Findings support further evaluation of combined lumbrical muscle splints and stretches as a method of conservative carpal tunnel syndrome treatment [52].
- The AAOS Appropriate Use Criteria provide guidance on the appropriateness of surgical versus nonsurgical interventions [8].
- The AAOS developed Appropriate Use Criteria to help determine the appropriateness of treatments for carpal tunnel syndrome by synthesizing evidence with expert opinion [10].
- A rational plan of therapy is available for each category of complications of carpal tunnel syndrome [13].

OPERATIVE MANAGEMENT

- Carpal tunnel decompression surgery is safe and effective, with 97% of patients experiencing complete or partial relief [7].
- Patients with end-stage carpal tunnel syndrome do not have worse long-term patient-reported outcomes after carpal tunnel release compared with the general population [1].
- Successful treatment of carpal tunnel syndrome is commonly defined based on a patient-reported outcome measure (PROM) [23].
- Carpal tunnel release surgery continues to evolve with new diagnostic techniques and less-invasive surgical methods [14].
- Open and endoscopic release procedures provided similar symptom relief and hand strength and sensibility recovery, and were safe for patients with carpal tunnel syndrome [44].
- Both open and endoscopic surgical methods have equal efficacy in relieving symptoms of carpal tunnel syndrome among employed patients [50].

- Effective management of recalcitrant carpal syndrome requires an accurate diagnosis and a comprehensive treatment strategy [45].
- Revision carpal tunnel release is less successful than primary release with up to 40% of patients having unfavorable outcomes [45].

COMPARATIVE EFFECTIVENESS

- Both surgical and conservative interventions had treatment benefit in carpal tunnel syndrome [47].

Complications

- Patients with end-stage carpal tunnel syndrome do not have worse long-term patient-reported outcomes after carpal tunnel release compared with the general population [1].
- Carpal tunnel decompression surgery is safe and effective, with 97% of patients experiencing complete or partial relief [7].
- The long-term outcome of carpal tunnel release is favourable with a rate of recurrence of 2.5% and a rate of persistence of 3.75% [26].
- At an average follow-up of 4.5 years, 28% of hands had persistent symptoms after Carpal Tunnel Release by the Agee Endoscopic Technique, but results were scarcely different from the conventional technique with no patient requiring reoperation [32].
- Corticosteroid injection is safe and effective for the temporary relief of carpal tunnel syndrome symptoms, but most patients will eventually require surgery for long-term control of their symptoms [54].
- Delayed carpal tunnel syndrome is typically due to alterations in carpal tunnel anatomy and requires etiology-specific treatment [37].
- Infectious etiologies such as Mycobacterium marinum should be considered in atypical carpal tunnel syndrome presentations or when symptoms persist after surgery [69].

Recovery

- Patients with end-stage carpal tunnel syndrome do not have worse long-term patient-reported outcomes after carpal tunnel release compared with the general population [1].
- Symptoms of carpal tunnel syndrome may improve without surgery, although further studies are needed to understand the natural history of the disorder [5].
- Patients with early carpal tunnel syndrome can be managed with conservative treatment, but carpal tunnel release should be recommended to patients who have failed nonsurgical treatment [9].
- One-third of patients with carpal tunnel syndrome had a long-term beneficial effect from corticosteroid injection, especially when they had a good initial response [12].
- The long-term outcome of carpal tunnel release is favourable with a recurrence rate of 2.5% and a persistence rate of 3.75% [26].

- Long-term improvement in patients with diabetes remained after carpal tunnel release to the same extent as for patients without diabetes [28].
- Ultrasound-guided carpal tunnel release quickly improves hand function and reduces hand discomfort, with improvement persisting beyond one year [31].
- At an average follow-up of 4.5 years, 28% of hands treated with the Agee endoscopic technique had persistent symptoms, but results were scarcely different from the conventional technique with no patient requiring reoperation [32].
- Idiopathic median neuropathy at the carpal tunnel acts more like a steadily and inevitably progressive disease than a self-limiting one [36].
- Patients undergoing revision open carpal tunnel decompression for recurrent carpal tunnel syndrome experience significant improvement in function and health-related quality of life [59].
- Patients with mild or moderate carpal tunnel syndrome experience a faster time to resolution of daytime numbness and tingling when compared with patients with severe carpal tunnel syndrome [92].
- Clinical severity of carpal tunnel syndrome at intake is the most important factor in estimating symptom relief after surgical treatment [93].
- A significant correlation was found between patients with an incomplete release and lack of a symptom-free period after carpal tunnel release [94].
- Symptoms experienced outside of the median nerve distribution had a high likelihood of resolution after carpal tunnel release, with over 85% of symptoms in each of the anatomic zones studied resolving [95].
- Patients with severe carpal tunnel syndrome experience considerable reduction in symptoms after surgery but should be informed that recovery may be more prolonged and, in some cases, incomplete 1 year after carpal tunnel release, particularly with regard to numbness [96].

Key Evidence

- [L4] Patients with end-stage carpal tunnel syndrome do not have worse long-term patient-reported outcomes after carpal tunnel release compared with the general population. (10.1177/1558944719857815)
- [L5] The article highlights ongoing debates in the diagnosis and management of carpal tunnel syndrome, including the utility of diagnostic tests, outcome measurement standardization, and cost-effectiveness calculations, while encouraging high-quality research to resolve these issues. (10.1177/17531934221080631)
- [Paper] This document provides clinical practice guidelines for the diagnosis, examination, and intervention of carpal tunnel syndrome based on a systematic review of the scientific literature accepted for publication prior to November 2018. (10.2519/jospt.2019.0301)
- [L3] The symptoms of carpal tunnel syndrome may improve without surgery, but further studies are needed to understand the natural history of the disorder. (10.1177/1753193411410155)

- [L3] Carpal tunnel decompression surgery is safe and effective, with 97% of patients experiencing complete or partial relief. (10.1054/jhsb.2001.0616)
- [L5] The AAOS Appropriate Use Criteria provide guidance on diagnostic and treatment options for carpal tunnel syndrome, including scenarios where electrodiagnostic studies are or are not necessary and the appropriateness of surgical versus nonsurgical interventions. (10.5435/jaaos-d-17-00454)
- [Paper] Patients with early carpal tunnel syndrome can be managed with conservative treatment, but carpal tunnel release should be recommended to patients who have failed nonsurgical treatment. (10.1016/b978-0-12-385157-4.00652-7)
- [L5] The AAOS developed Appropriate Use Criteria to help determine the appropriateness of treatments for carpal tunnel syndrome by synthesizing evidence with expert opinion. (10.5435/jaaos-d-17-00451)
- [L1] The document defines standards, guidelines, and options for EDX studies of carpal tunnel syndrome based on a critical review of the literature. (10.1212/wnl.58.11.1589)
- [L3] One-third of patients with carpal tunnel syndrome had a long-term beneficial effect from corticosteroid injection, especially when they had a good initial response. (10.1177/1753193412469580)
- [L5] A rational plan of therapy is available for each category of complications of carpal tunnel syndrome. (10.1016/s0749-0712(21)00316-4)
- [L4] Carpal tunnel release surgery continues to evolve with new diagnostic techniques and less-invasive surgical methods. (10.1097/gox.0000000000002692)
- [L4] This review discusses the anatomy of the carpal tunnel and the clinical presentation of the syndrome as well as the classification and diagnosis of the condition. (10.1016/j.berh.2015.04.026)
- [L5] Carpal tunnel syndrome is a common nerve compression syndrome generally not considered difficult to diagnose, though the method of diagnosis may vary among clinicians. (10.1016/j.pmr.2014.01.004)
- [L4] Carpal tunnel syndrome is extremely common and is seen in both community and hospital practice. (10.1136/bmj.g6437)
- [L4] Specialists do not consider pain without paresthesia or a noncharacteristic symptom distribution as characteristic of carpal tunnel syndrome. (10.1016/j.jhsa.2024.07.004)
- [L5] Carpal tunnel syndrome can be an early manifestation of systemic amyloidosis, and implementation of a straightforward algorithm using biopsy samples during carpal tunnel release will allow for early diagnosis of these progressive and lethal diseases. (10.1016/j.jhsa.2025.07.017)
- [L5] The diagnosis of carpal tunnel syndrome should shift from a dichotomous, all-or-none approach to one that considers probabilities of disease, utilizing tools like the hand diagram and CTS 6 to form baseline probabilities and guide management based on estimated probability and severity. (10.1016/j.jhsa.2009.12.034)
- [L5] Ultrasonography is a very useful method in the diagnostic evaluation of carpal tunnel syndrome, capable of discovering the cause of median nerve compression, especially in cases with an atypical clinical presentation. (10.1007/s11552-012-9435-z)
- [L1] Successful treatment of carpal tunnel syndrome is commonly defined based on a patient-reported outcome measure (PROM), highlighting recent efforts to measure outcomes from the patient's perspective. (10.1177/1558944720949951)

- [L5] The authors argue that nonsurgical methods for mild to moderate carpal tunnel syndrome are effective and underused, emphasizing patient choice and the slight complications of conservative treatment compared to surgical risks. (10.1016/j.jhsa.2009.05.009)
- [L3] The long-term outcome of carpal tunnel release is favourable with a rate of recurrence of 2.5% and a rate of persistence of 3.75%. (10.1302/0301-620x.99b10.bjj-2016-0587.r2)
- [L2] Long-term improvement in patients with diabetes remained after carpal tunnel release to the same extent as for patients without diabetes. (10.1016/j.jhsa.2014.01.012)
- [L5] Universal acceptance of diagnostic criteria for carpal tunnel syndrome remains elusive without prospective controlled studies verifying improved performance. (10.1016/j.jhsa.2012.07.041)
- [L4] Ultrasound-guided carpal tunnel release quickly improves hand function and reduces hand discomfort; improvement persisted beyond one year. (10.2214/ajr.20.24383)
- [L4] At an average follow-up of 4.5 years, 28% of hands had persistent symptoms, but results were scarcely different from the conventional technique with no patient requiring reoperation. (10.1054/jhsb.1999.0226)
- [L4] The altered hand dynamics in CTS patients may have implications for the pathophysiology and clinical evaluation of CTS, and ultrasound-based classification models may further support the diagnosis of CTS. (10.1002/mus.23246)
- [L5] The authors state that idiopathic median neuropathy at the carpal tunnel acts more like a steadily and inevitably progressive disease than a self-limiting one, and that hand surgeons are at their best when treating objective pathophysiology with evidence-based disease modifying treatments. (10.1177/1753193414526674)
- [L5] Delayed carpal tunnel syndrome is typically due to alterations in carpal tunnel anatomy and requires etiology-specific treatment. (10.1016/j.hcl.2017.09.003)
- [L2] Symptoms and signs characteristic of carpal tunnel syndrome significantly, but incompletely coincided with electrophysiological testing. (10.1177/1753193412461860)
- [L5] There is a severe discordance between the estimated prevalence of mild-to-moderate carpal tunnel syndrome based on clinical signs and symptoms (73%) versus electrodiagnostic studies and ultrasound (51%), calling into question whether clinicians can confidently diagnose patients with mild-to-moderate CTS. (10.1097/corr.0000000000002822)
- [L4] This case highlights the importance of considering uncommon aetiologies in patients with atypical symptoms of carpal tunnel syndrome. (10.1177/17531934241227809)
- [L4] Carpal tunnel syndrome is the commonest peripheral nerve problem in the United Kingdom and is readily treatable if recognised early. (10.1136/bmj.39282.623553.ad)
- [L4] The diagnostic process to differentiate pronator syndrome from carpal tunnel syndrome remains a challenge due to overlapping symptoms and limited reliable information in the literature; this review provides a comprehensive clinical comparison to aid in establishing appropriate diagnosis and treatment. (10.3390/diagnostics12102433)
- [L1] The procedures provided similar symptom relief and hand strength and sensibility recovery, and were safe for patients with carpal tunnel syndrome. (10.1002/brb3.439)

- [L5] Effective management of recalcitrant carpal tunnel syndrome requires an accurate diagnosis and a comprehensive treatment strategy, as revision carpal tunnel release is less successful than primary release with up to 40% of patients having unfavorable outcomes. (10.5435/jaaos-d-18-00004)
- [Paper] Initial treatment for carpal tunnel syndrome generally is nonoperative, with the strongest evidence supporting bracing/splinting. (10.1016/j.ocl.2017.11.009)
- [L1] Both surgical and conservative interventions had treatment benefit in carpal tunnel syndrome. (10.1186/1749-799x-6-17)
- [L1] In people with carpal tunnel syndrome, steroid injection combined with splinting resulted in modestly greater reduction of symptoms, functional recovery, and improvement of nerve function at 12-week follow-up compared to steroid injection alone. (10.1016/j.apmr.2017.01.018)
- [L4] Local steroid injection for carpal tunnel syndrome has an overall success rate of 45% after a mean follow-up of 16 months. (10.1016/j.jhsa.2021.09.022)
- [L1] Both methods have equal efficacy in relieving symptoms of carpal tunnel syndrome. (10.1136/bmj.38863.632789.1f)
- [L2] Our findings support further evaluation of this combination as a method of conservative carpal tunnel syndrome treatment. (10.1016/j.apmr.2011.08.013)
- [L5] Corticosteroid injection is safe and effective for the temporary relief of carpal tunnel syndrome symptoms, but most patients will eventually require surgery for long-term control of their symptoms. (10.1016/j.jhsa.2008.06.023)
- [L5] Grading severity of carpal tunnel syndrome in the electrodiagnostic report, with the understanding that it is the median neuropathy being graded and not the syndrome, fulfills the obligation of electrodiagnostic physicians to provide the referring source with the best possible interpretation and synthesis of physiologic data regarding the degree of nerve pathology. (10.1002/mus.23824)
- [L4] This study confirms that patients undergoing revision open carpal tunnel decompression for recurrent carpal tunnel syndrome experience a significant improvement in function and health-related quality of life. (10.1177/1753193419875945)
- [L5] There is sufficient evidence for orthopaedic and hand surgeons to seriously consider using ultrasound as the first-line confirmatory diagnostic tool for carpal tunnel syndrome. (10.2106/jbjs.o.01067)
- [L5] The paper argues that evidence available to purchasers and clinicians attempting to manage demand for carpal tunnel decompression is usually sparse and rarely comprehensive, and that universally applied and validated measures for hand surgery outcomes are rarely available. (10.1054/jhsb.1999.0328)
- [L4] The outcome of carpal tunnel decompression syndrome is good in the majority of the cases, with open and endoscopic techniques providing similar results. (10.1054/jhsb.2002.0780)
- [L4] Transverse movement of the median nerve is most marked with forearm supination, irrespective of other changes in the kinetic chain. (10.1258/ht.2011.011017)
- [L2] MRI of patients 3 months after successful endoscopic carpal tunnel release does not demonstrate a discrete gap or separation in the flexor retinaculum overlying the median nerve but may be useful for evaluating median nerve morphology. (10.1016/j.jhsa.2012.11.013)

- [L3] High resolution ultrasound is a valid and accurate diagnostic modality in carpal tunnel syndrome and correlated to CTS severity. (10.1186/s12891-019-3010-5)
- [L3] These parameters might be useful in the future as an additional tool for diagnosing or assessing the biomechanics of CTS. (10.1002/jor.21562)
- [L3] The results provide some support for a causative association between wrist morphometry, as measured by the wrist index, and CTS, but this difference is too small to be of diagnostic value in clinical or epidemiological practice. (10.1177/1753193408090142)
- [L4] The authors suggest considering an infectious etiology in atypical carpal tunnel syndrome presentations or when symptoms persist after surgery. (10.1016/j.jhsa.2017.05.027)
- [L5] Space occupying lesions of the carpal tunnel may be easily missed, and a carpal tunnel view and ultrasound scanning in suspected cases is mandatory. (10.1007/s12593-012-0076-9)
- [L4] With clinical evaluation as the reference standard, electrodiagnostic, ultrasound, and MRI are not helpful in making a diagnosis of pronator syndrome concurrent with carpal tunnel syndrome. (10.1016/j.jhsa.2020.06.006)
- [L4] Imaging tests such as ultrasound and MRI, while having lower diagnostic accuracy than nerve conduction studies, are proving to be useful for explaining persistence of symptoms following surgical relief. (10.1038/ncpneuro0216)
- [L4] Amyloidosis diagnosis after carpal tunnel release is rare but is associated with poor outcomes. (10.2106/jbjs.20.02093)
- [L5] When carpal tunnel syndrome is suspected an ultrasound examination can confirm the diagnosis and uncover the underlying etiology, but nerve conduction studies may still be required. (10.1177/0883073810387299)
- [L4] The study demonstrates the value of routine sonographic assessment when evaluating patients with carpal tunnel syndrome. (10.1016/j.jhsg.2025.100903)
- [L4] In cases with swelling or tenderness on the area of wrist flexion creases, it is important to obtain a carpal tunnel view, and MRI and/or CT should be supplemented in order to rule out SOLs around the carpal tunnel, if necessary. (10.3349/ymj.2009.50.2.257)
- [L4] Wrist ratio was the only significant predictor in the logistic regression analysis. (10.1002/ca.23198)
- [L4] Carpal tunnel syndrome caused by a space occupying lesion is rare and more complicated than idiopathic carpal tunnel syndrome. (10.1177/1753193411414352)
- [L3] Preliminary data show that ultrasonography can be used as an ancillary diagnostic modality in patients with suspected CTS, with the cross-sectional area of the median nerve at the tunnel inlet being the most useful diagnostic criterion. (10.1177/1753193408090396)
- [L4] This new system that measures each finger's grip strength at one time and records the time course of grip motion could quantify a patient's symptoms easily and objectively, which may contribute to the evaluation of hand function. (10.1186/s13018-020-01773-9)
- [L3] For screening purposes, it was suggested that simple external hand or wrist measurements could be used to predict the tendency for carpal tunnel syndrome. (10.1016/j.apmr.2012.11.017)

- [L3] Obesity, diabetes, use of hand-held vibratory tools, and repeated forceful movements of the wrist and hand are causes of impaired median nerve function. (10.1186/1471-2474-14-240)
- [L4] Splints that immobilize the wrist in a functional position of extension do not minimize carpal tunnel pressure. (10.2106/00004623-199511000-00008)
- [L5] This review aims to provide a detailed description of the SSCT as an anatomical structure, its (biomechanical) contribution to the carpal tunnel and the relation with the surrounding tendons and nerve. (10.1016/j.jelekin.2017.10.007)
- [L3] This method of HHD reliably quantifies palmar thumb abduction strength but is more reliable with the same rater than with different raters. (10.1016/j.jht.2017.08.005)
- [L3] Carpal tunnel syndrome impairs the performance of precision pinch movement as indicated by the increased variability. (10.1016/j.jhsa.2008.02.030)
- [L3] According to a quantitative analysis of published scientific evidence, the etiology of carpal tunnel syndrome is largely structural, genetic, and biological, with environmental and occupational factors such as repetitive hand use playing a minor and more debatable role. (10.1016/j.jhsa.2008.01.004)
- [L3] Further studies are merited to determine if reduced median nerve excursion at the carpal tunnel is clinically relevant in CTS, and can be influenced by movement-based interventions. (10.1016/j.apmr.2007.02.015)
- [L5] The study validates a repeatable technique for measuring palmar thumb abduction strength with excellent nonparametric reliability, though large differences between raters and a lack of variability in the sample limit clinical utility and require further study with a larger, more diverse population. (10.1016/j.jht.2018.09.010)
- [L4] Patients with mild or moderate carpal tunnel syndrome experience a faster time to resolution of daytime numbness and tingling when compared with patients with severe carpal tunnel syndrome. (10.1177/1753193415576248)
- [L2] Clinical severity of carpal tunnel syndrome at intake is the most important factor in estimating symptom relief after surgical treatment. (10.1016/j.jhsa.2018.05.017)
- [L4] A significant correlation was found between patients with an incomplete release and lack of a symptom-free period after carpal tunnel release. (10.1016/s0749-0712(21)00315-2)
- [L4] Symptoms experienced outside of the median nerve distribution had a high likelihood of resolution after carpal tunnel release, with over 85% of symptoms in each of the anatomic zones studied resolving. (10.1016/j.jhsa.2009.04.024)
- [L3] Patients with severe CTS experience considerable reduction in symptoms after surgery but should be informed that recovery may be more prolonged and, in some cases, incomplete 1 year after carpal tunnel release, particularly with regard to numbness. (10.1016/j.jhsa.2014.12.012)

References

[1] Outcomes of Mini-Open Carpal Tunnel Release in Patients With Unrecordable Preoperative Nerve Conduction Potentials at a Minimum of 5 Years. *HAND*. 2019. DOI: 10.1177/1558944719857815 [3] What's

new in carpal tunnel syndrome? Commentary and personal opinions. *Journal of Hand Surgery (European Volume)*. 2022. DOI: 10.1177/17531934221080631 [4] Hand Pain and Sensory Deficits: Carpal Tunnel Syndrome. *Journal of Orthopaedic & Sports Physical Therapy*. 2019. DOI: 10.2519/jospt.2019.0301 [5] A 6-year outcome of patients who cancelled carpal tunnel surgery. *Journal of Hand Surgery (European Volume)*. 2011. DOI: 10.1177/1753193411410155 [7] Carpal Tunnel Syndrome: The Correlation between Outcome, Symptoms and Nerve Conduction Study Findings. *Journal of Hand Surgery*. 2001. DOI: 10.1054/jhsb.2001.0616 [8] AAOS Appropriate Use Criteria: Management of Carpal Tunnel Syndrome. *Journal of the American Academy of Orthopaedic Surgeons*. 2018. DOI: 10.5435/jaaos-d-17-00454 [9] Carpal Tunnel Syndrome. *Encyclopedia of the Neurological Sciences*. 2014. DOI: 10.1016/b978-0-12-385157-4.00652-7 [10] Management of Carpal Tunnel Syndrome. *Journal of the American Academy of Orthopaedic Surgeons*. 2018. DOI: 10.5435/jaaos-d-17-00451 [11] Practice parameter: Electrodiagnostic studies in carpal tunnel syndrome [RETIRED]. *Neurology*. 2002. DOI: 10.1212/wnl.58.11.1589 [12] The long-term follow-up of treatment with corticosteroid injections in patients with carpal tunnel syndrome. When are multiple injections indicated?. *Journal of Hand Surgery (European Volume)*. 2012. DOI: 10.1177/1753193412469580 [13] COMPLICATIONS OF NONOPERATIVE AND OPERATIVE TREATMENT OF CARPAL TUNNEL SYNDROME. *Hand Clinics*. 1996. DOI: 10.1016/s0749-0712(21)00316-4 [14] Carpal Tunnel Syndrome Surgery: What You Should Know. *Plastic and Reconstructive Surgery - Global Open*. 2020. DOI: 10.1097/gox.0000000000002692 [15] Carpal tunnel syndrome and work. *Best Practice & Research Clinical Rheumatology*. 2015. DOI: 10.1016/j.berh.2015.04.026 [16] Carpal Tunnel Syndrome Diagnosis. *Physical Medicine and Rehabilitation Clinics of North America*. 2014. DOI: 10.1016/j.pmr.2014.01.004 [17] Carpal tunnel syndrome. *BMJ*. 2014. DOI: 10.1136/bmj.g6437 [18] Variation in Interpretation of Provocative Tests for Carpal Tunnel Syndrome. *The Journal of Hand Surgery*. 2025. DOI: 10.1016/j.jhsa.2024.07.004 [20] Carpal Tunnel Syndrome: A Potential Early, Red-Flag Sign of Amyloidosis. *The Journal of Hand Surgery*. 2025. DOI: 10.1016/j.jhsa.2025.07.017 [21] Diagnosis of Carpal Tunnel Syndrome. *The Journal of Hand Surgery*. 2010. DOI: 10.1016/j.jhsa.2009.12.034 [22] Elongated muscle belly of the flexor digitorum superficial causing carpal tunnel syndrome. *HAND*. 2012. DOI: 10.1007/s11552-012-9435-z [23] Outcome Metrics in the Treatment of Carpal Tunnel Syndrome: A Systematic Review. *HAND*. 2020. DOI: 10.1177/1558944720949951 [24] In Justification of Nonsurgical Treatment for Carpal Tunnel Syndrome. *The Journal of Hand Surgery*. 2009. DOI: 10.1016/j.jhsa.2009.05.009 [26] Long-term outcome of carpal tunnel release surgery in patients with severe carpal tunnel syndrome. *The Bone & Joint Journal*. 2017. DOI: 10.1302/0301-620x.99b10.bjj-2016-0587.r2 [28] Carpal Tunnel Release in Patients With Diabetes: A 5-Year Follow-Up With Matched Controls. *The Journal of Hand Surgery*. 2014. DOI: 10.1016/j.jhsa.2014.01.012 [30] Ultrasound and MRI in Carpal Tunnel Syndrome: The Dilemma of Simplifying the Approach to a Complex Disease or Making Complex Assessments of a Simple Problem. *The Journal of Hand Surgery*. 2012. DOI: 10.1016/j.jhsa.2012.07.041 [31] Minimally Invasive Ultrasound-Guided Carpal Tunnel Release Improves Long-Term Clinical Outcomes in Carpal Tunnel Syndrome. *American Journal of Roentgenology*. 2021. DOI: 10.2214/ajr.20.24383 [32] Carpal Tunnel Release by the Agee Endoscopic Technique. *Journal of Hand Surgery*. 1999. DOI: 10.1054/jhsb.1999.0226 [34] Ultrasonographic assessment of longitudinal median nerve and hand flexor tendon dynamics in carpal tunnel syndrome. *Muscle & Nerve*. 2012. DOI: 10.1002/mus.23246 [36] Re: Becker SJE, Makanji HS and Ring D. Changes in treatment plan for carpal tunnel syndrome based on electrodignostic test results. J Hand Surg Eur. 2014, 39: 187–93. *Journal of Hand Surgery (European Volume)*. 2014. DOI: 10.1177/1753193414526674 [37] Carpal Tunnel Syndrome and Distal Radius Fractures. *Hand Clinics*. 2018. DOI: 10.1016/j.hcl.2017.09.003 [39] Correspondence between clinical presentation and electrophysiological testing for potential carpal tunnel

syndrome. *Journal of Hand Surgery (European Volume)*. 2012. DOI: 10.1177/1753193412461860 [40] CORR Insights®: Diagnosis of Mild-to-moderate Idiopathic Median Neuropathy at the Carpal Tunnel Based on Signs and Symptoms is Discordant From Diagnosis Based on Electrodiagnostic Studies and Ultrasound. *Clinical Orthopaedics & Related Research*. 2023. DOI: 10.1097/corr.0000000000002822 [41] Carpal tunnel syndrome caused by an interosseous ganglion of the lunate. *Journal of Hand Surgery (European Volume)*. 2024. DOI: 10.1177/17531934241227809 [42] Carpal tunnel syndrome. *BMJ*. 2007. DOI: 10.1136/bmj.39282.623553.ad [43] How to Differentiate Pronator Syndrome from Carpal Tunnel Syndrome: A Comprehensive Clinical Comparison. *Diagnostics*. 2022. DOI: 10.3390/diagnostics12102433 [44] Intraindividual comparison between open and endoscopic release in bilateral carpal tunnel syndrome: a meta-analysis of randomized controlled trials. *Brain and Behavior*. 2016. DOI: 10.1002/brb3.439 [45] Management of Recalcitrant Carpal Tunnel Syndrome. *Journal of the American Academy of Orthopaedic Surgeons*. 2019. DOI: 10.5435/jaaos-d-18-00004 [46] Carpal Tunnel Syndrome. *Orthopedic Clinics of North America*. 2018. DOI: 10.1016/j.ocl.2017.11.009 [47] Is surgical intervention more effective than non-surgical treatment for carpal tunnel syndrome? a systematic review. *Journal of Orthopaedic Surgery and Research*. 2011. DOI: 10.1186/1749-799x-6-17 [48] Efficacy of Combined Ultrasound-Guided Steroid Injection and Splinting in Patients With Carpal Tunnel Syndrome. *Archives of Physical Medicine and Rehabilitation*. 2017. DOI: 10.1016/j.apmr.2017.01.018 [49] Cross-Sectional Area of the Median Nerve as a Prognostic Indicator in Carpal Tunnel Syndrome Treated With Local Steroid Injection. *The Journal of Hand Surgery*. 2023. DOI: 10.1016/j.jhsa.2021.09.022 [50] Outcomes of endoscopic surgery compared with open surgery for carpal tunnel syndrome among employed patients: randomised controlled trial. *BMJ*. 2006. DOI: 10.1136/bmj.38863.632789.1f [52] The Comparative Effectiveness of Combined Lumbrical Muscle Splints and Stretches on Symptoms and Function in Carpal Tunnel Syndrome. *Archives of Physical Medicine and Rehabilitation*. 2012. DOI: 10.1016/j.apmr.2011.08.013 [54] Corticosteroid Injection for Carpal Tunnel Syndrome. *The Journal of Hand Surgery*. 2008. DOI: 10.1016/j.jhsa.2008.06.023 [56] Grading severity of carpal tunnel syndrome in electrodiagnostic reports: Why grading is recommended. *Muscle & Nerve*. 2013. DOI: 10.1002/mus.23824 [59] Decompression for recurrent carpal tunnel syndrome provides significant functional improvement and patient satisfaction. *Journal of Hand Surgery (European Volume)*. 2019. DOI: 10.1177/1753193419875945 [61] An Alternative Solution for the Diagnosis of Carpal Tunnel Syndrome. *The Journal of Bone and Joint Surgery-American Volume*. 2015. DOI: 10.2106/jbjs.o.01067 [62] Carpal Tunnel Syndrome: Reconciling “Demand Management” with Clinical Need. *Journal of Hand Surgery*. 2000. DOI: 10.1054/jhsb.1999.0328 [63] Pedicled Fat Flap Coverage of the Median Nerve after Failed Carpal Tunnel Decompression. *Journal of Hand Surgery*. 2002. DOI: 10.1054/jhsb.2002.0780 [64] Scientific study of the extent of transverse movement of the median nerve at the wrist during active wrist extension in static positions of the upper limb tension test one. *Hand Therapy*. 2011. DOI: 10.1258/ht.2011.011017 [65] Magnetic Resonance Imaging After Endoscopic Carpal Tunnel Release. *The Journal of Hand Surgery*. 2013. DOI: 10.1016/j.jhsa.2012.11.013 [66] Diagnostic potential of ultrasound in carpal tunnel syndrome with different etiologies: correlation of sonographic median nerve measures with electrodiagnostic severity. *BMC Musculoskeletal Disorders*. 2019. DOI: 10.1186/s12891-019-3010-5 [67] Median nerve deformation in differential finger motions: Ultrasonographic comparison of carpal tunnel syndrome patients and healthy controls. *Journal of Orthopaedic Research*. 2011. DOI: 10.1002/jor.21562 [68] Carpal Tunnel Syndrome: A Case–Control Study Evaluating Its Relationship with Body Mass Index and Hand and Wrist Measurements. *Journal of Hand Surgery (European Volume)*. 2008. DOI: 10.1177/1753193408090142 [69] Mycobacterium

marinum and Carpal Tunnel Syndrome: Three Case Reports. *The Journal of Hand Surgery*. 2017. DOI: 10.1016/j.jhsa.2017.05.027 [70] Carpal Tunnel Syndrome Due to Hydroxyapatite Crystal Deposition Disease. *Journal of Hand and Microsurgery*. 2013. DOI: 10.1007/s12593-012-0076-9 [71] Clinical, Radiological, and Electrodiagnostic Diagnosis of Pronator Syndrome Concurrent With Carpal Tunnel Syndrome. *The Journal of Hand Surgery*. 2020. DOI: 10.1016/j.jhsa.2020.06.006 [72] Diagnosing carpal tunnel syndrome—clinical criteria and ancillary tests. *Nature Clinical Practice Neurology*. 2006. DOI: 10.1038/ncpneuro0216 [73] Diagnosing Systemic Amyloidosis Presenting as Carpal Tunnel Syndrome. *Journal of Bone and Joint Surgery*. 2021. DOI: 10.2106/jbjs.20.02093 [74] Carpal Tunnel Syndrome Secondary to Ganglion Cyst in a Child. *Journal of Child Neurology*. 2011. DOI: 10.1177/0883073810387299 [75] The Reversed Palmaris Longus: Sonographic Findings and Anatomical Correlation With Implications for Carpal Tunnel Syndrome Diagnosis and Management. *Journal of Hand Surgery Global Online*. 2026. DOI: 10.1016/j.jhsg.2025.100903 [77] Carpal Tunnel Syndrome Caused by Space Occupying Lesions. *Yonsei Medical Journal*. 2009. DOI: 10.3349/ymj.2009.50.2.257 [79] High wrist ratio is a risk factor for carpal tunnel syndrome. *Clinical Anatomy*. 2018. DOI: 10.1002/ca.23198 [80] Unusual causes of carpal tunnel syndrome: space occupying lesions. *Journal of Hand Surgery (European Volume)*. 2011. DOI: 10.1177/1753193411414352 [81] The Usefulness of Ultrasonography in the Diagnosis of Carpal Tunnel Syndrome. *Journal of Hand Surgery (European Volume)*. 2008. DOI: 10.1177/1753193408090396 [82] Assessment of grip-motion characteristics in carpal tunnel syndrome patients using a novel finger grip dynamometer system. *Journal of Orthopaedic Surgery and Research*. 2020. DOI: 10.1186/s13018-020-01773-9 [83] Role of Anthropometric Characteristics in Idiopathic Carpal Tunnel Syndrome. *Archives of Physical Medicine and Rehabilitation*. 2013. DOI: 10.1016/j.apmr.2012.11.017 [84] Differences in risk factors for neurophysiologically confirmed carpal tunnel syndrome and illness with similar symptoms but normal median nerve function: a case–control study. *BMC Musculoskeletal Disorders*. 2013. DOI: 10.1186/1471-2474-14-240 [85] Position of the wrist associated with the lowest carpal-tunnel pressure. *The Journal of Bone & Joint Surgery*. 1995. DOI: 10.2106/00004623-199511000-00008 [86] The biomechanics of subsynovial connective tissue in health and its role in carpal tunnel syndrome. *Journal of Electromyography and Kinesiology*. 2018. DOI: 10.1016/j.jelekin.2017.10.007 [87] Intrarater and interrater reliability of a hand-held dynamometric technique to quantify palmar thumb abduction strength in individuals with and without carpal tunnel syndrome. *Journal of Hand Therapy*. 2018. DOI: 10.1016/j.jht.2017.08.005 [88] Variability of Precision Pinch Movements Caused by Carpal Tunnel Syndrome. *The Journal of Hand Surgery*. 2008. DOI: 10.1016/j.jhsa.2008.02.030 [89] The Quality and Strength of Evidence for Etiology: Example of Carpal Tunnel Syndrome. *The Journal of Hand Surgery*. 2008. DOI: 10.1016/j.jhsa.2008.01.004 [90] Reduced Longitudinal Excursion of the Median Nerve in Carpal Tunnel Syndrome. *Archives of Physical Medicine and Rehabilitation*. 2007. DOI: 10.1016/j.apmr.2007.02.015 [91] Clinical relevance commentary in response to: Intrarater and inter-rater reliability of a handheld dynamometric technique to quantify palmar thumb abduction strength in individuals with and without carpal tunnel syndrome. *Journal of Hand Therapy*. 2018. DOI: 10.1016/j.jht.2018.09.010 [92] Pre-operative electrodiagnostic testing predicts time to resolution of symptoms after carpal tunnel release. *Journal of Hand Surgery (European Volume)*. 2015. DOI: 10.1177/1753193415576248 [93] Predicting Clinical Outcome After Surgical Treatment in Patients With Carpal Tunnel Syndrome. *The Journal of Hand Surgery*. 2018. DOI: 10.1016/j.jhsa.2018.05.017 [94] REOPERATION FOR CARPAL TUNNEL SYNDROME. *Hand Clinics*. 1996. DOI: 10.1016/s0749-0712(21)00315-2 [95] Topographical Assessment of Symptom Resolution Following Open Carpal Tunnel Release. *The Journal of Hand Surgery*. 2009. DOI: 10.1016/j.jhsa.2009.04.024 [96] The Benefit of

Carpal Tunnel Release in Patients With Electrophysiologically Moderate and Severe Disease. *The Journal of Hand Surgery*. 2015. DOI: 10.1016/j.jhsa.2014.12.012

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