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Denervation procedure of the lateral epicondyle for refractory lateral epicondylitis

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Background: Lateral epicondylitis is the most common cause of lateral elbow pain in adults, and nonoperative treatment is the first-line management modality of choice. Pain refractory to conservative management may improve with surgical interventions involving extensor carpi radialis brevis débridement or denervation. This investigation was conducted to evaluate the long-term analgesic efficacy, incidence of postoperative sensory deficits, and postoperative elbow functionality in patients who underwent a denervation surgery of the posterior branch of the posterior cutaneous nerve of the forearm (PBPCNF) for refractory lateral epicondylitis.

Methods: This investigation was an institutional review board–approved, single-center, single-surgeon case series of 22 patients who underwent denervation surgery with an average final follow-up of 4.7 years. Inclusion criteria for surgery were a minimum of 6 months symptom duration refractory to conservative therapies, a minimum of 2 years clinical follow-up, and significant (70-80%) pain relief from the nerve block test. Visual Analog Scale pain and Single Assessment Numeric Evaluation scores were used to assess pain and function, respectively. The incidence of postoperative sensory deficits was evaluated via clinical exam.

Results: Compared to the preoperative average, the cohort's mean Visual Analog Scale pain was significantly decreased at all postoperative follow-up intervals, including 2 weeks, 1 year, and final average follow-up of 4.7 years. At the final follow-up, the mean Single Assessment Numeric Evaluation score was 98.8 ± 2.6, and one patient (4.5%), who reported the same sensory deficit preoperatively, reported postoperative sensory deficits.

Conclusion: The PBPCNF denervation procedure is a highly efficacious procedure for achieving long-term pain control in the treatment of refractory lateral epicondylitis. The PBPCNF denervation procedure affords patients a high level of postoperative functionality with a low incidence of sensory deficits.

Lateral epicondylitis, also known as tennis elbow, is a common cause of elbow pain. The annual incidence of lateral epicondylitis is 1-3% in the US, affecting both men and women equally.[33] Epicondylitis is a misnomer for this condition, as tennis elbow is a tendinosis injury, characterized by chronic degeneration of the common extensor tendon.[1] This tendinosis is thought to arise from activities that involve repetitive loading and wrist extension, bending or twisting, radial deviation, or forearm supination, such as in screwing motions, culminating in micro-tearing and incomplete repair.[13] Several risk factors have been associated with lateral epicondylitis, including smoking, obesity, repetitive movements for at least two hours daily, vigorous activity, such as managing physical loads over 20kg, history of rotator cuff pathology, De Quervain's tenosynovitis, carpal tunnel syndrome, and prolonged oral corticosteroid therapy.[15,31]

Lateral epicondylitis typically affects the origin of the common extensor muscles of the forearm, including the extensor carpi radialis brevis (ECRB), extensor digitorum, extensor digiti minimi and extensor carpi ulnaris at the level of the lateral epicondyle of the humerus. Histologic examination of the common extensor origin has revealed angiofibroblastic hyperplasia, collagen

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disorganization, and vascular hyperplasia, with a lack of inflammatory cells.[17,19,22] Magnetic resonance imaging can reveal intrasubstance tears, marked irregularity of the lateral epicondyle, calcifications, thickening and heterogeneity of the common extensor tendon, and can be a useful imaging modality for injury pathological characterization.[16]

Initial management of this condition typically involves nonoperative methods, with spontaneous recovery usually occurring within 1-2 years in 80-90% of the affected population.[10,11,14] Nonoperative management may consist of physical therapy with eccentric strengthening exercises of the wrist extensors, countertraction bracing, ice after activity, oral or topical NSAIDs. In some cases, clinicians may consider corticosteroid or platelet-rich plasma (PRP) injections. While local corticosteroid injections are commonly employed for their short-term analgesic effects, their long-term use has been associated with adverse outcomes, including diminished pain relief and grip strength,[24] along with well-documented side effects such as localized skin hypopigmentation, skin atrophy, tendon rupture, and infection.[7,21] PRP injections, which include both leukocyte-rich and leukocyte-poor formulations, have emerged as a potential solution to enhance tendon healing through the stimulation of growth factors. Despite encouraging results in preclinical trials,[18] a recent randomized controlled trial assessing the efficacy of PRP injections reported no significant improvements in pain or functionality when compared to control groups, regardless of leukocyte content, during an 8-week follow-up period.[36] Although activity modification and bracing are often first-line managements, with the goal of reducing mechanical stress to facilitate healing of the pathologic "angiofibroblastic" alterations of the ECRB tendon, pain that is nonresponsive or refractory after prolonged conservative treatment may require other treatment techniques.[22] Surgical treatment options include arthroscopic or open debiridement, release or repair of the ECRB, and posterior cutaneous nerve of the forearm (PBPCNF) denervation surgery.

Partial joint denervation has been shown to preserve joint function while reducing pain by interrupting afferent nerve pathways.[19] In a cadaveric study by Dellon,[12] the posterior branch of the PBPCNF was found to innervate the lateral epicondyle in 100% of specimens. Sasaki et al showed that an increase in perivascular sympathetic innervation accompanied with associated loss of sensory innervation at the undersurface of the ECRB may play a role in chronic tennis elbow.[28] A study conducted by Rose et al involving 30 denervated elbows with an average follow-up of 28 months showed a significant improvement in pain in patients with a positive preoperative diagnostic nerve block test prior to surgery.[27] A more recent study conducted by Satake et al reported 90% of the 15 elbows included in the study had significant pain improvement, with a follow-up of 30 months.[29]

This investigation was conducted to assess the analgesic efficacy, incidence of postoperative sensory deficits, and impacts on functionality of the PBPCNF denervation surgery for refractory tendinosis of the common extensor tendon, or lateral epicondylitis. The primary objective of this investigation was to assess and quantify the long-term pain control afforded by this denervation procedure in patients suffering from refractory lateral epicondylitis. As a secondary objective, we examined the incidence of postoperative residual sensory disturbances following the PBPCNF denervation procedure. With the incidence of residual sensory disturbance reported to be as high as 20%, we examined if this incidence may differ significantly across institutions and techniques and if the incidence may change with greater follow-up length.[22] As a tertiary objective, we assessed if patients experienced any limitations in elbow functionality following the denervation procedure.

Materials and methods

This investigation was an institutional review board–approved retrospective case series for patients treated with the PBPCNF denervation procedure. All included patients were treated by a single fellowship-trained orthopedic sports medicine surgeon at a high-volume shoulder and elbow practice.

The diagnosis of lateral epicondylitis was made using several common clinical assessments, including tenderness of the lateral epicondyle and pain on resisted long-finger extension. Following the failure of conservative management to eliminate or reduce pain to tolerable levels, the PBPCNF denervation procedure was considered for these patients. Prior to the procedure, all patients underwent a diagnostic and therapeutic nerve block injection, or "block test", of the posterior branch of the PBPCNF. As described by Rose et al, the nerve block test is comprised of 2.5 mL 1% lidocaine and 2.5 mL 0.25% bupivacaine and is administered 4 cm proximal to the lateral epicondyle of the humerus.[27] This diagnostic nerve block is used to confirm that the patient's pain is arising from lateral epicondylitis, and it thereby serves as a diagnostic measure to differentiate pain arising from the area of concern innervated by the PBPCNF vs. pain arising from other causes. The PBPCNF denervation procedure is only offered to those patients who exhibit significant pain relief, greater than 70%-80%, following administration of this block test. Postoperatively, a similar rehabilitation protocol as that described by Rose et al, is followed, with the slight modification that patients are allowed to return to full activity 4-6 weeks after surgery.[19]

Between 9/2013 – 4/2022, 27 patients underwent the PBPCNF denervation procedure for treatment of elbow pain due to lateral epicondylitis that was refractory to conservative management techniques, including physical therapy and local injections. All patients were managed conservatively with physical therapy, and 12 patients received a steroid injection. Failure of conservative management was defined symptomatic lateral epicondylitis present 6 months after initiation of conservative measures. Of these 27 patients, 22 met the inclusion criteria for this investigation, including minimum clinical follow-up of two years and significant pain reduction following the diagnostic nerve block test. Five patients from this cohort were excluded from our analysis. Two patients were excluded due to preexisting cognitive issues that complicated follow-up assessments, and three patients were lost to follow-up during the study period despite repeated attempts to establish follow-up. In the final cohort of 22 patients, the average age was 49.7 ± 8.0 years. 15 patients were male, and 7 were female. 10 procedures were completed on right elbows and 12 left. The average final follow-up length was 4.7 ± 2.7 years with a range of 2.0-10.4 years.

The primary outcome of interest in this investigation was Visual Analog Scale (VAS) pain. VAS pain is scored on a scale of 0 -10, with 0 indicative of no pain and 10 indicative of maximal pain. VAS pain scores were collected preoperatively and postoperatively at 2 weeks, 1 year, and at final follow-up for all 22 patients.

The secondary outcome of interest was the incidence of postoperative sensory deficits arising in the dermatome of the PBPCNF. Postoperative sensory deficits, if present, were identified and examined in follow-up appointments. Clinical assessment was conducted to elucidate if these sensory deficits were likely a complication of the PBPCNF procedure or if they likely arose due to extraneous causes. This determination was made by assessing the clinical presentation of any sensory deficits, closely examining if any dysesthesia or numbness was present in the proximal posterolateral elbow or forearm. Patient history was also used in this assessment, and patients were specifically asked about the temporal onset of these sensory deficits and if the sensory area

affected resembles that of the pain location of their lateral epicondylitis.

The tertiary outcome of interest was the Single Assessment Numeric Evaluation (SANE) score. The SANE score is a validated and reliable patient-reported outcome measure used to assess functionality across a spectrum of orthopedic pathologies.[23,25,32] The SANE score is scored on a scale of 0 to 100, with 100 being maximal functionality. The SANE score has been validated for assessment of numerous shoulder pathologies and has been shown to be strongly correlated with the American Shoulder and Elbow Surgeons score and Western Ontario Rotator Cuff Index.[34] The SANE score was assessed by asking patients: "What percentage of normal is your elbow, with 100% being normal?". We used the SANE score in this study to investigate if the PBPCNF procedure impacted patients' reporting of their upper extremity functionality. SANE scores were collected for all patients (22) at final follow-up.

In completing statistical analyses of the data, summary statistics, including means and standard deviations, were calculated, and hypothesis testing was completed using the Wilcoxon signed-rank test with the 95% confidence interval (CI) for the mean difference to assess for differences between preoperative and postoperative VAS pain scores at the multiple postoperative intervals. Alpha was set at 0.05 for all statistical tests. All statistical analyses were completed using R software (R Core Team Version 2022.07.1 + 554; R Foundation for Statistical Computing, Vienna, Austria).

Results

VAS Pain scores were collected at several intervals, including preoperatively and postoperatively at 2 weeks, 1 year, and at final follow-up with an average of 4.7 years. At the preoperative interval, the cohort's mean VAS pain score was 6.5 ± 1.3. At 2 weeks postoperative, mean VAS pain decreased to 1.0 ± 1.5 (95% CI = 4.9 - 6.1, $P < .001$). At 1 year postoperative, the mean VAS pain was 0.3 ± 0.8 (95% CI = 5.7 - 6.6; $P < .0001$). At final follow-up of average 4.7 years, the mean VAS pain was 0.1 ± 0.4 (95% CI = 5.9 - 6.8; $P < .001$). The VAS pain scores for all patients at all follow-up points are available in Table I.

At final follow-up, patients were interviewed and clinically assessed for any postoperative sensory deficits. 1 patient (4.5%) reported the presence of sensory deficits and was assessed in the clinic to identify if these deficits arose as a direct sequela of the PBPCNF procedure. This patient presented with sensory deficits of the posterolateral elbow and reported that these deficits were present prior to the PBPCNF procedure and had arisen following a previous injection for pain control. The presence or absence of postoperative sensory deficits at final follow-up for all patients are available in Table I.

The SANE score was assessed at final follow-up to elucidate if patients experienced any functional limitations or dysfunction postoperatively. At final follow-up, the patient cohort of 22 patients had a mean SANE score of 98.8 ± 2.6. The SANE scores for all patients at follow-up are available in Table I.

Discussion

Lateral epicondylitis is one of the most common causes of elbow pain in patients presenting with elbow pain in general, with annual incidence of 1-3% in the US affecting both men and women equally.[33] Conservative treatment remains to be the initial modality for management. Pain that is nonresponsive or refractory after several months of conservative treatment may require more invasive treatment techniques, including percutaneous ultrasonic tenotomy and percutaneous needle tenotomy, both of which have been shown to yield significant pain relief and improved daily function at 1 and 3 years postoperative.[2,4,30,35] However, percutaneous procedures have been shown to yield a higher complication rate than arthroscopic procedures.[26] Surgical treatment options include arthroscopic or open débridement or release of a portion of the ECRB, and denervation surgery.

In this study, VAS pain scores of 22 patients collected preoperatively and postoperatively at a final average follow-up of 4.7 years showed a significant decrease from 6.5 to 0.1, respectively. This finding is in accord with those of other studies and illustrates that the PBPCNF neurectomy procedure provides substantial long-term pain control for patients suffering from refractory lateral epicondylitis. Rose *et al* assessed 30 denervated elbows preoperatively and postoperatively with mean follow-up of 34 months and found a significant decrease in average VAS pain, decreasing from an average of 7.9 to 1.9, respectively.[27] Moreover, a study conducted by Berry *et al* compared the VAS pain scale ranges within patients undergoing either an epicondylectomy alone (17 patients, mean follow-up of 7.5 months), a combined epicondylectomy and neurectomy (7 patients, mean follow-up of 16.0 months), or a neurectomy alone (6 patients, mean follow-up of 16.3 months).[5] They found that patients treated with denervation alone improved significantly more than those who underwent epicondylectomy with a mean VAS of 0.5 versus 5.1, respectively. The combined epicondylectomy and neurectomy procedure did not yield significantly different outcomes than the epicondylectomy alone, with a mean VAS of 1.3 versus 5.1, respectively. In addition, postoperative recovery from the denervation procedure alone was shown to be significantly faster than that of the epicondylectomy alone, with average return to work of 41 days versus 125 days, respectively.[8] Therefore, there are certain advantages in utilizing the denervation procedure, and this investigation provides long-term follow-up data illustrating longitudinal pain-control for refractory lateral epicondylitis.

In our secondary objective, we examined the incidence of postoperative sensory deficits following the PBPCNF denervation procedure. We found that 1 of 22 patients (4.5%) in this cohort reported postoperative sensory deficits at final follow-up time of 4.7 years. Of note, this patient reported that the sensory deficits were present prior to the procedure and arose from a previous ultrasound-guided needle tendon débridement which failed to provide pain control. Although this procedure has demonstrated some success in enhancing short-term pain relief and functional outcomes, Boden et al reported that 20% of their study cohort experienced persistent pain necessitating surgical intervention,[6] while Chalian et al observed a 10% surgical intervention rate after the initial treatment with ultrasound-guided percutaneous needle tenotomy procedure in their cohort.[9] Nevertheless, the low incidence of postoperative sensory deficits illustrated here is in accord with our expectations, as denervation involves transection of the PBPCNF and keeps the cutaneous component intact.[17]

Our results are similar to those of other studies examining neurectomy in treating lateral epicondylitis and provide longer follow-up data to further support the findings of previous investigators. Rose *et al* showed 5 out of 30 patients (16.7%) in their study on PBPCNF denervation developed dysesthesias in the posterolateral forearm that completely resolved in 80% of those affected within 3 months postoperatively.[27] Additionally, Satake *et al* observed sensory disturbance in the distribution of the PBPCNF in approximately 9 out of 10 cases, with resolution of the dysesthesia in an average of 12.2 months.[29] Bateman et al showed that denervation of the lateral epicondyle had a high margin of safety and resulted in no sensory complications with an average follow-up time of 21 months in addition to significantly improving perioperative pain.[3] Therefore, the denervation procedure to treat

Table I
Demographic data and outcomes.

Patient no.	Age	Sex	Laterality	Follow-up (months)	VAS pain score				Sensory disturbance	SANE score
					Preop	2 Weeks postop	1 Year postop	Final follow-up		
1	55	M	L	108	5	2	0	0	No	100
2	50	M	R	98	8	2	0	0	No	100
3	52	M	L	95	5	3	0	0	No	100
4	53	M	R	93	4	4	0	0	No	100
5	56	M	R	80	5	0	0	0	No	100
6	67	F	L	77	7	0	0	0	No	100
7	47	M	L	67	9	0	0	0	No	100
8	59	M	L	65	7	0	0	0	No	100
9	44	F	L	59	8	1	3	0	No	90
10	46	F	R	56	6	2	2	0	No	95
11	46	M	R	51	7	5	0	0	No	100
12	55	F	R	47	6	1	0	0	No	100
13	37	M	R	32	5	1	2	2	Yes	95
14	49	F	R	28	8	0	0	0	No	99
15	50	F	L	25	7	0	0	0	No	100
16	58	M	R	25	7	0	0	0	No	100
17	39	M	L	24	6	0	0	0	No	100
18	53	F	L	125	7	0	0	0	No	100
19	58	M	R	24	7	0	0	0	No	100
20	39	M	L	24	6	0	0	0	No	100
21	45	M	L	24	7	0	0	0	No	95
22	35	M	L	24	5	0	0	0	No	100

Preop, preoperative; *postop*, postoperative; *VAS*, visual analog scale; *SANE*, single assessment numeric evaluation.

refractory lateral epicondylitis has been shown to be a highly efficacious procedure for long-term analgesia and does not result in postoperative sensory deficits.

Percutaneous release of the extensor origin showed no loss of sensation or neuroma-type pain for 30 elbows in 24 patients with an average of 36 months of follow-up.[20] 1 of the 22 patients in our study reported sensory deficits, consisting of dysesthesia in the posterior lateral elbow that was present prior to the operation, not consistent with this procedure. This patient was evaluated by the senior author, and clinical examination elucidated that the dermal distribution of the sensory deficits was in a nonanatomical distribution. From our results, denervation of the PBPCNF has proven to be a highly effective treatment for lateral epicondylitis with significant pain reduction observed in 100% of our patients and zero instances of dysesthesias secondary to neurectomy in the follow-up period of 4.7 years.

Lastly, this investigation demonstrates that the PBPCNF denervation procedure allows patients to retain a high level of functionality of their elbow. The SANE score was used as a measurement to elucidate if patients experienced dysfunction following denervation for lateral epicondylitis. The SANE score is a patient reported measure of function based on each individual's perception of normal that is highly correlated with clinical improvement following shoulder and elbow surgery.[20] Shoulder dysfunction resulting from disuse following distal upper extremity injuries has been previously investigated in patients with hand injuries.[28] However, recent evaluation of patients with lateral epicondylitis has been found to have shoulder dysfunction secondary to weakness because of these injuries.[10] At final follow-up of 4.7 years, our patient cohort achieved a mean SANE score of 98.8, illustrating that patients do not experience loss of function or dysfunction following the PBPCNF denervation procedure.

This study does have several limitations. First, because this investigation is a case series, there was a lack of a control group. Also, there is a relatively small number of patients who met the final inclusion criteria. This study also lacked an elbow-specific scoring system to assess for specific functional outcome measures.

Conclusion

This investigation provides long-term follow-up examining the analgesic efficacy, incidence of postoperative sensory deficits, and postoperative functionality following the PBPCNF denervation procedure for refractory lateral epicondylitis. With an average final follow-up of 4.7 years, we provide extensive longitudinal data of our patient cohort of 22 patients. In accord with the findings of previous investigations, we have illustrated that the PBPCNF denervation procedure is a highly efficacious procedure, yielding substantial postoperative analgesia with a low incidence of postoperative sensory deficits and a high level of postoperative functionality.

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References

1. Ahmad Z, Siddiqui N, Malik SS, Abdus-Samee M, Tytherleigh-Strong G, Rushton N. Lateral epicondylitis: a review of pathology and management. Bone Joint J 2013;95-B:1158-64. https://doi.org/10.1302/0301-620X.95B9.29285.
2. Barnes DE, Beckley JM, Smith J. Percutaneous ultrasonic tenotomy for chronic elbow tendinosis: a prospective study. J Shoulder Elbow Surg 2015;24:67-73. https://doi.org/10.1016/j.jse.2014.07.017.
3. Bateman JE. Denervation of the elbow joint for the relief of pain; a preliminary report. J Bone Joint Surg Br 1948;30B:635-41.
4. Baumgard SH, Schwartz DR. Percutaneous release of the epicondylar muscles for humeral epicondylitis. Am J Sports Med 1982;10:233-6.
5. Berry N, Neumeister MW, Russell RC, Dellon AL. Epicondylectomy versus denervation for lateral humeral epicondylitis. Hand (N Y) 2011;6:174-8. https://doi.org/10.1007/s11552-011-9318-8.
6. Boden AL, Scott MT, Dalwadi PP, Mautner K, Mason RA, Gottschalk MB. Platelet-rich plasma versus Tenex in the treatment of medial and lateral epicondylitis. J Shoulder Elbow Surg 2019;28:112-9. https://doi.org/10.1016/j.jse.2018.08.032.
7. Brinks A, Koes BW, Volkers AC, Verhaar JA, Bierma-Zeinstra SM. Adverse effects of extra-articular corticosteroid injections: a systematic review. BMC Musculoskelet Disord 2010;11:206. https://doi.org/10.1186/1471-2474-11-206.

8. Budoff JE. The prevalence of rotator cuff weakness in patients with injured hands. J Hand Surg Am 2004;29:1154-9. https://doi.org/10.1016/j.jhsa.2004.06.006.
9. Chalian M, Nacey NC, Rawat U, Knight J, Lancaster T, Deal DN, et al. Ultrasound-guided percutaneous needle tenotomy using Tenex system for refractory lateral epicondylitis; short and long-term effectiveness and contributing factors. Skeletal Radiol 2021;50:2049-57. https://doi.org/10.1007/s00256-021-03778-9.
10. Chevinsky JD, Newman JM, Shah NV, Pancholi N, Holliman J, Sodhi N, et al. Trends and epidemiology of tennis-related sprains/strains in the United States, 2010 to 2016. Surg Technol Int 2017;31:333-8.
11. Degen RM, Conti MS, Camp CL, Altchek DW, Dines JS, Werner BC. Epidemiology and disease burden of lateral epicondylitis in the USA: analysis of 85,318 patients. HSS J 2018;14:9-14. https://doi.org/10.1007/s11420-017-9559-3.
12. Dellon AL. Partial joint denervation I: wrist, shoulder, and elbow. Plast Reconstr Surg 2009;123:197-207. https://doi.org/10.1097/PRS.0b013e31818cc23f.
13. Descatha A, Dale AM, Jaegers L, Herquelot E, Evanoff B. Self-reported physical exposure association with medial and lateral epicondylitis incidence in a large longitudinal study. Occup Environ Med 2013;70:670-3. https://doi.org/10.1136/oemed-2012-101341.
14. Hassebrock JD, Patel KA, Makovicka JL, Chung AS, Tummala SV, Hydrick TC, et al. Elbow injuries in national collegiate athletic association athletes: a 5-season epidemiological study. Orthop J Sports Med 2019;7:232596711 9861959. https://doi.org/10.1177/2325967119861959.
15. Herquelot E, Guéguen A, Roquelaure Y, Bodin J, Sérazin C, Ha C, et al. Work-related risk factors for incidence of lateral epicondylitis in a large working population. Scand J Work Environ Health 2013;39:578-88. https://doi.org/10.5271/sjweh.3380.
16. Jeon JY, Lee MH, Jeon I-H, Chung HW, Lee SH, Shin MJ. Lateral epicondylitis: associations of MR imaging and clinical assessments with treatment options in patients receiving conservative and arthroscopic managements. Eur Radiol 2018;28:972-81. https://doi.org/10.1007/s00330-017-5084-5.
17. Kannus P, Józsa L. Histopathological changes preceding spontaneous rupture of a tendon. A controlled study of 891 patients. J Bone Joint Surg Am 1991;73:1507-25.
18. Kaux JF, Drion P, Croisier JL, Crielaard JM. Tendinopathies and platelet-rich plasma (PRP): from pre-clinical experiments to therapeutic use. J Stem Cells Regen Med 2015;11:7-17. https://doi.org/10.46582/jsrm.1101003.
19. Kraushaar BS, Nirschl RP. Tendinosis of the elbow (tennis elbow). Clinical features and findings of histological, immunohistochemical, and electron microscopy studies. J Bone Joint Surg Am 1999;81:259-78.
20. Nazar M, Lipscombe S, Morapudi S, Tuvo G, Kebrle R, Marlow W, et al. Percutaneous tennis elbow release under local anaesthesia. Open Orthop J 2012;6:129-32. https://doi.org/10.2174/1874325001206010129.
21. Newman RJ. Local skin depigmentation due to corticosteroid injection. Br Med J (Clin Res Ed) 1984;288:1725-6.
22. Nirschl RP, Pettrone FA. Tennis elbow. The surgical treatment of lateral epicondylitis. J Bone Joint Surg Am 1979;61:832-9.
23. O'Connor CM, Ring D. Correlation of single assessment numeric evaluation (SANE) with other patient reported outcome measures (PROMs). Arch Bone Jt Surg 2019;7:303-6.
24. Olaussen M, Holmedal O, Lindbaek M, Brage S, Solvang H. Treating lateral epicondylitis with corticosteroid injections or non-electrotherapeutical physiotherapy: a systematic review. BMJ Open 2013;3:e003564. https://doi.org/10.1136/bmjopen-2013-003564.
25. Patel MS, Kirsch JM, Gutman MJ, McEntee RM, Alberta F, Ramsey ML, et al. Single assessment numeric evaluation correlates with American shoulder and elbow surgeons score for common elbow pathology: a retrospective cohort study. Am J Sports Med 2021;49:2771-7. https://doi.org/10.1177/03635465211024253.
26. Pomerantz ML. Complications of lateral epicondylar release. Orthop Clin North Am 2016;47:445-69. https://doi.org/10.1016/j.ocl.2015.10.002.
27. Rose NE, Forman SK, Dellon AL. Denervation of the lateral humeral epicondyle for treatment of chronic lateral epicondylitis. J Hand Surg Am 2013;38:344-9. https://doi.org/10.1016/j.jhsa.2012.10.033.
28. Sasaki K, Ohki G, Iba K, Kokai Y, Yamashita T, Wada T. Innervation pattern at the undersurface of the extensor carpi radialis brevis tendon in recalcitrant tennis elbow. J Orthop Sci 2013;18:528-35. https://doi.org/10.1007/s00776-013-0406-1.
29. Satake H, Honma R, Naganuma Y, Shibuya J, Takagi M. Strategy for the treatment of lateral epicondylitis of the elbow using denervation surgery. JSES Int 2019;4:21-4. https://doi.org/10.1016/j.jses.2019.10.102.
30. Seng C, Mohan PC, Koh SBJ, Howe TS, Lim YG, Lee BP, et al. Ultrasonic percutaneous tenotomy for recalcitrant lateral elbow tendinopathy: sustainability and sonographic progression at 3 years. Am J Sports Med 2016;44:504-10. https://doi.org/10.1177/0363546515612758.
31. Titchener AG, Fakis A, Tambe AA, Smith C, Hubbard RB, Clark DI. Risk factors in lateral epicondylitis (tennis elbow): a case-control study. J Hand Surg Eur Vol 2013;38:159-64. https://doi.org/10.1177/1753193412442464.
32. Torchia MT, Austin DC, Werth PM, Lucas AP, Moschetti WE, Jevsevar DS. A SANE approach to outcome collection? Comparing the performance of single- versus multiple-question patient-reported outcome measures after total hip arthroplasty. J Arthroplasty 2020;35(6S):S207-13. https://doi.org/10.1016/j.arth.2020.01.015.
33. Verhaar JA. Tennis elbow. Anatomical, epidemiological and therapeutic aspects. Int Orthop 1994;18:263-7.
34. Wickman JR, Lau BC, Scribani MB, Wittstein JR. Single Assessment Numeric Evaluation (SANE) correlates with American Shoulder and Elbow Surgeons score and Western Ontario Rotator Cuff index in patients undergoing arthroscopic rotator cuff repair. J Shoulder Elbow Surg 2020;29:363-9. https://doi.org/10.1016/j.jse.2019.07.013.
35. Yerger B, Turner T. Percutaneous extensor tenotomy for chronic tennis elbow: an office procedure. Orthopedics 1985;8:1261-3.
36. Yerlikaya M. Comparison of effects of leukocyte-rich and leukocyte-poor platelet-rich plasma on pain and functionality in patients with lateral epicondylitis. Arch Rheumatol 2018;33:73-9. https://doi.org/10.5606/ArchRheumatol.2018.6336.