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Strategy for the treatment of lateral epicondylitis of the elbow using denervation surgery

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Background: A number of treatments for lateral epicondylitis of the elbow have been described. We have developed a strategy for the treatment of this condition.
Methods: We diagnosed lateral epicondylitis of the elbow in 86 patients. Conservative treatment resulted in resolution in 71 patients. Surgery was required in the remaining 15 patients. If the posterior branch of the posterior cutaneous nerve of the forearm showed a positive response to local anesthesia (block test), we performed denervation surgery on the posterior branch of the posterior cutaneous nerve of the forearm. Patients were asked to rate the degree of pain and sensory disturbance using a visual analog scale; the 11-item version of the Disabilities of the Arm, Shoulder and Hand measure; and the Patient-Rated Elbow Evaluation.
Results: A positive response to the block test was seen in 10 elbows (67%). After denervation surgery, pain relief was seen in 9 of 10 elbows (90%). The mean follow-up period was 30.4 months. At final follow-up, the average scores on the visual analog scale, 11-item version of the Disabilities of the Arm, Shoulder and Hand, and Patient-Rated Elbow Evaluation were 4.3 mm, 10.45 points, and 5.9 points, respectively. In the early period after denervation surgery, sensory disturbance was observed in 9 cases (90%).
Conclusion: Our strategy of denervation surgery for lateral epicondylitis of the elbow was effective for pain relief among patients showing a positive response to the block test.

The guidelines for diagnosis of lateral epicondylitis of the elbow ("tennis elbow") stipulated by the Japanese Orthopaedic Association include a positive result on the resisted wrist extension test, tenderness predominantly of the lateral epicondyle, and absence of any radiohumeral joint disorder. The first choice of treatment is conservative therapy such as physiotherapy[2,10] or steroid injection.[7,8] However, surgical treatment is needed for patients in whom the condition is chronic or refractory. A review of the orthopedic literature indicates that at least 10 distinct surgical procedures have been used for the treatment of lateral epicondylitis. These techniques include open release[12] and arthroscopic release of the extensor carpi radialis brevis (ECRB) tendon,[1] as well as denervation,[6] depending on individual conditions. Although most forms of surgery offer a degree of pain relief, the outcome may occasionally be poor. After surgery involving repair or release of the ECRB tendon, a certain period is needed until tissue healing. On the other hand, denervation surgery offers early pain relief and does not require a rest period or rehabilitation.

Since 2013, denervation has been the primary choice for surgical treatment of lateral epicondylitis of the elbow in our department. In this study, we investigated the results of our strategy.

Materials and methods

We investigated 86 cases of lateral epicondylitis of the elbow diagnosed based on the Japanese guidelines between April 2013 and March 2017. Conservative therapy with wrist stretching was attempted first, and patients showing a poor response received steroid injection as the second choice. Poor responders to conservative therapy for 6 months underwent magnetic resonance imaging (MRI) and were scheduled for surgery. We evaluated degeneration and tearing of the ECRB tendon using T2-weighted and/or fat-suppression MRI on a 1.5-T system. Diagnostic subcutaneous mepivacaine injection 4 cm proximal to the lateral epicondyle, corresponding to the posterior cutaneous nerve of the forearm, was then performed using a 25-gauge needle. After

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Figure 1 A 4-cm incision is made 4 cm proximal to the lateral epicondyle of the left elbow. The posterior cutaneous nerve of the forearm (⟶) and the posterior branch of the posterior cutaneous nerve of the forearm (►) to the lateral epicondyle are detected in the subcutaneous fat. *PBCN*, posterior cutaneous nerve of the forearm; *RH*, radial head; *LE*, lateral epicondyle.

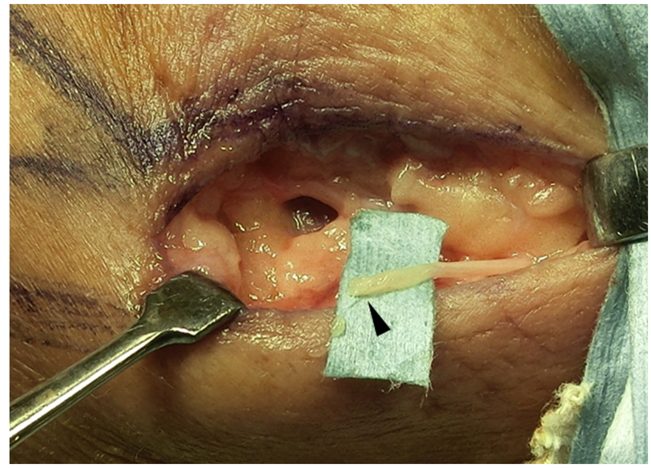

Figure 2 The posterior branch of the posterior cutaneous nerve of the forearm (►) is transected.

diagnostic injection, the degree of residual pain was self-assessed by each patient using a visual analog scale (VAS) comprising 100 gradation points. If the patient considered the nerve block test to have eased the pain satisfactorily, we recommended denervation surgery according to the methods of Dellon[3] and Rose et al.[15] A 4-cm incision was made 4 cm proximal to the lateral epicondyle (Video 1). The posterior cutaneous nerve of the forearm and the posterior branch of the posterior cutaneous nerve of the forearm (PBPCNF) to the lateral epicondyle were detected in the subcutaneous fat (Fig. 1). We injected 1% mepivacaine into the PBPCNF and transected the nerve (Fig. 2). A stump of the nerve was then embedded into the lateral head of the triceps muscle. If this procedure failed or if the block test elicited no response, we performed conventional arthroscopic release surgery for the ECRB tendon, open release of the common extensor tendon,[12] radial tunnel release, or radial nerve neurolysis.[14] After surgery, we carried out the resisted wrist extension test; assessed the degree of sensory disturbance using the brush and pinprick test; estimated residual pain using the VAS; and administered the 11-item version of the Disabilities of the Arm, Shoulder and Hand measure, as well as the Patient-Rated Elbow Evaluation.

Results

The success rate of conservative therapy was 83%, whereas surgery was needed in 17% of patients (Fig. 3). In 14 operative cases (100%) (1 case was not assessed), the ECRB tendon showed high signal intensity on MRI. The block test was effective in 10 elbows. The average VAS score for residual pain was 70.5 (range, 31-89) before the test and 21.2 (range, 5-52) after the test. Of the patients showing a positive response to the block test, all showed negative findings after the test. Conventional arthroscopic treatment was performed in 5 patients whose response to the block test was negative. Denervation surgery for the PBPCNF was performed in 10 elbows that had shown a positive response to the block test. Of these, 9 (90%) were improved by denervation surgery whereas 1 was not (Table I). None of the patients showing improvement after denervation surgery had pain on supination of the forearm. The patient showing no improvement received a diagnosis of radial tunnel syndrome associated with lateral epicondylitis and underwent reoperation. Arthroscopy revealed degenerative rupture of the ECRB and synovitis. Therefore, we performed débridement of the ECRB tendon and synovectomy and released the radial tunnel. Although the patient had pain relief thereafter, recurrence was seen 3 months later. Therefore, radial nerve neurolysis using the method of Roles and Maudsley[13] was performed, and the patient had no pain after 12 months. We were able to perform follow-up of the patients after denervation surgery for an average of 30.4 months (range, 24-60 months). The average scores on the VAS for pain, 11-item version of the Disabilities of the Arm, Shoulder and Hand measure, and Patient-Rated Elbow Evaluation were 4.3 mm (range, 0-23 mm), 10.45 points (range, 0-31.8 points), and 5.9 points (range, 0-26.7 points), respectively, at final follow-up. Sensory disturbance was observed in 9 cases (90%), but this disappeared in 7 cases (within 3 months in 4 cases and within 12 months in 3 cases). At the final follow-up point, 2 patients (20%) had residual sensory disturbance.

Discussion

Conservative treatment of lateral epicondylitis of the elbow is successful in most patients.[8] Various therapies have been advocated, but none have proved consistently effective. Physical therapy and steroid injection are 2 options for conservative treatment. In our series, the success rate of these treatments was 83%.

Nirschl[11] described this pathologic alteration of the ECRB as “angiofibroblastic tendinosis.” Nirschl and Pettrone[12] reported on open débridement and release of the extensor origin, whereas Baker et al[1] reported that arthroscopic release has the advantage of being less invasive. Lateral epicondylitis can be attributed to irritation or slight entrapment of the radial nerve fibers. Denervation surgery has been performed for lateral epicondylitis. The target of denervation has varied and included the articular branches of the radial nerve fibers,[6] the posterior antebrachial cutaneous nerve, or the collateral branch of the radial nerve.[18] Dellon[3] described PBPCNF denervation mainly for recurrent cases of lateral epicondylitis, and Rose et al[15] performed the same procedure in 30 primary cases, reporting effectiveness in 80% of patients. Our results support theirs.

Goldie[4] demonstrated microneuromata created by common extensor origin tears in the nerves that innervate the lateral epicondyle. Ljung et al[9] showed that nerve fibers associated with small vessels expressed neuropeptides such as substance P and calcitonin gene–related peptide in patients with lateral epicondylitis. Uchio et al[17] demonstrated that these neuropeptides as well as cytokines were expressed at the origin of the ECRB muscle. Nerve fibers showing positive immunoreactivity for neuropeptides were located

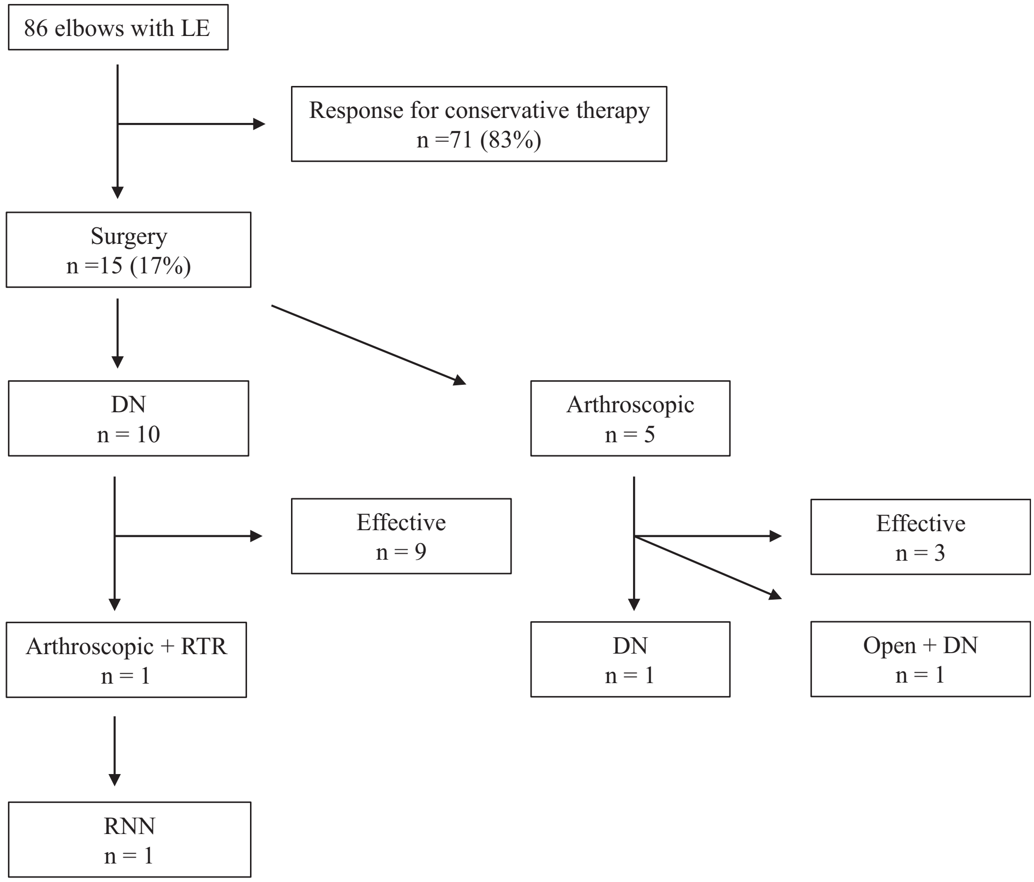

Figure 3 Flowchart of study. *LE*, lateral epicondylitis of elbow; *DN*, denervation; *Arthroscopic*, arthroscopic release of extensor carpi radialis brevis tendon; *RTR*, radial tunnel release; *Open*, open release of extensor carpi radialis brevis tendon; *RNN*, radial nerve neurolysis.

in a number of small vessels in their specimens. The pain associated with lateral epicondylitis may involve neurogenic factors, as nerve fibers associated with small vessels express neuropeptides in the absence of inflammatory cell infiltration. Thomsen[16] reported that initial inflammation of the muscles spread to the periosteum and that the resulting periostitis irritated the cutaneous antebrachial nerve, causing neuritis and pain. Denervation may therefore prevent pain sensation from reaching the central nervous system.

In our series, surgery was needed for 15 of 86 patients (17%) with lateral epicondylitis, and denervation surgery was indicated for 10 (67%) of those patients. This form of surgery was not indicated for all patients with chronic lateral epicondylitis. PBPCNF denervation was effective in 90% of patients who had a positive response to the subcutaneous upper-arm block test.

Rose et al[15] reported 5 failure cases (16.7%) with PBPCNF denervation surgery for lateral epicondylitis; 4 (13.3%) were

Table I
Demographic data

Case No.	Sex	Involved side	Age at surgery, yr	Duration of symptoms, mo	Postoperative follow-up, mo	VAS score, mm			MRI T2 high intensity	Sensory disturbance after surgery	Duration of sensory disturbance after surgery, mo	QuickDASH score, points	PREE score, points
						Preoperatively	After block test	At final follow-up					
1	M	R	61	31	60	50	18	0	+	+	12	15.9	0
2	F	R	59	6	24	31	7	0	+	−	−	0	2
3	F	R	63	38	38	80	5	0*	+	+	12	9.1*	0*
4	F	L	59	11	24	83	11	13	+	+	12	15.9	9.3
5	M	L	58	28	24	89	52	0	+	+	24†	15.9	8
6	M	L	72	65	29	76	17	7	+	+	29†	4.9	3.7
		R	72	65	29	80	5	23	+	+	12	31.8	26.7
7	M	R	50	6	28	75	32	0	‡	+	3	0	0
8	F	R	57	22	24	73	22	0	+	+	3	0	0
		L	58	9	24	68	43	0	+	+	3	11.4	9.3
Average			59.6	28.1	30.4	70.5	21.2	4.3			12.2	10.45	5.9

VAS, visual analog scale; *MRI*, magnetic resonance imaging; *QuickDASH*, 11-item version of Disabilities of the Arm, Shoulder and Hand; *PREE*, Patient-Rated Elbow Evaluation; *M*, male; *R*, right; *F*, female; *L*, left.
* After 3 operations.
† Remaining 20%.
‡ Not assessed.

identified as having radial tunnel syndrome. They performed radial tunnel decompression in these 4 patients, and 3 improved. In this series, we diagnosed lateral epicondylitis of the elbow in accordance with the Japanese guidelines. However, 1 patient (10%) received a diagnosis of radial tunnel syndrome associated with lateral epicondylitis after initial surgery. Roles and Maudsley[14] argued that the fibrous edge of the supinator muscle can cause entrapment neuropathy of the radial nerve, which can be relieved if the superficial part of this muscle is divided longitudinally. Jalovaara and Lindholm[5] performed decompression of the posterior interosseous nerve in 111 cases of lateral epicondylitis; 85% of cases showed improvement as a result. This finding suggests that entrapment of the posterior interosseous nerve might be a predominant cause of lateral epicondylitis.

Lateral epicondylitis of the elbow may not be improved in all cases with a single procedure. In this study, denervation was the first choice for surgery. However, it was not effective in 1 of the 10 cases. In 5 cases in which the nerve block test was not effective, arthroscopic surgery was performed, but 2 of these cases required reoperation. Our experience suggests that the surgical procedure required for lateral epicondylitis will vary depending on the individual condition of each patient. A variety of surgical and nonsurgical methods are available to treat lateral epicondylitis. Platelet-rich plasma (PRP) is one of the accepted treatments. Peerbooms et al[13] performed a study of 100 patients who were randomly assigned to PRP or corticosteroid injections for the treatment of lateral epicondylitis. Treatment with PRP significantly reduced pain and improved function compared with corticosteroid injections.

In this series, sensory disturbance was observed in 90% of cases, but this disappeared within 12 months in most of them and persisted slightly for 24 months in 2 cases. Therefore, sensory disturbance may be a disadvantage of this type of surgery.

This study had several limitations. First, it was based on a retrospective review of a small number of patients and lacked a control group. Second, there was little diagnostic evidence to distinguish lateral epicondylitis of the elbow from radial tunnel syndrome. Third, the follow-up period was relatively short, with an average of 30.4 months. Despite these limitations, denervation surgery for the PBPCNF may be one option for surgical treatment of lateral epicondylitis of the elbow among patients who show a positive response to the subcutaneous block test.

Conclusion

Although 83% of patients with lateral epicondylitis responded to conservative treatment, 17% had chronic symptoms develop and eventually required surgical intervention. Denervation surgery was indicated in 67% of the patients treated surgically. Our strategy using denervation surgery for lateral epicondylitis was effective for pain relief among patients with a positive response to the nerve block test.

Disclaimer

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Supplementary Data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jses.2019.10.102.

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