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Does use of the 70° arthroscope improve the outcomes of arthroscopic débridement for chronic recalcitrant tennis elbow?

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Background: The use of a 70° arthroscope has been reported to provide better visualization of the extensor carpi radialis brevis origin at the lateral epicondyle. We aimed to compare the surgical outcomes of arthroscopic débridement using an additional 70° arthroscope with those using a 30° arthroscope alone in the treatment of chronic recalcitrant tennis elbow.

Methods: A total of 68 consecutive patients who received arthroscopic débridement for chronic recalcitrant tennis elbow were retrospectively reviewed. A 30° scope was used in 41 patients (mean age, 47 years; range, 26-61 years), whereas an additional 70° scope was used in 27 patients (mean age, 50 years; range, 34-61 years). Outcomes were assessed using a visual analog scale for pain and the Quick Disabilities of the Arm, Shoulder and Hand questionnaire at the preoperative visit and at 3 months, 6 months, and 12 or more months after surgery.

Results: Both groups showed significant and progressive improvements in visual analog scale pain scores and Quick Disabilities of the Arm, Shoulder and Hand scores at 3 months, 6 months, and final follow-up ($P < .05$). However, no significant differences were found between the groups at all time points of measurement regarding those outcome measures ($P > .05$). In addition, the proportions of patients with excellent outcomes and those with clinically meaningful improvements were comparable between the groups ($P = .397$ and $P = .558$, respectively).

Conclusion: The use of an additional 70° arthroscope did not provide a significant improvement in the outcomes of arthroscopic débridement for chronic recalcitrant tennis elbow.

Level of evidence: Level III; Retrospective Cohort Design; Treatment Study

Keywords: Tennis elbow; arthroscopy; 70° arthroscope; comparative study; arthroscopic débridement; tendinopathy; QuickDASH

Tennis elbow is the most common disorder of the elbow joint.[24] Although its specific pathogenesis is still under investigation, it is essentially a degenerative process occurring at the bone-tendon interface, where the stress concentrates.[3,12] The natural course of tennis elbow is self-limiting in 80% to 90% of patients.[25] However, about a

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quarter of patients with tennis elbow experience severe pain and disability such that at least 1 activity such as dressing, carrying, driving, or sleeping was not possible.[28] Furthermore, patients who received steroid injections or who had a symptom duration of more than 6 months showed a worse prognosis.[6,22] Hence, patients with chronic severe symptoms but without responsiveness to conservative treatments have been considered candidates for surgical intervention.

The essential part of surgery for chronic tennis elbow is complete removal of the degenerated tissue at the enthesis of the extensor carpi radialis brevis (ECRB) tendon.[7,19] The arthroscopic débridement technique using a 30° arthroscope has been reported to provide successful outcomes, as well as several benefits such as rapid postoperative recovery and minimal invasiveness, compared with open techniques.[2,10,13,26] However, because the ECRB enthesis is located at the far lateral and extracapsular space of the elbow joint, it is obscured by the prominent capitellum and the radial lateral collateral ligament (RLCL) in the visual field of the 30° arthroscope; hence, a question has been raised regarding the ability of the arthroscopic technique with the 30° scope to remove the degenerated tissue in its entirety.[7] A recent study demonstrated that the use of an additional 70° scope provided a better, unhindered view that enables the surgeon to avoid RLCL injury and remove the degenerated enthesis completely.[1] However, no study has investigated whether arthroscopic débridement using an additional 70° arthroscope yields better outcomes than that using a 30° arthroscope alone in the treatment of chronic tennis elbow.

Therefore, we aimed to compare the surgical outcomes of arthroscopic débridement using an additional 70° arthroscope with those using a 30° arthroscope alone in the treatment of chronic recalcitrant tennis elbow. We hypothesized that the use of the additional 70° scope can provide greater clinical improvement compared with the use of the 30° scope alone.

Materials and methods

This was a retrospective comparative study on 2 arthroscopic techniques for treating chronic recalcitrant tennis elbow. We searched our institutional database for patients who underwent surgical treatment for chronic tennis elbow by a single surgeon from January 2011 to February 2017.

We made the diagnosis of tennis elbow based on the presence of tenderness to palpation at the ECRB origin of the lateral epicondyle and a positive Thomsen test. Additional routine physical examination included palpation of the soft spot and the lateral pivot-shift test to rule out other causes of lateral elbow pain such as radiohumeral plica syndrome or posterolateral rotatory instability (PLRI). Imaging studies including radiography and sonography were used for the differential diagnosis and for the confirmation of degenerative changes at the ECRB origin. The indications for surgery were unresponsiveness to conservative treatments for more than 3 months, symptom duration longer than 6 months, and severe pain (visual analog scale [VAS] pain score $\geq$ 5).

We excluded patients younger than 18 years and those with concomitant elbow lesions likely to affect elbow function, such as fracture or ligament injuries at the ipsilateral elbow, moderate to severe osteoarthritis of the elbow joint with large osteophytes and/or joint space narrowing, inflammatory arthritis of the elbow, and neurologic disorders with weakness of the ipsilateral upper extremity. We identified 82 consecutive patients who underwent arthroscopic débridement for the treatment of chronic recalcitrant tennis elbow. The arthroscopic technique varied depending on the timing of surgery. From January 2011 to November 2014, we only used the 30° arthroscopic technique for tennis elbow. We began to alternately use the 30° arthroscope technique alone and the technique with the additional 70° arthroscope from December 2014 to March 2015, and from April 2015 until now, we have been exclusively using the technique with the 30° arthroscope and the additional 70° arthroscope.

Of the 82 patients eligible for this study, 14 were excluded because of a short follow-up period (11 patients) or lateral ulnar collateral ligament (LUCL) insufficiency (3 patients), in whom lateral collateral ligament reconstruction was performed along with the Nirschl procedure. Thus, the study cohort comprised 68 elbows in 68 patients. The 30° group included 41 elbows in 41 patients with a mean age of 46.5 years (range, 41-75 years), 29 of whom were women. The 70° group consisted of 27 patients with a mean age of 49.8 years (range, 36-74 years), 16 of whom were women. There were no significant differences in demographic and clinical characteristics between the groups ($P > .05$, Tables I and II).

Arthroscopic techniques

Thirty-degree scope technique

Arthroscopic surgery was performed in a manner as previously described.[13] Under general or regional anesthesia, the patient was placed in the lateral decubitus position, and his or her upper arm was supported by a side bar, letting the elbow be flexed at 90° by gravity. After draping the elbow and inflating the tourniquet, we marked the anatomic landmarks and distended the joint through injection of 20 to 25 mL of saline solution. We established the proximal anteromedial portal as a viewing portal at 2 cm proximal to the medial epicondyle and 1 cm anterior to the medial intermuscular septum. We introduced a 2.9-mm 30° arthroscope (Linvatec, Largo, FL, USA) through the proximal anteromedial portal and made the proximal anterolateral (AL) portal at the level of the proximal margin of the capitellum using the outside-in technique under arthroscopic visualization. Joint distension was achieved with gravity inflow. We examined the anterior compartment of the elbow joint for pathologic lesions such capsule tear, articular cartilage degeneration, radiohumeral plicae, or PLRI. Then, we started to release the lateral joint capsule from the proximal margin of the capitellum using a 3.5-mm shaver (Linvatec) anterior to the imaginary border of the RLCL until the undersurface of the ECRB tendon was visualized (Fig. 1). At this point, only the anterior and distal parts of the ECRB tendon could be visualized because of the hindrance by the RLCL. Under arthroscopic visualization, we made an AL portal at the radiohumeral joint level and anterior to the radial head using the outside-in technique. We introduced a Freer elevator through the

Table I Demographic characteristics

Measure	30° group (n = 41)	70° group (n = 27)	*P* value
Age, mean (range), yr	46.5 (41-75)	49.8 (36-74)	.102
Male, n (%)	12 (71)	11 (59)	.433
Manual laborer, n (%)	17 (42)	5 (19)	.065
Height, mean ± SD, cm	162.5 ± 7	163.1 ± 7.8	>.760
Weight, mean ± SD, kg	63.2 ± 11.3	64.3 ± 12.5	>.690
Smoker, n (%)	10 (24)	4 (15)	.065
Dominant hand involvement, n (%)	30 (73)	17 (63)	.428
Symptom duration, mean (range), mo	20 (6-120)	15 (10-60)	.306
Local steroid injection, n (%)	34 (83)	22 (81.5)	>.999
Follow-up duration, mean (range), mo	25 (12-42)	21 (12-37)	.142
Workers' compensation, n (%)	0 (0)	0 (0)	NA
Concomitant upper-extremity lesions, n (%)	8 (20)	7 (26)	.562

SD, standard deviation; *NA*, not applicable.

AL portal to retract the joint capsule and extensor muscles and to secure extracapsular working space. We then advanced the arthroscope in the lateral and proximal direction following the ECRB tendon to achieve direct visualization of the ECRB origin. Tendinosis can typically be observed at and around the ECRB origin, resembling a lint, losing its shiny surface and parallel bundle alignment. Using a radiofrequency ablation device (ArthroCare, Sunnyvale, CA, USA) and the shaver, we started removing the tendinosis from the proximal and anterior edge of the ECRB footprint on the lateral epicondyle and proceeded in the posterior and distal direction, while taking care not to cross the midline of the radial head to avoid injuries to the LUCL. In many instances, however, we should blindly remove the part of the ECRB origin placed just posterior to the RLCL, the so-called around-the-corner area. We removed the radiohumeral plicae only when they were symptomatic, and we did not decorticate the lateral epicondyle. At the end of surgery, we checked elbow stability with the posterolateral drawer test and varus stress test. We repaired the skin incision and applied a bulky compressive dressing.

Seventy-degree scope technique

The 70° scope technique is essentially the same as the 30° scope technique until the step for creating the AL portal and inserting a Freer elevator. At that step, we switched the 30° scope to the 70° scope. The use of the 70° scope allowed the ECRB tendon and RLCL to be visualized in parallel as described in a prior study[1] such that the degenerated area of the ECRB origin could be fully visualized without being obscured by the RLCL (Fig. 1). When the borderline between the 2 structures was unclear, we dissected the borderline using a hook. In all cases, we could remove the whole ECRB origin under direct arthroscopic visualization without injury to the RLCL.

Postoperative protocol and outcome assessment

Patients started active range-of-motion exercise of the elbow on day 1 following surgery. On day 2, the bulky compressive dressing was changed to a light one. Stitches were removed on day 10 to 14. We encouraged patients to use their arms daily and during occupational activities as long as the amount of pain was tolerable.

An independent examiner blinded to the group category conducted the preoperative and postoperative assessments. Outcome measurements included VAS pain scores in 3 domains (average pain during the past week, during hard work, and at rest); the Quick Disabilities of the Arm, Shoulder and Hand (QuickDASH) questionnaire; and the lateral pivot-shift test or chair test for PLRI.[4] For VAS pain scoring, patients were asked to mark their level of pain on a 10-cm scale, ranging from 0 (no pain) to 10 (worst pain imaginable). The QuickDASH questionnaire is an 11-item questionnaire that was developed from the 30-item, full-length Disabilities of the Arm, Shoulder and Hand (DASH) questionnaire. Similarly to the DASH score, the QuickDASH score ranges from 0 to 100 points, with higher scores representing worse disability. A QuickDASH score of less than 20 points is considered to indicate the absence of functional disability. The QuickDASH questionnaire has been validated in various upper-extremity conditions, showing psychometric properties and precision for disability severity similar to those of the full-length DASH questionnaire. For analytical purposes, we defined an excellent outcome as a QuickDASH score of less than 20 points at the final measurement[13,26] and defined an improved state as a decrease in the QuickDASH score by at least 13.4

Table II Comparison of preoperative elbow function

Measure	30° group (n = 41)	70° group (n = 27)	*P* value
VAS pain score			
Mean	6.5 ± 1.9	6.6 ± 1.4	.678
Hard work	8.2 ± 1.6	8 ± 1.3	.436
Rest	4.2 ± 2.5	4.2 ± 2.5	.996
QuickDASH score, points	49 ± 18	55 ± 14	.116

VAS, visual analog scale; *QuickDASH*, Quick Disabilities of the Arm, Shoulder and Hand questionnaire.
Data are presented as mean ± standard deviation.

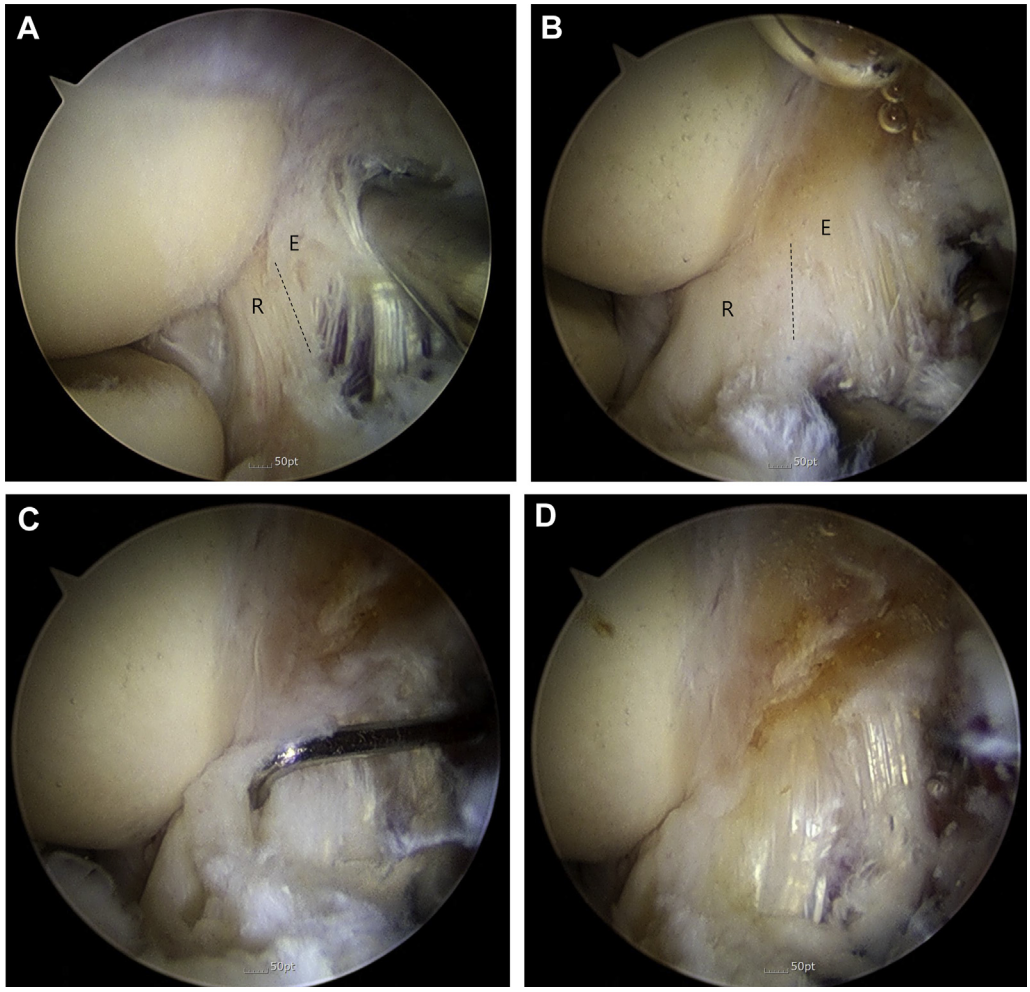

Figure 1 Arthroscopic views of left elbow during débridement for chronic recalcitrant tennis elbow. (**A**) Use of the 30° scope allowed only partial visualization of the extensor carpi radialis brevis (ECRB) origin (*E*) because it was obscured by the radial lateral collateral ligament (*R*) and prominent capitellum. The *dashed line* marks the border between the radial lateral collateral ligament and the ECRB origin. (**B**) The 70° scope, however, provided a parallel and separate view of the radial lateral collateral ligament (*R*) and the degenerated ECRB origin (*E*). The ECRB tendon looks dull and amorphous, losing its shiny surface and parallel fiber alignment. The *dashed line* marks the border between the radial lateral collateral ligament and the ECRB origin. (**C**) Dissecting the space between the radial lateral collateral ligament and the ECRB origin with a hook clarified the border between the 2 structures. (**D**) After débridement, the degenerated ECRB origin was cleared completely even from the around-the-corner area, and a shiny, healthy-looking tendon could be seen.

points from the preoperative measurement on the basis of the minimal clinically important difference for the QuickDASH score.[27]

Statistical methods

All data showed a Gaussian distribution according to the Kolmogorov-Smirnov test. To examine differences in clinical and demographic variables between the groups, we used the *t* test for continuous variables and χ^2 or Fisher exact test for dichotomous variables. To examine differences in outcomes between the 30° and 70° arthroscopic techniques and between the 4 time points, we used repeated-measures analysis of variance. In addition, as the proficiency level of arthroscopic techniques increased over time, possibly biasing the outcomes of comparative studies, we evaluated the effect of time of surgery on the outcomes of each arthroscopic technique using the Pearson correlation coefficient. We used SPSS software (version 23.0; IBM, Armonk, NY, USA). The level of significance was set at $P < .05$. We conducted a post hoc power analysis to calculate the sample size using the *t* test as a model (G*Power, version 3.1.3; University of Kiel, Kiel, Germany). We also used the Cohen *d*, which is the difference between 2 means divided by the standard deviation, to estimate effect sizes for power analysis. A Cohen *d* of 0.2 to less than 0.5 is considered a small effect size; 0.5 to less than 0.8, medium; and 0.8 or greater, large.[23] A sample size of 41 patients in the 30° group and 27 patients in the 70° group would have 51% power for detecting a medium effect size (Cohen *d* of 0.5 or QuickDASH score difference of 6.5 points) and 89% power for detecting a large effect size (Cohen *d* of 0.8 or QuickDASH score difference of 10.4 points).

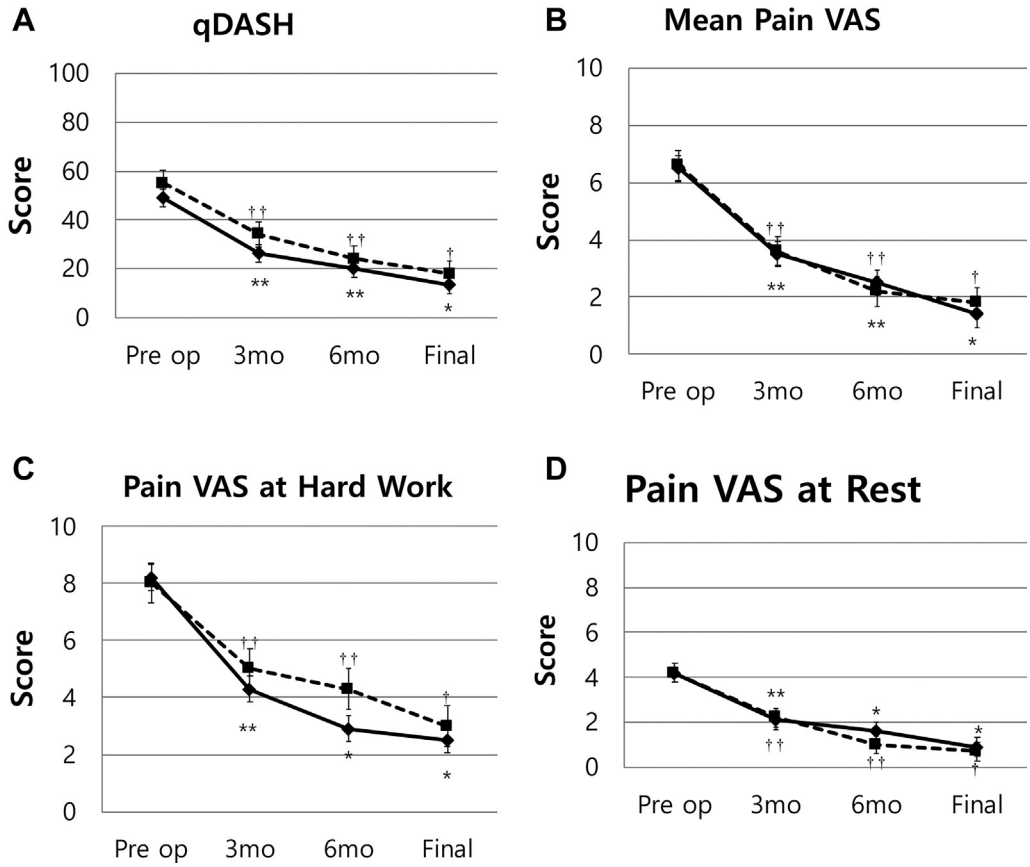

Figure 2 Temporal changes for Quick Disabilities of the Arm, Shoulder and Hand (*qDASH*) score (**A**), mean visual analog scale (*VAS*) score for pain (**B**), VAS score for pain during hard work (**C**), and VAS score for pain at rest (**D**) in 30° scope group (*solid lines*) and 70° scope group (*dashed lines*). The Quick Disabilities of the Arm, Shoulder and Hand and VAS pain scores significantly improved after arthroscopic débridement regardless of the technique, but the group differences were not significant ($P > .05$). The *error bars* indicate the standard error of the mean. *Significantly improved ($P < .05$) from preoperative (*Pre op*) measurement for 30° group. **Significantly improved ($P < .05$) from previous measurement for 30° group. †Significantly improved ($P < .05$) from preoperative measurement for 70° group. ††Significantly improved ($P < .05$) from previous measurement for 70° group.

Results

Both groups showed significant improvements in the QuickDASH score ($P < .001$) and VAS pain score in the 3 domains ($P < .001$) at 3 months, 6 months, and final follow-up after surgery compared with the scores at the preoperative evaluation (Fig. 2). The QuickDASH scores reached the lowest level at 6 months, and no significant improvement was found thereafter, although an improving trend could be observed to final follow-up. The VAS pain scores showed a similar trend of improvement, decreasing to their lowest level at 3 or 6 months depending on the domain measured. No significant differences were found between the groups regarding QuickDASH scores and VAS pain scores at each time point ($P > .05$, Fig. 2 and Table III). The proportion of patients with excellent outcomes (76% for the 30° group vs. 63% for the 70° group, $P = .558$) and those with clinically meaningful improvements (97% vs. 93%, $P = .397$) were not significantly different between the 30° and 70° groups (Table III). No significant correlations were noted between the time of surgery and the QuickDASH scores in the 70° group ($r = 0.304$, $P = .124$) and 30° group ($r = 0.121$, $P = .450$).

Concomitant intra-articular lesions were found in both groups (Table IV). The presence of capsular lesions, as described by Baker et al,[2] and the presence of osteoarthritic changes were not significantly different between the groups ($P = .603$ and $P = .533$, respectively). Radiohumeral plicae were observed in 2 patients in the 30° group vs. 6 patients in the 70° group ($P = .05$); 2 of these plicae were symptomatic and were removed during arthroscopic surgery. No complications such as infection, radial nerve palsy, or PLRI occurred.

Discussion

Arthroscopic débridement with the 30° arthroscope has been successful in the treatment of chronic recalcitrant tennis elbow. However, its limited visual field provides an

Table III Comparison of elbow function at final follow-up

Measure	30° group (n = 41)	70° group (n = 27)	*P* value
VAS pain score			
Mean	1.4 ± 1.5	1.8 ± 1.6	.293
Hard work	2.5 ± 1.9	3 ± 2	.245
Rest	0.9 ± 1.3	0.7 ± 1.2	.552
QuickDASH score, points	13 ± 13	18 ± 13	.161
Improved state	41 (97)	25 (93)	.558
Excellent outcome	31 (76)	17 (63)	.397

Data are presented as mean ± standard deviation or number (percentage).

Table IV Comparison of arthroscopic findings

Measure	30° group (n = 41), n	70° group (n = 27), n	*P* value
Capsule			.603
Baker type 1	26	19	
Baker type 2	13	8	
Baker type 3	2	0	
Osteoarthritis			.533
Grade 0	12	10	
Grade 1	10	5	
Grade 2	19	11	
Grade 3	0	1	
Plica	2	6	.05

overlapping view of the ECRB enthesis and RLCL, which makes it difficult to visualize the whole aspect of the ECRB enthesis and increases the risk of injury to the RLCL. The recently introduced 70° arthroscopic technique has been found to provide a better, separate view of the ECRB enthesis and RLCL, which enabled surgeons to remove the ECRB origin completely without injury to the RLCL. However, no study has investigated whether the 70° arthroscopic technique yields better outcomes than the 30° technique in the treatment of chronic recalcitrant tennis elbow. In this study, we found that the additional 70° arthroscopic technique did not provide a significant improvement in the outcomes of surgery for chronic recalcitrant tennis elbow compared with the 30° arthroscopic technique alone.

The findings in this study did not support our hypothesis that the 70° scope would yield better clinical outcomes by providing improved visualization of the ECRB origin. Arrigoni et al[1] demonstrated that the 70° scope allows complete visualization of the part of the ECRB origin located just posterior to the RLCL, the so-called around-the-corner area, which could not be seen with the 30° scope. As the remnant degenerated tissue could be a source of pain and dysfunction following surgery,[7] it would be reasonable to anticipate that use of the 70° scope could provide better removal of degenerated tissue in the around-the-corner area such that a greater improvement in pain and function could be achieved with the 70° scope than with the 30° scope. However, our study findings indicate that, although we did not measure the difference in the remnant degenerated tissue between the 2 techniques, the difference was not clinically important.

This conclusion, however, might be confounded by some factors. First, the QuickDASH score that we used is a region-specific questionnaire; despite being used for evaluating various elbow conditions in many studies,[15] it is not specific for elbow lesions and can be affected by the conditions at other anatomic sites in the upper extremities. However, the 70° and 30° groups showed comparable proportions of patients with upper-extremity conditions other than tennis elbow in this study. Second, a ceiling effect might be present such that the QuickDASH questionnaire failed to distinguish a small but important difference between the groups. However, because only 9 of 68 patients (13%) attained the best functional score, this study had no ceiling effect based on the 15% criterion.[17] Finally, as we started to use the 70° arthroscopic technique much later than the 30° technique, the level of proficiency of 1 surgeon might be lower for the 70° arthroscopic technique than for the 30° technique during the early transition period from the 30° to 70° arthroscope, which possibly biased the comparison of the outcomes in favor of the 30° technique. However, with the numbers available, we could not find any significant effects of time of surgery on the outcomes of either technique.

Another presumed advantage of the 70° scope is the reduction of the risk of PLRI because of its improved visual field.[1] The RLCL was found to play the same important role as the LUCL in preventing posterolateral instability of the elbow joint in cadaveric studies.[8,16] Therefore, the use of the 70° scope is expected to reduce PLRI by avoiding injury to the RLCL. However, in this study, we did not find any patients with significant PLRI in either group. In fact, iatrogenic PLRI is a very rare complication following arthroscopic débridement with the 30° scope.[11,18] Recent studies of arthroscopic débridement for chronic tennis elbow reported no PLRI regardless of the type of scope used.[1,13,14,26,29] This might be because the débridement procedure in these studies was kept strictly anterior to the coronal plane bisecting the radial head to protect the common origin of the RLCL and LUCL,[5] and an injury to the RLCL alone was not sufficient to generate PLRI.[8,21]

In this study, we found that the 70° scope did not provide faster improvement in the treatment of chronic tennis elbow than the 30° scope. The patients who

underwent the 30° and 70° scope techniques showed similar patterns of gradual improvement in the QuickDASH scores over the 6-month period following surgery, and these improving trends could be observed beyond 12 months to final follow-up. This finding is consistent with the findings of the study by Oki et al.[20] They reported a gradual but significant improvement in VAS pain scores, DASH scores, and grip strength in the first 3 months after arthroscopic débridement, and these trends were maintained up to 24 months.

The clinical outcomes of the 70° and 30° scope techniques in this study were in line with those of recent studies. Using the 70° scope, Arrigoni et al[1] reported a mean QuickDASH score of 20 points and good to excellent results in 84% of cases based on the Mayo Elbow Performance Score at a median follow-up of 24 months in a retrospective analysis of 18 patients. Kwon et al[13] found a significant improvement in the QuickDASH score from 47 to 13 points and excellent outcomes in 76% of cases at a mean of 28.5 months after arthroscopic débridement with the 30° scope in 55 patients. Yoon et al[29] showed significant improvements in the VAS pain score from 6.9 to 0.9 and Mayo Elbow Performance Score from 64 to 92 points, as well as an 82% satisfaction rate, at a mean follow-up of 27 months in a cohort of 45 patients who underwent arthroscopic débridement for chronic tennis elbow. Solheim et al[26] similarly demonstrated a significant improvement in the QuickDASH score from 60 to 12 points and excellent outcomes in 78% of cases at a mean of 49 months after arthroscopic débridement in 225 patients. Grewal et al[9] retrospectively analyzed 36 patients who underwent arthroscopic débridement for chronic tennis elbow and reported good to excellent results in 61% based on the Mayo Elbow Performance Index score and an increase in grip strength by a mean of 27% at a mean follow-up of 42 months. The latter 3 studies—although the scope type used was not specifically described—appeared to use the 30° scope. All of these studies reported no complications or a few minimal complications such as mild limitation of motion. Taken together, these findings indicate that the arthroscopic débridement technique, regardless of the scope type, is highly effective for chronic recalcitrant tennis elbow with minimal complications.

There are several limitations to this study. First, the retrospective nature and lack of a predefined study protocol in this study might introduce selection bias with respect to the choice of surgical technique. However, our chart review confirmed that, over the study period, consistent surgical indications were applied and the choice of surgical technique was not influenced by clinical or demographic factors. Second, the sample size of this study was relatively small, rendering the outcomes vulnerable to a type II error. A post hoc power analysis indicated that this study had adequate power for detecting a large effect size but inadequate power for detecting a medium effect size in the QuickDASH score.

Conclusion

We have demonstrated that arthroscopic débridement provided highly successful outcomes with the 70° and 30° scope techniques for chronic recalcitrant tennis elbow, and with the numbers available, both techniques were comparable regarding the clinical outcomes and rate of recovery. Thus, either technique can be a good choice for treating chronic recalcitrant tennis elbow. However, we prefer the 70° scope technique over the 30° scope technique because the former allows more targeted débridement and reduces the risk of injury to the RLCL. Future studies using a prospective randomized design and having a large sample size would be necessary to clarify the role of the 70° arthroscope in the treatment of chronic recalcitrant tennis elbow.

Disclaimer

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