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ELBOW

Extensor tendon release in tennis elbow: results and prognostic factors in 80 elbows

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Abstract
Purpose The objectives of this study were to evaluate the results in the outpatient treatment of recalcitrant lateral epicondylitis with release of the common extensor origin according to Hohmann and to determine any prognostic factors.
Methods Eighty tennis elbows in 77 patients with a characteristic history of activity-related pain at the lateral epicondyle interfering with the activities of daily living refractory to conservative care for at least 6 months and a confirmatory physical examination were included. Clinical outcome was evaluated using the QuickDASH score system. Data were collected before the operation and at the medians of 18 months (range 6–36 months; short term) and 4 years (range 3–6 years; medium term) postoperatively.
Results The mean QuickDASH was improved both at the short- and the medium-term follow-ups and did not change significantly between the follow-ups. At the final follow-up, the QuickDASH was improved in 78 out of 80 elbows and 81% was rated as excellent or good (QuickDASH <40 points). We found a weak correlation between residual symptoms (a high QuickDASH score) at the final follow-up and high level of baseline symptoms ($r = 0.388$), acute occurrence of symptoms ($r = 0.362$), long duration of symptoms ($r = 0.276$), female gender ($r = 0.269$) and young age ($r = 0.203$), whereas occurrence in dominant arm, a work-related cause or strenuous work did not correlate significantly with the outcome.
Conclusion Open lateral extensor release performed as outpatient surgery results in improved clinical outcome at both short- and medium-term follow-ups with few complications. High baseline disability, sudden occurrence of symptoms, long duration of symptoms, female gender and young age were found to be weak predictors of poor outcome.
Level of evidence Case series, Level IV.

Keywords Elbow · Tennis elbow · Lateral epicondylitis · DASH · Outcome study · Predictor variables

Introduction

Tennis elbow (TE)—also called lateral epicondylitis, epicondylosis, epicondylalgia or tendinopathy—is a common disorder of the elbow with a prevalence of 1–3% in the general population and 7% in manual workers [8, 28]. Previous studies have suggested a prevalence of 35–50% among tennis players [8, 28]. However, a recent prospective study in junior tennis players reported elbow injuries in 9% during the two studied years and found injuries to the ankle, shoulder or low back to be more common [18]. TE is occurring most often in the age group of 40–60 years—except in tennis players who are generally younger—and it affects men and women to the same degree [8, 20, 28]. In addition to age, risk factors for developing tennis elbow include repetitive and forceful motions of wrist and arm, participating in racket sports, using a faulty tennis playing technique and smoking tobacco [8].

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It has been claimed that conservative care leads to recovery in up to 90% of TE patients within 1–2 years and that surgery is indicated in less than 10% of the cases [5, 6, 25]. However, recent studies of patients with elbow complaints, including TE, in general practice report a less favourable prognosis [2, 17]. Bot and co-workers found that although 90% of all patients reported at least some improvement after 1 year of follow-up, only 13% of the patients reported full recovery at the 3-month follow-up and 34% at 12 months [2]. In patients with persisting pain and disability, surgery may be considered. Many different techniques have been described. However, at present no technique has been shown to lead to better results than the others. Few randomised studies have been reported, and many case studies are hampered by methodological shortcomings such as small study population, low percentage of follow-up and inclusion of cases with concomitant lesions in elbow, hand or shoulder [20]. The purpose of this study was to evaluate short-term (median 18 months after surgery) and medium-term (median 4 years after the surgery) results after open lateral release in recalcitrant tennis elbow and to determine any prognostic factors.

Materials and methods

Eighty-nine patients with 92 operated elbows met the criteria for inclusion in the study. Twelve patients did not agree to take part in the study. Thus, 77 patients (87%), 38 male and 39 female, with 80 operated elbows were available for analyses. The median patient age at the time of surgery was 46 years (range, 34–64 years).

Patients with a characteristic history of activity-related pain at the lateral epicondyle interfering with the activities of daily living refractory to conservative care for at least 6 months and a confirmatory physical examination that included palpable tenderness over the extensor tendon insertion, provoked pain with resisted wrist and third digit extension, normal range of movement of the elbow, normal neurological status, normal ligamentous laxity tests and no radiographic joint derangement were included in the study. Exclusion criteria were restricted range of movement, neurologic deficits, ligamentous instability, previous surgery in the elbow, fracture sequelae, chondral or osteochondral lesions, osteoarthritis or loose bodies.

Evaluation of the results

Clinical outcome was evaluated by the 11-item disability/symptom subset of Disabilities of the Arm, Shoulder and Hand Outcome Measure (DASH) named QuickDASH [1]. Data were collected before the operation and at the medians of 18 months (range, 6–36 months; short term) and 4 years (range, 3–6 years; medium term) postoperatively. We rated the QuickDASH outcome at the last follow-up as excellent (<20 points), good (20–39 points), fair (40–60 points) or poor (>60 points) [26]. The patient's profession was classified as strenuous or non-strenuous with respect to the upper extremities [16].

Surgical technique

The surgery was carried out in an outpatient surgery unit in combined general anaesthesia and local anaesthesia subcutaneously with the patient placed supine with a standard technique similar to that described by Verhaar and co-workers [33]. A tourniquet was not used. A gently curved incision approximately four centimetres long was made directly over the lateral epicondyle. The extensor origin was exposed, divided transversely close to its attachment on the lateral epicondyle and allowed to retract distally [33]. The joint capsule was released along with the extensor origin, and a small incision was made through the synovial membrane allowing inspection of the joint [33]. Decortication of the bone at the attachment site at the lateral epicondyle was performed with an osteotome. The subcutaneous tissue and skin were sutured and a compression bandage applied.

Rehabilitation

The arm was rested in a sling for 2 weeks. Rehabilitation consisted of early active range of motion and eventual return to full activity as tolerated. Heavy or repetitive manual work was discouraged for 6 weeks.

Statistical analyses

The statistical analyses were made with the Statistical Package for the Social Sciences (SPSS Inc., Chicago, Illinois, USA) on a personal computer. As measures of central location and spread of data, mean and SD or median and range were calculated. Repeated measures one-way ANOVA was used to compare the QuickDASH scores at different points in time. Multiple regression was used to explore the relationship (regression model) between QuickDASH at the final follow-up (dependent variable) and a combination of possible predictor variables; baseline QuickDASH, sex, age, occurrence in dominant or non-dominant arm, duration of symptoms, sudden or gradual onset of symptoms, work-related cause, strenuous or non-strenuous work and/or occupation. A P value <0.05 was considered significant.

Results

The median duration of symptoms was 13 months (range, 6–72 months). Fifty-five patients had experienced symptoms

for 12 months or more. The onset of symptoms was sudden in 9 patients. Twenty-six patients considered their work as the main cause of the elbow problem, whereas 2 patients related their problem to sporting activities. None of the patients played tennis on a regular basis. Twenty-three patients had occupations classified as strenuous according to Haahr et al. [16].

Fifty-five right elbows and 25 left elbows were operated upon. The dominant elbow was involved in 71%. We did not observe macroscopic ruptures or other convincingly grossly pathologic changes in the extensor origin or internal derangement of the joint such as chondral or osteochondral lesions, osteoarthritis or loose bodies. Major complications such as deep infection, permanent nerve injuries or stiffness of the elbow were not observed. Superficial wound problem/infection was seen in three patients, and a postoperative haematoma was evacuated in one patient. In three patients, revision surgery was carried out due to lack of improvement during the observation period.

The mean QuickDASH was significantly improved compared with baseline both at the median 18-month and the median 4-year follow-ups (Table 1). No significant difference was found in mean QuickDASH between the short-term and the medium-term follow-ups. An improvement of the QuickDASH at the final follow-up compared with the baseline was observed in 78 of 80 (97.5%) elbows. We rated the QuickDASH outcome according to Phillips et al. [26] as excellent in 58 of 80 elbows; good in 7 elbows, fair in 11 elbows and poor in 4 elbows.

We found a moderate correlation between the short-term and the medium-term results for the QuickDASH ($r = 0.691$; $P < 0.001$). We found a weak correlation between the QuickDASH at the final follow-up (a high value denotes residual symptoms) and baseline QuickDASH ($r = 0.388$; $P < 0.001$), acute occurrence of symptoms ($r = 0.362$; $P < 0.001$), duration of symptoms ($r = 0.276$; $P = 0.007$), female gender of patient ($r = 0.269$; $P = 0.009$) and age of patient ($r = -0.203$; $P = 0.04$). We found no significant correlation between the QuickDASH at the final follow-up and affection of dominant (vs. non-dominant) arm, a work-related cause (as evaluated by the patient) or strenuous (vs. non-strenuous) work and/or occupation. Thus, the latter variables were excluded in the stepwise regression analyses. The linear regression line equation was as follows: (QuickDASH at final follow-up) = 15.335 + 0.247 (baseline QuickDASH) + 17.845 (acute occurrence) + 0.388 (duration) + 4.057 (female gender) − 0.440 (age) ($P < 0.001$). The overall model R^2 was 0.338. The P value for the regression was <0.001.

Table 1 The mean value ± SD of the QuickDASH [from 0 (best) to 100 (worst)] before the operation and at the short- and medium-term follow-ups

	QuickDASH	P value*
Preoperative	61 ± 16	
Median 18-month follow-up	17 ± 20	$P < 0.001$
Median 4-year follow-up	18 ± 19	$P < 0.001$

* In comparison with preoperative data

Discussion

Tennis elbow is generally believed to be caused by repetitive mechanical load of the elbow while using a forceful hand grip leading to an overuse injury of the extensor tendons insertion. The condition has often been called epicondylitis but histologic examinations have failed to demonstrate inflammatory cells. The pathogenesis is believed to be cumulative microtrauma exceeding the tissue's capacity for repair leading to a degenerative process characterised by disruption of tendon fibres, invasion of fibroblasts, disorganised collagen and vascular hyperplasia [5, 25]. Recent studies suggest the neovascularisation represents a healing response [4]. Macroscopically, the findings reported by different authors vary greatly and include little or no grossly pathologic findings [3, 30, 33]; 'greyish, immature scar tissue which appears shiny, oedematous and friable' [25]; and partial or total rupture of the extensor tendon origin [5]—possibly reflecting different stages of a degenerative process. Swedish studies during the last decade have suggested that the pain in tennis elbow—as in achilles and patellar tendinosis—is caused by a so-called neurogenic inflammation mediated through neuropeptides such as substance-P and calcitonin gene regulated peptide [13, 23, 36].

Most surgical techniques aim to provide one or more of the following: relieve the stress at the tendons insertion by a release of the common extensor origin [19, 33]; removal of the degenerative tissue [25]; or stimulating repair by decortication of bone at the insertion site [25, 33]. A lateral release is performed by an open, mini-open or percutaneous approach. The latter approach may result in shorter rehabilitation [10].

The results after open surgery with recalcitrant TE have been reviewed by meta-analyses recently [20, 24]. While the different studies constituting the meta-analyses cannot be directly compared, the surgical success rates for the open technique have been reported to be between 19 and 100% with a mean of 80.4% [20]. Thus, the results of our study—81% was rated as excellent or good at the final median 4-year follow-up—seem to be in accordance with the typical outcome after open surgery. In the present study, the QuickDASH 11-item disability/symptom section of the original DASH questionnaire was used [1]. The QuickDASH is a more efficient version of the DASH outcome measure that appears to retain its measurement properties and can be

used instead of the DASH with similar precision in upper extremity disorders [14]. The DASH or QuickDASH scores have been used for evaluating the outcome after surgical treatment of TE in several studies [10, 22, 32, 34].

Several modifications of the original technique described by Hohmann [19] have been suggested. Most commonly are removal of tissue with macroscopic degenerative changes and decortication of bone with an osteotome or by drilling [25]. In the present study, decortication by an osteotome of a small area of bone at the insertion site of the extensor origin was carried out. The rationale for decortication is the release of pluripotent stem cells that may accelerate the repair process. However, some studies suggest that decortication is not necessary for achieving repair [7] and that it may even hamper the outcome by resulting in more postoperative wound bleeding, stiffness and pain [21, 37]. We observed only one case of postoperative hematoma requiring evacuation, but the design of our study does not permit any conclusion about the effect of decortication on the rate of complications or the outcome.

Similar to the observation by others [9, 33], we found little or no macroscopic degenerative changes in the extensor origin. However, as a transverse division of the extensor origin was performed only superficial changes will be visible, and deeper tendinous ruptures may be overlooked [25, 33]. We do not consider this to be a problem as the surgical technique used in our study does not include removal of tendinous tissue. In outcome studies with an observation period averaging 2 years or more, a good or excellent outcome has been reported in over 80% of the patients by both the Nirschl surgical technique or modifications of the latter that includes removal of degenerative tendinous tissue [11, 12, 25] and the Hohmann extensor release without removal of degenerative tendinous tissue [27, 33]. Further, there is no correlation between the intensity of the histologic reaction and the clinical outcome [9]. At present, it has not been shown that removal of degenerative tendinous tissue results in an improved clinical outcome [20, 24].

The age (median, 46 years; range, 34–64 years), distribution of gender (38 male and 39 female) and percentage affection of dominant arm (71%) of our patients are similar to that of other studies on surgical treatment of TE [25, 33]. The baseline symptoms and disability of our patients—as evaluated by the mean QuickDASH (61)—are also similar to that reported by others using the same set of questions [10, 22].

We found that high level of pain and disability at baseline ($r = 0.388$; $P < 0.001$), acute occurrence of symptoms ($r = 0.362$; $P < 0.001$), long duration of symptoms ($r = 0.276$; $P = 0.007$), female gender ($r = 0.269$; $P = 0.009$) and young age ($r = 0.203$; $P = 0.04$) are weak predictors of poor outcome, i.e. a high QuickDASH. Unfortunately, few previous studies analyse possible predictors of poor (or good) outcome after TE surgery and it is difficult to find studies that support or refute our findings. High level of pain and disability at baseline [2, 15] and long duration of symptoms [2, 29] have previously been shown to predict worse outcome after conservative treatment of TE. Worse clinical outcome in women has previously been observed after both conservative care, including physiotherapy [2, 35] and surgery [31].

Many clinical studies on surgical treatment of TE are hampered by shortcomings including retrospective design, low number of patients, loss of patients to follow-up, short-term follow-up period and inclusion of cases with concomitant procedures [20]. In evaluating the Coleman Methodology Score (CMS) of studies on operative management of tennis elbow, Karkhanis and co-workers [20] found that only 9 of 45 studies reported on more than 60 elbows (which is the lower study size limit for the top score of the CMS) and only five studies were sized 80 elbows or more. In the present study, 80 elbows (in 77 patients) were studied. We managed to follow-up 82% of the patients eligible for inclusion in the study.

Karkhanis found that the mean follow-up time fluctuated from 12 to 96 months in 45 outcome studies on surgical treatment of tennis elbow [20]. Whereas a long observation period is generally considered to strengthen the scientific value of a clinical study [20], most patients are just as interested in information about the short-term prognosis. Thus, it makes sense to include both a short-term follow-up and a medium- or long-term follow-up and to examine if a surgical result changes over time. In the present study, we evaluated the short-term (median 18 months) and medium-term (median 4 years) results of the treatment of recalcitrant TE with release of the common extensor origin. Contrary to the results of Verhaar et al. [33] who found a clinical improvement from 1 to 5 years postoperatively, no significant difference in outcome between the short-term follow-up and the medium-term follow-up was demonstrated in our study. However, our first follow-up was done at a later point in time (medium 18 months) than in the study of Verhaar et al. [33].

The strengths [20] of our study include the high number of patients, more than 80% follow-up, a single uniform surgical technique, no concomitant lesions, both short- and mid-term follow-ups, the use of a patient administered outcome score and registration of baseline symptoms/disability. The important limitations of our study are the lack of a control group and functional testing, e.g. grip strength.

Conclusion

We conclude that open lateral extensor release performed as outpatient surgery results in improved clinical outcome

at both short- and medium-term follow-ups with few complications. At the final follow-up (at median 4 years postoperatively), 81% was rated as excellent or good—a result that seems to be in accordance with the typical outcome after open surgery. High baseline disability, sudden occurrence of symptoms, long duration of symptoms, female gender and young age were found to be weak predictors of poor outcome.

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