The Boyd–McLeod procedure for tennis elbow: mid- to long-term results

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Abstract

Background: Tennis elbow is a common condition that usually responds to conservative measures. In refractory cases, surgical intervention is indicated. A plethora of surgical techniques have been described. We report the mid- to long-term outcomes of the Boyd–McLeod procedure for refractory tennis elbow.

Methods: A retrospective analysis and current review of patients that had undergone the Boyd–McLeod procedure over a 12-year period was undertaken. Demographics, time to discharge, length of follow-up and outcome scores were collected.

Results: Seventy patients underwent surgery. Mean time to discharge was 15.35 weeks, with 88% successful outcomes. Fifty-four patients were available for current follow-up at mean of 5.52 years (range 1.17 years to 11.49 years). Range of motion in all patients was unchanged. There were no revision procedures. Mean (SD) Mayo Elbow Performance Score was 90.85 (13.11), with 75.5% returning a good or excellent score and 24.5% a fair outcome. The mean (SD) Oxford Elbow Score was 44.04 (6.92); mean (SD) pain score was 89.5 (17.58); mean (SD) function score was 95.34 (9.59) and mean (SD) socio-psychological score was 91.50 (17.01). Overall, 83% of patients had an Oxford Elbow Score of 43 or greater, suggesting excellent outcome.

Conclusions: We show that the Boyd–McLeod procedure is an excellent option over both the short- and long-term for refractory tennis elbow.

Keywords

Boyd–McLeod, lateral epicondylitis, open release, tennis elbow

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Introduction

The surgical treatment of tennis elbow is reserved for those who are resistant to conservative measures. Although the natural history of the disease is to be self-limiting, with 70% to 80% of cases resolving spontaneously by 1 year¹, there is still the drive to manage the disorder in the acute setting with activity modification, nonsteroidal anti-inflammatory medications, physical therapy, clasps or supports, and steroid injections. The long-term benefits of these interventions are still unclear.² More recently, the use of platelet-rich-plasma (PRP) injections for chronic tennis elbow have become popular, prior to embarking on surgical intervention. The platelets release growth factors locally, resulting in tissue regeneration. Harvesting is achieved from the patient's whole blood using a cell-separating system.³ Two level 1, randomized control trials, one

comparing PRP with corticosteroid injections⁴ and the other comparing PRP with the active control of local anaesthetic,⁵ showed significantly better outcomes at short-term follow-up (2 years and 24 months, respectively) for the PRP groups.

First recognized in the mid 19th Century by Runge,⁶ and then described as occurring commonly in tennis players in 1883 by Morris,⁷ the condition has continued to prove challenging to treat in a small number of

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refractory cases. Treatment options include open release, arthroscopic release, percutaneous release and radiofrequency ablation; however, no randomized control trials comparing the above treatment strategies exists, and thus none have been proven to be superior.

The Boyd–McLeod procedure is one of many open releases described for resistant tennis elbow.⁸ First published in 1973, short-term results have proven to be encouraging.⁹ In the present study, we report the mid-to-long-term outcomes of the Boyd–McLeod procedure.

Materials and methods

A retrospective analysis was performed of a single surgeon's experience of the Boyd–McLeod procedure. The details of operated patients have been recorded in a database for a period of 11 years. There were 84 patients in this group. We were unable to find the notes for 10 patients, three had been revision procedures and thus were excluded and one had been deemed too unwell for surgery, leaving a total of 70 patients. The notes for all were obtained and a thorough analysis was undertaken, including demographics [side affected, age at time of surgery, handedness, occupation (manual or non-manual)], pre-operative treatment (clasp, injections, physiotherapy), duration of symptoms prior to surgery, grade of surgeon, tourniquet time, postoperative complications, postoperative range of motion and length of follow-up.

Subsequently, all patients were contacted to assess their current functional state. Of the original 70 patients, four had died since last review, 11 could not be contacted and one had had a total elbow replacement in the interim. This left a final follow-up group of 54 patients.

The patients were all contacted by telephone and assessed for current symptoms, current range of movement and whether this had changed from time of discharge. Postal patient-reported outcome scores were distributed to avoid bias, with scoring achieved utilizing the Oxford Elbow Score (OES)¹⁰ and the Mayo Elbow Performance Score (MEPS).¹¹ The MEPS considers four areas: pain, stability, range of movement and function, giving a total score out of 100; the higher the score, the better the outcome. If the total score falls between 90 and 100 points, it is considered excellent; between 75 and 89 points, it is considered good; between 60 and 74 points, it is considered fair; less than 60 points, it is considered poor.^{12–15}

The OES assesses three domains of the patients elbow; pain, socio-psychological effects and function. These are assessed via 12 questions: four for each domain. An overall score is created, plus a score for each individual domain, thus assessing which is the

most troublesome for the patient. Scores for each domain are calculated as the sum of each individual item score and, in each case, these are expressed on a scale of 0 to 100 (lower score representing greater severity). The formula used to convert to a metric score is: $(100/\text{maximum possible domain score}) \times \text{actual domain score}$.¹⁶

Technique

The Boyd–McLeod technique,⁸ as utilized by the senior author (NB), involved a 5-cm longitudinal incision centred over the lateral epicondyle. Sharp dissection down to the muscle fascia was made (Figure 1). The superior half of the extensor attachment was incised inline with its fibres and lifted sharply from the lateral epicondyle, with the lateral collateral ligament left undisturbed (Figure 2). Any mucinous degenerate tissue was debrided from the extensor carpi radialis brevis (ERCB). The conjoint flap was then raised distally to expose the annular ligament and the proximal

Figure 1. Incision centred over the lateral epicondyle, the superior half of the extensor attachment incised inline with its fibres and lifted sharply from the lateral epicondyle.

Figure 2. Showing the lateral collateral ligament left undisturbed.

Figure 3. Showing the conjoint flap after being raised distally, exposure and resection of the proximal 2 mm of the annular ligament, taking with it the synovial lining of the radiohumeral joint. Inspection of the elbow joint can be made and any mucinous degenerate tissue debrided from the extensor carpi radialis brevis.

Figure 4. Showing the lateral epicondyle being debrided and decorticated using an osteotome.

2 mm of the ligament was resected, taking with it the synovial lining of the radiohumeral joint. At this point, an inspection of the elbow joint could be made (Figure 3). The radial head is not de-stabilized because a large cuff of annular ligament remains. The lateral epicondyle is then debrided, decorticated using an osteotome and decompressed by drilling several holes with 2.0-mm K-wire (Figure 4). The conjoint tendon was then reattached using a 2.0 vicryl suture and the wound closed in layers.

Postoperatively, the patients were given a sling for 24 hours to 48 hours, and then left free to fully mobilize the elbow. Patients were reviewed at 2 weeks to check the wound and allow suture removal. They were then reviewed in the clinic at 6 weeks. Further follow-up was conducted at the discretion of the assessing physician. Patients were discharged once their pain has settled and function had returned. This remains the current practice.

Results

The mean (SD) age of the original group ($n=70$) of patients was 48.6 years (9.73 years). Of those, 61 were right-handed (87%), three were left-handed and six were not recorded. Forty-six had manual occupations (66%), 13 had non-manual occupations, three were unemployed, one had retired and seven had no occupation recorded.

Prior to surgery, the mean (SD) duration of symptoms was 26.6 months (14.38 months). All had had injections (steroid). The median number was 3. Only 29% (20/70) had a trial of clasp and 31% (21/70) had physiotherapy. Fifty-nine percent had an X-ray of the affected elbow, all of which were reported as normal in the clinical notes.

All patients underwent the Boyd–McLeod procedure as planned. All cases were discharged on the same operative day. Eighty-three percent (58/70) were right-sided operations, 17% (22/70) were left-sided and there were no bilateral procedures performed. The mean (SD) tourniquet time was 32.19 minutes (11.03 minutes). The grade of surgeon varied; 56% (39/70) were performed by the specialist orthopaedic trainee under supervision of the senior author (NB), 27% (19/70) were performed by the senior author himself, four of 70 were performed by a junior doctor under supervision and eight of 70 had no surgeon recorded.

Postoperatively, two patients failed to attend follow-up. The mean (SD) time to discharge was 15.35 weeks (14.04 weeks). The mean (SD) range of movement at discharge was: flexion 135.4° (14.04°), extension 1.12° (4.25°), supination 80° and pronation 80°. At discharge, seven patients had moderate pain and one had severe pain. The remaining 88% (60/68) patients were discharged with a successful outcome of either no or very mild discomfort. During the course of the early follow-up period, several complications arose, the majority of which resolved by the time of discharge without long-term consequence. Eight patients developed scar tenderness, three had numbness around the incision, two had wound infections treated with oral antibiotics, one developed a keloid scar and two patients developed heterotopic ossification for which they required no surgical intervention. Therefore, the complication rate was 23% but only 7% had on-going complications (asymptomatic heterotopic ossification and incisional numbness) at the time of discharge.

In the final follow-up group, a total of 54 patients from the original series were contactable (Table 1). The mean follow-up period was 5.52 years (range 1.17 years to 11.49 years). The range of movement in all patients had remained the same from the time of discharge. There were no revision procedures in this cohort.

Table 1. Summary of the main outcomes for the final follow-up group.

Outcome measure	Result
Follow-up, mean (range)	5.52 years (1.17 years to 11.49 years)
Overall OES, mean (SD)	44.04 (6.92)
OES pain domain, mean (SD)	89.5 (17.53)
OES socio-psychological domain, mean (SD)	91.50 (17.01)
OES function domain, mean (SD)	95.34 (9.59)

OES, Oxford Elbow Score.

The mean (SD) MEPS was 90.85 (13.11), with 75.5% returning a good or excellent score, and 24.5% a fair outcome. There were no poor scores.

The mean (SD) OES was 44.04 (6.92). The breakdown of the domains revealed: pain, mean (SD) score of 89.5 (17.58), median 100 (range 43.75 to 100); function, mean (SD) score of 95.34 (9.59), median, 100 (range 68.75 to 100); and socio-psychological, mean (SD) score of 91.50 (17.01), median 100 (range 37.5 to 100). Overall, 83% of patients had a OES of 43 (out of 48) or greater, suggesting excellent outcome. The remaining 17% had scores ranging from 24 to 36.

In the initial group, seven patients had moderate or severe pain on discharge. Of those, five were available for subsequent contact. One had resolved and had a MEPS of 100 and OES of 48/48. One had only mild pain with MEPS of 85 and OES of 46/48 (pain, 87.5; function, 100; socio-psychological, 100). The final three patients still had significant on-going pain, with a mean MEPS of 68.3 (range 65 to 70) and a mean OES of 29/48 (mean pain, 52; function, 79.1; psycho-social, 50).

Discussion

The Boyd–McLeod procedure is a modification of the Bosworth III procedure,⁸ where the lateral segment of the entire annular ligament is excised, which was hypothesized to lead to possible destabilization of the elbow. It appears to provide good to excellent outcomes over the short-term, which are maintained over the long-term. The original study by Boyd and McLeod⁸ described 28 patients undergoing surgery, 25 of whom had more than 6 months of follow-up. Twenty-two had pain relief by 3 months, one had moderate pain and two had mild pain. All but one had regained full movement by 4 months. Only one other study describes the short-term outcomes of the procedure, with a 91% success rate at a mean postoperative

follow-up of 16 months.⁹ Our series is equivalent in the short-term, with 88% success rate at a discharge time of 15.35 weeks. No other studies exist regarding the outcomes of the Boyd–McLeod procedure and the present study is the first to report long-term follow-up.

Multiple open techniques have been described, although there are few long-term results available. Dunn et al. reported the 10-year to 14-year follow-up (also by telephone) of the Nirschl technique.¹⁷ This technique involves approaching the ECRB tendon via the interval between the extensor carpi radialis longus (ECRL) and extensor digitorum communis (EDC). The tendonosis found on the ECRB is excised and one drill hole is made in the cortex of exposed lateral epicondyle, allowing improved vascularization. The ECRL and EDC are repaired but not the ECRB because this is considered to cause flexion contracture. The outcome of 84% good or excellent scores, achieved at a mean follow-up of 12.6 years in 83 patients, is very similar to our own results. Interestingly, Dunn et al. report no complications associated with their technique in 130 patients.¹⁷

The complication rate of 23% in our series may appear to be high but the majority of recorded complications had no long-term repercussions and were self-limiting within the early follow-up period. On discharge, 7% of patients had complications, which included asymptomatic heterotopic ossification in two patients. Heterotopic ossification has not been reported in other studies, even those that decorticate or drill the lateral epicondyle. One reason for this higher rate could be the more extensive release performed with the Boyd–McLeod procedure. Prospective studies comparing the rate of heterotopic ossification with or without epicondylar decortication are required to define more clearly the aetiological factors.

Other published series report mid- to long-term data. Posch et al. found 90% good or excellent outcomes at 8-year follow-up of open fasciotomy.¹⁸ Verhaar et al. reported 56% excellent and 33% good results, utilizing a lateral extensor release, at 5-year follow-up.¹⁹ Rayan and Coray demonstrated 95% success at a mean of 41.2 months with a V-Y slide of the common extensor origin.²⁰ Calvert et al., with a mean follow-up of 74 months, found that 57% of patients were pain free with 89% satisfaction using a simple lateral release.²¹ Coonrad and Hooper found all patients to be satisfied with outcome of open resection and suture of the extensor origin, at a mean of 60 months.¹ Das and Mafulli reported a 75% success rate at a mean of 52.8 months with simple open release and open release plus drilling of epicondyle.²² Thus, the overall outcomes of open release do correspond with that of the Boyd–McLeod procedure, with success rates ranging from 75% to 95% over the long-term. The surgical technique involved in

the Boyd–McLeod procedure does address the potential failures of other approaches. Pain arising from an impinging synovial fold, inflammatory changes in the annular ligament or other intra-articular related pathology can be assessed and treated at the time of surgery using this technique. This clear distinction between techniques highlights the need for more prospective, well powered and controlled surgical studies comparing different surgical strategies.

The development of many different surgical strategies for tennis elbow arises from the lack of understanding of the exact aetiology that still exists. It was originally considered to be an inflammatory process brought on by traumatic events, such as the back hand swing in tennis, thus leading to the misleading name ‘lateral epicondylitis’.⁷ It is now suggested that repeated microtrauma does occur at the insertion of the ERCB, causing microtears. This may result from repeated eccentric and concentric contractions of the ERCB muscle,²³ combined with impingement of the tendon on the lateral edge of the capitellum during elbow extension and flexion.²⁴ Recent studies, however, have shown that no inflammatory cells are found on analysis of tissue taken from affected elbows.^{25,26} Indeed, investigations of the vascularity of the ERCB tendon have revealed that the undersurface of the tendon is avascular in cadaveric specimens,²⁷ and there are definite zones of hypovascularity at the lateral epicondyle.²⁸ There is hypercellularity and vascular proliferation with invasion of immature fibroblasts but no obvious inflammatory infiltrate, leading Nirschl to describe the pathophysiology as ‘angiofibroblastic tendinosis’.²⁹ Overtime, there have been many aetiological theories for the development of tennis elbow, many of these not related to the ERCB tendinous complex. In 1936, Cyriax surmised 29 aetiological factors of tennis elbow or lateral elbow pain.³⁰ Bosworth later described chronic inflammation of the annular ligament arising from rotation of the radial head which is asymmetric and eccentrically located.³¹ This provided the basis for his techniques involving the partial excision of the ligament, with reasonable results.³² Synovial plicae of the lateral elbow have been implicated in refractory cases.³³ Impingement of the subluxing radiocapitellar capsular complex has also been described.³⁴ There is assumed to be a neurological origin for the pain experienced in tennis elbow, with innervation to this region arising from the posterior interosseous (PIN) branch of the radial nerve. Denervation of the PIN has been shown to provide relief from tennis elbow in 92% of patients³⁵; however, other studies have reported more mixed results.³⁶ The success of the Boyd–McLeod procedure could lie with the fact that it addresses the majority of the above mentioned aetiologies, with the exception of denervation.

Tennis elbow occurs most commonly in young active patients, generally in the fourth decade of life. They are often manual workers and, as such, require a rapid resolution of their pain to function and avoid the potential socio-economic problems associated with an inability to work. The condition is self-limiting, with most cases resolving spontaneously or with conservative measures. The present study suggests that, with operative treatment, patients will be discharged by 16 weeks, the beneficial effects of which are long lasting, with no need for revision surgery. Newer, less invasive techniques have evolved. The results of arthroscopic release have been promising, with several reports of the technique showing good patient-reported outcomes.³⁷ Baker described the results of 42 arthroscopic resections for tennis elbow with a mean follow-up of 130 months; of the 30 patients available for follow-up, 77% were much better and 20% were better.³⁸ Rubenthaler et al. reported mean elbow scores of 93.2 for arthroscopic release versus 87.5 for open at a mean of 92 months.³⁹

Percutaneous release has also shown acceptable results, although no long-term follow-up studies are available. In 1982, Baumgard and Schwartz reported 91.4% success at a mean follow-up of 35 months.⁴⁰ Subsequently, Dunkow et al. reported that patients returned to work quicker and had faster resolution of their symptoms with improved Disabilities of the Arm, Shoulder and Hand scores compared to open release.⁴¹ Grundberg and Dobson reported 90% good or excellent outcomes at a mean of 26 months following percutaneous release.⁴² A recent study, however, has shown that, when compared with arthroscopic release, the percutaneous technique gave less favourable results over the short-term.¹⁵

Microtenotomy using radiofrequency ablation has been shown to provide satisfactory outcomes in the short-term. Tasto et al. reported on 13 cases using this technique with a follow-up of 2 years, with patients reporting a significant reduction in pain within 7 days to 10 days, which was maintained at 2 years.⁴³ More recently, Meknas et al., in a small prospective randomized study, showed that ablation resulted in early pain reduction (by 3 weeks) and early improved grip strength compared to an open technique. The reduction in pain did equalize between the two groups by 10-month to 18-month follow-up.⁴⁴

The limitations of the present study include its retrospective nature, with no control group. There are no early pre- or postoperative scores. We were unable to trace 16 patients from the original operative group; thus, follow-up was incomplete. Part of the long-term follow-up data were collected via telephone. Ideally, clinical assessment would have been undertaken; however, as a result of a lack of funding, this was not

feasible. Thus, the movement ranges were based on patient's description of changes from their discharge range, and applied to the MEPS scoring systems.

Conclusions

This is the first study to describe the long-term outcomes of the Boyd–McLeod procedure. The main complaint with tennis elbow is pain. As an endpoint in our original series, the successful resolution of pain was excellent, with 88% of patients discharged with improved outcome. This success has been shown to have excellent longevity, with up to 83% of patients recording a good or excellent outcome at a mean of 5.52 years (up to 11.5 years). However, when discussing surgical intervention with patients, it must be emphasized that, across the literature, there is a 15% to 20% failure rate and, as our data suggest, a 7% complication rate. The Boyd–McLeod procedure provides excellent short- and long-term symptom control in the majority of patients, equivalent to other established techniques. It also has the advantage of addressing other pain generators in and around the lateral elbow.

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