Rupture of the long head biceps tendon treated with tenodesis to the coracoid process. Results at more than 30 years

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Abstract We evaluated patients at very long term with rupture of the long head biceps tendon (LHBT) in whom the tendon stump had been sutured to the coracoid tip (Gilcreest technique). Our aim was to determine the natural history of shoulders deprived of the LHBT and to assess the validity of the surgical technique. Between 1969 and 1981, 30 patients with rupture of the LHBT and no evidence of cuff tear underwent the Gilcreest operation. The mean age of the patients was 32 years (range, 20–49). Six of them were professional gymnasts. The 28 patients that could be traced were evaluated a mean of 31 years after operation. The mean Constant score (CS) was 74 in the entire group, and 86 in 22. The latter patients complained occasionally of mild shoulder pain. The remaining six patients had a mean CS of 56 (range, 40–81). Of the six, four (aged 66–71 years) had clinical and MR evidence of rotator cuff tear. The other two had undergone arthroscopic cuff repair (CS, 75–81). After operation, all professional gymnasts had returned to sport activity and all the other patients had resumed their jobs. After 30 years, the majority of the patients who had undergone the Gilcreest operation had good functional and cosmetic outcomes. Only a few patients had a cuff tear. The role of the LHBT as depressor

of the humeral head is probably less important than generally believed.

Introduction

The long head biceps tendon (LHBT) is thought to be a key stabiliser of the humeral head within the glenohumeral joint [1, 2]. It may be affected by several pathological conditions, such as acute or chronic tendonitis, instability (subluxation or dislocation), and partial or complete tear. Tendon rupture usually results from sudden contraction of the biceps associated with resisted flexion and supination of the forearm [3], and a predisposing role is possibly played by intrinsic degeneration of the tendon tissue or frictional wear of the tendon belly. The tear most commonly occurs near the glenoid insertion or at the proximal portion of the intertubercular groove [4].

Ruptures or instabilities can be treated by open [5–8] or arthroscopic techniques [9, 10]. However, the indications for repair of an acute rupture remain controversial, since many studies have shown that complete tendon tears are responsible for quite severe cosmetic defects, but minimal or no dysfunction of the arm. In fact, most patients with chronic unrepaired ruptures have a normal or nearly normal flexion and supination of the forearm, while young active individuals may have pain and cramping in the biceps muscle when performing heavy activities [11–13].

The aim of our study was to evaluate, at very long term, the possible changes occurring in the shoulder when deprived of the action of the biceps tendon as a depressor of the humeral head and to assess the functional outcome of re-attachment of the tendon stump of torn LHBT using the Gilcreest technique [5].

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Materials and methods

In the period 1969–1981, 30 patients with acute (less than ten days) rupture of LHBT were submitted, in our Department, to tenodesis of the involved tendon using the Gilcreest technique, which consists of suturing the long head of the biceps to the coracoid tip with non absorbable sutures (Fig. 1a). All patients were submitted to arthrography of the involved shoulder pre-operatively. All operations were performed by the senior author (LP).

We excluded 20 patients from this study with clinical evidence of rotator cuff tear confirmed by arthrograms. Furthermore, we excluded patients older than 50 years because they were treated conservatively.

All patients, except for two, were traced and evaluated at a mean of 31 years after operation (range, 27–37 years). Their mean age was 32 years at the time of the injury (range, 20–49) and 57 years (range, 45–74) at the time of follow-up. All 28 patients were males. The right shoulder

was involved in 18 cases (64.3%). Six patients were professional gymnasts (21.4%) and 14 were involved in non-combative sport (50%). The others were non sporting.

Preoperative diagnosis was made by clinical examination, based on the presence of the classic Popeye sign or a less striking descent of the biceps muscle in the middle part of the arm. Postoperatively, all patients wore a Desault bandage or a sling for 26 days on average; then passive and active exercise were carried out for 15–35 days.

Between 1996 and 2009, 28 patients were traced and asked to attend for clinical evaluation. The Constant score (CS) [14] and Mayo elbow performance score (MEPS) [15] were calculated and X-rays (true anteroposterior and axillary view) were made. Shoulder strength (as described by the Constant score) (1 point = 1 lb) and flexion strength of the forearm (with the forearm flexed at 90° and the arm adducted to the body, with the hand in full supination) (1 point = 1 lb) were measured using the MicroFET dynamometer (Hoggan Health Industries, West Jordan, UT, USA). Each measure-

Fig. 1 **a** Long head biceps tenodesis according to the Gilcreest technique. **b** Professional gymnast submitted to tenodesis (left shoulder) in the 1970s. **c–d** After a follow-up period of 25 years, the patient works as a gym teacher. Post-operative biceps shape is maintained

ment was recorded by three of the authors. An MRI of the involved shoulder was also obtained.

Subacromial width was calculated on radiographs using Petersson's method [16].

Differences in the Constant score and the Mayo elbow performance score between the involved and contralateral side were analysed with the chi-square test. Interobserver reliability of strength measurements was also analysed. $P < 0.05$ was considered to be significant.

Results

No complications occurring after surgery were recorded in the clinical charts.

At the last follow-up, the mean CS of the involved shoulder was 74 points (range, 40–94), compared to 78 points (range, 52–92) on the contralateral side ($p = 0.13$). The range of motion was similar in the two shoulders. In 22 patients, including the six athletes, the mean score was 86. These patients reported that occasionally they had mild shoulder pain. The remaining six patients (21.4%) had a mean Constant score of 56 (range, 40–81). Four of them (aged 66–71 years), who were or had been heavy labourers, had clinical evidence of a large cuff tear, confirmed by MRI. The other two had undergone arthroscopic rotator cuff repair with a good result (CS, 75–81). The MEPS was 99.46 for the elbow of the involved side and 99.64 for the contralateral side ($p = 0.23$). On MR scans of all patients the soft tissue just beneath the coracoid tip was thickened but no individual tendon could be identified. The subacromial space appeared to be decreased in width in the patients with untreated cuff tear, while in the remaining 24 patients it was interpreted as normal.

Mean shoulder strength was 17 points on the affected side (range, 11–23), as well as on the contralateral side (range, 10–23) ($p = 0.77$). Mean flexion strength of the forearm resulted in 15 points (range, 8–19) on the affected side and 17 on the contralateral side (range, 12–20) ($p = 0.067$). All patients were fully satisfied with the cosmetic results (Fig. 1b–d).

A mean of nine months (range, 11–17) after surgery, all professional gymnasts had returned to sporting activity, but four had to change the sequence of the exercises.

Discussion

In recent years, management of the diseases of the LHBT has become an area of renewed interest and debate. Nowadays, tenotomy of the LHBT, with or without tenodesis of the distal stump, is a widely accepted surgical

procedure for treating chronic tendonitis, severe tendon degeneration, partial or complete tears, or instability of the tendon [17].

In the 1970s, Neer warned surgeons against performing a thoughtless biceps tenodesis, because it “destroys” the function of the tendon “as a head depressor and may precipitate an impingement problem”. Furthermore, he underlined the worsening of medium and long-term outcomes in direct relationship to the progressive realignment of the humeral head [18]. Subsequently, Leffert and Rowe [19] stated that the LHBT represents a weak humeral head depressor, the role of which increases in the presence of rotator cuff tear. Over time, however, anatomical and biomechanical studies have reconsidered previous theories on the functional role of the LHBT on glenohumeral stability and humeral head depression [1, 2]. In our series, only six patients (21.4%) developed a rotator cuff tear, a similar percentage to that found in autopsy studies of the rotator cuff in adult subjects [20, 21]. This suggests that the role of the LHBT as a depressor of the humeral head protecting the rotator cuff is probably less important than generally believed.

In our department, from 1969 to 1981, the Gilcreest technique was used to treat ruptures of the LHBT in young active patients. The majority of them were found to have satisfactory results, not only functionally but also from the cosmetic viewpoint, despite the long skin incision on the anterior aspect of the arm.

In this study that assessed the results of biceps tenodesis to the bicipital groove at the longest term, the patients were found to have good outcomes a mean of 10.9 years after fixation of the tendon to the bicipital groove [22].

In 1988, Mariani et al. [14] independently reported on the adopted surgical procedure, that an adequate fixation allows tendon healing and an early postoperative rehabilitation, especially in young active individuals, as our patients were. In our study the result of surgery was evaluated after three decades, on average. The satisfactory outcomes that we found, in the absence of any complications, may lead to reconsider the Gilcreest procedure as opposed to tenodesis to the bicipital groove by anchors or absorbable interference screws, or the introduction of the tendon stump in a metaphyseal hole (keyhole technique). These techniques, although potentially requiring a shorter exposure than tenodesis to the coracoid, are known to be responsible, even if rarely, for failure due to pull-out of the screw, inflammatory processes around the absorbable screw or fracture of the humerus [23, 24].

Conflict of interest The authors declare that they have no conflict of interest.

References

1. Rodosky MW, Harner CD, Fu FH (1994) The role of the long head of the biceps muscle and superior glenoid labrum in anterior stability of the shoulder. *Am J Sports Med* 22:121–130
2. Pagnani MJ, Deng XH, Warren RF, Torzilli PA, O'Brien SJ (1996) Role of the long head of the biceps brachii in glenohumeral stability: a biomechanical study in cadavera. *J Shoulder Elbow Surg* 5:255–262
3. Brown GA, Pena F, Grontvedt T, Labadie D, Engbretsen L (1996) Fixation strength on interference screw fixation in bovine, young human and human cadaver knees: influence of insertion torque, tunnel-bone black gap and interference. *Knee Surg Sports Traumatol Arthrosc* 3:238–244
4. Burkhead WZ, Arcand MA, Zeman C (1990) The biceps tendon. In: Rockwood CA, Matsen FA (eds) *The shoulder*, 3rd edn. Saunders, Philadelphia
5. Gilcreest EL (1926) Two cases of spontaneous rupture of the long head of the biceps flexor cubiti. *Surg Clin North Am* 6:539–554
6. Hitchcock HH, Bechtol CO (1948) Painful shoulder observation on the role of the tendon of the long head of the biceps brachii in its causation. *J Bone Joint Surg Am* 30:263–273
7. DePalma AF, Callery GE (1954) Bicipital tenosynovitis. *Clin Orthop* 3:69–85
8. Froimson AI, Oh I (1974) Keyhole tenodesis of biceps origin at the shoulder. *Clin Orthop* 112:245–249
9. Gartsman GM, Hammerman SM (2000) Arthroscopic biceps tenodesis: operative technique. *Arthroscopy* 16:550–552. doi:10.1053/jars.2000.4386
10. Richards DP, Burkhart SS, Lo IKY (2003) Arthroscopic biceps tenodesis with interference screw fixation: The lateral decubitus position. *Oper Tech Sports Med* 11:15–23
11. Warren RF (1985) Lesions of the long head of the biceps tendon. *Inst Course Lect*, vol. 34. Rosemont, IL: American Academy of Orthopaedics Surgeons, pp 204–209
12. Strunznegger M, Beguin D, Grunig B, Jakob RP (1986) Muscular strength after rupture of the long head of the biceps. *Arch Orthop Trauma Surg* 105:18–23
13. Mariani EM, Cofield RH, Askew LJ, Li GP, Chao EY (1988) Rupture of the tendon of the long head of the biceps brachii. Surgical versus non-surgical treatment. *Clin Orthop* 228:233–239
14. Constant CR, Murley AHG (1987) A clinical method of functional assessment of the shoulder. *Clin Orthop* 214:160–164
15. Morrey BF, An KN, Chao EYS (1993) Functional evaluation of the elbow. In: *The elbow and its disorders*. Morrey BF (ed) WB Saunders, Philadelphia, pp 86–89
16. Petersson CJ, Redlund-Johnell I (1984) The subacromial space in normal shoulder radiographs. *Acta Orthop Scand* 55:57–58
17. Sethi N, Wright R, Yamaguchi K (1999) Disorders of the long head of the biceps tendon. *J Shoulder Elbow Surg* 8:644–654
18. Neer CS (1972) Anterior acromioplasty for the chronic impingement syndrome in the shoulder. A preliminary report. *J Bone Joint Surg Am* 54-A:41–50
19. Leffert RD, Rowe CR (1989) Tendon rupture. In: Rowe CS (ed) *The shoulder*. Churchill Livingstone, New York, pp 131–163
20. Fukuda H, Mikasa M, Ogawa K, Hamada K (1983) The partial thickness tear of the rotator cuff. *Orthop Trans* 7:137
21. Ozaki J, Fujimoto S, Nakagawa Y, Masuhara K, Tamai S (1988) Tears of the rotator cuff of the shoulder associated with pathological changes in the acromion. A study in cadavera. *J Bone Joint Surg* 70-A:1224–1230
22. Scapinelli R, Candiotti S, Ferrari GP, Iacobellis C (1999) Subcutaneous rupture of the tendon of the long head of the biceps brachii in subacromial impingement syndrome. *Chir Organi Mov* 84:229–237
23. Friedel R, Markgraf E, Schmidt I, Dönicke T (1995) Proximal humerus shaft fracture as a complication after keyhole-plasty. A case report. *Unfallchirurgie* 2:198–201
24. Friedman DJ, Dunn JC, Higgins LD, Warner JJ (2008) Proximal biceps tendon: injuries and management. *Sports Med Arthrosc* 16:162–169. doi:10.1097/JSA.0b013e318184f549