

PREVALENCE OF POPEYE DEFORMITY AFTER LONG HEAD BICEPS TENOTOMY AND TENODESIS

PREDOMÍNIO DA DEFORMIDADE DE POPEYE APÓS TENOTOMIA E TENODESE DA CABEÇA LONGA DO BÍCEPS

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ABSTRACT

Objective: To evaluate whether body mass index (BMI) 30 can be used as a cut-off point in decisions about whether or not to perform long head biceps (LHB) tenodesis, leading to a low rate of esthetic complaints, and to compare two tenodesis techniques. **Methods:** Ninety-six patients underwent shoulder arthroscopy where tenotomy was performed separately in patients with a BMI ≥ 30 and was followed by tenodesis when BMI < 30 . The patients were assessed on the basis of their personal perception of the deformity and by 3 independent observers. **Results:** The patient's perception of esthetic deformity in the arm was 15.6%. In the tenotomy group (12.5%) and in the tenodesis group (17.9%) - ($p = 0.476$). Patients with rocambale-like tenodesis perceived the deformity in 13.2% of cases, while patients with anchor tenodesis noticed the deformity 27.8% ($p = 0.263$) of the time. There was no statistical difference in the perception of deformity among the independent examiners. **Conclusion:** BMI 30 can be used as a cut-off point in decisions about whether or not to perform LHB tenodesis, leading to low rates of esthetic complaint by patients (12.5%). The rocambale-like tenodesis technique appears to be more able to avoid esthetic deformity of the arm after the LHB tenotomy according to the patients' observations. **Level of evidence II, Prospective comparative study.**

Keywords: Shoulder/surgery. Arthroscopy. Tenotomy. Obesity.

RESUMO

Objetivo: Avaliar se índice de massa corporal (IMC) 30 pode ser utilizado como ponto de corte nas decisões sobre realizar ou não a tenodese da cabeça longa do bíceps (CLB), levando a um baixo índice de queixa estética, e comparar duas técnicas de tenodese. **Métodos:** Foram submetidos à cirurgia artroscópica no ombro 96 pacientes, sendo a tenotomia realizada de forma isolada nos pacientes com IMC ≥ 30 e seguida de tenodese quando IMC < 30 . Os pacientes foram avaliados por sua percepção pessoal da deformidade e por três observadores independentes. **Resultados:** A percepção da deformidade estética no braço pelo paciente foi de 15,6%. No grupo tenotomia (12,5%) e no grupo tenodese (17,9%) - ($p=0,476$). Pacientes com tenodese rocambale perceberam a deformidade em 13,2% dos casos, enquanto os pacientes com tenodese em âncora a notaram em 27,8% das vezes ($p=0,263$). Não houve diferença estatística para a percepção da deformidade entre os examinadores independentes. **Conclusão:** IMC 30 pode ser usado como ponto de corte nas decisões sobre realizar ou não a tenodese da CLB, levando a baixos índices de queixa estética por parte dos pacientes (12,5%). A técnica de tenodese tipo rocambale parece ter mais capacidade de evitar a deformidade estética do braço após a tenotomia da CLB, conforme a observação dos pacientes (13,2%). **Nível de evidência II, estudo prospectivo comparativo.**

Descritores: Ombro/cirurgia. Artroscopia. Tenotomia. Obesidade.

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INTRODUCTION

The long biceps head (LHB) is a frequent source of pain in the shoulder joint.¹ The literature is controversial for the different forms of surgical approach of painful LHB in the failure of conservative treatment and the suggested procedures vary from the surgical debridement of LHB, the isolated tenotomy and tenotomy followed by tenodesis.¹⁻³ Arthroscopic debridement is indicated when there are signs of LHB tendonitis and involvement of less than 50% of tendon thickness.³

In the presence of lesions that compromise 50% or more of LHB thickness, in the presence of instability in the bicipital sulcus or degenerative SLAP lesion, tenotomy, whether or not followed by LHB tenodesis is necessary.³

Isolated LHB tenotomy is an excellent treatment alternative. It is a simple technique, with low morbidity and rapid rehabilitation, but it is not free of complications. Among the reported complications are fatigue, arm discomfort, Popeye's deformity, and loss of flexion

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and supination elbow strength.^{1,3,4} there are no valid criteria in the literature to define which patient will evolve well with an isolated tenotomy of LHB and which patient will require tenodesis. The main objective of this research is to evaluate if the Body Mass Index (BMI) of 30 can be used as a cut-off point in decisions about whether or not to perform the LHB tenodesis, leading to a low rate of aesthetic complaint by the patients. As a secondary objective, we will compare two techniques of tenodesis, regarding the ability to avoid the aesthetic deformity of the arm.

METHODS

The study was prospective. We evaluated 96 patients submitted to arthroscopic surgery on one shoulder, from January 10, 2010 to July 27, 2017. The study was submitted to the institution's ethics committee (CAAE 40167714.8.0000.5331). Every patient received an informed consent form that was signed and filed with the institution. No revision surgeries and any patient presenting with a history of surgery, atrophy or any aesthetic modification in the contralateral upper limb that could compromise the visual comparison between the upper limbs were chosen for this study.

The mean age of the patients was 57 ± 8.5 years. With regard to sex, 63 patients (65.6% -IC95%: 55.2% -75%) were female. The dominant side was affected in 78 (81.3% -IC95%: 72% -84.5%) patients.

All patients underwent height and weight measurements in the immediate preoperative period. The values found were used to calculate the BMI through the specific equation.⁵ The result is obtained when dividing the weight (in kilos) by the square of the height (in meters). Its result is given in "kg / M²": $BMI = \text{Weight} / \text{Height}^2$ (Table 1).

The surgeries were always performed by the senior surgeon with the patient positioned in lateral decubitus, with the upper limb (UL) abducted at 30°, flexed at 20° and with longitudinal traction of 5 kg. Whenever a compromise of 50% or more of the LHB thickness, an intertubercular groove instability, or a degenerative SLAP lesion was found, the patient was elected to the study and the LHB tenotomy was performed with a Trimmer forceps in its insertion in the upper lip of the glenoid. It was performed in isolation in patients with a $BMI \geq 30$ kg/m² and was followed by tenodesis when $BMI < 30$ kg/m².

In the group of patients with $BMI < 30$ kg/m², two tenodesis techniques were used. The anchor tenodesis was used whenever was found an injury of the Subscapular or lesion of the medial pulley of the LHB and the "rocombole" tenodesis⁶ in the other cases. In the anchor tenodesis, a 5.0 Super-Revo[®] pre-loaded with two high strength wires was used in the bicipital groove. In the "rocombole" tenodesis⁶ the LHB is exteriorized through the anterior portal and rolled onto itself until it is about 3 times its normal thickness, then it is repositioned at the joint, preventing its sliding in the bicipital groove.

Patients were divided into 3 groups. The Tenotomy Group consisted of 40 patients, the "Rocombole" Tenodesis Group

composed of 38 patients and the Anchor Tenodesis Group composed of 18 patients.

All patients were immobilized with a neutral rotation sling. Regardless of the procedure performed at the LHB, the patients received guidance to avoid forced elbow flexion as well as their full extension within the first four weeks postoperatively.

The patients were evaluated with a median of 8 months (IIQ 6-15.5 months) postoperative. At the evaluation, the attending physician informed each patient that he would be questioned about his aesthetic perception of the operated UL, and that other professionals would photograph him for the purpose of aesthetic evaluation. It was again clarified, according to the terms of the Informed Consent previously signed, that there would be no exposure of its identification.

Patients were asked about their perception of any aesthetic deformity in their operated arm.

The patients were photographed with an Apple-branded cell phone at a distance of 60 cm, with the UL adducted at the trunk, the elbow at 90 degrees and the forearm in maximal supination. The photographs were performed in ambient light, hiding the patient's face and exposing the arm with the shoulder and elbow joints.

Patient photographs of 8x5 cm were placed in a blue-and-green Microsoft PowerPoint presentation. The photo of the operated UL was on the left and the photo of the contralateral UL on the right. (Figures 1, 2, and 3) The Microsoft-Powerpoint presentation was examined by three professionals with specialization in shoulder surgery, where they were invited to observe each slide separately for a maximum time of 60 seconds and to mark in the response grid if he observed or not some aesthetic deformity that could result from a distal migration of the LHB. No descriptive patient data or clinical history was revealed.

The studied variables were: age, sex, operated side, dominance, perception of deformity by the patient, perception of the deformity by the professional specialist and degree of agreement among the specialists.

The data were analyzed with the statistical package SPSS 20.0 (IBM SPSS Inc., 2011). For the statistical analysis, the following were used: calculation of means, standard deviation, median, frequency and percentage. The t-student test for age assessment was used. The Chi-square test and Fisher's exact test were used when the variables were categorical. A one-digit numerical precision was used after the comma in the presentation of the data, except for the data of the value P where three digits remained. A 5% α ($p < 0.005$) and a 90% β were considered statistically significant.

Table 1.

Classification	BMI
Very Low Weight	16 a 16,9 Kg/m ²
Low Weight	17 a 18,4 Kg/m ²
Normal	18,5 a 24,9 Kg/m ²
Overweight	25 a 29,9 Kg/m ²
Obesity Grade 1	30 a 34,9 Kg/m ²
Obesity Grade 2	35 a 40 Kg/m ²
Obesity Grade 3 (Morbid)	>40 Kg/m ²

Classification of the degrees of obesity according to the values of the Body Mass Index.



Figure 1. Examples of patient photos in the Microsoft-Powerpoint presentation.



Figure 2. Examples of patient photos in the Microsoft-Powerpoint presentation.



Figure 3. Examples of patient photos in the Microsoft-Powerpoint presentation.

RESULTS

The perception of the aesthetic deformity by the patient resulting from the bicipital shortening was 15.6% (15 patients). Two patients reported crackling in the bicipital sulcus (2%).

The perception of aesthetic deformity in the tenotomy group was 12.5% (ICC95%: 2.2% -22.7%) (5/40), whereas in patients who underwent tenodesis it was 17.9% (ICC95 % 7.8% -27.8%) (10/56) ($p = 0.476$).

Patients who underwent rocambole-type tenodesis perceived the aesthetic deformity in 13.2% (ICC95%: 2.4% -23.9%) (5/38), while the patients submitted to tenodesis with anchor in 27.8% (ICC95%: 7.1% -48.5%) (5/18) ($p = 0.263$).

The specialists who analyzed the photos of the patients were named as examiner 1, 2 and 3.

Examiner 1 verified the aesthetic deformity in 3 patients (3/40) who underwent LHB tenotomy (7.5% -ICC95%: 1.6% -20.4%) and in 18 patients (18/56) who underwent tenodesis (32.1% -ICC95%: 20.3% -46.0%) ($p = 0.004$).

The examiner 2 verified the aesthetic deformity in 14 patients (14/40) who underwent LHB tenotomy (35% -ICC95%: 20.6% -51.7%) and in 19 patients (19/56) who were submitted to tenodesis (33.9% -ICC95%: 21.8% -47.8%) ($p = 0.913$).

The examiner 3 verified the aesthetic deformity in 12 patients (12/40) who underwent LHB tenotomy (30% -ICC95%: 16.6% -46.5%) and in 26 patients (26/56) who were submitted to tenodesis (46.4% -ICC95%: 33% -60.3%) ($p = 0.105$).

The examiner 1 verified the aesthetic deformity in 11 patients (11/38) who underwent "rocombole" tenodesis (28.9% -ICC95%: 15.4%

-45.9%) and in 7 patients (7/18) who underwent anchor tenodesis (38.9% -ICC95%: 17.3% -64.3%) ($p = 0.457$).

Examiner 2 verified the aesthetic deformity in 14 patients (14/38) who underwent "rocombole" tenodesis (36.8% -ICC95%: 21.8% -54%) and in 5 patients (5/18) who underwent anchor tenodesis (27.8% -ICC95%: 9.7% -53.5%) ($p = 0.503$).

The examiner 3 verified the aesthetic deformity in 17 patients (17/38) who underwent "rocombole" tenodesis (44.7% -ICC95%: 21.8% -54%) and in 5 patients (9 / 18) who underwent anchor tenodesis (50% -ICC95%: 9.7% -53.5%) ($p = 0.712$).

DISCUSSION

The surgical treatment of LHB pathologies is indicated when occurs failure of the conservative treatment.^{1,3,7} Khazamet al.¹ consider indications for the surgical treatment of LHB lesions are partial lesions affecting more than 25% of the tendon diameter, longitudinal lesions, instabilities in the pulley and association with the injury of the subscapularis muscle tendon. Boileau et al.⁷ add to the previous list hourglass lesions and the detachment of the superior glenoid lip. Among the modalities of treatment of pathologies of LHB recommended in the literature are: debridement, isolated tenotomy and tenotomy of LHB followed by tenodesis.¹ Arthroscopic debridement is indicated when there are signs of chronic tendonitis and for lesions with involvement from 25% of tendon thickness, for some authors, or from 50% for others.^{1,3} The literature is even more controversial in lesions where there is a need for LHB tenotomy, due to the possibility of aesthetic deformity, loss of muscle strength and residual pain when this technique is performed in isolation. In our study, we indicated tenotomy followed or not by tenodesis for lesions that compromised 50% or more of tendon thickness, for instability in the bicipital groove or for the finding of degenerative SLAP lesion. For the indication of tenodesis after the LHB tenotomy, the most diverse subjective criteria are used. Godinho et al.⁶ and some other authors recommend tenodesis in young, active patients less than 50 years of age. Walch et al.² recommend not to perform isolated LHB tenotomy in patients under 55 years of age. Szabó et al.⁸ suggest tenodesis for more active patients and those under 60 years of age. There are authors who suggest avoiding isolated tenotomy of LHB in young patients without mentioning age. Checchia et al.⁹, recommends the isolated LHB tenotomy only in elderly patients. In our study, the age criterion was not used.

The LHB isolated arthroscopic tenotomy has some advantages, among which the following are cited: the lower morbidity of the procedure, fewer complications, faster performance, less interference with rehabilitation, and lower cost.^{2,10} However, the technique presents as disadvantages the deficiency of tension control in LHB, muscle atrophy, flexion and supination strength deficit of the elbow, painful popping in the intertubercular groove and, the main one of them, the aesthetic deformity in the arm after the distal migration of the LHB tenotomy.

Concerned with the residual aesthetic deformity of the patients, some authors analyzed the frequency of aesthetic complaint where LHB had been tenotomized. Boileau et al.⁷ found 66.6% of aesthetic complaint in their patients after the isolated LHB tenotomy. Maynou et al.¹¹ noted only 5% of aesthetic complaint. Lim et al.¹² found 45%; Delle Rose et al.,¹³ 37.5%; De Carli et al.¹⁴ 17% and Checchia et al.⁹ 8.3%. Slenker et al.¹⁵ carried out a systematic review of the literature. They observed that the presence of aesthetic deformity occurred in an average of 43% of the patients with isolated LHB tenotomy. We published a study in 2008¹⁶ evaluating the aesthetic complaint after the isolated LHB tenotomy and we verified 35.1% of aesthetic complaint by the patient, with no statistical difference for the different ages evaluated. However, male patients with BMI below 30 kg/m² and operated on the dominant UL showed a significantly higher

prevalence of aesthetic complaint. Kelly et al.⁴ also found a higher frequency of aesthetic complaints among men. On the other hand, Osbahr et al.¹⁷ did not find difference between sexes.

The aesthetic deformity may also occur after tenotomy followed by tenodesis.¹⁸ Godinho et al.⁶ verified 11.1% of aesthetic complaint by the patient after tenotomy followed by "rocambolé" tenodesis. Checchia et al.,¹⁹ suturing the LHB in the rotator cuff lesion, verified 6.6% of aesthetic complaint.

Some authors have studied the perception of aesthetic deformity by the medical professional. Walch et al.,² followed the results of 307 LHB tenotomies and reported the difficulty in evaluating the presence of deformity in obese or elderly patients with weak muscle tone, eventually classifying them as dubious. In general, they verified the aesthetic deformity in 50.2% of their casuistry. Godinho et al.⁶ demonstrated that the ability to verify the residual deformity of the Popeye deformity is more concise in the professional. They used an independent examiner to assess the presence of the deformity after performing the LHB tenotomy associated with "rocambolé" tenodesis. The professional verified the aesthetic deformity in 31.8% of the patients. Almeida et al.²⁰ analyzed the perception of aesthetic deformity after LHB tenotomy by different categories of professionals. They found that professionals specialized in shoulder surgery perceived the aesthetic deformity more frequently than general orthopedists and fellow residents and that, when obese patients were analyzed (BMI > 30 kg/m²), the greatest capacity of perception of the deformity by the specialists was lost.

The absence of standardization and criteria that define the patients who must present more or less complaints of the residual aesthetic deformity after LHB tenotomy motivated the study. Using as an objective criterion, the BMI > 30 kg/m² to perform the isolated LHB tenotomy we verified a 12.5% of aesthetic complaint in our patients. The result is about 1/3 of the amount of aesthetic complaint perceived

in the study previously published in 2008 (35.1%).¹⁶ We believe that this criterion can be used with a certain degree of safety leaving both the medical professional and the patient, satisfied with the aesthetic aspect of the upper limb after the treatment of the bicipital pathology. We have not found studies comparing different LHB tenodesis techniques with regard to the ability to avoid Popeye's aesthetic deformity. Godinho et al.⁶ verified the perception of aesthetic deformity by 11.1% of the patients using the "rocambolé" technique, without relation to the age group, sports practice or associated injury of the subscapularis tendon and its repair.

In our study, although there was a reduction in the perception of aesthetic deformity by the patient in "rocambolé" tenodesis, this was not significant. Also when we verified the difference of perception of aesthetic deformity by the medical professional, we did not find statistical significance.

We believe that it is extremely difficult to find objective criteria to avoid aesthetic complaint, due to subjectivity influenced by various personal, psychological and social factors. We considered bias of our study the limited number of the sample and the lack of randomization in the choice of patients.

CONCLUSION

The BMI 30 can be used as a cut-off point in decisions about whether or not to perform LHB tenodesis, leading to low rates of aesthetic complaint by patients.

The "rocambolé" tenodesis technique seems to be more capable of avoiding the aesthetic deformity of the arm after LHB tenotomy, according to the observation of the patients, although the finding was not significant. The evaluation of aesthetic deformity by specialists in shoulder surgery did not show a difference between the two techniques of tenodesis.

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