Histology of the Biceps in Patients with Chronic Tendinitis Treated with Subpectoral Tenodesis

Damián Arroquy,[*,,#] Juan Martín Botta,[*,#] Juan Manuel Barrios,[*,**] Luciano Mañero,[*] Nadia González,[#] Gustavo Zanelli,[#] María Pía Silvestrini[#]**

[*]*Orthopedics and Traumatology Service, Clínica María Auxiliadora (Olavarría, Buenos Aires, Argentina)*

[**]*Orthopedics and Traumatology Service, Hospital Etchegaray (Gral. La Madrid, Buenos Aires, Argentina)*

[#]*School of Medicine, UNICEN (Olavarría, Buenos Aires, Argentina)*

ABSTRACT

Introduction: The objective of the present study was to evaluate the morphological changes in the intra- and extra-articular area of the long head of the biceps in patients who had undergone subpectoral tenodesis. **Methods:** We included 9 patients with a diagnosis of biceps tendinitis, who underwent subpectoral tenodesis of the long head of the biceps. The removed portion of the biceps tendon was placed in 10% formalin and divided into 2 segments. The proximal area extended from the supraglenoid insertion to the proximal edge of the pectoralis major and the distal area corresponded to the insertion of the pectoralis major. The segments were histologically evaluated using the Bonar score. **Results:** Macroscopically, all the tendons were found to be thickened in the proximal region. In the histological evaluation, among the most relevant variables evaluated by the Bonar score, the cell morphology score in the proximal area was significantly higher than in the distal area (p <0.0001). **Conclusion:** Our findings showed higher levels of pathology within the proximal biceps, supporting the elimination of this segment for chronic biceps tendinopathy, which can be accomplished through subpectoral tenodesis.

Key words: Biceps; histology; subpectoral tenodesis.

Level of Evidence: IV

Histología del bíceps en pacientes con tendinopatía crónica tratados con tenodesis subpectoral

RESUMEN

Introducción: El objetivo de este estudio fue evaluar los cambios morfológicos en la zona intrarticular y extrarticular de la porción larga del bíceps de pacientes sometidos a una tenodesis subpectoral. **Materiales y Métodos:** Se incluyeron 9 pacientes con diagnóstico de tendinopatía de bíceps, a quienes se les realizó una tenodesis subpectoral de la porción larga del bíceps. La porción eliminada del tendón del bíceps se colocó en formalina al 10% y se dividió en 2 segmentos. Quedaron definidas la zona proximal, desde la inserción supraglenoidea hasta el borde proximal del pectoral mayor y la zona distal correspondiente a la inserción del pectoral mayor. Los segmentos se tiñeron con hematoxilina y eosina, y se evaluaron histológicamente utilizando el puntaje de Bonar. **Resultados:** Macroscópicamente todos los tendones estaban engrosados en la región proximal. En la evaluación histológica, entre las variables más relevantes evaluadas por el puntaje de Bonar, el puntaje de morfología celular en la zona proximal fue significativamente más alto que en la zona distal (p <0,0001). **Conclusiones:** Nuestros hallazgos mostraron niveles más altos de patología dentro del bíceps proximal, lo que respalda la eliminación de dicho segmento cuando se realiza un procedimiento para la tendinopatía crónica del bíceps, lo cual se puede lograr con una tenodesis subpectoral.

Palabras clave: Bíceps; histología, tenodesis subpectoral.

Nivel de Evidencia: IV

Received on April 6th, 2020. Accepted after evaluation on May 27th, 2020 • DAMIÁN ARROQUY, MD • damianarroquy@hotmail.com https://orcid.org/0000-0003-1045-7840

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INTRODUCTION

The treatment of chronic biceps tendinopathy remains controversial. This is due to the uncertain function of the biceps tendon at the shoulder.[1]

Recently, increased attention has been paid to the intra-articular portion of the biceps tendon as a source of pain due to a better understanding of the changes that occur in association with inflammation, subluxation, dislocation, and tendon rupture. On the other hand, the extra-articular portion of the tendon can also be a source of pain, and tenderness of the bicipital groove on physical examination is often indicative of pain from this area. At present, it is not clear whether this pain is associated with acute inflammation or with chronic degenerative changes of the tendon in the extra-articular area.[1-6]

Biceps tenodesis has been promoted as the procedure of choice for chronic biceps tendinopathy by many authors.[4,7-10] This intervention is based on the fact that anterior shoulder pain caused by the biceps is lessened when the long portion of the shoulder is removed from its proximal supraglenoid tubercle and transferred to the biceps groove. The anatomical location of the tenodesis (proximal or distal) and the method of fixation remains highly controversial. Studies have shown difficulties in evaluating the biceps tendon by arthroscopy throughout its entire trajectory and, as such, distal tenodesis techniques have the advantage of removing the biceps tendon from a potentially inflammatory extra-articular environment, either within the bicipital groove or closer to the musculotendinous junction.[9]

Since there is insufficient evidence for the ideal anatomical location of tenodesis, we believe that being able to define this through knowledge of the histological changes along the tendon would be of great importance.

The objective of the present study was to evaluate the morphological changes in the intra- and extra-articular area of the long head of the biceps of patients who underwent a tenotomy and subpectoral tenodesis.

MATERIALS AND METHODS

Between June 2017 and December 2018, nine patients with a diagnosis of biceps tendinopathy, isolated or associated with another pathology, were included. The patients underwent a subpectoral tenodesis of the long head of the biceps. Patients who had undergone concomitant shoulder procedures for instability, rotator cuff tears, or adhesive capsulitis were not excluded from the study. Five patients were men and four were women; the average age of the patients was 38.2 years (range, 26-52 years).

In addition to the increase in inflammatory fluid surrounding the biceps tendon, evidenced by magnetic resonance imaging, the determining symptom for its diagnosis and inclusion was pain in the bicipital groove accompanied by tenderness on palpation during physical examination. These findings were frequently accompanied by a combination of the Yergason tests and active compression[10] (Figure 1). Of the nine patients, six had undergone corticosteroid infiltration as symptomatic treatment within no less than 3 months after surgery in any case.

SURGICAL TECHNIQUE

The patients were placed in a beach chair position and treated with open subpectoral biceps tenodesis after arthroscopy. At the time of tenodesis, the arm was placed in external rotation and adduction. Then, the biceps groove was identified by palpation through a 4-5 cm approach in the axillary fold in all cases. Intraoperative anatomical findings from both arthroscopic and open visualization of the proximal biceps were recorded.

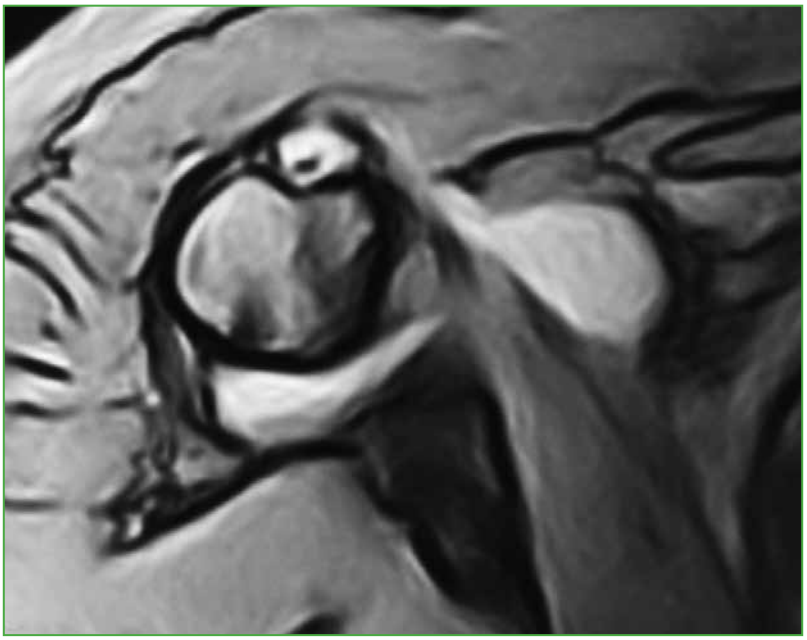

Figure 1. Magnetic resonance axial plane showing tendinitis of the long head of the biceps.

The tendon was collected and preserved in formaldehyde to be later sent to the pathologist for analysis (Figure 2). Patient information was coded and stored confidentially throughout the study. The patients gave their consent to participate in the study.

Figure 2. A 4-5 cm approach is observed at the level of the axillary fold and the biceps tendon.

HISTOPATHOLOGY

The removed portion of the biceps tendon was placed in a 10% formalin solution. After formalin fixation, each tendon was divided into 2 segments. Thus, the proximal area, which extends from the supraglenoid tubercle to the proximal edge of the pectoralis major, and the distal area, corresponding to the insertion of the pectoralis major, were defined (Figure 3).

Figure 3. Image of the formalin-fixed proximal half of the biceps.

The samples were histologically processed and 2 mm sections were obtained. They were stained with H&E and histologically evaluated using the Bonar[2] score for tendon pathology. It included the following items:

1) Cell morphology
2) Breakage of collagen bundles.
3) Vascular proliferation.
4) Increased mucin with histochemical mucicarmine (alcian blue).
5) Cellularity (hypocellularity is defined as less than 20 nuclei per 40x field and hypercellularity as more than 30 nuclei per 40x field).

STATISTICAL ANALYSIS

To determine the significant differences between the proximal and distal ends for each analyzed variable, the nonparametric Kruskal-Wallis test was used. A significance level of 0.05 was defined. The Insostat statistical program was used (Di Rienzo et al., 2015).

FINDINGS

Nine tendons were evaluated in longitudinal cuts. They were studied with serial cuts every 2 millimeters on the proximal and distal areas (four proximal and four distal inclusion blocks were made).

Intraoperative findings under arthroscopic view included type 1 SLAP tears, corresponding to non-specific degenerative changes of tenosynovitis in 7 patients, who presented concomitant rotator cuff injury. The two remaining cases presented type IV SLAP lesion. All tendons were observed in the correct position within the bicipital groove and, macroscopically, they were found to be thickened in the proximal region.

In the histological evaluation, among the most relevant variables evaluated by the Bonar score, cell morphology scores in the proximal area (2 ± 0) were significantly higher than in the distal area (1 ± 0) ($p < 0.0001$) . As for the broken or altered collagen scores in the proximal area (2.22 ± 0.67), they were significantly higher than in the distal area (0.88 ± 0.35) ($p < 0.0007$). Significant changes in vascular proliferation were also observed between the proximal area (1.89 ± 0.6) and the distal area (0 ± 0) ($p < 0.0001$). Regarding cellularity, it was significantly higher in the proximal area (1.67 ± 0.5) than in the distal area (1 ± 0) ($p < 0.009$). Regarding degeneration due to the presence of mucin, we obtained a higher score in the proximal area (1.25 ± 0.46) than in the distal area (0 ± 0), which was statistically significant (p 0.0001) (Figure 4 and Table).

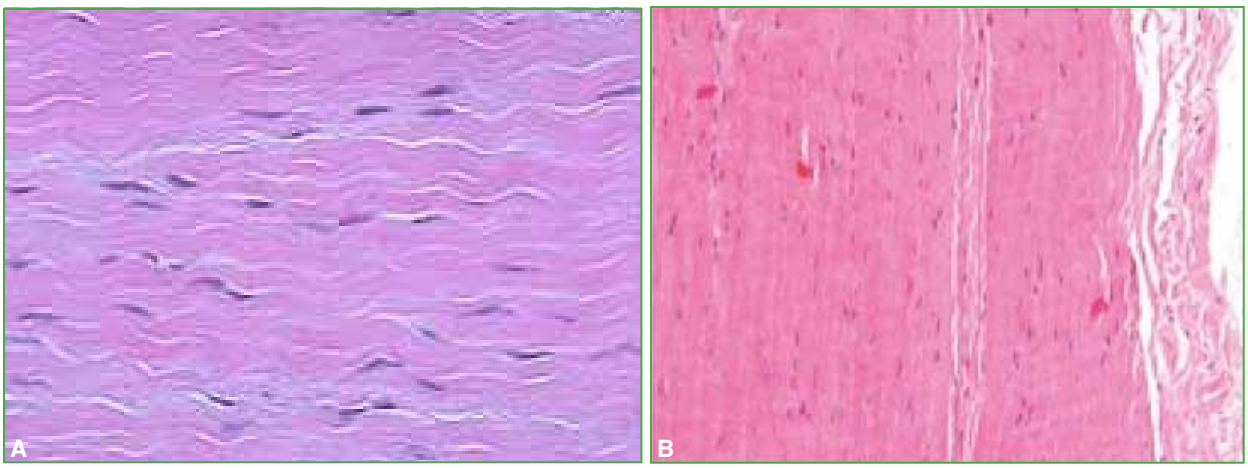

Figure 4. A. Microscopic image of the proximal area of the biceps showing cell proliferation and collagen alteration. **B.** Microscopic image of the distal area of the biceps with few cells and organized collagen.

Tabla. Summary of the statistical analysis

Variable	Group 1	Group 2	Average (1)	Average (2)	SD (1)	SD (2)	p
Morphology	Distal	Proximal	1	2	0	0	<0.0001
Collagen	Distal	Proximal	0.88	2.22	0.35	0.67	0.0007
Cellularity	Distal	Proximal	1	1.67	0	0.5	0.009
Vascularity	Distal	Proximal	0	1.89	0	0.6	<0.0001
Degeneration	Distal	Proximal	0	1.25	0	0.46	0.0001

SD = standard deviation

DISCUSSION

All studies show an improvement in clinical outcomes in patients with injury of the long head of the biceps, regardless of whether tenotomy or tenodesis is performed.[2-8] Tendon degeneration, more commonly known as tendinitis, histologically results in collagen atrophy, tendon fissures, fibrinoid necrosis, and fibrocyte proliferation.[4] The predominant cause of tendinitis is believed to be secondary to the mechanical irritation caused by the coracoacromial arch.[9] Therefore, injuries to the long head of the biceps may be closely related to rotator cuff abnormalities.[9] In our sample, 77.7% (7 patients) had concomitant rotator tears, which were the main reason why surgery was indicated.

Taylor et al. reported on the clinical importance of the extra-articular segment of the tendon and its "bicipital tunnel." In a cadaveric study, he showed that standard diagnostic arthroscopy only allows 55% of the long head of the biceps to be visualized. The latter would correspond to the proximal margin of the pectoralis major. This author then reported that 47% of the 277 patients with chronic refractory biceps tendinitis had extra-articular lesions affecting the biceps tendon that remained hidden from view during standard diagnostic arthroscopy.[11] Similarly, Gilmer evaluated the arthroscopic versus open comparison of biceps tendon pathology in patients requiring tenodesis and found that arthroscopic examination allows only 32% of the tendon to be visualized and may lead to an underestimation of the pathology. In a second study, Taylor et al. divided the biceps into 3 different anatomical zones: zone 1 extends from the articular margin to the margin of the subscapularis tendon, zone 2 within the bicipital area extends from the margin of the subscapularis tendon to the proximal margin of the pectoralis major and zone 3 extends from the subpectoral region to the musculotendinous junction.[12] Similarly to his findings, our study showed a significant amount of pathology within the proximal area of the biceps tendon. This provides evidence that higher levels of inflammation can occur in the proximal half of the tendon corresponding to the intra-articular and subscapularis areas, despite the fact that there are no significant intraoperative visual differences. This finding would potentially support the removal of at least the proximal half of the biceps when performing a procedure for chronic biceps tendinopathy.[9,12]

Mazzocca et al. evaluated histological changes in the biceps tendon in three different disease states: instability, tendinosis, and degenerative joint disease, while dividing the biceps into proximal (intra-articular) and distal (extra-articular) segments. This study showed a higher degree of degeneration of the proximal region of the tendon in all pathological groups.[9] As in their study, our findings showed higher levels of pathology within the proximal biceps, similar to those reported by Clayton, who additionally reported that the findings of the MRI and intraoperative view are not consistent with the histological alteration.[4]

The limitations of our study are the small size of the sample, the fact that the biceps samples were mostly associated with rotator cuff injuries of different sizes, some of which had previously been infiltrated with corticosteroids, and that the patients were very heterogeneous. For the reasons mentioned above, we believe it is necessary to continue with further research. On the other hand, the scant literature on histology of the entire trajectory of the long head of the biceps tendon is a strength of this study.

CONCLUSIONS

After the histological evaluation of the biceps tendon in patients with chronic tendinitis treated with subpectoral tenodesis, our findings showed higher levels of pathology within its proximal half, providing evidence that higher levels of inflammation may occur in the proximal half of the tendon corresponding to the intra-articular area and the subscapularis area. This would potentially support the removal of at least the proximal half when performing a procedure for chronic biceps tendinopathy, which can be achieved through a subpectoral tenodesis performed either openly or arthroscopically.

Conflict of interests: Authors claim they do not have any conflict of interests.

J. M. Botta ORCID ID: https://orcid.org/0000-0001-5858-4115
J. M. Barrios ORCID ID: https://orcid.org/0000-0002-1235-9788
L. Mañero ORCID ID: https://orcid.org/0000-0002-2102-5798
N. González ORCID ID: https://orcid.org/0000-0003-0132-1933
G. Zanelli ORCID ID: https://orcid.org/0000-0002-8101-0969
M. P. Silvestrini ORCID ID: https://orcid.org/0000-0002-7649-2318

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