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Original article

Magnetic resonance imaging without contrast as a diagnostic method for partial injury of the long head of the biceps tendon☆

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ABSTRACT

Objective: To evaluate the use of magnetic resonance imaging (MRI) without contrast as a diagnostic method of partial lesions of the long head of the biceps, using arthroscopic surgery as the gold standard.

Methods: We evaluated data from MRI and arthroscopic surgical findings of patients operated due to rotator cuff and SLAP injuries. MRI without contrast of at least 1.5 T, with a radiologist report, was used as a criterion for the detection of long head of the biceps injury. All cases were operated by the same surgeon at this hospital.

Results: This study evaluated data from 965 patients, 311 women (32%) and 654 men (68%), with a mean age of 45 years, who underwent arthroscopic surgery for rotator cuff and SLAP repair from September 2012 to September 2015. Overall, the sensitivity and specificity of MRI was 0.22 (CI: 0.17–0.26) and 0.98 (CI: 0.96–0.99), respectively.

Conclusions: MRI has a low sensitivity and high specificity for detection of partial tears of the long head of the biceps tendon.

Avaliação da ressonância magnética sem contraste como método para diagnóstico de lesões parciais do tendão da cabeça longa do bíceps

Palavras-chave:
Sensibilidade e especificidade
Manguito rotador
Imagem por ressonância magnética

RESUMO

Objetivo: Avaliar a ressonância magnética (RM) sem contraste como método diagnóstico da lesão parcial da cabeça longa do bíceps com o uso da cirurgia artroscópica como padrão ouro.

☆ Study conducted at the Hospital Orthoservice, Grupo de Ombro e Cotovelo, São José dos Campos, SP, Brazil.

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Métodos: Foram avaliados dados de RM e achados cirúrgicos artroscópicos de pacientes operados devido à lesão do manguito rotador e à lesão do alto do labrum de anterior para posterior (do inglês *superior labral anterior to posterior* SLAP). Foi usado como critério de detecção de lesão da cabeça longa do bíceps ressonância magnética sem contraste de no mínimo 1,5 Tesla, com laudo de radiologistas. Todos os casos foram operados por um único cirurgião em nosso hospital.

Resultados: O estudo avaliou dados de 965 pacientes, 311 mulheres (32%) e 654 homens (68%), com média de 45 anos, que se submeteram a cirurgia artroscópica para reparo do manguito rotador e da SLAP, entre setembro de 2012 e setembro de 2015. De forma geral, a sensibilidade e a especificidade da RM fora, de 0,22 (IC:0,17 a 0,26) e 0,98 (IC: 0,96 a 0,99), respectivamente.

Conclusões: A RM tem baixa sensibilidade e alta especificidade para detecção de roturas parciais do tendão da cabeça longa do bíceps.

Introduction

Injuries of the long head of the biceps tendon are common in patients with shoulder pain; surgery is required in approximately half of cases. Pathological changes of the long head of the biceps tendon include tenosynovitis, partial rupture, complete rupture, subluxation, and dislocation.[1,2]

Although in most cases the lesion of the long head of the biceps is part of a syndrome or is associated with other conditions, it is not uncommon to identify it as the sole cause of shoulder pain.[3–5]

Magnetic resonance imaging (MRI) is routinely used as a method to assess cases of shoulder pain and diagnose rotator cuff injury and injuries of the long head of the biceps. The literature on the effectiveness of MRI without contrast consists of small case series that examined biceps injury, but as a secondary objective.[1,6] There are only four studies that specifically examined the validity of MRI without contrast in the detection of partial injuries of the long head of the biceps tendon as the primary goal, none of which were conducted in Brazil.[3,7–9]

This study aimed to assess the use of MRI as a diagnostic method for partial rupture of the long head of the biceps tendon. Arthroscopic surgery was adopted as the gold standard (Fig. 1).

Material and methods

Data from 965 patients operated at a single center by a single surgeon were retrospectively evaluated. Data from the MRI report of patients who would undergo arthroscopic surgery for rotator cuff repair or SLAP lesions were recorded, with special attention to the description of the conditions of the long head of the biceps. After arthroscopy, data on the long head of the biceps were recorded in cases of partial rupture of its fibers.

Inclusion criteria comprised patients with a diagnosis of rotator cuff injury or SLAP injury, who had undergone MRI without contrast of at least 1.5 Tesla, with a radiologist report, and who had undergone arthroscopic shoulder surgery.

Patients with MRI of less than 1.5 Tesla, with a diagnosis of instability of the glenohumeral joint, with complete rupture of the long head biceps, and those who had undergone previous surgery, in which tenotomy or tenodesis of the long head of the biceps was performed, were excluded from the study. Cases of previous surgery that did not approach the long head of biceps were not excluded.

Arthroscopic treatment

All surgical procedures were performed by the same surgeon, with patient under general anesthesia and nerve block, in the beach chair position. Both glenohumeral joint and subacromial space were examined, which allowed for the assessment of the glenoid labrum, rotator cuff, and long head of the biceps. The long head of the biceps tendon was directly visualized and inspected for tendinitis and partial or total rupture. Only the exams in which there was partial rupture of the fibers of the long head of the biceps tendon were considered as positive.

Statistical analysis

Surgical findings were recorded in 2×2 tables as true and false positives and true and false negatives for partial rupture of the biceps tendon. Tables were created to determine sensitivity, specificity, predictive values, likelihood ratio, and odds ratio, which were calculated by Excel. A 95% confidence interval was considered for the analysis of all data. Pearson's correlation coefficient was used to assess the correlation between the severity of the condition and the presence of partial damage, through Excel. Values between 0 and 0.3 were considered as a weak correlation; between 0.3 and 0.6, moderate correlation; and greater than 0.6, strong correlation. To assess this relationship, the Mann–Whitney test was also used in the Minitab program.

Results

Data were collected from 965 patients, 311 women (32%) and 654 men (68%), mean age 45 years, who underwent

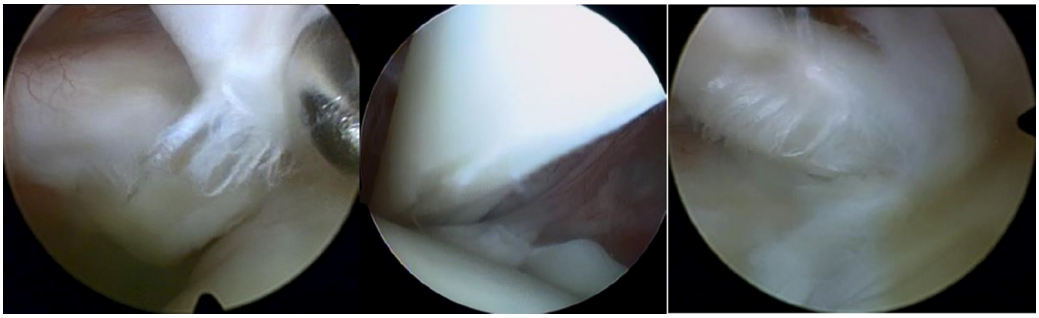

Fig. 1 – Examples of partial lesion of the long head of the biceps seen on arthroscopy.

Table 1 – Effectiveness of MRI for the diagnosis of lesions of the long head of the biceps.

	No IO lesion	IO lesion	Total
No MRI lesion	615	263	878
MRI lesion	14	73	87
Total	629	336	965
Sensitivity	22%	CI (0.17–0.26)*	
Specificity	98%	CI (0.96–0.99)*	
Accuracy	71%	CI (0.68–0.74)*	
Positive predictive value	84%	CI (0.74–0.91)*	
Negative predictive value	70%	CI (0.67–0.73)*	
Positive likelihood ratio	9.8	CI (5.6–17.0)*	
Negative likelihood ratio	0.8	CI (0.76–0.85)*	
Diagnostic odds ratio	12.2	CI (6.8–22.0)*	

IO, intraoperative; MRI, magnetic resonance imaging.
* 95% confidence interval.

arthroscopic surgery for rotator cuff injury repair and SLAP from September 2012 to September 2015. The results obtained from the assessment of all patients together were compiled in Table 1. The prevalence of lesions of the long head of the biceps was 0.35 (CI: 0.32–0.38). Patients were divided into four groups, depending on the disorder concerned and the severity of the injury: SLAP injury (Table 2); partial rotator cuff tear (Table 3); rotator cuff tear <3 cm (Table 4); and rotator cuff tear >3 cm (Table 5).

The prevalence of complete rotator cuff tears was 33% (319/965) throughout the sample, with 53% partial rotator cuff tears (513/965) and 14% SLAP lesions (133/965). Of the complete tears, 7% (70 of 965) were larger than 3 cm and 26% (249 of 965) were smaller than 3 cm. The prevalence of partial lesion of the long head of the biceps was 9% (12 of 133) in SLAP injuries, 28% (144 of 513) in partial supraspinatus lesions, 48% (119 of 249) in complete lesions of the supraspinatus smaller than 3 cm, and 87% (61 of 70) in lesions greater than 3 cm. Pearson's coefficient showed a moderate correlation (0.38) between the severity of the injury and the presence of partial injuries of the long head of the biceps. The Mann–Whitney test showed a statistically significant value for this correlation, with $p < 0.0001$.

Table 2 – Effectiveness of MRI for the diagnosis of lesions of the long head of the biceps, when associated with SLAP lesions.

	No IO lesion	IO lesion	Total
No MRI lesion	117	9	126
MRI lesion	4	3	7
Total	121	12	133
Sensitivity	25%	CI (0.08–0.53)*	
Specificity	97%	CI (0.92–0.98)*	
Accuracy	90%	CI (0.85–0.95)*	
Positive predictive value	43%	CI (0.11–0.79)*	
Negative predictive value	93%	CI (0.86–0.96)*	
Positive likelihood ratio	7.56	CI (1.9–29.9)*	
Negative likelihood ratio	0.78	CI (0.56–1.08)*	
Diagnostic odds ratio	9.75	CI (1.9–50.4)*	

IO, intraoperative; MRI, magnetic resonance imaging.
* 95% confidence interval.

Table 3 – Effectiveness of MRI for the diagnosis of lesions of the long head of the biceps, when associated with partial lesion of the supraspinatus tendon.

	No IO lesion	IO lesion	Total
No MRI lesion	364	110	474
MRI lesion	5	34	39
Total	369	144	513
Sensitivity	24%	CI (0.17–0.31)*	
Specificity	99%	CI (0.97–0.99)*	
Accuracy	78%	CI (0.74–0.82)*	
Positive predictive value	87%	CI (0.72–0.95)*	
Negative predictive value	77%	CI (0.73–0.80)*	
Positive likelihood ratio	17.4	CI (6.9–43.7)*	
Negative likelihood ratio	0.77	CI (0.7–0.85)*	
Diagnostic odds ratio	22.5	CI (8.6–58.9)*	

IO, intraoperative; MRI, magnetic resonance imaging.
* 95% confidence interval.

Table 4 – Effectiveness of MRI for the diagnosis of lesions of the long head of the biceps, when associated with complete lesion of the supraspinatus tendon <3 cm.

	No IO lesion	IO lesion	Total
No MRI lesion	125	90	215
MRI lesion	5	29	34
Total	130	119	249
Sensitivity	24%	CI (0.17–0.32)*	
Specificity	96%	CI (0.91–0.98)*	
Accuracy	62%	CI (0.56–0.68)*	
Positive predictive value	85%	CI (0.68–0.94)*	
Negative predictive value	58%	CI (0.51–0.64)*	
Positive likelihood ratio	6.34	CI (2.53–15.8)*	
Negative likelihood ratio	0.79	CI (0.70–0.87)*	
Diagnostic odds ratio	8.05	CI (3.0–21.6)*	

IO, intraoperative; MRI, magnetic resonance imaging.
* 95% confidence interval.

Table 5 – Effectiveness of MRI for the diagnosis of lesions of the long head of the biceps, when associated with complete lesion of the supraspinatus tendon >3 cm.

	No IO lesion	IO lesion	Total
No MRI lesion	9	54	63
MRI lesion	0	7	7
Total	9	61	70
Sensitivity	11%	CI (0.05–0.21)*	
Specificity	100%	CI (0.7–1.0)*	
Accuracy	23%	CI (0.13–0.33)*	
Positive predictive value	100%	CI (0.56–1.0)*	
Negative predictive value	14%	CI (0.07–0.26)*	
Positive likelihood ratio	NC		
Negative likelihood ratio	0.89	CI (0.8–0.96)*	
Diagnostic odds ratio	NC		

IO, intraoperative; MRI, magnetic resonance imaging.
* 95% confidence interval.

Discussion

In the literature, studies that assess imaging methods for the diagnosis of partial lesions of the long head of the biceps are rare. Almost all studies evaluate the accuracy of these tests only for complete injuries of this tendon. Literature review retrieved only four studies that specifically examined validity of MRI without contrast in the detection of partial damage to the long head of the biceps tendon as primary goal.[3,7–9]

The present study showed that MRI without contrast has high specificity for partial lesions of the long head of the biceps tendon, but low sensitivity. There appears to be an agreement

among studies reporting lower sensitivity and higher specificity of MRI in detecting pathologies of the long head of the biceps.[7] In their study, Houtz et al.[10] observed low sensitivity, which ranged from 7% to 33%, versus specificity values ranging from 95% to 100% in the 31 cases of alterations of the long head of the biceps out of 104 cases evaluated by MRI without contrast, regardless of the radiologists' place of work (community *vs.* academia). Nourissat et al.[11] addressed only tendinopathy in the intra-articular portion of the long head of biceps and reported a sensitivity of 43% and a lower specificity value (75%). Beall et al.,[3] with a sample size of 111 patients, reported sensitivity and specificity of 52% and 86%, respectively, for total or partial ruptures of the long head of the biceps, with a prevalence of 21% (23 of 111). In partial ruptures of the long head of the biceps, previous studies are consistent with the low sensitivity observed in the present study.[7,11] Mohtadi et al.,[1] who examined the long head of the biceps in a prospective study of 58 patients, observed a prevalence of partial lesions of 19%, with sensitivity and specificity of 50% and 70%, respectively. Dubrow et al.[7] reported a sensitivity of 28% and specificity of 84% for the detection of partial rupture of the long head of the biceps. Mohtadi et al.[1] reported sensitivity of 0% and a specificity of 94% for full-thickness biceps tendon tear.

Partial ruptures remain a challenge for diagnosis by MRI without contrast due to several reasons. The long head of the biceps is subject to an MRI artifact that occurs in the cranial portion of the intertubercular groove, which is surrounded by collagen and appears hyperintense, and thus can be mistaken for a pathological change.[12]

The anatomy of the rotator interval is complex, and rotator cuff tears may hinder the interpretation of the long head of the biceps due to fluid that extends to the region. Another factor is that positioning the patient with the arm in internal rotation increases the difficulty of assessing the tendon.

In the present study, the reduced sensitivity values in patients with rotator cuff tears larger than 3 cm indicate that the most serious injuries probably add difficulty to diagnosis of injuries of the long head of the biceps. In their study, Razmajou et al.[9] found results similar to those of the present study, demonstrating that the severity of the rotator cuff injury decreases the sensitivity of the MRI to detect the biceps injury. In the present study, rotator cuff injuries that appeared more severe at the MRI presented lower sensitivity; in these cases, the prevalence of partial ruptures of the long head of the biceps presents its highest value. Therefore, as also shown in other studies, the severity of the rotator cuff injury (retraction of the tendon, muscle atrophy, and fat infiltration) may result in underestimation of the biceps injury and contribute to lower sensitivity.[13]

Some considerations should be made in relationship to the present study. As it was a retrospective study, it presents the inherent shortcomings of this type of study. Another issue is the fact that the scans were interpreted by radiologists from the community, who were not necessarily trained to interpret musculoskeletal MRIs; nonetheless, some studies have failed to identify differences in MRI interpretation by academic and community radiologists.[10] As a positive aspect, this study had a significant sample of 965 patients; to the best of the authors' knowledge, that is the largest sample in the subject.[1–14]

Conclusion

MRI without contrast has low sensitivity and high specificity for the detection of partial lesions of the long head of the biceps tendon. In partial rotator cuff injuries, complete small-and-medium lesions smaller than 3 cm, and in SLAP lesions, MRI sensitivity is a little better, but still far from optimal. The higher the severity of the rotator cuff injury, the lower the sensitivity of MRI for the diagnosis of partial rupture of the long head of the biceps tendon.

Conflicts of interest

The authors declare no conflicts of interest.

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