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Original article

Comparative analysis on arthroscopic sutures of large and extensive rotator cuff injuries in relation to the degree of osteopenia☆

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ABSTRACT

Objective: To analyze the results from arthroscopic suturing of large and extensive rotator cuff injuries, according to the patient's degree of osteopenia.
Method: 138 patients who underwent arthroscopic suturing of large and extensive rotator cuff injuries between 2003 and 2011 were analyzed. Those operated from October 2008 onwards formed a prospective cohort, while the remainder formed a retrospective cohort. Also from October 2008 onwards, bone densitometry evaluation was requested at the time of the surgical treatment. For the patients operated before this date, densitometry examinations performed up to two years before or after the surgical treatment were investigated. The patients were divided into three groups. Those with osteoporosis formed group 1 ($n = 16$); those with osteopenia, group 2 ($n = 33$); and normal individuals, group 3 ($n = 55$).
Results: In analyzing the University of California at Los Angeles (UCLA) scores of group 3 and comparing them with group 2, no statistically significant difference was seen ($p = 0.070$). Analysis on group 3 in comparison with group 1 showed a statistically significant difference ($p = 0.027$).
Conclusion: The results from arthroscopic suturing of large and extensive rotator cuff injuries seem to be influenced by the patient's bone mineral density, as assessed using bone densitometry.

☆ Work developed at Hospital Saúde and in the Orthopedics Residency Service of Hospital Pompeia, Caxias do Sul, RS, Brazil.

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Análise comparativa da sutura artroscópica de lesões grandes e extensas do manguito rotador com relação ao grau de osteopenia

Palavras-chave:
Densidade óssea
Osteoporose
Bainha rotadora
Ombro

RESUMO

Objetivo: analisar o resultado da sutura artroscópica das lesões grandes e extensas do manguito rotador (MR) de acordo com o grau de osteopenia do paciente.

Método: coorte prospectiva nos pacientes operados a partir de outubro de 2008 e retrospectiva nos demais. Foram analisados 138 pacientes submetidos à sutura artroscópica de lesões grandes e extensas do MR entre 2003 e 2011. Aos pacientes operados a partir de outubro de 2008 era solicitada uma densitometria óssea (DO) por ocasião do tratamento cirúrgico. Nos pacientes operados antes de outubro de 2008, pesquisaram-se densitometrias feitas dois anos antes ou após o tratamento cirúrgico. Os pacientes foram divididos em três grupos. Os com osteoporose formaram o grupo 1 ($n = 16$), os com osteopenia o 2 ($n = 33$) e os normais o 3 ($n = 55$).

Resultados: ao analisar o escore da Universidade da Califórnia em Los Angeles (UCLA) do Grupo 3 e compará-lo com o Grupo 2, não foi verificada uma diferença estatisticamente significativa ($p = 0{,}070$). Ao analisar o Grupo 3 e compará-lo com o Grupo 1, foi verificada uma diferença estatisticamente significativa ($p = 0{,}027$).

Conclusão: o resultado da sutura artroscópica das lesões grandes e extensas do MR parece sofrer influência da densidade mineral óssea do paciente avaliada por meio de DO.

Introduction

Development and dissemination of arthroscopic suturing techniques for the rotator cuff have made shoulder arthroscopy one of the most frequently performed procedures in orthopedic surgical centers.[1,2] The great challenge is to identify risk factors that might interfere with the postoperative evolution of each patient, especially in the view of large and extensive nature of rotator cuff injuries. Identification of these risk factors has so far been subjective and dependent on professional experience.

Some risk factors have already been described in the literature. The patient's age at the time of the surgical procedure seems to have an influence on healing and on gains relating to range of motion and muscle strength.[3,4] Other variables such as sex,[5] smoking,[6–10] tendon quality shown on magnetic resonance imaging,[11] humerus-acromion distance <7 mm shown on X-rays[12] and impairment of the long head of the biceps have been considered to be deleterious for the final result from the treatment.[13–17]

Some data regarding bone mass losses from the greater tubercle induced by rotator cuff injuries have been published in the literature.[18–20] These data, along with some mechanical studies, suggest that osteopenia may have a deleterious effect on the postoperative healing of the rotator cuff.[11,21,22] We were unable to find any data analyses on the relationship between the bone loss inherent to aging and the results from arthroscopic suturing of the rotator cuff.

The aim of the present study was to comparatively analyze the results from arthroscopic suturing of rotator cuff injuries, according to the patient's degree of osteopenia measured through bone densitometry.

Methods

This was a prospective cohort study on patients operated from October 2008 onwards and a retrospective cohort study on the remainder.

A total of 138 patients who underwent arthroscopic suturing of large and extensive rotator cuff injuries[23] between January 21, 2003, and February 4, 2011, were assessed.

After general anesthesia had been induced, the patient was positioned in lateral decubitus with the upper limb abducted at 30°, flexed at 20° and under traction of 5 kg. The joint distension technique comprised use of physiological serum in suspension for the patients operated up to January 2006 and use of a joint distension pump from this date onwards.[24] Arthroscopic suturing of the rotator cuff injury was always performed by the same surgeon.

All the patients were immobilized while still anesthetized, in the surgical theater, using a sling together with an abduction pad.

For the purposes of analyzing the degree of osteopenia among the patients who were operated from October 2008 onwards, bone densitometry was requested as a preoperative examination. The patients operated before October 2008 were asked about any densitometry examinations that had been performed up to two years before or after the surgical treatment on the shoulder.

All patients who underwent complete arthroscopic closure of the rotator cuff injury and whose operations were not more than 12 months before the assessment data were evaluated. All of these patients had a bone densitometry examination that was considered to be valid, which was performed not more than two years before or after the date of the surgical treatment.

Table 1 – Groups according to the degree of osteoporosis.

	n	Densitometry	Diagnosis
Group 1	16	−3.90 to −2.50	Osteoporosis
Group 2	33	−2.49 to −1.01	Osteopenia
Group 3	55	−1.00 to 4.00	Normal

All patients under the age of 40 years, those who were smokers, those whose rotator cuff injury closure was partial and those who underwent revision surgery were excluded.

For the purposes of the statistical analysis, the lumbar and femoral T values from bone densitometry were used. Patients were considered to present osteopenia if they were in the range of −2.49 to −1.01 in one or both measurements. They were considered to present osteoporosis if they were below −2.49 and were considered normal if they were above −1.01.[25–28] The patients were divided into three groups according to their densitometry values and degree of osteopenia (Table 1). These with osteoporosis formed Group 1 ($n = 16$); those with osteopenia, group 2 ($n = 33$); and normal individuals, group 3 ($n = 55$).

The results were evaluated by means of the UCLA scale.[29,30]

The variables studied were sex, age, degree of osteopenia, UCLA index and muscle strength.

The data were analyzed using the SPSS software (Statistical Package for the Social Sciences), version 19.0 (SPSS Inc., 2011). For the statistical analysis, calculations of medians, interquartile intervals, frequencies and percentages were used. To make comparisons, the Mann–Whitney *U* test and chi-square test were used. Differences with $p < 0.05$ for a 95% confidence interval were considered significant.

Results

This study evaluated 138 shoulders that were operated, of which 34 were excluded. Thus, the study sample comprised 104.

The median length of the postoperative evaluation was 30 months (minimum of 12 and maximum of 97). The mean age was 60.7 ± 8.3 years. In relation to sex, 35 patients (33.6%) were male and 69 (66.4%) were female.

The groups were analyzed regarding the proportions of male and female patients (Table 2). The three groups were considered to be similar, although female patients predominated in group 2 ($p = 0.009$).

Table 2 – Sex in relation to osteoporosis.

	Diagnosis	n	Gender n (%)		p[a]
			Male	Female	
Group 1	Osteoporosis	16	4 (25.0)	12 (75.0)	0.233
Group 2	Osteopenia	33	7 (21.2)	26 (78.8)	0.009
Group 3	Normal	55	26 (47.3)	29 (52.7)	0.680

[a] Chi-square with Yates correction.

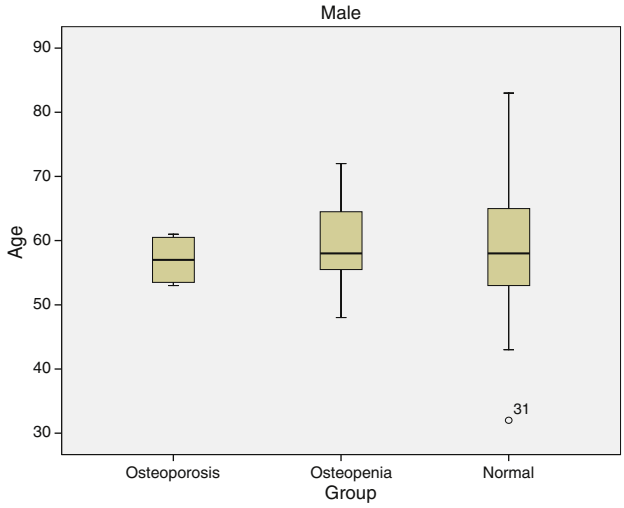

Fig. 1 – Ages of the male patients.

The groups were analyzed regarding age group according to the patients' sex (Table 3). The groups were considered to be similar (Figs. 1 and 2).

In analyzing the UCLA score of group 3 (55 patients; 52.8%) and comparing this with the score of group 2 (33; 31.7%), no statistically significant difference in the results was observed ($p = 0.070$) (Table 4).

In analyzing the UCLA score of group 3 (55 patients; 52.8%) and comparing this with the score of group 1 (16; 15.5%), a statistically significant difference in the results was observed ($p = 0.027$) (Table 5).

In analyzing the UCLA score of group 3 and comparing this with the scores of groups 2 and 1, no statistically significant difference in the results was observed ($p = 0.746$) (Table 6).

The column of values relating to the strength of anterior flexion on the UCLA scale in groups 3 and 1 was analyzed separately. Patients with values of 4 and 5 were considered to have

Table 3 – Age group in relation to osteoporosis.

	Diagnosis	n	Median age (years) (IIQ[a])		p[b]
			Male	Female	
Group 1	Osteoporosis	16	57.0 (53.5–60.5)	64.5 (56–70)	0.129
Group 2	Osteopenia	33	58.0 (55.5–64.5)	59.5 (55–68)	0.708
Group 3	Normal	55	58.0 (53–65)	53.0 (53–65)	0.846

[a] IIQ, interquartile range.
[b] Mann–Whitney *U* test.

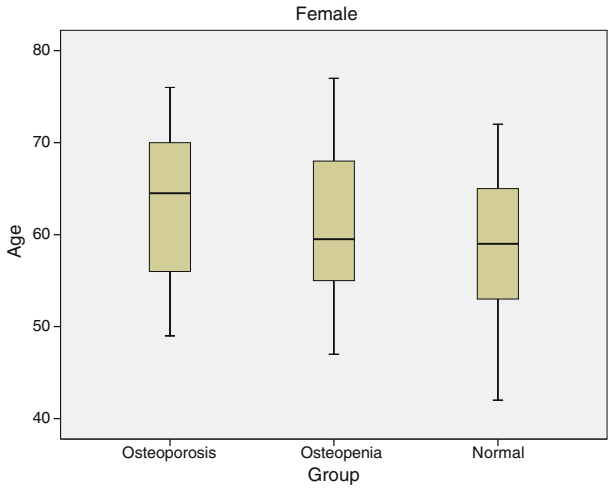

Fig. 2 – Ages of the female patients.

Table 4 – Comparison between normal and osteopenic groups.

UCLA	Normal $n = 55$	Osteopenic $n = 33$	p[a]
Median (IIQ[b])	30 (27–32)	32 (29–34)	0.070
Minimum	9	16	
Maximum	35	35	

[a] Mann–Whitney *U* test.
[b] IIQ, interquartile range or amplitude.

Table 5 – Comparison between normal and osteoporotic groups.

UCLA	Normal $n = 55$	Osteoporotic $n = 16$	p[a]
Median (IIQ[b])	30 (27–32)	27 (21.5–29)	0.027
Minimum	9	12	
Maximum	35	35	

[a] Mann–Whitney *U* test.
[b] IIQ, interquartile range or amplitude.

recovered their strength, whereas those with values from 0 to 3 were considered to present altered strength (i.e. they had not recovered). Comparison of the strength values between the groups using the UCLA scale did not show any statistically significant difference in the results ($p = 0.165$) (Table 7).

Table 6 – Comparison between normal group and osteopenic and osteoporotic groups together.

UCLA	Normal $n = 55$	Group 1 + group 2 $n = 49$	p[a]
Median (IIQ[b])	30 (27–32)	30 (27–32)	0.746
Minimum	9	12	
Maximum	35	35	

[a] Mann–Whitney *U* test.
[b] IIQ, interquartile range or amplitude.

Table 7 – Analysis on muscle strength.

Densitometry	Strength n (%)		p[a]
	Altered	Normal	
Osteoporosis	11 (68.8)	5 (31.2)	0.165
Normal	27 (49.1)	28 (50.9)	

[a] Chi-square with Yates correction.

Discussion

Surgical treatment of rotator cuff injuries presents varying results that depend on the type and size of the injuries sutured. Injuries classified as large and extensive according to Cofield[23] are the ones that present the worst results, with the greatest numbers of cases of failure to heal and reopening.[17,31–33] These are therefore the injuries that most evidently demonstrate the influence of factors for worse prognoses.[17]

The ages of the patients operated has already been studied by several authors as an important prognostic factor, especially for individuals over the age of 65 years.[3,4,34] Thus, we chose to exclude patients under the age of 40 years, among whom no basis for studying osteoporosis would exist.[25] We took care to evaluate the patients' ages in the three groups so that the sample would be as homogenous as possible.

With regard to sex as a predictive factor for the result, it has been found that women's expectations and concerns interfere more significantly with the postoperative recovery.[6] We evaluated the groups in relation to the numbers of men and women. Even though women predominated in group 2, all the groups were considered to be similar from a statistical point of view.

There is controversy in the literature with regard to whether smoking is a factor giving a poor prognosis for the results from surgical treatment of the rotator cuff. Boissonnault et al.[35] did not demonstrate any negative impact from smoking on the postoperative results from rotator cuff suturing. However, most authors have shown that smoking has a deleterious effect on these patients' microvascularization, healing and final clinical results.[7–10,36,37] In accordance with the trend among the majority of articles in the literature, we excluded smokers.

Charousset et al.[11] and Miyazaki et al.[16] studied tendon quality at the time of tendon suturing and observed that injuries that were sutured early on, i.e. before muscle atrophy and fatty degeneration had become established, evolved with better clinical results. In our study, we did not include the parameter of the time interval between the injury and the suturing because of difficulty in obtaining this information and its imprecision.

The bone loss inherent to aging has been recognized as giving rise to higher incidence of fractures in the third age.[38] On the other hand, osteoporosis does not seem to delay fracture healing, provided that the fractures have been adequately stabilized.[39]

In shoulders that have been affected by rotator cuff injuries, there is a decrease in bone mass centered on the region of the greater tubercle, due to loss of the stimulus of tendon traction. It has been found that patients who are able to improve their

rotator cuff function through conservative treatment present less localized bone loss.[19]

Galatz et al.[20] demonstrated that there was a deterioration in tissue healing properties in the group of patients for whom tendon injury repair was late, which coincided with bone mass loss in the greater tubercle. These results, which were also seen by Charousset et al.,[11] indicate that bone mass loss in the greater tubercle may be an important factor leading to poor healing.[11,20]

Mechanical studies on cadavers and studies on animal models have demonstrated a relationship between loss of bone mineral density and failure of tendon sutures.[21,22] Brown et al.[21] demonstrated that low bone mineral density in the greater tubercles of cadavers that underwent operations was a significant factor favoring reopening after arthroscopic suturing of the rotator cuff. Cadet et al.[22] demonstrated that when the bone density in the region of the rotator cuff insertion of rats that received bisphosphonates was improved, the time taken for the tendon suture to fail through stress was prolonged.

Evaluation of bone mineral density directly in the proximal humerus requires special software that is not available in most bone densitometry services in our setting. Densitometry is an examination performed to evaluate patients' bone mineral density and, through well-defined criteria, helps in managing prevention and treatment for osteoporosis.[28] To enable our study, we used evaluations on lumbar and femoral T measurements, which indirectly assess patients' bone mineral density. From these results, the patients were stratified into three groups: normal, osteopenic and osteoporotic. The statistical analysis showed that the patients in the group with densitometric values within the range for osteoporosis presented worse clinical results on the UCLA scale than did those with densitometric values with the range of normality ($p = 0.027$). This was the main outcome from our study, given that we did not find any other studies in the literature that had correlated the results from arthroscopic suturing of large and extensive rotator cuff injuries with the patients' bone mineral density.

Boileau et al.[3] found that healing occurred in only 43% of the patients over the age of 65 years who were operated. Similar results were found by Favard et al.[34] Godinho et al.[4] observed that the gains in muscle strength were more inconsistent among patients over the age of 60 years, which suggests that tissue healing at the tendon suture was not taking place. There is a direct relationship between recovery of muscle strength and healing of the suture after the surgical procedure.[20] However, we were unable to demonstrate this relationship in a statistically significant manner when we compared the item that evaluated muscle strength on the UCLA scale of the groups with normal and osteoporotic densitometric values ($p = 0.165$).

We can state that the sources of bias in our study consisted of the fact that high-resistance thread only started to be used in our sample in 2006 and that we used an indirect measurement to evaluate the patients' bone mineral density, by means of lumbar and femoral bone densitometry. It is possible that direct assessment of bone mass in the proximal humerus or use of quantitative tomography (osteoabsorptiometry) would have reached different results.

Conclusion

The results from arthroscopic suturing of large and extensive rotator cuff injuries seem to be influenced by the patients' bone mineral density, as assessed by means of the bone densitometry technique available in our setting. Patients with osteoporosis present worse clinical results, as assessed using the UCLA scale.

Conflicts of interest

The authors declare no conflicts of interest.

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