ABSTRACT

Background: Calcific tendinitis affects up to 7% of the population and is the cause of about 20% of the painful shoulders.

Despite the high prevalence of this disease, there is a lack of studies with long term follow-up about the association of calcific tendinitis with rotator cuff tears and shoulder arthritis.

The primary outcome of this study was to evaluate the prevalence of the gleno-humeral arthritis in patients affected by calcific tendinitis with a minimum follow-up of 10 years.

Secondary outcomes were to present the long-term clinical results associated with the management of this pathology and to assess the prevalence of rotator cuff tears.

Methods: Thirty five patient were evaluated, with a mean follow up of 13 years.

Demographic data were recorded: affected side, age, gender, BMI, smoking, trauma, type of treatment, concomitant systemic or musculoskeletal diseases.

The clinical evaluation was performed using the Constant-Murley Score, American Shoulder and Elbow Surgeons Score and the Numeric Rating Scale.

Each patient underwent an ultrasound and a radiographic evaluation.

Results: The the mean age was 58.89 (± 7.9) years at follow up and 45 years (± 13.9) at diagnosis.

Our data showed a prevalence of diabetes of 3% and a prevalence of autoimmune diseases of 25%.

The prevalence of gleno-humeral arthritis was 17.14% in the study populations and the arthritis progressed in 14.29% of these shoulders.

Full thickness tears of the rotator cuff were not found under ultrasound evaluation.

The x-ray examination showed residual calcifications in 31 patients, with a diameter ranging from 2 mm to 20 mm (mean diameter 5.54 mm). In 30 cases there was a reduction of the diameter, in 4 cases the calcification increased in size and in 1 case the size did not change.

There were no differences in terms of pain and functionality between untreated patients and those treated with corticosteroids injection and shock waves therapy.

Discussion: Results of this study did not find an increased incidence of osteoarthritis and rotator cuff tears in patients with calcific tendinitis over 10 years from the diagnosis. The lower scores obtained by our patients do not seem to be related to the presence of these pathologies, but we suppose that they could be due to the persistence of residual calcifications not efficiently treated at the onset with consequent chronicity and persistence of symptoms.

Study Design: Cohort Study, Level of evidence 3.

Keywords: shoulder, rotator cuff, calcific tendinitis, long term follow-up

INTRODUCTION

Calcific tendinitis, also known as Duplay disease, is a common cause of shoulder pain, especially in middle-aged female population[1–4]; in particular, patients typically report severe pain and significant limitation of range of motion, without an history of trauma[5,6].

The etiopathogenesis of calcific tendinitis is still highly discussed, but is hypotized to be due to low blood perfusion in tendon tissue with decrease of local oxygen partial pressure, leading to fibroblast metaplasia with resultant production and deposition of calcium hydroxyapatite within rotator cuff tendons[3,7].

Despite being a self-limiting disorder, whose symptom relief is usually obtained within few weeks, hydroxyapatite deposits could remain for many months and, in some cases, for years[8,9] . These crystals may potentially affect tendon structures, causing rotator cuff tears and subsequent arthritic evolution[10,11] .

Most of the studies in literature have explained the clinical and radiological history of calcific tendinitis at short and mid-term follow-ups[12–16] evaluating the biological effect of hydroxyapatite calcium on surrounding tissues and the effect on shoulder kinematics.

Few studies have analyzed the evolution of hydroxyapatite deposits on rotator cuff tendons at long term follow-up after the diagnosis [17–19], but there are no studies that research or hypothesize the possible evolution of calcific tendinopathy of the shoulder in osteoarthritis.
This lack of data in literature can make it difficult to clearly establish the association of calcific tendinitis and the development of gleno-humeral arthritis.

On these bases, the aim of this study was to evaluate the prevalence of gleno-humeral arthritis and rotator cuff tears in a cohort of patients affected by calcific tendinitis, at least ten years after the diagnosis, and to present the long-term clinical results associated with its management.

MATERIALS AND METHODS

The primary aim of this prospective clinical trial on an historical cohort was to assess the prevalence of gleno-humeral arthritis in patients affected by calcific tendinitis at a minimum follow-up of ten years after the diagnosis using radiological evaluation.

Secondary outcomes were to evaluate the prevalence of rotator cuff tears through ultrasound examination and to assess shoulder pain and function using the Constant-Murley Score (CMS)[20] the American Shoulder and Elbow Surgeons Score (ASES)[21] and the Numerical Rating Scale (NRS)[22] .

The study protocol was approved by the Regional Ethical Committee ([redacted]).

A single researcher performed an internal database search in November 2017 to find all the patients who referred to the emergency department of our institution between August 2001 and June 2008 with clinical and radiographic diagnosis of calcific tendinitis.

The patients were identified using specific numeric code (ICD-9 code: 726,11) used in emergency setting to classify this pathology.

Patients affected by calcific tendinitis confirmed both by clinical report and x-ray, diagnosed between 30 and 60 years 8 (in order to have an homogeneous sample) and with a follow-up of ten years or more were included in the study.

Patients were excluded when the x-rays were not available, or if the images available did not support the diagnosis of calcific tendinitis.

A telephone interview was conducted to inquire if each selected patient had undergone treatments on the shoulder**,** to collect NRS, ASES score, and to assess subjective satisfaction.

Patients were then invited for a functional and radiological evaluation of the affected shoulder.

The following data were collected: affected side, dominant side, age, gender, date of diagnosis, age at diagnosis, BMI at follow-up, smoking, type of job (light or hard physical demand), trauma, type of treatment (shock waves therapy and/or subacromial corticosteroids injections, conservative treatment such as physical therapy or NSAIDs), diabetes, bilateral shoulder pain, inflammatory diseases, and other systemic or musculoskeletal diseases.

During the clinical evaluation, the CMS was collected and isometric strength in shoulder forward flexion and abduction was measured.

All measures were performed in triplicate with a dynamometer (Kern HCB, Kern & Sohn GmbH, Germany) between October 2017 and October 2018.

Each patient also underwent shoulder radiographs (standard true anteroposterior and lateral views) and an ultrasound examination of the rotator cuff, performed with the high-frequency linear transducer (12.5 MHz) of a Samsung RS80A Prestige ultrasound system by a senior radiologist.

On standard anteroposterior shoulder x-rays views, the presence of shoulder osteoarthritis was classified according to Samilson-Prieto classification[23], and the presence of calcifications and the calcium deposits were measured on x-ray with IMPAX 6.5.2 and distinguished by morphology and density using the Gärtner classification[13] both in baseline and final control (Fig.1).

The possible relationships between the evidence of arthritis progression and the following variables were investigated: a) size of calcifications, b) type of calcifications according to the Gärtner classification, c) presence of rotator cuff lesions, d) specific treatment performed.

The ultrasound examination was performed by a dedicated musculoskeletal radiologist (M.B.G.) and used to define rotator cuff tendons integrity with Hinsley classification[24].

This classification considers three different grades of lesion: a) normal tendon, b) abnormal tendon without partial or full thickness tears, c) partial thickness tear, and d) full thickness tear (subgrouped in longitudinal tear < 2.5 cm; transverse tear > 2.5 cm and large full thickness tear > 2.5 cm).

The presence of subacromial bursitis, biceps tendon tenosynovitis and calcifications were also recorded.

Statistical analysis

Statistical analysis (A.M.) was performed with GraphPad Prism software (v 6.0; GraphPad Software Inc) and SAS software (v 9.4; SAS Institute, Inc).

The differences between the groups of patients for continuous variables were evaluated with the unpaired Student t test or Mann-Whitney test according to the characteristics of the data distribution.

Categorical variables were evaluated with the chi-square test or Fisher exact test.

For all analyses, the significance level was set at P \ .05.

RESULTS

Baseline demographics

One hundred ninety one patients satisfied the age-related inclusion criteria and were eligible for the follow-up evaluation**.** All patients where called using the numbers available in internal database.

Seventy nine patients were available for a telephonic interview, and forty six patients also agreed to return to our institution for clinical and radiological evaluation.

Eleven patients were further excluded because of the lack of baseline radiographs. Thirty five patients were finally included in the analysis.

A flow diagram illustrates the grouping and flow of patients in this clinical study (Fig. 2).

Demographic data of the group of patients who received a clinical and radiographic assessment are reported in Table 1.

The 74% of included patients were women, the mean age was 58.89 (± 7.9) years at the final follow-up of 13 years.

Thirty patients were right-handed, 2 left-handed and 3 were ambidextrous.

The calcifications afflicted the dominant side in 21 cases, in 14 cases the non-dominant side.

Regarding clinical comorbidities, we found a prevalence of diabetes of 3% and a prevalence of autoimmune diseases (rheumatoid arthritis, psoriatic arthritis, Hashimoto's thyroiditis, DM1, celiac disease, psoriasis) of 25%.

Eleven patients smoked at the follow-up and 14 at the baseline.

Seven patients were treated with corticosteroids injection, 8 patients underwent shock waves therapy, 11 were treated with both corticosteroid injections and shock waves, and 1 patient with ultra-sound guided percutaneous lavage.

Eight patients were treated just with oral painkillers and anti-inflammatories or physical therapy.

Gleno-humeral osteoarthritis

At the baseline we found radiographic signs of gleno-humeral osteoarthritis in 4 patients (grade 1 of Samilson-Prieto Classification).

At the final follow-up the prevalence of gleno-humeral osteoarthritis was 17.14% (6 patients).

The arthritis progression, defined as an increase of at least 1 grade in the Samilson-Prieto scale from the baseline to the follow-up was find in 5 patients (14.28%). Of these, two patients showed the ex-novo appearance of gleno-humeral osteoarthritis, in the other three patients osteoarthritis was already present at the diagnosis and has worsened.

Subgroup analysis: gleno-humeral arthritis

The study population was further divided in two different groups according to the gleno-humeral arthritis progression as classified by Samilson and Prieto: patients with arthritic changes and patients without arthritic changes.

A stratified analysis was performed comparing demographic and clinical data to find potential risk factors for arthritic evolution (Table 2, 3).

Our analyses revealed that samples were homogeneous for all the considered parameters, in fact no statistically significant differences were found for age, sex, BMI, follow up, affected side, dominant side, smoking, type of job, diabetes, autoimmune diseases and traumas (Table 2 and 3).

No statistically significant association was encountered between the gleno-humeral arthritis progression and the evaluated variables.

Although patients with arthritic changes showed a more relevant mean reduction of calcification diameter compared with non-arthritic patients (10.2mm vs 7.7mm), the differences in means between the two groups were not statistically significant.

Under ultrasound evaluation, patients with arthritis progression showed a higher percentage of degenerative manifestations on rotator cuff tendons, but the difference was not statistically significant.

No full thickness tears of the rotator cuff were found.

Subgroup analysis: type of treatment

Given the extreme treatment variability, patients were subsequently divided in two groups (treated: corticosteroid injections and/or shock waves therapy and percutaneous lavage; untreated: physical therapy, NSAIDs or nothing) and their clinical and radiological data were compared.

The mean variation of the calcification maximum diameter was 8.74 mm in the treated group compared to 5.63 mm in the untreated group, but no significant differences were noted. (Table 4).

Calcifications

At the diagnosis the calcifications had a diameter ranging from 5 mm to 27 mm with an average diameter of 12.9 mm.

The most affected tendon was the supraspinatus, followed by subscapularis.

Residual calcifications were observed in 31 patients (88.57%) with a diameter ranging from 2 mm to 20 mm (mean diameter 5.54 mm).

At the final follow-up, the residual calcifications in 8 cases had a diameter of less than 2 mm , in 13 cases had a diameter between 3 mm and 9 mm and in 4 cases a diameter greater than 10 mm.

In 30 cases we found a reduction of the diameter (with a mean percentage of reabsorption of 57%), in 4 cases the calcification increased in size and in 1 case the size did not change (Fig.3) .

Subgroup analysis: persistence of calcifications

Calcifications with a maximum diameter of less than or equal to 2 mm were compared to those greater than 2 mm in diameter for the following variables.

The mean ASES score was 74.1 in the group with larger calcifications and 89.4 in patients with smaller calcifications (p 0.08, n.s).

The NRS was 2.7 in the larger calcification group compared to 1.0 in the smaller calcification group (p 0.22, n.s.). (Table 5).

DISCUSSION

Primary outcome of this study was the evaluation of the prevalence of gleno-humeral osteoarthritis in patient affected by calcific tendinitis at 10 years from the diagnosis.

Radiological results did not show an increased prevalence of gleno-humeral osteoarthritis in our patients..

We found a prevalence of gleno-humeral osteoarthritis of 17.14%, similar to that estimated in the general Japanese population by Kobayashi et al.[25]

These authors observed a prevalence of about 15% in 541 subjects between 40 and 75 years old according to the Samilson-Prieto classification .

These results support that patients with calcific tendinitis seem to have the same risk of arthritic degeneration compared to the general population of the same age.

This study also investigated the prevalence of partial and full thickness rotator cuff tears.

The evaluation of rotator cuff tears using ultrasound did not showed full thickness tears in any patient, but only signs of cuff degeneration in ten patient.

Our results have shown a persistence of the calcification in the vast majority of the shoulder evaluated (88.57%) with a mean percentage of reabsorption of 57%.

This is a relevant finding in contrast to the belief that the natural history of this pathology leads to full reabsorption of the deposits[3].

Better outcomes were reported in the 4 patients without calcifications compared to those who had residual deposits, and their dimension have influenced negatively the outcome. It has been reported that patients with radiological improvement over years report better clinical outcomes[18].

We have supposed that the presence of calcific deposits alters shoulder biology leading to inflammation as synovitis and subacromial bursitis, influencing shoulder kinematics and bringing to slower or incomplete recovery.

Indeed, patients with smaller calcifications (diameter < 2 mm) showed better functionality of the shoulder during clinical evaluation and lower inflammatory signs on ultrasound images than those with bigger ones, but no significant difference between the groups was recorded.

Our findings are in agreement with those reported by other authors[18,26],where a close association between better clinical outcomes and absence of calcifications at long-term follow-up was observed.

Porcellini et al[26] reported similar results evaluating, clinically and with ultrasound, 63 patients affected by calcific tendinitis and treated by arthroscopic needling with a follow-up of 3 years.

They found the persistence of calcifications in 45 patients who presented the lower mean clinical scores, and they assessed that the outcome was inversely related to the number and size of residual calcifications

In our cohort of patients no statistically significant difference in terms of pain and functionality was found between patients subjected to conservative treatment and those who underwent to corticosteroids injections and shock waves therapy.

The latter group had only little more reabsorption of the calcification compared to untreated (66.9% of the original deposit in the treated versus 59.3% in the untreated).

Results about pain relief and recovery are in line to those obtained by De Witte et al.[17] who assessed the evolution of calcific tendinitis with a long-term follow-up and whose patients reached lower outcomes regardless of the treatment performed.

Regarding demographic characteristics, an increased prevalence of diabetes was not observed, whereas an association between these two pathologies is reported.[27]

The high prevalence of autoimmune diseases of about 25% in the included patients and an increased number of smokers compared to the general population (40%) are relevant data, reported in few previous manuscripts[28,29].

This group of pathologies and habits could probably influence the vascularity of the tendons leading to an increase of calcium deposits and to a decrease of tendons healing.

Our study has some limitations: first of all is the lack of a control group. The prevalence of gleno-humeral osteoarthritis, as well as that of cuff lesions, increases physiologically with age therefore the lack of a control group of healthy patients makes it difficult to demonstrate its appearance as an evolution of shoulder calcific tendinopathy.

Furthermore there is a lack of information regarding the prevalence of rotator cuff tears and shoulder osteoarthritis in a population similar for age and origin to our patients therefore we can't compare what we have found with this data.

The study design (prospective clinical trial on an historic cohort) did not allow to include a clinical and ultrasound assessment at the diagnosis that would have lead to a more accurate comparison with follow-up evaluation.

Furthermore included patients have been subjected to many different treatments over a long period of time (10 years). To obtain substantial results authors divided the patients in two groups, comparing those who underwent conservative treatment and those who were subjected to corticosteroids injections, shock waves therapy or needling. These groups include different treatments and a selection bias is present.

Another limitation of this study is the high number of patients unwilling or unable to return to our institution for the clinical and radiological evaluations: a study conducted with a larger sample population probably would have given more significant results. Therefore conclusions must be drawn with caution specially for subgroups which present a small patient cohort (i.e.: arthritic progression group, untreated group).

CONCLUSIONS

Results of this study did not show an increased prevalence of gleno-humeral osteoarthritis in patients affected by calcific tendinitis of the shoulder.

Tendon calcifications are present at more than 10 years of follow-up in the majority of the patients, in contrast with common knowledge of a self-limiting pathology[16,30].

The lower clinical outcomes obtained by patients included in this study do not seem to be related to the presence of gleno-humeral joint pathologies such as osteoarthritis or rotator cuff tears.

The persistence of residual calcifications could be the cause of persistence of minor symptoms at long term follow-up[26].

If the association between persistence of calcifications and long term follow-up symptoms will be confirmed, it would be interesting to see if a faster and more aggressive approach, such as percutaneous lavage or arthroscopic needling, could give better results than the conservative treatments to which our cohort of patients underwent.

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FIGURE LEGENDS

Fig.1. Residual calcification (Gartner Type 1). This patient was clinically and radiographically assessed after ten years from the diagnosis. The x-ray shows the absence of arthritic signs. **(FIGURA DA ELIMINARE)**

Fig.2. Flowchart.

Fig. 3. Bilateral calcific tendenitis showed on x-rays performed at the diagnosis (A-C) and after 10 years (B-D). The same treatment produced a different evolution: in the right shoulder there was the persistence of the calcification while in the left the treatment led to a complete resorption. **(FIGURA DA ELIMINARE)**

TABLE LEGENDS

Table 1. Patients' demographics.

Data are reported as mean (± SD), median [Q1-Q3] or frequency/ratio. BMI: body mass index; F/M: females/males; N: No; L/R: left/right, Q1: first quartile; Q3: Third quartile; SD: standard deviation; Y: yes.

Table 2. Subgroup analysis: arthritic progression and patient characteristics.

Data are reported as mean (± SD), median [Q1-Q3] or frequency/ratio. BMI: body mass index; F/M: females/males; N: No; n.s.: non-significant; R/L: left/ right, Q1: first quartile; Q3: Third quartile; SD: standard deviation; Y: yes.

Table 3. Subgroup analysis: arthritic progression and clinical and radiological results.

Data are reported as mean (± SD), median [Q1-Q3] or frequency/ratio. n.s.: non-significant; Q1: first quartile; Q3: third quartile; RC: Rotator cuff; SD: standard deviation; Y: yes; N: No.

Table 4. Subgroup analysis: type of treatment and clinical and radiological results.

Data are expressed as mean (± SD),or frequency/ratio. ASES: American Shoulder and Elbow Surgeons score; CMS: Constant-Murley Score; mm: millimeters; NRS: Numeric Rating Scale; n.s.: not significant; SD: Standard Deviation; Y: yes; N: No.

Table 5. Subgroup analysis: calcification diameter and clinical and radiological results.

Data are expressed as mean (± SD), median [Q1-Q3] or frequency/ratio. ASES: American Shoulder and Elbow Surgeons score; CMS: Constant-Murley Score; NRS: Numeric Rating Scale; n.s.: not significant; Q1: first quartile; Q3: third quartile; SD: Standard Deviation; Y: yes; N: No.