Original article

The Seebauer classification for the staging of rotator cuff massive tear arthropathy: intra- and interobserver concordance analysis

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ABSTRACT. *Introduction:* L Seebauer developed a radiologic classification of arthropathy due to massive rotator cuff tear, based on the medial and/or proximal displacement of the humeral head as a result of disease progression. The purpose of this paper is to conduct an evaluation of the concordance of such classification. *Methods:* A group of 34 patients with massive rotator cuff lesion was created. Their X-rays were reviewed and classified by 5 independent observers. An inter- and intraobserver concordance analysis was carried out using the Kappa index, and the results were interpreted according to the Landis and Kock criteria. *Results:* The intraobserver concordance determined for the 5 observers showed that the one with the greatest experience had an agreement close to 100%; the interobserver concordance found that only 2 of the 5 observers had moderate agreement and, finally, the interobserver concordance of the stages of classification 2A showed a substantial agreement, while a moderate agreement was found for IA and IB. *Discussion:* An important variability was found in the intraobserver concordance, where the capacity to reproduce the same results depends on the observer's experience. The results of the interobserver concordance show that the criteria established by Seebauer are insufficient to be reproduced. Finally, in the concordance among the

RESUMEN. *Introducción:* L Seebauer, desarrolló una clasificación radiológica de la artropatía por desgarro masivo del manguito de los rotadores, basándose en el desplazamiento medial y/o proximal de la cabeza humeral como resultado de la progresión de la enfermedad. El objetivo de este trabajo es realizar una evaluación de concordancia de dicha clasificación. *Métodos:* Se conformó un grupo de 34 pacientes con lesión masiva del manguito de los rotadores, sus estudios radiográficos fueron revisados y clasificados por 5 observadores independientes. Se realizó un análisis de concordancia inter e intraobservador con el índice Kappa y los resultados interpretados por los criterios de Landis y Koch. *Resultados:* La concordancia intra-observador determinada entre los 5 observadores mostró al observador con mayor experiencia con un acuerdo cercano al 100%; en la concordancia inter-observador encontramos que sólo 2 de los 5 presentaron un acuerdo moderado y finalmente la concordancia inter-observador entre los estadios de la clasificación 2A tuvo un acuerdo sustancial mientras que IA y IB sólo moderado. *Discusión:* Encontramos una variabilidad importante en la concordancia intra-observador donde la capacidad para recrear los mismos resultados depende de la experiencia del observador. Los resultados de la concordancia inter-observador permiten ver,

Level of evidence: IV (Act Ortop Mex, 2010)

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stages a moderate agreement was found in each of the stages. *Conclusion:* The results of this paper show that the Seebauer classification is experience-dependent, which hinders its routine use by orthopedists not sufficiently trained on shoulder surgery or by residents in training.

Key words: shoulder, classification, arthroplasty, rotator cuff.

que los criterios establecidos por Seebauer son insuficientes para ser reproducidos. Finalmente en la concordancia entre los estadios encontramos un acuerdo moderado entre cada estadio. *Conclusión:* Los resultados del presente muestran que la clasificación de Seebauer, es experiencia dependiente, lo cual dificulta su aplicación rutinaria por ortopedistas con poca preparación en el terreno de la cirugía de hombro o por los residentes en formación.

Palabras clave: hombro, clasificación, artroplastía, manguito de los rotadores.

Introduction

In 1983 Neer described the massive rotator cuff tear arthropathy as the final stage in the natural history of the massive rotator cuff tear. At this stage there is upper and anterior migration of the humeral head towards the subacromial space, together with degenerative changes in the humeral head, the glenoid and the acromion.[1] The diagnosis of massive rotator cuff tear is made considering the clinical picture and the findings of the imaging studies that allow to assess the severity of the injury according to different parameters, as is the case of Patte, who describes the injury according to its extension, number of tendons and their medial retraction towards the scapula;[2] Thomazeau with MRI or Goutallier with CT scan determine the extension and/or chronicity of the injury according to the degree of replacement of the muscle tissue of the rotator cuff by fatty tissue.[3,4] Not all patients with massive rotator cuff tear develop arthropathy, as Patte and Vad point out when they report a 60 to 75% rate in groups with osteoarthritis secondary to a massive rotator cuff tear.[2,5]

There are several ways of staging the massive rotator cuff tear arthropathy. Sirveaux described the glenoid erosion,[6] while Van de Sande and Nove-Josserand measure the acromiohumeral and coracohumeral intervals.[7,8] Hamada included different characteristics of the condition, such as the migration of the head through the acromiohumeral interval, the acetabulization of the coracoacromial arch, and the collapse of the humeral head.[9] Seebauer developed a biomechanical classification based on a radiologic criterion that depends on the center of rotation and the stability of the joint. The nomenclature may be divided into two large groups: I and II. It is determined according to the location of the humeral head center of rotation with respect to the glenoid center of rotation, while subgroups A and B are determined considering the stability of the humeral head. Based on these criteria, Seebauer proposed 4 stages: IA represents a stable joint with minimum migration due to an intact contention, with the presence of acetabularization of the coracoacromial arch and femoralization of the humeral head; IB adds the

presence of medial glenoid erosion that compromises the articular stability, but it remains contained; IIA involves superior translation of the humeral head and migration lf the articular center of rotation due to loss of anterior contention, it has minimum stability due to the coracoacromial arch; IIB shows an anterosuperior «leak» of the humeral head due to loss of anterior contention and of the coracoacromial arch.[10]

The purpose of this study is to carry out an intra- and interobserver concordance analysis of the Seebauer classification of massive rotator cuff tear arthropathy to see whether it can be generalized.

Methods

An intra- and interobserver concordance analysis was performed of the biomechanical-radiological classification proposed by Seebauer to stage the massive rotator cuff tear arthropathy. Patients with a diagnosis of massive rotator cuff tear proven with MRI, ultrasound or direct vision of the injury during the surgical procedure were enrolled in the study between January 1st and December 31st, 2005. Patients with a diagnosis of rotator cuff lesion associated with other conditions (avascular necrosis of the humeral head, sequelae of proximal humerus fracture or rheumatic arthropathy) were excluded from the study. A study group was formed to carry out a concordance analysis of the radiologic study (true AP X-ray of the affected shoulder) with 5 independent observers. This group consisted of a 4th year resident of Orthopedics (1), an orthopedic surgeon who was a student at the postgraduate course on shoulder and elbow reconstruction (2), two surgeons with 3 years of experience in shoulder surgery (3,4) and a surgeon with 20 years of experience in shoulder surgery (5). All patients' X-rays were digitalized and they were presented at random for classification purposes during two different sessions held with a two-week interval.

The information the observers were given was the diagnosis of a massive rotator cuff tear; they did not have any data on the history, age, gender, symptomatology or physical exam of the patients. The observers reviewed the X-rays

and stratified the injuries twice with a two-wee, interval between the sessions. The intra- and interobserver concordance was documented on both occasions.

A third presentation was held with all five observers, which resulted in a consensus on the 34 patients; this was used as a reference to compare the individual results of each observer. The X-rays were digitally saved and placed at random in both evaluations to avoid any memory bias; the order was known only by the first author (FGS). Finally, a consensus of the 5 observers was prepared and was used as a reference. The inter- and intraobserver concordance was assessed with the kappa index using the SPSS 16.0 software (SPSS Inc., Chicago, IL) for Windows and the coefficients were interpreted according to the Landis and Koch criteria.[11]

Results

The approval of the Research Committee of the institution was not required. A group of 34 patients with a diagnosis of massive rotator cuff tear who presented at the service during the above mentioned period was created.

The intraobserver concordance varied 0.26 in the case of observer 1, 0.55 for observer 2, 0.55 for observers 3 and 4, and 0.97 for observer 5. According to the Landis and Koch criteria a variation from discrete to almost perfect occurred among our observers *(Chart 1)*.

In the interobserver concordance analysis observer 1 had a kappa index of 0.20; observer 2, 0.29; observers 3 and 4, 0.29 and 00.41, respectively, and observer 5, 0.58. According to Landis and Koch, these results range from discrete to moderate. *Chart 2* shows the results.

To conclude, an interobserver concordance analysis was conducted to obtain a consensus among each of the studies and the Seebauer classification; we divided them as follows: Does not apply, IA, IB, IIA and IIB. Does not apply had a concordance of 0.42, IA of 0.57, IB of 0.47, and IIA of 0.61; considering Landis and Koch as a reference, we obtained a moderate agreement in all of them with the exception of IIA, where it was good. There were no IIB cases. *Chart 3* shows the results.
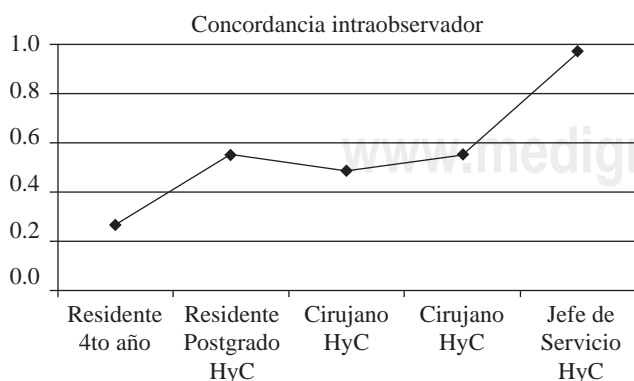
Chart 1. Muestra un acuerdo discreto en el observador con menor experiencia y casi perfecto en el de mayor experiencia. (HyC hombro y codo).
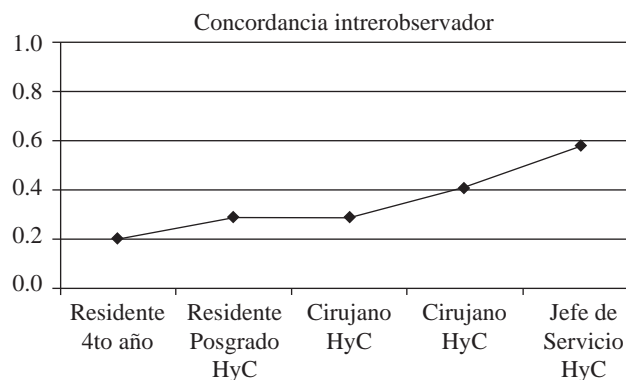
Chart 2. Muestra un acuerdo discreto en los observadores con menor experiencia y moderado en los de mayor experiencia. (HyC Hombro y codo).
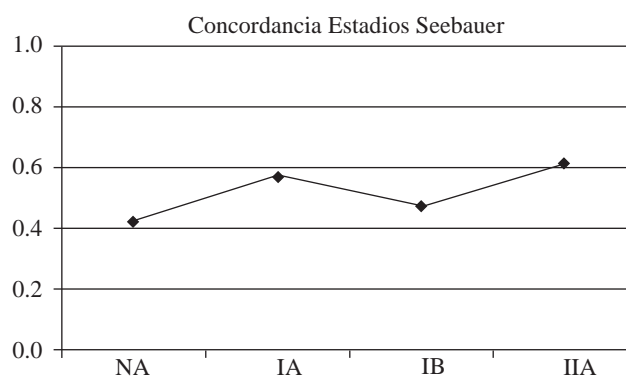
Chart 3. Muestra IIA con acuerdo sustancial y el resto con acuerdo moderado. Sin casos IIB.

Discussion

In our institution we stage the patients with massive rotator cuff tear according to the Seebauer classification to determine if they comply with the criteria of massive rotator cuff tear arthropathy.

In the concordance intraobserver analysis we found an important variability among our 5 observers. It was found that the variability depends on the surgeon's experience, since while our least experienced surgeon (1) had a concordance of 0.26, the one with the most experience (5) had 0.97. This leads us to believe that there is little consistency in each observer and the capacity to reproduce the same results depends on the surgeon's expertise.

In the evaluation of the interobserver concordance versus the consensus, we found that most observers (1, 2, 3), based on Landis and Koch, had a discrete agreement; only observers 4 and 5 had a moderate agreement when compared with the consensus. The aforementioned results indicate that the Seebauer criteria are not detailed enough to be consistently reproduced and generalized.

During the interobserver concordance analysis for each of the classification stages we could not include stage IIB

patients, since there were no such patients in the sample. There was a substantial agreement in stage IIA, while the rest of the stages only achieved a moderate agreement. We think that the criteria for each of the stages are not properly defined and this may be the main reason for a moderate-to-poor agreement among the observers.

It was not possible to compare the results with other studies because no concordance studies for massive rotator cuff tear arthropathy were found. Hamada described his classification before Seebauer did and he depiced the evolution of the condition. But his descriptions may be mistaken for avascular necrosis and, same as Seebauer, he did not include the prognostic factors.[9,10]

The only related paper is the one by Iannotti, who compares three classifications of massive rotator cuff tear arthropathy; he used 4 observers for this purpose, but all of them were experienced in shoulder surgery. Among others, one of his conclusions is that the Seebauer classification only achieves a discrete agreement which increases when other clinical criteria are included, and it is influenced by the observer's training and expertise; likewise, he refers to the difficulty in distinguishing among the stages, with the greatest difficulty being attributed to the distinction between IIA and IIB.[12]

We think that these results are important due to the high prevalence of massive tears, especially in asymptomatic patients. The cadaver work done by Reilly found 21% of massive tears and Milgrom found that 55% of the patients older than 55 years had massive tears.[13,14] Yao developed an algorithm for the treatment of massive rotator cuff tear arthropathy based on clinical findings like deltoid integrity or the presence of the coracoacromial arch.[15] We think that a classification including radiological and clinical criteria should be developed to determine which is the best management of this condition and to make the prognosis.

According to our results, the classification proposed by Seebauer has no consistency and cannot be easily reproduced with more than one observer, which turns it into clinically unspecific. We think that the differences among each of the stages in the classification are subtle, particularly between stages IA and IB, where the concept of medialization depends on the technical quality of the study or the discrete proximal migration does not consider the possibility of associated scapular dyskinesia. The former is important because the purpose of the Seebauer classification is to propose a treatment according to the stage of the disease – hemiarthroplasty, reverse arthroplasty, etc. – and thus achieve a successful result, as well as determining the prognosis of the condition.

The weaknesses of the paper are as follows: First, no standardized technique was used to take the radiological images, with the best option being a true AP X-ray with the patient standing up and with neutral shoulder rotation (Figure 1); second, the sample size and the fact that there were no stage IIB cases. To conclude, it is thought that the experience in this field of a 4th year resident or a surgeon with

Figure 1. True AP X-ray of the shoulder.

20 years of experience do not necessarily correspond to the experience of other 4th year residents or other surgeons with the same number of years of experience.

Conclusions

The Seebauer classification relies on a qualitative evaluation of the images, without considering other radiological measurements or findings. According to our results, this classification relies on each observer´s expertise in the field of shoulder surgery. We draw the conclusion that this classification is good to determine and stage the massive rotator cuff tear arthropathy, provided that the surgeon using it has received a special training on shoulder pathology, but it is not the best tool for the training physician who has not developed the necessary expertise to distinguish among each of the stages. We think that a modification of the classification to include qualitative and quantitative evaluations of the images as well as other parameters like the clinical findings would be useful to minimize the interobserver variability.

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