INTEROBSERVER CORRELATION IN CLASSIFICATION OF BONE LOSS IN TOTAL KNEE ARTHROPLASTY

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ABSTRACT

Objective: Considering the difficulty for classifying bone losses the present study was designed to analyze if the AORI classification based on pre-operative radiographies is consistent and reproducible between different orthopedic surgeons. Methods: Six orthopedists specialized in knee surgery were trained for the use of the classification based on radiographic evaluation. All the surgeons individually classified 26 pre operative knee radiographs. Results: There was a moderate (> 50%) matching of the classification in 24 of 26 cases in the femur and 22 of 26 in the tibia. A good matching (> 80%) was present in 12 of 26 cases in the femur and in 7 of 26 cases in the tibia. Conclusion: We observed that the AORI classification presented a moderate radiographic correlation between surgeons. Evidence of level III, Study of nonconsecutive patients; without consistently applied reference ''gold'' standard.

Keywords: Arthroplasty, Replacement, Knee. Radiography/ classification. Knee prosthesis.

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INTRODUCTION

The incidence of knee revision surgery has been growing year by year.[1] Revision of total knee arthroplasties is always challenging. There are several indications for the revision of a knee prosthesis such as: stiffness, pain and functional limitation without improvement with non-surgical treatment, evidence of considerable progressive bone loss in the radiography, patella fracture or dislocation, instability of components, infection and periprosthetic fractures.[2] Osteolysis, often present in knee arthroplasties, originates from various factors, the main one being wear and tear and release of small fragments (debris),[3,4] which induce inflammatory activity and osteoclastic activation at the interface with the bone. It has insidious and asymptomatic presentation, but is a precursor of loosening of the implants and can lead to mechanical instability.

Restoration of the joint line height, restoration of the knee joint center, obtainment of an adequate limb axis, restoration of range of motion and obtainment of adequate ligament balance are some of the challenges in revision arthroplasty. Bone losses make surgery difficult as they affect the stability and the alignment of the implant, so that the preoperative assessment to plan the correct handling of these defects becomes essential. The choice of the implant to be used is not always simple, and depends mainly on three factors: measurement of existing bone loss, ligament stability and function of the extensor mechanism. The evaluation of ligament stability and of knee extensor mechanism function can be performed effectively by the physical examination and by analyzing information relating to previous surgery and the imaging exams.

Dorr[5], Insall[6], Rand[7], Clatworthy[8] and Engh[9,10] proposed classifications to evaluate bone loss in the knee. It is observed, however, that the presence of the metallic implant hinders the evaluation and quantification of bone loss by radiographic interpretation, even for experienced surgeons. The classification proposed by Engh,[9,10] called Anderson Orthopedic Research Institute (AORI), is based on findings obtained after the removal of the total knee arthroplasty components. Nevertheless, bone loss can also be estimated in preoperative radiographies. The classification divides bone loss independently for the femur and for the tibia:

Degree I - metaphysis preserved without important defects. Articular interline preserved and slight osteolysis. Femur with condylar profile maintained and tibia with component above the fibular head and metaphysis intact. (Figures 1, 2 and 3).

Degree II - Important metaphyseal damage with significant loss of spongy bone. Divided into A (Figures 4, 5, 6 and 7),

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one condyle involved and B (Figures 8 and 9) both condyles involved. Femur with elevated articular interline and/or reduced condylar profile and tibia with tibial defect at the level of or slightly below the fibular head with partial loss of the metaphyseal format (flare).

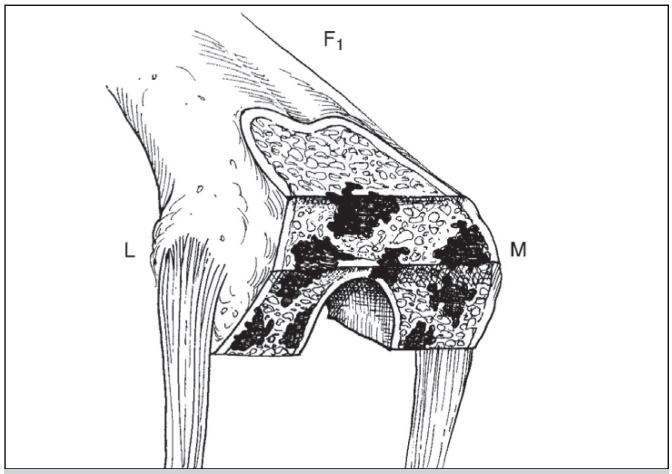

Figure 1. *Degree I defect in femur[9].*

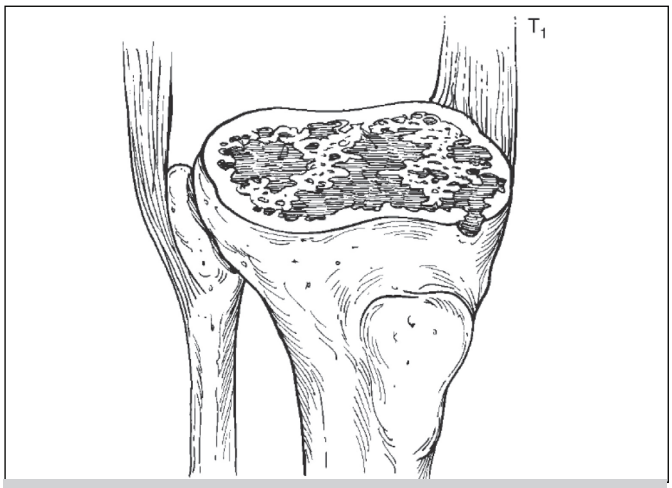

Figure 2. *Degree I defect in tibia[9].*

Figure 3. *Degree I defect in tibia.*

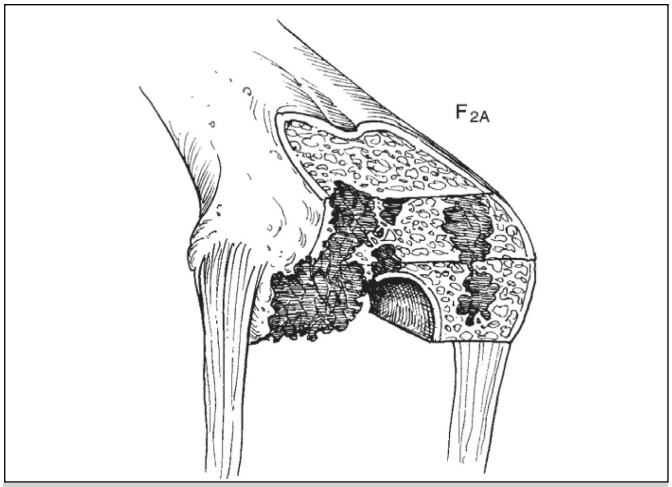

Figure 4. *Degree IIA defect in femur[9].*

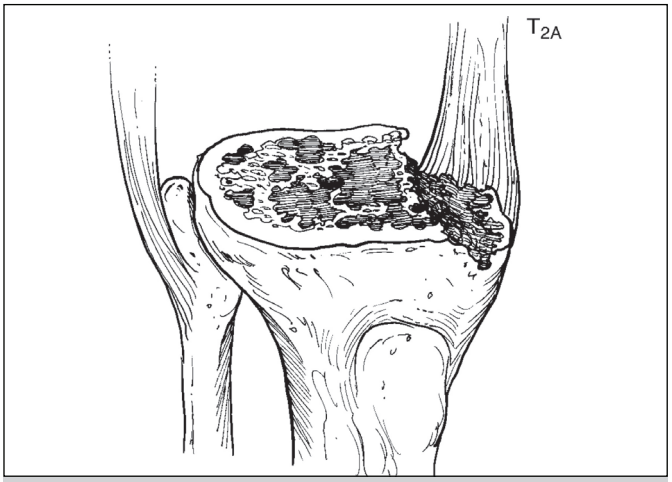

Figure 5. *Degree IIA defect in tibia[9].*

Figure 6. *Degree IIA defect in tibia.*

Figure 7. *Degree IIA defect in tibia.*

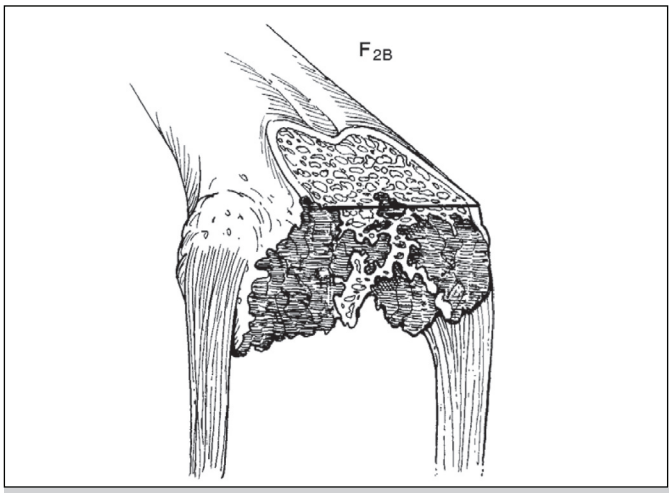

Figure 8. *Degree IIB defect in femur[9].*

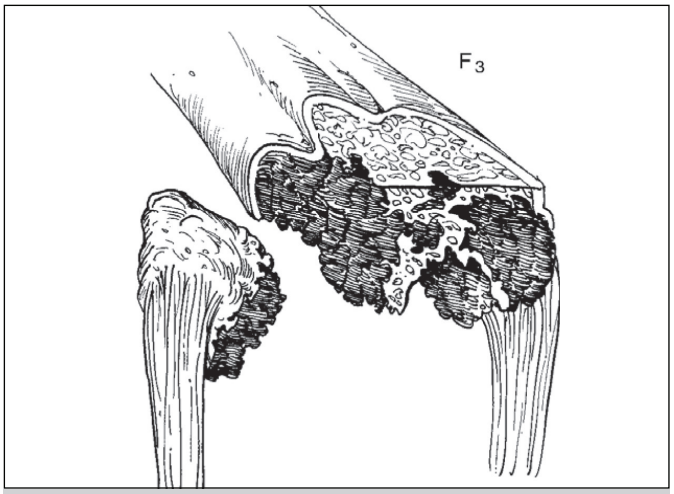

Figure 10. *Degree III defect in femur[9].*

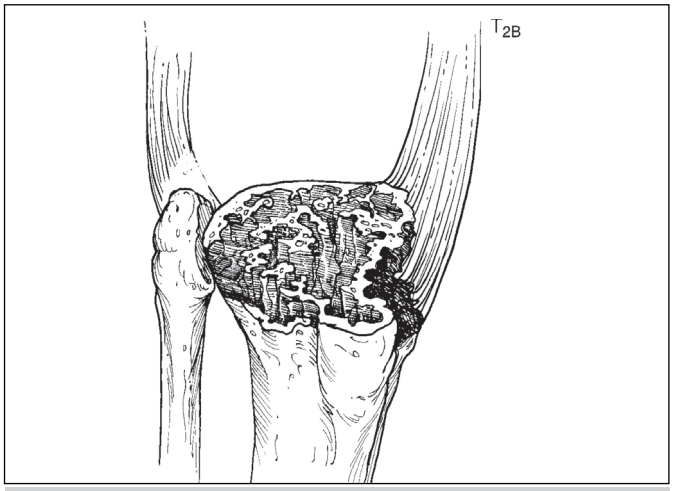

Figure 9. *Degree IIB defect in tibia[9].*

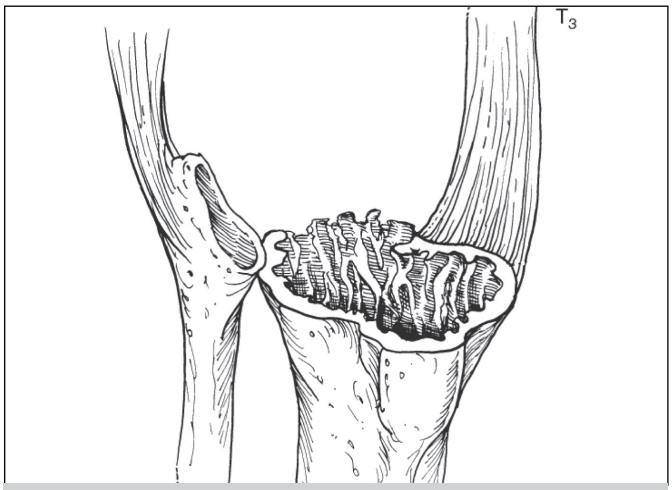

Figure 11. *Degree III defect in tibia[9].*

Degree III - Bone loss of most of the metaphyseal region. Common association with collateral ligament injury or patellar tendon avulsion. Femur with migration of components and osteolysis at the level of epicondyles and tibia with complete loss of the metaphyseal format with migration and osteolysis. (Figures 10, 11 and 12) Nowadays, several scientific articles, clinical trials including multicentric ones and treatment guideline protocols on knee revision surgery use the AORI classification for bone loss.[11-15]
Classifications should have the following main objectives: to standardize the language and communication on similar clinical situations, to enable the development of conduct protocols and to allow the comparative analysis of clinical data. The reproducibility of the classifications used in scientific studies and in treatment guideline flowcharts is essential for these to be comparable, and to allow their adequate clinical application.
Considering the difficulty in evaluating the preoperative radiography to classify bone defects, we consider it necessary to evaluate whether the bone loss classification is trustworthy and reproducible among different physicians. Thus, we proposed a study to evaluate interobserver correlation of the radiographic evaluation of bone defects based on the AORI classification.

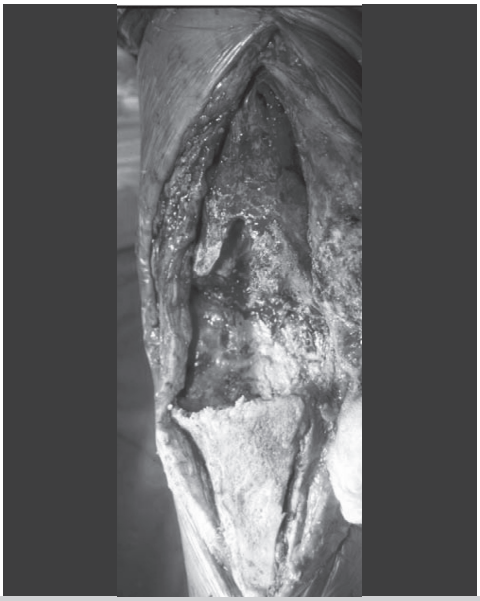

Figure 12. *Degree III defect femur and tibia.*

MATERIALS AND METHODS

Six orthopedists with subspecialization in knee surgery (members of SBOT – Brazilian Society of Orthopedics and Traumatology and SBCJ – Brazilian Society of Knee Surgery), who routinely supervise patients to perform revision total knee arthroplasty surgery at a large hospital - it performs more than 20 revision knee arthroplasty surgeries per year - were trained to use the AORI classification in preoperative radiographies. The training involved the distribution and reading of a scientific article with the classification, lessons with the use of multimedia resources and theoretical and practical discussions concerning the classification.

Twenty-six cases of TKA failure with indication of revision were selected for the study. All the radiographies were classified by all the participants, without identification of cases and without contact among the participants during the period used to classify them. The data were tabulated and the participants analyzed the frequency of each type in the classification and the frequency of coincidence of results, in turn split into groups: > 50%, >65%, > 80% and 100% of coincidence (cumulative).

RESULTS

Table 1 presents the frequency of each AORI classification category for each patient in the evaluation of the preoperative radiography by the 6 participant physicians.

Then the participants classified the frequency of coincidence of the classifications for each patient in the following categories:

- 100%: (6 physicians classified the same way);
- >80% (5 or more physicians classified the same way);
- >65% (4 or more physicians classified the same way);
- >50% (3 or more physicians classified the same way).

The results are summarized in Table 2.

It was verified that there was coincidence of >50% (moderate correlation) of the classification in 24 of the 26 cases in the femur and in 22 of the 26 cases in the tibia; and correlation of >80% (good correlation) in 12 of the 26 cases in the femur and in 7 of the 26 cases in the tibia.

It is also perceived that all the correlations were lower in considering the tibial evaluation in relation to the femoral evaluation.

DISCUSSION

Classifications for bone loss in knee arthroplasty are important and should be adopted in scientific studies and treatment protocols involving revision knee replacements.

Nowadays, people in Brazil and in other countries are discussing the adoption of national records on primary and revision arthroplasties. In the revision arthroplasty databases under implementation in Brazil it will be necessary to establish a standard classification of bone losses. This requires an analysis of the advantages and disadvantages of the various existing classifications. One of the indispensable aspects of the classifications used on a large scale is reproducibility among appraisers.

Moreover, the classification should be easy to learn and memorize and contemplate important aspects relating to bone losses while being simple. The method used to execute the classification should not imply additional costs for the health service, such as the performance of exams not used on a routine basis.

Our study aimed to analyze the AORI classification. We suggest

Table 1. *Frequency of defects.*

		Tibia				Femur			
Patient	Side	I	II-A	II-B	III	I	II-A	II-B	III
1	R	4	1	1	0	6	0	0	0
2	R	0	2	2	2	0	2	3	1
3	L	0	2	2	2	5	0	1	0
4	R	0	0	5	1	4	0	2	0
5	R	1	0	5	0	0	0	3	3
6	L	1	1	3	1	4	0	2	0
7	R	6	0	0	0	6	0	0	0
8	R	1	3	0	2	5	0	1	0
9	L	0	0	2	4	0	0	0	6
10	L	2	2	2	0	1	0	5	0
11	L	0	0	4	2	0	0	2	4
12	L	1	4	1	0	5	0	1	0
13	R	0	5	1	0	4	2	0	0
14	R	2	3	1	0	0	1	5	0
15	L	0	0	1	5	1	0	5	0
16	L	0	5	0	1	1	0	4	1
17	L	5	1	0	0	5	1	0	0
18	R	3	0	2	1	2	2	2	0
19	L	0	0	3	3	0	0	3	3
20	R	0	0	2	4	0	0	6	0
21	L	2	3	1	0	1	1	2	2
22	L	0	0	4	2	1	1	4	0
23	R	0	3	2	1	6	0	0	0
24	L	0	2	2	2	0	1	4	1
25	L	2	1	4	2	2	0	4	0
26	D	0	1	2	3	1	1	4	0

Table 2. *Frequency of coincidence of the classification (cumulative).*

	100%	> 80%	> 65%	> 50%
FEMUR	19.23%	46.15%	80.77%	92.31%
TIBIA	3.83%	26.92%	53.85%	84.62%

the performance of similar studies using other classifications accessing its reproducibility. Other aspects referring to the AORI classification could be observed. This classification presents easy learning and memorization as well as fast application (the radiography analysis is done in a short space of time), and does not require additional costs for its execution.[4]

As regards the reproducibility of the classification, we observed that the AORI classification based on radiography analysis presents moderate interobserver correlation (>50% in almost all the cases). Therefore, when this classification is used in scientific studies and in a large-scale database, the data analysis should be executed with considerable criticism and attention, as the chances of the same physician classifying in the same manner are not very high.

Another aspect to be considered is the difference in evaluation between the femur and the tibia. We would expect an easier evaluation of bone loss in the tibia due to less overlapping of metal and bone due to the conformation of the tibial implant. The difficulty in evaluating less visible bone defects below the femoral component may induce an underestimation of defects, making the classification more level. Yet other studies are necessary to address this matter.

Thus, we understand that the radiographic AORI classification does not allow a high degree of certainty that groups of patients assessed by different surgeons in different scientific studies are indeed similar. Therefore, we suggest caution in reading scientific studies that refer to bone defects analyzed only by the AORI classification in radiographies.

Anyway, we emphasize that we do not know of any classification superior to the AORI for classifying bone defects in the knee, considering the various aspects related to classifications. In our database we currently adopt the AORI classification and are aware of its reproducibility limitations.

Accordingly, despite the limitations of the AORI classification, we suggest its use until the development of a new classification with the same advantages (cost, learning, simplicity and scope) with better reproducibility among surgeons. At present, we consider the AORI classification suitable for use in treatment protocols with flowcharts based on the degrees of bone loss or on the national databases of revision arthroplasties.

Moreover, we emphasize that the intraoperative observation of bone loss and its classification using the AORI is more trustworthy than the radiographic classification. To this effect, we suggest using the intraoperative classification of bone loss whenever possible.

CONCLUSION

When based on radiographic findings, the AORI classification has moderate correlation for the grading of bone loss in knee arthroplasties.

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