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Evaluation of Immediate Versus Late Post-Operative Radiography Alignment in Total Knee Arthroplasty

Avaliação do Alinhamento da Radiografia Pós-Operatória Imediata Versus a Tardia na Artroplastia Total do Joelho

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Abstract

Objective: The objective of the study was to evaluate the radiographic alignment in total knee arthroplasty (TKA) between the immediate versus the late postoperative period.
Method: The study was retrospective and observational. The study population consisted of 200 patients with primary knee osteoarthritis undergoing total knee arthroplasty.
Results: Only the lateral view showed statistical significance between the differences in measurements on the immediate postoperative radiographs of TKA and 3 months after the operation.
Conclusion: Our study showed variation between the immediate postoperative radiograph of total knee arthroplasty and the control radiography 3 months after the operation only in the lateral view. Therefore, we can infer that immediate postoperative radiograph of total knee arthroplasty might be a suitable exam for postoperative analysis.

Keywords

Total knee arthroplasty; Radiograph; Alignment.

Resumo

Objetivo: O objetivo do estudo foi avaliar o alinhamento radiográfico na artroplastia total do joelho (ATJ) entre o pós-operatório imediato versus o tardio.
Método: O estudo foi retrospectivo e observacional. A população do estudo foi composta de 200 pacientes com osteoartrite primária do joelho submetidos à artroplastia total do joelho.
Resultados: Apenas a incidência em perfil evidenciou significância estatística entre as diferenças das medições das radiografias pós-operatória imediata da ATJ e com 3 meses de pós-operatório.
Conclusão: o nosso estudo demonstrou variação entre a radiografia pós-operatória imediata da artroplastia total do joelho e a radiografia de controlo com 3 meses de pós-operatório apenas na incidência em perfil. Assim sendo, podemos fazer uma inferência que a radiografia pós-operatória imediata na artroplastia total do joelho poderá ser um exame adequado para a análise pós-operatória.

Palavras-chave

Artroplastia do joelho; Radiografia; Alinhamento.

Introduction

One of the main determinants of a good result from total knee arthroplasty (TKA) is the alignment of the prosthesis. When the implant is properly positioned, the surgery presents better results in terms of pain, range of motion of the knee, stability and durability of the implant.[1]
Knee radiographs are required at some point in the postoperative period of TKA2 to assess knee alignment and positioning of prosthetic components.[2] The surgeon also uses these radiographs to identify the presence of fractures, displacement of the implant and the presence of free cement in the joint.[2] These alterations may change the postoperative rehabilitation protocol as well as weight bearing, in addition to indicating the need for a new surgical procedure.
The immediate postoperative TKA radiography (IPTKAR) is usually performed in the operating room (figure 1). However, the quality of this imaging exam is limited.[3-14] Usually, the patient is sedated or in pain, has a reduced range of motion due to immediate surgery, in addition to the possibility of the presence of an aspiration drain. In addition, there are several factors that can interfere with the quality of the



Figure 1 – Immediate postoperative X-ray of total knee arthroplasty.

radiological examination. Among them we can mention the absence of complete knee extension, the variation in the posterior tibial slope, the lack of neutral positioning of the lower limb regarding rotation, the absence of load and the use of portable X-ray equipment.[3,4] This IPTKAR can generate unnecessary radiation exposure to the patient and the surgical team,[5,6] and it is important to emphasize that radiographs generate accumulated radiation[5] to the population. Nevertheless, this first radiographic examination is used as important information for surgeons, becoming an immediate control examination of the procedure. In addition, it serves for evolutionary comparison with other radiographs and for academic purposes.[2]

In patients undergoing joint replacement surgery, hospital costs reach almost 80% during the first 48 hours of hospitalization. Failure to perform the IPTKAR generates savings in the cost of this surgery.[7] On the other hand, performing the first imaging exam in the late postoperative period makes it possible to evaluate a patient with less pain, at a reduced cost, using loaded radiographs, with better technical quality and without medical-legal implications.[8]

The objective of the study was to evaluate the radiographic alignment in total knee arthroplasty (TKA) between the immediate versus the late postoperative period.

Material and Methods

A retrospective and observational study was performed using the institution's radiographic image archive. The study population consisted of 200 patients with primary osteoarthritis of the knee who underwent TKA at our institution, from July 2019 to January 2020.

The study included patients of both sexes, aged over 55 years, with a range of motion of at least 90°, without significant angular deformities and with radiographic alterations of osteoarthritis compatible with Ahlbäck grade 4 or 5.15 The free and informed consent form was applied by the researcher after admission to the institution, which usually occurred the day before the proposed date of surgery. The project was approved by the Institutional Research Ethics Committee (CAAE 39821020.8.0000.5273) and met the assumptions of the Declaration of Helsinki.

Patients who underwent previous osteotomy, patients who required bone graft, intramedullary nail, wedges or additional implants were excluded. In addition, patients with a history of infection, neoplasia in the operated knee and history of fractures in the lower limbs were excluded. Cases in which the radiographs taken did not present adequate technical conditions for angular evaluations were also excluded, especially with regard to the aspect of rotation.

All patients underwent primary total arthroplasty with the Legion PS implant (Smith&Nephew®) posterostabilized with patellar replacement. The radiographs used were taken using a technique standardized by the institution's radiology service, which allowed for an adequate assessment of the coronal and sagittal alignment. In the IPTKAR, a Shimadzu 500 mA portable X-ray device (Shimadzu, Kyoto, Japan) with a 50 KV and 35 mA technique was used. A 30×40 cm film was placed at a distance of one meter from the ampoule of the digital radiographic device. Late postoperative X-rays were obtained with a Super 100® fixed X-ray device (Philips, Brazil), with a 50kV and 35 mA technique. The tube-film distance was one meter. Care was taken to place the lower extremity in a neutral position so that the patella was directed anteriorly. On the lateral radiograph, the patient was maintained with a 20º knee flexion with the tube-film distance standardized at 1m. Study images were then obtained. No clinical, demographic information or medication records were collected in this study. The choice of age group for the study was justified by the higher prevalence of the disease in the population over 50 years old. The choice of implant material was based on its availability at the research institution during the selected study period.

Surgeries were performed between July 2019 and January 2020 by surgeons who were members of the hospital's knee group, all with more than 5 years of experience in performing TKA.

The images of radiographs of the operated knee obtained in the immediate postoperative period in anteroposterior (AP) and profile, as well as the images in AP and profile of the knee with weight, performed after 3 months of clinical follow-up were analyzed, according to the institution's protocol. Imaging exams were evaluated by a single observer who was a member of the knee surgery group. The radiographical analysis was performed blindly without identifying the patient. The software used for the study was mDicomViewer 3.0 (Microdata, RJ-Brazil, 2007). Coronal and sagittal alignment were determined by measuring five radiographic angles.[15] The first was evaluated on AP radiography. This analysis was performed using an angle formed by the distal surface of the femoral component and the axis of the femoral diaphysis, as well as a second angle formed between the tibial plateau and the axis of the tibial diaphysis (figure 2 A-B). In addition, we analyzed the tibiofemoral angle, formed between the anatomical axes of the femur and tibia (figure 3). Alignment assessment in the sagittal plane was performed using lateral radiography, determining the angle between the most distal part of the femoral fixation surface and the axis of the femoral diaphysis (figure 4). Similarly, the evaluation of tibial alignment in this view corresponds to the angle between the tibial plateau and the axis of the tibial diaphysis (figure 5). Patellofemoral alignment was not evaluated.

The measurements of the angles measured on radiographs in AP and lateral view of the knee in the immediate postoperative period and in the control after three months of the procedure were evaluated in a Microsoft Excel database for analysis.

The analysis of the results found was performed using the GraphPad PRISM program (Prism 5 for Windows, 5.01) through the paired Student t-test. Comparisons whose p-value was less than 0.05 were considered significant.

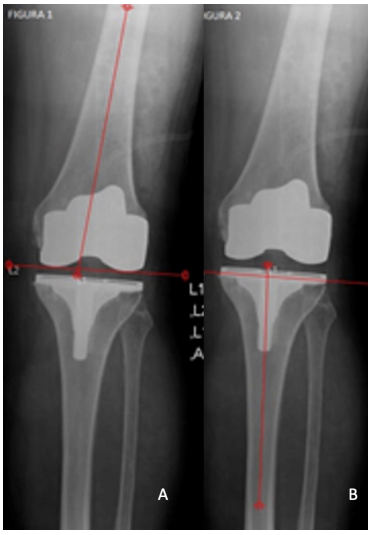


Figure 2 – A: Angle formed by the distal surface of the femoral component and the axis of the femoral diaphysis. B: Angle formed between the tibial plateau and the axis of the tibial diaphysis.



Figure 3 – Tibiofemoral angle.



Figure 4 – Angle between the most distal part of the femoral fixation surface and the axis of the femoral diaphysis.

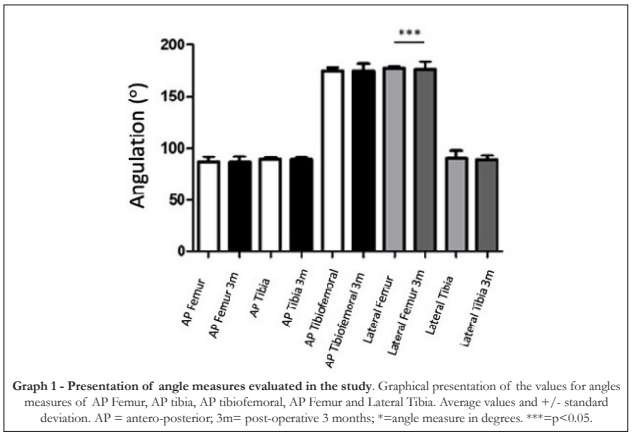


Figure 5 – Angle between the tibial plateau and the axis of the tibial diaphysis.

Results

Regarding the angle of the femur in the AP, we observed a p of 0.6753. In the IPTKAR we obtained an average of 86.67 and with 3 months of 86.58. Standard deviation was 5.11 at IPTKAR and 5.38 at 3 months postoperatively. The tibial angle in the AP showed a p of 0.2896. In the IPTKAR we obtained an average of 89.24 and with 3 months of 89.11. Standard deviation was 1.88 at IPTKAR and 2.28 at 3 months postoperatively. In the tibiofemoral angle in the AP we observed a p of 0.6340. In the IPTKAR we obtained an average of 174.9 and with 3 months of 174.7. The standard deviation was 2.94 at IPTKAR and 6.97 at 3 months postoperatively. The angle of the femur in profile shows a p-value of 0.0329. In the IPTKAR we obtained an average of 177.4 and with 3 months of 176.3. Standard deviation was 1.55 at IPTKAR and 7.42 at 3 months postoperatively. Regarding the angle of the tibia in profile, a p value of 0.0397 was observed. In the IPTKAR we obtained an average of 89.95 and with 3 months of 88.80. The standard deviation was 8.02 at IPTKAR and 4.19 at 3 months postoperatively.

As a result, we can say that in relation to the 3 angles evaluated in the AP view, there was no statistically significant difference regarding the measurement between the IPTKAR and at 3 months postoperatively. On the other hand, when analyzing the 2 incidence angles in profile (1 on the femur and 1 on the tibia), there was a statistically significant difference between the difference in measurements of the IPTKAR and 3 months after the operation (figure 6).



Graph 1 - Presentation of angle measures evaluated in the study. Graphical presentation of the values for angles measures of AP Femur, AP tibia, AP tibiofemoral, AP Femur and Lateral Tibia. Average values and +/- standard deviation. AP = antero-posterior; 3m= post-operative 3 months; *=angle measure in degrees. ***=p<0.05.

Figure 6 – Analysis of results.

Discussion

The use of IPTKAR is a controversial topic.[13] There are several studies that confirm that IPTKAR is unnecessary.[4,2,6,9,10,11] For this reason, we are interested in carrying out this research.

Proponents of performing IPTKAR allege that there is an academic nature, legal medical reasons and the risk of a complication going unnoticed.[9] There is reluctance on the part of surgeons to change their conduct.[9] However, Kosashvili et al. observed 3 cases for immediate revision in TKA: a fracture of the medial condyle without deviation not evident during surgery, an anterior notch of the femur with a risk of periprosthetic fracture and an invasion of the medial cortical bone in a patient with a previous osteotomy.5 Sambandam et al. did not find any legal medical aspect about not performing IPTKAR.[9] In our opinion, IPTKAR has an educational character and, in addition, it allows the surgeon to feel at ease when verifying the procedure performed.

Moussa et al. consider 60 days as the ideal time for outpatient radiographic control.[10] According to these authors, the main immediate complications of TKA occur during this time frame. During this period, we could observe: acute infection, bulky hematoma, gross technical error and arthrofibrosis.[10] Our study used three months postoperatively as a landmark for a new control radiograph. We believe that in this timeframe, the patient could walk without complaints and with minimal pain.

There is literature supporting that IPTKAR has a poor quality, being ineffective in identifying any complications.[9] Moussa et al. also mention that the quality of IPTKAR was poor.[10] In addition, cost, patient discomfort and exposure to radiation are factors that only justify performing TKA control radiography at an outpatient level.[10] Our study shows that standardized IPTKAR has its space.

Moskal et al. state that the radiography after TKA can be postponed until the first outpatient visit without compromising patient care.[11] Sambandam et al. stated that the absence of IPTKAR did not change the rehabilitation protocol and patient safety,[9] and no complications were

observed. Our study showed radiographic alterations with a statistically significant difference in the lateral view of the femur and tibia. Our thought is that the reproducibility of the lateral radiographic view of the knee is lower. Post-TKA weight-bearing knee radiography can be uncomfortable in this population. Furthermore, Meneghini et al. state that the femoral fixation surface can be an inaccurate landmark.[15] These authors state that the housing of the femoral component in the prosthesis that sacrifices the posterior cruciate ligament can generate a bias in the measurement.[15] For this reason, we believe that it may be the explanation for the statistical change in this measurement.

The limitation of the research is due to the fact that a retrospective study was carried out, thus depending on the quality of the database and the standardization of the imaging techniques, in addition to the fact that the study did not use clinical data of the patients to assess the need for reoperation in the immediate postoperative period based on changes identified in the IPTKAR. The radiograph of the knee in lateral view showed a statistically significant difference, however, it may be clinically irrelevant, due to the small magnitude variation between the groups. The study population was based on a previous study.[16]

Conclusion

Our study demonstrated a variation between the immediate postoperative radiograph of total knee arthroplasty and the control radiograph 3 months after surgery only in the lateral view. Therefore, we can infer that immediate postoperative radiography in total knee arthroplasty may be a suitable exam for postoperative analysis.

Ethical Disclosures / Divulgações Éticas

Conflicts of interest: The authors have no conflicts of interest to declare.

Conflitos de interesse: Os autores declaram não possuir conflitos de interesse.

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Suporte financeiro: O presente trabalho não foi suportado por nenhum subsídio ou bolsa.

Confidentiality of data: The authors declare that they have followed the protocols of their work center on the publication of data from patients.

Confidencialidade dos dados: Os autores declaram ter seguido os protocolos do seu centro de trabalho acerca da publicação dos dados de doentes.

Protection of human and animal subjects: The authors declare that the procedures followed were in accordance with the regulations of the relevant clinical research ethics committee and with those of the Code of Ethics of the World Medical Association (Declaration of Helsinki).

Protecção de pessoas e animais: Os autores declaram que os procedimentos seguidos estavam de acordo com os regulamentos estabelecidos pelos responsáveis da Comissão de Investigação Clínica e Ética e de acordo com a Declaração de Helsínquia da Associação Médica Mundial.

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