



## Original Article

# Evaluation of intraoperative radioscopy on the coronal alignment of the tibial component in primary knee arthroplasty<sup>☆</sup>



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## ABSTRACT

**Objectives:** The present study had the objective of evaluating the effect of the use of intraoperative radioscopy in cases of primary knee arthroplasty, on the final alignment of the tibial component.

**Methods:** Patients who underwent total knee arthroplasty (TKA) between April 13, 2013, and April 20, 2013, were included in the study. These patients were evaluated retrospectively and two groups were identified: one in which intraoperative radioscopy was used to assess the positioning of the tibial component during the surgery and the other in which this resource was not used.

**Results:** The mean angle of alignment of the tibial component in relation to the tibial diaphysis was greater in the group without use of intraoperative radioscopy (90.82) than in the group with radioscopy (90.63), which was a statistically significant result ( $p < 0.05$ ).

**Conclusion:** Use of intraoperative radioscopy during TKA produced a better mean angle of alignment between the tibial component and the tibial diaphysis, in comparison with nonuse.

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## Avaliação da radioscopia intraoperatória no alinhamento coronal do componente tibial em artroplastias primárias de joelho

## RESUMO

**Objetivos:** Avaliar o efeito do uso da radioscopia intraoperatória em artroplastias primárias de joelho sobre o alinhamento final do componente tibial.

**Métodos:** Foram incluídos no estudo os pacientes submetidos à artroplastia total do joelho (AT) entre 13/04/2013 e 20/04/2013. Os pacientes foram avaliados retrospectivamente e dois

## Palavras-chave:

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grupos foram identificados, um com uso de radioscopia intraoperatória para avaliação do posicionamento do componente tibial durante a cirurgia e o segundo sem uso desse recurso. **Resultados:** A média do ângulo de alinhamento do componente tibial em relação à diáfise da tibia foi superior no grupo sem uso de radioscopia intraoperatória (90,82) em comparação com o grupo com radioscopia (90,63), com resultado estatisticamente significativo ( $p < 0,05$ ). **Conclusão:** O uso de radioscopia no intraoperatório de ATJ produz melhor média de ângulo de alinhamento entre o componente tibial em relação à diáfise da tibia quando comparado ao não uso.

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## Introduction

The total number of knee arthroplasty procedures performed every year has increased exponentially and the mean age of the patients undergoing this intervention has decreased, such that the topic of longevity or survival of implants has gained greater attention.<sup>1,2</sup>

The success of this procedure is related to achieving proper alignment and correct management of ligament balance, along with precise positioning of its components.<sup>3-5</sup>

Many authors have investigated the outcomes from total knee arthroplasty (TKA) and they have reported that varus or valgus misalignments greater than  $3^\circ$  result in greater chances of aseptic loosening and failure of the implant.<sup>5,6</sup> Berend et al.<sup>7</sup> investigated the mechanisms through which the tibial component failed and concluded that misalignment of this component greater than  $3^\circ$  would increase the failure rate.

During surgical procedures, the methods that physicians have available to them for verifying satisfactory positioning of the components include classical alignment guidance systems, evaluation methods using navigated surgery, conventional radiographs and intraoperative radioscopia.<sup>2,3,8</sup>

After the operation, the alignment of prosthetic components can be evaluated by means of simple radiographs, as recommended by the Knee Society.<sup>1,9</sup> On panoramic radiographs in AP view, the tibial component should be at  $90^\circ$  in relation to the long axis of the tibia<sup>1</sup> (Fig. 1).

The present study had the objective of evaluating the effect of using intraoperative radioscopia on the final alignment of the tibial component, in cases of primary knee arthroplasty.

## Materials and methods

We retrospectively evaluated 115 patients who underwent total knee arthroplasty between April 13 and 20, 2013: 53 in a group without use of intraoperative radioscopia and 62 in a group with use of radioscopia. All the patients had indications for undergoing total knee arthroplasty, with a diagnosis of primary osteoarthritis. The exclusion criteria were previous surgery, body mass index  $> 35$ , extra-articular deformity, varus and valgus deformity  $> 10^\circ$ , flexion  $> 10^\circ$ , bone defects greater than 5 mm and rheumatic diseases. All of the patients constituted a homogenous group without serious deformities and with moderate knee osteoarthritis.



**Fig. 1 – Postoperative radiographic alignment.**

The primary arthroplasty was performed in accordance with the classical techniques that have been described, with the only difference that intraoperative radioscopia might or might not be used, according to the preference of the surgeon of the group. In the group in which it was decided to use radioscopia with a Philips® image intensifier, a single AP view of the knee was produced on the operated knee just after the tibial cuts had been made and the test component had been emplaced. This made it possible for the surgeon to interfere in the final result from positioning the tibial component, such that the viewed position could be accepted or could be altered through making a bone cut.

After analysis on the sample, patients with incomplete medical documentation or absence of complete pre and postoperative routine radiological examinations would be excluded. However, none of the patients in our sample were excluded.

The immediate postoperative radiographic routine of our knee surgery group involves production of AP radiographs of the knee and lateral and AP panoramic radiographs including

**Table 1 – Means of the absolute values.**

	With radioscopy	Without radioscopy
Mean	90.63	90.82
Source: Hospital service files.		

the long axis of the leg. These are produced in a standardized manner by the radiology service. The panoramic radiographs of the long axis of the leg were produced in AP projection with the knee extended, and this was done for all the patients after the operation. The tube-film distance was two meters. Care was taken to place the lower limb in a neutral position, such that the patella would be directed anteriorly. A Shimatzo X-ray machine was used, with a technique consisting of 50 kV and 40 mA. The radiographs were evaluated regarding the coronal alignment of the tibial component, on AP panoramic radiographs that included the long axis of the leg. The angle between a line parallel to the surface of the tibial component and a line along the long axis of the tibia was calculated. This calculation was done using the angle measurement tools belonging to the Mdicom Viewer version 3.0 (27) digital radiological viewing software (Microdata System). In addition, objective analysis was performed on the medical files of the patients allocated to each group and it was verified from the postoperative protocol card whether radioscopy had been used or not. If it had been used, there was a change to the surgical strategy regarding the tibial cut, with the aim of ensuring better final alignment of the tibial component. The radiological analysis and viewing of the medical files were done blindly by a single physician who is a titular member of the Brazilian Society of Orthopedics and Traumatology, and who did not participate in the surgical procedures.

The data were subjected to statistical analysis, in order to investigate the relationship between the coronal alignment angles of the tibial component of the groups with and without use of intraoperative radioscopy. Analysis by means of Student's t test was used to ascertain whether there was any significant difference between the groups. For this, *p* values < 0.05 were taken to be significant.

## Results

The results from the two groups in question were analyzed retrospectively. The group for which intraoperative radioscopy was used was composed of 53 patients and the group without this comprised 62 patients.

The mean alignment angle of the tibial component in relation to the diaphysis of the tibia was  $90.82 \pm 1.34$  in the group without use of intraoperative radioscopy and  $90.63 \pm 0.64$  in the group with use of radioscopy (Table 1). The range in the group without use of radioscopy was from 88.52 to 94.25 and in the group with use of radioscopy, 89.00–93.12 (Table 2).

From the results of the t test, it can be stated that there was evidence from the sample that indicated that the mean displacements would be different between the groups (*p* = 0.0069).

In the group without use of radioscopy, five patients obtained alignment angles for the tibial component in

**Table 2 – Values of the angles in the groups with and without radioscopy.**

Without radioscopy	With radioscopy
92.18	90.30
93.32	90.90
94.10	89.90
91.00	91.16
93.50	89.82
90.10	90.30
90.80	91.50
89.70	90.30
90.10	90.60
89.30	89.90
92.80	90.07
89.70	90.31
90.10	89.90
89.90	93.12
89.80	90.32
90.30	90.46
92.23	89.95
90.10	89.80
90.60	90.42
90.00	90.26
90.00	90.80
90.50	89.30
90.30	89.80
91.10	92.70
89.00	90.13
91.00	89.83
90.03	90.15
90.10	90.30
91.60	89.92
89.00	90.10
90.10	89.90
90.72	90.10
89.00	89.87
89.80	90.16
91.10	90.30
91.60	89.76
90.10	90.31
90.30	90.16
91.00	90.06
91.50	89.97
90.90	90.31
90.27	90.32
90.83	89.76
93.32	90.41
92.70	89.87
90.56	90.07
90.17	90.03
90.10	90.30
90.20	89.16
88.52	90.62
92.27	89.93
94.75	90.03
91.54	90.52
	90.24
	90.93
	90.87
	90.30
	89.00
	89.90
	90.50
	90.30
	90.10
Source: Hospital service files.	

relation to the diaphysis of the tibia that were greater than  $93^\circ$ . In the group with use of radioscopia, one patient obtained an angle greater than  $93^\circ$ .

## Discussion

Studies in the literature are unequivocal regarding the importance of proper alignment of the prosthetic components of total knee arthroplasty for the final result relating to the functional outcome. Likewise, the complications inherent to poor alignment, especially with regard to mechanical failure, have been well documented.<sup>4</sup> Thus, the relevance of assessing intraoperative methods for guiding the precision of the alignment has been increasing. Nonetheless, the studies so far have been inconclusive regarding what would constitute the gold standard. For this reason, our study evaluated the final alignment subsequent to total knee arthroplasty, in accordance with the usual routine of our knee surgeons, and compared groups with or without use of intraoperative radioscopia.

The classical method, and the one most used in medical practice, is the mechanical method, making use of alignment rods designed from test components that have been implanted. Our thinking is that the anatomical parameters are important, but that the human eye is flawed and may give rise to deviations of more than  $3^\circ$ .

Authors such as Mullaji et al.<sup>4</sup> and Hourlier et al.<sup>10</sup> have indicated radioscopia as an effective optional method for guiding the intraoperative alignment, with favorable results. Our study showed that arthroplasty procedures that were checked using intraoperative radioscopia tended to obtain better final coronal alignment of the tibial component, even if the difference was only small, in comparison with the classical methods that do not have this verification. Hence, we corroborate the affirmations cited above and confirm that good positioning of the implant in association with durability is important. On the other hand, one negative factor in this method is the radiation to which patients are exposed through use of radioscopia. Our thinking is that when the risks are compared with the benefits, there is an advantage in using radioscopia.

Another factor of relevance in favoring this technique is the observed large number of bone cuts for tibial correction (30 cuts, i.e. 48.4% of this group) that was performed subsequently to fluoroscopy. These were made viable through this immediate assessment of the final result, provided through the advent of radioscopia, with the aim of improving the positioning of the tibial component.

The difference in the means of the alignment angle of the tibial component, in relation to the diaphysis of the tibia in the two groups, was statistically significant ( $p = 0.0069$ ). Moreover, the group with radioscopia showed a mean angle closer to the neutral axis ( $90^\circ$ ) than that of the group without use of radioscopia ( $90.63$  versus  $90.82$ , respectively, which depicts the greater tendency of this first group to correctly attain the target axis.

The literature shows that varus or valgus misalignments greater than  $3^\circ$  result in greater chances of aseptic loosening and implant failure.<sup>5,6</sup> It was observed in this study that in the group with use of radioscopia, only one patient presented varus greater than  $3^\circ$ , while in the group without use of radioscopia,

five patients presented varus greater than  $3^\circ$ . This shows that there was a tendency toward greater chance of misalignment in the group without use of radioscopia.

Navigated surgery for total knee arthroplasty is another technique in which the aim is to achieve a well-aligned implant, thereby leading to greater durability of this prosthesis. The navigated surgery technique has been presented as an important option for addressing the deficiency of precision of traditional guides, but it adds to the duration of the operation and to the final cost.<sup>2,11-14</sup> For this reason, we advocate the use of radioscopia in total knee arthroplasty procedures. This can be used in most hospitals in Brazil, given that software and sensors are unnecessary. The navigation technique used in total knee arthroplasty procedures may sometimes have to be aborted due to problems with the sensors or with anatomical reference points that are marked erroneously.

The strong points of this study that we can highlight include the large sample that was achieved over a short period of time, provided through a knee referral center and the center's experienced group of knee surgeons with the capacity to use a uniform technique that diverged only in a few operative stages, particularly with regard to use of radioscopia, which was the focus of our study. Moreover, our patients constituted a homogenous group without serious deformities and with moderate knee osteoarthritis. Another positive point was the blinding of a single evaluator of the final angles obtained.

The facts that the surgical procedures were not performed by a single surgeon and that no postoperative descriptions of the cuts made in the group without radioscopia were included in the files can be taken to be weaknesses of our study.

## Conclusion

Use of intraoperative radioscopia during total knee arthroplasty produces a better mean alignment angle between the tibial component and the diaphysis of the tibia, in comparison with nonuse.

## Conflicts of interest

The authors declare no conflicts of interest.

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