ORIGINAL RESEARCH PAPER

Orthopaedics

KEY WORDS:

ANALYSIS OF PREOPERATIVE COMPUTED TOMOGRAPHY BASED COMPUTER GUIDED TEMPLATING AND ACTUAL IMPLANT SIZE USED INTRAOPERATIVELY IN ROBOTIC TOTAL KNEE REPLACEMENT

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ABSTRACT

Templating is the process of anticipating the size and position of implants prior to surgery. The use of robotics in the field of arthroplasty has been constantly increasing. In this paper we have taken 98 knees which underwent robotic knee replacement and have analyzed the differences in the preoperative computer planned implant sizes and the actual implant sizes used intraoperatively. It was found that the templating was accurate in 91.84% knees for the femur and in 69.39% knees for the tibia.

INTRODUCTION

Templating allows prediction of implant sizes needed to be available in operating room and provides a reliable starting point in determining size and position of implants.

Initially acetate templating was used to template implants using preoperative radiographs and then the world moved towards digital templating of implants using a computer with appropriate software. A number of studies have compared the accuracy of digital versus acetate templating for total knee arthroplasty: Specht et al. looked at 50 consecutive knee replacements and overall concluded that digital templating was more accurate than acetate templating, and noted that digital templating tended to oversize both components, whereas acetate templating tended to undersized the femoral component, and oversized the tibial component [1].

Then came the advent of CT based templating. Rahul et al. in a study found that the improvement in the ability to predict the size of the prosthetic components obtained by the CT images was statistically significant compared to that obtained by the radiographic study to predict the size of the tibial and femoral component [2].

This study aims to assess the accuracy of CT guided robotic assisted TKR templating at our institution, by comparing the templated component sizes with those implanted and if, there was a mismatch between the implanted and templated sizes at our institution in the Indian population.

AIM

To analyze the differences in the planned implant size by CT guided robotic assisted TKR templating software and the actual implant size used intraoperatively.

MATERIALS AND METHODS

Study Design – Retrospective study
Study Area – Apollo hospitals, Chennai, India
Study population – 98 Robotic Assisted Total Knee Replacements
Inclusion Criteria – All RA-TKR's done by a single surgeon between January 2022- December 2022

METHODOLOGY

Data's from 98 RA-TKR's at our institution was collected and the preoperative planned implant sizes by the CT guided Robotic TKR software was determined. The actual implant sizes used intraoperatively was also determined and both were analyzed. All RA-TKR's were performed with the Stryker Mako Robotic System and Stryker Triatholon knee implants were used in all cases.

RESULTS

Of the 98 knees templated with the CT guided robotic assisted TKR software we arrived at the following findings. Intraoperatively the size of the femur implanted was the same as the template size in 90 out of the 98 knees and the size of the tibia implanted was the same as the template size in 68 out of the 98 knees. Thus this shows a templating accuracy of 91.84% for the femur and an accuracy of 69.39% for the tibia.

It was also found that the femur implant was downsized in 4 knees because of very tight flexion gaps during balancing. In 3 knees tibia was downsized due to implant overhang. Whereas tibia was upsized in 27 knees and femur was upsized in 4 knees for better implant-bone coverage.

The difference in the actual implant was only +\- 1 size from the templated size in all the knees.

Table 1 - Showing the actual implant sizes used intraoperatively

Component	Templated size used	Templated size + 1	Templated size - 1
Femur	90	4	4
Tibia	68	27	3

DISCUSSION

In this study we analyzed the differences in the planned implant size by CT guided robotic assisted TKR and the actual implant size used intraoperatively. It was found that the templating was accurate in 91.84% knees for the femur and in 69.39% knees for the tibia. Further it was noted that in 4 knees the surgeon downsized the femur owing to very tight flexion gaps during ligament balancing and the tibia was over sized in 27 knees for better implant bone- coverage. So in knees when flexion and extension gaps are difficult to balance due to tight ligaments or severe deformity removing extra bone from the femur and tibia will help in increasing the gaps. This leads to using an implant size different from the templated size because the soft tissue tension isn't taken into account in the preoperative templating process.

Arora in a study found that templating was accurate for both tibial and femoral components in only 53.2% of observations. This study also revealed that templating is a highly-subjective and observer-dependent technique. Inter-observer and intra-observer mismatch was present in 46.8% and 43.6% of readings respectively and concluded that preoperative templating was neither accurate nor reproducible [3]. Our study shows a significantly higher accuracy in preoperative templating which shows that CT guided RA-TKR software based templating is superior to the older methods of templating.

Acetate and digital templating being an observer depended technique always has room for inter-observer variations. Whereas the CT based RA-TKR templating reduces the observer bias.

Pietzrak in a study found that preoperative CT-based templating for RA-TKR more accurately predicts the size of

implants compared with traditional 2D digital templating [4]. This study involved the Caucasian population. The observation by Pietzrak has been found to hold good even in the Indian population as analyzed by our study.

CONCLUSION

From this study we conclude that CT based templating of Robotic Assisted Total Knee Replacement is highly accurate. Even with such high accuracy the surgeon's inputs intraoperatively are of utmost importance especially in cases with severe deformities and tight flexion extension gaps.

Statements and Declarations

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Conflicts of interest/Competing interests – No conflicts of interest.

Ethics approval - Not applicable.

Consent to participate - The patients were informed that data concerning their cases would be used for research purposes.

Consent for publication – The author of this manuscript consents for publication.

Abbreviations

RA TKR – Robotic assisted Total Knee Replacement
CT – Computed tomography

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