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## Original Article

# The accuracy and reliability of pre-operative templating in revision total knee arthroplasty. A comparison of analogue and digital methods



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## ABSTRACT

**Aims:** To determine whether the size of the prostheses used in revision knee arthroplasty may be accurately and reproducibly predicted using analogue or digital pre-operative templating techniques.

**Methods:** Pre-operative radiographs were templated using analogue radiographs and acetate templates, digital radiographs and acetate templates and digital radiographs and digital templating software.

**Results:** Overall accuracy of predicting the size of implant used at surgery was 44%. There was no significant difference in the accuracy of the various templating techniques ( $p = 0.098$ ).

**Conclusions:** Templating in revision knee arthroplasty is neither of suitable accuracy nor reliability enough to safely recommend its use for implant size prediction.

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## 1. Introduction

Pre-operative planning is recommended for all surgery. Pre-operative templating has become very popular when planning orthopaedic surgical procedures and is extensively used in arthroplasty surgery. It is suggested that templating is a

useful tool in aiding the surgeon to determine both the size and orientation of the prosthesis that is to be inserted.<sup>1–4</sup>

Many studies have reviewed the accuracy of templating in both primary knee and primary hip arthroplasty.<sup>5,6</sup> The consensus is that it should not be used as an absolute guide but merely as a general guide as to the size of the prosthesis to be inserted. This is due to most studies demonstrating

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discrepancies in the predicted prosthesis size and the actual prosthesis size used.<sup>1–6</sup>

It has also been proposed that templating may have a role in revision arthroplasty.<sup>2</sup> It was suggested that templating is excellent at predicting the size of a primary prosthesis to within one size, either larger or smaller. The suggestion being that such templating may identify the required revision prosthesis to within one size. This would decrease the need for a wide range of extensive and less used stock being kept on site and permit the ordering in of the necessary sizes on demand. As a result, this may be more cost effective.<sup>2</sup>

With most orthopaedic departments now utilising digital rather than analogue radiographs, the templating techniques have changed to involve computer aided design (CAD) software rather than the use of acetate templates for either analogue or digital radiographs.

The aim of this study was to determine if the size of the prostheses used in revision knee surgery could be accurately and reproducibly predicted by pre-operative templating. We also aimed to assess whether analogue or digital radiographs, and manual acetate or computer-aided templating had an effect on the accuracy of the templating.

## 2. Patients and methods

Ten patients underwent revision knee arthroplasty at our unit. Each patient had both digital and analogue pre-operative antero–posterior (AP) and lateral radiographs. All received the Nexgen LCKK prosthesis (Zimmer, Warsaw, Indiana, USA).

The pre-operative radiographs were retrospectively templated for revision total knee replacement by two consultants with a specialist interest in revision lower limb arthroplasty (JP & JK). Each radiograph was templated using three different techniques; analogue radiograph and manual acetate template (Analogue & Acetate – AA), digital radiograph and manual acetate template (Digital & Acetate – DA) and digital radiograph and Orthoview computer aided design template (Digital & Orthoview – DO).

This process was repeated following a four-month period with an alteration in the sequence of the radiographs displayed. The findings were then compared to the actual size of the implant used at the time of surgery as documented in the operation note. With these findings we were able to analyse the accuracy and reproducibility of templating and determine which was the superior technique for templating (AA, DA or DO).

All pre-operative radiographs that were templated had been taken within a close time period to surgery thereby negating any possibility of a change in the bone stock of the patient, which may influence the templated prosthesis sizes.

The AA group was the use of an analogue radiograph and the standard acetate template. The DA group involved the use of a digital radiograph and an acetate template. This was possible as there was a calibration ball (measuring 2.54 cm in diameter) on the digital radiograph. The radiograph size was altered until this ball measured the actual size of 2.54 cm on the acetate. The DO group used digital radiographs and a computer software programme that was able to calibrate appropriate sizes of the prosthesis templates from the calibration ball mentioned previously.

Accuracy was determined by comparing the templated size of the implant to the actual implant size used. We then assessed the accuracy to within one size of the size of implant used at the time of surgery, either one size too big or one size too small. Comparing the kappa scores for intra-observer and inter-observer errors and determining the Pearson coefficient determined reproducibility, and therefore reliability. The accuracy and reproducibility of each of the different modes of templating was observed to determine which was the most accurate and which the most reproducible.

## 3. Results

### 3.1. Accuracy

The overall accuracy of predicting the correct size of implant used in the surgery was 44%. The accuracy of the different templating techniques is summarised in Fig. 1.

The accuracy of predicting the femoral component to within one size of that used at the time of surgery was 91%. The accuracy of predicting the tibial component to within one size was 85% overall.

### 3.2. Reproducibility

The overall intra-observer error demonstrated a kappa value of 0.52 that is described as moderate agreement. The overall inter-observer error resulted in a kappa score of 0.467 that is also described as moderate agreement.

The overall Pearson coefficient was 0.711 suggesting strong correlation between the templated sizes suggested by the surgeons templating the radiographs.

### 3.3. Templating technique

The AA group had the highest overall exact accuracy of 54% and the DO group was the lowest at 37.5%. Accuracy improved when measuring accuracy within one size with each of the templating techniques. There was no statistically significant difference between the three groups in terms of accuracy,

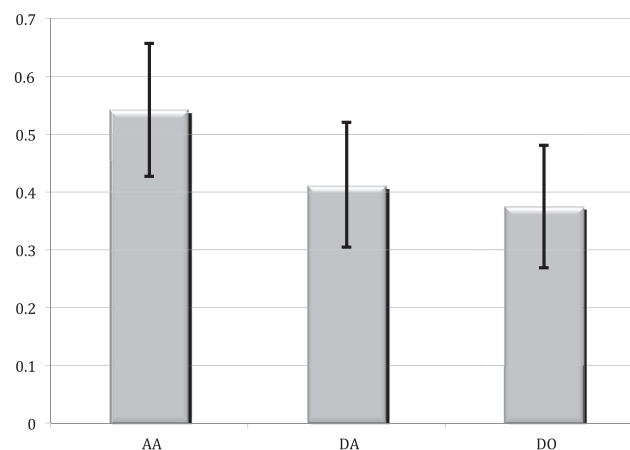


Fig. 1 – Accuracy of different templating techniques with 95% confidence interval.

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