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Does the Use of a CT Based 3D Plan Improve Joint Balancing in Total Knee Arthroplasty? A Multi-Center Study

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Abstract

Studies have shown that dissatisfaction following TKA may stem from poor component placement and iatrogenic factors related to variability in surgical execution. A CT-based robotic assisted system allows surgeons to dynamically balance the joint prior to bone resection. This study aimed to determine if this system could improve TKA planning, reduce soft tissue releases, minimize bone resection, and accurately predict component size.

Six hundred and sixty-six cases undergoing primary robotic assisted TKA we enrolled in a prospective, multicenter study. Seven surgeons participated from seven US centers. Patient demographics and intraoperative surgical details were collected. Initial and final 3-dimensional alignment, component position, bone resection depths, use of soft tissue releases, knee balancing gaps, and component size were collected intraoperatively. Descriptive statistics were applied to determine the changes in these parameters between initial and final values.

In this study, 513 varus knees, 86 valgus knees, and 26 neutral knees were captured and stratified for analysis. Native deformity ranged from 12 degrees of valgus to 19 degrees of varus. 85% of all patients in this study did not require a soft tissue release. Complex deformities who required a soft tissue release were corrected on average to 3.36 degrees while cases without releases were corrected to 1.1 degree on average. All surgeons achieved their planned sizes on the tibia and femur more than 97.5% of the time within one size, and 100% of the time within two sizes. Flexion and extension gaps during knee balancing were within 2mm (mean 1mm) for all knees.

New tools may allow for enhanced execution and predictable balance for TKA, which may improve patient outcomes. In this study, preoperative planning via CT scan allowed surgeons

to assess bony deformities and subtly adjust component position to reduce soft tissue trauma. Patient follow up is needed to determine clinical outcomes.

1 Introduction

Studies have shown that poor survivorships and clinical outcomes following TKA may stem from poor component placement, overall limb alignment, and iatrogenic factors related to variability in surgical execution [1,2]. A CT-based robotic-arm assisted system allows surgeons to dynamically balance the joint prior to bone resection and demonstrates great accuracy to plan (within 1 degree) [3]. This study aimed to determine if this system could improve TKA planning, reduce soft tissue releases, minimize bone resection, and accurately predict component size.

2 Materials and Methods

Six hundred and sixty-six cases undergoing primary robotic assisted TKA were enrolled in a prospective, multicenter study. Seven surgeons participated from seven US centers. Patient demographics and intraoperative surgical details were collected. Initial and final 3-dimensional alignment, component position, bone resection depths, use of soft tissue releases, knee balancing gaps, and component size were collected intraoperatively. Descriptive statistics were applied to determine the changes in these parameters between initial and final values.

3 Results

In this study, 513 varus knees, 86 valgus knees, and 26 neutral knees were captured and stratified for analysis. Native deformity ranged from 12 degrees of valgus to 19 degrees of varus. 85% of patients in this study did not require a soft tissue release regardless of their level of coronal or sagittal deformity (Figure 1). Complex deformities who required a soft tissue release were corrected on average to 3.36 degrees while cases without releases were corrected to 1.1 degree on average with the overall goal as traditional mechanical alignment (Figure 2). All surgeons achieved their planned sizes on the tibia and femur more than 97.5% of the time within one size, and 100% of the time within two sizes. All cases were adjusted intraoperatively prior to bony resection, resulting in an average change of 0.34mm between initial and final cuts in all knees. Flexion and extension gaps during knee balancing were within 2mm (mean 1mm) for all knees.

4 Discussion and Conclusion

In this study, preoperative planning via CT scan allowed surgeons to assess bony deformities and subtly adjust component position to reduce soft tissue trauma. only 15% of patients required soft tissue releases to correct the deformity to neutral. Component size predictions are relatively accurate within 1 size. RA technology allows surgeons to plan the case and make intraoperative component adjustments prior to bone cuts [4]. In literature, RA technology has been shown to reduce in post-operative pain and opioid usage which provides benefits to the patient and the hospital system [5]. Patient follow up is needed to determine clinical outcomes.

5 Figures

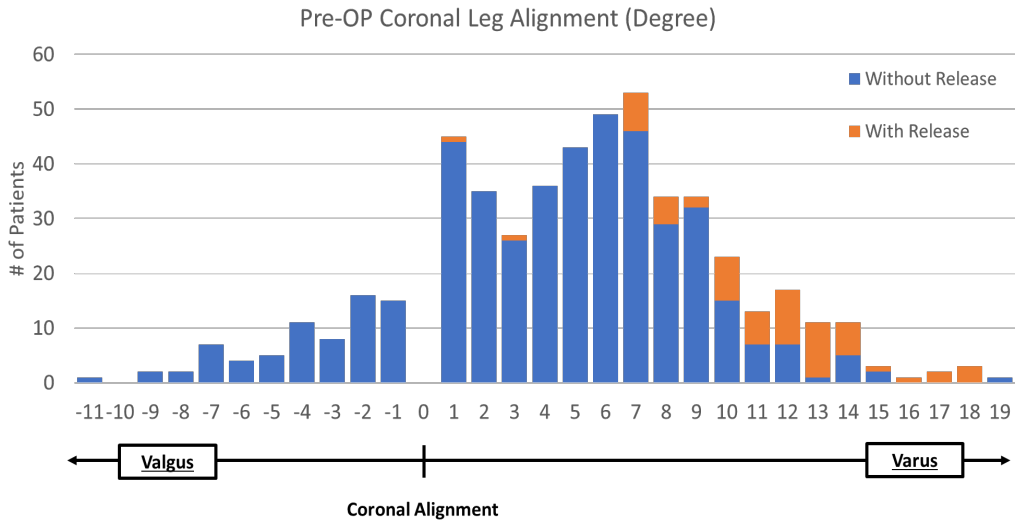

Figure 1. Patients with greater non-correctable varus (positive angles) deformities pre-operatively required a greater number of soft tissue releases. Valgus (negative angles) cases were corrected with bone cuts alone.

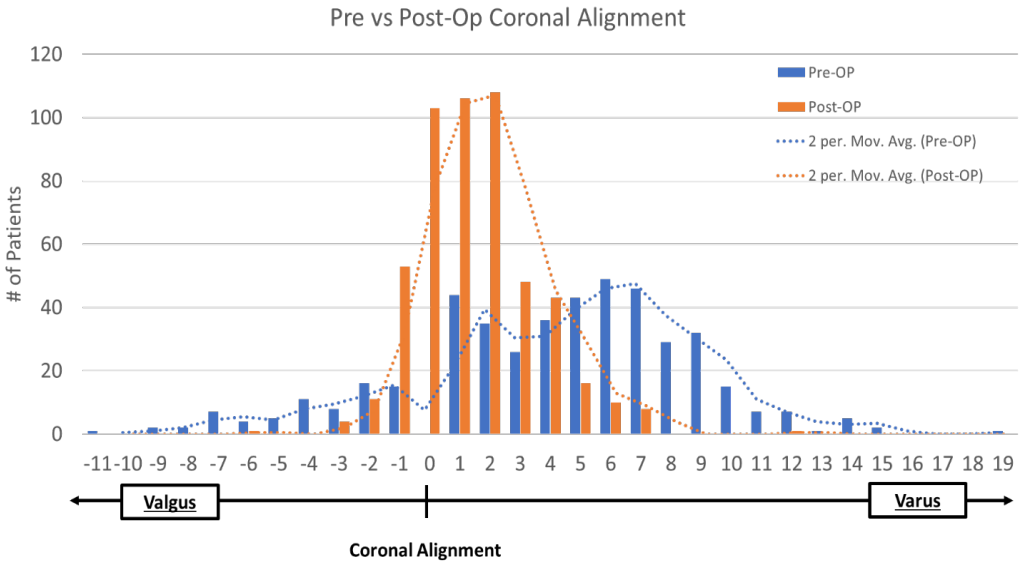

Figure 2. Pre-operative and post-operative coronal alignment following robotic assisted TKA.

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