The Impact of Workflow on Cutting Time for Partial Knee Arthroplasty

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Abstract

To date, there are no studies aimed at characterizing the active cutting time for a robotic-assisted PKA procedure and the impact of workflow. This study quantified the active cutting time for three medial PKA workflows using the same robotic-assisted system.

Three surgeons each prepared six cadaveric knees for PKA with robotic-assisted technology using one of three workflows: A) burr-only, using a legacy cutting system and burr design; B) burr-only, using a new cutting system and burr design; or C) planar, using a new cutting system, burr design and saw. For a burr-only workflow, the femur and tibia were prepared with a burr. For a planar workflow, the femur and tibia were prepared with a burr and saw. The total mean trigger time to complete all femoral or tibial bony resections was measured and statistically compared between workflows using ANOVA and Tukey Pairwise Comparison.

There was statistically significant less time required to prepare the femur and tibia in B and C, compared to A (p≤0.05). Less time was required in C than B, but this was not statistically significant (p>0.05). Workflow A took an average of 429±104 seconds (range, 314 to 529 seconds), B took an average of 302±40 seconds (range, 244 to 363 seconds), and C took an average of 236±50 seconds (range, 196 to 332 seconds).

The new burr design, when used with both burr-only and planar workflows, has the potential to be more efficient (30 and 45% faster, respectively) compared to the legacy burr using the burr-only workflow, for a medial PKA. Bone resection time should be investigated in a clinical setting.

1 Introduction

Partial knee arthroplasty (PKA), also termed unicompartmental knee arthroplasty (UKA) when associated with a single compartment, has been performed for isolated single compartment knee osteoarthritis (OA) since the 1970s.[1] PKA can be carried out in the medial, lateral or patellofemoral (PF) compartments. When compared to total knee arthroplasty (TKA), studies have shown that medial PKA patients have experienced greater retention of normal knee kinematics and accelerated recovery, while suffering less blood loss and reduced post-operative morbidity.[2-5]

Despite the evidence demonstrating the benefits of PKA, there remains a desire to decrease operative times without sacrificing the ability to achieve high accuracy. To date, there are no studies aimed at characterizing the active cutting time for a robotic-assisted PKA procedure and the impact of workflow. This study quantified the active cutting time for three robotic-assisted medial PKA workflows.

2 Materials and Methods

Three surgeons each prepared six cadaveric knees for PKA (for a total of 18 knees) with robotic-assisted technology using one of three workflows. Efforts were made to limit operator variability by selecting three surgeons who had prior exposure to robotic-assisted PKA surgery. Each surgeon was assigned the configurations shown in Table A for each of the three sets of cadavers.

Table A: Specimen configurations

Cadaver specimen	Left	Right
1	Workflow A	Workflow C
2	Workflow B	Workflow A
3	Workflow C	Workflow B

The assignments were intended to distribute procedures between specimens to eliminate any potential baseline variability from a single specimen, by splitting procedures across the specimens to have no two identical preparations between the left and right knees of the same specimen. There was an equal number of left and right cases for Workflow A, B and C. Further, attempt was made to evenly distribute OA between surgeon and surgical application based on grading of the pre-operative X-rays.

The three workflows investigated were: Workflow A) burr-only, using a legacy cutting system and burr design; Workflow B) burr-only, using a new cutting system and burr design; and Workflow C) planar, using a new cutting system, burr design and saw. For a burr-only workflow, the femur and tibia are prepared with a burr. For a planar workflow, the femur and tibia are prepared with a burr and saw.

The total mean trigger time, or the active cutting time, to complete all femoral or tibial bony resections was measured and statistically compared between workflows using ANOVA and Tukey Pairwise Comparison.

3 Results

There was statistically significant less time required to prepare the femur and tibia in B and C, compared to A (p≤0.05). Less time was required in C than B, but this was not statistically significant (p>0.05). Workflow A took an average of 429±104 seconds (range, 314 to 529 seconds), B took an average of 302±40 seconds (range, 244 to 363 seconds), and C took an average of 236±50 seconds (range, 196 to 332 seconds).

4 Discussion and Conclusion

Past studies have demonstrated that robotic-assisted technology has enabled the surgeon to accurately and consistently place the femoral and tibial PKA components in accordance with preoperative plans and to effectively restore soft tissue balancing.[6-7] This technology is associated with a short learning curve to achieve time neutral surgery compared to manual surgery, without influencing the ability to achieve high accuracy.[8] However, the desire still remains to decrease operative times.

In this study, the new burr design, when used with both burr-only and planar workflows, has the potential to be more efficient (30 and 45% faster, respectively) compared to the legacy burr using the burr-only workflow, for a medial PKA. For further confirmation, bone resection time should be investigated in a clinical setting.

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