Improved Mediolateral Gap Balance Achievement with Instrumented Navigated Total Knee Arthroplasty Compared to Conventional Instrumentation

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INTRODUCTION: Total knee arthroplasty (TKA) represents a well-established reconstructive procedure for end-stage knee joint disorders with balancing of soft-tissue envelope throughout the full arc of motion as a newly emerging possibility. This cadaveric study evaluated the ability to achieve targeted mediolateral gap balance throughout the arc of motion using conventional mechanical instrumentation versus a computer-assisted orthopaedic surgery (CAOS) system featuring an intraarticular distractor according to two levels of user's experience.

METHODS: For the CAOS system, an intraarticular distractor applied a quasi-constant distraction force to the knee joint (instrumented) while the conventional system involved conventional spacers. At the end of each procedure, a CAOS-based laxity test was conducted to assess the mediolateral (ML) balance by placing the intraarticular distractor between the proximal tibial cut and the trial femoral component.

RESULTS: Regardless of the experience level, the instrumented TKAs were associated with a significantly lower ML gap differential than the conventional TKAs ($p<0.001$) (Figure 2A). In contrast, regardless of the type of instrumentation, there were no significant differences between the junior and senior surgeon mean gaps (see Figure 2A). The lack of significance was due to the junior surgeon group that generated a higher ML gap differential relative to the expert surgeon for their conventional TKAs ($p<0.001$), but the junior surgeon group generated a lower ML gap differential for the instrumented TKAs ($p<0.001$). As a result, while the senior group achieved moderate gain regarding the ML gap differential between their conventional TKAs and their instrumented TKAs ($p<0.001$ for unsigned difference, $p=0.220$ for signed difference), the junior group achieved a significant reduction in the ML gap differential between their conventional TKAs and their instrumented TKAs ($p<0.001$ regardless of the signature) (Figure 2B).

DISCUSSION: Historically, soft tissue balancing during TKA has been reported as an art rather than a science. In this regard, the addition of dedicated technology to characterize the soft-tissue envelope during TKA has the potential to provide an augmented perspective to the surgeon and can be particularly beneficial for junior surgeons. The present study established that the usage of instrumented CAOS led to significantly lower ML gap differences than conventional instrumentation.

SIGNIFICANCE/CLINICAL RELEVANCE: The improved gap balance using instrumented CAOS found in this study provided surgeons with a more advanced approach that can achieve more favorable surgical outcomes.

IMAGES AND TABLES:

Figure 1: Conventional mechanical instrumentation (A) and instrumented CAOS system (B)

Figure 2A: Mean and standard deviation of the signed and unsigned ML gap differential for the different considered groups
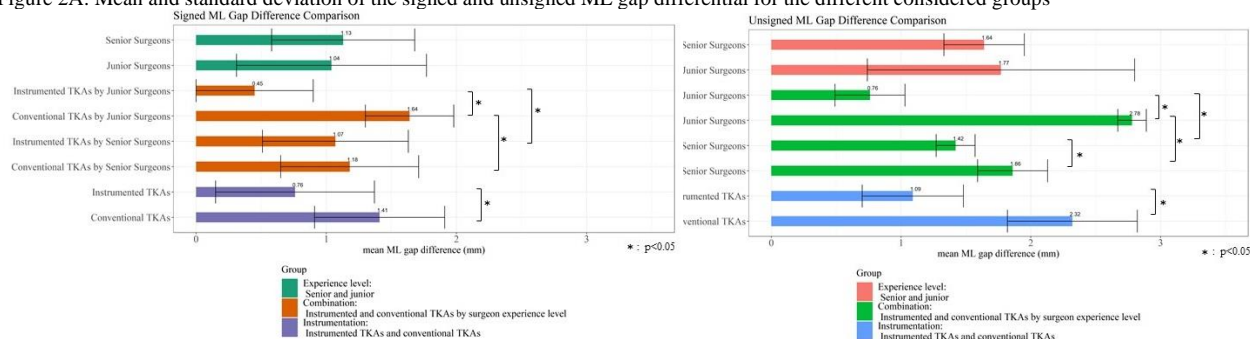

Figure 2B: Impact of the instrumentation on the unsigned ML gap differential as a function of the flexion angle for the senior and the junior groups