Robotic-arm assisted total knee arthroplasty demonstrated soft tissue protection

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Introduction

- While manual total knee arthroplasty (MTKA) procedures have demonstrated clinical success, occasionally intraoperative complications can occur. Robotic-arm assisted TKA (RATKA) provides a surgeon the ability to three dimensionally plan a TKA and use intraoperative visual, auditory, and tactile feedback to ensure that only the desired bone cuts are made. The potential benefits of soft tissue protection in these surgeries need to be further evaluated.
- Primary Study Aim: Assess the A) integrity of various knee soft tissue structures (medial collateral ligament (MCL), lateral collateral ligament (LCL), posterior cruciate ligament (PCL), and the patellar ligament), as well as B) the need for tibial subluxation and patellar eversion in RATKA procedures.

Materials and methods

- Sample Size: 14 cadaveric specimens prepared for Triathlon CR TKA using the Mako System (Stryker, Mahwah, NJ) by more than 5 surgeons with no prior clinical, robotic experience, compared to 7 specimens prepared using MTKA by single surgeon.
- Presence of soft tissue disruption assessed by having a surgeon perform visual evaluation and palpation of the PCL, MCL, LCL, and the patellar ligament after the procedures.
- Documented leg pose and retraction during bone resections.
- Recorded any tibial subluxation and/or patellar eversion.

Results

- RATKA cases demonstrated several aspects of soft tissue protection, in this cadaveric study.

Leg positioning and retraction

- During RATKA bone resections, tibial subluxation and patellar eversion were not required for visualization (Figure 1A).
- MATKA cases required tibial subluxation and patellar eversion to achieve optimal visualization (Figure 1B).

RATKA MTKA

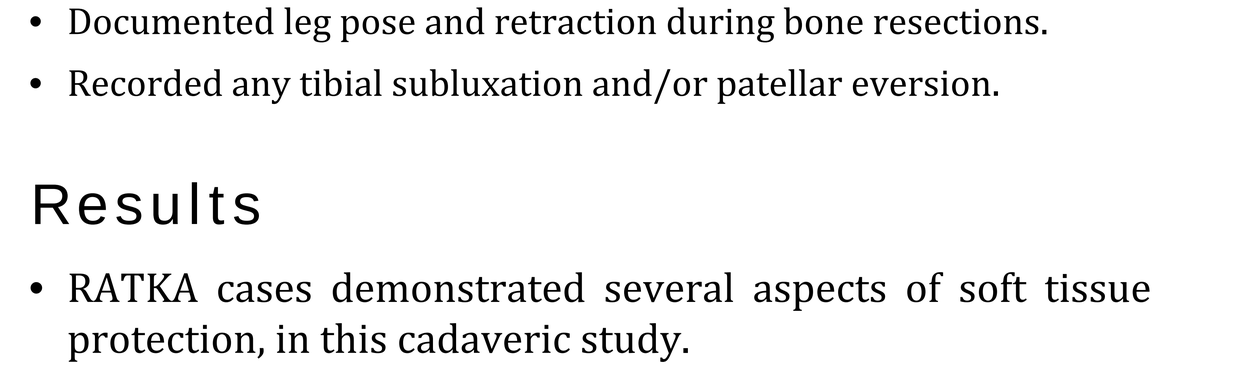

Figure 1. Examples of leg positioning and retraction in a) robotically performed TKA and b) manually performed TKA.

Ligament assessments

- In RATKA cases, there was no damage, injury, or disruption of the medial collateral ligament, lateral collateral ligament, posterior cruciate ligament, and patellar ligament based on visual evaluation and palpation.
- In 2 of the 7 manual cases there was slight fraying of the PCL.

RATKA MTKA

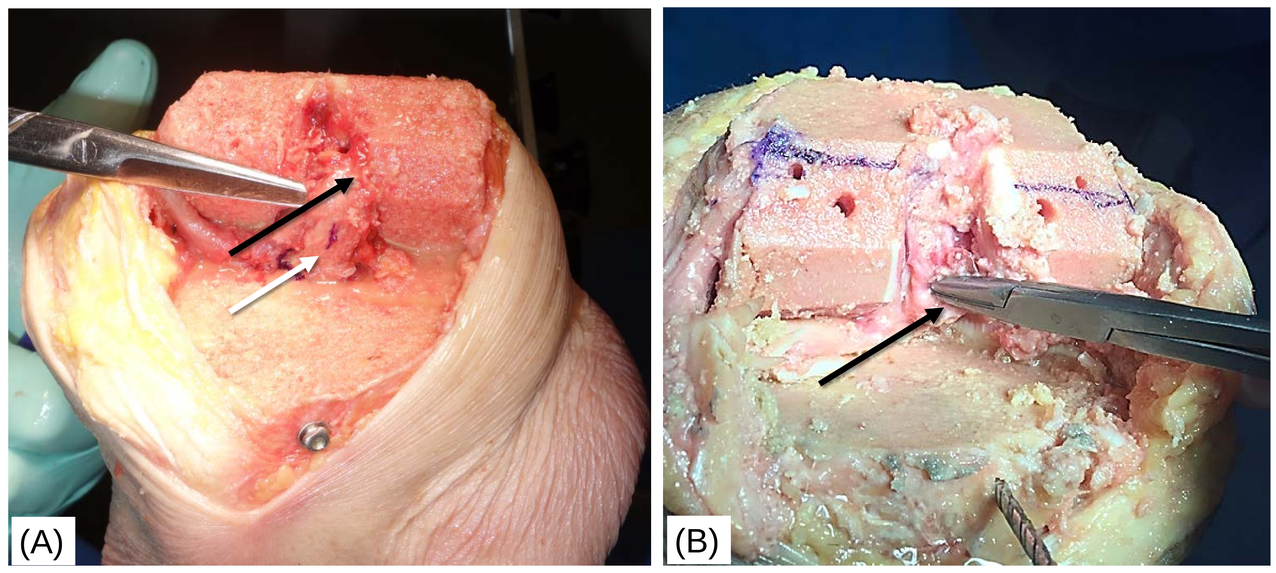

Figure 2. Examples of A) robotically performed TKA with bone island preparation in front of PCL and B) manually performed TKA with arrow pointing to PCL with no bone island. Black arrow points to PCL. White arrows outline bone island.

PCL bone island

- RATKA cases were successfully left with a bone island on the tibial plateau, which protected the PCL (Figure 3), and did not require tibial subluxation or PCL protector.

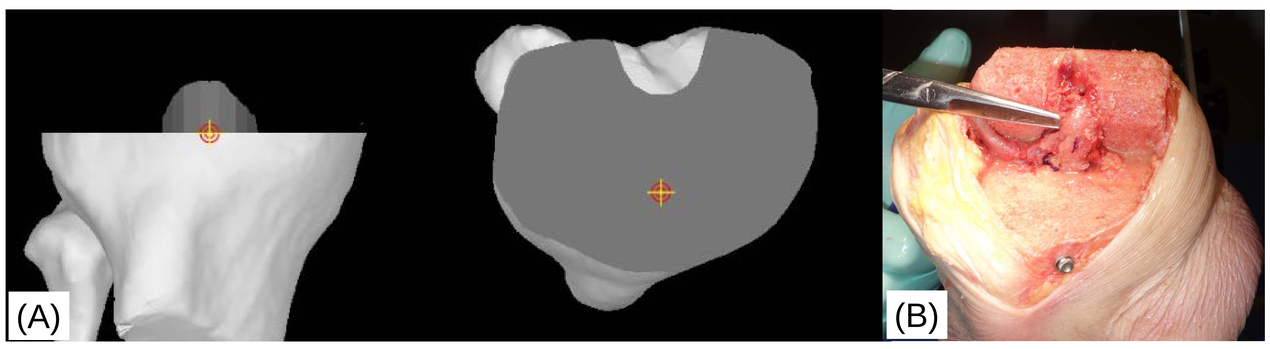

Figure 3. Examples of corresponding robotically performed TKA with A) planned tibial resection and B) bone island preparation in front of PCL.

Discussion

- In general, RATKA demonstrated aspects of soft tissue protection (PCL bone island, no PCL/MCL/LCL/patellar ligament disruption, and no tibial subluxation or patella eversion for visualizing during cutting).
- Since RATKA uses a stereotactic boundary to constrain the sawblade, which is generated based on the implant size, shape and plan, and does not have the ability to track the soft tissue structures, standard retraction techniques during cutting are recommended.

Significance

Aspects of soft tissue protection were noted in this cadaver study for RATKA, and should be investigated clinically. This is the first study to have soft tissue injury parameters assessed for RATKA, and may serve as a platform for future studies.

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