CT-based patient-specific instrumentation is effective in patients with pre-existing hardware about the knee

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Introduction: Patient-Specific Instrumentation (PSI) is a recent addition to the techniques to perform a Total Knee Arthroplasty (TKA). PSI involves the acquisition of an X-ray, CT scan, or MRI scan preoperatively to digitally recreate the patient’s anatomy. The TKA implantation is planned and rapid prototyping technology is used to create a block, or instrument, that is used by the surgeon to perform the bony resections during TKA. Hardware in or about the knee joint presents a number of challenges to the surgeon in performance of TKA. Conventional Instrumentation usually requires a modification of technique or removal of the metallic implants prior to the performance of TKA. Computer-Assisted TKA (CAOS) is another option, but adds complexity and time to the procedure. MRI-based PSI cannot be used as the metal cause’s unwanted artifact and renders the images for planning useless. However, CT scans are not affected by metal and thus can be used in patients with pre-existing hardware. The present study retrospectively evaluates 12 patients with pre-existing hardware using CT-based PSI (MyKnee®, Medacta International, SA, Castel San Pietro, Switzerland). We are unaware of any other literature to evaluate PSI in this specific sub-group of patients.

Materials and Methods: 12 consecutive eligible knees (10 patients) of the senior author underwent TKA using the CT-based PSI. All patients received a GMK (Medacta International) implant. In this technique, CT scan of the lower extremity is obtained utilizing a proprietary protocol including the hip, knee, and ankle. From these images, the knee can be reconstructed 3Dimensionally. Surgical planning is performed according the surgeons’ preferences for implantation. Furthermore, implant sizing is planned. The goal is to create a neutral mechanical axis. Once planned and approved, the blocks are made. This process requires a minimum 3 weeks. During surgery, the PSI cutting block is registered on the femur first and secured with smooth pins. The distal
femoral resection is performed directly through the block. An appropriate sized 4-in-1 block is placed according to previously placed drill holes (setting rotation and size) and the remaining resections are performed in routine fashion. The tibial resection block is registered and resection performed. Final bone preparation, patella resurfacing, and trialing is performed as is standard to all surgical techniques. The tourniquet is let down after placement of the implants while the cement is polymerizing. The present study evaluates radiographic, clinical, and complications in this subgroup. Pre- and Post-operative long-standing radiographs were compared. In addition, Knee Society Scores (KSS), Range of Motion (ROM), and peri-operative complications were recorded. Tourniquet time was recorded as a measure of surgical efficiency.

**Results:** Of the 12 TKAs, there were 5 Left and 7 Right Knees performed in 6 females and 6 males. The average BMI was 33.19 and average age was 53 (range 44-63). All diagnoses were either osteoarthritis or post-traumatic osteoarthritis. Follow-up averaged 59 weeks (range 18.6-113.7). Nine patients had pre-operative varus deformities with HKA deformities average of 171.9° (range 154°-178.5°). One patient had pre-operative valgus deformity of 184.5°. Two patients were neutral (180°). Post-operative alignment for all patients (n=11) was 179° (range 177°-180°). All patients were within 3° neutral, post operatively. Four patients measured 180°, 4 measured at 179°, 2 measured at 178°, and only one at 177°. The pre-operative range of motion averaged 2.9° to 98.3° (Extension range 0-15° and flexion range 30-115°). Post-operative ROM was 2.9° to 101.3°. (Extension range 0-5° and flexion range 65-125°). Knee Society Score (KSS) improved from 42.3 to 82.3, and KSS Function Score improved from 52.1 to 77.5. No intraoperative complications were recorded. Average tourniquet time was 42.1 minutes (range 28-102). Hardware consisted of 5 patients with femur or tibia staples, 3 with plate and multiple screws, 3 patients with ACL interference screws, and one titanium rod. No hardware was removed unless necessary for implantation. Only 3 patients required some hardware removal – 2 partial removal only and 1 complete. The other 9 did not have any hardware removed.

**Discussion:** Many techniques exist for performance of TKA. PSI allows the surgeon to pre-operatively determine coronal and sagittal alignment, rotation, resection depths, and sizing prior to the operative procedure itself. The present study definitively shows that CT-based PSI can be used successfully in patients with pre-existing hardware in or about the knee joint. Intraoperative efficiency of surgery is important to all participants in TKA: surgeon, hospital, and patient. As demonstrated by tourniquet time, efficiency was maintained while not sacrificing accuracy. The radiographic goals of surgery were achieved. Regardless of the deformity, the patient’s post-operative mechanical axes HKA averaged 179° (range 177-180). Clinical scores were typical for TKA patients with improvement in both KSS and final ROM. Furthermore, the technique appears safe as no peri-operative complications occurred. In conclusion, early results using PSI in patients with pre-existing hardware in or about the joint, is safe, efficient, and accurate in performance of TKA.