The Role of Navigation and Robotics in Total Knee Arthroplasty (TKA)

Summary of key points from Dr. Michael Dunbar's presentation at the 3rd CAS Introduction to Arthroplasty Fundamentals Course – Knee Module

Key Points:

1. **Biological Variation and Alignment**:
    - Just like height or weight, knee alignment varies across the population and follows a bell-curve distribution.
    - Traditional TKA targets a neutral mechanical alignment (0° ±3°), but many patients fall outside this norm, suggesting a need for more individualized approaches.
2. **Accuracy vs. Precision in Surgery**:
    - Accuracy = closeness to a true target.
    - Precision = consistency of repeated attempts.
    - Traditional mechanical instruments often achieve neither well; true progress demands high accuracy and high precision tailored to each patient.
3. **Navigation and Robotics**:
    - Navigation systems helped improve precision but were limited by outdated alignment targets and 2D imaging.
    - Early custom guides (e.g. ShapeMatch) based on CT scans lacked precision due to materials and feedback issues.
4. **Robotic-Assisted TKA**:
    - Modern robotic systems use CT-based planning and precise execution, avoiding cartilage variability and allowing for pre-operative simulation.
    - These systems allow real-time assessment of ligament balancing and bone cuts with defined safety limits, improving outcomes and reducing complications.
5. **Evidence and Registry Data**:
    - Studies (e.g., from the Australian registry) show that robotically-assisted TKAs may lead to lower pain, shorter hospital stays, and improved outcomes.
    - Robotic systems are especially useful in complex cases (e.g., rickets, severe deformities, revisions) due to better pre-operative planning and reproducibility.
6. **Future of Orthopaedics**:
    - Robotic and personalized approaches are rapidly growing.
    - Young surgeons should embrace these technologies as they become standard practice in achieving better, patient-specific results.