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NYU Langone Orthopedics

Utilizing Artificial Intelligence to Predict Coronal Plane Alignment in Robotic-Assisted Total Knee Arthroplasty

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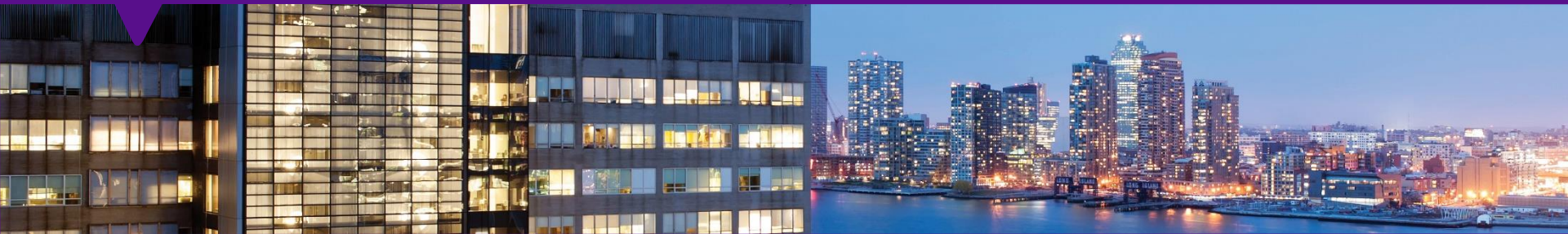


Disclosures

Meftah: CAIRA surgical: Stock or stock Options; Innomed: IP royalties; Intellijoint: Paid consultant; ISTA: Board or committee member; PAS: Board or committee member; Smith & Nephew: Paid consultant; Orthopedics: Editorial or governing board

Bosco IV, Wixted, Di Gangi, Habibi, Watson, Antonioli: None

Introduction

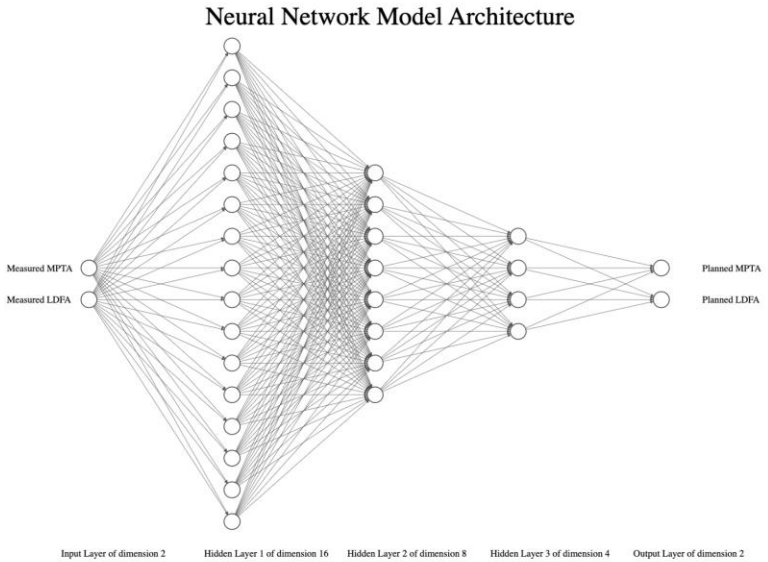
- Proper coronal alignment is important for the function and stability of knee replacements
- Robotic technology provides the ability to achieve optimal coronal alignment with minimal soft tissue releases
- This is achieved through planned and precise distal-femoral and proximal-tibial bone cuts
- Artificial intelligence (AI), can model patterns between pre-operative data and post-operative results, which can serve as a guide for determining target knee alignment in the planning stage

Purpose

Using AI, we developed a model to predict optimal postoperative Coronal Plane Alignment of the Knee (CPAK) during the planning stage using corresponding native bony measurements comprising of medial-proximal tibial angle (MPTA), and lateral-distal femoral angle (LDFA).

Methods

- Compiled data on preoperative and target postoperative coronal alignment from 530 primary TKAs
- We normalized the data into input/output examples for supervised learning
- We constructed and trained a neural network architecture to transform preoperative MPTA, LDFA alignment into postoperative MPTA, LDFA alignment based on the examples in the dataset
- Implemented 10-fold regression tests to assess the model's accuracy



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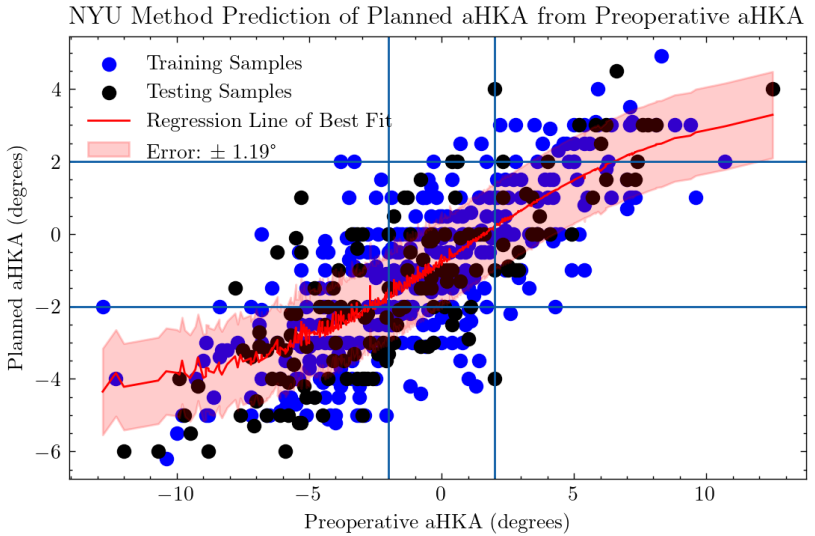
Results

- The model converged after approximately 105 epochs
- Accuracy testing revealed mean absolute error of 1.19°, which is well within the distribution of knee alignments
- Predictive power (r-squared) was 0.38, indicating the model is 38% more accurate than making predictions about the mean



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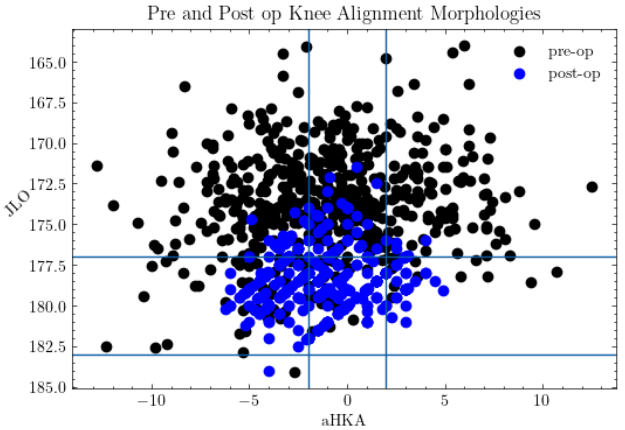
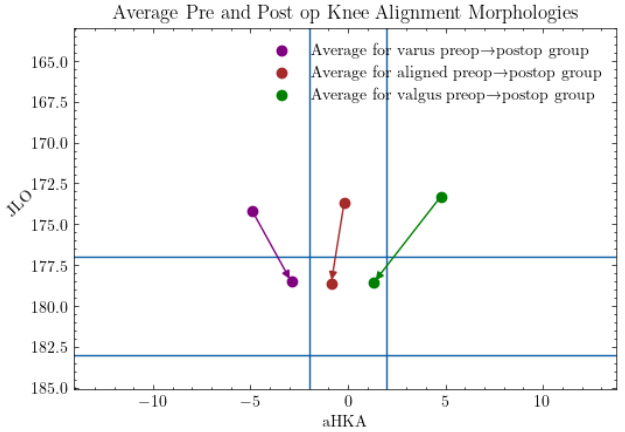
Results

- The preoperative alignment distribution is wider and more varied than the postoperative distribution
  - Postoperative alignments are more concentrated in the neutral / aligned CPAK group
- The correction of joint-line obliquity (JLO) is more consistent than anterior hip-knee alignment (aHKA)
- Valgus aHKA alignments are corrected more than Varus alignments ($p<0.001$)





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Conclusions

- The increasing availability of patient data through EMRs and adoption of robot-assisted TKR provides an excellent climate for utilizing predictive AI models
- These models can predict optimal measurements before the first cut is made, giving surgeons actionable predictions which they can use when inputting resections amounts into the robot

Thank you!

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By the Numbers

CLINICAL CARE

34,000+
surgical procedures performed annually

450,000+
office visits annually

ADVANCED TECHNOLOGY
30+ robotics and navigation platforms systemwide

EDUCATION

LARGEST AND ONE OF THE MOST DIVERSE
orthopedic residency programs in the United States

87
residents across two accredited programs

21
fellows across six specialty programs

RESEARCH

#8
in NIH funding for orthopedic surgery

350+
peer-reviewed publications annually

as of October 2022

#1 ranking source: Vizient 2022 Top Performers: Bernard A. Birnbaum, MD, Quality Leadership Award for comprehensive academic medical centers, and Vizient Ambulatory Quality and Accountability Award