Outcomes of Functional Versus Mechanical Robotic Total Arthoplasty -- An Analysis of Pre- Versus Post-operative CPAK

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INTRODUCTION:

Functional alignment (FA) is a surgical philosophy that aims to achieve balanced flexion and extension gaps by adjusting implant positioning while minimizing changes to constitutional joint line obliquity (JLO). Robotic total knee arthroplasty (TKA) enables greater precision and reproducibility, allowing the surgeon to functionally balance the knee and achieve the ideal implant position based on pre- and intra-operative planning.

The Coronal Plane Alignment of the Knee (CPAK) provides a nuanced classification system to describe the knee alignment based on the JLO and arithmetic hip-knee angle (HKA). This study aims to analyse the outcomes of functionally-aligned TKA (FA-TKA) whereby patients with pre-operative CPAK 1 and 2 maintained the same post-operative CPAK (ie. JLO unchanged) versus a change to CPAK 5 (mechanical alignment).

METHODS:

Retrospective analysis of 315 consecutive Stryker Mako robotic TKAs performed during 2018-2021 was conducted. Only patients with 2 year functional outcomes (ie. not lost to follow up) were included. Functional outcomes measured included the pre- and post-operative (at 6 months and 2 years) knee range of motion (ROM), Knee Society Knee and Function Score (KSKS and KSFS), Oxford Knee Score (OKS), SF36 physical and mental component scores (PCS and MCS), whether patients' expectations were met and whether patients were satisfied with the surgery. Comparison was made between functionally aligned and mechanically aligned knees, with independent samples t-test for continuous variables and chi-square test for categorical variables.

RESULTS:

Mean age was 68.6+/-7.19 years and mean BMI 30.8+/-4.64 kg/m^2. Pre-operatively, the most common CPAK phenotypes were 58.7% CPAK 1, 15.9% CPAK 2 and 11.7% CPAK 4. Post-operatively, the most common CPAK phenotypes were 30.5% CPAK 5 and 20.6% CPAK 4. There was no difference in demographics and pre-operative functional scores between FA vs MA knees. At 6 months post-surgery, FA knees had a better OKS (FA 17.6+/-3.93 vs MA 20.5+/-5.76, whereby a lower score is better, $p=0.020$) and SF36 PCS (FA 51.2+/-4.87 vs MA 46.2+/-8.90, $p<0.001$) than MA knees. At 2 years post-surgery, FA knees maintained a better SF36 PCS than MA knees (FA 51.6+/-6.69 vs MA 47.1+/-9.61, $p=0.008$), but had no difference in all other functional outcomes.

DISCUSSION AND CONCLUSION:

Our study population has a high proportion of pre-operative knees with constitutional varus with an apex distal joint line. We illustrate how CPAK phenotypes change after robot-assisted TKA. Pre-operative CPAK 1 and 2 knees who underwent FA-TKA demonstrated better functional outcomes at 6 months and 2 years post-surgery compared to MA-TKA, suggesting that respecting the knee's native alignment and soft tissue envelope through FA may result in better long term outcomes.