Preliminary results with kinematic alignment in TKA

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Introduction: One long-held tenet of Total Knee Arthroplasty (TKA) is that mechanical alignment is the gold standard when it comes to obtaining better clinical results and survival rates. Several recent studies have shown that a postoperative mechanical axis of $0° \pm 3°$ does not improve implant survival rate in modern TKA designs¹. On the other hand, a new approach seems progressing: that the best alignment for TKA is the pre-arthritic alignment of the lower limb and not the mechanical axis². Moreover the trans-epicondylar axis is questioned as the best possible axial alignment for TKA, and the alternative transcylindrical, or functional axis is suggested as allowing a better soft tissue balance during knee flexion-extension³.

Patient specific instrumentation (PSI) is nowadays offered as the most effective technology available in TKA to obtain more accurate alignment when compared to conventional guides, with outcomes at least comparable with surgical navigation. The benefits claimed of PSI technology include reduction in the operative time, fewer surgical instrument trays, and the availability of a preoperative plan where the patient's component size, position, and alignment can be simulated⁴. However the results available for this technology are not consistent⁵⁻⁶.

The purpose of this study was to report the preliminary clinical and radiological results of patients operated with TKA while examining these two possible advancements in TKA. Therefore one group was operated with the conventional technique, a second group with PSI technology, targeting neutral overall limb alignment (NOLA) and a third group with PSI aiming at the functional axis.

Patients and Methods: A four-centre randomized study of 144 patients has been designed to make quantitative evaluations over these three techniques. In every centre, 36 plus 5 test patients are planned to be operated, 12 for each technique. Currently in our centre 18 patients have been operated on: 6 with conventional technique (Group A), 3 with PSI targeting NOLA (Group B), and 9 (5 test patients plus 4 protocol patients) operated with PSI targeting functional alignment. All patients operated with PSI followed the Otismed imaging protocol which includes pre-operative MRI scans at the hip, knee and ankle joints. All the patients were operated with Triathlon TKA cruciate retaining (Stryker Orthopaedics, Mahwah, NJ, USA) with patella resurfacing. The clinical evaluation was performed pre-operatively, at 45 days, and 3, 6 and 12 months post-operatively using the IKSS (International Knee Society Score). Moreover, at 45 days post-operatively a weight-bearing long leg radiograph was performed in order to measure the alignment of the components with respect to the NOLA in group A and B, and with respect to the planned component alignment in group C.

Results: The mean post-operative knee and functional scores at the most recent follow-up in the NOLA groups (A + B) were respectively 78 ± 19 (min 51, max 95) and 80 ± 23 (min 45, max 100), whereas in group C these were 91 ± 12 (min 65, max 100) and 89 ± 15 (min 60, max 100).

The mean alignment of the mechanical axis in the coronal plane in group A was $1.5°$ in varus, with 20% being what would traditionally be considered outliers, i.e. larger than $3°$. In the PSI groups (group B + group C) the mean absolute difference with respect to the planned alignment was $0.7°$ with no outliers.
Only one complication was observed (group B), for a patient where a manipulation was necessary two months after surgery due to low range of knee motion.

**Discussion:** The standard mechanical axis alignment has been - and still is - used as the ideal reference in TKA, but it does not reflect normal morphology. Several studies affirm that an important fraction of the normal population has a natural alignment at the end of growth of more than 3° varus or valgus, and also that the trans-epicondylar axis differs from the trans-cylindrical axis, the former being not a good surrogate of the latter for a physiological flexion-extension at the knee joint. Aligning the prosthesis components to the mechanical axis, in order to theoretically reduce stress to the polyethylene, may come at a price. If the knee is not straight the bone cuts executed to obtain a correct mechanical axis will alter the soft tissue balance around the knee, possibly introducing instability, and altering kinesthetic and motor function; subsequently compelling a soft tissue release in order to reduce this imbalance. The present preliminary single-centre results of this randomized study, have shown that during surgery not a single patient in group C required a soft tissue release, whereas 25% of patients in groups A and B had either a release of the medial or lateral structures. Moreover better clinical results, and better range of motion was observed in group C.

Currently there is considerable debate also regarding the efficacy of the PSI systems, with several papers showing better results, similar to those after navigation, and other papers showing worst results. In our group B and C, where PSI was used, good accuracy and reproducibility of the alignment with respect to the planned alignment was achieved, with no outliers.

In conclusion the preliminary results of this study reveal a good efficacy of this PSI system, and better clinical results for the patients with the functional alignment.

**References**