Conventional Neutral Mechanical Alignment Versus Shape-matching Kinematic Alignment In Tka: Preliminary Results Using Video-fluoroscopy And Emg.

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Disclosures:

Introduction: Literature on total knee arthroplasty (TKA) reports that mechanical alignment (MA) is generally the gold standard for obtaining good clinical results and longer implant survivorship. Unlike this consensus, a number of recent studies reported that a postoperative leg alignment of 0° ± 3° does not improve such survivorship [1,2]. Accordingly, a novel implantation approach in TKA seems to emerge, this being referred to as kinematic alignment (KA) approach. This approach is based on the pre-disease alignment of the lower limb. Particularly, this implies the adoption of a reference axis, i.e. the trans-cylindrical, as an alternative to the trans-epicondylar axis, for the alignment of the femoral component. The KA axis is defined as the line passing through the centers of the posterior femur condyles, suitably modeled as cylinders, and is thought to allow a better knee soft tissue balance during joint flexion [3].

Patient specific instrumentation is nowadays offered as a novel technology in TKA to obtain more accurate implant alignment compared to conventional TKA instrumentation. In addition to a shorter surgical time and the use of fewer surgical instruments, it provides a virtual tool for preoperative implant planning that can be based on both MA and KA approaches, for postoperative TKA alignment [4].

KA in combination with ShapeMatch technology claims, in addition to above mentioned advantages, improved joint kinematics as well as closer to normal lower limb muscle activity. However, the current results when using general patient specific instrumentation are still poor and inconsistent [5, 6].

The purpose of this study was to report the preliminary joint kinematic and electromyography results of two patient groups operated either using conventional MA or ShapeMatch KA.

Methods: A European four-centre randomized study of 144 patients was designed to make quantitative evaluations for these techniques. In every centre, 36 plus 5 learning curve patients are planned to be operated. Currently in our center, 19 patients affected by primary gonarthrosis were implanted with a cruciate-retaining fixed bearing TKA prosthesis (Triathlon® - Stryker Orthopaedics, Mahwah, New Jersey, USA) with patella resurfacing. Nine patients, 5 operated using the conventional instrumentation aiming for MA and 4 following the ShapeMatch KA approach (Stryker Orthopaedics, Mahwah, New Jersey, USA), were assessed clinically and biomechanically at 6 month follow-up. Clinical outcome was quantified using the IKS score. Knee kinematics were assessed using mono-planar video-fluoroscopy (CAT Medical System, Monterotondo, Italy) during stair climbing, chair rising, and extension against gravity, suitably synchronized with electromyography analysis (Wave Wireless, Cometa, Milan, Italy) using a novel protocol for an in-depth activity assessment of knee extensor and flexor muscles.

Two-dimensional to three-dimensional registration procedures [7] were used to calculate knee flexion/extension (FE), add/abduction (AA), internal/external rotation (IE), together with the rotation of the contact-line (CLR) on the tibial base-plate, this being the line connecting the medial (MCP) and lateral (LCP) tibio-femoral contact points. The separate antero-posterior translation of these contact points on the same plane was also calculated. Mean values and standard deviations (SD) over the patient groups were worked out.

Results: The mean postoperative knee and functional scores in the conventionally MA patients were respectively 78±19 and 80±23, whereas for ShapeMatch KA patients these were 91±12 and 89±15.

AA mean range was found smaller than 3 degrees, physiological ranges of FE and IE were found in both groups, the latter being on average 9.2±3.5 degrees, 10.8±3.4 and 6.7±3.7 in the three motor tasks in the conventional, 8.2±4.0, 10.5±2.5 and 9.8±6.8 in the ShapeMatch group. From maximum extension to maximum flexion, MCP moved anteriorly 10.3% of the tibial baseplate length, 13.6 and 11.9 in the conventional, 11.3, 17.5 and 17.3 in the ShapeMatch group; corresponding LCP movements were 6.3, -4.1 and 6.2, in conventional, -2.0, -1.8 and 2.9 in the ShapeMatch group. These resulted in a CLR equal to 9.2±4.5, 11.6±2.6 and 9.3±6.3 in ShapeMatch. In the figure, a graphical representation of contact points and CLR during chair rising from a well representative patient is depicted.

Much more consistent patterns of motion were observed in the ShapeMatch than in the conventional group.

In the EMG data, prolonged activation of the medial and lateral vasti muscles were observed in the conventional knees.

Discussion: These preliminary results show that better knee and functional scores can be expected in patients operated with
ShapeMatch following a kinematic alignment approach. In the present postoperative assessment of replaced knee joint kinematics, in addition to standard clinical scoring systems, an original combination of three-dimensional video-fluoroscopy and electromyography was exploited; this was performed without problems in each patient and every motor task, resulting in original findings. Though not relevant differences were observed between the two patient groups in terms of mean range for the kinematic variables analyzed, a higher consistency of these patterns of knee motion was observed in the ShapeMatch KA group. In addition, the less prolonged activation of the knee extensor muscles suggest that a more natural soft tissue balance is experienced in this group when compared to the conventional knee replacement group. The observed better postoperative scores and joint stability during flexion-extension were in fact according the expectations of the TKA’s when performed with ShapeMatch technology in combination with the novel KA approach. All these features should theoretically result in smaller stress at the polyethylene, leading to a longer survivorship of the implant.

The preliminary results of this study show a good efficacy of ShapeMatch KA TKA. A thorough clinical and functional analysis of the total number of patients in this study and a longer follow-up are necessary to establish the claimed superiority of the modern ShapeMatch KA in TKA.

**Significance:** This study shows evidence on the good efficacy in-vivo of the shape-matching kinematic alignment TKA in terms of postoperative scores and joint stability.

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**References:**