Patient specific "à la carte" knee reconstruction with unicompartmental knee replacement – a feasibility study

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Introduction: How to position a unicompartmental knee replacement (UKR) remains a matter of debate. Basically, there are two opposite philosophies: to restore the so-called normal anatomy with a 0° tibio-femoral coronal mechanical axis, or to leave some degrees of hypocorrection of the deformation to protect the ligamentous balance. But both techniques do not include an individual analysis of the bone anatomy and of the ligamentous balance. We suggest an original technique based on the intra-operative anatomic and dynamic analysis of the operated knee by a navigation system, with a patient-specific reconstruction by the UKR. The goal of the current study was to assess the feasibility of the new technique and its potential pitfalls.

Material: 100 patients were consecutively operated on for an end-stage medial knee osteoarthritis by implantation of a UKR with help of a well validated, non-image based navigation system, by one single surgeon with known experience of this procedure. There were 41 men and 59 women, with a mean age of 68 years (range, 51 to 82 years).

Methods: After data registration, the navigation system provided the dynamic measurement of the coronal tibio-femoral mechanical angle in full extension. The reducibility of the deformation was assessed by a manually applied torque in the valgus direction. The patient-specific analysis was based on the following hypotheses: 1) The normal medial laxity in full extension is 2° (after previous studies), 2) there was no abnormal medial laxity (which may be routinely accepted for varus knees) and 3) the total reducibility is the sum of the patient’s own medial laxity and of the bone and cartilage loss. We assumed that the optimal correction may be calculated by the angle of maximal reducibility, less 2° to respect the normal medial laxity. The bone resections were performed accordingly to this calculated goal. No ligamentous balance or retension was performed. The fine tuning of the remaining laxity was performed by adapting the height of polyethylene component with a 1 mm step. The final measurements (coronal tibio-femoral angle in full extension and medial laxity in full extension) were performed with the navigation system after the final components fixation. The implantation had to fulfill these two parameters: optimal correction as defined previously, and a 2 ± 1° of medial laxity.

Results: Before UKR, the mean coronal tibio-femoral angle in full extension was 3.9°± 2.4° without stress, and 0.7°+2.3° with valgus stress. The mean medial laxity in full extension before UKR was 3.2°+1.3°. After UKR, the mean coronal tibio-femoral angle in full extension was 2.6°+2.9°. The mean medial laxity in full extension after UKR was 1.9°+0.8°. The complete goal was obtained for 74% of the case. The optimal correction of the coronal tibio-femoral angle in full extension alone was achieved for 78% of the cases. 94% of the cases had an optimal medial laxity in full extension.

Discussion: The patient-specific UKR reconstruction according to the criteria defined was possible and its accuracy was good. The accuracy of a navigation system and the modularity of the prosthesis components seem to be significant prerequisites. The adaptation of the UKR to the patient may be easier, and the ligamentous physiology may be better restored because of the absence of any soft-tissue release. The final functional result may be improved.

Conclusions: This preliminary study gave interesting results which must be confirmed by the assessment of the functional results.