Digital and CT-based planning in total knee prosthesis using patient specific instrumentation: a prospective study

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Background: A preoperative planning for accurately predicting the size and alignment of the prosthetic components may allow to perform a precise, efficient and reproducible total knee replacement. The planning can be carried out using as a support digital radiographic images or CT images with three-dimensional reconstruction.

Aim of the Study: Evaluate and compare the accuracy of two different types of pre-operative planning, in determining the size of the femoral and tibial component in total knee arthroplasty performed with PSI method (patient specific instrumentation). The two techniques were: digital radiography and "CT-Based".

Materials and Methods: A prospective study was conducted to compare the accuracy in predicting the size of the prosthetic components in total knee replacement in 71 patients diagnosed with primary and symptomatic osteoarthritis of the knee. Inclusion criteria was "Easy Knee": BMI ≤ 35, varus/valgus deviation ≤15° and residual flexion of the knee ≥ 90°.

Pre-operatively all the patients underwent to the same standard protocol including digital radiographs with calibration and a CT scan. A dedicated IMPAX digital software (Agfa-Gevaert, NV, USA) was used to template the radiographs. The CT-based planning was performed on 3D reconstruction of CT scans of 3 joints: hip, knee and ankle, as established in standardized protocol to build up patient specific cutting mask (MyKnee, Medacta, Castel S.Pietro, Switzerland).

All the surgeries were performed by 2 senior Authors (M.A and N.C.) using the same implant and the definitive component sizes implanted were registered and compared with the sizes suggested by both planning techniques considering also the range of error. Results analysis was carried out using nonparametric tests.

Results: The planning of digital radiography indicates the correct size in 63% of the cases for the femoral component and 53% for the tibial. The accuracy reaches 90% for both components if we consider the maximum error of one size. CT-based planning reached an accuracy of 95% for the femur and 63% for the tibia considering the exact size. The accuracy reaches 100% for both components if considered the maximum error of a size using CT-based planning with a statistically lower range of error (p=0.04)

Conclusions: The planning, regardless of the method of execution helps to plan the surgery.

In our study the accuracy of the X-ray planning using dedicated softwares confirms the results obtained by other studies in the literature. Likewise the CT-based planning does provide significant more accurate data and the error is never more than one size. Further studies are needed even to evaluate any potential economical advantage in term of reduce hardware and sterilization costs in the operating theatre despite more expensive exams.

Bibliography