INTRODUCTION
In Total Knee Replacement (TKR), anterior knee pain results also from patellar maltracking. In case of severe complications, this pain can lead ultimately to failure of the replacement and consequent revision [1]. Furthermore, in case of TKR with patellar resurfacing, prosthetic component misalignment at both tibio-femoral (TFJ) and patello-femoral (PFJ) joint complexes is generally considered the main cause of patellar mal-tracking. Particularly, it is still debated the necessity, or not, to resurface the patella for adapting better its articular surface to the corresponding femur prosthetic component [1].

A number of studies in the past literature on TKR reported significant correlations between post-operative TFJ kinematics and femoral and tibial component implantation parameters [2], but generally disregarding the role of the patella, even in case of resurfacing. Only a few studies both in-vivo and in-vitro have addressed fully three-dimensional patellar tracking in the intact knee and after TKR [3].

In computer-aided surgery, knee surgical navigation systems were developed in order to allow the accurate intra-operative monitoring of all six degrees of freedom of TFJ kinematics during all phases of TKR, and to improve femoral and tibial prosthesis component positioning [2]. Recently, a new technique that includes a new device and an original methodology has been developed for assessing thoroughly also PFJ motion by these systems simultaneously with the assessment of TFJ kinematics [3].

The aim of this study was to identify in TKR with patellar resurfacing the geometrical parameters of patellar component implantation, including also patellar cut orientation, as traditionally executed. All possible correlations between these parameters and PFJ kinematics have been investigated by using a surgical knee navigation system, suitably adapted to this study aim.

METHODS
TKR was performed on sixteen fresh frozen legs from cadavers with intact joint capsule, ligaments and quadriceps tendon. Cruciate-retaining (CR) and posterior-stabilized (PS) TKR (Scorpio®, Stryker Orthopaedics, Mahwah, NJ-USA) were implanted on eight specimens per prosthesis design. In all TKRs, the patella was resurfaced with a domed-shape component.

All TKRs were performed by using a standard navigation system (Stryker® Leibinger, Freiburg, Germany) also used as measurement preparation and component implantation for this resurfacing, which experiments in-vitro demonstrated the fundamental value of bone potentials to support for these assessments.

Independently from the TKR design, significant correlations were observed between patellar cut orientation on the transverse plane and PFJ flexion (R²=0.59, P=0.02), tilt (R²=0.64, P=0.02) and translation along the femoral medio-lateral axis (R²=0.25, P=0.03). Significant correlation were also observed between patellar component positioning along patellar proximo-distal axis and PFJ tilt (R²=0.65, P=0.01) and translation along femoral medio-lateral axis (R²=0.27, P=0.04). Generally, PFJ tilt and patellar translation along femoral medio-lateral axis were not restored.

DISCUSSION
The results here reported confirm that, in case of TKR with patellar resurfacing, patellar component implantation affects final PFJ kinematics. Particularly, an incorrect restoration of the original patellar thickness together with a misaligned patellar component alters sensibly PFJ kinematics. This can result in-vivo in anterior knee pain and, ultimately, in TKR failure.

In clinical practice, the patellar component needs to be carefully positioned onto the patella in case of resurfacing. In this perspective, intra-operative quantitative of implant parameters together with relevant measurements of PFJ kinematics are important since all possible misalignments, including also those occurring for patellar component positioning, can be recognized and corrected intra-operatively. Modern knee navigation systems seem to have the potentials to support for these assessments.

SIGNIFICANCE
This study reports important evidence on the controversial effect in TKR of patellar resurfacing on PFJ kinematics. Carefully performed experiments in-vitro demonstrated the fundamental value of bone preparation and component implantation for this resurfacing, which would require specific procedures within surgical navigation systems.

REFERENCES