Alignment in total knee arthroplasty

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The alignment in total knee arthroplasty (TKA) has been discussed of being an important factor to prevent early implant failure for many years [11].

A varus/valgus alignment within a range of three degree has been recommended because of the best clinical outcome is expected. Incorrect alignment may lead to early aseptic loosening, patellofemoral maltracking, abnormal wear, instability and finally inferior clinical outcome.

Numerous novel technologies were introduced over the last decades such as computer-assisted surgery (CAS), patient-specific instrumentation (PSI) and robotic-assisted surgery in order to improve component alignment and clinical outcome in TKA. Many studies used the mechanical alignment within $\pm 3^\circ$ as a quality parameter in order to evaluate the novel technologies. A meta-analysis of level-1 studies compared the coronal alignment after computer-assisted surgery and conventional surgery. The authors showed incorrect alignment of $>3^\circ$ in 12.1 % of patients in the CAS group and of 28.7 % in the conventional group [6]. In conclusion, CAS was able to reduce significantly

the outlier in mechanical alignment. No outlier was even reported in robotic-assisted surgery (0 %) when compared with conventional surgery (24 %) [14]. In contrast, PSI did not show significant improvement in mechanical alignment when compared with conventional surgery [5, 7].

However, can we expect any difference in clinical outcome between conventional surgery, CAS or PSI taking the mechanical alignment into consideration? Most of the studies did not show any clinical difference in outcome after conventional surgery, CAS or PSI. Why do we not find any clinical difference despite the fact that we are able to reduce the outlier significantly? No association between prosthetic alignment after total knee replacement and dissatisfaction or change in Oxford Knee Score was reported [8]. That goes in line with a recent review on coronal plane alignment and implant survivorship. The authors did not see a strong correlation between the mechanical alignment and implant survivorship [17]. A multivariate analysis of the clinical outcome showed also no impact of leg alignment on clinical outcome [12].

There remains the question what does alignment within a range of three degrees mean in total knee arthroplasty?

Despite improvement in accuracy of mechanical alignment, a meta-analysis of the literature failed to show significant difference in clinical outcome [4, 8]. The 15-year implant survival rate was not improved in knees with a mechanically alignment within $\pm 3^\circ$ [13]. The goal of being within the range of $\pm 3^\circ$ seems to be of little value predicting implant survival. Better function and early successful rehabilitation has been shown in very few studies within the first year when coronal femoral alignment was within 2° [10].

Alignment in the coronal plane is one issue, but we need to take the component alignment in the sagittal and transverse plane into consideration as well. The current issue will present results about the impact of tibial rotation on

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the retropatellar pressure [9, 15]. Femoral rotation also is very important for correct patella tracking and femorotibial stability especially in flexion. However, we know how difficult it is to identify the epicondylar line, the landmark for correct femoral component placement in rotation. Significant variation of 15 mm in the anteroposterior dimension and of 19 mm in the proximal–distal dimension has been reported when identifying the medial and lateral epicondyle of the femur [16]. Despite knowing the anatomical landmarks very well, it seems to be difficult to achieve correct component placement. Cutting errors should not be underestimated, which limits the accuracy in TKA despite improved technology also [1].

There remains a wide field of further research when discussing optimal component alignment. However, at the same time we have to take other factors into consideration such as femoral or tibial component sizing [3], patients expectation [2] or even the quality of patients evaluation after TKA.

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