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Does augmented reality improve clinical outcome in TKA? A prospective observational report

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Abstract

AIMS: The Pixee Knee+ system offers intraoperative assistance through augmented reality glasses. This allows the surgeon to see the tibial and femoral axis depicted on the surgical field, providing real-time information during surgery.

METHODS: 122 patients received TKA surgery with the Pixee Knee+ system, and were matched based on gender and age to 122 patients who received conventional surgery. PROMs (Oxford knee Score, KOOS, and Forgotten Joint score) were collected preoperatively, at 6 weeks and 3 months. The difference between the scores at 6 weeks versus preoperative (Delta) was analyzed over time of surgery, in order to evaluate any possible surgeon learning curve.

RESULTS: Pixee patients scored significantly lower on the symptoms sub-scale of the KOOS score at 6 weeks. Similarly, at 3 months, the Quality of life sub-score, Forgotten Joint score and Oxford Knee Score were all significantly worse for the Pixee group. When analyzing the Delta KOOS over time, a clear increase in the linear model could be established for the Pixee group, whereas the Delta KOOS outcomes in the conventional group remained at a plateau.

CONCLUSION: The use of the Pixee Knee+ system results in an initial inferior clinical outcome when comparing the average of the two groups. This is likely explained by a learning curve, which shows an increase over time of the Delta KOOS at 6 weeks in the Pixee group. To what extent this increase over time will persist remains to be investigated

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1 Introduction

A major goal in the advancement of total knee arthroplasty is to improve implant positioning and enhance the precision of bone preparation as well as component alignment (Gromov et al., 2014). The Pixee Knee+ system offers intraoperative assistance through augmented reality glasses. This allows the surgeon to see the tibial and femoral axis depicted on the surgical field, providing real-time information during surgery. This intraoperative feedback can guide the surgeon in choosing the correct posterior slope on the tibial cut, varus or valgus angle, the valgus distal femoral cut, and flexion or extension of the femoral component.

A recent clinical pilot trial by Iacono et al. showed that the Pixee Knee + system results in a cutting error of less than 1° of difference regarding the coronal alignment of femur and tibia, and less than 2° difference of flexion/extension regarding femur and posterior tibial slope (Iacono et al., 2021). Whether this high precision leads to a beneficial clinical outcome remains to be established, as well as whether this technique is associated with a surgeon learning curve similar to robotic surgery(Mitchell et al., 2021).

2 Methods

As of April 2021 up until January 2022, 122 patients received TKA surgery with the

Pixee Knee+ system, whereas 257 patients received conventional surgery. All patients were operated on by 2 orthopedic surgeons and received the Evolution Medial-Pivot Knee Systems prosthesis (MicroPort Orthopedics).

PROMs (Oxford knee Score, KOOS, and Forgotten Joint score) were collected during routine practice via the moveUP platform and analyzed in order to compare the clinical outcome at 6 weeks and 3 months postoperatively as well as to assess whether the use of the Pixee Knee+ system translates into better clinical outcome. Secondly, the difference between the scores at 6 weeks versus preoperative (Delta) will be analyzed over time of surgery, in order to evaluate any possible surgeon learning curve.

A matched cased control analysis was performed on 122 Pixee-patients compared to 122 conventional patients, matched on both age and gender.

3 Results

In both groups, Oxford knee Score, KOOS and FJS were significantly increased at 6 weeks and 3 months as compared to the preoperative scores. However, multiple significant differences between Pixee or conventional surgeries were found, all favoring the conventional surgeries. At 6 weeks, patients who received surgery with the pixee Knee + systems scored significantly lower on the symptoms sub-scale of the KOOS score. Similarly, at 3 months, the Quality of life sub-score, Forgotten Joint score and Oxford Knee Score were all significantly worse for the Pixee group as compared to conventional surgery. However, when analyzing the Delta KOOS over time, a clear increase in the linear model could be established for the Pixee group, whereas the Delta KOOS outcomes in the conventional group remained at a plateau.

4 Discussion

In conclusion, the use of the Pixee Knee+ system results in an initial inferior clinical outcome when comparing the average of the two groups. This is likely explained by a learning curve, which shows an increase over time of the Delta KOOS at 6 weeks in the Pixee group. Similar learning curves have been established in the use of robotics for TKP surgery(Ali et al., 2022; Mahure et al., 2021). To what extent this increase over time will persist remains to be investigated. Future research could focus on correlating the clinical outcome to objective intra-operative parameters such as component alignment.

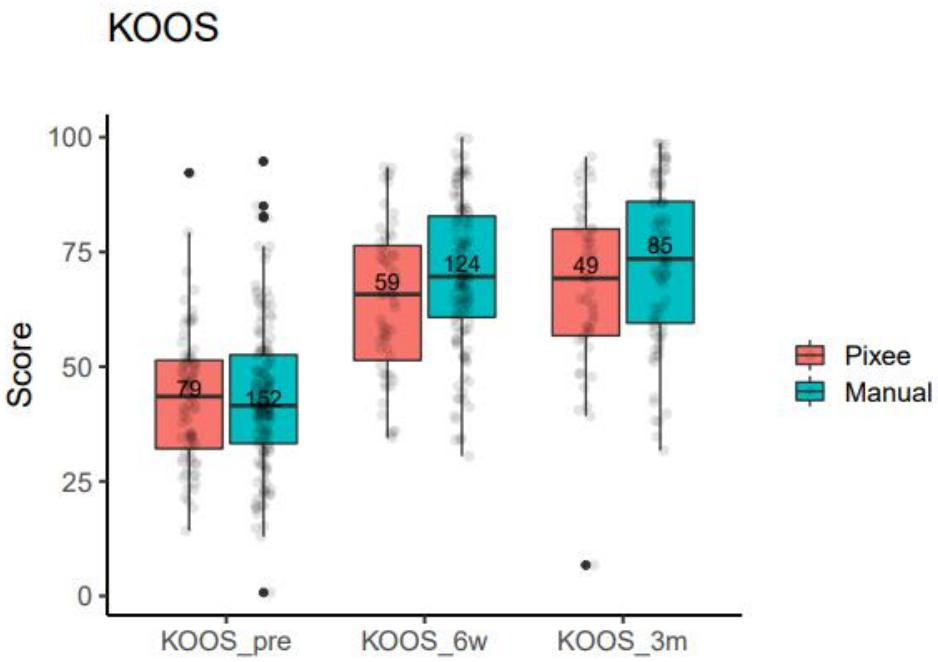

Figure 1: Comparison of KOOS scores of patients who received either conventional surgery or surgery under guidance of the Pixe Knee + system

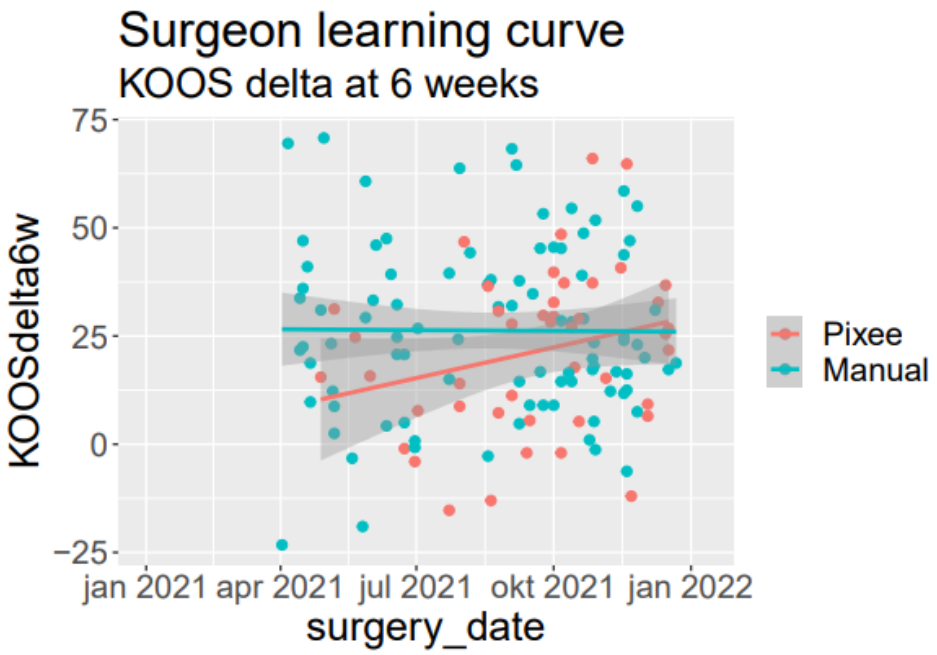

Figure 2: Linear models fitted to the KOOS delta at 6W over time (surgery date). The fitted models show a learning curve with an increase in the KOOS outcome at 6 weeks for the pixee group, while the conventional group remains stable.

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