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Comparison of Clinical Outcomes Between the Slider Device and Standard Physiotherapy for Knee Osteoarthritis Patients Undergoing Knee Replacement Surgery: A Pilot Study

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Abstract

Objectives: Physiotherapy is an established part of the post-operative protocol for total knee replacement (TKR). As length of hospital stay has decreased, rehabilitation has moved to the home setting with little direct supervision. The Slider, a smart exercise device utilises gamification to optimize patient engagement during self-directed physiotherapy. This pilot study aimed to evaluate whether the Slider device in addition to standard physiotherapy could improve outcomes following TKR.
Methods:18 patients undergoing robotic primary TKR surgery at a single institution. Nine patients were allocated to the Slider group (device & standard physiotherapy) and nine patients to the standard physiotherapy group. Outcome measures included range of motion (ROM), Oxford Knee Score (OKS), EQ-5D-3L, and patient-reported outcome measures (PROMs) at six weeks postoperatively.
Results: Intraoperative and discharge ROM values were similar between groups (124 vs. 123, p=0.430; 76 vs. 78, p=0.624). Six-week postoperative ROM was superior in the Slider group (104 vs. 89, p=0.121). The Slider group had a shorter hospital stay and a similar number of inpatient physiotherapy sessions (2 vs. 3, p=0.332; and 4 vs. 4, p=0.999). The Slider group reported higher Likert scale satisfaction scores for post-op care (p=0.017). Both OKS and EQ-5D-3L were better in the Slider group, with OKS reaching statistical significance (39 vs. 33, p=0.045; 85 vs. 79, p=0.778).
Conclusion: The Slider device aids early patient rehabilitation after total knee replacement, improving OKS and satisfaction scores. This device shows promise in supporting home-based rehabilitation and will allow clinicians to supervise the process and identify struggling patients early.

1 Introduction

Total knee replacement is an effective procedure for arthritis that has failed conservative management. Physiotherapy is an established part of the post-operative protocol, improving pain, function and range of motion(Konnyu et al., 2022; Sarpong et al., 2019). Early post-operative results are correlated to long term satisfaction, and therefore maximising early range of motion is a key priority of therapy(Goh et al., 2021). As length of hospital stay has decreased rehabilitation has moved to the home setting, with the onus on the patient to conduct prescribed exercises with little direct supervision(Jacobs et al., 2021). The Slider, a smart exercise device, utilises gamification to optimize patient engagement during self-directed physiotherapy. It is the only device capable of measuring both force and motion during sessions, providing real-time feedback to patients and clinicians. In doing so, it aims to improve patient outcomes from early post-operative rehabilitation.

2 Objective

This pilot study aimed to evaluate whether adding the Slider device to standard physiotherapy could improve clinical outcomes for patients undergoing TKR.

3 Methodology

This locally approved study included 18 patients with knee OA undergoing Mako robotic arm assisted primary TKR surgery at a single institution. Nine patients were allocated to the Slider group, which used the Slider smart device for home exercises in addition to our institute's standard physiotherapy protocol. The other nine patients comprised the control group, following standard physiotherapy protocol only. Groups were matched for age, gender, comorbidities, and baseline functional status. Both groups followed similar timelines for preoperative and postoperative rehabilitation. Patients in the Slider group used the device daily, with progress monitored remotely via the Slider Online app, allowing real-time data sharing between patients and clinicians. Outcome measures included range of motion (ROM), Oxford Knee Score (OKS), EQ-5D-3L, and patient-reported outcome measures (PROMs) at six weeks postoperatively. The Mann-Whitney test was used to assess statistical significance.

4 Results

The mean age of the Slider group was 72 years, while the control group had a mean age of 74 years ($p=0.689$). The mean preoperative ROM in the Slider group was higher (118 vs. 108, $p=0.477$). Intraoperative and discharge ROM values were similar between groups (124 vs. 123, $p=0.430$; 76 vs. 78, $p=0.624$). Six-week postoperative ROM was superior in the Slider group (104 vs. 89, $p=0.121$). Fixed flexion measurements at six weeks also showed a trend favouring the Slider group (1 vs. 5, $p=0.127$). The Slider group had a shorter hospital stay and a similar number of inpatient physiotherapy sessions (2 vs. 3, $p=0.332$; and 4 vs. 4, $p=0.999$). A significant difference was observed in Likert scale satisfaction scores between groups ($p=0.017$), with the Slider group reporting higher satisfaction. Both OKS and patient-reported health scores were better in the Slider group, with OKS reaching statistical significance (39 vs. 33, $p=0.045$; 85 vs. 79, $p=0.778$).

Figure 1 The Slider device- a pressure sensor and optical tracker which fit under the heel during self-directed physiotherapy sessions

Figure 2 Screenshot of a Slider game. The patient interacts by use of the Slider device, thereby making physiotherapy sessions interactive challenges. Scores and feedback are shown once game complete

5 Discussion

The Slider exercise device (AI Rehab Ltd, UK) is an innovative adjunct to physiotherapy in the perioperative management of total knee replacement patients. It comprises of a heel device with inbuilt pressure sensor and optical tracker (Figure 1). This allows for detection of force and motion, which are transmitted to the supplied tablet computer. Software on this tablet prompts patients to undertake their daily physiotherapy sessions in the form of a number of challenges (Figure 2). This leverages the concept of gamification – the use of game elements to promote certain behaviours – which has proven effective across a range of settings(Hamari et al., 2014; Mazeas et al., 2022).
In this pilot study, we demonstrate that the Slider offers improved early post-operative range of motion, patient satisfaction and Oxford Knee Scores. These early OKS improvements have been shown to persist into the long term and favour a "happy" knee replacement(Goh et al., 2021; Tay et al., 2023). All nine patients in the Slider group engaged with the device on a regular basis and we believe this resulted in better adherence to self-directed home physiotherapy. The Slider Online app provided an additional level of oversight for clinicians to review individual patient progress and identify those failing to rehabilitate as expected. Whilst not required in this study, this would facilitate early intervention aimed at reducing chronic pain or restricted motion.
This pilot study has a range of limitations associated with it including small sample size, lack of blinding and duration of follow up. We believe these results warrant further investigation with a larger study population to confirm effect size and duration. In addition, a cost-effectiveness analysis is essential to determine whether incorporating the Slider can reduce the number of in-person physiotherapy sessions, thereby lowering healthcare costs and freeing up physiotherapy resources for more complex cases. As our arthroplasty population becomes increasingly technology literate, we expect the role of devices such as the Slider to increase.

6 Conclusion

The Slider device aids patient rehabilitation after total knee replacement. At six weeks post-op the Oxford Knee Score showed a significant improvement versus standard care. Range of motion, fixed flexion deformity, length of hospital stays and number of physiotherapy sessions showed a trend favouring the Slider group, though this did not reach significance. This device shows promise in supporting home-based rehabilitation, and will allow clinicians to supervise the process and identify struggling patients early. This may allow healthcare systems to allocate resources more effectively and provide personalised rehabilitation where necessary.

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