Journal of Population Therapeutics & Clinical Pharmacology

RESEARCH ARTICLE
DOI: 10.53555/jptcp.v31i8.7532

IMPACT OF PREOPERATIVE REHABILITATION ON FUNCTIONAL OUTCOMES FOLLOWING TOTAL KNEE ARTHROPLASTY; A RANDOMIZED CONTROLLED TRIAL

Adnan Yaqub[1], Israr Ahmed[2], Madiha Zia[3], Ghulam Meeran[4], Junaid Javaid[5], Syed Abdur Rub Abidi[6], Yousuf Qamar[7], Baqir Hussain[8*]

[1]Orthopedic Specialist, Orthopedics Department, Bahawal Victoria Hospital, Bahawalpur
[2]Consultant Orthopedic Surgeon, DHQ Hospital Battagram, KPK
[3]Assistant Professor, Physical Medicine and Rehabilitation, Sindh Institute of Physical Medicine and Rehabilitation, Karachi
[4]Consultant Orthopedic Surgeon, National Hospital, Faisalabad
[5]Assistant Professor, Orthopedic Department, Watim General Hospital, Rawalpindi
[6]Associate Professor, Orthopedic Surgery Department, Jinnah Medical &Dental College Karachi
[7]MBBS, Dow International Medical College, Karachi
[8*]Assistant Professor, Orthopedic Department, Lady Reading Hospital (MTI) Peshawar

***Corresponding Author:** Baqir Hussain
*E-mail: dr.baqirturi@gmail.com

ABSTRACT

Background: A popular surgical procedure for end-stage osteoarthritis is total knee arthroplasty (TKA), which often requires a lengthy recovery time. This research assesses how preoperative rehabilitation affects post-TKA functional results.

Objective: to evaluate the impact on functional mobility, pain thresholds, quality of life, and duration of hospital stay in patients undergoing total knee arthroscopy (TKI).

Methods: This randomized controlled trial included 88 Bahawal Victoria Hospital, Bahawalpur, patients having major TKA visits. Participants were randomly assigned to control or preoperative rehabilitation groups (n = 44). Rehabilitation participants exercised for four weeks before surgery, while the control group received standard care. Functional mobility, discomfort, and quality of life were assessed at six weeks and three months after surgery using the Timed Up and Go (TUG) test, Visual Analog Scale (VAS), and Knee Injury and Osteoarthritis Outcome Score (KOOS). Noted was hospital stay length.

Results: Comparing the rehabilitation group to the control group, there were significant improvements in TUG test timings (14.2 ± 2.3 vs. 16.5 ± 2.8 seconds, $p < 0.001$) and pain levels (VAS score of 3.8 ± 1.2 vs. 4.6 ± 1.5, $p = 0.01$). Additionally, the rehabilitation group's KOOS quality of life score was considerably higher (59.9 ± 6.9 vs. 54.2 ± 7.2, $p = 0.005$). Furthermore, the rehabilitation group was admitted to the hospital for 3.8 ± 0.9 days as opposed to 4.4 ± 1.1 days ($p = 0.02$).

Conclusion: With the extra advantage of shorter hospital stays, preoperative rehabilitation dramatically improves functional results, lowers pain, and improves quality of life after total knee arthroplasty (TKI).

Keywords: Preoperative Rehabilitation, Total Knee Arthroplasty, Functional Mobility, Pain Reduction, Quality of Life, Hospital Length of Stay

Introduction

For individuals with end-stage osteoarthritis, total knee arthroplasty (TKA) is a very successful surgical procedure that significantly reduces pain and improves function. Though TKA is a successful procedure, patients often have a drawn-out recuperation time marked by decreased mobility, weakened muscles, and worsened functional results[1, 2]. The resumption to daily activities might be delayed and the general quality of life greatly impacted by these postoperative difficulties. As a result, a major area of interest for orthopedic research is improving preoperative techniques to improve postoperative healing. Prehabilitation, also referred to as preoperative rehabilitation, has become a viable strategy for enhancing results after a variety of surgical procedures, including TKA[3]. Prehabilitation is the process of enhancing physical health, strength, and range of motion before to surgery in order to better prepare the body for the stress of the procedure. Prehabilitation may improve a patient's functional results, decrease hospital stays, and expedite postoperative recovery by improving their physical state prior to surgery[4, 5].

Prehabilitation is based on the knowledge that a patient's preoperative functional and physical state has a significant impact on their recovery after surgery. Due to restricted mobility and persistent joint discomfort, patients having TKA may have impaired muscular strength, joint flexibility, and aerobic ability[6]. Targeted preoperative exercise programs that address these weaknesses may help to lessen the effects of surgery and hasten the healing process. Preoperative rehabilitation has advantages in theory, however there is conflicting data on its effectiveness in treating TKA patients[7-9]. While some studies have shown promising results, such better postoperative function and shorter hospital stays, others have not shown any significant variations from conventional treatment. These contradictory results emphasize the need for further investigation to fully comprehend how prehabilitation affects postoperative results in patients undergoing total knee arthroplasty[10, 11].

The purpose of this randomized controlled experiment was to look at how a structured preoperative rehabilitation program affected the functional results of total knee replacements. This research aimed to offer strong evidence on whether prehabilitation might improve functional outcomes, shorten recovery durations, and increase overall patient satisfaction after TKA by comparing the postoperative recovery of patients who get prehabilitation with those who receive conventional treatment. The research delves into the particular elements of the prehabilitation program that have the greatest impact on enhanced results, offering crucial knowledge to both medical professionals and patients.

Methodology

Study Design and Setting: Bahawal Victoria Hospital, Bahawalpur, is home to the orthopedic department where this randomized controlled experiment was carried out. The purpose of the research was to assess how preoperative rehabilitation affected postoperative functional outcomes after total knee arthroplasty (TKA). January 2023 marked the start of the 18-month study, which ended in June 2024.

Participants and Sample Size Calculation*:* 88 people with major TKA visits were included in the study. The TUG test was used as the main outcome measure to figure out the sample size, with an estimated effect size of 0.5. With a two-tailed alpha of 0.05 and a power of 80%, at least 40 cases in each group were needed to find a significant difference. To account for possible losses, the sample

size was increased to 88 cases, with 44 in each group. The calculation was done with G*Power program.

Inclusion and Exclusion Criteria: Adults between the ages of 50 and 75 who had been diagnosed with end-stage osteoarthritis and were scheduled for primary to TKA were the study's inclusion criteria. It was necessary for participants to be willing to engage in the preoperative rehabilitation program and to be able to provide informed permission. Patients with severe cardiovascular or pulmonary problems that preclude activity, a history of neurological disorders impairing movement, a history of prior knee surgery, or those receiving physical therapy for other illnesses were among the exclusion criteria. In addition, the patient was excluded if the investigator believed that the condition would prevent them from finishing the trial.

Randomization and Allocation: Using a computer-generated randomization process, participants were randomized 1:1 to the intervention group (preoperative rehabilitation) or the control group (standard care). The use of opaque, sealed envelopes guaranteed allocation concealment.

Intervention: A systematic preoperative rehabilitation program, including supervised exercise sessions aimed at improving lower limb strength, joint flexibility, and cardiovascular fitness, was provided to the intervention group. In the four weeks before surgery, the program was held three times a week. Standard preoperative care was provided to the control group, and no organized exercise program was implemented.

Outcomes: The Timed Up and Go (TUG) test assessed mobility six weeks and three months following surgery. VAS was used to assess post-surgery discomfort. The Knee Injury and Osteoarthritis Outcome Score (KOOS) was used simultaneously to assess quality of life.

Data Collection and Analysis: At the start, six weeks, and three months after surgery, data were collected. Statistics were done with the help of SPSS. Means and standard deviations were used to show continuous factors, while rates and percentages were used to show binary data. Chi-square and independent t-tests were used to compare the two groups' results. It was statistically significant when the p-value was less than 0.05.

Ethical Considerations: Approved by the Pakistan Institute of Medical Sciences (PIMS), Islamabad Ethical Review Board, the research was carried out in compliance with the Declaration of Helsinki. Written informed permission was obtained from each participant prior to their involvement in the research. A thorough description of the goals, methods, possible dangers, and advantages of the research was provided as part of the consent process. The research's participants were reassured that their participation was entirely voluntary and that their withdrawal from the study would not affect their access to regular medical treatment. Each participant was given a unique identification to ensure data confidentiality, and all information was securely kept with access limited to the study team.

Results

In all, 112 patients had their eligibility evaluated between August 2023 and June 2024. Of these, twenty-four patients were eliminated (12 for failing to satisfy inclusion criteria, 8 for refusing to take part, and 4 for other reasons). In the end, 88 individuals were randomly allocated to the trial, 44 of them were placed in the control group and 44 in the preoperative rehabilitation group. The individuals' initial characteristics were similar in the two groups. The rehabilitation group's mean age was 65.2 ± 6.8 years, whereas the control group's mean age was 64.7 ± 7.1 years. With 27 females (61.4%) in the rehabilitation group and 29 females (65.9%) in the control group, the gender distribution was comparable. The rehabilitation group's average body mass index (BMI) was 29.8 ± 4.2 kg/m², whereas the control group's average BMI was 30.2 ± 4.6 kg/m². Table 1 displays the results of the Timed Up and Go (TUG) test, which measures baseline functional mobility, and the Visual Analog Scale (VAS), which measures pain levels. Both tests did not reveal any statistically significant changes.

Table 1: Baseline Characteristics of Participants

Characteristic	Rehabilitation Group (n = 44)	Control Group (n = 44)	p-value
Age (years)	65.2 ± 6.8	64.7 ± 7.1	0.68
Gender (Female), n (%)	27 (61.4%)	29 (65.9%)	0.65
BMI (kg/m²)	29.8 ± 4.2	30.2 ± 4.6	0.54
Baseline TUG Test (seconds)	18.7 ± 3.4	19.0 ± 3.6	0.75
Baseline VAS Pain Score	7.2 ± 1.3	7.4 ± 1.4	0.52

In comparison to the control group, the rehabilitation group's mean TUG test time showed a substantial improvement at six weeks postoperatively. The control group's mean TUG time was 16.5 ± 2.8 seconds, but the rehabilitation group's was 14.2 ± 2.3 seconds ($p < 0.001$). At the 3-month follow-up, the rehabilitation group continued to exhibit improvement in functional mobility, with a time difference of 12.8 ± 2.1 seconds compared to 15.4 ± 2.5 seconds in the control group ($p < 0.001$), as shown in figure 1.

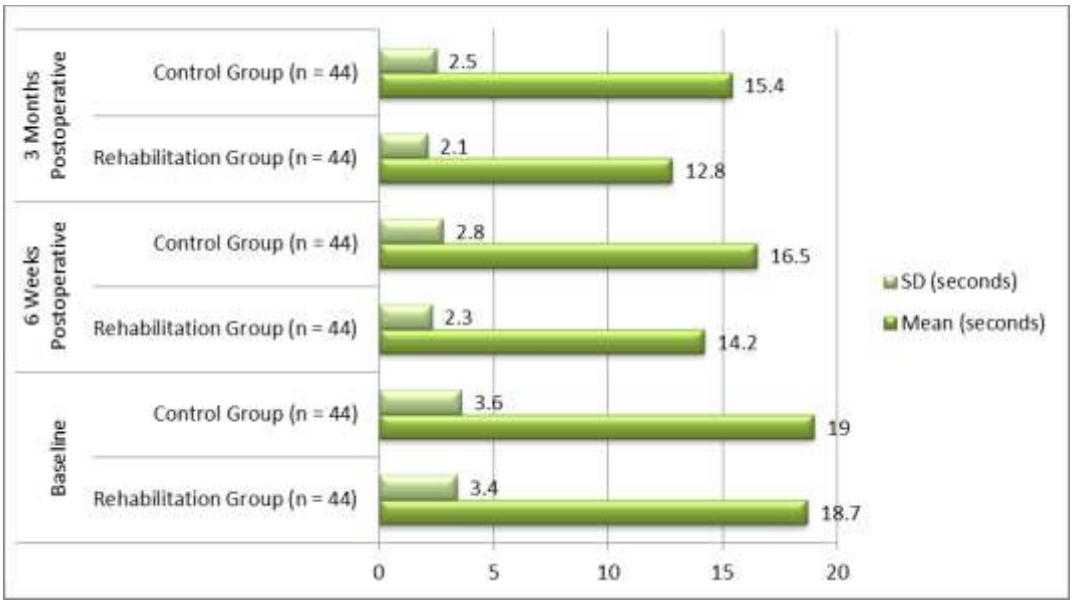

Figure 1: Timed Up and Go (TUG) Test Results

At six weeks and three months after surgery, the rehabilitation group had less pain, as indicated by the VAS. At six weeks, the rehabilitation group's mean VAS score was 3.8 ± 1.2, whereas the control group's was 4.6 ± 1.5 ($p = 0.01$). Pain levels had dropped further in both groups by three months, although the rehabilitation group kept reporting lower pain levels (mean VAS score of 2.7 ± 1.0 vs 3.5 ± 1.3 in the control group; $p = 0.02$) (Table 2).

Table 2: Visual Analog Scale (VAS) Pain Scores

Time Point	Rehabilitation Group (n = 44)	Control Group (n = 44)	p-value
Baseline (VAS score)	7.2 ± 1.3	7.4 ± 1.4	0.52
6 Weeks Postoperative (VAS score)	3.8 ± 1.2	4.6 ± 1.5	0.01
3 Months Postoperative (VAS score)	2.7 ± 1.0	3.5 ± 1.3	0.02

The therapy group did statistically better on all parts of the KOOS that measure pain, symptoms, daily living tasks, sports and leisure, and quality of life. The therapy group did better at the 3-month follow-up, as shown in Figure 2. Their mean increase in the KOOS quality of life subscales 21.5 ± 6.7 points, while the control group's increase was 15.2 ± 5.9 points ($p = 0.005$).

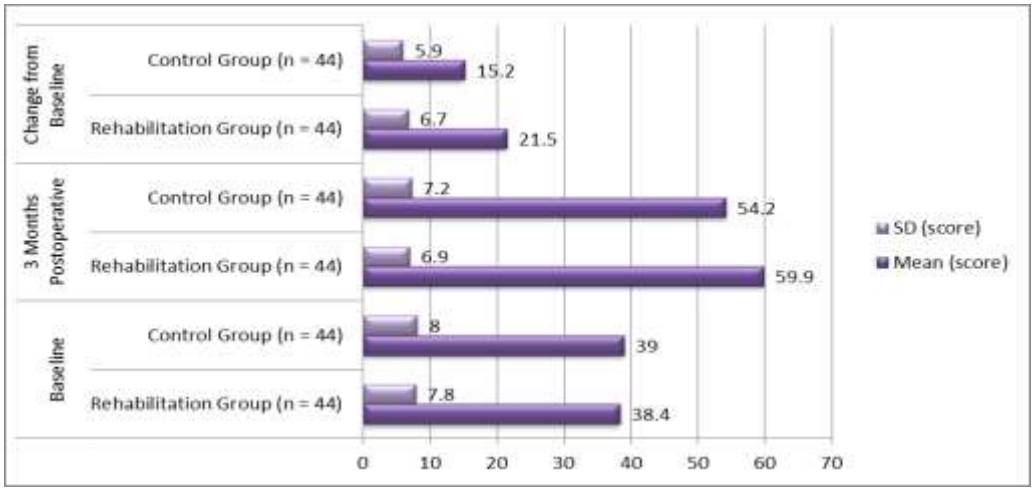

Figure 2: Knee injury and Osteoarthritis Outcome Score (KOOS) Quality of Life Subscale

Preoperative rehabilitation program adherence was strong; at least 90% of the recommended sessions were completed by 41 out of 44 participants (93.2%). There have been no significant side effects linked to the prehabilitation program. Eight individuals (18.2%) in the rehabilitation group had mild adverse effects, such as discomfort in their muscles, but these were temporary and went away on their own without any help. In the rehabilitation group, the average duration of hospital stay was 3.8 ± 0.9 days, whereas in the control group it was 4.4 ± 1.1 days (p = 0.02). The rehabilitation group's overall recovery trajectory accelerated as a result of this shorter hospital stay (Table 3).

Table 3: Length of Hospital Stay

Group	Mean Length of Stay (days)	p-value
Rehabilitation Group (n = 44)	3.8 ± 0.9	0.02
Control Group (n = 44)	4.4 ± 1.1	

Discussion

The results of this randomized controlled study show that patients having TKA have far better functional mobility, experience less pain, and have a higher quality of life after a systematic preoperative rehabilitation program. These findings are in line with other studies that looked at the function of prehabilitation after orthopedic procedures, especially total knee arthroplasty.

The Timed Up and Go (TUG) test findings showed a substantial increase in functional mobility in the rehabilitation group, which is consistent with other research that has shown the advantages of preoperative exercise regimens[12]. According to a meta-analysis, prehabilitation may improve functional results after surgery, especially in terms of shortening the recovery period for regained mobility. Our study's faster recovery was probably influenced by prior studies that found patients who took part in prehabilitation had superior early postoperative results, such as increased muscular strength and gait speed[13, 14]. It's crucial to remember, nevertheless, that some research did not discover a statistically significant difference in postoperative function between the control and prehabilitation groups[6]. This disparity might be explained by changes in the prehabilitation programs' length and intensity as well as in the timing of the outcome evaluations. It's possible that the thorough and prolonged prehabilitation program we used in our trial, spanning four weeks, supplied enough stimulation to result in the noted gains in functional mobility. Another important outcome of our research is the decrease in postoperative pain levels in the rehabilitation group. Research shows that patients who exercised before to surgery had less pain afterward and used fewer analgesics, which supports this conclusion[15]. The mechanism behind this benefit might be related to increased pain tolerance, greater joint flexibility, and stronger muscles around the knee joint, all of which help with better pain management after surgery. On the other

hand, prehabilitation has not been shown to significantly lower pain levels in some trials[16]. The discrepancies in the results might be the result of different patient demographics, different exercise regimens and intensities, or different pain measurement techniques. The findings of our research imply that a well-thought-out, highly adhered-to prehabilitation program may, in fact, improve pain outcomes and perhaps the patient's overall recuperation experience.

The improvement in the rehabilitation group's quality of life as shown by the KOOS highlights the comprehensive advantages of prehabilitation. Prior research has shown how preoperative exercise improves patients' views of their health and well-being in addition to their physical function[17]. This increase in life quality is especially noteworthy in the context of total knee arthroplasty (TKI), since patients often go through a protracted healing phase that may negatively affect their mental and emotional well-being. While all KOOS subscales showed considerable improvements in our research, other investigations, especially in the early postoperative period, revealed limited influence on various elements of quality of life. This discrepancy could be explained by our study's extended follow-up period, which allowed the advantages of prehabilitation to materialize over time. The rehabilitation group's reduced length of stay in the hospital is consistent with research showing prehabilitation may hasten postoperative healing and enable early departure [18, 19]. Shortening hospital stays might have a significant impact on healthcare systems by reducing expenses and better using available resources. Other research, however, has not shown a statistically significant variation in hospital stays between the prehabilitation and control groups[20]. The particular discharge criteria that are used and the effectiveness of the postoperative care procedures may both affect how inconsistent the findings are. The prehabilitation program's high rate of adherence and the lack of significant adverse events bolster the viability and security of introducing such programs into clinical practice. This result is in line with the research, which shows that when patients feel the program is helpful and it is well-integrated into their preoperative treatment regimen, adherence rates are often high[21].

Limitations and Future Suggestions: The absence of long-term data beyond three months and the very little follow-up time are two of this study's drawbacks. Furthermore, the research was carried out in a single location, which might restrict how broadly applicable the results are. Multi-center studies with longer follow-up should be a part of future research to evaluate long-term effects and confirm that preoperative rehabilitation is applicable to a variety of groups. Investigating various prehabilitation procedures and intensities may also provide light on how best to treat TKA patients prior to surgery.

Conclusion

This research shows that in patients receiving total knee arthroplasty, preoperative rehabilitation dramatically improves functional mobility, lowers discomfort, and improves quality of life. A shorter hospital stay is another benefit of the strategy, along with good adherence and few side effects. These results provide credence to the idea that prehabilitation ought to be a regular part of TKA patients' treatment in order to enhance their recuperation and postoperative results.

References

1. Su W, Zhou Y, Qiu H, Wu H. The effects of preoperative rehabilitation on pain and functional outcome after total knee arthroplasty: a meta-analysis of randomized controlled trials. Journal of orthopaedic surgery and research. 2022 Mar 21;17(1):175.
2. Blasco JM, Acosta-Ballester Y, Martínez-Garrido I, García-Molina P, Igual-Camacho C, Roig-Casasús S. The effects of preoperative balance training on balance and functional outcome after total knee replacement: a randomized controlled trial. Clinical rehabilitation. 2020 Feb;34(2):182-93.
3. Nguyen C, Boutron I, Roren A, Anract P, Beaudreuil J, Biau D, Boisgard S, Daste C, Durand-Zaleski I, Eschalier B, Gil C. Effect of prehabilitation before total knee replacement for knee

osteoarthritis on functional outcomes: a randomized clinical trial. JAMA network open. 2022 Mar 1;5(3):e221462-.
4. Domínguez-Navarro F, Silvestre-Muñoz A, Igual-Camacho C, Díaz-Díaz B, Torrella JV, Rodrigo J, Payá-Rubio A, Roig-Casasús S, Blasco JM. A randomized controlled trial assessing the effects of preoperative strengthening plus balance training on balance and functional outcome up to 1 year following total knee replacement. Knee surgery, sports traumatology, arthroscopy. 2021 Mar;29(3):838-48.
5. Gränicher P, Stöggl T, Fucentese SF, Adelsberger R, Swanenburg J. Preoperative exercise in patients undergoing total knee arthroplasty: a pilot randomized controlled trial. Archives of physiotherapy. 2020 Dec;10:1-1.
6. Ma JX, Zhang LK, Kuang MJ, Zhao J, Wang Y, Lu B, Sun L, Ma XL. The effect of preoperative training on functional recovery in patients undergoing total knee arthroplasty: a systematic review and meta-analysis. International Journal of Surgery. 2018 Mar 1;51:205-12.
7. An J, Ryu HK, Lyu SJ, Yi HJ, Lee BH. Effects of preoperative telerehabilitation on muscle strength, range of motion, and functional outcomes in candidates for total knee arthroplasty: a single-blind randomized controlled trial. International Journal of Environmental Research and Public Health. 2021 Jun 4;18(11):6071.
8. Hamilton DF, Beard DJ, Barker KL, Macfarlane GJ, Tuck CE, Stoddart A, Wilton T, Hutchinson JD, Murray GD, Simpson AH. Targeting rehabilitation to improve outcomes after total knee arthroplasty in patients at risk of poor outcomes: randomised controlled trial. bmj. 2020 Oct 13;371.
9. Tanaka R, Hayashizaki T, Taniguchi R, Kobayashi J, Umehara T. Effect of an intensive functional rehabilitation program on the recovery of activities of daily living after total knee arthroplasty: a multicenter, randomized, controlled trial. Journal of Orthopaedic Science. 2020 Mar 1;25(2):285-90.
10. Jahic D, Omerovic D, Tanovic AT, Dzankovic F, Campara MT. The effect of prehabilitation on postoperative outcome in patients following primary total knee arthroplasty. Medical Archives. 2018 Dec;72(6):439.
11. Wang D, Wu T, Li Y, Jia L, Ren J, Yang L. A systematic review and meta-analysis of the effect of preoperative exercise intervention on rehabilitation after total knee arthroplasty. Annals of palliative medicine. 2021 Oct;10(10):109860996-10996.
12. Peer M, Rush R, Gallacher P, Gleeson N. Pre-surgery exercise and post-operative physical function of people undergoing knee replacement surgery: a systematic review and meta-analysis of randomized controlled trials. Journal of rehabilitation medicine. 2017 Mar 29.
13. Fransen BL, Hoozemans MJ, Argelo KD, Keijser LC, Burger BJ. Fast-track total knee arthroplasty improved clinical and functional outcome in the first 7 days after surgery: a randomized controlled pilot study with 5-year follow-up. Archives of orthopaedic and trauma surgery. 2018 Sep;138:1305-16.
14. Lenguerrand E, Artz N, Marques E, Sanderson E, Lewis K, Murray J, Parwez T, Bertram W, Beswick AD, Burston A, Gooberman-Hill R. Effect of group-based outpatient physical therapy on function after total knee replacement: results from a multicenter randomized controlled trial. Arthritis Care & Research. 2020 Jun;72(6):768-77.
15. Cooper NA, Rakel BA, Zimmerman B, Tonelli SM, Herr KA, Clark CR, Noiseux NO, Callaghan JJ, Sluka KA. Predictors of multidimensional functional outcomes after total knee arthroplasty. Journal of Orthopaedic Research. 2017 Dec;35(12):2790-8.
16. Kim JH, Kim BR, Kim SR, Han EY, Nam KW, Lee SY, Kim WB. Functional outcomes after critical pathway for inpatient rehabilitation of total knee arthroplasty. Annals of rehabilitation medicine. 2019 Dec 31;43(6):650-61.
17. Bade MJ, Struessel T, Dayton M, Foran J, Kim RH, Miner T, Wolfe P, Kohrt WM, Dennis D, Stevens-Lapsley JE. Early high-intensity versus low-intensity rehabilitation after total knee arthroplasty: a randomized controlled trial. Arthritis care & research. 2017 Sep;69(9):1360-8.

18. Piva SR, Schneider MJ, Moore CG, Catelani MB, Gil AB, Klatt BA, DiGioia AM, Almeida GJ, Khoja SS, Sowa G, Irrgang JJ. Effectiveness of later-stage exercise programs vs usual medical care on physical function and activity after total knee replacement: a randomized clinical trial. JAMA network open. 2019 Feb 1;2(2):e190018-.
19. Aytekin E, Sukur E, Oz N, Telatar A, Demir SE, Caglar NS, Ozturkmen Y, Ozgonenel L. The effect of a 12 week prehabilitation program on pain and function for patients undergoing total knee arthroplasty: A prospective controlled study. Journal of clinical orthopaedics and trauma. 2019 Mar 1;10(2):345-9.
20. Buhagiar MA, Naylor JM, Harris IA, Xuan W, Kohler F, Wright R, Fortunato R. Effect of inpatient rehabilitation vs a monitored home-based program on mobility in patients with total knee arthroplasty: the HIHO randomized clinical trial. Jama. 2017 Mar 14;317(10):1037-46.
21. Bäcker HC, Wu CH, Schulz MR, Weber-Spickschen TS, Perka C, Hardt S. App-based rehabilitation program after total knee arthroplasty: a randomized controlled trial. Archives of orthopaedic and trauma surgery. 2021 Sep 6:1-8.