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A REVIEW OF THE LITERATURE ON THE IMPACT OF PREHABILITATION ON BALANCE, IN PATIENTS WHO UNDERWENT TOTAL KNEE ARTHROPLASTY

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ABSTRACT **Background:** Total knee arthroplasty is the common joint replacement procedure with the aims to improve quality of life and satisfaction. As end -stage osteoarthritis is a severe debilitating condition, elevated pain, decline in quality of life and function are seen. Prehabilitation consists of various exercise modalities such as strength training, neuromuscular training and aerobic exercises improves post-operative balance. **Aim:** The aim of the review is to compare the effects of prehabilitation in improving balance versus those who did not undergo prehabilitation while awaiting total knee arthroplasty. **Methods:** Allied and Complementary Medicine Database (AMED), Medline (EBSCO), Cumulative Index to Nursing and Allied Health Literature (CINAHL), Cochrane Library, Physiotherapy Evidence Database (PEDro) was conducted to identify the relevant studies. Data Extraction: The researcher evaluated the papers as per the eligibility criteria and the quality of the papers were screened using PEDro. The authors, population, intervention, control group data were extracted. **Results:** Combination of preoperative balance training combined with strength training helps to improve balance post-operatively. However, variations in the intensity and balance training were noticed. **Limitations:** There is no gold standard to measure the balance in patients with knee osteoarthritis. There are variations seen in the interventions. The quality of the studies was assessed by a single author. **Conclusions:** Preoperative strength training combined with balance training enhances balance in patients undergoing total knee arthroplasty versus those who did not undergo usual care.

KEYWORDS : Resistance Exercises Or Strength Training, Balance Exercises, Total Knee Arthroplasty.

INTRODUCTION

Osteoarthritis is the leading cause of the long-term disability and chronic joint pain that affects the hip, knee and hand joints but involves most of the joints (Steinmetz, 2023). It affects more than 250 million people globally above the age of 40 that highlights that the scope of the problem (Cui et al, 2021).

Osteoarthritis of the knee can impact the activities of daily living such as self-care, climbing stairs, and walking which affects the quality of life physically, socially and emotionally (Palo et al., 2015). According to Palazzo et al, (2016), the risk factors of knee osteoarthritis can be divided into person-level factors and joint-level factors. The article by Johnson et al. (2014), the person-level factors include age, gender, genetics, obesity and diet, while the joint-level factors include abnormal joint loading and injury.

Narrowing of the joint space, subchondral cysts, osteophytes presence, and subchondral cysts are the four cardinal features of osteoarthritis (Audrey et al. 2014). According to the National Institute for Health and Care Excellence [NICE] (2022), the diagnosis of the criteria is usually clinical in the patients above the age of 45 that have pain on activity and presence of morning stiffness of more than 45 minutes or no morning stiffness.

According to British Orthopaedic Association. (2022), around 7,30,000 patients await the total knee arthroplasty in England and Wales. The incidence of the total knee arthroplasty in Scotland in 2021, was 42.7% per 100,000 population and the waiting time was 316.8 days (NHS Public Health Scotland., 2021). Elevated pain level, decline in function and poor quality of life are associated with increased waiting time for joint replacement surgery as end-stage osteoarthritis is a severe debilitating system (Jabbal et al., 2013). The burden of healthcare system and the waiting time due to total knee arthroplasty is expected to increase in the future as the numbers of elderly in the population increases.

"Prehabilitation" or exercising prior to surgery provides a window of opportunity, to positively impact the health -related quality of life (HRQOL), muscle function and strength while awaiting total knee arthroplasty (Punnose et al., 2023). The aim of prehabilitation is to enhance general well-being and health before any major surgical procedure (Durrand., 2019). Research indicates that 6-week prehabilitation supervised by a physiotherapist is effective to decrease pain, improve the function of the knee joint and enhances activities of daily living (Vaisilieiadis et al., 2022).

Strength training is beneficial prior to total knee arthroplasty as muscle strength and activity declines by 60 % and 40 % respectively, and aging increases the risk of decline (Calatayud et al., 2017). Furthermore, muscle strength training is crucial to prevent the post-operative functional decline and preoperative muscle strength is an important predictor for joint function one to three post-operatively (Cheng et al., 2022). Despite these strength gains, proprioceptors can be affected during total knee arthroplasty leading to decreased balance and joint position which contribute to early post-operatively falls which are the main osteoarthritis consequences (Sun et al., 2023). Preoperatively balance training as crucial as it helps the patient to adjust to altered kinematics due to prosthesis of joint during functional activities (Lo et al, 2021).

According to the core standard of practice, in the United Kingdom, the measurement of outcome is important for all physiotherapists requirement (Chartered Society of Physiotherapy., 2005). However, it could be argued that there is a lack of standardisation in measuring outcome post TKR and in particular when consideration is given to balance and proprioception.

The aim of this review is to compare the effects of prehabilitation in improving balance while awaiting total knee arthroplasty surgery versus those who underwent usual care in patients with knee osteoarthritis. The objectives of this review to explore the different prehabilitation techniques used in recent literature and to determine the appropriate outcome measure of balance.

METHODOLOGY

Literature Search Strategy

An electronic search using databases such as Cumulative Index for Nursing and Allied Health (CINAHL), Allied and Complementary Medicine Database (AMED), Medline (EBSCO), Cochrane Library, Physiotherapy Evidence Database (PEDro) was conducted to identify the relevant studies.

A combination of search terms was searched: Osteoarthritis knee, Osteoarthritis, Strength training, Resistance training, balance exercises, balance training, prehabilitation. Preoperative rehabilitation, usual care and standard care. The Boolean operators "AND" and "OR" were used to identify appropriate studies.

Eligibility Criteria

The titles and abstracts of the literature were screened. The full text of the literature was screened by the researcher and included according to the eligibility criteria.

Inclusion Criteria

All studies included individuals scheduled for total knee arthroplasty or total knee replacement aged 45 years or older. Prehabilitation training had to include both strengthening and balance training and studies had to have considered a balance related measure of outcome.

Exclusion Criteria

Studies were excluded where participants had comorbidities or cognitive impairment and studies that were not in English language.

Quality Assessment

In the included studies, Physiotherapy Evidence for Database (PEDro) scale was used to assess the methodological quality (Matos and Pegorari.,2020).

RESULTS

A total of 36 studies were initially identified from the databases. Following scrutiny, a total of five studies were included in the study. PRISMA flowchart for used to document the findings of literature search. (Figure 1)

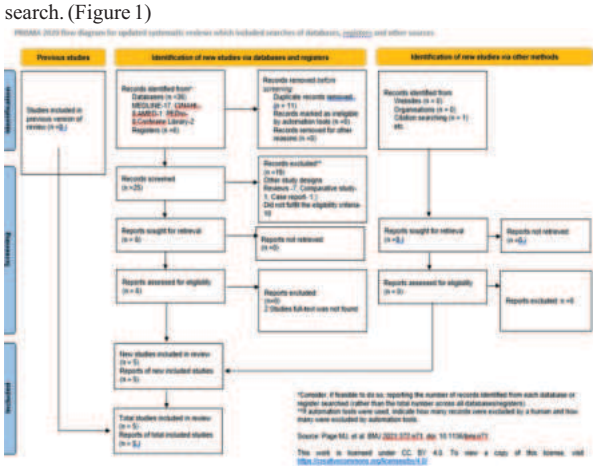

Figure 1 PRISMA Flowchart

Quality Assessment

An overall "good to excellent" -level of quality was found in the studies which indicate meaningful and reliable results for- use clinical practice use - (Matos et al., 2020).

Population

The total number of participants was 455, with 260 participants who underwent prehabilitation and 195 participants underwent only usual care. The male to female ratio was 142:344 which indicate 55 % of the participants were women who underwent total knee arthroplasty for knee osteoarthritis. The average age of the participants who underwent total knee arthroplasty was 68.5 years across all the six studies. All participants gave their consent in written format across the literature.

Intervention

Certain commonalities and differences can be noticed in the literature. Warm-up mainly consisted of step up and down, calf raises, aerobic training included 10 minutes of stationary bicycle or light ergometry cycling in the studies. The quadriceps and hamstrings were strengthened were commonly strengthened, however, the frequency and intensity varied.

The major differences can be seen in balance training exercises which consisted of the single leg stance on the unstable device (BOSU balance trainer), standing with feet aligned, standing on forefoot and opposite heel, standing on the forefoot, walking in a straight line, and multi-directions walking. There were significant differences in frequency and intensity of balance.

Outcomes

Balance was assessed using various outcome measures such as Timed Up and Go (TUG) test, Berg Balance Scale (BBS), Centre of Pressure (COP) and single leg standing in the five included studies. It was observed that TUG test was used in four included studies. The TUG test assesses leg function, mobility and fall risk without any particular equipment required (Katoka et al., 2023). The single leg-standing test was used to evaluate balance in the study by Dominguez-Navarro et al., (2022). With the help COP in mediolateral and anteroposterior range, balance was assessed by Casana et al., (2019).

The table 2 summarizes the findings of all articles.

Authors	Summary of the findings of the article
Sun et al., (2023)	Preoperative high intensity resistance training along with balance training with end-stage osteoarthritis enhances balance outcomes after knee osteoarthritis.
Dominiguez-Navarro et al., (2021)	Positive effects of preoperative strength training combined with balance training are not maintained a year after the surgery.
Casana et al., (2017)	Postural control and balance are enhanced before and after the surgery by prehabilitation.
Calatayud et al., (2017)	Supports the use of preoperative training in the end-stage of osteoarthritis undergoing TKR.
Skoffer et al., (2016)	Pre-operative resistance training is a safe and effective intervention in enhancing post-operative muscle strength, but the improvements in the patient reported balance outcomes were not observed in the study.

DISCUSSION

The aim of this review was to compare effects on balance of pre-surgery rehabilitation (prehabilitation) versus usual care in patients following knee osteoarthritis. The objective of this review was to explore the type and impact of prehabilitation techniques used whilst determining the most appropriate outcome measure of balance.

Impact of Prehabilitation on Balance

It can be concluded from the five papers reviewed that pre-operative high intensity strength training combined with balance training can improve strength, range of motion (ROM), and balance in the short term, (1 year), which can enhance the post-operative knee function and recovery is accelerated. The accelerated recovery reduces the length of hospital stay. However, the interventions varied across the papers, in addition to that, frequency and duration also varied.

Strengthening and hypertrophy of the muscles can lead to decreased muscle spindle impairments, improvement in joint position sense and decreases the severity of knee osteoarthritis (Hubbard et al., 2010). Thus, balance training can decrease the risk of falls, improve postural control and activities of daily living such as lifting, standing and walking (Sun et al., 2023). The findings of the study by Sun et al., (2023) states the effectiveness of balance training combined with high-intensity resistance training motivates patients to undergo preoperative training to achieve better surgical outcomes such as decreased risk of falls due to improved proprioception and leading to better functional outcomes like better quality of life and balance. The study by Calatayud et al., (2017) found that combination of strength training and balance training helps to regain faster function which results in a reduced length of stay and reduction in health costs due to reduce patients' need of social health care.

Therefore, further research needs to be carried out to standardise both interventions for improving balance in patients undergoing total knee arthroplasty. Larger studies looking at the longer impact of this may inform prehab in improving balance and decreasing the risk of falls in patients undergoing total knee arthroplasty.

Outcome Measures for Clinical Practice

Patient-reported outcomes can be used as a prognostic tool in determining those patients "at risk of falling or re-injury following TKR and psychometric properties of outcome measures are important factors to consider. Despite, the authors concluding that prehabilitation does appear to improve balance and reduce the risk of fall, there are no recognised gold standard measures of outcome which are used universally for this population.

In this review, Timed Up and Go (TUG) test was found to be used in most of the studies. The TUG test is an easy, quick performance-based measure of function of lower limb, which relates to the risk of falls and mobility (Herman et al., 2011). Dobson et al., (2013) goes further in suggesting that the TUG test is a good measure of dynamic balance. Shunway-Cook et al (2000) found that the TUG test has the specificity and sensitivity of 87 % to measure dynamic balance and risk of falls. Although the TUG test consists of common tasks in everyday life, various parts of these tasks can be complex, with planning, orientation in space and organization required (Herman et al., 2011). A clinical advantage of the TUG test is that it can be performed at any place (Ortega-Bastidas et al., 2019). Functional balance can also be evaluated with the help of the 14-item Berg Balance Scale (Tirasci et al., 2024). Takacs et al., (2014) found that the Berg Balance Scale has a high validity of 85 % in knee osteoarthritis patients.

Limitations of the Research Reviewed.

Dominguez- Navarro et al, (2021) commented upon the common limitation of a high number of drop-outs due to the long follow-up

period; this can reduce the size of the sampled cohort, resulting in an increase in risk of type 2 errors and bias in reporting. The impact of prehabilitation on the healthcare providers and patients to postpone the surgery and cost-effective analysis has not been assessed in this review. Future research should be carried on this because prehabilitation improves balance in post-operative patients and analysis of cost-effective is important as the cost-effective management helps to reduce the economic burden on the healthcare system. It was also noted in the literature reviewed that inclusion/ exclusion criteria should recognise the presence and impact of patients with co-morbidities, in an attempt to authenticate a realistic sample of patients typically listed for TKR.

CONCLUSIONS

It can be concluded that preoperative rehabilitation, which may or may not include a level of balance training improve post-operative balance in patients undergoing total knee arthroplasty. The potential longitudinal impact of this on the risk of falling and re-injury should be recognised and explored further.

Despite the lack of a standardised measure of outcome of balance in this population, the TUG test and Berg Balance Test may be considered practical and appropriate outcomes for use in clinical practice.

REFERENCES

1. Aggarwal, V. A., Sambandam, S. N., & Wukich, D. K. (2022). The impact of obesity on total knee arthroplasty outcomes: A retrospective matched cohort study. Journal of Clinical Orthopaedics and Trauma, 33, 101987. https://doi.org/10.1016/j.jcot.2022.101987
2. Audrey, H. X., Abd Razak, H. R. B., & Andrew, T. H. C. (2014). The Truth Behind Subchondral Cysts in Osteoarthritis of the Knee. The Open Orthopaedics Journal, 8(1), 7–10. https://doi.org/10.2174/1874325001408010007
3. Berg, K. (1989). Measuring balance in the elderly: preliminary development of an instrument. Physiotherapy Canada, 41(6), 304–311. https://doi.org/10.3138/ptc.41.6.304
4. BOA. (2022, March). England and Wales T&O Waiting Times data for March 2022. Www.boa.ac.uk. https://www.boa.ac.uk/resource/england-and-wales-t-o-waiting-times-data-for-march-2022.html
5. Bramer, W. M., Rethlefsen, M. L., Kleijnen, J., & Franco, O. H. (2017). Optimal Database Combinations for Literature Searches in Systematic reviews: a Prospective Exploratory Study. Systematic Reviews, 6(1). https://doi.org/10.1186/s13643-017-0644-y
6. Chang, A. H., Song, J., Lee, J., Chang, R. W., Semanik, P. A., & Dunlop, D. D. (2020). Proportion and associated factors of meeting the 2018 Physical Activity Guidelines for Americans in adults with or at risk for knee osteoarthritis. Osteoarthritis and Cartilage. https://doi.org/10.1016/j.joca.2020.03.007
7. Cheng, Y.-Y., Liu, C.-C., Lin, S.-Y., Lee, C.-H., Chang, S.-T., & Wang, S.-P. (2022). Comparison of the Therapeutic Effects Between Isokinetic and Isotonic Strength Training in Patients After Total Knee Replacement: A Prospective, Randomized Controlled Trial. Orthopaedic Journal of Sports Medicine, 10(6), 232596712211058. https://doi.org/10.1177/23259671221105852
8. Choi, W. (2023). Comparison of physical function, proprioception, muscle strength, postural balance, and walking in older women with and without total knee arthroplasty. Medicine, 102(24), e33034. https://doi.org/10.1097/MD.0000000000033034
9. Cui, A., Li, H., Wang, D., Zhong, J., Chen, Y., & Lu, H. (2020). Global, regional prevalence, incidence and risk factors of knee osteoarthritis in population-based studies. EClinicalMedicine, 29-30(100587), 100587. https://doi.org/10.1016/j.eclinm.2020.100587
10. Cunha, J. E., Barbosa, G. M., Castro, P. A. T. de S., Luiz, B. L. F., Silva, A. C. A., Russo, T. L., Vasilceac, F. A., Cunha, T. M., Cunha, F. Q., & Salvini, T. F. (2019). Knee osteoarthritis induces atrophy and neuromuscular junction remodeling in the quadriceps and tibialis anterior muscles of rats. Scientific Reports, 9(1). https://doi.org/10.1038/s41598-019-42546-7
11. Domínguez-Navarro, F., Silvestre-Muñoz, A., Igual-Camacho, C., Díaz-Díaz, B., Torrella, J. V., Rodrigo, J., Payá-Rubio, A., Roig-Casasús, S., & Blasco, J. M. (2020). 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, 29(3), 838–848. https://doi.org/10.1007/s00167-020-06029-x
12. Durrand, J., Singh, S. J., & Danjoux, G. (2019). Prehabilitation. Clinical Medicine, 19(6), 458–464. https://doi.org/10.7861/clinmed.2019-0257
13. Gkastaris, K. (2020). Obesity, osteoporosis and bone metabolism. Journal of Musculoskeletal and Neuronal Interactions, 20(3), :372-381.
14. Loeser, R. F. (2010). Age-Related Changes in the Musculoskeletal System and the Development of Osteoarthritis. Clinics in Geriatric Medicine, 26(3), 371–386. https://doi.org/10.1016/j.cger.2010.03.002
15. M Jabbal, Burt, J., Clarke, J., Moran, M. D., Walmsley, P., & Jenkins, P. J. (2023). Trends in incidence and average waiting time for arthroplasty from 1998–2021: an observational study of 282,367 patients from the Scottish arthroplasty project. Annals of the Royal College of Surgeons of England, 106(3). https://doi.org/10.1308/rcsann.2023.0039
16. Matos, A. P., & Pegorari, M. S. (2020). How to Classify Clinical Trials Using the PEDro Scale? Journal of Lasers in Medical Sciences, 11(1), 1–2. https://doi.org/ 10.15171/jlms.2020.01
17. NICE. (2022, October 19). Recommendations | Osteoarthritis in over 16s: diagnosis and management | Guidance | NICE. Www.nice.org.uk. https://www.nice.org.uk/guidance/ng226/chapter/Recommendations#diagnosis
18. Page, M. J., McKenzie, J. E., Bossuyt, P. M., Boutron, I., Hoffmann, T. C., Mulrow, C. D., Shamseer, L., Tetzlaff, J. M., Akl, E. A., Brennan, S. E., Chou, R., Glanville, J., Grimshaw, J. M., Hróbjartsson, A., Lalu, M. M., Li, T., Loder, E. W., Mayo-Wilson, E., McDonald, S., & McGuinness, L. A. (2021). The PRISMA 2020 statement: An updated guideline for reporting systematic reviews. British Medical Journal, 372(71). https://doi.org/10.1136/bmj.n71
19. Palazzo, C., Nguyen, C., Lefevre-Colau, M.-M., Rannou, F., & Poiraudeau, S. (2016). Risk Factors and Burden of Osteoarthritis. Annals of Physical and Rehabilitation Medicine, 59(3), 134–138. https://doi.org/10.1016/j.rehab.2016.01.006
20. Palo, N., Chandel, S. S., Dash, Sunil. K., Arora, G., Kumar, M., & Biswal, M. R. (2015). Effects of Osteoarthritis on Quality of life in Elderly Population of Bhubaneswar, India. Geriatric Orthopaedic Surgery & Rehabilitation, 6(4), 269–275. https://doi.org/10.1177/2151458515604357
21. Skoffer, B., Maribo, T., Mechlenburg, I., Hansen, P. M., Søballe, K., & Dalgas, U. (2016b). Efficacy of Preoperative Progressive Resistance Training on Postoperative Outcomes in Patients Undergoing Total Knee Arthroplasty. Arthritis Care & Research, 68(9), 1239–1251. https://doi.org/10.1002/acr.22825
22. Skou, S. T., Pedersen, B. K., Abbott, J. H., Patterson, B., & Barton, C. (2018). Physical Activity and Exercise Therapy Benefit More Than Just Symptoms and Impairments in People With Hip and Knee Osteoarthritis. Journal of Orthopaedic & Sports Physical Therapy, 48(6), 439–447. https://doi.org/10.2519/jospt.2018.7877
23. Steinmetz, J. D., Culbreth, G. T., Haile, L. M., Rafferty, Q., Lo, J., Fukutaki, K., Cruz, J. A., Smith, A. E., Stein Emil Vollset, Brooks, P., Cross, M., Woolf, A. D., Hagins, H., Mohsen Abbasi-Kangevari, Abedi, A., Ackerman, I. N., Amu, H., Antony, B., Jalal Arabloo, &
24. Sun, J., Shan, Y., WU Li-xia, Li, N., Xu, F. R., Kong, X., & Zhang, B. (2023). Preoperative high-intensity strength training combined with balance training can improve early outcomes after total knee arthroplasty. Journal of Orthopaedic Surgery and Research, 18(1). https://doi.org/10.1186/s13018-023-04197-3
25. Takacs, J., Garland, S. J., Carpenter, M. G., & Hunt, M. A. (2014). Validity and Reliability of the Community Balance and Mobility Scale in Individuals With Knee Osteoarthritis. Physical Therapy, 94(6), 866–874.
26. https://doi.org/10.2522/ptj.20130385
27. Vasileiadis, D., Drosos, G., Charitoudis, G., Dontas, I. A., & Vlamis, J. (2022). The Efficacy of High-Intensity Preoperative Physiotherapy Training on Postoperative Outcomes in Greek Patients Undergoing Total Knee Arthroplasty: A Quasi-Experimental Study. Cureus, 14(3). https://doi.org/10.7759/cureus.23191