

Research Article

Effects of footwear modification along with physiotherapy on activity of daily living (ADLS) in patients with medial knee osteoarthritis

Usman Iqbal Janjua¹, Syeda Mahnoor Hassan², Shahbaz Ashraf³, Muhammad Farhan Khokhar⁴, Rukhma Muazzam⁵, Haseeba Asif⁶, Farah Salman⁶, Rimza Safdar⁶

ABSTRACT

Background: the management of osteoarthritis (OA) of the knee with biomechanical therapies claimed that application of orthotic devices is another crucial component of a rehabilitation program. Several footwear modifications are used to lessen medial knee loading (MKL), which helps to reduce pain and other symptoms.

Objective: to compare the effects of lateral heel wedge insole alone and in combination with medial arch support on ADLs in patient with medial knee OA.

Methodology: A randomized clinical trial was conducted on n=60 patients with medial knee OA were randomly allocated in to group A, received lateral heel wedge insole (LHWI) along with medial arch support (MAS) and group B only adjusted with LHWI. Nonprobability convenient sampling technique was used to collect the data on the knee injury and osteoarthritis outcomes score (KOOS) was used as outcome measures. The outcome measures were assessed at the baseline, and after 8 and 16 weeks.

Results: The results of independent t-test showed that group A which received LHWI along with MAS showed more significant improvement ($p < 0.05$) in pain, ADLs, sports activity on KOOS questionnaire at each level of assessment than group B which only received the LHWI. But KOOS quality of life scores only showed significant improvement after 8 weeks of intervention in group A while after 16th weeks no significant difference ($p = 0.09$) was observed.

Conclusion: the lateral wedge insoles with medial arch support combined with conventional physical therapy protocol is more effective to improve activities of daily living (ADLS) in patients having medial knee osteoarthritis.

Keywords: Footwear, osteoarthritis, lateral heel wedge insoles, KOOS, ADLs.

Designation & Affiliation

¹ PhD Scholar, Isra University Islamabad, Head of Department of Physical Therapy, Elite College of Management Sciences, Gujranwala, Pakistan.

² Lecturer, Department of Physical Therapy, Elite College of Management Sciences, Gujranwala, Pakistan

³ Clinical Head of Department of Physical Therapy, Farooq Hospital, West Wood Branch, Lahore, Pakistan

⁴ Head of Department of Physical Therapy, Siddique Medicare Hospital, Kamoke, Pakistan

⁵ House Job Officer, Department of Physical Therapy, Elite College of Management Sciences, Gujranwala, Pakistan

⁶ House Job Officer, Department of Physical Therapy, Al-Rae Trust Hospital, Gujranwala, Pakistan

Citation

Janjua UI, Hassan SM, Ashraf S, Khokhar MF, Muazzam R, Asif H, Salman F, Safdar F. Effects of footwear modification along with physiotherapy on activity of daily living (adls) in patients with medial knee osteoarthritis. T Rehabili. J. 2022;07(01):504-509 doi: 10.52567/trj.v7i01.212

Copyright (c) 2023

Usman Iqbal Janjua, Syeda Mahnoor Hassan, Shahbaz Ashraf, Muhammad Farhan Khokhar, Rukhma Muazzam, Haseeba Asif, Farah Salman, Rimza Safdar. This work is licensed under a Creative Commons Attribution 4.0. Authors retain copyright and grant the journal right of first publication and allows others to share the work with an acknowledgment of the work's authorship and initial publication in this journal. No use, distribution or reproduction is permitted which does not comply with these terms.

Received on: 17-02-2023

Revision on: 21-03-2023

Published on: 31-03-2023

Correspondence

Usman Janjua. PhD Scholar, Isra University Islamabad, Head of Department of Physical Therapy, Elite College of Management Sciences, Gujranwala, Pakistan
E-mail: usmanjanjua84@hotmail.com

INTRODUCTION

Osteoarthritis (OA) is the most frequently diagnosed joint disease worldwide. It is distinguished by borderline bone outgrowth and articular cartilage degradation[1]. According to statistics, 10% of adults above 60 years have serious clinical problems may have osteoarthritis. Knee OA was predicted to become the fourth most frequent cause of disability by the year 2020[2]. People with high body mass indices are seven times more likely to develop knee osteoarthritis[3]. Patients been diagnosed with knee OA frequently struggle with knee pain, stiffness, restricted mobility, crepitation, an unstable and swollen joint, diminished muscular strength, motor and sensory issues, and functional limitations that restrict their ability to engage in regular physical activity and have a negative impact on their quality of life[4].

In order to maintain regular mobility and an independent way of life, pain-free walking is a key requirement. Mobility constraints can be brought on by irregular gait patterns, muscle wasting, a reduced range of motion (ROM), decreased endurance, functional loss, and knee tightness. Walking with pain can cause people to become less active and restrict their participation[5].

Combination therapies are a large category of interventions offered by a diverse group of medical professions[6, 7]. The management of OA of the knee with biomechanical therapies is a current area of ongoing research. Exercise is an essential component of treating knee OA and focus on reducing pain and improving function [8-11]. Exercises for knee OA should Investigations on long-term favorable effects are also few, and they indicate that over time, the benefits of exercise diminish[12]. Functionally and mechanically, the entire lower limb is seen to be an interconnected entity, thus any change in one area of the limb, like the foot, can have a major effect on other areas of the limb, like the knee [13]. Understanding the design, selection, and application of orthotic devices is another crucial component of a rehabilitation programme. As treating patients with complex illnesses holistically requires a variety of skills and knowledge, multidisciplinary teams are particularly effective in rehabilitation when orthotics and prosthetics are included[14,15]. Numerous footwear changes are used to lessen Medial Knee Loading (MKL), which helps to reduce pain and other symptoms, halt the disease's progression, and improve both the quality of life for people who have knee problems as well as their overall quality of life. Lateral heel wedged insoles have been shown to lower peak knee loading in patients having OA of the medial compartment of the knee[13]. The LWIs with medial arch support considerably decreased the knee adduction moment to 8.8% during walking in

healthy adults when compared to lateral heel wedged insoles (LWIs) alone[16].

There is widespread agreement that reliable outcome assessments are required to distinguish between ineffective and effective therapies. To achieve this, patient-centered, uniform, and cost-effective measures are required. Symptoms and functional restrictions are the most common reasons why patients seek treatment. Therefore, it is essential to give these outcomes priority when comparing the efficacy of various treatment modalities[17]. So the purpose of the study was to compare the lateral heel wedge insole alone and in combination with medial arch support on ADLS in patient with medial knee OA.

METHODOLOGY

A randomized clinical trial (NCT04536519) was conducted on n=60 patients with medial Knee osteoarthritis (OA). The data was collected from Janjua Rehab Centre after the approval from the ethical review committee of department of physical therapy, Elite College of Management Sciences, Gujranwala (ECOMS/ER/01-0717).

A non-probability convenient sampling technique was used to collect the sample The 50 years or older patient with BMI range 22-25 kg/m² and radiographically diagnosed case of grade 2-3 medial knee OA according to the Kellgren-Lawrence System for Classification of knee osteoarthritis², having knee pain for minimum 1 month with a severity of at least 4 on numeric pain rating scale (NPRS), were included in the study. Patients with systemic arthritic disease, serious medical conditions or severe co-morbidities, systemic disease which cause dependent edema, that makes it challenging to wear shoes in the previous month, patients having established histories of the knee injury, patients going through knee or lower extremity surgical intervention for fracture or joint replacement, patients receiving intra-articular injections which are steroid-based or physical therapy treatment in the previous six months, and patients with any of the following conditions were excluded.

The data was collected after taking the written informed consent from the all participants. The data was recorded on Knee injury and Osteoarthritis outcomes score (KOOS) which is a valid and reliable tool for measuring knee related quality of life with internal consistency ranged from 0.65-0.94 for KOOS Pain, 0.56-0.83 for Symptoms, for ADL ICC reported as 0.78-0.97, for Sport/Rec was 0.84-0.98, and for QOL was 0.71-0.85[17-19]. It is a self-administered questionnaire and was filled by the patients themselves or by therapist according to patient responses. The assessment was done at the

baseline, after 8th week and 16th week of intervention.

The participants were randomly allocated in to group A (n=30), received lateral heel wedge insole (LHWI) along with medial arch support and group B

(n=30) only adjusted with LHWI. From the both groups there were n=4 participants were lost the follow up due to unknown reason, some comorbidity as well accessibility issue. A total of n=56 participant completed the intervention protocol and included in the analysis (Figure 1).

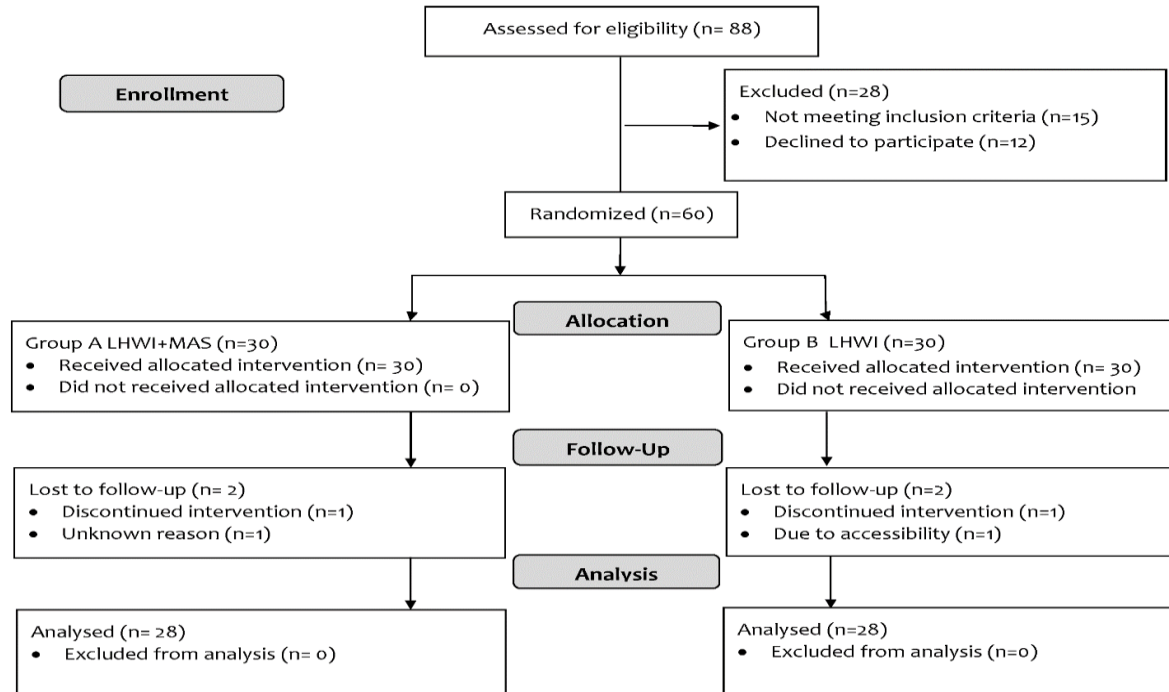


Figure 1: CONSORT diagram

Since all groups get the same standard of treatment, closed shoes made it possible for patients to conceal. The individuals received treatment for 16 weeks. Both groups also received conventional physical therapy as well.

The conventional physical therapy treatment methods that were used were as follows: Manual mobilization techniques (3 set x 10 reps per session), sustained hamstring and calf stretches (3 times/session 15 sec hold, depending upon patient tolerance, and 10 sec rest interval) and Active ROMS (two 15-sec bouts with 3-sec hold at each end range) to improve mobility, quadriceps setting, hamstring setting and multiple angle isometric exercises of knee (1 set of 7-10 repetitions with 6 seconds hold, as patient tolerance, and 10 sec rest between repetitions) to improve neuromuscular control as well as muscle performance and improving balance through therapeutic balance training exercises and low-impact aerobic exercises were used. These conventional activities were given to both groups as initial treatment.

The lateral heel wedged insoles (LHWIs) used in the study were non-custom, distributed bilaterally, high-density ethyl-vinyl acetate insoles which were preferred to be encased in leather. The lateral wedge tilt of the insoles was 5°-6°. Other insole

consisted of above-mentioned lateral heel wedged insole (LHWIs) with a medial arch support made up of same material which extended to full length of metatarsals. The patients were advised to wear modified footwear for 16 weeks while standing, walking, or doing any ambulation task.

For data analysis, Statistical Package for Social Sciences (SPSS) version 24 was used. The frequencies of demographics were presented as mean \pm standard deviation for some variables and percentages for other variables as well. For within-groups analysis, Repeated Measures ANOVA with Bonferroni correction was applied and for between-groups analysis, independent t-test was applied.

RESULTS

The mean age of the participants was 57.52 ± 3.77 years and average BMI was 23.98 ± 0.78 kg/m². A total of n=23 participants were males, while remaining n=33 were females. The results of RM ANOVA with Bonferroni correction showed a significant improvement ($p < 0.001$) in all five subscales' of KOOS in both groups from the baseline to 16th weeks at each level of assessment. (Table 1)

Table 1: Within-groups comparison of KOOS Score

*KOOS Subscales	Group A				Group B			
	Mean±SD	MD	F(df)	P-value	Mean±SD	MD	F(df)	p-value
Pain Score	Baseline	32.94±5.27	31.13 ^a	690.4(2,54)	33.83±6.04	19.74 ^a	445.52 (2,54)	0.00*** ^a
	8 th week	64.07±6.39	8.14 ^b		53.57±5.81	12.19 ^b		0.00*** ^b
	16 th week	72.21±7.21	39.27 ^c		65.76±7.06	31.93 ^c		0.00*** ^c
ADLs Score	Baseline	33.81±6.48	24.39 ^a	342.3(2,54)	32.98±5.75	21.23 ^a	1101.8 (1.61,43.48)	0.00*** ^a
	8 th week	58.20±4.32	11.22 ^b		54.21±4.01	9.9 ^b		0.00*** ^b
	16 th week	69.42±6.73	35.61 ^c		64.11±4.60	31.13 ^c		0.00*** ^c
Sports Score	Baseline	8.39±8.39	35 ^a	301.41(2,54)	10.17±7.99	29.29 ^a	399.6 (1.65,44.5)	0.00*** ^a
	8 th week	43.39±8.17	14.46 ^b		39.46±5.82	13.75 ^b		0.00*** ^b
	16 th week	57.85±9.56	49.46 ^c		53.21±7.35	43.04 ^c		0.00*** ^c
Quality of Life (QOL) Score	Baseline	24.80±5.51	24.78 ^a	306.25(2,54)	26.58±6.93	17.63 ^a	359.1 (2,54)	0.00*** ^a
	8 th week	49.58±7.95	12.73 ^b		44.21±5.62	14.51 ^b		0.00*** ^b
	16 th week	62.31±7.88	12.73 ^c		58.72±7.68	32.14 ^c		0.00*** ^c

^abaseline to after 8 weeks, ^bafter 8 weeks to after 16 weeks, ^cbaseline to 16 weeks.

Level of significance p<0.05*, p<0.01**, p<0.001***

The results of independent t-test showed that group A which received LHWI along with MAS showed more significant improvement (p<0.05) in pain, ADLs, sports activity on KOOS questionnaire at each level of assessment than group B which only

received the LHWI. the KOOS quality of life only showed significant improvement after 8 week of intervention in group A while after 16th weeks no significant difference (p=0.09) was observed. (Table 2)

Table 2: Between groups comparison for KOOS score

*KOOS Subscales	Group A	Group B	Mean Difference	p-value	
	Mean±SD	Mean±SD			
Pain Score	Baseline	32.94±5.27	33.83±6.04	-0.886	0.56
	8 th week	64.07±6.39	53.57±5.81	10.504	0.00***
	16 th week	72.21±7.21	65.76±7.06	6.446	0.00***
ADLs Score	Baseline	33.81±6.48	32.98±5.75	0.829	0.615
	8 th week	58.20±4.32	54.21±4.01	3.989	0.00***
	16 th week	69.42±6.73	64.11±4.60	5.307	0.00***
Sports Score	Baseline	8.39±8.39	10.17±7.99	-1.786	0.418
	8 th week	43.39±8.17	39.46±5.82	3.929	0.04*
	16 th week	57.85±9.56	53.21±7.35	4.643	0.04*
Quality of Life (QOL) Score	Baseline	24.80±5.51	26.58±6.93	-1.789	0.29
	8 th week	49.58±7.95	44.21±5.62	5.368	0.00***
	16 th week	62.31±7.88	58.72±7.68	3.586	0.09

Level of significance p<0.05*, p<0.01**, p<0.001***

*KOOS: Knee Injury and Osteoarthritis Outcome Score

DISCUSSION

The current study found the effects of lateral heel wedged insoles (LWIs) alone and LWIs with medial arch support along with physical therapy on daily living functional status of patients having knee osteoarthritis. The findings of study showed that a significant difference was found in KOOS Pain, ADLs and Sports score between group A and B with a higher score recorded in group A. These results indicate that in knee OA patients, administration of physical therapy protocol and using LWIs with medial arch support is more effective in reducing knee related difficulties in daily living tasks as compared to physical therapy with LWIs alone.

These findings were strengthened by a recent investigation by Michael A. Hunt et al [20], which compared the effects of lateral heel wedged insoles with medial arch support and LWIs alone. They came to the conclusion that 77% of patients in the medial arch group and 58% of patients in the LWIs group had improved physical function. These findings

demonstrate that, in comparison to LWIs alone, the lateral wedged insole anchored by the medial arch is more effective in enhancing knee OA function [20]. The validity of these conclusions was further strengthened by a study that found that LWIs with medial arch support are effective in lowering adduction moment of knee joint, which improves the overall stress distribution on the knee and enhances functional ability in patients having medial knee osteoarthritis [21]. LWIs paired with medial arch support result in a decrease in KOOS pain score, according to a meta-analysis by Mobina Khosravi et al [22] on the impact of orthoses and LWIs on pain and physical function in knee OA[22]. Contrarily, Dessery et al [16] found no appreciable differences in pain severity when comparing those wearing 6° and 10° lateral wedge insoles having arch support to those not using insoles [16].

To determine the effects of LWIs among Pakistan's knee osteoarthritic people, Rabbia Riaz



et al [23] conducted a study. The results of the study demonstrated that conventional physiotherapy alone was better to lateral wedge insoles, which were thought to be more beneficial in treating knee osteoarthritis. A within-group analysis revealed that while both groups' KOOS scores significantly improved during the treatment, conventional physical therapy showed more clinically significant improvement[23]. A comparison of the two groups revealed a substantial difference between the group utilising lateral wedge insoles and the group receiving conventional physical treatment. The lateral wedge insoles may increase pronation and foot invertor moment, according to this study's other findings[23]. The patient's ability to do ADLs is hindered because an elevated moment of invertors causes the muscles in the lower extremities to get exhausted after prolonged use. Insoles with arches in the lateral wedge reduce the ankle eversion and moment of inversion as a result[23].

In current study, there was a difference recorded in mean values of KOOS Symptoms score but a statistically, a non-significant difference was observed in KOOS Symptoms score, which is contrary to previous findings[23]. According to a study, a medial arch support may have nullified the effectiveness of LWI in generating foot pronation and lower extremity postural changes that decrease adduction moment of knee. The authors advise against using lateral heel wedged insoles with medial arch supports based on this theory[24, 25]. Another study that compared the effects of LWIs alone and LWIs with medial arch support found that the pain rating of the two groups did not vary significantly, whereas the knee adduction moment was reduced considerably in the medial arch groups. This resulted in patients feeling more comfortable when using lateral heel wedges with medial arch support because it offers better foot support[26].

Hsieh and Wen-Chung Lee[27] came to the conclusion that there was a significant difference between the baseline KOOS quality of life score and the post-3-month follow-ups score ($p=0.021$). According to the study's findings, individuals with knee OA who used LW with medial arch insoles for a short while reported pain reduction, improved function during physical activity, daily living, sports, and recreation, and a better quality of life in relation to their knees[27].

In this study, the intervention's effects are only examined for a small amount of time—16 weeks (4 months)—but they may be examined for a prolonged time to understand their long-term impacts more fully. Moreover, the study does not address the complications which may arise due to biomechanical alteration of knee joint that in turn may affect opposite side. So, Future studies should be conducted while considering these effects.

CONCLUSION

The lateral heel wedged insoles with medial arch support combined with conventional physical therapy protocol is more effective to improve ADLs as compared to physical therapy with lateral heel wedged insoles alone in patients with medial knee osteoarthritis.

Author's Contribution

UIJ and SMH: substantial contributions to the conception and design of the study.

UIJ and SA: acquisition of data for the study.

MFK: interpretation of data for the study.

RM: analysis of the data for the study.

HA: drafted the work.

FS and RS: revised it critically for important intellectual content.

UIJ, SMH, SA, MFK, RM, HA, FS and RS: final approval of the version to be published and agreement to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. All authors contributed to the article and approved the submitted version.

Ethical Statement

The study was conducted on $n=60$ patients with medial Knee osteoarthritis (OA). The data was collected from Janjua Rehab Centre after the approval from the ethical review committee of department of physical therapy, Elite College of Management Sciences, Gujranwala (ECOMS/ER/01-0717).

Consent Statement

Informed consent was obtained from all subjects involved in the study.

Data Availability Statement

The data presented in this study are available on request from the corresponding author.

Acknowledgments

Thanks to the participants of this study for sharing their personal experiences.

Conflicts of Interest

The authors declare no conflict of interest. The funders had no role in the design of the study; in the collection, analyses, or interpretation of data; in the writing of the manuscript; or in the decision to publish the results.

REFERENCES

1. Tawhid A. Characteristics of osteoarthritis at knee joint patients attended at CRP: Department of Physiotherapy, Bangladesh Health Professions Institute, CRP; 2012.
2. Khan M, Adili A, Winemaker M, Bhandari M. Management of osteoarthritis of the knee in younger patients. *CMAJ*. 2018 22;190(3):E72-E79. [[CrossRef](#)] [[PubMed](#)]
3. Lee R, Kean WF. Obesity and knee osteoarthritis. *Inflammopharmacology*. 2012 Apr;20(2):53-8. [[CrossRef](#)] [[PubMed](#)]
4. Hunter DJ, Felson DT. Osteoarthritis. *BMJ*. 2006 18;332(7542):639-42. [[CrossRef](#)] [[PubMed](#)]
5. Stutz-Doyle CM. The Effects of Traditional Strengthening Exercises Versus Functional Task Training on Pain, Strength, and Functional Mobility in the 45-65 Year Old Adult with Knee Osteoarthritis. 2011.
6. Parker DA, Scholes C, Neri T. Non-operative treatment options for knee osteoarthritis: current concepts. *Journal of ISAKOS*. 2018;3(5):274-81. [[CrossRef](#)]
7. Finney A, Healey E, Jordan JL, Ryan S, Dziedzic KS. Multidisciplinary approaches to managing osteoarthritis in multiple joint sites: a systematic review. *BMC Musculoskelet Disord*. 2016 8;17:266. [[CrossRef](#)]
8. Members OP, Group OM, Brosseau L, Wells GA, Tugwell P, Egan M, et al. Ottawa panel evidence-based clinical practice guidelines for therapeutic exercises and manual therapy in the management of osteoarthritis. *Phys Ther*. 2005;85(9):907-71. [[PubMed](#)]
9. Jordan KM, Arden NK, Doherty M, Bannwarth B, Bijlsma JW, Dieppe P et al; Standing Committee for International Clinical Studies Including Therapeutic Trials ESCISIT. EULAR Recommendations 2003: an evidence based approach to the management of knee osteoarthritis: Report of a Task Force of the Standing Committee for International Clinical Studies Including Therapeutic Trials (ESCISIT). *Ann Rheum Dis*. 2003;62(12):1145-55. [[CrossRef](#)] [[PubMed](#)]
10. Voelker R. Guideline provides evidence-based advice for treating osteoarthritis of the knee. *JAMA*. 2009 4;301(5):475-6. [[CrossRef](#)] [[PubMed](#)]
11. Altman R, Hochberg M, Moskowitz R, Schnitzer T. American College of Rheumatology Subcommittee on Osteoarthritis Guidelines. Recommendations for the medical management of osteoarthritis of the hip and knee: 2000 update. *Arthritis Rheum*. 2000;43(9):1905-15.
12. Pisters MF, Veenhof C, van Meeteren NL, Ostelo RW, de Bakker DH, Schellevis FG, Dekker J. Long-term effectiveness of exercise therapy in patients with osteoarthritis of the hip or knee: a systematic review. *Arthritis Rheum*. 2007 15;57(7):1245-53. [[CrossRef](#)] [[PubMed](#)]
13. Shakoor N, Sengupta M, Foucher KC, Wimmer MA, Fogg LF, Block JA. Effects of common footwear on joint loading in osteoarthritis of the knee. *Arthritis Care Res (Hoboken)*. 2010;62(7):917-23. [[CrossRef](#)] [[PubMed](#)]
14. Chui KC, Jorge M, Yen S-C, Lusardi MM. Orthotics and Prosthetics in Rehabilitation E-Book: Elsevier Health Sciences; 2019.
15. Jankovic J, Mazziotta JC, Pomeroy SL, Newman NJ. Bradley and Daroff's Neurology in Clinical Practice: Elsevier; 2022.
16. Dessery Y, Belzile É, Turmel S, Corbeil P. Effects of foot orthoses with medial arch support and lateral wedge on knee adduction moment in patients with medial knee osteoarthritis. *Prosthet Orthot Int*. 2017;41(4):356-363. [[CrossRef](#)] [[PubMed](#)]
17. Roos EM, Roos HP, Lohmander LS, Ekdahl C, Beynon BD. Knee Injury and Osteoarthritis Outcome Score (KOOS)-development of a self-administered outcome measure. *J Orthop Sports Phys Ther*. 1998;28(2):88-96. [[CrossRef](#)] [[PubMed](#)]
18. Salavati M, Akhbari B, Mohammadi F, Mazaheri M, Khorrami M. Knee injury and Osteoarthritis Outcome Score (KOOS); reliability and validity in competitive athletes after anterior cruciate ligament reconstruction. *Osteoarthritis Cartilage*. 2011;19(4):406-10. [[CrossRef](#)] [[PubMed](#)]
19. Collins NJ, Misra D, Felson DT, Crossley KM, Roos EM. Measures of knee function: International Knee Documentation Committee (IKDC) Subjective Knee Evaluation Form, Knee Injury and Osteoarthritis Outcome Score (KOOS), Knee Injury and Osteoarthritis Outcome Score Physical Function Short Form (KOOS-PS), Knee Outcome Survey Activities of Daily Living Scale (KOS-ADL), Lysholm Knee Scoring Scale, Oxford Knee Score (OKS), Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC), Activity Rating Scale (ARS), and Tegner Activity Score (TAS). *Arthritis Care Res (Hoboken)*. 2011;63 Suppl 11(0 11):S208-28. [[CrossRef](#)] [[PubMed](#)]
20. Hunt MA, Takacs J, Krowchuk NM, Hatfield GL, Hinman RS, Chang R. Lateral wedges with and without custom arch support for people with medial knee osteoarthritis and pronated feet: an exploratory randomized crossover study. *J Foot Ankle Res*. 2017 2;10:20. [[CrossRef](#)] [[PubMed](#)]
21. Yeh HC, Chen LF, Hsu WC, Lu TW, Hsieh LF, Chen HL. Immediate efficacy of laterally wedged insoles with arch support on walking in persons with bilateral medial knee osteoarthritis. *Arch Phys Med Rehabil*. 2014;95(12):2420-7 [[CrossRef](#)] [[PubMed](#)]
22. Khosravi M, Babaei T, Daryabor A, Jalali M. Effect of knee braces and insoles on clinical outcomes of individuals with medial knee osteoarthritis: A systematic review and meta-analysis. *Assist Technol*. 2022 3;34(5):501-517. [[CrossRef](#)] [[PubMed](#)]
23. Riaz R, Althomali OW, Sultana B, Amjad I, Abbas S, Khan N. Effectiveness of lateral wedge insole on knee osteoarthritis outcomes in pakistani population. *The Rehabil.J*. 2022;6(02):361-66. [[CrossRef](#)]
24. Abdallah AA, Radwan AY. Biomechanical changes accompanying unilateral and bilateral use of laterally wedged insoles with medial arch supports in patients with medial knee osteoarthritis. *Clin Biomech (Bristol, Avon)*. 2011;26(7):783-9. [[CrossRef](#)] [[PubMed](#)]
25. Yasuda K, Sasaki T. The mechanics of treatment of the osteoarthritic knee with a wedged insole. *Clin Orthop Relat Res*. 1987;(215):162-72. [[PubMed](#)]
26. Hatfield GL, Cochrane CK, Takacs J, Krowchuk NM, Chang R, Hinman RS, Hunt MA. Knee and ankle biomechanics with lateral wedges with and without a custom arch support in those with medial knee osteoarthritis and flat feet. *J Orthop Res*. 2016;34(9):1597-605. [[CrossRef](#)] [[PubMed](#)]
27. Hsieh RL, Lee WC. Clinical effects of lateral wedge arch support insoles in knee osteoarthritis: A prospective double-blind randomized study. *Medicine (Baltimore)*. 2016;95(27):e3952. [[CrossRef](#)] [[PubMed](#)]