



A clinical review on footwear modification in knee osteoarthritis patients.

Aishwarya Patel¹, Gowrishankar Potturi², *Neha Dubey³, K.B. Ranjeet Singh Chaudhary⁴, Anjali Agarwal⁵

¹. MPT 1st year, Department of Physiotherapy, Faculty of Paramedical Sciences, UPUMS, Saifai, Etawah (U.P.)

². HOD, Department of Physiotherapy, Faculty of Paramedical Sciences, UPUMS, Saifai

³. Faculty, Department of Physiotherapy, Faculty of Paramedical Sciences, UPUMS, Saifai

⁴. Faculty, Department of Physiotherapy, Faculty of Paramedical Sciences, UPUMS, Saifai

⁵. Faculty, Department of Physiotherapy, Faculty of Paramedical Sciences, UPUMS, Saifai

Corresponding author: Neha Dubey

Email id: physioneha05@gmail.com

Address for Correspondence: Department of Physiotherapy, Faculty of Paramedical Sciences, UPUMS, Saifai, Etawah, (U.P.)

Email id:

¹ aishwaryapatel8366@gmail.com

² potturigowrishankar@gmail.com

³ physioneha05@gmail.com

⁴ chaudhary.ranjeetrediffmail.com

⁵ anjaliagarwalupums@gmail.com

ABSTRACT:

Introduction: Osteoarthritis is considered one of the most common and significant causes of pain and disability worldwide. Treatment options for osteoarthritis in modern times vary from medicine to surgery. LWI is a helpful treatment for this condition. The purpose of this review is to determine whether changing footwear can help patients with osteoarthritis of the knee. **Methodology:** A random selection of research articles related to footwear modification in knee osteoarthritis patients, such as from PubMed, PubMed Central, Cochrane Library, and other internet sources. **Discussion:** The study articles were examined at random, and their conclusions were documented without regard to how they arrived at their findings. **Conclusion:** The lateral wedge insole is effective in eliminating pain and improving quality of life in patients with medial knee osteoarthritis.

Keywords: Knee osteoarthritis, Footwear, Modification, and Lateral wedge insole A clinical review on footwear modification in knee osteoarthritis patients.

Introduction:

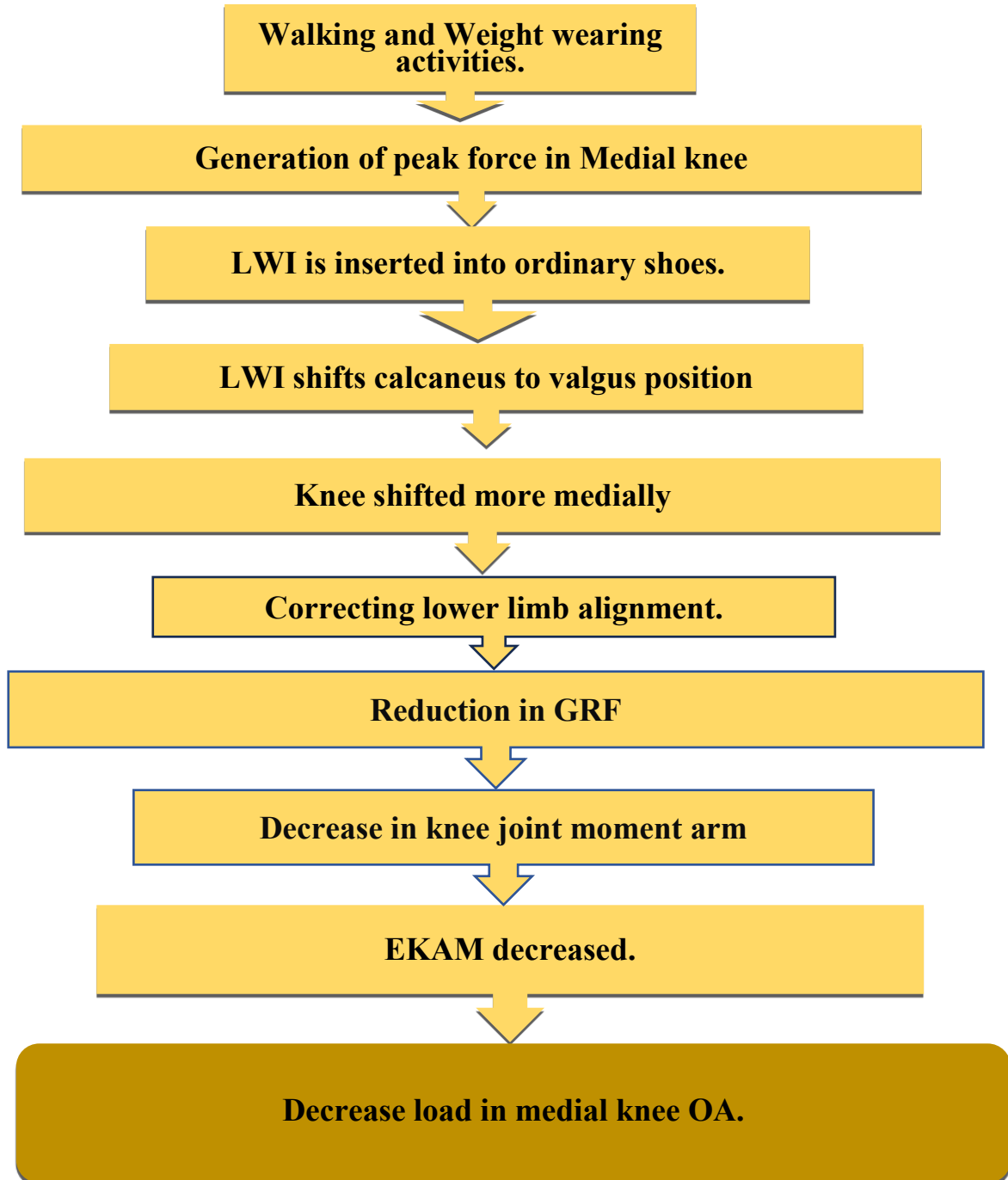
Osteoarthritis is a degenerative joint condition characterized by deterioration of the joint's articular surface, which results in pain and restricted joint movement.^{1,2,3} It is a significant cause of disability, particularly among individuals aged 40 and older, due to its impact on joint function and mobility.^{4,5} Evidence suggests that the medial compartment is 10 times more affected than the lateral.^{1,2} Osteoarthritis affects about 595 million of the population, which is about 7.6% of the population globally in 2020.⁶ In India, the prevalence rate of osteoarthritis (2016) is about 22% to 39%.⁷

Osteoarthritis in the knee has led to instability in the frontal plane, resulting in excessive varus motion or increased force during gait, which is worsened by lateral thrust.^{8,9} Increased force may be a contributing factor in the progression of knee osteoarthritis.^{1,10,11,12} It is seen that in healthy subjects, between 71%- 89% of total knee force is transmitted through the medial tibiofemoral compartment, compared to 100% in osteoarthritis.^{1,10,11,12} It was seen that lateral wedges insole and barefoot walking reduced the knee adduction angular impulse in the early stance and reduced the external knee adduction moment in the later stance as compared to the control shoe.¹³ Therefore, our study aims to review on footwear modification in knee osteoarthritis patients.

Mechanism:

During walking and weight-bearing activities, the medial compartment of the knee typically experiences higher peak forces compared to the lateral compartment; this increased load on the medial side can contribute to the higher prevalence of osteoarthritis in that specific compartment.¹⁴ The use of lateral wedge insoles is considered a conservative treatment for knee osteoarthritis patients, insoles which are made of sponge rubber material and are

inserted into ordinary shoes.¹ Sasaki and Yasuda (1987) reported on the lateral insole.¹⁵ Wedge insoles work by shifting the calcaneus into the valgus position relative to the tibia, thereby shifting the tibia more medially and correcting the alignment of the lower limb to a more anatomical position, lateral wedge insole shifts the point of application of ground reaction force towards the outside of the foot or resultant reduction in ground reaction force and lateralization of the center of pressure, the lateral shift lightly decreases the length of knee joint moment arm; therefore, the knee extension adduction moment is also reduced, and leading to a decrease in load in the medial compartment.¹⁶ The mechanism of footwear modification in knee osteoarthritis patients.



Flow chart-1 Mechanism of footwear modification in knee osteoarthritis patients.

Methodology:

The search for the relevant journal was carried out referring to many different databases, such as PubMed, PubMed Central, Cochrane Library, and other internet sources.

Abbreviations:

- **OA:** Osteoarthritis
- **LWI:** Lateral wedge insole
- **MKOA:** Medial knee osteoarthritis
- **EKAM:** External knee adduction moment
- **KAAI:** Knee adduction angular impulse
- **GRF:** Ground reaction force

Data extraction and analysis:

Four reviewers independently completed data extraction and reviewed the extracted information. The following study characteristics include:

Introduction (research aim)

1. Mechanism
2. No. of subjects include
3. Methodology
4. Conclusion

Study Selection:

Our study included osteoarthritis patients in the age group ≥ 40 -80 years. The detailed inclusion and exclusion categories are described in Table 1.

Table 1: Selection Criteria.

Criteria	Inclusion	Exclusion
Study year	2012- 2023	Studies before 2012
Study design	1. A randomized control trial 2. Systematic review 3. Meta-analysis 4. Original paper	1. Dissertation 2. Review of literature 3. Manuscript 4. Abstract 5. Letter 6. Surveys
Settings	1. Rehabilitation center 2. O.P.D 3. I.P.D 4. Hospitals	1. Community 2. Camp 3. NGOs
Context	1. Lateral wedge insole 2. Barefoot walking 3. Medial wedge insole 4. Control shoes	1. Surgical treatment 2. Other knee splints 3. Assisted devices
Outcome measures	1. WOMAC scale 2. VAS scale 3. Lequesne index 4. Kellgren–Lawrence grade (radiological definition of OA) 5. 6-minute walk test 6. Health assessment questionnaire (quality of life).	1. FIM Scale 2. Barthel index 3. MMT Scale 4. Mini mental status scale 5. VCT Scale 6. MAS scale

Table 2:
Evidence-based studies regarding footwear modification in patients with knee osteoarthritis

Characteristics	Author	Year	Country	No. of the subject with methodology	Types of Research	Conclusion
Effects of various kinds of lateral wedge insoles on the performance of individuals with knee joint osteoarthritis.	Rafiaee M., Karimi M.T. et al. ¹	2012	Iran	Out of the (n=36) patients, they were divided into two groups. Group A (n=18) received 3mm LWI, whereas group B (n=18) received 7mm LWI.	A randomized control trial (RCT)	It was observed that 7mm LWI is more effective as compared to 3mm LWI. Use of 3mm and 7mm LWI has a significant decrease in pain and improves quality of life.
Lateral wedge insoles as a conservative pain treatment for patients with medial knee osteoarthritis.	Parkes M.J., Maricar N., Lunt M. et al. ¹⁹	2013	England	Out of (n=885) patients, only (n=12) were included; (n=11) used LWI; and (n=1) received variable stiffness shoes for treatment of pain with medial knee osteoarthritis.	Meta-analysis	The findings of the study do not support the use of lateral wedge insoles as a conservative treatment for pain in patients with medial knee osteoarthritis.
Mechanical effectiveness of lateral foot wedging in medial knee osteoarthritis post 1 year of wear.	Barrios J.A., Butler R.J., Crenshaw J.R. et al. ¹⁸	2013	Dayton	38 patients were divided into two groups. Out of which, intervention group (n=19) received wedged orthosis, whereas 19 received neutral orthosis in the control group.	A randomized control trial (RCT)	It was found that in the control group, there was an increase in knee adduction moment and frontal plane motion over time, but not in the intervention group.

Effect of different types of orthosis or shoe modifications on medial knee loading in patients with medial knee osteoarthritis: a randomized trial.	Jones R.K., Chapman G.J. Parkes M.J. et al. ¹⁴	2015	United Kingdom	70 patients were divided into two groups. One group was given a lateral wedge insole, while another group received different shoes to see medial loading in knee osteoarthritis.	A randomized control trial (RCT)	It was found that different lateral wedge insoles show reductions in medial knee loading, and the mobility shoe did not affect medial loading.
*Effect of lateral wedge insertion on gait variability evaluated using wearable sensors in patients with osteoarthritis of the medial compartment of the knee.	Ishii Y., Ishikawa M., Kurumadani H. et al. ¹³	2023	Japan	28 patients were included in the study and were divided into two groups. Group A (n=15) received symptomatic patients in group B (n=13) include asymptomatic patients.	A randomized control trial (RCT)	It was recommended that LWI could improve gait variability and reduce dynamic knee instability.
Ineffectiveness of lateral-wedge insoles in improving pain and function in medial knee osteoarthritis: a meta-analysis of controlled randomized trials.	Zhang J., Wang Q., Zhang C. et al. ²⁰	2018	China	A total of (n=938) patients were included in the study. (n=478) patients receive LWI and (n=460) receive neutral shoe or no treatment.	Meta-analysis of controlled randomized trials	It was observed that lateral wedge insoles appear to be ineffective. In attenuating knee pain and functional improvement.
Are wedge inserts an effective treatment option compared to Flat (placebo) inserts: systematic review and meta-analysis.	Zhang B., Yu X., Liang L. et al. ⁴	2018	China	Out of (n=413) citations, 8 studies met the inclusion criteria. A comparative study was conducted between the use of LWI in intervention and flat or neutral insole in control conditions.	A Systematic Review and Meta-Analysis	It was found that knee varus angle is reduced in the case of LWI, but LWI is no more efficacious than neutral inserts for improvement of pain and function in patients with knee osteoarthritis.
Bio-mechanical effects of lateral and medial wedge insoles on unilateral loading.	Sawada T., Kito N., Yukimune M. et al. ¹⁶	2016	Japan	Out of (n=30) healthy young patients, (n=18) grouped under normal foot, (n=6) with pronated foot, and (n=6) with a supinated group who were assessed using foot postural index.	A randomized control trial (RCT).	The study findings reveal that in both normal and pronated foot groups, there is a significant decrease in knee adduction moment under LWI as compared with the medial wedge insole.
*Can small deviations from lateral wedge insoles lead to significant bio-mechanical changes in patients with knee	Ferreria V., Machado L., Vilaca A. et al. ²¹	2022	Portugal	Out of (n=38), in which patients, (n=15) males, (n=23) females were studied, and 6 different lateral wedge	A randomized control trial (RCT)	The study findings reveal a reduction in knee adduction moment under

osteoarthritis?				insoles (0, 2, 4, 6, 8 and 10°) were given to each patient in a randomized order and a control condition (shoe with a 0° insole). The study was conducted to see the bio-mechanical effect of different amounts of wedging in medial osteoarthritis patients.		control conditions and an increase in ankle eversion and external knee adduction moment in the lateral insole; hence, even a slight change in foot induces a significant bio-mechanical change in knee osteoarthritis.
*Efficacy of lateral wedge inserts on medial areas of knee osteoarthritis treated with viscous supplements.	Kanaujia V., Gupta A., Kumar D. et al. ²²	2020	India	A total of 60, patients were distributed into two groups: group A (n=30) received Viscosupplements, and group B (n=30) received LWI with Viscosupplements for 2 nd , 4 th , and 12 th weeks, and effectiveness is compared in terms of pain, function, and quality of life is assessed.	A randomized control trial (RCT)	The study findings reveal that there was improvement in both groups, but a significantly better result is seen in group B in the 2 nd and 4 th weeks. Group A decreases pain, quality of life, and function and Group B gives initial relief in stiffness, and function but not in pain and quality of life.
Efficacy of a lateral wedge inserts for painful medial knee osteoarthritis.	Felson D.T., Parkes M., Carter S. et al. ²³	2019	UK	A total of 83 patients, were (n=62) were included in the study, one group (n=31) received LWI and other group received neutral insole for a period of 8 weeks, with outcome measure of knee pain (0-10) scale during past weeks, and pain was assessed.	A randomized control trial (RCT)	The study findings reveal that lateral wedge shows a great reduction in pain but not in neutral insole.
Knee varus limits the analgesic efficacy of lateral wedge insoles and ankle foot orthosis in medial knee osteoarthritis.	Bartsch L.P., Schwarze M., Block J. et al. ²⁴	2022	Germany	A total of 28 patients with medial knee osteoarthritis, (n=28) wore 5mm lateral wedge insole and ankle foot orthosis for a period of 6 weeks and pain was correlated with limb alignment during that period.	A randomized control trial (RCT)	The study findings reveal that in both ankle foot orthosis and lateral wedge insole can be uses successfully in reducing pain in medial knee osteoarthritis patients.

Discussion:

In this article, we review the application of various interventions on footwear modification in patients with knee osteoarthritis, aged between ≥ 40 -80 years, on pain, quality of life, functional improvement, knee varus angle, adduction moment, and ground reaction force. Several articles were studied on behalf of this article and are listed below.

Rafiaee M., Karimi M.T., et al. (2012) in his randomized trial predict that the use of 3mm and 7mm LWI had a significant decrease in pain and improved the quality of life in (n=36) MKOA patients.¹

Barrios J.A., Butler R.J., Crenshaw J.R., et al. (2013) evaluated (n=38) MKOA patients aged 40-74 years with grade 2 severity for 12 months and observed that in the control group there is an increase in knee adduction moment and frontal plane motion over time, but not in the intervention group.¹⁸

Parkes M.J., Maricar N., Lunt M., et al. (2013) did not support the use of LWI as a conservative treatment for the management of pain in (n=885) MKOA patients when performed for a period of 2 weeks - 2 years.¹⁹

Jones R.K., Chapman G.J., Parkes M.J., et al. (2015) estimate (n=70) MKOA patients. He found that EKAM and KAAI reduced during early stance in the control shoe, LWI, and barefoot walking had no effect, but in the case of mobility shoes, there was a significant reduction in EKAM in later stance, and hence therefor LWI shows a reduction in medial loading in knee osteoarthritis.¹⁴

Sawada T., Kito N., Yukimune M., et al (2016) evaluated (n=30) MKOA patients. He found out that there was a significant decrease in the EKAM under the LWI condition compared to the medial wedge insole. Additionally, knee-ground reaction force and lever arm significantly decreased under the LWI condition compared with the medial wedge insole condition.¹⁶

Zhang J., Wang Q., Zhang C., et al. (2018) estimated (n=938) MKOA patients, for a period of 6 weeks to 12 months, in his study it was found that LWI appears to be ineffective in altering knee pain and function improvement.²⁰

Zhang B., Yu X., Liang L., et al. (2018) conducted a study for a period of 2 weeks to 2 years. During this period, he found that knee varus angle is reduced in the case of LWI, but lateral wedges are no more efficacious than neutral inserts for improvement of pain and function in subjects with knee OA.⁴

Felson D.T., Parkes M., Carter S. et al. (2019) estimated (n=83) patients with MKOA for a period of 8 weeks, in this study the researcher found that the use of LWI shows reduction in pain but not in neutral insole.²³

Kanaujia V., Gupta A., Sharma D.K., et al. (2020) estimated (n=60) patients with MKOA for a period of 2nd, 4th, and 12th weeks. The findings reveal that Viscosupplementation has a significant role in pain, function, and quality of life as compared with LWI, which provides initial relief in stiffness, function, but not on pain and quality of life.²²

Ferreira V., Machado L., Vilaca A., et al. (2022) evaluated (n=38) MKOA patients between 40-80 years of age with grade 2 and 3 OA, at the end of the study they concluded that even a slight change under the foot induce significant bio-mechanical changes in the knee.²¹

Bartsch L.P., Schwarze M., Block J., et al. (2022) estimated (n=28) MKOA patients, found out that there is a correlation between varus misalignment and pain reduction, both LWI and ankle foot orthosis shows reduction in pain wearing for a period of 6 weeks of study.²⁴

Ishii Y., Ishikawa M., Kurumadani H., et al. (2023) estimate (n=28) MKOA patients. At the end of the study, he found out that LWI could improve gait variability and reduce dynamic knee instability.¹³

When discussing the efficacy or applicability of various treatments in clinical practice, it's common for scientific communities to have different opinion based on available evidences, but after reviewing several articles on behalf of this article, it had been found that LWI is a effective treatment for patients with MKOA.

Conclusion:

LWI is a simple and inexpensive method for reducing medial loading of the knee, thus eliminating pain in the osteoarthritic knee. It also reduces peak knee adduction angular impulse, varus angle, and improves quality of life. We recommended various clinical trials on the diversified population of osteoarthritis to assess the benefits of LWI.

Acknowledgement:

I would like to express my gratitude to the institution of Uttar Pradesh University of Medical Sciences, Saifai, Etawah, HOD of Department of Physiotherapy, Faculty Members and my dear parents for providing all possible support to complete this review article.

Conflict of interest: Author has no conflict of interest.

Funding: The study was not funded by any organization.

REFERENCES:

1. Rafiaee M., Karimi M.T. (2012). The effects of various kinds of lateral wedge insoles on performance of individuals with knee joint osteoarthritis. *International journal of preventive medicine*; 3(10):693-698.
2. Wilson W.A. (1999). Estimates of the US prevalence of systemic lupus erythematosus: comment on the article by Lawrence et al. *Arthritis and rheumatism*, 42(2), 396. [https://doi.org/10.1002/1529-0131\(199902\)42:2<396::AID-ANR27>3.0.CO;2-D](https://doi.org/10.1002/1529-0131(199902)42:2<396::AID-ANR27>3.0.CO;2-D)

3. Kerrigan D.C., Lelas J.L., Goggins J., Merriman G.J., Kaplan R.J., & Felson D.T. (2002). Effectiveness of a lateral-wedge insole on knee varus torque in patients with knee osteoarthritis. *Archives of physical medicine and rehabilitation*, 83(7), 889–893. <https://doi.org/10.1053/apmr.2002.33225>
4. Zhang B., Yu X., Liang L., Zhu L., Dong X., Xiong Y., Pan Q. & Sun Y. (2018). Is the Wedged Insole an Effective Treatment Option When Compared with a Flat (Placebo) Insole: A Systematic Review and Meta-Analysis. *Evidence-based complementary and alternative medicine : ecam*, 2018, 8654107. Doi: <https://doi.org/10.1155/2018/8654107>
5. Shen J., & Chen D. (2014). Recent progress in osteoarthritis research. *Journal of the American Academy of Orthopedic Surgeons*, 22(7), 467-468. <https://doi.org/10.5435/JAAOS-22-07-467>
6. GBD 2021 Osteoarthritis Collaborators. *Global, regional, and national burden of osteoarthritis, 1990–2020 and projections to 2050: a systematic analysis for the Global Burden of Disease Study 2021. The Lancet Rheumatology*. 21 August 2023. Doi: 10.1016/S2665-9913(23)00163-7.
7. Pal C.P., Singh P., Chaturvedi S., Pruthi K.K. & Vij A. (2016). Epidemiology of knee osteoarthritis in India and related factors. *Indian journal of orthopaedics*, 50(5), 518–522. Doi: <https://doi.org/10.4103/0019-5413.189608>
8. Hunt M.A., McManus F.J., Hinman R.S., & Bennell K.L. (2010). Predictors of single-leg standing balance in individuals with medial knee osteoarthritis. *Arthritis care & research*, 62(4), 496–500. <https://doi.org/10.1002/acr.20046>
9. Chang A, Hayes K, Dunlop D, Hurwitz D, Song J, Cahue S, Genge R, & Sharma L. (2004). Thrust during ambulation and the progression of knee osteoarthritis. *Arthritis and Rheumatism*, 50(12), 3897-3903. <https://doi.org/10.1002/art.20657>
10. Childs J.D., Sparto P.J., Fitzgerald G.K., Bizzini M., & Irrgang J.J. (2004). Alterations in lower extremity movement and muscle activation patterns in individuals with knee osteoarthritis. *Clinical biomechanics (Bristol, Avon)*, 19(1), 44–49. <https://doi.org/10.1016/j.clinbiomech.2003.08.007>
11. Harrington I.J. (1983). Static and dynamic loading patterns in knee joints with deformities. *The Journal of bone and joint surgery. American volume*, 65(2), 247–259. <https://doi.org/10.2106/00004623-198365020-00016>
12. Sharma L, Hurwitz D.E., Thonar E.J., Sum J.A., Lenz M.E., Dunlop D.D., Schnitzer T.J., Kirwan-Mellis G., & Andriacchi T.P. (1998). Knee adduction moment, serum hyaluronan level, and disease severity in medial tibiofemoral osteoarthritis. *Arthritis and rheumatism*, 41(7), 1233–1240. [https://doi.org/10.1002/1529-0131\(199807\)41:7<1233::AID-ART14>3.0.CO;2-L](https://doi.org/10.1002/1529-0131(199807)41:7<1233::AID-ART14>3.0.CO;2-L)
13. Ishii Y, Ishikawa M, Kurumadani H, Sunagawa T, Date S, Takahashi M, Iwamoto Y, Adachi N, "The Effect of Lateral Wedge Insole on Gait Variability Assessed Using Wearable Sensors in Patients with Medial Compartment Knee Osteoarthritis", *Journal of Healthcare Engineering*, vol. 2023, Article ID 6172812, 7 pages, 2023. Doi: <https://doi.org/10.1155/2023/6172812>
14. Jones RK, Chapman GJ, Parkes MJ, Forsythe L & Felson DT. (2015). The effect of different types of insoles or shoe modifications on medial loading of the knee in persons with medial knee osteoarthritis: a randomized trial. *Journal of orthopedic research : official publication of the Orthopedic Research Society*, 33(11), 1646–1654. Doi: <https://doi.org/10.1002/jor.22947>
15. Sasaki T, & Yasuda K. (1987). Clinical evaluation of the treatment of osteoarthritic knees using a newly designed wedged insole. *Clinical orthopaedics and related research*, (221), 181–187.
16. Sawada T, Kito N, Yukimune M, Tokuda K, Tanimoto K, Anan M, Takahashi M & Shinkoda K. (2016). Bio mechanical effects of lateral and medial wedge insoles on unilateral weight bearing. *Journal of physical therapy science*, 28(1), 280–285. Doi: <https://doi.org/10.1589/jpts.28.280>
17. Hinman RS, Bowles KA, Metcalf BB, Wrigley TV, Bennell KL. Lateral wedge insoles for medial knee osteoarthritis: Effects on lower limb frontal plane biomechanics. *Clinical Biomechanics*, Volume 27, Issue 1,2012,Pages 27-33,ISSN 0268-0033, Doi: <https://doi.org/10.1016/j.clinbiomech.2011.07.010>
18. Barrios JA, Butler RJ, Crenshaw JR, Royer TD & Davis IS. (2013). Mechanical effectiveness of lateral foot wedging in medial knee osteoarthritis after 1 year of wear. *Journal of orthopedic research : official publication of the Orthopedic Research Society*, 31(5), 659–664. Doi: <https://doi.org/10.1002/jor.22252>
19. Parkes MJ, Maricar N, Lunt M, Ilavalle MP, Jones RK, Segal NA, Takahashi-Narita K & Felson DT. (2013). Lateral wedge insoles as a conservative treatment for pain in patients with medial knee osteoarthritis: a meta-analysis. *JAMA*, 310(7), 722–730. Doi: <https://doi.org/10.1001/jama.2013.243229>
20. Zhang J, Wang Q & Zhang C. (2018). Ineffectiveness of lateral-wedge insoles on the improvement of pain and function for medial knee osteoarthritis: a meta-analysis of controlled randomized trials. *Archives of orthopedic and trauma surgery*, 138(10), 1453–1462. Doi: <https://doi.org/10.1007/s00402-018-3004-z>
21. Ferreira V, Machado L, Vilaca A, Xara- Leite F, Roriz P. (2022). Can Slight Variations to Lateral Wedge Insoles Induce Significant Bio mechanical Changes in Patients with Knee Osteoarthritis? *Biomechanics*; 2(3): 342-351. Doi: <https://doi.org/10.3390/biomechanics2030027>
22. Kanaujia V, Gupta A, Sharma DK, Verma S, Yadav RK. (2020). Study of effectiveness of lateral wedge insole on medial compartment of osteoarthritis of knee treated with Viscosupplementation. *Indian Journal of Pain* 34(2):p 106-111, May–Aug 2020. | Doi: https://doi.org/10.4103/ijpn.ijpn_48_20
23. Felson D.T., Parkes M., Carter S., Liu A., Callaghan M.J., Hodgson R., Bowes M., & Jones R.K. (2019). The efficacy of a lateral wedge insole for painful medial knee osteoarthritis after prescreening: A Randomized control trial. *Arthritis & rheumatology (Hoboken, N.J.)*, 71(6), 908-915. Doi: <https://doi.org/10.1002/art.40808>
24. Bartsch L.P., Schwarze M., Block J., Alimusaj M., Schiltenswolf M. (2022). Varus knee limits pain relief effects of lateral wedged insoles and ankle-foot orthosis in medial knee osteoarthritis. *Journal of rehabilitation medicine*, 54,jrm00324. Doi: <https://doi.org/10.2340/jrm.v54.1129>