

Original Research Article

Effect of Knee Brace (As a Non-Chemical Treatment) on Amplitude of Electrical Activity of Lower Limb Muscles during Walking: A Systematic Review

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ABSTRACT

Introduction: Recently, the use of knee braces in the elderly to increase the electrical range and activity of knee has become widespread, but the results have not been gathered in one study to determine its effects. Therefore, the present study was conducted with the aim of the effect of knee brace (as a non-chemical treatment) on the electrical activity range of the lower limb muscles during walking in a systematic way.

Methodology: In this systematic review, keywords such as knee brace, electromyography, elderly, and walking with the help of Boolean operators in English and Persian databases Iranmedex, SID, Magiran, MEDLINE, SCOPUS, Science Direct, PUBMED, Cochrane Library, Google Scholar, EMBASE, and Proquestand Ebsco/CINAHL were searched.

Results: In this review, 4 articles were included in the study. A total of 87 people were investigated and the period of publication of articles varied from 2010 to 2022. The results of all articles indicated that the use of a knee brace leads to an improvement in the functional state of the knee, an increase in the strength of the biceps biathlon muscles, and an increase in electrical activity and the quality of walking.

Conclusion: The use of braces is effective in improving muscle activity in the elderly during different sub phases of walking. This is applied to both men and women. Despite this, more research is needed to prove this issue as well as possible.

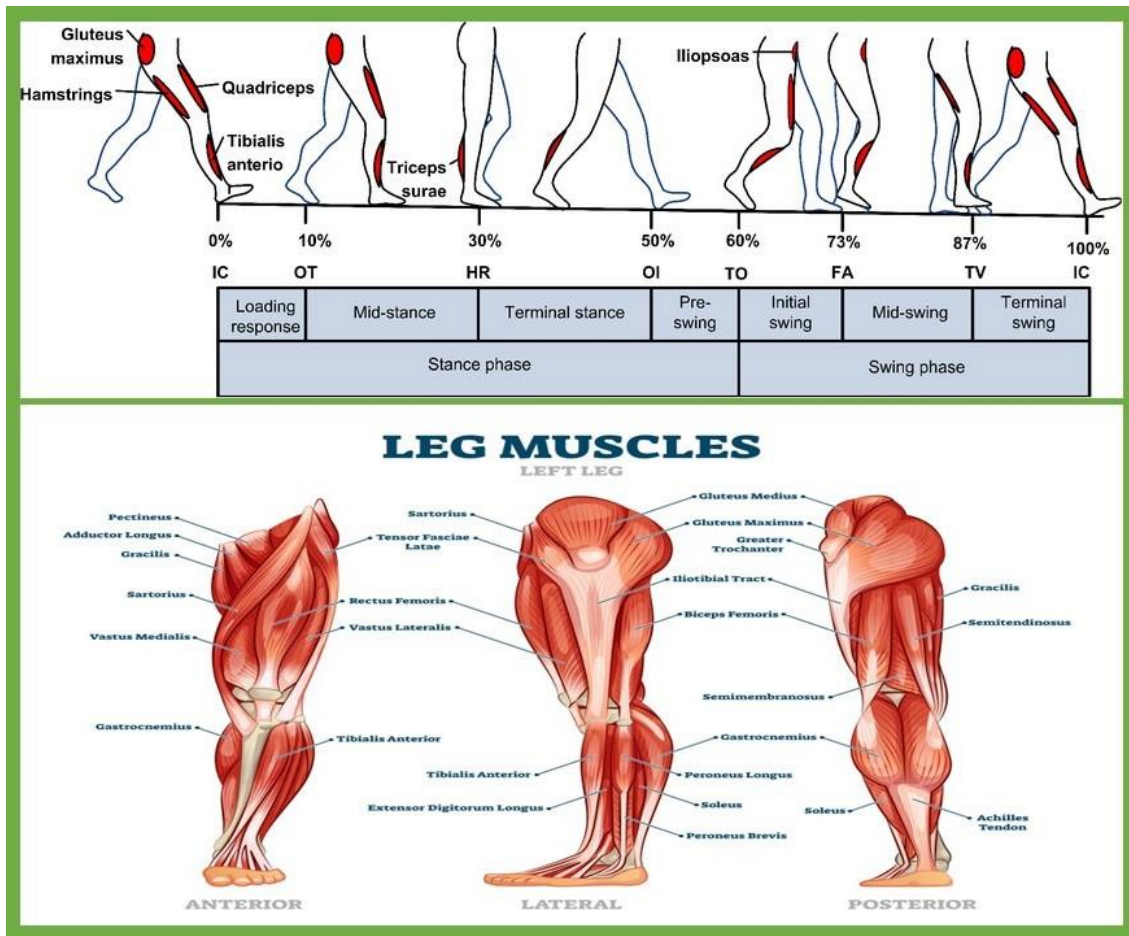
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GRAPHICAL ABSTRACT



Introduction

With the onset of old age, various body systems deteriorate and human abilities decrease, which causes an increase in the dependence of these people on others, an increase in disability, a decrease in independence in daily activities, an increase in care costs and economic pressure on healthcare institutions, and the life quality of the elderly, its effects on their families [1-3]. Therefore, the society should show more attention and sensitivity to solve the needs and problems of these people [4-6].

The central nervous system, by assimilating visual, vestibular, and sensory information along with the design of movement strategies, maintains, and establishes balance in different states and conditions [7-9].

Disability or disorder in the sensory systems can cause the balance to be disrupted and the posture stability disturbed [10-13].

With the beginning of aging process, due to the decrease in the efficiency of vestibular system, there is a disturbance in establishing balance, which increases the probability of falling and tripping in the elderly [14-16]. The variability of walking patterns and movement disabilities are directly related to the risk of falling, which according to reports, a high percentage of these falls occur during daily activities such as walking. One of the basic strategies in the treatment and prevention of balance problems and disorders is to strengthen the sensory inputs effective in maintaining balance, including the proprioceptive sense of the joints [17-19]. The

proprioception sense helps to establish the dynamic stability of the joints. In other words, the ultimate goal of proprioceptive system is the dynamic stability of joint [20-22]. The initiators of proprioceptive feedback loop are the organs mechanoreceptors, the most important of which are the receptors in the skin, joint capsule, ligaments, and muscles [23].

Tests and joint support tools, including braces, elastic bandages, and tapes, by stimulating the touch and pressure receptors of skin, muscles, and joint capsule, help to improve joint proprioception and subsequently, to joint functional stability. Since there is no report about the side effects of protective treatments, the first treatment in the elderly is to use this type of treatment [24-26].

The effects of using a brace on treatment and recovery of the elderly and patients in past studies have shown that the "brace that creates

valgus" counteracts the application of valgus torque against the Varus torque caused by the ground reaction force. Therefore, using a valgus brace, the external torque of the knee will be reduced, and joint pain will be reduced as a result. By changing the direction and biomechanical forces applied to the knee, braces can reduce pain, increase performance and improve quality of life and walking parameters (Figure 1) [27-29]. Schmalz *et al.*, who investigated the use of a prefabricated brace on the kinetic and kinematic parameters of walking on 16 subjects, stated that after four weeks of using the brace, the external knee torque when using the brace was reduced by 10% compared with the condition without the brace. Studies investigating the orthosis effect on people's knee pain have reported a reduction in pain. It was also stated that the use of a valgus brace reduces the adductor torque created in the support phase by 25% [30-32].

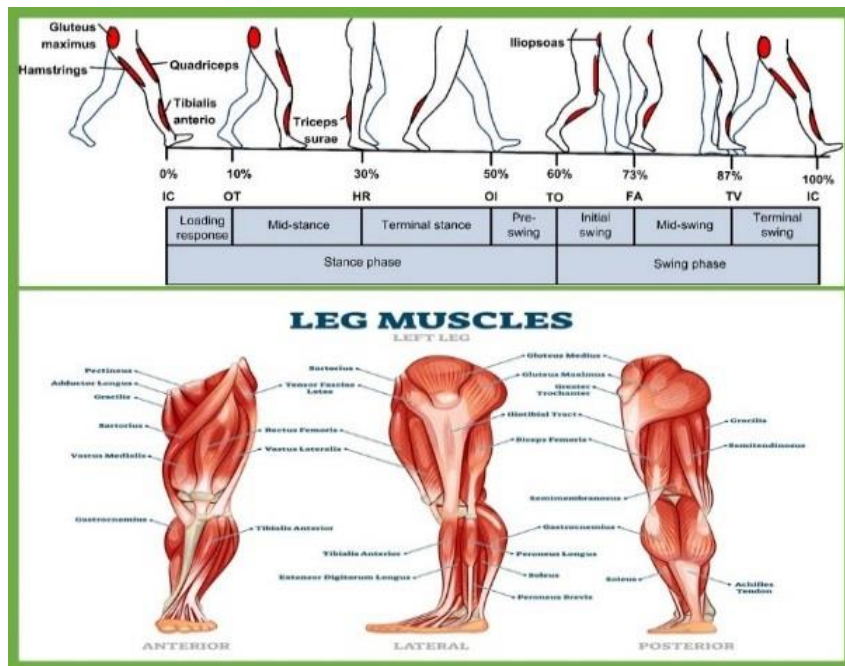


Figure 1. Limb Muscles During Walking.

Concerning that joint supports strengthen the proprioceptive sense by stimulating the skin receptors that are part of the proprioceptive sense of the joints [33-35]. Therefore, in this

research, the effect of braces on the balance and muscle activity of the elderly is investigated. Despite the existence of numerous articles and studies in the field of the effect of using tests

(such as braces), the present research is conducted because most of these studies were conducted on young people, especially athletes, and on the elderly who maintain balance is one of their vital factors and depend on proprioception. It is more important in maintaining balance than other senses, no study was found that dealt with the effect of braces on the muscle activity of the elderly [36-38]. In addition, most of the existing researches were carried out in conditions of non-weight bearing, although this reductionism seems reasonable to control interfering factors, but if this increase in proprioceptive efficiency does not improve balance functions and muscle activity, doubts arise in its usefulness. The purpose of this study is to "investigate the effect of using a knee brace on the range of electrical activity of selected muscles of the lower limbs of the elderly while walking" [39-41].

Recently, the use of knee braces has become popular in the elderly to increase the electrical range and activity of knee, but its results have not been collected in one study to determine its effects. Therefore, the present study was conducted with the aim of the effect of knee brace (as a non-chemical treatment) on the electrical activity range of lower limb muscles during walking in a systematic way [42-44].

Method

The current study is a systematic review that was designed and conducted in Tabriz University of Medical Sciences during 2022. Systematic review articles are carried out according to a process in which existing studies and scientific works related to a specific topic are identified. The desired studies are selected from the searches after evaluating and interpreting the findings of articles by combining the results obtained into a basic question is answered. Since these articles express objective and precise scientific findings in relation to a specific topic, they are one of the important and referable sources of information for researchers, and they can use these types of

articles to obtain research literature and screened information about a specific topic [45]. These articles are very useful and practical for researchers who are not able to access and study all the primary research in their research. Due to the fact that all the stages of scientific writing of systematic review articles are done based on a precise and predetermined plan and instructions, they are named systematic review articles. Searching the available texts in the databases to determine the studies related to the question set in the review article and finding the required information is another action that researchers of systematic review articles have in their agenda.

In this regard, it is recommended to use databases that provide the extensive referencing information [46-48]. To minimize the deviation from the desired result, it is better to conduct a comprehensive search of several databases to access the highest number of retrievable studies in a better way. It is very important to consider the criteria included in the contract for selecting articles, their entry, and exit criteria at this stage. If the steps of searching and choosing the appropriate database are done correctly, a significant amount of useful information will be available to researchers to obtain new evidence. The databases examined in this study included English and Persian databases Iranmedex, SID, Magiran, MEDLINE, SCOPUS, Science Direct, PUBMED, Cochrane Library, Google Scholar, EMBASE, and Proquestand Ebsco/CINAHL. In these databases, keywords such as knee brace, electromyography, elderly, and walking were searched with the help of Boolean operators [49].

Results

In this review, 4 articles were included in the study. A total of 87 people were investigated and the period of publication of articles varied from 2010 to 2022. The results of all the articles indicated that the use of a knee brace leads to an improvement in the functional state of knee, an increase in the strength of biceps biathlon

muscles, an increase in electrical activity, and the quality of walking [50-52].

Table 1. Summary of articles included in this systematic review

Final result	Intervention done	Sample size	First author/year
<p>The effect of brace on the range of electrical activity of tibialis anterior, semitendinosus, and spine straightener muscles during walking in the response phase of loading, middle support, pushing, and swing showed a significant difference. In addition, the effect of this test was significant on the external and internal broad muscles during the response phase of loading and pushing, and on the medial biceps, biceps femora's, and medial gluteal muscles during the middle phase of support, pushing, and swing.</p> <p>The use of knee brace led to the improvement of the functional condition of the knee, increase in the strength of biceps femora's muscles, increase in electrical activity, and quality of walking.</p>	<p>Using a knee brace while walking. After placing the brace on the leg, the subjects were placed at the starting point of the designated 10-meter path and started walking at the speed of their choice according to the examiner's instructions. Therefore, the "self-selected" walking speed was considered so that the walking pattern of the subjects does not change and does not affect the activity of muscles and other components. The rest time between each attempt was 30 seconds. After three attempts, the brace was removed from the subject's leg and the test was repeated in three attempts without using the brace.</p>	<p>30 people 15 men and 15 women Age range between 60 and 70 years old.</p>	Dehghani/2022
<p>Using a knee brace led to a decrease in pain intensity, an increase in walking speed, an increase in the strength of the thigh muscles, an increase in the range of motion, and an increase in the strength of the leg muscles.</p>	<p>Using a knee brace while walking. All participants used the knee brace during daily walks. The duration of use for all participants was 4 weeks.</p>	<p>16 people 8 men and 8 women Age range between 41 and 67 years old.</p>	Schmalz/2010
<p>Using a knee brace led to an increase in dynamic balance, a decrease in pain intensity, an increase in functional status, an increase in the range of electrical activity, and an increase in muscle strength.</p>	<p>Using a knee brace while walking. The participants were asked to walk a 7-meter path at their desired and usual speed; each participant walked the respective route 20 times, and then rested for 30 minutes.</p>	<p>10 persons The number of people by gender was unknown. The average age of the participants was 56 years old.</p>	Yazdani/2018
	<p>Using a knee brace during normal walking. Participants wore a knee brace while walking three times a week for eight weeks.</p>	<p>3 people All participants were elderly women. The age of the participants was between 60 and 80 years old.</p>	Pouradeli/2020

Discussion

According to the findings of the present study, the effect of brace agent on the electrical activity range of tibialis anterior, semitendinosus, and spine straightener muscles during walking in the response phase of loading, middle support, pushing, and oscillation showed a significant difference. Likewise, the effect of this test was significant on the external and internal broad muscles during the response phase of loading and pushing, and on the medial biceps, biceps femora's, and medial gluteal muscles during the middle phase of support, pushing, and swing [53]. A significant difference was observed in the study of the effect of group factor on tibialis anterior muscles, biceps femora's during the loading response phase, on the medial biceps femora's, and biceps femora's muscles during the pushing and swing phase [54-56]. The interactive effect of brace and group on the biceps femora's muscle during the middle phase of support, internal biceps, and latissimus dorsi muscles during the pushing phase, latissimus dorsi, and semitendinosus muscles was significant during the swing phase [57-59]. According to the study of Schmalz *et al.*, it has been reported that the soleus activity and tibia anterior muscles during the middle phase of support in the elderly is more than other phases [60].

On the other hand, this group of people has a higher activity in the medial broad muscles and hamstring than young people during the response phase of loading and middle support, which indicates an increase in co-contraction in the knee and ankle joints in the elderly [61-63]. The findings of Schmalz *et al.*'s study were contrary to the results of the present study, so that the present study reported a decrease in tibialis anterior muscle activity. The reason for the difference in the results can also be explained by the difference in the studied population (the elderly with osteoarthritis) [64-66].

According to the results of a research, it has been reported that the activity of quadriceps muscles

in the elderly has increased significantly during the middle phase of support, and the reason for this increase is the inefficiency of quadriceps muscles in this node, because the weakness of quadriceps muscles causes more effort to start oscillation and control of knee flexion. The results of the present study are justified by the possibility that decrease in activity of the semitendinosus muscle when using a brace increases the extensor moment of knee in the middle phase of support [67-69].

In a study, during fast walking in the phase of weight transfer and middle support, the researchers reported an increase in the activity of the semitendinosus muscle. Nali is effective in plantarflexion. Therefore, this muscle had more activity in the mentioned phase. The increase in the activity level of biceps femora's and semitendinosus muscles in the elderly during the early stages of walking at high speeds can be because these muscles contribute to increase the power of thigh extensors naturally in the elderly during walking. The findings of the mentioned research were contrary to the results of the present study so that in the mentioned research, a decrease was reported in the activity of biceps femora's and hamstring muscles. The reason for this difference in results can be considered as the use of brace [70-72].

According to a study similar to our study, the decrease in the activity of medial gluteal muscle can be due to a compensatory mechanism to reduce people's pain. According to the mentioned study, which was a report about the immediate and long-term effect of the knee support brace on muscle electrical activity during the loading response phase, it was found that due to the immediate use of the brace, the medial gluteal muscle experienced a decrease in activity, which the current research in the field of electrical activity. The gluteus medius muscle did not show any significant difference during the loading response phase [73-75].

Another study has shown that situations such as immobility and removal of mechanical loads from the internal broad muscle cause atrophy of this muscle, and as a result reduce the ability of skeletal muscles to produce work and mechanical power [76]. The researcher has considered the atrophy of this muscle due to the use of a special brace in his study, because this brace has a support pad on the outside that passively pushes patella to the inside of knee, and there is a possibility that the vastus medialis muscle affect and even weaken it. The results of this research confirm the findings of the present study during the middle phase of leaning and pushing and during the loading response phase. Because the brace effect on the electrical activity range of latissimus dorsi muscle decreased during the response phase of loading and increased during the middle phases of leaning and pushing [77]. No study was found that investigated the effect of braces on the range of electrical activity of spinal erector muscle. It can be claimed that the present study is the first study investigating the effect of braces on the electrical activity range of this muscle. The findings of the study revealed that braces can increase the activity of this muscle in the response phases of loading, mid-rest, pushing, and swing. The possible reason for this could be due to the limitation of the knee movement caused by the brace, which probably led to an increase in trunk movements as a compensatory mechanism, which, as a result, made the muscles in this area more active. Different foot shapes can be one of the reasons for using different muscles [79-81].

In addition, differences in muscle fibers are responsible for gender differences in joint biomechanics during walking between male and female groups. In the case of isometric contraction, gender differences may not be evident [82]. Therefore, we should accept the hypothesis that gender differences will be more obvious in muscles that have concentric or

eccentric activity [83-85]. Carson and Grell did not observe a significant difference in the isometric contraction of the quadriceps muscles between both groups of men and women.

Conclusion

Using a brace is effective in improving muscle activity in the elderly during different sub phases of walking. This is applied for both men and women. Nevertheless, to prove this matter as much as possible, more research is needed.

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