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The Effect of Long-Term Application of Kinesiotape on the Function and Balance of Children with Spastic Cerebral Palsy: A Narrative Review

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Review Article

Abstract

Introduction: Cerebral palsy (CP) is a group of persistent abnormalities in body posture and movement resulting from non-destructive lesions in the fetal or neonatal brain that can lead to impaired body structure and functions, and activity limitations. Therefore, timely treatment is necessary due to such disorders. The kinesiotaping technique is a non-invasive, cost-effective, relatively modern, and available method to treat some of the lesions and function in these children. The purpose of this article was to review the literature to investigate the effect of long-term application of kinesiotape technique on improving the function and balance of children with spastic cerebral palsy.

Materials and Methods: Using Kinesiotape, Kinesiotaping, CP, Cerebral Palsy, Function, and Balance keywords in databases such as Pubmed, Google Scholar, Science direct, Proquest, Ovid, Scopus, and Scientific Information Database (SID), 14 articles were selected based on inclusion and exclusion criteria, and then sorted according to the placement of application of kinesotape on the body.

Results: A review of related articles showed that in most studies, the kinesiotape improved activities such as standing up, walking, sitting, grasping, and releasing, separate movements of fingers, upper and lower limb movement patterns, daily living activities, and trunk balance while sitting or walking.

Conclusion: Long-term use of kinesiotape appears to be effective in combination with other rehabilitation therapies to improve the function and balance of children with spastic cerebral palsy.

Keywords: Cerebral palsy; Kinesiotape; Postural balance; Function

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Introduction

Cerebral palsy (CP) refers to a group of permanent disorders of body posture and movement caused by non-destructive lesions in the fetus or infant's brain (1) which is often accompanied by sensory, perception, cognition, communication, and behavior disorders, as well as seizures and secondary musculoskeletal disorders (MSDs) (2,3). CP, with a prevalence rate of about 1.4 to 2.4 cases per 1000 live births (1,4), is the most common physical disability in childhood (5). This complication may be classified according to the type, range, or anatomical location of the movement disorder (3). The movement disorders can be divided into spastic, hypotonic, dyskinetic, or ataxic types (6). The most common pattern described in the classification based on the anatomical location of the movement disorder is hemiplegia, which involves paralysis of the upper and lower limbs on one side of the body. Diplegia involves both the lower limbs and quadriplegia involves involvement of all four limbs and the torso muscles (3).

Spasticity is present in about 75% of children with CP (7). The results of a study reported spasticity distribution in children with CP as 44, 23, 24, and 6% for quadriplegia, diplegia, hemiplegia, and triplegia, respectively (8). Damage to the central nervous system (CNS) may cause secondary injuries in children with CP, including muscle spasms, decreased muscle tone, skeletal abnormalities, myasthenia gravis (MG), developmental coordination disorder

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(DCD), and balance disorders (9). As a result, children with CP are more likely to fall and experience more limited motor skills (10). Injuries such as spasticity, muscle weaknesses, and sensory impairments cause problems in daily activities of a child's life, such as playing, environmental exploration, and self-care (11,12).

The effective use of hand function for daily activities depends on the complex interaction between fine motor functions and proprioceptive, tactile, and visual information (13). Hands are tools that are often used to perform tasks and daily activities and play, and manual skills are necessary to interact with the environment (14,15). Sitting, on the other hand, is an important step for a child to achieve a standing position, as well as an essential activity to create a proper postural tone for upper limb function (16). However, children with CP often show balance problems while sitting and incorrect sitting positions, such as a crooked torso with a kyphosis and the torso asymmetry (17).

Walking is one of the most complex human functions, and it is very difficult to predict its initiation in children with CP (18). According to a study in Europe, 54% and 16% of children with CP walk respectively without and with a helper and 30% of them are unable to walk (19). Treatment for children with CP includes surgery, botulinum toxin (Botox) injections, rehabilitation, drug treatment, and serial casting (20). These methods, while time consuming and incurring high costs to the patient, create many functional limitations for the individual (21).

The Kinesio Taping (KT) method, first described by Kenzo Kase in 1996 (13), is a non-invasive, cost-effective, relatively novel, and accessible method for treating some lesions and function in children (21) which is often used in sports injuries (22), patients with a stroke (23), and more recently for children with CP (24). In this method, an elastic adhesive is used which is composed of cotton fibers and lacks latex or medicinal properties (14). When the adhesive is applied properly, due to the flexibility, it not only does not restrict the movement of soft tissue, but also supports weakened muscles and, while providing proper limb alignment, allows full joint movement (25).

The use of KT influences the skin receptors of the sensory-motor system, and since these receptors are associated with pain, proprioception, and motor control, they affect the skin, lymphatic system, and muscle and joint function. In addition, they can increase proprioception, decrease muscle spasm, strengthen weak muscles and, as a result, improve functional independence in children with CP (13,26). Given the investigations, when KT is attached to the skin, it lifts the skin from the muscles, and the convulsions create a wider space between the muscles and the skin, thus improving blood circulation and lymphatic system activity (27).

KT can be applied to the skin for short-term (24 hours to a week) or long-term (more than a week) (28). The long-term use of KT causes neural effects on the muscular system, which differ from the effects of the short-term use of KT (29).

Given the importance of improving the function of children with CP in performing daily activities and increasing their independence, and due to the widespread use of KT in the rehabilitation of these children, the present study is carried out aiming to review the studies conducted on the effect of the KT technique on the improvement of children with CP. Since the previous review studies did not take into account the duration of use of KT, this study only examines the long-term effect of KT.

In the current study, the studies performed on the long-term use of KT in children with CP were collected to help clinical specialists use this approach for children with CP and in order to provide a ground for researchers to separate and compare the short-term and long-term effects of the KT technique.

Materials and Methods

This was a review study and domestic and international databases were used to collect the relevant references. To find relevant documentation, the Scopus, Ovid, ProQuest, ScienceDirect, Google Scholar, PubMed, and Scientific Information Database (SID) databases were searched using English keywords "Cerebral Palsy, Taping, Kinesiotaping, Function, Balance, Kinesiotape, and CP" as well as their Persian equivalents and all existing articles were ultimately analyzed based on the inclusion and exclusion criteria. The clinical trials published in Persian or English from the beginning of 1996 to December 2019, the abstract or full text of which was available, were included in the study. Studies that addressed the effect of short-term use of KT on patients with CP, or did not consider performance or balance in measuring their outcome measurements were among the excluded studies.

Results

After performing the search, 43 articles were obtained, among which15 articles had the conditions to enter the review according to the inclusion and exclusion criteria. The full text of all these articles was available (Figure 1).

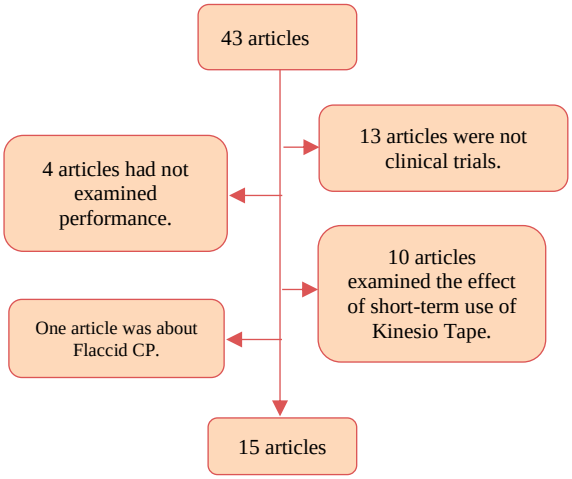

Figure 1. Study drop based on the exclusion criteria
CP: Cerebral palsy

Among the remaining articles, 3, 4, 6, and 1 articles addressed the upper limb function (13,14,20), lower limb function (30-34), trunk function (17,35-39), and trunk and upper and lower limb function (26), respectively. In all studies performed on the arm and upper limb, improvement in upper limb function was reported, except for the study by Sadeghi Moghaddam et al., which showed no change in weight tolerance and protective extension (14). In all of the studies performed on the lower limbs (26,30-34), the balance and function of the lower limbs showed a significant improvement. In a study by Kora et al., lower limb KT improved performance, but there was no significant difference between the effect of the two corrective and inhibitory KT methods (33).

On the other hand, it can be said that in all studies performed on the trunk (17,26,35-39), there was an improvement in balance and the trunk-related functions, but the results of the study by Simsek et al. indicated that the trunk KT had no effect on gross motor function and functional independence (39). In addition, in a study conducted by Footer, there was no significant difference in the rate of improvement of sitting function (37). A summary of the articles reviewed is presented in table 1.

Discussion

The objective in this study was to investigate the effects of long-term use of KT on the performance and balance of children with spastic CP. The results of studies on fine and gross motor functions revealed that the KT technique is effective in activities such as sitting, walking (30,34), sitting (18,19,39,41,42), grasping and releasing (13,14,25), separate movements of fingers (14, 13), upper and lower limb motor patterns (13,24,30,34), and daily activities (13,24). Moreover, the results of investigations which dealt with balance (35,37,39) suggested that KT improves the trunk balance in sitting position (39) or while walking (35,37).

Along with the positive effects observed in other studies, Footer did not notice a significant change in his study in improvement of sitting in children with quadriplegia (37). Furthermore, Simsek et al., beside observing the positive effect of KT on sitting posture, did not report any effect on gross motor function and trunk static balance (39). The results of the study by Sadeghi Moghaddam et al. did not repor any change in weight bearing and upper extremity protective extension (14).

There are some major differences between the two recent studies and other ones. The results of a review study carried out by Rasti et al. (40) considered the difference between the study by Footer (37) and other studies to be dependent on the gross motor function level. However, since Badawy et al. (17), Elbasan et al. (36), and Simsek et al. (39) in their studies also treated children with levels 4 and 5 of the Gross Motor Function Classification System (GMFCS), the reason for the different result of the study by Footer (37) could be the small number of patients compared to the other studies. Another difference is the duration of stay of KT on the child's skin during the treatment period. In this study, KT remained on the patient's skin for one day, and the skin was allowed to rest the next day, and this process continued throughout the treatment period (37), but in other studies performed on the trunk, KT was placed for 3 to 4 days on the patient's skin and then it was given a one-day rest to reapply. Therefore, it seems that the duration of remaining of the tape on the skin is also the reason for the difference between the results of Footer (37) and other studies. Secondly, the study by Simsek et al. (39) examined the effect of KT on children with CP of both flaccid and spastic types and did not differentiate and compare the results. Therefore, it is not possible to generalize the negative impact of KT on these cases to all spastic children. The difference in the findings of the study by Sadeghi Moghaddam et al. (14) with other studies on upper limb was its short course of treatment. Among all the studies reviewed, Sadeghi Moghaddam et al. had a 12-day course of treatment (14). The course of treatment for the other two studies (13,20) is 1 and 17 months, respectively. Therefore, 12 days does not seem to be enough to achieve the desired outcomes.

Table 1. Summary of the results of the articles reviewed (the order of the articles in the table is based on the location of application of the Kinesio Taping (KT) technique on the body

Reference	Objective	CP type	Sample size	Age	Kinesio Taping site	Evaluation tool	Course of treatment	Outcome
Mazzone et al. (20)	KT effect on upper limb function	Hemiplegia	16	1-5 years	Upper limb in the direction of wrist extension, forearm supination, and external shoulder rotation	Melbourne Assessment scale	17 months	Improved hand function
Sadeghi Moghaddam et al. (14)	Effect of KT on wrist function	Diplegia	26	3-6 years	Wrist extensor surface	QUEST	12 days	Improvement and separate movement of fingers, no change in weight tolerance and protective extension
Roy and Dixit (13)	Effect of Kinesiotaping of forearm muscle on fine motion functions	Diplegia	60	3-6 years	Forearm extensor muscles	MACS, PDMS	One month	Improvement in all tests
Hussein Zeinab and El-Meniawy Gehan (32)	KT effect on postural control	Hemiplegia	30	5-7 years	Lower limbs to below the knee	Biodex system	12 weeks	Significant improvement in balance between the two groups
Kora et al. (33)	Effect of corrective and inhibitory KT on gross functional movements	All types of spastic CP	32	2-4 years	Gastrocnemius and tibialis anterior muscles	PDMS	3 months	No significant difference between the effects of the two methods of Kinesio Taping
Dixit (30)	KT effect on motor recovery	Diplegia	60	4-8 years	Quadriceps femoris and hamstring	1-Minute walk test, 10-MWT, Lateral step-up, Timed-stair test, Sit to stand test	One month	Significant improvement of motor function in all tests
Tabatabaee et al. (31)	Effect of lower limb KT on balance	Diplegia and quadriplegia	30	3-10 years	Ankle, tibialis anterior and posterior, rectus femoris, and hamstring	BBS, Forward Functional Reach Test	14 days	Significant improvement in balance after two weeks
Tabatabaee et al. (34)	Effect of lower limb KT on functional movements	Diplegia and quadriplegia	30	4-10 years	Ankle, tibialis anterior and posterior, rectus femoris, and hamstring	TUG	14 days	Improved gait performance
Footer (37)	KT effect on sitting control and gross motor function	Quadriplegia	18	3-13 years	Paraspinal and lower trapezius	GMFM (Sitting)	12 weeks	Lack of significant differences in sitting function

Table 1. Summary of the results of the articles reviewed (the order of the articles in the table is based on the location of application of the Kinesio Taping (KT) technique on the body (continue)

Reference	Objective	CP type	Sample size	Age	Kinesio Taping site	Evaluation tool	Course of treatment	Outcome
Simsek et al. (39)	KT effect on sitting posture, gross motor function, and functional independence	(Spastic and flaccid) diplegia and quadriplegia	31	8-12 years	Paraspinal between the seventh cervical vertebra to the first sacral vertebra	GMFM (Sitting), WeeFIM, SAS	12 weeks	Positive effect on sitting position and lack of impact on gross motor function and trunk static balance
Ibrahim (38)	Effect of KT on the trunk posture and control	Diplegia	30	7-10 years	Erector spinae from the first sacral vertebra to the seventh cervical vertebra	GMFM (Sitting)	12 weeks	Significant improvement in sitting function
Badawy et al. (17)	KT effect on sitting improvement	Diplegia	30	10-16 months	Paraspinal	GMFM (Sitting)	12 weeks	Significant improvement in sitting function
Karabay et al. (35)	Effect of KT on sitting and comparison with the effect of neuromuscular electrical stimulation	Diplegia	75	3-9 years	From acromioclavicular joint to twelfth thoracic vertebra	GMFM (Sitting)	4 weeks	Significant improvement in sitting function
Elbasan et al. (36)	Effect of physiotherapy with neuromuscular stimulation and Kinesio Taping on postural and sitting balance	Diplegia and quadriplegia	45	5-12 years	Paraspinal	GMFM (Sitting), SPCM	6 weeks	Significant improvement in sitting function and balance
Kaya et al. (26)	Effect of KT on body activity and function	Hemiplegia	30	7-14 years	Wrist, forearm, shoulder, ankle, knee, pelvis, trunk	WeeFIM, BOT, GMFM (Standing, Walking, Running, Jumping), STMP, Lateral step up test, Sit to stand test, Stand through Half Knee	12 weeks	Positive results in all tests

Limitations

One of the limitations of the present study was the small number of clinical trial studies available on the effect of long-term use of KT in the rehabilitation of children with spastic CP. Given that the effect of KT depends on its adhesion technique, another limitation of the study was the uncertainty of the technique used in most of the studies reviewed. Furthermore, the different types of the tapes used in the studies, differences in the elastic properties, the type of the adhesive used, and the durability of different brands of the tapes were among the other limitations of the study. As a result, it was not possible to generalize the results to the technique used.

Recommendations

To achieve more accurate results of the effectiveness of KT, it is suggested that the effect of KT on different types of CP be examined separately and compared with each other. Additionally, the effect of short-term and long-term use of KT should be compared with each other according to the studies conducted so far.

Conclusion

Given the findings of the present study, the long-term use of KT improves the fine and gross motor functions of the upper and lower limbs, sitting posture, and trunk balance while sitting, standing, or walking in children with spastic CP.

This result could be effective in decision-making of therapists to use the KT technique in rehabilitating children with spastic CP.

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Authors' Contribution

Bahareh Ziaei: Study design and ideation, supportive, executive, and scientific study services, providing study equipment and samples, data collection, analysis and interpretation of results, manuscript preparation, specialized manuscript evaluation in terms of scientific concepts, confirmation of the final manuscript to be submitted to the journal office, responsibility for maintaining the integrity of the study process from the beginning to publication, and responding to the referees' comments; Reza Azizi-Malamiri: Study design and ideation, supportive, executive, and scientific study services, providing study equipment and samples, data collection, analysis and interpretation of results, manuscript preparation, specialized manuscript evaluation in terms of scientific concepts, confirmation of the final manuscript to be submitted to the journal office, responsibility for maintaining the integrity of the study process from the beginning to publication, and responding to the referees' comments; Gholamhosein Nassadj: Study design and ideation, attracting financial resources for the study, supportive, executive, and scientific study services, providing study equipment and samples, data collection, analysis and interpretation of results, manuscript preparation, specialized manuscript evaluation in terms of scientific concepts, confirmation of the final manuscript to be submitted to the journal office, responsibility for maintaining the integrity of the study process from the beginning to publication, and responding to the referees' comments.

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Conflict of Interest

The authors declare no conflicts of interest. Dr. Gholamhosein Nassadj attracted the budget for basic studies related to this article from Ahvaz Jundishapur University of Medical Sciences and has been working as an assistant professor of physiotherapy at this university since 2012. Bahareh Ziaei has been a graduate student of physiotherapy at the School of Rehabilitation, Ahvaz Jundishapur University of Medical Sciences since 2017. Dr. Reza Azizi-Malamiri has been working as an assistant professor of pediatric neurology at Department of Pediatrics, School of Medicine, Golestan Hospital, Ahvaz Jundishapur University of Medical Sciences since 2005.

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