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The Effect of Kinesiotaping in Improving Fine Motor Skills In Children With Spastic Diplegic Cerebral Palsy

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Abstract
Background: *The purpose of this study was to examine the effect of application of Kinesiotape over the forearm from lateral epicondyle of elbow to the tip of fingers, over the muscles belly of extensor muscles along with conventional occupational therapy to improve hand functions of children with cerebral palsy, which in turn can affect their functional performance and can effectively explore the environment with their hands.*
Objective*: To find out the effect of kinesiotaping over the forearm muscular along with conventional occupational therapy, in improving fine motor function of children with Spastic diplegic cerebral palsy.*
Study Design: *Pre Test and Post Test experimental study design.*
Method: *60 Spastic diplegic cerebral palsy children who were fulfilling the inclusion criteria were selected by convenient sampling from Occupational Therapy unit of Sir Sunderlal Hospital Banaras Hindu University, Varanasi, India. A written informed consent was obtained from the guardians and ethical permission was taken from the institute. Manual Ability Classification System (MACS) & Peabody development of motor skills (PDMS) was used as instruments for measuring improvement in fine motor skills of these children .Therapy for both groups was given for 1 hour per session. In the experimental group along with conventional occupational therapy, kinesiotape was applied over the extensor muscles from lateral epicondlye of elbow to the tip of all the fingers. KT of 5 cm width was applied in the form of "fan technique". The bands were applied for three days and then removed leaving the skin free for 24 hours, and then KT was applied again. While in the control group, children were exposed to 1 hour of conventional occupational therapy without kinesiotape.*
Results: *Results of Wilcoxon signed rank test of PDMS are significant for experimental group and control group with P value of 0.004& 0.014 respectively with confidential interval value set at 0.05. There is significance of results of Wilcoxan signed rank test of Manual Ability Classification System (MACS) in experimental and control group. The P value for experimental group is 0.025 and for control group is 0.005 with confidential interval value set at 0.05, which shows that results were significant for experimental group as well as control group. Also the results of Mann Whitney U test show that Z value of PDMS is more i.e.-3.507 making it more sensitive to capture changes in fine motor functions of children than MACS with Z value of -3.905 with P of 0.002 &0.001 with confidential interval value set at 0.05 .*
Conclusion*: It can be concluded that application of kinesiotape along with conventional occupational therapy can be used to enhance & improve fine motor skills in children with Spastic diplegic cerebral palsy; so that they can have the more functional independence, and can successfully meet the demands of everyday life.*
Key Words: *kinesiotape, fine motor skills, occupational therapy, Spastic diplegic cerebral palsy.*

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I. Introduction

Cerebral palsy (CP) is the most common cause of physical disability in childhood. It is a neurodevelopment disorder caused by non-progressive lesion(s) in the immature brain implying spasticity, muscle weakness, decreased selective motor control and secondary musculo-skeletal problems usually accompanied also by sensory and cognitive impairments (Bax M et al 2005). One of the most common clinical types of cerebral palsy is spastic diplegia in which there is sensory motor impairment in the lower extremities more than in the upper ones as well as significant weakness in their trunk musculature .The upper limb is usually more severely involved than lower one. This limits reaching, grasping and object manipulation, interfering also with exploration, play, self-care and other activities of daily living (Tong-Wai R et al.2006). Effective use of hand function for daily activities is dependent on complex interaction between fine motor

functions and tactile, proprioceptive, and visual information/perception for accuracy (Sophie Levit et al 2004). Effective use of hand function for daily activities is dependent on complex interaction between fine motor functions and tactile, proprioceptive, and visual information/perception for accuracy. Wrist muscles strongly influence digital functions for skilled movements. Fundamental prerequisites essential for this are (a) capacity for independent control over fingers, (b) a sophisticated somatosensory system to guide finger movements, and (c) the ability to transform (Henderson A, Pehoski C 2006). Because of lesions in the sensory motor cortex and corticospinal tract (both play key roles in precision grips and individual finger movements), primitive and autonomic movements become more apparent. The lesions lead to abnormal reflexive tone, abnormal movements (loss of motor control, co-contraction, reciprocal inhibition, and delayed motor unit activity termination) and restriction in range of motion, resulting in dysfunctions of fine motor skills in children with CP. (Henderson A et al 2006 and Stamer M 1996). To facilitate development of fine motor skills in children with CP, there are many therapeutic approaches (e.g., constrained induced movement therapy, neuro developmental treatment, sensory integration, goal-directed training, and hand-arm bimanual therapy)and kinesiotaping or proprioceptive Neuromuscular Taping (Patel DR 2005 and Yasukawa A et al 2006). It assists muscle excitability by stimulating cutaneous receptors and mechanoreceptors (Simsek T et al 2011 Kase K et al 2003, 13 Cepeda JP et al 2008). Over the last 5 years , proprioceptive Neuromuscular Taping (NMT) technique has become a mainstream treatment protocol in post-operative, oncological, neurological care of patients and in sports medicine (Costantino C et al 2012).This innovative taping application is based on eccentric stimulation of the skin, muscle tissue, tendons, neurological vessels, lymphatic and vascular pathways improving their functioning. NMT provides passive stretching through the application of a tape with eccentrical properties encouraging Kinesio Taping method which was first described by Dr. Kenzo Kasein 1996 (Kase Ket 1996)as it can be used to increase sensory stimulation, strengthen the weak muscles, inhibit spastic muscles, increase joint stability, increase functional motor skills, help with postural control and improve functional independence in pediatric rehabilitation clinics in addition to other therapeutic techniques (Kase K, Martin P, Yasukawa A 2006).KT according to its inventor (Kase Ket 1996), is said to inhibit muscle tone if it is applied distally to proximally, whereas application in the opposite direction is used to facilitate a weak muscle .The aim of this study was to assess if kinesio taping (KT) could be effectively applied to the forearm of children with spastic diplegic Cerebral Palsy. The authors' hypothesis was that occupational therapy could be more effective if associated to KT.

II. Methodology

60 children with medical diagnosis of spastic diplegic cerebral palsy were enrolled in this study. The Ethical Committee of university approved our protocol .Children excluded from the study were those on Botox therapy (within the past 6 months) or muscle relaxants, those with active seizure disorders, those who had undergone any surgery for the upper limb, and those having allergic reaction to Kinesiotape. In all the subjects, wrist and finger flexor muscles spasticity was lower than 2 on the Modified Ashworth Scale and passive wrist extensions were a minimum of 30 degrees, with preserved ability to actively open the hand irrespective of the wrist position. The study purpose and test procedure were elaborately explained to the parents/guardians, after which written informed assent was obtained for their child's participation. A patch test with the Kinesio tape was performed on the dorsum of the hand (to confirm or rule out subject's allergy to Kinesio tape).

Application of Kinesio tape

Tape application was performed in a quiet environment with each child's being positioned comfortably on the mother's lap. The skin was cleaned by Surgical Spirit 70% alcohol, and then Kinesio tape was applied over the the muscles belly of Extensor Carpi Radialis Brevis, Extensor Carpi Radialis longus, Extensor digitorum , Extensor carpi ulnaris, Extensor digiti minimi i.e. from the lateral epicondyle of the humerus to the dorsal aspect of the hand till the tip of fingers, using the "fanning" technique. The Kinesio tape was kept on the child's hand for 3 days. After 3 days KT was removed and area of application was left open for 24 hours. Then again it is applied for other 3 days. This sequence was carried for a month.

Pretest and Posttest scores were collected using Grasping, object manipulation and Visual-Motor Integration components of PDMS.

Ability to handle ADL tools was analyzes and scored according to the levels of MACS before applying kinesiotape and after a month of intervention.

Picture 1: Showing the pattern of kinesiotaping

III. Results

The Statistical Package for Social Sciences version 17.0 was used to analyze the data.

The level of significance was set at < 0.05; with a 95% confidence interval. Kinesio taping also facilitated a shift in the PDMS-2 Fine Motor (Grasping, object manipulation, Visual-Motor Integration and PDMS-2 Fine Motor Scale subtest) rating in children with CP. Descriptive characterstics is shown in Table 1 which describes that 60%of children were males and 40% were females. Age range Male 42 -72 and female 36-69 .And about the hand dominance Right 40%; n = 24, Left 60%; n = 36. Right 46.2%; n = 28 and Left 53.8%; n = 32.Table 2 shows the changes in **(**mean ± SD) in Peabody Developmental fine Motor Scale scores in pre tape removal and post tape removal conditions. Table 3: Changes in number of children in fine motor rating in Peabody Developmental Motor Scale system. Wilcoxon signed rank test for PDMS shows that significant results of experimental group and control group were obtained with (*P*=0.004; 95% CI: 5.34 to 10.67 and 95% CI: 4.16 to 7.89 respectively) and *Z*=-2.877 & *Z*=2.449 respectively with the level of significance set at *P*≤ 0.05 in table 4. The results of wilcoxon signed rank test shown in table 5 for MACS (*P*=0.025; 95% CI: 8.98 to 11.12 for experimental group and *P*=0.005; 95% CI: 8.09 to 9.54 for control group) shows that findings were more significant for experimental group as compared to control group with *Z*= -2.236 & *Z*= -2.810 respectively with level of significance set at *P*≤0.05. Results of Mann Whitney U test shown in table 6 *Z*= -3.507 for PDMS making it more sensitive to capture changes in balances in children as compared to MACS with *Z* =-3.905 and *P*=0.002; 95% CI:4.14 to 9.00 and *P*=0.001; 95% CI: 7.56 to 9.70 respectively with level of significance set at *P*≤0.05.

Table 1: Demographic detail of children with Cerebral Palsy.

Age range of children with cerebral palsy included in study: 36 to 72 months and (mean ± standard) (58.69 ± 10.05)

Gender	Male female	60%(35) 40%(25)
Age range	Male female	42 -72 months 36-69 months
Dominance	Right Left	40%; n = 24 60%; n = 36
Involved hand	Right Left	46.2%; n = 28 53.8%; n = 32

Table 2: Changes in (mean ± SD) of Peabody Developmental fine Motor Scale.

Outcome Measures	**Scores**	**Pre-tape application (mean ± SD)**	**Pre tape removal (mean ± SD)**	**Post tape removal (mean ± SD)**
Grasping subtest	Raw scores Percentile scores Age equivalent scores	38.03 ± 9.61 5.40 ± 10.17 22.03 ± 14.67	43.88 ± 7.21 20.01 ± 23.11 36.23 ± 16.57	44.19 ± 6.80 20.2 ± 22.98 36.73 ± 16.04
Object manipulation	Raw scores Percentile scores Age equivalent scores	88.50 ± 24.04 98.42 ± 22.86 99.03 ± 21.74	98.42 ± 22.86 7.91 ± 13.14 28.80 ± 11.03	99.03 ± 21.74 7.95 ± 13.12 28.92 ± 10.90
Visual-Motor	Raw scores Percentile	60.92 ± 11.49	71.84 ± 16.52	72.19 ± 16.22

Integration	scores Age equivalent scores	71.84 ± 16.52 72.19 ± 16.22	10.85 ± 17.41 60.92 ± 11.49	10.85 ± 17.41 55.04 ± 9.60
PDMS-2 Fine Motor Scale	Raw scores Percentile scores Age equivalent scores	51.90 ± 9.12 60.92 ± 11.49 2.89 ± 4.84	54.40 ± 9.66 71.84 ± 16.52 10.85 ± 17.41	55.04 ± 9.60 72.19 ± 16.22 10.85 ± 17.41

*P ≤ 0.05
**P ≤ 0.001

Table 3: Changes in number of children in fine motor rating in Peabody Developmental Motor Scale system.

No. Changes in fine motor rating	Grasping subtest	Object manipulation	Visual-Motor Integration	PDMS-2 Fine Motor Scale
Very poor	Pre KT 16 Post KT 9	Pre KT 8 Post KT 7	Pre KT 5 Post KT 3	Pre KT 9 Post KT 6
Poor	Pre KT 4 Post KT 3	Pre KT 3 Post KT 13	Pre KT 8 Post KT 6	Pre KT 4 Post KT 2
Below Average	Pre KT 5 Post KT 4	Pre KT 5 Post KT 3	Pre KT 7 Post KT 9	Pre KT 9 Post KT 10
Average	Pre KT 1 Post KT 9	Pre KT 9 Post KT 3	Pre KT 3 Post KT 6	Pre KT 4 Post KT 7
Above Average	Pre KT 4 Post KT 5	Pre KT 5 Post KT 4	Pre KT 7 Post KT 6	Pre KT 4 Post KT 5

*****KT is kinesiotape

Table 4: Results of Wilcoxon Signed Rank Test (PDMS)

Groups	***Z* (2 tailed)**	***P* (2 tailed)**	**95% Confidence Interval Value**	
			Lower Limit	***Upper Limit***
Experimental	-2.236	0.025	8.98	11.12
Control	-2.810	0.005	8.09	9.54

*For both the groups *P* value is significant

Table 5: Results of Wilcoxon Signed Rank Test (MACS)

Groups	***Z* (2 tailed)**	***P* (2 tailed)**	**95% Confidence Interval Value**	
			Lower Limit	***Upper Limit***
Experimental	-2.236	0.025	8.98	11.12
Control	-2.810	0.005	8.09	9.54

*For both the groups *P* value is significant.

Table 6: Results of Mann Whitney U tests (MACS AND PDMS)

Outcome Measures	***Z***	***P***	**95% Confidence Interval Value**	
			Lower Limit	**Upper Limit**
PRT	-3.507	0.002	4.14	9.00
PBS	-3.905	0.001	7.56	9.70

*For both the groups *P* value is significant

Table 7. Showing the number of children in different levels of MACS.

No. of Children In Levels of MACS	No. before KT	No. after KT
Level 1	9	5
Level 2	6	8
Level 3	5	10
Level 4	7	5
Level 5	3	2

Pre-tape application (mean ± SD) of MACS: 51.90 ± 9.12
Pre tape removal (mean ± SD) of MACS: 54.40 ± 9.66
Post tape removal (mean ± SD) of MACS: 55.04 ± 9.60

IV. Discussion

The results suggest that the Kinesio tape may improve fine motor skills in children with CP. The use of kinesiotape application as an adjunct to treatment may assist in the goal-oriented functional therapeutic strategies to improve hand functions in children

with CP.Kinesiotaping enhances the kinesthetic inputs and facilitates enhanced control in the forearm and wrist muscles to improve volitional control of the muscle and tendon movement during activities, thereby improving the grip control and manual ability in the hand, so improving fine motor hand function (Yasukawa A et al 2006),.We assume that extension of the tape over the dorsum of the wrist and hand might have enhanced carpal and metacarpal stability, which probably would have improved intrinsic muscle activity, hence facilitating better finger activities(Kase K et al 2003).Because the tape was retained for a month over the involved hands of children with CP, we assume that the anticipatory control due to the presence of the tape over the forearm and wrist muscles would have induced better muscular coordination and hence improved fine motor skills and hand functions. Because the kinesiotape was applied over the forearm muscles (extensors group) starting from their origin (lateral epicondyle of humerus) and extended up to the dorsum of the hand, covering the metacarpals and phalanges, we believe that such techniques would have provided improved stability. This would have facilitated clinically positive changes in the fine motor functions of hands. This comes in consistent with Hsu et al., who reported that neuromuscular tapping as an adjunct to the therapeutic procedures can improve strength, functional activities, proprioception, control and positioning. KT increases blood circulation in the taped area (Ogura1998; Oliveria 1999; Vorhies 1999; Wallis 1999; Kase 1994; Kase and Hashimoto 2005; Murray 2005), and this physiological change may affect the muscle and myofascia functions after the application of neuromuscular tapping helping the children to generate the necessary force required for the function. An additional theory is that neuromuscular tapping stimulates sensory receptors and cutaneous mechanoreceptors at the taped area. Cutaneous mechanoreceptors activate nerve impulses when mechanical loads create deformation. The activation of cutaneous mechanoreceptors by an adequate stimulus causes local depolarizations that trigger nerve impulses along the afferent fiber traveling toward the central nervous system (Garcia 2001; Goo 2001; Halseth et al. 2004; Maruko 1999; Mori 2001; Murray and Husk 2001; Ogura1998; Vorhies 1999; Wallis 1999; Kase et al. 2003). The application of KT may apply pressure to the skin or stretch the skin, and this external load may stimulate cutaneous mechanoreceptors causing physiological changes in the taped area. Studies previously conducted to determine the effects of neuromuscular tapping on cutaneous mechanoreceptors (Garcia 2001; Goo 2001; Halseth et al. 2004; Maruko 1999; Mori 2001; Murray and Husk 2001;Ogura 1998; Vorhies 1999; Wallis 1999) have reported that neuromuscular tapping on select muscles and joints may improved muscle excitability. There is no study in the literature investigating the use of neuromuscular tape application over the forearm, wrist and hand in improving fine motor functions among children with spastic diplegia.

V. Conclusion

It can be concluded that application of kinesiotape along with conventional occupational therapy can enhance & improve fine motor skills among children with spastic diplegic cerebral palsy, so that they can have the functional independence, to meet demands of everyday life.

References

[1]. Bax M Goldstein M, Rosenbaum P et al 2005. Executive Committee for the Definition of Cerebral Palsy. Proposed definition and classification of cerebral palsy. Dev Med Child Neurol; 47: 571 – 576].

[2]. Tong-Wai R, Webster R and Shevel M 2006: A clinical and etiologic profile of spastic diplegia.

[3]. Sophie Levit Treatment of Cerebral palsy and motor delay. 3rd ed. Oxford, UK: Blackwell Publishing Ltd; 2004. p. 1-10. Patel DR. Therapeutic intervention in cerebral palsy. Indian J Pediatr.

[4]. Henderson A, Pehoski C .Hand function in the child, foundation for remediation. 2nd ed. Philadelphia: Elsevier; 2006

[5]. Stamer M Posture and movement of the child with cerebral palsy. Therapy Skill Builders;A Psychological Corporation, Academic Court, San Antonio, Texas, USA. 1996. p. 10-15. The deficient fine motor skills in children with CP limit participation in daily activities.

[6]. Patel DR Therapeutic intervention in cerebral palsy. Indian J Pediatr. 2005;72:979-83. Eliasson AC, Forssberg H, Hung YC, Gordon A. Development of hand function and precision grip control in individual with cerebral palsy-13 year follow up study. Pediatrics.2006;118:1226-36.

[7]. Kinesio Tex taping (applied directly over the skin of involved extremities) is a therapeutic approach that facilitates fine motor skills in children with CP.10, Yasukawa A Patel P, Sisung C. Pilot study: investigating the effects of kinesio taping in an acute pediatric rehabilitation setting. Am J Occup Ther. 2006;60:104-10.

[8]. Simsek T, Turkucuoglu BT, Cokal N, Ustunbas G, Simsek IE. The effect of Kinesio taping on sitting posture, functional independence and gross motor function in children with CP,Disabil Rehab. 2011; 33:2058-63.

[9]. Wallis J, Kase T. Clinical therapeutic applications of the kinesio taping method. 2nded. Tokyo: Ken Ikai Co; 2003.12. of muscles back to the point of origin.Cepeda JP ,Fishweicher A, 11.Gleeson M, Greenwood, Carol Motyka-Miller. Does KinesioTaping of the abdominal muscles improve the supine-to-sit transition in children with hypo tonia? [Online]. 2008 [11 Nov 2011];[6 pages]. Available from: http://www.kinesiotaping.no/omoss/forskning/frontpage/kt_hypoton_barn.pdf 2005;72:979-83.

[10]. Filippo Camerota1, Manuela Galli2,3, Veronica Cimolin2, Claudia Celletti1, Andrea Ancillao3, David Blow4, &Giorgio Albertini 2013 .Neuromuscular taping for the upper limb in Cerebral Palsy: A case study in a patient with hemiplegia .Developmental Neurorehabilitation.

[11]. Costantino C ,Licari O, Granella F, Sghedoni S. Neuromuscular taping in multiple sclerosis: A pilot study. Acta Biomedica 2012;83(2):103–107.]

[12]. .Short-Term Effects of Kinesiotaping on Fine Motor Function in Children with Cerebral Palsy—A Quasi-Experimental Study Saraswati B. Chitaria,a Amitesh Narayan,a* Sailakshmi Ganesan,a & Niraj Biswasb a Department of Physiotherapy, Kasturba Medical College, Mangalore, India;bDepartment of Microbiology, Gujarat Medical Education and Research Society Medical College, Manipal University, Valsad, Gujarat, India. Critical Reviews™ in Physical and Rehabilitation Medicine, 27(1): 41–50 (2015)

[13]. Yasukawa A et al , Patel P, Sisung C. Pilot study: investigating the effects of kinesio taping in an acute pediatric rehabilitation setting. Am J Occup Ther. 2006; 60:104-10.

[14]. Kase K, Wallis J, Kase T. Clinical therapeutic applications of the kinesio taping method. 2nded. Tokyo: Ken Ikai Co; 2003.12. Simsek T, Turkucuoglu BT, Cokal N, Ustunbas G, Simsek IE. The effect of Kinesio taping on sitting posture, functional independence and gross motor function in children with CP,Disabil Rehab. 2011; 33:2058-63.

[15]. Miller C.M., Greenwood S., Michael Gleeson M., Nardone F. And Faigle K.: Kiensio Taping And Hypotonia. The International Organisation Of Physical Therapists In Paediatrics, Vol. 5, Pp. 10, 2010.

[16]. Ogura R (1998) Overuse syndrome for long-distance runners and taping [in Japanese]. 14th Annual Kinesio Taping International Symposium Review. 51–52.

[17]. Oliveria R (1999) Soft tissue injuries in sports people—The contribution of kinesiotaping [in Japanese]. 15th Annual Kinesio Taping International Symposium Review.13–23.

[18]. Vorhies, D (1999) Testimonial of a kinesiotape convert [in Japanese]. 15th Annual Kinesio Taping International Symposium Review. 122–123.

[19]. Wallis J (1999) Effects of kinesio taping on pain perception of athletes with patellofe pain syndrome A pilot study [in Japanese]. 15th Annual Kinesio Taping International Symposium Review. 44–46.

[20]. Kase K (1994) Illustrated Kinesio-Taping. 2nd ed. Tokyo, Japan: Ken'i-kai Information. 6–9, 73.

[21]. Kase K (2001) Until today from birth of Kinesio taping method [in Japanese]. Albuquerque,NM: KMS, LLC. 7–30.

[22]. Kase K, Hashimoto T (13 March 2005) Changes in the volume of peripheral blood flow by using kinesio tape. Available at http://kinesiotaping.com/content. asp?CustComKey =13776&CategoryKey=13777&pn=Page&DomName= kinesiotaping.com

[23]. Kase K, Hashimoto T, Okane T (1996) Kinesio taping perfect manual: Amazing taping therapy to eliminate pain and muscle disorders. Albuquerque, NM: KMS, LLC.

[24]. Kase K, Wallis J, Kase T (2003) Clinical Therapeutic Applications of the Kinesio Taping Method. Tokyo, Japan: Ken'i-kai Information.

[25]. Murray H (25 February 2005) Effects of kinesio taping on muscle strength after ACL-repair. Available at http://kinesiotaping.com/content.asp?CustComKey = 13776&CategoryKey=13785&pn=Page&DomName=kinesiotaping.com

[26]. Murray H, Husk L (2001) Effect of kinesio taping on proprioception in the ankle. Journal of Orthopedic Sports Physical Therapy 31: A-37.

[27]. Garcia D (2001) Kinesio taping for the sense of balance on knee [in Japanese]. 16th Annual Kinesio Taping International Symposium Review, 20–23.

[28]. Goo J (2001) A new step for treatment of ankle sprain [in Japanese]. 16th Annual Kinesio Taping International Symposium Review, 16–19.

[29]. Halseth T, McChesney JW, DeBeliso M, Vaughn R, Lien, J (2004) The effects of kinesio taping on proprioception at the ankle. Journal of Sports Science and Medicine 3: 1–7.

[30]. Maruko K (1999) Aqua therapy using kinesio taping of central cooperation disabled pediatrics [in Japanese]. 15th Annual Kinesio Taping International Symposium Review. 47–54, 70–73.

[31]. Mori S (2001) How Kinesio taping method can induce effectiveness for treatment of scapular arch [in Japanese]. 16th Annual Kinesio Taping International Symposium Review. 50–53.

[32]. Murray H (25 February 2005) Effects of kinesio taping on muscle strength after ACL-repair. Available at http://kinesiotaping.com/content.asp?CustComKey = 13776&CategoryKey=13785&pn=Page&DomName=kinesiotaping.com

[33]. Murray H, Husk L (2001) Effect of kinesio taping on proprioception in the ankle.

[34]. Journal of Orthopedic Sports Physical Therapy 31: A-37.

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