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Effects of kinesiology taping on swallowing functions in newborns with swallowing difficulties: a randomized controlled pilot study

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SUMMARY

OBJECTIVE: This study investigated the efficacy of kinesiology taping application in premature infants with dysphagia.

METHODS: A total of 60 premature newborns (born ≤37weeks' gestational age who reached the age ≥34 weeks of postmenstrual age) with sucking and swallowing problems were randomly assigned to the kinesiology taping group [n=31; 18 males, 13 females; mean postmenstrual age 35.4 weeks (SD 0.9 weeks, range 34–38 weeks)] or control group without kinesiology taping application [n=29; 16 males, 13 females; mean postmenstrual age age 35.6 weeks (SD 1.4 weeks, range 34–40 weeks)].

RESULTS: Kinesiology taping group yielded significant improvement in the oral reflexes ($p<0.001$) and in the sucking functions including tongue movement, sucking power, number of sucks and sucking pause, maintenance of alertness, jaw movement, tongue cupping, and maintenance of rhythm ($p<0.001$, $p=0.011$, $p=0.002$, and $p=0.001$, respectively). There was a significant difference in favor of the taping group with respect to the number of neonates whose feeding improved (26 (84%) vs. 7 (24%), $p<0.001$).

CONCLUSION: The results of this study show that kinesiology taping can be applied as a safe and effective method to improve feeding functions in premature infants with sucking and swallowing difficulties.

KEYWORDS: Kinesio tape. Premature infant. Dysphagia.

INTRODUCTION

Advances in perinatal care and technology have resulted in increased rates of premature newborns, and a greater number of infants are surviving with significant feeding problems[1]. Providing effective oral feeding for adequate growth and development is a prerequisite in the care of premature infants. The prevalence of feeding problems is two times more common in preterm infants compared with full-term infants, and the causes of feeding difficulties are multifactorial[2,3]. Neurosensory and neuromotor pathways organization, cognitive development, and social stimulation of preterm infants are poor; therefore, these infants are at increased risk for impaired sucking, swallowing, and breathing[1,4]. Sucking and swallowing difficulties in premature infants are related to poor nutritional intake, aspiration, and recurrent respiratory illness, requiring frequent hospitalization and increased gastrostomy needs and have a detrimental effect on growth and neurodevelopmental outcomes[5-7].

Kinesiology taping (KT) is widely used in musculoskeletal system, nervous system, sports, and pediatric rehabilitation to reduce pain, facilitate or inhibit muscle function, prevent injuries, improve stability to joints, and provide proprioceptive feedback[8-10]. KT has been shown to improve blood flow in microcirculation and activation of the cutaneous sensory system that provides stimulation to neuromuscular functions[10,11]. Previous studies have examined the effect of KT on pediatric rehabilitation in patients with congenital muscular torticollis and spastic cerebral palsy[12,13]. There is a paucity of data in the literature evaluating the effect of KT on swallowing difficulties. Park et al. demonstrated a new treatment method for dysphagia rehabilitation in adults using KT[14]. As discussed by Lin et al., there is only one case report worldwide that used the KT method on infants suffering from impaired sucking and swallowing[15].

To the best of our knowledge, no randomized control trial has been performed to show the effects of the KT method on infants with sucking and swallowing difficulties. The purpose of this study was to investigate the effects of applying KT for sucking and swallowing problems in premature infants.

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METHODS

Participants

This study was a single-blind randomized controlled study and was performed in the neonatal intensive care unit and neonatal service. A total of 76 premature infants (born ≤37 weeks' gestational age who reached the age ≥34 weeks of post-menstrual age (PMA)) with sucking and swallowing problems were enrolled in the study. The exclusion criteria were (1) the presence of congenital abnormalities and syndromes, (2) infants exposed to drugs and alcohol, (3) infants with central nervous system diseases, (4) infants with chromosomal abnormalities, (5) the presence of musculoskeletal system and skin disorders, (6) newborns who have cardiopulmonary disease affecting the sucking, swallowing, and breathing patterns such as bronchopulmonary dysplasia, and (7) infants whose parents refused to participate.

Ethics considerations

Ethical approval was obtained from the local ethics committee of the University of Health Sciences Turkey, Ankara City Hospital (E2-21-91). Parents were informed about the application of KT, and written informed consent was obtained from each guardian, which followed the ethical principles outlined in the Declaration of Helsinki.

Procedure

Of the 76 participants, 32 were randomized to the KT group and 32 to the control group without KT application as shown in the flowchart (Figure 1). One premature infant discontinued treatment in the KT group, and three premature neonates who required invasive respiratory support or had pneumonia discontinued in the control group. The kinesiology tape (Kinesio® Tex Gold Light Touch; 5 cm×5 m, United States) was applied by a certified physician. Three types of KT were prepared and attached based on Lin et al.: (1) two I-shaped tapes were used for taping on the upper orbicularis oris (3.3 cm long tape) and lower orbicularis oris (5 cm long tape) muscle with pulling force of about 15% to the bilateral corner of the mouth to facilitate lip closure; (2) the Y-shaped tape was attached from the symphysis of the mandible bone to the hyoid bone toward the sternum to improve the elevation of the hyoid bone by inhibiting the sternohyoid muscle and stimulating the mylohyoid muscle; and (3) the masseter muscle was facilitated with tape (separated into three ends under 15% pulling force, mild strength) anchored on the lower border of the zygomatic arch and elongated to the coronoid process of the mandible bone to improve the jaw movement and chewing activity[15]. After applying

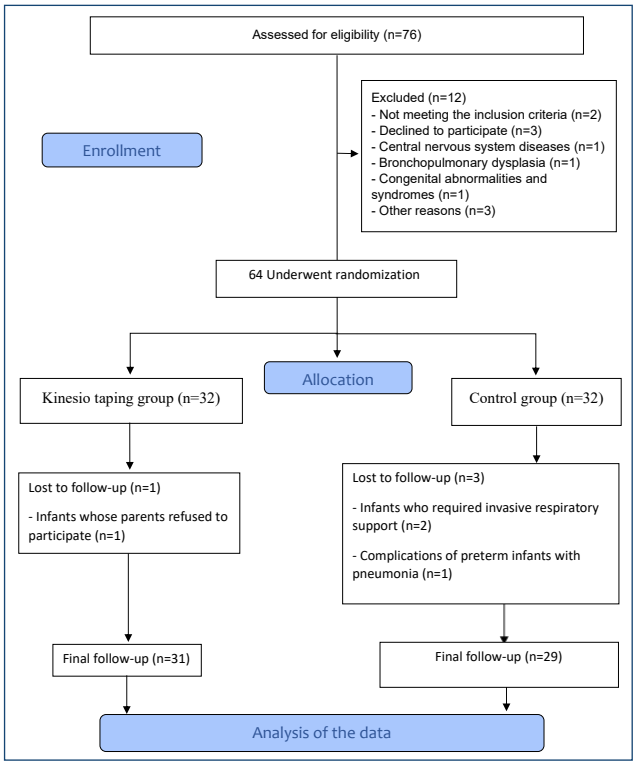

Figure 1. Flowchart of study subjects.

the KT, the tape remained on the skin for 24 h. At the end of 24 h, the tape was removed allowing infants to rest for 24 h. The tape was then applied again in the same way every 48 h. All participants received a total of five taping sessions with 1-day interval for 10 days. Sucking and swallowing functions (i.e., oral posture, oral reflex, sucking, and symptoms) were evaluated before and after the taping application of each session by two experienced speech-language therapists. Lips and tongue posture were assessed for oral posture function; rooting, sucking, and biting reflexes were evaluated for oral reflex; tongue and jaw movements, tongue cupping, sucking power, number of sucks, sucking pause, maintenance rhythm, and state of alertness were recorded for sucking function. Stress signs, accumulation of saliva, apnea, changes in skin color, hiccups, and crying were also noted during the evaluation[16].

Statistical analysis

All data analyses were performed with SPSS version 26.0 (IBM Corp., Armonk, New York, USA). Categorical variables are expressed as counts and percentages, and continuous variables are presented as mean±standard deviation or as median. Categorical variables were compared by the chi-square test or Fisher's exact tests as appropriate. The McNemar test was used to evaluate bivariate categorical data, and the marginal homogeneity test was used to evaluate trivariate categorical data between

two dependent groups. Kolmogorov-Smirnov tests were used to evaluate the distribution of variables. Comparisons of parametric values between the two groups were compared using the independent-samples t-test. A two-sided p-value of <0.05 was considered statistically significant.

RESULTS

The study included 60 premature neonates (n=60) (≥34 completed weeks' PMA) with sucking and swallowing difficulties randomized between the KT group (n=31; 18 males, 13 females; mean PMA 35.4 weeks [SD 0.9 weeks, range 34–38 weeks]) and the control group (n=29; 16 males, 13 females; mean PMA age 35.6 weeks [SD 1.4 weeks, range 34–40 weeks]) receiving usual care. The baseline general characteristics of the subjects are shown in Table 1. There was no statistically significant difference between the groups in terms of PMA, gender, method of delivery, number of pregnancies, birth weight, gestational age, blood groups, and initial milk-feeding amounts, indicating that the groups were well-matched.

After 10 days of KT application, a comparison of sucking and swallowing functions in the KT and control groups was done and the details are given in Table 2. Comparison results within the group after the intervention revealed that there were no significant differences in lip and tongue posture activity between the study groups (p>0.05). Similarly, no differences were observed in the infants' stress signs, apneic attacks, changes in skin color, crying, and hiccups. However, oral reflexes were assessed via rooting, sucking, and biting reflexes, with results showing better oral reflexes in the KT group compared with the control group (p<0.001). Also, after 10 days of application, the taping group showed a significant improvement in sucking behaviors including tongue movement, sucking power, number of sucks and sucking pause, maintenance of alertness, jaw movement, tongue cupping, and maintenance of rhythm (p<0.001, p=0.011, p=0.002, and p=0.001, respectively).

Table 1. Baseline characteristics of the participants.

	Control group (n=29)	KT group (n=31)	p-value
Gender			
Male	16 (55%)	18 (58%)	0.821
Female	13 (45%)	13 (42%)	
Method of delivery			
Vaginal	4 (14%)	4 (13%)	0.919
Cesarian section	25 (86%)	27 (87%)	
Number of pregnancies			
First pregnancy	17 (59%)	22 (71%)	0.411
Second pregnancy	11 (38%)	9 (29%)	
Third pregnancy	13 (%)	0	
Birth weight (g)	1,392±340	1,370±341	0.803
Gestational age (weeks)	29.9±1.5	29.8±1.6	0.732
Blood groups			
A Rh positive	19 (65%)	20 (64%)	0.939
A Rh negative	1 (3%)	1 (3%)	
B Rh positive	3 (10%)	2 (6%)	
B Rh negative	1 (3%)	1 (3%)	
O Rh positive	2 (7%)	5 (16%)	
O Rh negative	1 (3%)	1 (3%)	
AB Rh positive	2 (7%)	1 (3%)	
Postmenstrual age at the start of assessment	35.6±1.4	35.4±0.9	0.513
Milk feeding every 2–3 h (oral, mL)	8.2±5.0	9.3±4.0	0.377
Milk feeding every 2–3 h (orogastric, mL)	20.5±7.8	17.6±4.2	0.080

Table 2. Comparison of the results between the kinesio taping and control groups.

	KT group (n=31)	Control group (n=29)	p-value
Evaluation of oral reflex			
Rooting			<0.001
Weak	4 (13%)	22 (76%)	
Present	27 (87%)	7 (24%)	
Sucking			<0.001
Weak	6 (19%)	23 (79%)	
Present	25 (81%)	6 (21%)	
Biting			<0.001
Weak	6 (19%)	17 (59%)	
Present	25 (81%)	12 (41%)	
Sucking function			
Tongue movement			<0.001
Decreased	3 (10%)	22 (76%)	
Adequate	28 (90%)	7 (24%)	
Tongue cupping			0.002
Absent-decreased	8 (26%)	19 (65%)	
Adequate	23 (74%)	10 (35%)	
Jaw movement			0.011
Decreased	8 (26%)	17 (59%)	
Adequate	23 (74%)	12 (41%)	
Sucking power			<0.001
Weak	6 (19%)	22 (76%)	
Strong	25 (81%)	7 (24%)	
Number of sucks and sucking pause			<0.001
<5	2 (6%)	14 (48%)	
5–8	9 (29%)	8 (27%)	
>8	20 (65%)	7 (25%)	
Number of infants whose feeding improved at the end of 10 days	26 (84%)	7 (24%)	<0.001

We evaluated nutritional status by controlling the amount of milk feeding and the infant's dependency on tube feeding in these infants before and after KT application. As a result of the comparison between groups from baseline to 10 days, the KT group showed significant differences in oral feeding and the number of infants whose nutritional status improved was higher in the taping group (26 (84%) vs. 7 (24%), p<0.001).

DISCUSSION

This study is the first single-randomized controlled trial focusing on the effects of KT application in premature infants with sucking and swallowing difficulties. We showed that taping improved the sucking and swallowing performance of premature newborns.

With the development of neonatal intensive care practices, higher rates of survival of premature infants are seen; however, prematurity has led to risk for adverse neurodevelopmental outcomes like feeding difficulty by mouth[1,17]. The pathophysiology of dysphagia in preterm infants is multifactorial and most likely the consequence of neuromotor and neurophysiological dysfunctions such as delayed or not efficient reflexes, hypotonia, poor suck-pharyngeal coordination, and generalized lack of coordination[4,6]. For efficient and safe nourishment,

premature infants need to properly provide coordination of breathing with sucking and swallowing and the interaction of lips, jaw, tongue, palate, pharynx, larynx, and oesophagus[4,18]. Preterm infants with sucking and swallowing problems are at increased risk for prolonged hospitalization, parenteral nutrition, supplemental oxygen, and aspiration pneumonia, with detrimental effects on postnatal growth and dietary intake[1,6,7].

To date, several studies have shown that KT is an effective method in musculoskeletal system, nervous system, sports, pediatric rehabilitation, and various other disorders[8-10]. For example, this technique was performed to investigate the immediate effect of KT on the muscular imbalance in the lateral flexors of the neck for infants with congenital muscular torticollis in pediatric rehabilitation. Likewise, Kaya et al. also demonstrated that KT could increase proprioceptive feedback and improve gross motor function in children with unilateral spastic cerebral palsy[13]. However, few published studies are available with KT that show the use of the KT method for dysphagia. Recently, Jung et al. suggested that taping may promote oropharyngeal muscle thickness and could be a potentially therapeutic clinical exercise for stroke patients with dysphagia[19]. It has also been reported that KT application pulls the hyoid bone and larynx downward which improves activation of the suprahyoid muscle during swallowing in adults with dysphagia rehabilitation[14]. One recent publication indicated the effectiveness of KT method in drooling and speech intelligibility in children with oral dysphagia[20]. Additionally, another recent case report demonstrated the effect of KT on premature infants with sucking and swallowing difficulties[15].

The act of feeding and swallowing consists of four phases, namely, oral phase, triggering of the swallowing reflex, pharyngeal phase, and esophageal phase[21]. The suprahyoid muscle, consisting of the geniohyoid, mylohyoid, digastric, and stylohyoid muscles, plays a critical role in swallowing function in the pharyngeal phase[22]. The taping facilitates muscle activation and is related to increased motor unit activation that reflects an increase in the strength of the muscle[23,24]. As such, it has been suggested that KT induces muscle activation by adding load to the suprahyoid muscles during swallowing for patients with dysphagia[14].

Lin et al. indicated that KT could easily attach to the skeletal muscles to induce the orbicularis oris muscle for lip closure, the masseter muscle for jaw movement and chewing activity, and the mylohyoid muscle for hyoid bone elevation and inhibit the sternohyoid muscle activity for better sucking and swallowing functions[15]. Likewise, our results confirmed the influence of taping on sucking and swallowing difficulties in premature infants. We agree with Lin et al. on the possible underlying mechanism of using KT in the improvement of sucking and swallowing functions via muscle facilitation and inhibition[15].

The results of our study should be assessed with some limitations. First, this is a single-center study with a relatively small sample size. Second, we could not use a video fluoroscopic swallow study or a fiberoptic endoscopic evaluation for detecting dysphagia, which is more reliable compared with clinical examination alone. Therefore, further prospective and randomized clinical trials are required to assess the effectiveness of the KT method.

CONCLUSION

This is the first randomized controlled study using the KT method in dysphagia rehabilitation in premature infants and demonstrated that KT resulted in improvement in sucking and swallowing functions. The taping is a simple, inexpensive, and less traumatic method that may be valuable in the rehabilitation of dysphagia for premature newborns.

AUTHORS' CONTRIBUTIONS

TÖÇ: Conceptualization, Data curation, Investigation, Methodology, Writing – original draft. **PB:** Conceptualization, Formal Analysis, Investigation, Writing – review & editing. **CT:** Data curation, Resources, Writing – review & editing. **MK:** Conceptualization, Software, Writing – review & editing. **FÇ:** Conceptualization, Software. **EY:** Resources, Writing – review & editing.

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