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Preliminary Application of Kinesio Taping in Rehabilitation Treatment of Temporomandibular Disorders

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Abstract

Background: Temporomandibular disorder (TMD) is a frequently occurring and common oral and maxillofacial disease with relevant clinical issues (such as pain, clicking sound, and difficulty in opening the mouth). Kinesio taping (KT) is a typical soft tissue taping technique that plays a role in relieving pain, relaxing muscles, and increasing proprioception.
Objectives: The study aimed to investigate the function of the KT technique in the rehabilitation of TMD.
Methods: In this prospective study, 60 TMD patients (group I disorders, muscle disorders) were recruited from the outpatients of the Department of Rehabilitation Medicine of Shanghai First People's Hospital, China, between June 2016 and September 2016 based on the inclusion/exclusion criteria. They were randomly divided into the control, short wave, and taping groups using a random number table, with 20 cases in each group. Different rehabilitation methods were applied according to the grouping. The course of treatment was six days. The estimations of the Fricton craniomandibular index (CMI), Self-Rating Anxiety scale (SAS), and Self-Rating Depression scale (SDS) were conducted in pretherapy and post-treatment by a physician who was blinded to the patients' groups.
Results: No significant differences were observed between patients in the three groups ($P > 0.05$) in pretherapy in the temporomandibular joint dysfunction index (DI), muscle palpation index (PI), CMI, SAS, and SDS. In post-treatment, the CMI in the short wave and taping groups was significantly improved compared to the control group ($P < 0.05$). The SAS in the taping group improved significantly compared to the control and short wave groups ($P < 0.05$). The SDS in the short wave group improved significantly compared to the control and taping groups ($P < 0.05$).
Conclusions: Taken together, KT effectively improved the dysfunction and mood of TMD patients with the group I disorders, thereby necessitating further investigation for widespread application.

Keywords: Temporomandibular Disorders, Rehabilitation Treatment, Kinesio Taping, Dysfunction, Mood

1. Background

Temporomandibular disorder (TMD) is a frequently occurring and common oral and maxillofacial disease in the general population (1). It is a broad terminology for a group of diseases that involve the temporomandibular joint (TMJ) and/or the masticatory muscle system and yield relevant clinical issues (such as pain, clicking sound, and difficulty in opening the mouth) (2). A sampling survey showed that approximately 33% of the population experienced facial pain and other subjective symptoms and approximately 5% needed medical intervention (3, 4). A survey (5) of adolescents in Germany and China showed a significant difference in the TMD incidence in different races (Asian and European). The diagnostic rate of group II disorders (disc displacements) was higher in Germany, whereas group I and III disorders were higher in China (6).

The goals of TMD treatment are to relieve pain, restore function, and improve the patient's quality of life. In 2010, the American Association for Dental Research (AADR) published a new report on TMD diagnosis and treatment strategies (7), stating that unless there is a clear and reasonable indication, conservative therapy should be the first line of TMD treatment. In recent years, China has also gradually unified the TMD treatment concept (8): only when all reversible non-surgical treatments have failed, various irreversible treatments will be considered. The conservative treatments for TMD include health education, drug therapy, and physical therapy.

The soft tissue taping technique is a treatment that applies the tape to the skin according to the characteristics of

the muscle and the joint to protect the muscle and bones and improve the motor function. Kinesio taping (KT) (9) is a typical example of this technique; it plays a role in relieving pain, relaxing muscles, and increasing proprioception (10-15). In addition, the technique has significant efficacy in the rehabilitation treatment of various soft tissue disorders. In TMD patients, physical and other therapies often present acceptable outcomes; however, there are still issues such as varied length of the recovery cycle, poor compliance, and relapse. The TMD allows three groups of diagnoses: group I (muscle disorders), group II (joint disk displacements), and group III (other joint conditions). On a daily basis, most TMD patients are diagnosed as the group I muscular disorder based on the main symptoms such as pain and limitation of movement, which are the typical type 2 soft-tissue injuries. Thus, whether KT can be used to treat the patients with the group I muscular disorder is yet to be determined.

2. Objectives

Therefore, the present study aimed to evaluate the effect of KT on the treatment of TMD patients with the group I disorders.

3. Methods

3.1. Study Subjects

The study subjects were recruited from the outpatients of the Department of Rehabilitation Medicine of Shanghai First People's Hospital, China, between June 2016 and September 2016. These patients were previously diagnosed as unilateral TMD by the Dental Department. The inclusion criteria were as follows: (1) group I (muscle disorders) of axis I diagnostic criteria for TMDs (RDC/TMD, research diagnostic criteria for TMDs) was fulfilled, including myofascial pain and that accompanied by the limitation of mouth opening. All patients presented varying degrees of mandibular joint movement disorders or muscle pain around the joints, as well as limitation of mouth opening; however, there were no joint clicking and friction sounds and the organic disease of the joint structure was excluded by the X-ray examination; (2) no systematic conservative treatment was administered before this treatment; (3) satisfactory compliance was achieved. The patients were able to understand the treatment and voluntarily participate in the study; (4) the patients were aged between 18 and 55 years. The exclusion criteria were as follows: (1) the patients could not be contacted or were unable to cooperate in the study; (2) patients with cognitive dysfunction or mental disorders or administered with antipsychotic drugs; (3) patients with a history of TMJ injury, surgery or rheumatism, and other systematic diseases.

Eventually, based on the inclusion and exclusion criteria, 60 patients (28 males and 32 females) were selected among 78 admitted patients, and the duration of the disease was 3 - 30 days. According to the random number table, all patients were randomly divided into the control group, short wave treatment group (short wave group), or KT group (taping group), with 20 cases in each group. This prospective study was approved by the Medical Ethics Committee of Local Hospital (ethical approval number: 2017-47). The clinical registration number of this trial was ChiCTR1900025729. All patients were informed of the treatment details and signed consent forms were obtained.

The demographic information of the patients is shown in Appendix 1 in Supplementary File. The control group comprised of nine male and 11 female patients aged between 18 and 50 years, with an average age of 35.10 $\pm$ 1.923 years and disease duration of 3 - 21 days. The short wave group comprised of 11 male and nine female patients aged between 21 and 55 years, with an average age of 36.75 $\pm$ 2.045 years and disease duration of 5 - 30 days. The taping group comprised of eight male and 12 female patients aged 22 - 48 years, with an average age of 35.65 $\pm$ 2.003 years and disease duration of 4 - 28 days. There are no significant differences in the characteristics of patients in the three groups, such as gender, age, and disease duration ($P > 0.05$).

3.2. Research Methods

The final 60 TMD patients were administered with different rehabilitation intervention methods according to their grouping. The control group was provided with routine health education only; the short wave group was administered with short wave treatment in addition to routine health education; whereas, the taping group received the KT treatment on the basis of routine health education.

Routine Health Education: Each patient was given health instructions at the time of admission. They were requested to avoid excessive opening the mouth (for example, laughing out loud and yawning), chewing on very hard food, head, and face oppression or catching a cold, and exhaustive physical labor. The patients could use a warm compress at home when appropriate.

Short Wave Treatment: Based on previous experience during treatment, we used an SW-180 continuous and pulsed shortwave diathermy unit by ITO Co., Ltd. (Tokyo, Japan) with 70 mm condenser electrodes. The continuous shortwave diathermy was performed under the condenser mode with an output of 30 W for 20 min, one time/day for

six days. Two condenser electrodes were placed at the affected side of TMJ. A distance of 1 cm was maintained between the skin and the electrode; a pulse (variable peak) mode was used.

KT Treatment: The taping method included "relieving pain" and "relaxing the masseter muscle" (16, 17). (1) For pain relief, an "X"-shaped tape (natural tension) was used. A position of voluntarily opening the mouth to the maximum angle was assumed and the tape was cut in half (approximately 2.5 cm width). The middle "anchor" was fixed at the TMJ (the common pain site of TMD) formed by the condyle and the glenoid fossa of the temporal bone, and the "tails" extended to both sides; (2) to relax the masseter muscle, a "Y"-shaped tape (natural tension) was used. The tape was cut in half (approximately 2.5 cm width), the starting point "anchor" was fixed to the mandible, and the "tails" extended along the masseter muscles on both sides of the cheekbones. Taping was performed by the doctor on every alternate day and the tape was retained on the body for 48 h, for a total of three taping times.

3.3. Assessment Methods

One rehabilitation assessment was revealed by a physician who was blinded to the patients' groups both pretherapy and post-treatment. The evaluation content included the Fricton craniomandibular index (CMI), Self-Rating Anxiety scale (SAS), and Self-Rating Depression scale (SDS). By comparing the evaluation results, the effect of KT on TMD treatment was further investigated.

As a specific assessment scale for TMD, the Fricton CMI is widely used with a satisfactory outcome. The greater the value, the worse the condition. The Fricton CMI (18) includes the dysfunction index (DI) and the muscle palpation index (PI) of TMJ. The average of DI and PI is the Fricton CMI. The examined parameters included the four aspects including mandible movement (MM) (16 items), joint noise (JN) (four items), joint palpation (JP) (six items), and muscle palpation (MP) of the masticatory and related muscles (28 items). Every positive sign for each item was recorded as one point. We used the following: DI = (MM JN + JP)/26, PI = MP/28, and CMI = (DI + PI)/2. As an objective quantitative assessment method for the evaluation of TMJ functional condition, the reliability and validity of the Fricton CMI were tested, showing that it can be used in clinical practice to compare the results of treatments (19, 20).

The symptoms of a large number of TMD patients become chronic and recurrent, thereby significantly affecting their mental state and social activities. Several studies (21, 22) have reported that TMD is closely correlated with anxiety, depression, and other psychological states. In the present study, SAS and SDS were used for assessing the psychological conditions of patients (23). Both SAS and SDS are composed of 20 entries and use four-level scoring; they are widely applicable indices mainly used for assessing the degree of adult anxiety, depression symptoms, and changes in the treatment (24). The cutoff value of China's SAS standard is 50 points; points 50 - 59 indicate a tendency of mild anxiety. The normal upper limit of China's SDS standard score is 53 points; points 53 - 62 indicate a tendency to mild depression.

3.4. Statistical Analysis

We used SPSS 17.0 software (version 17.0, SPSS Inc., Chicago, USA) for statistical analysis. The numerical count data are represented as $\bar{x} \pm$ SEM. To analyze the data, we used the χ^2 test for proportions' equality. Log transformation was used for non-normal data. The comparison between different groups during the same period was made by one-way ANOVA and the comparison between pretherapy and post-treatment within groups was made using the paired sample *t*-test. We defined $P < 0.05$ as a significant difference. The power for the primary outcome (CMI) was calculated by ANOVA-multiple comparisons with a significance level of 5% ($\alpha = 0.05$). The null hypothesis (H0) for each group was equal (0.30), and the alternative hypotheses (H1) were 0.32, 0.24, and 0.26 for the taping group, short wave group, and control group, respectively. The standard deviation for each group was 0.05. With a sample size of 18 (n = 18) for each group, the trial would have more than 80% power to detect a difference between three groups on their function in the rehabilitation of TMD.

4. Results

The schematic representation of the study is shown in Figure 1. A total of 60 patients were enrolled in this study. Before the treatment, DI, PI, CMI, SAS, and SDS of the patients had no significant differences between the three groups ($P > 0.05$). After treatment, the values of DI, PI, CMI, SAS, and SDS significantly reduced in the short wave and taping groups compared to pretherapy ($P < 0.05$). After health education, the various scores of the control group were also improved although the difference was not statistically significant. The scores of Fricton CMI in the short wave and taping groups were similar after treatment; however, there was a significant improvement when compared to that of the control group ($P < 0.05$). With respect to the aspect of anxious mood (SAS), the improvement in the taping group was more significant than that of the control and short wave groups ($P < 0.05$ and $P < 0.05$). In terms of depressed mood (SDS), the improvement in the short wave group was more significant than that of the control and taping groups ($P < 0.05$ and $P < 0.05$, respectively) (Tables 1 and 2).

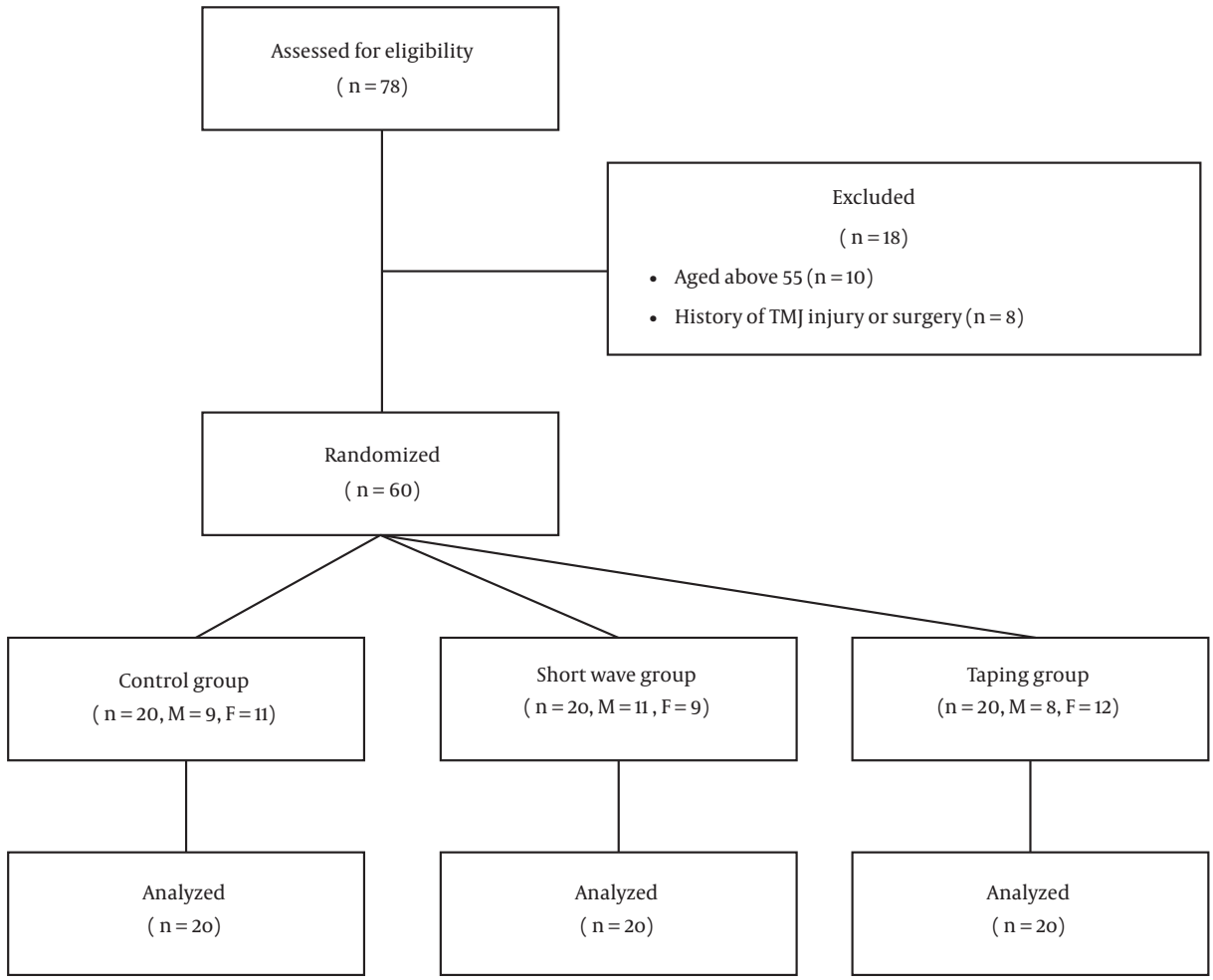

Figure 1. Schematic design of the study

Table 1. Comparison of the Fricton Index of Patients in Three Groups Before and After Treatment[a]

	DI		PI		CMI	
	Before Treatment	After Treatment	Before Treatment	After Treatment	Before Treatment	After Treatment
Control group	0.38 ± 0.01	0.37 ± 0.01	0.28 ± 0.03	0.27 ± 0.03	0.33 ± 0.01	0.32 ± 0.01
Short wave group	0.36 ± 0.02	0.34 ± 0.02[b]	0.26 ± 0.03	0.13 ± 0.02[b, c]	0.31 ± 0.02	0.24 ± 0.01[b,c]
Taping group	0.38 ± 0.01	0.30 ± 0.01[b,c,d]	0.26 ± 0.03	0.21 ± 0.03[b,d]	0.32 ± 0.01	0.26 ± 0.01[b,c]

[a] Values are expressed as mean ± SD.
[b] Compared to the pre-treatment in the same group, P < 0.05.
[c] Compared to the control group, P < 0.05.
[d] Compared to the short wave group, P < 0.05.

5. Discussion

After one course of treatment, the Fricton CMI, SAS, and SDS indicators in the short wave and taping groups were significantly improved compared to pretherapy (P < 0.05), thereby indicating that both short wave and KT were effective methods for conservative treatment.

For CMI, the outcome of both short wave and KT groups was significantly improved after treatment. However, the PI outcome of the short wave group was better than that of the taping group; whereas the DI of the taping group

Table 2. Comparison of SAS and SDS Values of Patients in Three Groups Before and After Treatment[a]

	SAS		SDS	
	Before Treatment	After Treatment	Before Treatment	After Treatment
Control group	53.70 ± 3.04	52.20 ± 3.16	63.85 ± 2.66	62.85 ± 2.54
Short wave group	55.20 ± 3.28	46.35 ± 3.00[b]	60.55 ± 2.61	52.25 ± 2.39[b, c]
Taping group	54.75 ± 2.83	38.35 ± 2.14[b, c, d]	62.65 ± 2.20	59.75 ± 1.77[b, d]

[a]Values are expressed as mean ± SD.
[b]Compared to the pre-treatment in the same group, $P < 0.05$.
[c]Compared to the control group, $P < 0.05$.
[d]Compared to the short wave group, $P < 0.05$.

was better than that of the short wave group. Dysfunction index mainly includes MM, JN, and JP (three items). In addition, the external JN symptoms had been excluded when the patients with the group I disorders were enrolled. Moreover, the patients with the group I disorders rarely had JP. Therefore, the scale of DI mainly depended on MM while the PI scale was according to the MP of the masticatory and the related muscles. Therefore, the short wave treatment had a better relieving effect on MP, while the taping group had a better improving effect on MM. Similarly, Wang et al. (25) found that TMJ function was better when DI and CMI values were significantly lower. Therefore, both KT and short wave could improve the function of TMJ for the treatment of TMD.

Compared to the general population, most TMD patients have different degrees of anxiety, depression, and somatization, as well as other symptoms (26, 27). A previous study (28) showed that among TMD patients with muscle pain, the proportions of patients with moderate and high degrees of sleep disorders, anxiety, or depression were as high as 15.6%, 62.5%, and 31.3%, respectively. Patients with muscle pain presented severe pain, prolonged disease, severe mental stress, and psychological burden (29). In the present study, the pre-treatment anxiety and depression levels of the patients in each group were similar; however, the SAS scale of both short wave and taping groups was significantly reduced after treatment, indicating the taping group had better outcomes, which might be due to the ever-present tape on the face of this group of patients. The tape can be retained on the skin of the patient for 48 h when taping treatment was performed each time. Therefore, although the patient visits the hospital every alternate day, the therapeutic effect of the taping is continuous and the patient's feeling of being treated is not ceased. However, for the short wave group, although the patients visited the hospital every day, the treatment time was only 20 min. Perhaps, some patients' feeling of "being treated" was not as strong as that of the taping group. The SDS scales in the short wave and taping groups were also significantly reduced after the treatment in this study. The psychological factors are correlated with the occurrence and development of TMD (30). The neurotransmitters, norepinephrine and 5-hydroxytryptamine, are highly related to depressed mood and closely related to the valve mechanism of pain; thus, depression might be the cause of pain, as well as the result of pain. Therefore, patients in the taping group exhibited a significant improvement in MM, which might have led to improved SDS scores.

The study results also prompted us to explore novel clinical ideas with respect to the different tendencies of short wave and taping methods in improving patients' symptoms. In future treatment, perhaps the patients' symptoms could be further subdivided such that highly specific and effective treatments can be administered. Nonetheless, for patients mainly exhibiting limited mandibular movement symptoms, more taping treatments can be used, whereas for patients mainly experiencing pain and tenderness, shorter wave physical therapies would be used. For patients with complex symptoms, combined treatment with both methods might be optimal. However, the final choice of treatment should consider the patient's symptoms, time, personal expectations, and other decisive factors.

In addition, the optimization of treatment therapy includes the improvement of the treatment content. In this study, for the taping that achieved good results in improving the mandibular movement, the "relaxing the masseter muscle" method was consistently used; however, in clinical practice, the method can be improved further according to the movement limitations of the patients. For example, Kumbrink et al. (17) used taping for the muscles and ligaments on the diseased side, which was combined with correction taping on the contralateral fascia in order to achieve relaxation of the important muscles affecting the mandibular movement and improvement of joint mechanics. Bae (31) used KT on the latent myofascial trigger points of the sternocleidomastoid muscle and observed that taping could significantly lower the Visual Analogue

scale (VAS) score of the myofascial pain and improve the motion of TMJ. All these findings can be utilized for the improvement of the taping method.

The present study was a preliminary attempt to use the KT technique for the treatment of TMD, and hence, despite the above results, several limitations are notable. First, the sample size was small indicating an inadequate representation of the population. For further accurate treatment results, we aspired to add a combination group (short wave + taping); however, it failed due to the less number of patients recruited in the study. Second, the study had a short intervention time (six days); if the observation time was prolonged, the various indicators would have altered further, which might have provided an in-depth insight into the treatment effect. Furthermore, the assessment methods were scale-dependent. Thus, for future studies, introducing ultrasound, nuclear magnetic resonance, and other imaging assessment indicators into the TMD diagnosis and treatment should be considered for objective and quantitative judgments of the results that can guide the choice of clinical treatment.

5.1. Conclusions

In summary, as one of the effective treatment methods for many musculoskeletal disorders, KT has specific application value in treating TMD, thus necessitating further exploration and promotion.

Supplementary Material

Supplementary material(s) is available here [To read supplementary materials, please refer to the journal website and open PDF/HTML].

Footnotes

Authors' Contribution: Fei He, Yuhang Ma, and Bo Yu were responsible for the conception and design of the research and drafting the manuscript. Yun Miao performed data acquisition. Renxin Ji performed the data analysis and interpretation. Jianqiang Lu and Wenhua Chen participated in the design of the study and performed the statistical analysis. All the authors have read and approved the manuscript.

Clinical Trial Registration Code: Clinical trial registration code was ChiCTR1900025729.

Conflict of Interests: The authors declare that they have no competing interests.

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Informed Consent: Informed consent was signed by the study participants or patients.

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