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Original Research Article

A randomized, double-blind controlled trial of the acute effects of Kinesio taping in patients with localized myogenic temporomandibular dysfunction

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Abstract

Objective: To investigate the acute effects of applying Kinesio Tape (KT) in patients with myogenic temporomandibular dysfunction. **Material and methods:** A double-blind randomized clinical trial, with parallel groups. Setting: The Clinical School of Physiotherapy, Tuiuti University of Parana. Subjects: This study involved 70 participants (18-60 years of age) with a clinical diagnosis of temporomandibular joint disorders (TMD) and myogenic pain using the Research Diagnostic Criteria for Temporomandibular Joint Disorders (RDC/TMD). The participants were randomly assigned to an experimental group (KTG) or to a control group (CG). Interventions: The KTG group of patients received KT while the CG received a placebo treatment involving adhesive tape. Main measures: Pain (Visual Analog Scale and algometry), thermography, and electromyography (EMG) were recorded at baseline, just before the application of tape, and on the third day of treatment. **Results:** There was no difference in the EMG between KTG and CG in the masseter ($p = 0.1494$) and temporal ($p = 0.699395$) muscle. There was a decrease in the values of thermography in the GKT (33.43 ± 0.12 for 32.51 ± 0.21), and maintenance in CG (33.43 ± 0.13 for 33.42 ± 0.2). **Conclusion:** Multidisciplinary interaction is essential for the treatment of myogenic TMD and even a single application of KT can result in clinical improvement. However, it is now necessary to determine results of such treatment over medium and long terms.

Introduction

The practice of feeding and verbal communication [35] promote compression and shear forces in the region of temporomandibular joint (TMJ) [58], which is the strongest of the human body [16]. However, a previous study reported that due to trauma, rheumatic disease, meniscal injury or chronic overload of the joint, both the ATM as periarticular structures can suffer injuries other than leave it susceptible to a framework of temporomandibular disorders (TMD) [54].

Temporomandibular Dysfunction (TMD) refers to a group of diseases that affect the muscles of mastication, the Temporomandibular Joint (TMJ) and adjacent structures [14, 17, 50], and represents the largest subgroup of myogenic changes. More than 80% of TMD cases occur in females [30, 38, 45, 51] aged between 20 and 40 years of age [22, 38], causing negative impact upon the lives of the population affected [2, 52].

In 1992 were created the Research Diagnostic Criteria for Temporomandibular Dysfunction (RDC/TMD) [18] to provide a standard system with which to examine, diagnose and classify TMD. These criteria were subsequently divided into 3 groups [23, 32, 55, 57]. And in 2014 these criteria were upgraded to allow better identification of the classification of different types of TMD [42], thus enabling clinicians the best opportunity of making an accurate diagnosis and formulating better, more directed therapeutic strategies [15]. These developments indicated that a multidisciplinary approach, involving physical, speech-language and dental therapy [6, 18] are fundamental and should aim to reduce overheads and provide appropriate pain relief [46, 51].

Recent research has shown that therapy involving Kinesio Tape (KT), created by Kase in 1992 [28], can be used as a technique to treat a variety of disorders, and can promote the reduction of myogenic joint pain [1, 3], via dermal and lymphatic actions, [27] which aim to promote increased somatosensory stimulation through proprioceptive input and mechanoreceptivity, thus allowing appropriate inhibition, activation and muscular facilitation [13]. And while for the various regions of the body are a variety of studies, there are few focused at TMJ.

So, the present work therefore aimed to investigate the acute effects of KT therapy on pain, temperature and local muscle activity in adult patients with myogenic TMD.

Material and methods

This randomized, controlled, double-blind trial was approved by the Committee of Ethics in Research in Human Beings (2.287.402). The trial took place in the Physiotherapy Clinic, Tuiuti University of Paraná, in which participants were recruited.

Participants

Participants were selected based on the following criteria: a present diagnosis of myogenic TMD using the RDC/TMD; aged between 18 and 60 years. Patients were excluded if they had recent or old injuries to the face and had received treatment for TMD in the last six months, or were taking analgesics and/or anti-inflammatory drugs, wore an occlusal board, were undergoing orthodontic treatment, had central or peripheral neurological disorders, had received a diagnosis of systemic disease, or had undergone surgery and/or had a history of tumors or trauma in the head and/or neck region.

In total, 77 participants were screened for eligibility and 7 of these were excluded: two for wearing an occlusal board and 5 others due to their use of anti-inflammatory drugs.

Following the acquisition of informed consent, the final 70 participants were randomly separated into two groups using numbered envelopes. Cards annotated with 'experimental group (KTG)' and 'control group (CG)' were placed separately into sealed envelopes. Each participant was then asked to choose an enveloped at random and passed this envelope to the physical therapist who would then apply the appropriate technique (figure 1).

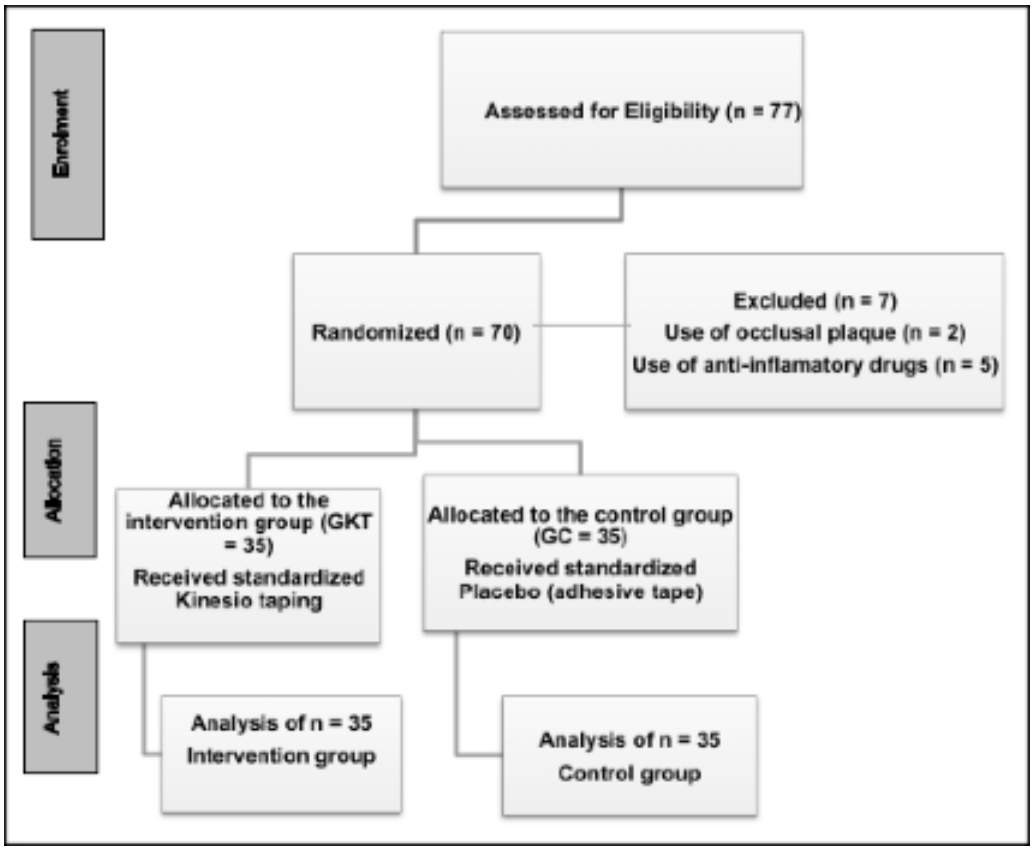

Figure 1 – Flow diagram of the progress through the phases of a parallel randomized trial of two groups

All reviewers and participants were blinded with respect to the treatment. Only the physical therapist researcher, who applied the therapy, was aware of the division of groups receiving KT or placebo treatment (AT - adhesive tape). The physiotherapist involved was certified to use these techniques.

Intervention

The KTG (n = 35) was treated with KT by inhibition technique [28] with Y application in the muscle masseter and temporal (figure 2), with anchor fixation in the TMJ and with the mouth closed. The stretch of the other ends in 15% (light tension) with in full opening of the mouth [27].

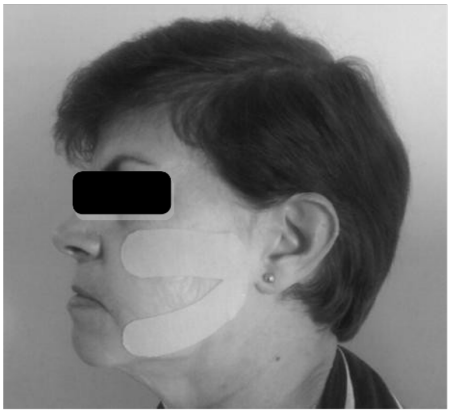

Figure 2 – Application of Y - KT inhibition technique

Control

The CG (n = 35) were treated with AT, which was the same color and texture as KT, in the same region and from a neutral position (closed mouth) without stretching of the tape.

Measurements of potential outcomes

All participants underwent the following assessments: visual analogue scale (VAS), algometry, thermography and surface electromyography (EMG) of the affected region. Patients were then treated in the appropriate manner and were re-assessed after 3 days. Prior to assessment, it was washed and shaved the site to be treated and carried out investigations in the following order.

1. Assessment of pain using the VAS and algometry.
2. Thermography. Patients were maintained for 15 minutes in a controlled environment (temperature: 22 ± 1ºC; relative humidity: 30 and 40%), and lighting that did not interfere with these parameters. Participants were positioned in a standardized manner, with framing and fixed positioning of equipment in order to ensure reliability in the pre- and post-treatment assessments. Other instructions for the acquisition of thermographic data were as described by the International Academy of Clinical Thermology [25]. Average acquisition time was 30 seconds.
3. EMG surface electrodes were positioned in the masseter and temporalis muscle, and the neutral electrode was placed in the frontal bone. Data was acquired with maximal muscle contraction over a duration of 3 seconds; data was acquired on three occasions, with an interval of 1 minute between each acquisition [44]. The data of greater amplitude was considered for the study.

Statistical analysis

Data were analyzed using descriptive statistics. To evaluate of significant differences for the variables mean EMG, median masseter EMG, mean temporal EMG, median temporal EMG, pain scale, algometric score, and thermography for each and between groups, it was carried out the following approach.

For each of the variables, it was calculated the variation (Δ) of each variable in relation to the moment before treatment, as specified in equation 1, below:

Equation 1:

$$\Delta\, the\ pain\ scale = \frac{pain\ scale\ after\ treatment - pain\ before\ treatment}{pain\ scale\ before\ treatment}$$

If the value of Δ was positive for a given participant, then it was evident that the post-intervention assessment showed a higher level of pain than the pre-intervention assessment. However, if Δ was negative, it was evident that the post-intervention assessment showed a lower pain level that the pre-intervention assessment. The extent of post-interventional change in relation to the pre-interventional value is presented as a percentage (%).

It was used the Shapiro-Wilk test to investigate data sets for a normal distribution [43]. Considering the null hypothesis of the Shapiro-Wilk test for normality, a $p > 0.05$ indicated that the data being tested were normally distributed, otherwise, the data were considered not to have been generated from a normal distribution.

If data were normally distributed, then we used the Student's t-test for independent samples and different variances between groups, [11] to assess whether the mean variation (Δ) was different between groups. When data were not normally distributed, we used the Mann-Whitney U test. The null hypothesis for the Student's t-test was that there was no difference between the mean parameters when compared between the two groups (CG and KTG). When $p < 0.05$, the null hypothesis was rejected. Similarly, the Mann-Whitney U test tested the difference of positions (ranking).

When the Mann-Whitney was applied, the results were interpreted in terms of median, minimum and maximum values for each parameter [11].

To investigate for correlation between thermography and algometry, and between pain (EVA) and algometry, the Pearson correlation coefficient (r) was used. In using the test, the objective to evaluate if the value of p is nonzero, where p 0.05 indicates that the $p <$ is nonzero and, otherwise, the value of p is equal to zero (no linear correlation).

All statistical analyses were carried out using the R software [11].

Results

Sample characterization

After the recruitment process (figure 1), a final sample of 70 participants with myogenic TMD (56 females and 14 males; table I) were selected. The majority of the study cohort (80%) were female, with the pain on the TMJ region the main symptom.

The mean age of the KTG group was slightly smaller than the CG, however, both groups had minimum and maximum ages equal to 20 and 57 years respectively, and the standard deviations of the two groups were very similar. A total of 77.1% for the KTG group and 82.9% for the CG had a time longer than a year of involvement.

Table I – Characterization of the sample in relation to sex, age (in years), and time to TMD with myogenic involvement in the KTG (n = 35) and CG (n = 35)

Variables	Categories	KTG	CG
Sex	Female	27 (77.1%)	29 (82.9%)
	Male	8 (22.9%)	6 (17.1%)
Age, years	Female	30.59 ± 8.97	32.6 ± 9.24
	Male	26.7 ± 7.18	31 ± 4.38
Time of involvement	6 to 12 months	8 (22.9%)	6 (17.1%)
	13 to 18 months	13 (37.1%)	19 (54.3%)
	>19 months	14 (40%)	10 (28.6%)

Electromyographic signals in the masseter muscle and temporalis

Pre- and post-interventional EMG results shows no difference in the masseter muscle variation between the KTG and CG. The Shapiro-Wilk rejected the hypothesis of normality to this KT group (p 0.29578 for CG and 0.00021 for KTG), and the test for the difference of U Mann Whitney (p-value equal to 0.14934) declaring that there is no difference in variance between groups because the range of variation of the values of the masseter EMG median is similar between the GC and KTG, however the median of the KTG was higher than that of the CG.

To evaluate the normality of the masseter EMG variation between the groups, the Shapiro-Wilk test was conducted again. By using the Student's *t*-test to test the difference between the groups, p values of 0.48741 and 0.28518 were obtained for the CG and KTG, respectively. The p value should be equal to 0.15143; otherwise, it rejects the hypothesis H0, which is that the two groups has no significant difference in variance.

Then, when compared the averages of the temporal muscle of both groups and found no difference in the temporal variation of the EMG among the groups, as the values between the medians are close.

To evaluate the normality of the variation of the EMG time between the groups, the Shapiro-Wilk test was performed. With a p value of 0.09228 for CG and 0.04089 for KTG, it was tested the difference between the groups by using the Mann-Whitney U test, where the p value for the Wilcoxon test was 0.59926, which does not reject the hypothesis H0, that is, no difference in variance between them.

To evaluate the normality of the masseter EMG variation between the groups, the Shapiro-Wilk test was conducted. The p-values obtained, 0.29578 for CG and 0.00021 for KTG, rejected the hypothesis of normality to this KT group. To test the difference between groups was used then the test for the difference of U Mann Whitney and, with a p-value equal to 0.14934, do not reject the H0 hypothesis, i.e. declaring that there is no difference in variance between groups.

The range of variation of the values of the masseter EMG median is similar between the GC and KTG, however the median of the KTG was higher than that of the CG.

To evaluate the normality of the masseter EMG variation between the groups, the Shapiro-Wilk test was conducted again. And by using the Student's *t*-test to test the difference between the groups, p values of 0.48741 and 0.28518 were obtained for the CG and KTG, respectively. The p value should be equal to 0.15143, and this rejects the hypothesis H0, which is that the two groups has no significant difference in variance.

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To evaluate the normality of the variation of the EMG time between the groups, by the Shapiro-Wilk test, it was found a p value of 0.09228 for CG and 0.04089 for KTG. The difference between the groups, by using the Mann-Whitney U test, showed a p value for the Wilcoxon test of 0.59926, which does not reject the hypothesis H0, that is, no difference in variance between them.

The table shows no significant difference in time between the EMG variation groups, as the median lines between the groups are close, although slightly superior in the KTG group than in the CG.

The normal range of variation of the EMG time between the groups was assessed using the Shapiro-Wilk test, obtaining a p-value of 0.18019 for CG and 0.00026 for KTG, rejecting the hypothesis of normality for this group, possibly due to the *outlier*. The test for difference with the Mann-Whitney U test with a p value of 0.69395 does not reject the hypothesis H0, which states that the two groups have no significant difference in variance.

Table also shows the results related to the KT interventions (KTG) and AT (CG), one can observe the intra-group changes, inferring measures for post-treatment versus pre-treatment, for each variable in relation to groups.

Thus, the variable masseter EMG revealed an abnormal distribution. The CG had median of −0.04, which means that at least half of the participants showed a decrease in electromyographic activation by up to 4% from before to after treatment. A maximum of 36% leads us to understand that any participants, after treatment, improved 36% of the pain they were feeling before treatment, with a decrease of the same.

In the case of the KTG, no change in the variable (median, 0) was observed even if some participants achieved an increase in activation in EMG after treatment, with 31% contractility.

With regard to the temporal muscle of the CG, the median of −0.01 means that at least half the participants presented 1% lower electromyographic activation value than that before treatment, and a 25% reduction in electromyographic activity can be considered high. In the KTG, the median value was 0.02, which represents a 2% improvement in at least half of this group. However, was found 37% reduction in activation as the higher value of worsening.

Thermographic evaluation results of the KTG and GC pre and postintervention

To evaluate the normality of the variation in thermography among the 0.1562 for the CG and 0.15433 for the KTG. The results of Student's *t*-test rejected the hypothesis H0 ($p < 0.00001$), which states that the two groups had no significant difference in thermography variation between the groups.

Table II presents the differences between the groups, the mean initial and end temperatures were 33.43°C ± 0.12°C and 32.51°C ± 0.21°C for the KTG group and 33.43°C ± 0.13°C and 33.42°C ± 0.2°C for the CG, where the values for the CG were maintained, whereas those for the KTG decreased.

Table II – Descriptive measures for all variables in the original scale according to groups (CG and KTG), before and after intervention

Variables	Before CG					After CG					Before KTG					After KTG				
	min	m	med	SD	max	min	m	med	SD	max	min	m	med	SD	max	min	m	med	SD	max
T	33.2	33.43	33.42	0.13	33.82	32.99	33.42	33.42	0.2	33.89	33.23	33.44	33.43	0.12	33.73	32.13	32.51	32.47	0.21	33.04
A	1.04	1.88	1.9	0.34	2.42	1.35	1.94	1.97	0.28	2.39	0.97	1.83	1.93	0.36	2.27	1.05	1.99	2.1	0.41	2.84
VAS	5	7.97	8	1.2	10	5	7.74	8	1.27	10	4	6.89	7	1.51	10	3	5.94	6	1.55	9
EMGTM	201.15	235.26	229.91	23.03	315.01	204.88	226.56	222.74	16.35	278.8	198.56	229.95	225.5	19.32	295.47	206.81	227.74	221.5	21.14	311.95
EMGTMD	142	193.43	193.85	18.95	230.96	168.3	189.86	189.94	13.75	225.59	166.5	191.97	189.45	15.51	230.96	145.51	190.02	187.01	17.96	250.49
EMGMM	185.3	227.37	226.58	25.75	301.7	182.22	215.53	209.49	24.11	307.81	156.82	217.48	216.21	22.96	269.93	189.01	217.99	211.12	30.25	335.57
EMGMMD	150.39	186.85	183.59	25.21	247.31	150.39	176.46	168.46	26.44	284.13	135.6	175.64	175.78	24.31	232.42	130.86	173.7	165.53	28.82	284.18

T: thermography; A: algometric score; VAS: visual analog scale; EMGTM: temporal muscle EMG mean value; EMGTMD: temporal muscle EMG median value; EMGMM: masseter muscle EMG mean value; EMGMMD: masseter muscle EMG median; min: minimum; m: average; med: median; SD: standard deviation; max: maximum

Results of EVA and algometry

VAS

Participants in the CG showed median change of 0, meaning no difference between before and after. For the KTG the median was equal to -0.14, i.e., at least half of the patients showed lower pain then 14% compared to before and a value of 43% means that some of them after treatment improved by 43% the pain he was feeling before treatment, with respective reduction of pain.

To evaluate the normality of variance between groups, the Shapiro-Wilk U test showed p-value less than 0.0001 for CG and 0.00031 for KTG, characterizing the absence of normality.

To test the difference between the groups the Mann Whitney test showed a p-value for the Wilcoxon test of 0.00009, rejecting the H0 hypothesis, in which individuals in the KTG obtained lower values of the VAS after the experiment than pre-treated individuals, compared with CG subjects.

Algometry

Between the groups, to evaluate the normality of algometry variation, the Shapiro-Wilk test was performed (CG value-p = 0.02245, KTG = 0.05673). To test the difference between groups the Mann Whitney test was performed, and with a p-value for the Wilcoxon test of 0.08213, showed that there was no difference in the algometry variation between the groups.

Thermography X algometry.

When analyzing the thermography against algometry, the Pearson's sample correlation coefficient is +0.12, a value very close to zero, and the p-value equal to 0.13, both indicate that the correlation was null between the two variables.

VAS X algometry

The Pearson sample correlation coefficient was -0.37, and the p-value for the test was equal to 0.0000014, indicating that the correlation found was not random, with -0.37 being considered as weak or at most moderate.

Discussion

Sample characterization

The majority of the study cohort (80%) were female, thus concurring with previous literature, which also show a female predominance [4, 54, 56] which in some cases, showed a ratio of 8 females to 1 male [34].

The mean age was very similar to the literature, with reports of TMD in patients aged between 20 and 45 years of age with an etiology of myogenic origin more common prior to 40 years; after this age, the arthrogenic becomes more common [5].

Results of pre- and post-interventional EMG data of KTG and CG

EMG data provides detailed information for improvement upon clinical evaluation, and represents an evaluation method that records electrical activity resulting from the action potentials of muscles during contraction, and can reveal ability of the neuromuscular system to control muscle activation [41]. It has been established that the EMG is an effective resource for physical therapy, dental and speech therapy in the diagnosis of musculoskeletal injuries [31, 39], and can provide an objective and accurate method for investigating muscle activity in a specific muscle or muscle group.

In relation to TMD, numerous studies have been performed using EMG to investigate the clinical symptoms of participants with changes in myogenic pain and to clarify the potential mechanisms involved [7, 12, 19, 20, 32, 33], thus providing significant for EMG as a kinesiological instrument to record muscle function by capturing the electrical potentials of musculoskeletal fibers [37].

Electromyographic signals in the masseter muscle and temporalis

The results show no significant difference in time between the EMG variation groups, also shows the results related to the KT interventions (KTG) and AT (CG).

Although the variable masseter EMG revealed an abnormal distribution, the CG had at least half of the participants showed a decrease in electromyographic activation by up to 4% from before to after treatment and any participants, after treatment, improved 36% of the pain they were feeling before treatment, with a decrease of the same; and in the case of the KTG had no change in the variable (median, 0), some participants achieved an increase in activation in EMG after treatment with 31% contractility.

These results corroborate those of a previous study [51] in which immediate improvement in local pain was observed after analysis of the effectiveness of KT in sore shoulders, similar to

that with the CG. On the basis of the effects found, that can result no evidence supports the use of KT as therapy and that the strong placebo effect was due to the use of a fake bandage for KT in the CG. Furthermore, disregarded, in part, the effects of therapy and praised improvements other than those of the treatment.

With regard to the temporal muscle of the CG, the median of −0.01 means that at least half the participants presented 1% lower electromyographic activation value than that before treatment, and in the KTG, the median value (0.02) represents a 2% improvement in at least half of this group. But, the 37% reduction in activation and the highest value of worsening, features of the treatment for these patients, therefore, had no effect.

The results agree with those of a previous study [24] that included amateur basketball players with shoulder impingement syndrome, subdivided into a group that received application of KT in the region and a CG that included those who received placebo taping. The EMG evaluation of the upper and lower trapezius, and serratus anterior muscles during the intervention, with KTG and CG showed more activities in the lower trapezius muscle between 60° and 30° during the downward phase of the arm, and showed increased activity in the same angles (tilt) as those in the posterior scapula.

One can speculate that as the evidence observed in this muscle is inconclusive, the treatment effect of KT is unclear.

Thermographic evaluation results of the KTG and GC pre and postintervention

The participants who showed improvement with KTG had greater variation in thermography than those in the CG, although with no significant difference in the variation between the groups.

According to the literature, thermal variation is due to muscular injuries in the region committed to increased local temperature [36]. This occurs due to increased blood flow around the affected site, inferring that these points can be measured by evaluating of temperature [10]. Evaluation of temperature can be obtained by means of thermography, which, therefore, lends itself as an auxiliary tool in the diagnosis of injury [48, 53].

This reasoning is based on the fact that infrared radiation is captured, emitted in all bodies above absolute zero, which is transformed into image, evidenced by a spectrum of different colors and shades, and equivalent to the temperature of each body region [8].

Several studies refer to KT as a technique that has great practicality; is noninvasive, painless, safe, rapid, and performed in real time; does not require contact with the evaluated patient to register body temperature; and can be used to diagnose muscle injuries of any etiology [8, 26, 36, 40, 48].

In addition, other studies report that the real value of thermography comes from its high sensitivity in detecting vascular diseases, and neurological and muscular skeletal disorders, in which it plays an important role in the pathogenesis and diagnosis conducted by the evaluator, enabling detailed analysis of the affected region to make a definitive diagnosis of pain and myofascial trigger points, as in the case of TMD [9].

However, though varied, there is still a lack of studies using thermography as a complementary feature of Physiotherapeutic diagnosis, like this study.

Results of VAS and algometry

VAS

The CG had no difference between before and after treatment, and the least half of the KTG patients showed lower pain then 14% compared to before, and that some of them after treatment improved by 43% the pain he was feeling before treatment, with respective reduction of pain.

For the KTG group was seen that the negative values indicated that after treatment the subjects ending with less pain compared to before the experiment. But, as with EMG, the results are not very clear either due to the variability found.

Algometry

Considering the increases in the minimum, maximum, medium and median values, the values presented for the KTG show that there was improvement for the great majority of the participants.

Even for CG, with a lower maximum value, the lower standard deviation values lead to a higher concentration near to the mean and median values that have risen.

However, as this is close to the level of significance, this may lead to speculate that both the intervention may have positively affected the symptoms of myalgia, as can considers him the placebo effect of the treatment. This would corroborate [47] when in cross-sectional survey participants suffering from pain in the patellofemoral region, which pointed to have the use of KT or AT placebo favored improves due to proprioceptive stimuli when used on site.

Thermography X algometry

The correlation coefficient and the p-value indicate that it is not possible to affirm that there is a relationship between the two data collected.

VAS X algometry

The absolute values of algometry and VAS show conflicting data. Individuals with high values of algometry, with high capacity to withstand pain, also present a high degree of pain by VAS, although not constantly.

And the results indicated that the correlation found, weak or at most moderate, well demonstrating that there is no strong correlation between the data collected.

Conclusion

TMD with myogenic pain presents itself as a myofunctional change that is difficult to treat. Cooperation among professionals of various specialties in the treatment of this dysfunction is essential to the selection of the appropriate treatment among the various existing therapeutic modalities or even the combination of two or more procedures.

The results of this study confirm that KT is a noninvasive and painless method with few side effects and that a single application of the technique resulted in improvement in symptomatology of TMD myogenic pain, being a choice of therapy for the treatment of this disorder. However, a larger number of surveys should be conducted to determine the clinical effects of KT in the medium and long terms.

Clinical messages findings

- Kinesio taping has acute effects on temporomandibular dysfunction;
- The low-cost and easy-to-apply technique is effective for temporomandibular dysfunction;
- Kinesio taping is useful as a tool for functional recovery in temporomandibular dysfunction;
- Kinesio taping can be considered as an option or supplement in the treatment of temporomandibular dysfunction.

Limitations of the study

The present study presents some limitations on methodology. We propose that further studies with a larger number of samples and greater homogeneity (initial differences between the groups on the right and left temporal parameters) be conducted in the future.

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