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Effect of awareness through movement on the head posture of bruxist children

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SUMMARY The aim of this study was to evaluate the effectiveness of physiotherapy to improve the head posture and reduce the signs of bruxism in a group of bruxist children. A single-blind randomized clinical trial was performed. All the subjects were 3- to 6-year old, had complete primary dentition, dental and skeletal class I occlusion and were classified as bruxist according to the minimal criteria of the ICSD for bruxism. For each child, a clinical, photographic and radiographic evaluation of the head and cervical posture were realized with standardized techniques. The children were randomized in an experimental (n = 13) and a control (n = 13) group. A physiotherapeutic intervention was applied to the children of the experimental group once a week, until 10 sessions were completed. Afterwards, the cephalogram and the clinical and photographic evaluation of the head posture were measured again. The data were analysed with the t-test and Mann–Whitney test. The subjects of the experimental group showed statistically significant improvement in the natural head posture. The physiotherapeutic intervention showed to be efficient to improve the head posture at the moment of measurement in the studied children. The relationship between bruxism and head posture, if exists, seems to be worthwhile to examine.

KEYWORDS: physiotherapy, bruxism, head posture

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Introduction

The aetiology of bruxism has been defined as multifactorial (1). It is mainly regulated centrally, and influenced peripherally (2). This fact means that oral habits, temporomandibular disorders (TMD) (3), malocclusions (4), hypopnoea (5), high anxiety levels (6) and stress (7) among others (8) could influence the peripheral occurrence of bruxism. These factors act as a motion stimulus to the central nervous system, which reacts with an alteration in the neurotransmission of dopamine (9) and the answer is the clenching or grinding of the teeth.

Bruxism not only affects the masticatory muscles, but also all the muscles of the craniofacial complex, shoulders and neck (10). These structures share innervations through the trigeminocervical complex, which is composed by the upper cervical and trigeminal nerves. Also, anatomically, the axes for the excentric movements of the mandible and cervical column concur in the occiput (11). These connections make the jaw position to influence the activity of the cervical muscles (12) and the neck inclination to influence the bilateral sternocleidomastoid activity (13).

The oral airway resistance increases with modest degrees of head and neck flexions in healthy adult humans (14), while in healthy infants, hyperflexion of the head has been shown to affect the airflow, airway patency and pulmonary mechanisms (15, 16). Additionally, sleep bruxism has been correlated to hypopneas (5) and increasing airway patency (17). More anterior and downward head postures and kyphotic necks had been found in bruxist children, with hyperflexion of the head posture (18). These characteristics could affect the dimensions of the

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pharyngeal and free airway in the bruxist children as has been already demonstrated in adults (19) and could be part of the aetiology of their parafunction. Now, the question is whether physiotherapeutic therapies applied aiming at changing head posture could work as a therapeutic option for bruxist children. That is why the objective of this study was to evaluate the effectiveness of physiotherapy to improve the head posture and reduce the signs of bruxism in a group of bruxist children.

Materials and methods

A single-blind randomized controlled clinical trial was performed. The procedures, possible discomforts or risks, the radiation to which the children were going to be exposed, as well as possible benefits were fully explained to the participant patients and their parents, and the informed consent from their parents was obtained prior to the investigation. The institutional ethics committee of the CES University and Susalud were informed about the whole methods and approved the study.

Subjects

Participating children were included from a previous phase of this study (18), were required to be healthy, with normal facial morphology, complete primary teeth, absence of other types of oral habits, presence of dental wear and with no history of trauma. A new sample size was calculated with a confidence of 95% and a statistical power of 80%. The number of subjects required in each group to make the comparisons was 12.

Inclusion and exclusion criteria

The exclusion criteria were skeletal malocclusions confirmed with cephalometric X-rays (20, 21) and dental malocclusions confirmed with dental casts. The reports of respiratory diseases, presence of mouth breathing and functional alterations in the body posture, caused by any illness, were also reasons to exclude patients from the study. The asymmetry in the children's legs and any other mobility alteration that could generate changes in head posture because of anatomically detectable reasons were exclusion criteria as well.

The parents were asked to sleep with the children for at least 2 weeks and all the children accomplished the minimal criteria of the International Classification of Sleep Disorders (ICSD) (22) for sleep bruxism:

1 The children parents indicated in an interview with one of the examiners, the occurrence of tooth-grinding or tooth-clenching during sleep at least once during the night for at least five nights in a 2-week period.

2 No other medical or mental disorders (e.g. sleep-related epilepsy, accounts for the abnormal movements during sleep).

3 Other sleep disorders (e.g. obstructive sleep apnea syndrome) were absent.

As part of the inclusion criteria, all the children were required to present high anxiety level according to the Conners' Parents' Rating Scales (23) as other symptom of bruxism. Anxiety has been reported to have a high prevalence in bruxist patients (6). All the children were 3- to 6-year old. The mean age was $56{\cdot}70 \pm 7{\cdot}22$ months.

Examination

The physiotherapeutic evaluation (24) was performed to exclude any possible anatomical disturbance of the cervical column that could affect the head posture or the craniofacial growth of the studied children (18). A lateral cephalogram was taken before and immediately after the 10 session physiotherapeutic intervention for each child with the Natural Head Posture technique, described previously by different authors (25). The technique is reproducible (26–28) and allows the clinician to evaluate the natural position of the cervical vertebras and the inclination of the cervical column and head posture.

Afterwards, the digital record of lateral cephalograms were processed in agreement with Solow and Tallgren (25), using a program developed under Matlab 5·3*. The measurements in the lateral cephalogram were the following (18):

1 Angle between Tangent (CVT) to the cervical Vertebra (cv4ip) and VV: The wider the angle, the more relevant the kyphosis of the cervical column.

2 Angle between CVT and HOR: The narrower the angle, the more significant the anterior tilt of the head.

3 Angle between the Tangent (OPT) to Odontoides (cv2ip) and VV: The wider the angle, the more relevant the kyphosis of the cervical column.

*MathWorks, Inc., Natick, MA, USA.

4 Angle between OPT and HOR: The narrower the angle, the more relevant the anterior tilt of the head.

The method error ranged from 0·27° to 0·64° and the coefficients of reliability from 0·97 to 1·00. Photographs of the head and neck posture of all the children in the experimental and control groups were made before and immediately after the finalization of the 10 session physiotherapeutic intervention, using the technique reported by Raine *et al.* (29). The craniovertebral angle (CVA) was measured digitally in each picture using Scion Image® (Scion Corporation, Frederick, MD, USA), the PC version of Image program developed by NIH. The normal measurement of CVA in healthy children under 6 years is 61·4 (s.d. 5·3) (29).

For the photographic evaluation, the children stood in their natural head posture. The specific reference points are shown in Fig. 1. The examiners evaluating the condition of bruxism were not aware of who were those that performed the physiotherapeutic intervention and those who analysed the photographs and the X-ray images. Prospective random allocation, using a stratified block randomization method was used to assign the children to either the experimental group with physiotherapeutic intervention (n = 13) or to the control group without treatment (n = 13).

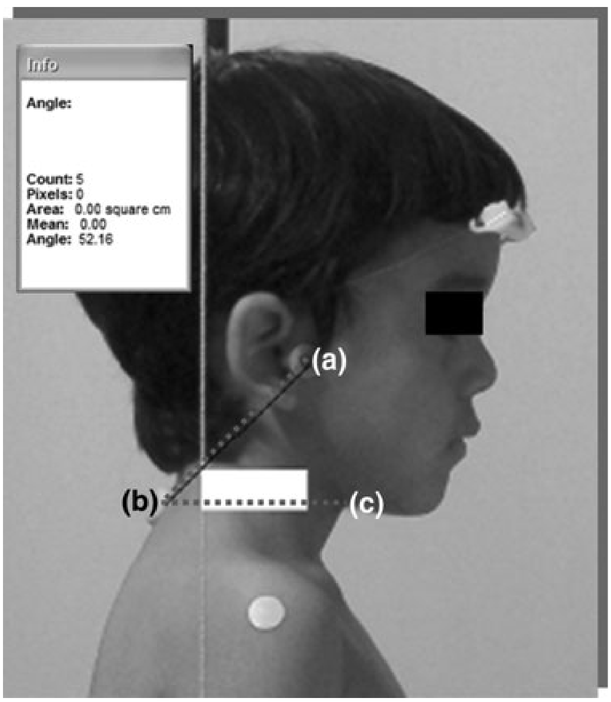

Fig. 1. (a) Tragus. (b) Spinous process. (c) Cervicomandibular angle.

Physiotherapeutic intervention

The physiotherapeutic intervention was based in the Awareness Through Movement (ATM) (30–33). It is an established method of movement re-education where coordination and posture are significant factors. Its proponents believe more effective and efficient actions can emerge from guided exploration of movement that promotes improved attention and awareness and refines the ability to detect information and make perceptual discriminations.

'Awareness through Movement' (ATM) (34) is a process, which facilitates the learning of strategies for improving organization and coordination of body movement by developing spatial and kinaesthetic awareness of body-segment relationships at rest and during motion, awareness of ease of movement, reducing effort in action and learning the feeling of longer muscles in action. Through the specific use of sensorimotor experiences, the ATM purports to enhance people's awareness of their habitual solutions to motor problems and the sensations accompanying those habits.

Regarded as complimentary to physiotherapeutic intervention, it provides an educational approach for re-training abnormal movement patterns. The intervention was followed all the international ethical parameters. Ten physiotherapeutic sessions were planed during a 10-week period, all of them based in children games. Each session lasted 3 h and pursued the following steps:

1 Presentation to the parents of the somatic awareness technique for each day.

2 Movements, games, motor tales and exercises performed by the children, guided by the parents and with the guide of the physiotherapists.

3 In each session, a guide book with cartoons was given to the children and their parents to reinforce the exercises at home to keep a long-term result regarding the body and head posture. The guide book was designed and created by physiotherapists, teachers and advertisers that were not participating in the study.

4 After the first session, a feedback was given before starting the next session, so the exercises at home and the difficulties were reviewed and solved.

The children of the experimental group and their parents were guided by two expert physiotherapist previously standardized and the sessions took place in a room surrounded by mirrors, where the children were able to see their own movements. All the children assisted together to all the sessions and the instructions and instruments given to the children and their parents were the same for all of them. The parents helped their own children.

Error of method

There were not statistically significant differences, regarding the age of the two groups. As the children were all bruxist, they were assumed to have postural disturbances (18), but their prevalence in each group were not established before the therapy.

Standardizations of the examiners and calibration of all the techniques to evaluate the children regarding the clinical examination and the physiotherapeutic evaluation were made on 12 subjects different from the ones included in the investigation. The Intra-tester (ICC > 0·9 two-way ANOVA) and intertester error (κ > 0·7) were not statistically significant.

A calibration of the X-ray and photographic technique and a standardization of the digital tracing of both the pictures and the cephalogram were also performed. The tracing of the cephalogram was standardized between two investigators with 10 X-rays, scanned and traced three times each by each of the two investigators. To determine the Intra-tester and intertester reliability, the intra-class correlation coefficient was applied (ICC > 0·6). Two examiners were standardized as well to trace and analyse digitally the craniovertebral angle in four pictures of eight subjects different of the children that were participating in the study (ICC > 0·9 and κ > 0·7).

Statistical analysis

All the data were analysed with SPSS® 11·0† for windows. Distributions were tested using the Shapiro–Wilk test. The data were compared using the Student's *t*-test, or Mann–Whitney tests. For all tests, significance was set at 5% ($P < 0{\cdot}05$).

Results

There were six girls and seven boys in each group and the mean age was 55·2 months (s.d. 7·8) and 56·7 months (s.d. 7·2) respectively for the control and experimental groups. Most of the variables were statistically homogenous at the beginning, which means and that the two groups (experimental and control) were comparable.

The head posture was evaluated with lateral cephalograms and with photographs. Even though, there were no statistically significant differences, the angulations of the head posture and the cervical column were

†SPSS Inc. Headquarters. Chicago, IL, USA.

Table 1. Comparison of the head and cervical column posture before the intervention between the experimental and the control group

	Experimental	Control	*P*-value
CVT-HOR (°)	84·4 (4·0)	85·5 (2·2)	0·6*
OPT-HOR (°)	84·3 (4·2)	85·5 (3·1)	0·6*
CVT-VV (°)	5·6 (4·1)	4·4 (2·2)	0·6*
OPT-VV (°)	5·6 (4·2)	4·4 (3·1)	0·6*
CVA (°)	50·7 (4·7)	57·4 (6·3)	0·8**

CVT-HOR, angle between tangent (CVT) to the cervical vertebra (cv4ip) and horizontal line (HOR); OPT-HOR, angle between the tangent (OPT) to odontoides (cv2ip) and horizontal line (HOR); CVT-VV, angle between tangent (CVT) to the cervical vertebra (cv4ip) and vertical line (VV); OPT-VV, angle between the tangent (OPT) to odontoides (cv2ip) and vertical line (VV); CVA, craniovertebral angle.
Values are expressed as mean (s.d.).
*Mann–Whitney test.
**Student's *t*-test.

Table 2. Comparison of the head and cervical column posture after the physiotherapeutic intervention between the control and experimental group

	Experimental	Control	*P*-value
CVT-HOR (°)	80·3 (6·9)	79·4 (7·1)	0·6*
OPT-HOR (°)	84·9 (8·2)	85·7 (6·9)	1·0*
CVT-VV (°)	6·5 (4·2)	15·0 (26·7)	0·6*
OPT-VV (°)	5·7 (5·4)	5·6 (4·3)	0·9*
CVA (°)	54·4 (3·1)	43·5 (6·9)	0·0**

CVT-HOR, angle between tangent (CVT) to the cervical vertebra (cv4ip) and horizontal line (HOR); OPT-HOR, angle between the tangent (OPT) to odontoides (cv2ip) and horizontal line (HOR); CVT-VV, angle between tangent (CVT) to the cervical vertebra (cv4ip) and vertical line (VV); OPT-VV, angle between the tangent (OPT) to odontoides (cv2ip) and vertical line (VV); CVA, craniovertebral angle.
Values are expressed as mean (s.d.).
*Mann–Whitney test.
**Student's *t*-test.

Table 3. Comparison of the head and cervical column posture before and after the physiotherapeutic intervention in the control and experimental group

	Experimental			Control		
	Before	After	P-value	Before	After	P-value
CVT-HOR (°)	84·4	80·3	0·1*	85·5	79·4	0·03*
OPT-HOR (°)	84·3	84·9	0·9*	85·5	85·7	0·7*
CVT-VV (°)	5·6	6·5	0·5*	4·4	15·0	0·06*
OPT-VV (°)	5·6	5·7	0·9*	4·4	5·6	0·3*
CVA (°)	50·7	54·4	0·0**	57·4	43·5	0·00**

CVT-HOR, angle between tangent (CVT) to the cervical vertebra (cv4ip) and horizontal line (HOR); OPT-HOR, angle between the tangent (OPT) to odontoides (cv2ip) and horizontal line (HOR); CVT-VV, angle between tangent (CVT) to the cervical vertebra (cv4ip) and vertical line (VV); OPT-VV, angle between the tangent (OPT) to odontoides (cv2ip) and vertical line (VV); CVA, craniovertebral angle.
*Mann–Whitney test.
**Student's *t*-test.

respectively more anterior and kyphotic for the experimental group. This means that the control group had better posture of the head and cervical column than the experimental group at the beginning (lower values for the angles CVT-VV and OPT-VV in the control group; Table 1).

After the physiotherapeutic intervention, the experimental group improved the head and the cervical posture, with a statistically significant increase of the CVA angle (Table 2), compared with the control group. In the control group, the clinical, photographic and radiographic measurements of the head and cervical posture showed an increase in the kyphotic posture of the cervical column and a more anterior position of the head, when compared with the data before the treatment (Table 3). Only the changes for the CVA could be considered clinically relevant, regarding the head posture.

At the beginning, all the parents indicated the occurrence of nocturnal bruxism in the children, as it was part of the inclusion criteria. After the physiotherapeutic intervention, 77% of the parents of the children included in the experimental group answered no when they were asked about the occurrence of nocturnal bruxism in their children, while in the control group the same question was answered no by 15·38% of the parents.

As the result of the positive results of this investigation, the children from the control group initiated the physiotherapeutic intervention. The results of the control group did not present statistically significant differences with the results after treatment of the experimental group.

Discussion

The effectiveness of a physiotherapeutic intervention to improve the head posture was tested. Although there are investigations about several treatments for bruxism in children (35, 36), there is still a lack of evidence to support therapeutic options for bruxism in children.

When a deep search about bruxism in the scientific literature is performed, it can be observed that most of the methods to diagnose it are indirect; dental wear, anxiety, temporomandibular disorders, etc. The point is that those measurements are not constant and always related to bruxism, so the diagnosis could be mistaken and false positives or false negatives are present.

Polysomnography is a reliable tool, but only useful during the active phase of bruxism, so a patient that is really a bruxer but goes to the polysomonographic examination the day he or she is not in an active phase, then the diagnosis is going to be wrong. This technique is still not validated in children.

Thus far, the most reliable method to diagnose nocturnal bruxism in children is when the parents' or guardians' relate its occurrence. The problem with this method is that most of the kids do not sleep with their parents or closed to them, so the parents are not always aware of their children's episode of bruxism. This study pretended to eliminate this bias, as all the parents were asked to sleep with their children at least 2 weeks before starting the measurements. On the other hand, the minimal criteria of the ICSD, included the indication of occurrence of tooth-grinding or tooth-clenching during sleep by the parents. The limitation was that day-time bruxism was not considered.

The technique to take the X-rays used in this investigation used the minimum possible radiation. The parents were fully informed about the risks. They gave their permission as they considered that it is worth it, because their children were going to learn a better body posture, even if bruxism would not reduce or disappear.

The anterior head posture had been previously demonstrated to be present in bruxist children (18) and to affect the oxygenation of the central nervous system (37). The experimental group had a more disturbed posture than the controls at the start of the intervention programme in this investigation. The children in the experimental group improved their head posture more than the control, whose position was worse in the second measurement. This could mean that bruxism induce an anterior head tilt of the head that may be progressive. This affirmation needs further studies to be confirmed.

Low levels of oxygen are associated with increased levels of dopamine (38), which at the same time are related to the occurrence of bruxism in children (39). However, physiotherapeutic interventions to change the head posture to improve the free airway and therefore to reduce the occurrence of bruxism have not previously been published. There are case reports, where the physical therapy was used in children with bruxism (40), but was not a clinical trial and the objective was not to change the head posture. However, a causal relationship or peripheral modulation with bruxism is not clear. Still there is a lack of evidence about the association of the head posture with the occurrence of bruxism and the type of respiration and bruxism. Further physiologic studies are needed to clear up these relationships.

When the airway pressure is reduced, it has been found higher anxiety levels, which are probed symptoms of bruxism. Another benefit of changing the forward head posture in children with bruxism is that the anxiety can be reduced when the airway pressure is higher (41).

Unfortunately, a systematic review was not found in the literature to compare the evidence regarding the available physical therapies to modify the head posture in normal children. Most of the therapies to change the head posture in children, are designed for patients with deformities or motor problems such as cerebral palsy. Certain therapies to change the head posture are reported in the literature for normal patients, using Swiss ball (42) or exercises in the floor (43), for example. The first study was performed in children, but the second one is reported in adults. Its stability during time has not been reported. The physiotherapeutic intervention used in this work attempts to keep the conscience of the body posture by each child and to practice the posture exercises daily at home. The program took 10 times three hours sessions for all the children. It was selected, because ATM uses games, results could be achieved with few sessions as reported by the authors (31–34) and there's no fatigue induction by the therapy. However, further investigations are necessary to assure that the results obtained with the physiotherapeutic intervention applied here are stable and to compare this kind of physical therapy with others.

The changes in the body posture were more evident in the pictures than in the X-rays. The skeletal changes take more time to be evident as they depend on the osseous maturation of each subject (44). In contrast, muscular changes seem to take place earlier, so the clinical changes could be detected before, as it was seen in the pictures taken in this investigation. However, to establish cut-off points to determine clinical relevance changes even of the CVA would require epidemiological studies that are still not available.

A sample size was calculated with a confidence of 95% and a statistical power of 80%. This makes the results to be reliable. However, limited variations in the X-rays measurements could be found due to the small group or to the observation time, so further studies are needed.

Conclusions

The head posture found in the experimental group after the physiotherapeutic intervention was less anterior and downward than the head posture found in the control group. This fact means that the physiotherapeutic intervention showed to be efficient to improve the head posture in the studied children. Further work is required to evaluate the long-standing results of the physiotherapeutic intervention on bruxism and the head posture in children and to see the results through the X-rays.

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