Evaluation of soft-tissue, dental, and skeletal characteristics in children with and without tongue thrusting habit: A review of literature

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Abstract

Although swallowing is the first function to be established in the stomatognathic system, it is the last process to mature, because while the bone structures are growing and the dentition has not yet erupted, the tongue cannot acquire mature positioning and movement. Only when the child is around two years of age can an inconstant swallowing pattern that is transitional to the mature pattern (known as somatic swallowing) be expected, with the tongue at the limits of the dental arcade, the soft tissues more adjusted and the lips sealed. A visceral form of swallowing can persist well beyond the fourth year of life. Many studies have proved that tongue thrusting plays a significant role in the etiology of some orofacial deformities. To learn more about the relationship between tongue function and the form of orofacial structures, it is important to recognize patients with abnormal swallowing patterns. Tongue thrusting habit is a condition in which the tongue makes contact with any teeth anterior to the molars during swallowing. Abnormal positioning of tongue may result in dental and skeletal abnormalities. Through a careful analysis of the scientific literature, we want to analyze a comparison of soft-tissue, dental, and skeletal characteristics in children with and without tongue thrusting habit; we were chosen from "PubMed" several publications about growth and development, occlusion/orthodontics, oral habits, deglutition. Significantly, higher number of children with tongue thrust showed lip incompetency, mouth-breathing habit, hyperactive mentalis muscle activity, open-bite and lisping when compared to children without tongue thrust. Children with tongue thrust showed increased upper lip thickness and proclination of maxillary incisors.

Introduction

The oral myofunctional disorder of tongue thrust has been described in various ways, such as ‘deviate swallow’ ‘infantile swallow, and ‘abnormal swallow’ to name a few. The term 'tongue thrust' has been adopted, mainly because of its greater usage among authors, and since it gives a more accurate description of the lingual behavior about to be discussed. ‘Tongue thrust’ and ‘tongue thrusting’ are used in preference to ‘tongue thrust swallow’ or ‘tongue thrust swallowing’ because this behavior is generally thought to be less associated with the act of swallowing and more with the resting posture of the tongue. ‘Thrust’ is still an inappropriate word since the tongue is not really ‘thrusting’ during rest. However, it must be remembered that 'thrusting' in this instance is still a mild but continuous lingual pressure factor. The significance lies in whether or not this 'thrust, either during swallowing and other functional behaviors, or during rest, is responsible for, contributes to, or is a consequence of the development of a malocclusion. However, a visceral form of swallowing can persist well beyond the fourth year of life and it’s then considered to be a dysfunction or abnormality because of its association with certain dental malocclusions and facial growing abnormalities. Such deglutition is classified as atypical. The investigation of tongue function is an important part of oral diagnosis. Many studies have demonstrated that tongue thrust plays an important role in the aetiology of open bite as well as in the relapse of treated open bite patients. The tongue is a muscular organ, the muscles of which can be divided into two types: extrinsic and intrinsic. Extrinsic muscles are the styloglossus, palatoglossus, hyoglossus, and geniohyoid. The intrinsic muscles are composed of longitudinal and transverse muscles and probably also vertical muscles. Among these muscles the genioglossus is the most important for forward movement of the tongue. The genioglossus originates on the genial tubercle of the mandible and inserts into the anterior and central parts of the tongue. In order to determine the aetiology of tongue dysfunction, it is important to identify patients with abnormal swallowing patterns. Basically, three swallowing patterns have been described: visceral, somatic, and inconstant. Cranial movement of the tongue tip is typical of somatic swallowing and does not cause pressure on teeth, but on the incisive papilla. Inconstant swallowing is characterized as a pattern of swallowing during the
transitional period between infantile and somatic swallowing. Under normal neurological conditions, respiration, sucking, and deglutition functions are established at birth, in order to maintain extraterine life. At the first occasion when neonates meet mother’s breast, they should be capable of sucking and swallowing. At this stage of development, the tongue has a large volume, occupies the entire oral cavity, and can perform postero-anterior movements within the oral cavity. Only when the child is around 2 years of age, a pattern of transitory (inconstant) swallowing to the mature pattern—called somatic swallowing—is expected, with the tongue on the limits of the dental arcade, with the soft tissues more adjusted, and the lips sealed. A visceral type of swallow can persist well after the fourth year of life. However, it is then considered as a dysfunction or abnormality because of its association with certain malocclusions (Graber et al., 1985; Peng et al., 2003).

Methods

We carried out a careful analysis of the scientific literature about morphological and functional characteristics of soft-tissue, dental, and skeletal tussues in children with and without tongue thrusting habit. We were chosen from "PubMed" several publications about growth and development, occlusion/orthodontics, oral habits, deglutition. The movements of the tongue during swallowing may be clinically assessed by asking the child to swallow liquids, semi-solids or solids, or even only saliva, to observe the protrusion of the tongue with the lips half-open or, if necessary, with lips opened with the fingers. By placing the hands on the massters, it is possible to observe the presence or absence of contraction and to observe the ascendant movement of the hyoid bone under the thyroid cartilage. The participation of the perioral muscles is also observed, as well as whether the swallowing is loud, whether there is any retraction movement with the head, or whether any sign characterizing childlike swallowing is present.

Synchronization of sucking and swallowing is achieved through a close relationship between the muscles of the oral region, in order to generate suction pressure for opening and closing the mandible and for using the tongue for bolus formation and peristaltic transportation to the pharynx. During oral feeding, mechanical respiration involves appropriate activation of the diaphragm, intercostal muscles and muscles of the upper airways from the nose to the glottis.

Teleradiographs are standardized extraoral images that are routinely used as an orthodontic/orthopaedic functional diagnostic tool (Malkoc et al., 2005). Teleradiography has been used in a large number of studies on craniofacial growth (Pae et al., 2008; Sheng et al., 2009). Through this method, the spatial relationships between the cranium, vertebrae, mandible, and hyoid bone can be easily examined (Stepovich, 1965; Bibby and Preston, 1981; Rocabado, 1983; Bibby, 1984).

While it has been noted that anterior position of the tongue may result in open-bite, other evidence suggests that tongue thrusting habit may be an effect of an open-bite that, in actuality, may facilitate an otherwise absent oral seal. Tongue thrust with an open-bite has been shown to be associated with long facial pattern and proclination of upper anterior teeth. Other associated features with tongue thrust have been high and/or narrow maxillary arch and Class II div I malocclusion. It also may lead to lisping or impaired speech; however, many tongue thrust patients do not exhibit altered sibilant production.

Review

A study of Machado et al. was to evaluate the possible correlation between the radiographic position of the hyoid bone and the airway space on lateral radiographs in children with atypical deglutition, in comparison with those with normal swallowing. Their study sample consisted of 110 teleradiographs in lateral view, from 52 female and 58 male subjects. The two groups were similar with regard to gender distribution. Twenty lateral teleradiographs on 20 patients with a clinical diagnosis of atypical deglutition and another 20 lateral teleradiographs on 20 subjects with normal deglutition were selected for a pilot study in order to calculate the sample size. For this, the standard deviation of the control group and the difference between the means of the control and experimental groups were calculated. The examinations were performed with the patient’s head in a natural position (mirror position), and were performed by the same examiner. Using the selected lateral teleradiographs, cephalometric examination was performed and the following anatomoradiographic points and planes were marked on the sheet: T-H: tuber (line of intersection between the center of the pterygomaxillary fissure and the posterior nasal spine) to hyoid (most anterosuperior point of the body of the hyoid bone); MP-H: mandibular plane (line from the midpoint of the mandibular angle to the lowest point on the outline of the mentonian symphysis) to hyoid; PAS: frontal wall of pharyngeal airway to posterior wall of
pharyngeal airway. The average distance of the MP-H variable was 11.69 millimeters for the control group and 16.14 millimeters for the experimental group, with a statistically significant difference (P = 0.016). The average distance of the T-H variable was 2.26 millimeters for the control group and -5.89 millimeters for the experimental group, with a significant difference (P < 0.001)\(^9\). The average distance of the PAS variable was 7 mm in the experimental group and 10 mm in the control group, with a statistically significant difference (P < 0.001). There were positive correlations between MP-H and PAS (P = 0.0053) and T-H and PAS (P = 0.0286), but these correlations were only observed in the control group\(^7\). We reported also a study of Dixit and Shetty, in which they analyze a total of 21 children with tongue thrust habit and 21 children without any habit between age 10 and 14 years were selected for the study. Various soft-issue, dental and cephalometric parameters were measured and compared statistically. Significantly higher number of children with tongue thrusting showed lip incompetency (86% vs. 14%), mouth-breathing habit (38% vs. none) and hyper-active mentalis muscle activity (24% vs. none) when compared to children without tongue thrust. Furthermore, upper lip in children with tongue thrusting habit was significantly thicker (14.9 mm) than in children without the habit (13.4 mm). Although, naso-labial angle for children in the Group TT was found to be more acute, the difference between the two groups was not significant. Most of the children included in their sample had convex profile irrespective of presence or absence of tongue thrust. Open-bite was present in half of the children with tongue thrust whereas, none without tongue thrust had open-bite, the difference being significant. Comparatively more children with tongue thrust showed edge-to-edge bite of incisors (no over jet), while most without tongue thrust exhibited 1-2 mm over jet. The difference was found to be significant. Significantly, more children with tongue thrust showed proclination of maxillary incisors in all the three angles measured as compared to children without tongue thrust. However, no significant differences were found in proclination of mandibular incisors between the two groups. Inter-incisal angle was found to be significantly lower in children with tongue thrust indicating proclination of maxillary incisors. No statistical differences were found in any of the parameters studied to evaluate relationship of maxilla to cranial base, mandible to cranial base, maxilla to mandible, vertical height, and growth pattern of the mandible between the two groups\(^6\).
differences were not found in the sample that we studied. Differences in proclination of lower incisors between the two groups in our study were not significant. This may be because most of the children even in the control group showed convex profile and higher than normal upper incisor to SN and upper incisor to NA as well as IMPA and lower incisor to NB angles indicative of a bimaxillary dento-alveolar protrusion. Proclination of mandibular incisors in the control group may have masked the differences in the two groups in proclination of mandibular teeth. Other studies showed that overjet is the only variable which significantly increases in tongue thrust individuals compared to control subjects. Hanson et al reported that the deleterious forces of the tongue result in excessive eruption of posterior teeth, open bite or overjet. There were no significant differences in overbite, upper incisor inclination, lower incisor inclination, and interincisal angle between the groups of this study. This finding is contradictory to the results of a study carried out by Alexander and Sudha who reported a significant increase in proclination of upper anterior teeth in tongue thrust individuals. It should be noted that the mean amount of overbite was smaller in the test group compared to control subjects and although the difference was not statistically significant, there were 3 cases of anterior open bite in the test group. In a study of Ovsenik et al., an atypical swallowing pattern was present in half of the examined children at 3 years of age, changed significantly after 6 years, but was still present in 25 per cent at 12 years of age. Melsen et al. (1979) reported that an atypical swallowing pattern was present in 25–30 per cent of 9 year olds, confirming the results of the Ovsenik et al.’s study.

Conclusion(s)

A careful analysis of the literature shows that the tongue thrust seemed to affect some of the soft-tissue and dental characteristics causing lip incompetency, mouth-breathing habit, hyper-active mentalis muscle activity, lisping, open-bite, and proclination of maxillary incisors. Tongue thrust had no effect on lateral maxillary growth and effects on mandibular incisor position were minimal. Tongue thrust did not cause significant skeletal changes in the maxilla and mandible. Also there are positive correlations between the MP-H and PAS measurements and between the T-H and PAS measurements only in the group with normal swallowing. These correlations were not observed in the group with atypical swallowing.

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