THE ACCURACY OF PALATOGRAPHY AS A DIAGNOSTIC AID FOR TONGUE THRUST SWALLOWING PATTERN IN CHILDREN: A PILOT STUDY

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OVERVIEW

ABSTRACT

AIM: *The aim of the present study was to diagnose tongue thrust swallowing patterns in children using the palatographic method.* ***MATERIALS AND METHOD:*** *A total of 24 children between the age of 8 -14 years were divided into two groups based on quota sampling. Group 1 (n=12) was the control group that comprised children without tongue thrusting habit whereas Group 2 (n=12) was the experimental group where children had tongue thrusting habit. The index test used for the diagnosis of tongue thrust swallowing pattern (TTSP) was palatography. The reference standards used were the measurements of dental (overjet, overbite, open bite, palatal vault height) and radiographic (cephalometric analysis). Data was tabulated and evaluated statistically.* ***RESULTS:*** *The palatography test had a sensitivity of 100% and specificity of 100%. The results of the index test were in line with the diagnostic accuracy of reference standards.* ***CONCLUSION:*** *This pilot study concludes that palatographic method can be a reliable diagnostic aid for TTSP in children.*

Keywords: Tongue habits, Deglutition, Oral Diagnosis, Tongue Thrusting, Swallowing, Pediatric Dentistry

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INTRODUCTION

Swallowing is a complex process. The normal swallowing pattern in infants is marked by protrusion of tongue between the alveolar pads, placement of tongue against the lower lip, strong lip activity and deglutition with lips apart. This type of swallow is known as an infantile swallow or reverse swallowing pattern.

In a mature adult swallow, the tip of the tongue rests in the lingual part of the maxillary anterior dentoalveolar area, teeth are in contact and there is minimal activity of the perioral tissues. The transition between infantile swallow to a mature swallow takes place between 2-4 years of age. If the infantile swallow persists beyond this age, tongue thrust swallowing pattern (TTSP) develops.

Tulley defined tongue thrust swallow as the forward movement of the tongue tip between the teeth to meet the lower lip during deglutition and speech, so that the tongue lies interdentally.[1]

During TTSP the tongue applies pressure on the palatal surface of the maxillary anterior teeth resulting in their proclination. Furthermore, dental abnormalities like open bite, spacing problems, bimaxillary protrusion, maxillary arch constriction, increase in palatal vault height, lip incompetency and convex facial profile are not rare.

Palatography is a technique used to identify which parts of the mouth are used when making different sounds. Palatography has been previously used to understand the soft tissue, dental and skeletal characteristics of children with tongue thrusting habits. This study aims to analyse its effectiveness as a diagnostic aid.

A record made through palatography is called a palatogram. It involves painting a colouring agent on the tongue or the roof of a person's mouth and having that person pronounce a specific sound. A photograph of the mouth roof and tongue helps in understanding how the sound was articulated.[2]

The palatographic method can thus be utilized to check for the contact of the tip of the tongue to the palatal surface of upper incisors during infantile swallowing pattern, as the colouring

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dye gets imprinted on the palatal surface of the teeth.[3] Thus, the purpose of the study was to assess if palatographic method could be a diagnostic aid for TTSP in children. This study was reported in accordance with the STARD (Standards for Reporting Diagnostic Accuracy Studies) 2015 guidelines.[4]

MATERIALS AND METHOD

Children in the outpatient department of the Department of Pediatric and Preventive Dentistry at the College of Dental Sciences and Research Centre, Ahmedabad, India were screened for TTSP.

Children were asked to sit comfortably on the dental chair and were asked to swallow their saliva three times. The position of the tongue during swallowing was then evaluated by placing the lips apart (Figure 1). If the child swallowed by thrusting his/her tongue against the maxillary incisors or between the incisors, the child was referred to have tongue thrust swallow. 12 such children had tongue thrust swallow and they were grouped as experimental group. 12 other children without this swallow were allotted to the control group to allow for matched pair analysis.

The inclusion criteria were that children between the age of 8 to 14 years who had no previous orthodontic treatment, premature loss of primary teeth, complete eruption of permanent incisors and first permanent molars, were included in the study.

An informed consent was obtained from the parents after explanation of the entire procedure. History related to feeding practises and other related oral habits were asked for. Oral prophylaxis was done with ultrasonic scaling in order to avoid the misinterpretation of extrinsic stains as the colouring agent.

Chocolate essence was the chosen dye for the study. It was applied on the tip and anterior 1/3rd of the tongue (Figure 2). Children were then asked to swallow their saliva as they usually did. The palate was then visualized with a mirror and an image was captured for record with a digital camera (Figure 3 and Figure 4).

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Figure 1 Application of Chocolate essence on tip and anterior 1/3rd of the tongue

Figure 2 Lips apart swallow examination

Alginate impression was then made to achieve a model cast and a lateral cephalogram was taken for each child. The child's facial profile and lip competency was noted.

Palatographic investigation was done by two different researchers who made their observations based on where the dye was imprinted on the palate.

Figure 3 Palatographic images of the experimental group, showing dye on the anterior part of the palate mainly the palatal surface of the maxillary incisors

Figure 4 Palatographic images of the control group, showing dye on the middle and posterior part of the palate

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Overjet was measured in millimetres as the difference between the incisal edge of the most proclined upper anterior tooth to the corresponding point on the labial surface of the mandibular incisors.

Overbite was measured by marking the incisal edge of the upper anterior teeth was marked on the labial surface of the lower anterior teeth and distance between the incisal edge of the lower incisor and the mark gave overbite in millimetres.

For palatal vault height, a string was placed across the palate from the buccal cusp of first permanent molar on one side to the buccal cusp of first permanent molar on the other. One tip of the divider was placed touching the string and the other tip at the deepest point of the palatal vault. This gave us the palatal vault height in millimetres.

Cephalometric analysis was done by measuring the SNA and SNB angles, interincisal angle, upper incisor and palatal angle, and lower incisor and mandibular plane angle.

RESULTS

In accordance with the flat sample size rule of thumb for two-group studies, this pilot study had a sample size of 24 (12 in each group) at a power level of 80%. The mean age of the participants in the control group and experimental group was 11.50 years and 12.40 years respectively.

Palatographic imprints were subject to observational analysis by two independent observers. A comparison of their observations revealed no conflicting observations. All participants of the experimental group had the colouring agent imprinted on the anterior part of the maxilla, especially on the palatal surface of the maxillary incisors. In contrast, participants in the control group had the colouring agent imprinted on the middle and posterior region of the palate.

A t-test was used for calculating the significance of model cast and cephalometric readings (Table 1 and Table 2). Model cast analysis revealed a significantly increase in overjet and palatal vault height in the experimental group. Though the mean overbite was more in

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experimental group, the comparison was not of statistical significance. Only two children in the experimental group had an anterior open bite.

SNA and SNB angles were within normal range for both the groups. The palatal plane-upper incisor angle measured significantly more in the experimental group than the control group which indicated proclined maxillary incisors. This was further substantiated by significantly lower interincisal and mandibular plane-lower incisor angle values.

Additional observational analysis included a greater proportion of children in the experimental group with a convex profile (91.6%) and incompetent or potentially competent lips (100%). In the control group, a convex facial profile was observed in 30% of the children and all participants had competent lips.

The mean time period of breastfeeding or bottle feeding was more in the experimental group (16.2 months) compared to the control group (11.7 months). Children belonging to the experimental group had no adjunctive parafunctional oral habits.

Sensitivity, Specificity, Predictive Values

Palatographic observations accurately diagnosed TTSP in all participants of the experimental group. The sensitivity and specificity of palatography in this pilot study was 100%. Both positive and negative predictive values for palatography is 100%.

	Experimental		Control		p-value
	Mean	SD	Mean	SD	
SNA Angle	82.90	3.28	84.90	3.45	0.56
SNB Angle	79.70	5.27	80.70	6.78	0.71
Palatal-Upper Incisor Angle	112.15	9.08	105.80	11.67	< 0.05*
Mandibular Plane-Lower Incisor Angle	89.65	6.45	99.15	5.51	< 0.05*
Upper Incisor-Lower Incisor Angle	70.55	9.97	93.70	39.10	< 0.05*

Table 1: Comparison of the values obtained for the cephalometric angles between the experimental and control group

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	Experimental		Control		p-value
	Mean	SD	Mean	SD	
Overjet	5.70	0.95	3.55	0.86	< 0.05*
Overbite	4.05	2.31	3.75	0.95	0.29
Open Bite	6.85	1.80	4.00	1.00	< 0.05*
Palatal Vault Height	16.50	3.57	13.60	1.51	< 0.05*

Table 2: Comparison of values obtained through model cast between the experimental and control group

DISCUSSION

Tongue is an important organ in many oral functions like speech, respiration, mastication and deglutition. TTSP is a common feature in infants. Gellin ME stated that this swallow decreases with increasing age.[5] This may be a result of an improved muscular balance during swallowing. This self-correction is estimated to occur at the age of 3- 4 years of life. Hence, in the present study, children between the age of 8 – 14 years were selected with the anticipation that the effects of tongue thrust would be more pronounced in this age group due to the longer duration of the habit.[6]

Habitual swallowing of saliva was chosen rather than water swallowing pattern because the frequency of swallowing saliva is estimated to be around 1200–3000 times every day thus believed to have a stronger effect on dentofacial morphology compared to water swallowing. Thus, children included in our study were asked to swallow their saliva and not water during the examination.[7]

In our study, children who had tongue thrust habit had a convex facial profile and incompetent lips. This finding was similar to previously reported studies.[8]

In the present study, disclosing agent was not used as a dye material since children complained about irritation in throat after swallowing the solution. Various other materials

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were tried and tested as the material of choice to dye the palate in this study. These materials were gentian violet, syzygium cumini syrup, paste of beetroot and saline, and chocolate essence. Children found it difficult to swallow gentian violet and paste of beetroot. Syzygium cumini syrup couldn't efficiently dye the palate. Apart from a high value of acceptance, we found chocolate essence the best as it is edible and efficiently dyed the palatal region after swallowing.

Our study indicated that the TTSP in children affected the position of the maxillary incisors. Increased measured overjet on the model cast and increased palatal plane and upper incisor measured on the cephalogram indicated proclination of the maxillary incisors. This observation is in accordance with previous studies compared maxillary anterior teeth proclination with tongue thrusting.[1 9]

Tongue thrusting is one of the primary etiological reasons for open bite. However, as a reference standard, out study demonstrated only two participants with an open bite in the experimental group.[5] The increased palatal vault height in the experimental group can be the result of increased duration of breastfeeding and bottle feeding.

Eslamian et al used electropalatovision device to check for the contact of tongue to the palate during pronunciation of consonants and selected words in tongue thrust patients. Similar to our study, they too found that tongue contact was more pronounced in the anterior region of the palate.[6] The electropalatovision device was not used because of the constraints in the availability of the device and cost criteria.

The limitation of this study is that while the dye can get imprinted on the palatal surface, one cannot estimate the role of saliva in smearing the essence in various areas of the mouth. In regards to this, an electropalatovision can have an upper hand as a diagnostic aid in evaluation of TTSP.

CONCLUSION

The results obtained through the index test (palatography) convey a similar diagnosis as indicated by the reference standards (lateral cephalogram and model casts). Moreover, the

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measures of accuracy reveal that results obtained from palatographic method are not false positive. Hence, palatographic method can be a reliable diagnostic aid for TTSP in children.

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