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Scrutiny of Tongue Thrust: A Comprehensive Review

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Abstract

Background: The different abnormal habits may affect orofacial structures and presence of even a single habit can be reason behind inducing a new habit. Basically, tongue thrust is a habit in which tongue touches to the upper anterior portion of the teeth rather than molars while swallowing.

Tongue thrust caused because of various etiological factors such as tongue tie or retained infantile swallow i.e., physiologic, habitual, functional, or anatomic. As there are so many literatures available pertaining to the management of the tongue thrust however it is important to diagnose the condition and it is more important to have a knowledge how to identify tongue thrust for its correct management. The aim of this pertinent review is to summaries and briefly explain older as well as recent diagnostic aids or techniques to identify tongue thrust.

Literature review: A review of pertinent literature is based on article searched through PubMed, EBSCO, Scopus, Google scholar and Web of science electronic databases published in English language till year 2021 by Using Mesh terms, free text terms and some basic pamphlets related to tongue thrust. The Initial search was given 38 to 40 articles with the help of Mesh terms and 20 to 35 were selected based on the requirement

In simple words, tongue trust is habit in which a person or a child while swallowing uses his/her facial muscle of expressions rather than using muscles of mastication. There is also widespread controversy amongst specialists that, only the resting posture of the tongue is an etiological factor behind the habit. The patient may or may not exhibit all the characteristics attributed to tongue thrust and no any single diagnostic method is superficial to identify tongue thrust. So, in this review we will be enlisting and explaining in detail about diagnostic aids available till date for tongue thrust habit.

Conclusion: Tongue plays an important role in development of perioral structures as well as in the swallow to good speech articulation and dental occlusion. As pediatric dentist it is important to know how to diagnose the habit as early as possible for proper management and to avoid problems such as malocclusion/skeletal abnormalities. This literature will help in general dentist or pediatrician or pediatric dentist in diagnosing tongue thrust habit timely with the help of diagnostic aids including normal examination of structures, signs, and symptoms up to different tongue pressure measuring devices.

Introduction

Tongue push, a swallowing behavior in which the tongue protrudes between the teeth, is a serious issue for dental health and speech development.

Tongue thrust is a normal developmental stage in infancy, but it can linger into early childhood and cause a variety of oral and dental issues. The incidence varies by population, with estimates ranging from 40-80% in children aged between the ages of four and six and 3-25% for children aged 12 to 15 years, depending on the diagnostic criteria. [1].

Structural abnormalities, neuromuscular dysfunction, habitual behaviors, genetic susceptibility, and environmental variables are all potential contributors.

Tongue push can produce malocclusion, particularly anterior open bite, and interfere with the normal articulation of speech sounds, resulting in articulatory mistakes and speech intelligibility problems. Children with chronic tongue thrust may show compensatory articulation patterns to address these issues, affecting their communication abilities and social interactions.[2].

This literature review examines research findings on the etiology, assessment, implications, and intervention strategies of tongue thrust.

Understanding the etiology, assessment methods, and management strategies is crucial for dental practitioners. But only after diagnosing one can treat so, our focus should be on early and prompt diagnosis.

Discussion

Tongue thrusting habit is most common oral habit affecting normal growth and development of oral and facial structures.[3].

It is forward placement of tongue between anterior teeth during swallowing, talking or at rest. Various terms are used to describe tongue thrust for e.g., deviate swallow, infantile swallow, reverse swallow, immature swallow, and tongue thrusting. [4].

Oral habits occur because of multiple factors all together, whereas tongue thrust causes most commonly due to retained infantile swallow. In simple words, child having tongue thrust habit uses his/her muscles of expression for swallowing instead of muscles of mastication. It is normal to swallow or place tongue that way until certain age after that age, swallow pattern changes but in some of children swallow pattern remains unchanged. Those normal swallowing patterns are[3].:

1. Infantile swallow:

The before teeth eruption tongue rests between gum pads before teeth eruption. Facial muscle contraction stabilizes the mandible. The muscles involved during this swallow are muscles of facial expression which eventually transforms into mature swallow with eruption of teeth.

2. Normal mature swallow:

It is characterized by contraction activity of muscles of mastication, tongue, lip, and cheek. These muscles carry out movements of mandible for mastication in such a way that the tongue maintains a complete valve seal against the teeth and alveolar process. During the mixed dentition, the lips may contract and secure the seal when there is interdental spacing with seal not ensured by tongue.

Transition from infantile to mature swallow: At the 6-7years of age with growth and development of jaws and muscles there is transition of swallow with eruption of permanent dentition to mature swallow.

3. Retained infantile swallowing Behavior:

After eruption of permanent teeth, there is failed transition of swallow and persistence of infantile swallow

ing is termed as Retained infantile swallow.
Tongue thrust can further be divided into simple and complex based on its severity[5], [6].

Simple tongue thrust Swallow	Complex Tongue thrust swallow
• It is contraction of the lips, mentalis, mandibular elevators, and the teeth • In this tongue thrust is present but as a result to seal open bite there is a normal swallow. • It is an adaptive mechanism to maintain an open bite created by usually by other habits.	• It is a thrust with teeth apart swallows. • Patient lacks contraction of the mandibular elevators.

As we know that deviation from normal is a result of multiple factors, such as local or general factors which are responsible for abnormal swallowing[3].

• Hereditary factors, such as a large tongue.
• Vertical skeletal problems.
• Other habits
• Short lingual frenum (tongue tie).
• Mouth breathing.
• Sore throat, enlarged tonsils, or adenoids that cause difficulty in swallowing.
• Premature loss of primary teeth and abnormal tongue adaptation.
• Muscular, neurologic, or other physiologic abnormalities, such as loss of muscle coordination.

As we all know no one diagnostic criteria should be enough for identifying any oral habit. All diagnostic methods from basic criteria, case history with observation of patients from their entrance into the clinic to recent advanced diagnostic methods are listed and thoroughly explained further [6].:

A) Informal Observation

The moment from patient enters the examiner's office he/she is under scrutiny as much as information can be gathered from casual observation till the he/she leaves. These behaviors are obvious to the examiner and he/she must look for Resting posture, movements, swallowing and speech[7].

1. Resting posture

Any deviation from normal posture of tongue can be studied while mandible is at rest or if lips rest apart.

- **Position of the tongue**

Observation should include the resting posture characteristic of patients as well as look for contractions of muscles, open position of mandible, flaccid Lips, and the tongue placement. (Fig 1)

2. Swallowing.

Deglutition assessment methods carry out by visual examination, questions pertaining to relevant details,

information regarding etiological factors, any infections, and histories.
Throughout the session, the examiner has every opportunity to observe swallowing of saliva and the patient should be unaware of being watched.
Look for the facial smirks that may accompany swallowing.

3. Articulation

Assessing the patient's spontaneous speech will reveal the existence or absence of articulatory difficulties. This articulation demonstrates speech that sounds correct but looks incorrect.
This incorrect articulation includes sounds like /s/, /z/, "she," "ch," and "j" because their tongue glides out between the teeth. With other sounds like /n/, /t/, /d/and /l/ may also associated with because of weak tongue musculature

B) Direct Examination of the orofacial structures and swallow

The direct examination of structures is the most important and difficult diagnostic procedure. The thorough examination of the patient's oral structures during rest, swallowing and movements gives an idea about absence or presence of tongue thrust which may or may not be associated with all the characteristics.
Clinical examination can be carried out first with extra oral followed by intra oral examination[8],[9],[10].

Clinical examination:

1.The Teeth-

Determination of the type of malocclusion, any crowding or spaces and type of dentition.
Degree of overbite, overjet (protrusion), open bite should be measurements which will help to quantify changes in occlusion and result of treatment.

2.The Jaw -

The Strength and Mobility of muscles with size & shape of structures are assessed by direct examination. Discrepancies of upper and lower jaws between arch size, Teeth spacing and shape are figured out.
For assessment of TMJ problems patient's mandibular movements are noticed.

3.The Palate -

In cases where tongue never touches palate there is narrow/high arched palate and the palatal rugaes in tongue thrusters shows jellylike or sharp well-defined structure with increase in number (Figure 2).

4.The Tongue -

The mobility and range of movement of the tongue are measured by making gross nonspeech motions. These patients have difficulty following the examiner's actions without glancing in the mirror. So, before beginning any therapy, the examiner should familiarize the patient with his or her oral anatomy. The state of the lingual frenum can be determined by assessing these motions (Figure 3). It is critical to identify cases with tongue tie with thrust behavior.
The strength and activity of the tongue muscles can be evaluated by having the patient push against a tongue depressor or spoon to indicate increased or decreased tongue strength in tongue thrusters.

5.The Lips

Lip incompetency indicates the existence of any abnormalities in the orofacial structures. Tongue thrusters have a short, thick top lip that falls flaccid beneath the nose, exposing the upper incisors and a piece of the neighboring gums, while the bottom lip is tight and hyperactive. Exercise or pressure gauzing can be used to test lip strength and tonicity.

6. Examination of swallow –

Patient's tongue is observed during various swallows' complete evolution of swallow is nothing but obser-

vation of patient while swallowing saliva, solid and liquids.

1. **Unconscious swallow**

Initially ask patient to seat upright and observe unconscious swallow, while observing this look for any forced opening closing or movement of muscles and lips.

2. **Command swallow of water**

Patient is asked to drink little water and squirt it in mouth, as soon as swallow begins part the lips and observe.it is quiet misleading, so examiner must observe swallow stepwise by using clear plastic cup.

3. **Conscious swallow during mastication**

Observe the patient while swallowing and biting solid food with assessment of tongue posture and movements of muscles.

Observe excessive tongue and jaw movements or facial grimaces or biting pattern during chewing. This will ensure exact pattern of mastication and swallow of solid food.

In Normal swallow - posterior tooth contact, relaxed lips, and the tongue placed on the palate.

In Abnormal swallow- teeth are apart with hyperactivity of the muscles of facial expression.

7.Palpatory examination:

Palpation is carried out by placing hand over temporalis muscle and patient is asked to swallow (Figure 4).

- Normally there will is contraction of Temporalis & elevated mandible.
- In Tongue thrusting there will be no temporalis contraction.

Cause history

Case history is one of the common methods which helps in diagnosis. Various Questions will be asked throughout the session in presence of parents. Each question in that will have sequence starting from basic Demographic data (e.g., name, address, telephone numbers, birthdate, and past treatment) to habit related questions.[3].

After that, the patient's history should be documented relating to sucking habits, neuromuscular issues, identify the swallow pattern of siblings and parents (hereditary etiology), and whether any therapy was offered before.

To rule out any etiology related points of hereditary factors should be covered with some questions asked by examiner to patients and parents such as:

Related to Feeding and History

- Patient was breast-fed or bottle-fed?
- Frequency and duration of breast-fed?
- Upto what period bottle feeding continued? (6months/12months/beyond that)
- Was there any difficulty during weaning or at start of solid food?
- Did the patient suck his or her thumb or finger? If so, then what its duration and frequency?
- Did the patient use a pacifier?

Medical History

- Is there a history of upper respiratory problems?
- If patient have tonsils? Are they enlarged?
- Any allergies?
- Any ear infections or Sinus problems?
- Past dental/medical treatment has the patient had?

- Any hospitalization or medication history?

Dental History

- Eruption rate,sequence and exfoliation of milk teeth appear to be normal? Was any early loss of teeth due to trauma?
- Has patient visited any dentist/orthodontist before? If yes, how was the experience?
- If the patient had undertaken any treatment? Or under a treatment if yes then ask about X-rays, impressions, referrals?
- History of any completed orthodontic treatment?
- for how long were braces worn/ removed? What kind of retainer did or does the patient wear for how long?

Family History

- Familial history about medical/dental problem?
- Any family members history regarding dental/orthodontic treatment or any therapy?
- Do parents, siblings, or other relatives have any habit/similar signs as patient?

Eating Habits

- Does the patient drink water/liquid during meals?
- Is he/she a fast or slow eater?
- Does the patient chew food adequately? During chewing are there any facial grimse? Resist foods that are difficult to chew?
- Have frequent digestive problems?

Associated Oral Behaviors

- Does the patient breathe through the mouth, nose, or both? (duration/frequency)
- Does the patient clench or grind teeth/nails/cuticals/other objects?
- Does the patient lick lip excessively?
- Does the patient prop the chin or head on palm?

Above concern behaviors the parents may have never noticed or faced any such behaviors and that may have diagnostic value.[11].

The parents or patients do not agree on or give the answers to these questions. Because of this case history alone should not be considered by an examiner as an adequate diagnostic aid. So apart from case history different basic and advanced diagnostic aids with their enhanced quality methods are enlisted (Table 1) and explained further.

A) Palatography:

This technique permits examination of tongue dysfunction to be observed during swallowing and speaking. This method also evaluates influence of different functional appliances on tongue. It is mainly meant for assessment of speech disorders. Palatography may be applied in Direct and indirect method.[10],[12].

- **Direct method:**

Mixture of Arabic gum, flour or Impression material is painted on the superior part of tongue and patient is asked to perform different functional exercises. The contacts made by tongue with palate and teeth were then transferred into upper jaw cast with red ink.

Now a days after exercises and instant paint (polaroid) is marked over palatal region with help of mirror and examination is carried out by looking into picture.

- **Indirect Method:**

In this method, Black Indian rubber plate made of upper cast and tongue is painted with mixture of chalk and alcohol. The contacts made by tongue on that rubber plate then transferred to cast as in direct method.

B) Cineradiography

Successive images appearing on a fluoroscopic screen as Motion picture record. e. g, to investigate tongue movements recorded images are used during deglutition process.[13].

X-ray Videotape recorder system used to record tongue movements in each stage of deglutition. Tongue is attached with lead markers on tip and dorsal surface and patient is asked to swallow 5ml of diluted barium.

The tongue tip protruded and pushes anterior teeth due to which negative pressure created in both the tip and dorsum of the tongue.[14].

C) Serial cinephotographic

Serial cinephotographic is longitudinal approach highlights the tongue variations[13]. Also tongue movements through surgical defects are recorded perfectly.

D)Video-Fluoroscopy/Cinefluoroscopic

This technique evaluates movements with help of images taken with small image intensifiers but those images are two dimensional and speed is slow. This technique can be an option as aid along

E) Electro-Palatography (EPG):

EPG is a biofeedback device placed in patient's mouth which provides visual representation of the lingual-palatal contact on a computer screen[15].It is used during the treatment of Orofacial Myofunctional Disorders Speech therapy and indicated in improvement of lingual placement of tongue during swallowing.

F) Dental Models

Dental models are created by dentist to study relation of Oro-facial structures. Useful in visual presentation of oral structures. Those are oldest one which are used in diagnosis as well as in treatment of patient up to date. Any malocclusions or signs representing habitual appearance are intended immediately by models.

G) Sensors or force/pressure transducers

Different sensors are used to measure intraoral pressures. The tongue is probably more important than the surrounding musculature causing malocclusion and relapse of orthodontic treatment.

This transducers aids in Measuring maximum strength of the tongue and lips. Sensors are adjusted in oral cavity (30sec) then patient is asked to swallow and performance is recorded within a minute. A new measurement is conducted by requesting the participants to swallow in habitual position which is assessed in 3 rest periods of 10 sec each selected at start, middle and at the end of measurement for evaluation of maximum and mean forces carried out. When the participant showed no evident peak of tongue force during directed swallowing the maximum force value is considered as the maximum value. When participants are requested to perform swallowing two extra times if value is not recorded until the end of the measurement.

Now a days, to measure tongue pressure intraoral pressures can be measured more accurately with different types of devices used in studies those are enlisted in Table 2. [11].

H) Cephalometric head films. –

It is easily available technique used for diagnosis of tongue thrusting by evaluating tongue posture at rest and habitual. There are differences between the relaxed and habitual postures of tongue in relation with teeth with possible variations.

Lateral Cephalometry is also a one of the possible methods to study the posture of the tongue while the mandible is in postural position and evaluation of tongue posture in any tongue thruster (Figure 5).

I) Ultrasound/Ultrasonography

It is a Static imaging of the oral cavity in which scan of upper and lower lip in relaxed and contracted state is recorded at a single stretch with linear probe. The thickness of the lip in the center as well as in the periphery is recorded. Both lips were divided into three portions, right, middle and left for the convenience of scanning and measurements are taken in millimeters. This measurement shows changes in the thickness of circumoral muscle in the relaxed and contracted states in various malocclusion.[16].

J) Magnetic Resonance Imaging:

MRI is an alternative, noninvasive radiation involving technique to record superior details of soft tissue structures. It provides direct coronal or sagittal scanning sections which allows accurate description of the lingual musculature.

K). Electromyography (EMG)

It is non-invasive a test given by Moyers. with help of electrodes the functions and the action potentials in contracting muscles are studied (Lingual and masseter muscles activity).

Individuals engaged in oral habits facial pain EMG levels are increased provides a window into the individual's level of muscle activity, even when the individual is unaware of engaging in activities.

L) Payne technique (Garlinger)

It is a noninvasive easy, low-cost technique and straightforward deglutition test.

Deglutition evaluation should always be performed during unconscious swallowing.

It is performed in a dark room. First, patient is asked to stick out the tongue, and saliva excess was removed with a gauze.

After that fluorescein (Fluorescent ore-base) is applied on the tongue the participant is asked to swallow only once, and then open the mouth.

An estimation is made with a Payne lamp to observe contact points of tongue (Figure 6). Those points are noted in a graph with the data collection format designed but not possible practically.

The selected constants in this technique are: gingival margin contact, contact with the palatal rugae, contact in the middle area of the palatal surface, presence, or absence of tongue protrusion, and contact with the lingual surface of lower teeth. [17].

M). The chocolate Test

It is the non-invasive technique for diagnosing swallowing disorders by nerve innervations of subjects. For testing the correlation between sensory and motor functions of the tongue the sensory function and the motor function of the glossopharyngeal nerve is evaluated using chocolate or raw carrots (**E**dible test-raw carrots) during chewing cycles.

N) Neurophysiologic experiments

Various neurologic tests are used to study the behavior of the tongue and differences in lingual sensorimotor factors using of stereo gnostic tests.[18].

O) Submental scanning: Cushion scanning method:

It is a Technique of Dynamic tongue sonography which involves Cushion device, a head support, a probe holder, and a head position recording device (Figure 7). With help of this parts the tongue dynamic can be correctly recorded and measured the difficulties during swallowing[19].

P) M-mode ultrasound technique

Motion mode is one of the forms of ultrasound imaging. It is high clinical utility for the interpretation of

tongue movement.[20].

M-mode images and technique the swallowing phases can be distributed into Five subphases for detailed analysis of swallowing:

1. I-shovel,
2. IIa-early transport,
3. I1b-late transport,
4. IIIa-early final and
5. IIIb-late final phases.

Conclusion:

Tongue plays a significant role in development of facial structures, good speech articulation and dental occlusion as well as in the swallow. So, it is essential to know basic alterations in and these structures and for that it is important to diagnose what exactly is hidden below these alterations for correct management and to avoid further complications. In this study we tried to enlist and explain detail about different diagnostic aids used to diagnose Tongue Thrust Habit. Which will guide clinicians with early and accurate diagnosis and eventually underlying habit and its management.

Future Aspects:

As not a single aid should be used alone for diagnosis. So, this literature will help in general dentist or pediatrician or pediatric dentist in diagnosing tongue thrust habit timely with the help of diagnostic aids including normal examination of structures, signs, and symptoms up to different tongue pressure measuring devices.

References:

1. Dixit UB, Shetty RM. Comparison of soft-tissue, dental, and skeletal characteristics in children with and without tongue thrusting habit. Contemp Clin Dent. 2013 Jan;4(1):2-6. doi: 10.4103/0976-237X.111585. PMID: 23853444; PMCID: PMC3703688.
2. Suchita Madhukar Tarvade, Sheetal Ramkrishna, “Tongue thrusting habit: A review,” Int J Contemp Dent Med Rev, Vol. 2015, Article ID 151214, 2015. doi: 10.15713/ins.ijcdmr.26
3. Devi, Oinam & Somani, Rani & Bashir, Arwah & Basu, Payel & Leleesh, Mayanglambam & Thanglienzo, Grace & Kumar, Sarath. (2022). TONGUE THRUSTING ORAL HABIT - A REVIEW. International Journal of Advanced Research. 10. 351-368. 10.21474/IJAR01/14212.
4. Shah SS, Nankar MY, Bendgude VD, Shetty BR. Orofacial Myofunctional Therapy in Tongue Thrust Habit: A Narrative Review. Int J Clin Pediatr Dent. 2021 Mar-Apr;14(2):298-303. doi: 10.5005/jp-journals-10005-1926. PMID: 34413610; PMCID: PMC8343673.
5. BRAUER JS, HOLT TV. TONGUE THRUST CLASSIFICATION. Angle Orthod. 1965 Apr;35:106-12.PMID: 14280960.
6. Fraser C. Tongue thrust and its influence in orthodontics. Int J Orthod Milwaukee. 2006 Spring;17(1):9-18. PMID: 16617883.
7. Klein ET. Pressure habits, etiological factors in malocclusion. American Journal of Orthodontics [Internet]. 1952 Aug 1;38(8):569–87. Available from: http://resolver.scholarsportal.info/resolve/00029416/v38i0008/569_phefim.xml

8. Ovsenik M. A 2d ultrasound evaluation of swallowing in children with unilateral posterior crossbite. European Journal of Orthodontics, 36, 665-671.
9. Weiss CE. A directional change in tongue thrust. Int J Lan Com Dis 1972;7:131-4.
10. Graber T M, Rakosi T, Petrovic A G. DentofacialOrthopedics with Functional appliance. 2nd ed. St. Louis: Mosby; 1997.
11. Tulley WJ. A critical appraisal of tongue-thrusting. Am J Orthod. 1969 Jun;55(6):640-50. doi: 10.1016/0002-9416(69)90040-2. PMID: 4890737.
12. Legou, Thierry & Marchal, Alain & Meynadier, Yohann & Andre, Carine. (2008). 3D Palatography. Proceedings of ISSP 2008 - 8th International Seminar on Speech Production. 10.13140/RG.2.1.3988.8885.
13. Kawamura M, Nojima K, Nishii Y, Yamaguchi H. A cineradiographic study of deglutitive tongue movement in patients with anterior open bite. Bull Tokyo Dent Coll. 2003 Aug;44(3):133-9. doi: 10.2209/tdcpublication.44.133. PMID: 14694828.
14. Fujiki T, Takano-Yamamoto T, Noguchi H, Yamashiro T, Guan G, Tanimoto K. A cineradiographic study of deglutitive tongue movement and nasopharyngeal closure in patients with anterior open bite. Angle Orthod 2000; 70:284-9
15. Baken.R. J(1987)clinical measurement of speech and voice, Taylor and Francis, page no.442.
16. Peng C et al. differential diagnosis between infantile and mature swallowing with ultrasonography European Journal of Orthodontics, 25,2003., 451-456.
17. Meyer- Marcotty P, Hartmann J. Dentoalveolar open bite treatment with spur appliances. Journal of Orofacial Orthodontics 2007;70: 468-484.
18. 18.Ekberg O, Hillarp B. Radiologic evaluation of the oral stage of swallowing. Acta Radiol Diagn 1986;27:533-7
19. Chien-Lun Peng, Paul-Georg Jost-Brinkmann, Noriaki Yoshida, Hsin-Hua Chou, Che-Tong Lin,Comparison of tongue functions between mature and tongue-thrust swallowing—an ultrasound investigation,American Journal of Orthodontics and Dentofacial Orthopedics,Volume 125, Issue 5,2004,Pages 562-570,https://doi.org/10.1016/j.ajodo.2003.06.003.
20. Saul T, Siadecki SD, Berkowitz R, Rose G, Matilsky D, Sauler A. M-Mode Ultrasound Applications for the Emergency Medicine Physician. J Emerg Med. 2015 Nov;49(5):686-92. doi: 10.1016/j.jemermed.2015.06.059. Epub 2015 Aug 17. PMID: 26293413.

Figures

Fig 1: Resting posture of tongue

Fig 2: Sharp defined rugaes in tongue thruster's palate

Fig 3: Assessment of status of lingual frenum

Fig 4: Palpation of Temporalis Muscles

Fig 5: Evaluation of Tongue posture using Lateral Cephalometry

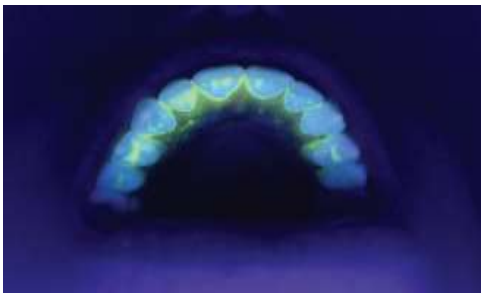

Fig 6: Payne Technique

(Gonzalez, et al 2020) look for citation

https://doi.org/10.1111/1556-4029.14313

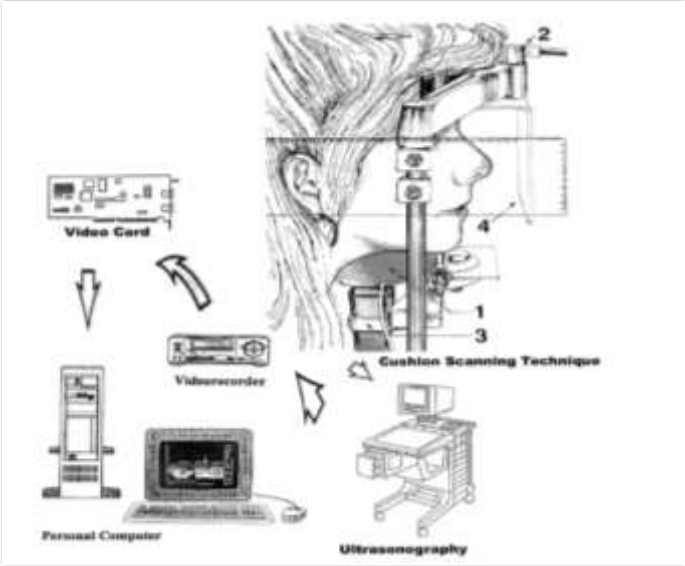

Fig 7: Submental scanning: Cushion scanning method

Peng.et.al, American Journal of Orthodontics and Dentofacial Orthopedics, May2004.

Tables

Wholetongue imaging	Noninvasive techniques	Flesh point tracking technique	Dynamic ultrasound investigation
•Palatography •Cineradiography •Serial-cinematography •Video-fluoroscopy	•Cephalometry •Ultrasonography- •MRI •Electromyography (EMG) •Payne Technique	•Electromagnetic articulography	•Submental scanning •M-mode ultrasound technique

Table 1: Basic diagnostic aids followed by recent advances are enlisted

Mouthpiece containing strain gauges	Mouthpiece containing load cells	Mouthpiece containing force sensing resistors
Pressure sensors attached on teeth or on palatal plates	Dynamometers	Bulbs filled with some fluid and connected to a pressure sensor
Myometer 160	Flexible resistive sensors	

Table 2: Different types of devices used to measure tongue pressure