



# Prevalence of abnormal oral habits and its relation to malocclusion in dental patients of the lower northern part of Thailand

Udom Sasigornwong, Patcharaphol Samnieng, Sasima Puwanun, Thosapol Piyapattamin, Ratchawan Tansalarak, Kulthida Nunthayanon, Sirichom Satrawaha

Department of Preventive Dentistry, Faculty of Dentistry, Naresuan University.

## Abstract

**Objective:** To determine the prevalence of abnormal oral habits and its relation to malocclusion among the dental patients of the lower north part of Thailand.

**Materials and methods:** A cross sectional study was constructed in 400 dental patients (169 males, 231 females, ages 4 years and over, mean age 31 years who attended at dental hospital, Naresuan university. Information about abnormal oral habits was obtained with questionnaire interviews and clinical examination. Malocclusion were also examined by one trained dentist.

**Results:** Seventy seven percent of all patients presented at least one abnormal oral habit. The most prevalent habit were tongue-thrust swallowing (62.3%) followed by lip-sucking/biting (25.5%), mouth-breathing (16.9%), nail-biting (15.0%), digit-sucking (10.3%), other-object biting (6.5%), other-object sucking (3.5%) and pacifier-sucking (2.5%). The younger groups showed significant higher percentage of many habits (digit-sucking, lip-sucking/biting and nail-biting) than the older groups ( $p < 0.05$ ). Logistic regression showed tongue-thrust swallowing associated with anterior open bite with Odd ratio (OR = 11.3), anterior crossbite (OR = 4.3), mesiocclusion (OR = 3.7) and protrusion of maxillary incisors (OR = 2.9) compared with the absence of this habit.

**Conclusion:** The high prevalence of abnormal oral habits was found in dental patients of the lower northern part of Thailand. Tongue-thrust swallowing was the most prevalent habit which associated with various types of malocclusion. Dentist should concern for management of abnormal oral habits which could affect success and failure of the treatment.

**Keywords:** Prevalence, abnormal oral habit, malocclusion, Thailand

**How to cite:** Sasigornwong U, Samnieng P, Puwanun S, Piyapattamin T, Tansalarak R, Nunthayanon K, Satrawaha S. Prevalence of abnormal oral habits and its relation to malocclusion in dental patients of the lower northern part of Thailand. *M Dent J* 2016; 36: 113-122.

## Corresponding author:

Udom Sasigornwong  
Department of Preventive Dentistry,  
Faculty of Dentistry, Naresuan University.

**Received:** 30 April 2016

**Accepted:** 22 June 2016

## Introduction

Abnormal oral habits could alter a normal growth of oro-facial structures and also related to malocclusion which caused by various reasons such as unusual repetitive behaviors in an oral cavity<sup>1-3</sup>. They could be classified as digit-sucking, tongue-thrust swallowing, lip-sucking and lip-biting, nail-biting and mouth-breathing<sup>1, 4</sup>. These habits could alter normal growth of oro-facial structures<sup>1, 2</sup>, and related to malocclusion<sup>1</sup>. For example, digit-sucking which caused anterior open bite<sup>1</sup> due to forcing maxillary incisors to tip labially and mandibular incisors to tip lingually, and increased overjet<sup>5</sup>, tongue-thrust swallowing which affected open bite, increased overjet<sup>6</sup> and increased the degree of proclination/protrusion of maxillary incisors<sup>7</sup> and lip-sucking and lip-biting which affected lower lip to located under maxillary incisors as a result of protrusion of maxillary incisors, open bite and lingual collapsed of mandibular incisors<sup>1</sup>. The presence of only one abnormal oral habit may induce others<sup>2</sup>. They were also important factors affecting success in orthodontic treatment. In addition, they play an important role in retention and relapse during post-treatment period<sup>8-12</sup> such as tongue-thrust swallowing which was consider as a contributing factor of relapse after orthodontic treatment by many investigators<sup>9-11</sup>.

The previous studies reported an association between the abnormal oral habits and malocclusion<sup>13-15</sup> which was mostly concerned in the field of orthodontics and pediatric dentistry. In clinical view, if the patients' abnormal oral habits were not examined and evaluated accurately, their dental treatment especially orthodontic treatment could increase more complexity or lead to failure in treatment. Many studies reported the high percentage of prevalence of abnormal oral habits in different regions<sup>4, 13-17</sup>, therefore dentists should pay more attention to evaluate them.

Although there are many studies about the prevalence of abnormal oral habits in various populations, they are still controversial according to differences in races, region and abnormal oral habit classifications<sup>4, 13-17</sup>. In Thailand, the only one prevalence study of abnormal oral habits was carried out in the population in the central part of Thailand<sup>4</sup>. However, the data were obtained by using patients' chart record that might lack of a clear examination procedure. In the population of lower northern part of Thailand, the study about the prevalence of abnormal oral habits has not been available yet. If there is a study of prevalence of abnormal oral habits in this population, it would remind dentists to increase awareness to the existence of these habits in treatment planning of patients in this region. In addition, the relationship between certain abnormal oral habits and malocclusion has been still debated especially the tongue-thrust swallowing whether it associates to malocclusion<sup>6, 18-21</sup> or not<sup>22, 23</sup>. Therefore this study aims to determine the prevalence of abnormal oral habits and its relation to malocclusion in the population of the lower northern part of Thailand.

## Samples and methods

The study was approved by Naresuan university ethical committee, Phitsanulok, Thailand (IRB No. 405/58). A total of 400 randomized-by-using-non-probability-sampling patients who attended for dental treatment at the dental hospital, Naresuan University from November 2015 to April 2016 were constructed in this study. The inclusion criteria included the dentulous patients who reside in the lower northern part of Thailand (Kamphaeng Phet, Nakhon Sawan, Phetchabun, Phichit, Phitsanulok, Sukhothai, Tak, Uthai Thani and Uttaradit) with ages 4 years and over, no of history of orthodontic treatment, oro-facial trauma or surgery, mental retardation, active

respiratory infection and active seasonal allergy. The informed consents were obtained from all patients or, parents/caretakers in the case of patients under 12 years.

All data were obtained from history taking by using questionnaire for a structural interview and a clinical examination. A questionnaire was developed by constructing the set of question and questionnaire formats about the presence or history of abnormal oral habits included 1) digit-sucking habit, 2) pacifier-sucking habit, 3) tongue-thrust swallowing habit, 4) lip-sucking and lip-biting habit, 5) nail-biting habit 6) mouth-breathing habit, 7) other-object sucking habit and 8) other-object biting habit. A developed questionnaire was reviewed by the group of experts including orthodontist, pediatric dentist and expert in occlusion.

All abnormal oral habits were clinical examined except pacifier-sucking habit which is a rare method to investigate. The patients were diagnosed as the digit-biters when their digits expressed calluses and/or blisters<sup>24</sup>. Diagnosis of tongue-thrust swallowing habit was investigated by modifying the method suggested by Weiss and Van Houten<sup>25</sup>. The patients were set in upright position and asked to swallow the saliva (Figure 1A) followed by a 10 ml of water (Figure 1B). While swallowing, the examiner depressed the patients' lower lips with the examiner's thumbs (Figure 1C). The patients were diagnosed as tongue-thrust swallows when they presented at least one

of the following characteristics.

1. Their tongues thrust against maxillary central incisors or between maxillary and mandibular incisors.
2. They swallowed without contact between maxillary and mandibular incisors.
3. They swallowed with hyperfunction of the lower lip.

This method was done in triplicate. If the patient presented at least one of the above characteristics for twice or over, they would be diagnosed as tongue-thrust swallows.

By inspection of patients' lips, lip-suckers or lip-biters may present the following characteristics; inflammation of lips, dryness of lips, lip crack and hypertrophy of vermillion border<sup>26</sup>. Various factors could cause the occurrence of dried or cracked lip. Therefore, the patient were diagnosed as lip-suckers when they presented at least three of mentioned characteristics.

Nail-biters were diagnosed when the patients' fingernails showed a sever manner<sup>19</sup>.

Mouth-breathing habit was investigated by modifying the Rashmdeep's method which is a method to confirm nasal breathing<sup>27</sup>. The examiner wear the cut glove, which it's cutting area covers two nostrils of the patient, on his hand. After that the examiner placed his left hand over patient's lips with the cut area of thumb is below the nostrils of the patient then observe the expired air from the patient (Figure 2). The patients were diagnosed as mouth-breathers



**Figure 1** Modified method of Weiss and Van Houten method for identifying tongue-thrust swallowing

if the examiner could not feel an expired air from the patients. According to Gay et al. who studied a capacity in breath holding duration<sup>28</sup>, the duration which examiner could place his left hand over patients' lips was 25 seconds for the heavy smokers, the patients with history of obstructive pulmonary disease (COPD) or patients with history of congestive heart failure (CHF). Other patients were placed over the lips for 45 seconds. This method was also done in triplicate. When the examiner could not feel an expired air from the patients along the period of time twice or over, the patients were diagnosed as mouth-breathers. It is cautioned that there is a risk during the process of this method as the mouth-breathers may breathe difficultly. For the safety of patients, they were asked to raise left hand when they felt uncomfortable or unable to breathe during the process before the examination was performed. If the patients raise their hands, the examination would be stopped immediately.

Clinically examination of various types of malocclusion included Class II molar relationship (distoclusion), Class III molar relationship (mesioclusion), protrusion of maxillary incisors, large overjet, anterior open bite, posterior open bite, anterior crossbite and posterior crossbite.

Class II and Class III molar relationships were defined by using Angle's classification<sup>29</sup>. The maxillary incisors protruded when this two condition were met: 1) the upper lip were prominent and everted and 2) the upper lip were separated more than 3 to 4 mm at the rest



**Figure 2** Modified method of Rashmdeep' method for identifying mouth breathing

position<sup>30</sup>. When horizontal overlap of maxillary and mandibular incisors was greater than 3 mm, large overjet was diagnosed<sup>30</sup>. Failure of maxillary and mandibular incisors to overlap was diagnosed as anterior open bite<sup>30</sup> whereas failure of posterior teeth to occlude (unilateral or bilateral) was diagnosed as posterior open bite<sup>30</sup>. Anterior crossbite was diagnosed when mandibular incisors were located in front of maxillary incisors<sup>30</sup>. When maxillary posterior teeth were located at the buccal or lingual position compared with mandibular posterior teeth, posterior crossbite were diagnosed<sup>31</sup>.

Both history taking and clinical examination were assessed by one trained dentist. The patients were diagnosed with abnormal oral habits when they presented the abnormal oral habits from either questionnaire or clinical examination.

Obtained data was analyzed by computer program; SPSS (Version 17.0, Copyright) 1993-2007, SPSS Inc., Chicago, United States of America. The presences of abnormal oral habit were reported with the descriptive statistics. One-Way ANOVA was used for identifying the difference of abnormal oral habits between ages and sexes. Logistic regression was used for identifying relationship and quantifying how strongly the presence or absence of each abnormal oral habit is associated with the presence or absence of malocclusion. This was performed by using the number of patients presenting malocclusion without habit as reference compared with the number of patients presenting malocclusion with habit, then the calculated data was shown in term of Odd ratio (OR). All statistics were conducted by using 95% confident interval. (P-value < 0.05)

## Results

Out of 400 patients included in this study, 169 (42.3%) were males and 231 (57.7%) were females. Mean age of the samples was 31

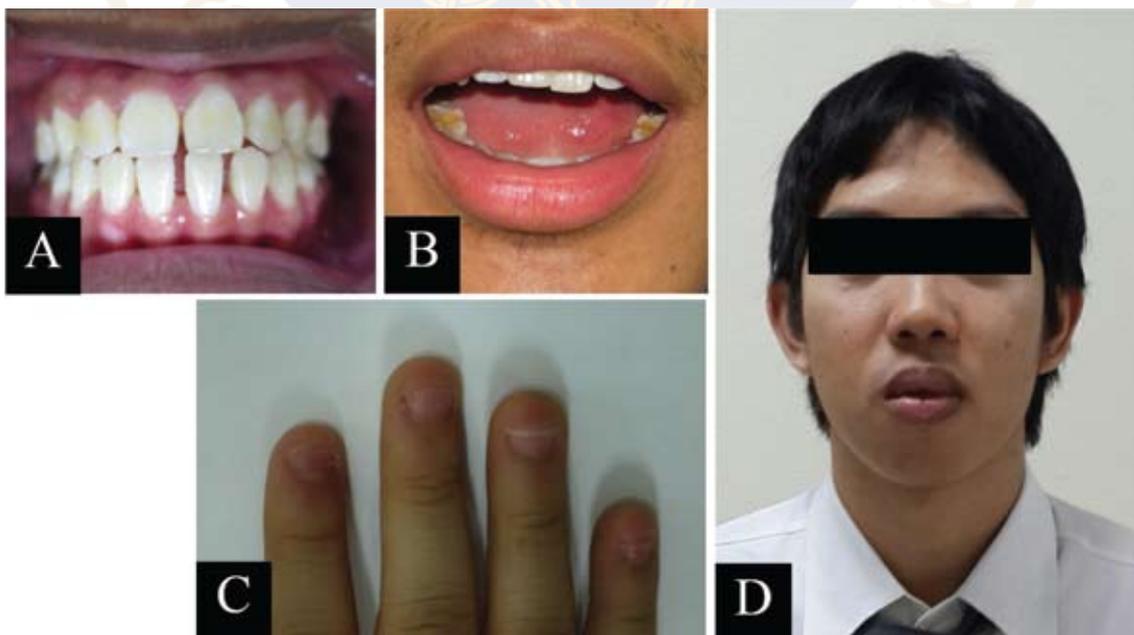
years. Ages of the patients were classified into 5 groups with the modified method of Havighurst's developmental task theory<sup>32</sup>. The distribution of patients according to age and sex was shown in Table 1.

Three hundred and eleven patients presented at least one abnormal oral habit (77.7%). However, one person could present only one until six habits (Table 2). Examples of some habits' characteristics were shown in the Figure 3; tongue-thrust between maxillary and mandibular incisors in a tongue-thrusters (Figure 3A), dried, cracked and inflamed lips in a lip-biter (Figure 3B), sever manner in a nail-biter (Figure 3C), Adenoid facies in a mouth-breather (Figure 3D)

The most prevalent habit was tongue-thrust swallowing or about 62.3%. The second was lip-sucking and lip-biting which is 25.5%. Mouth-breathing and nail-biting were around 15.0% in each group followed by 10.3% of patients having digit-sucking. The prevalence of other-object biting, other-object sucking and pacifier-sucking was found 6.5%, 3.5% and 2.5% respectively (Table 3). The objects were

suck or bite included towels, clothes, pens, pencils, and amulets.

The relationship between sexes and abnormal oral habits was not statistically significance. However we found the statistical significance between age and abnormal oral habit (Table 3 and 4). Digit-sucking, lip-sucking and lip-biting, and nail-biting habits showed a significantly higher prevalence in the younger groups (4-29 years of age) compared with the older groups (over 30 years of age). The most prevalent group of digit-sucking was the adolescence (16.3%) and this habit was not found in the elderly person. The most prevalent group of lip-sucking and lip-biting was the early adulthood (41.3%) then this habit was reduced overtime when the patients' ages increased. The most prevalent group of nail-biting was the childhood (27.5%) and also this habit was reduced to 3.8% in each group (middle adulthood and elderly person groups). However, pacifier-sucking was the last prevalent habit in the patients of this study. The most prevalent group of this habit was the adolescence group (8.8%) but no habit in the early adulthood and elderly



**Figure 3** Characteristics of some habits found in this study

person. The tongue-thrust swallowing was the most prevalent habit compared to the other habits which were more than a half (52.5% to 70.0%) in every group of patients. The childhood group was the most prevalent of tongue-thrust swallowing (70%) compared with the other age groups and also was statistically significant to middle adulthood group.

No patient in elderly person group presented in the other-object sucking that was a statistically significant lower than the early adulthood group (6.3%). Other-object biting was mostly found in early adulthood group (15.0%) which was statistically significant higher than the other groups except the adolescence group.

Anterior open bite was the most prevalent malocclusion (25.7%) followed by protrusion of maxillary incisors (21.5%), large overjet (20.5%) and Class III molar relationship (19.2%). In addition, class II molar relationship, anterior crossbite, posterior crossbite and posterior open bite were found 16.0%, 11.0%, 2.7% and 1.6% of patients, respectively (Table 5).

Logistic regression showed that tongue-thrust swallowing was the most effective habit which associated with malocclusion. Strong association, the presence of this habit associated to anterior open bite ( $p$ -value = 0.000) about 11 times (OR=11.3) compared with absence of this habit. This habit also associated with protrusion of maxillary incisors, anterior crossbite and Class III molar relationship with 2.9, 4.3, 3.7 times respectively compared with absence of this habit. Moreover, other-object sucking was associated with posterior crossbite with 25 times compared with absence of this habit.

## Discussion

There are many studies that reported the prevalence of abnormal oral habits in various populations which was 25.9% (15) or reach up to 96.6%<sup>13</sup> of patients (Table 7). This wide range may be due to differences in race,

geographic factor (region) and also various inclusion criteria of samples and classification of abnormal oral habits. Almost studies were constructed in young patients ranged from 2 to 15 years of age<sup>4, 13-17</sup>. The only one study about the prevalence of abnormal oral habits was carried out in the people ages 5 to 7 years of the central part of Thailand<sup>4</sup>. This study was constructed in patients of all ages of the lower northern part of Thailand, which showed that the high prevalence of certain habits was also found in all age groups.

The abnormal oral habits in this study was classified as digit-sucking, pacifier-sucking, tongue-thrust swallowing, lip-sucking and lip-biting, nail-biting, mouth-breathing, other-object sucking and other-object biting. This was modified from Moyer's classification<sup>1</sup> and the study of Kaewsutha et al. which carried out in Thailand<sup>4</sup>. This classification was also similar to many studies included the study of Oropeza et al. carried out in Portugal<sup>13</sup>, the studies of Pruthi et al.<sup>15</sup> and Shetty et al.<sup>17</sup> which both of them were carried out in different regions of India.

This study showed that the abnormal oral habits were commonly found in the dental patients of lower northern part of Thailand. Almost seventy eight percent of patients presented at least one abnormal oral habit. This result was higher than the other similar studies which reported 39.7%<sup>4</sup>, 33.8%<sup>13</sup>, 25.9%<sup>15</sup> and 33.2%<sup>17</sup> of patients presented at least one abnormal oral habit. This may be caused of racial difference and/or inclusion criteria of sample such as age of the patients. In addition, it may be each region presented a unique pattern.

This study found that the prevalence of digit-sucking in childhood group was higher than the study carried out in central part of Thailand<sup>4</sup>, India<sup>17</sup> and Portugal<sup>14</sup> but lower than the studies of Nigeria<sup>16</sup> and Mexico<sup>13</sup>. This result corresponded to previous knowledge that

digit-sucking which is a non-nutritive sucking usually presents during the early period of life or about 3-4 years of age<sup>1</sup> and significantly decreased when the child is 4 years old<sup>33</sup>. However, our result showed that this habit was more prevalence in the adolescence and early adulthood groups than the childhood group. The reason might be caused the patients on both groups gave the history of digit-sucking when they were in the childhood period. The prevalence of the other non-nutritive sucking were investigated in this study was also the same pattern, most of patients in adolescence and middle adulthood groups might gave the history of pacifier-sucking in childhood period.

We found that tongue-thrust swallowing was the most prevalent of abnormal oral habit in the people of the lower northern part of Thailand. All age groups presented this habit more than a 50% of patients. The highest percentage of this habit was found in childhood group with 70.0% of patients. Previous studies also found that there were more than a half of childhoods presented this habit<sup>13, 17</sup>. Our result showed that the prevalence of this habit decreased when the age increased. However, the elderly group who was more likely lost their anterior teeth might cause the tongue-thrust swallowing occurred. This may be a compensation of swallowing by protruding the tongue to seal the space from the missing anterior teeth<sup>2</sup>. Many patients in this study were not usually aware of the tongue thrusting. Most of them were diagnosed as tongue-thrusters with clinical examination. This study agreed with the study of Shetty et al. which their diagnosis method of tongue-thrust swallowing was based on clinical examination<sup>17</sup>.

Lip-sucking and lip-biting was found 25.5% of patients in this study. The childhood group presented this habit 36.3%. This result was the highest prevalence compared with many studies<sup>4, 13, 14, 16, 17</sup>. Previous studies were carried

out in Childhood and adolescence people, our result showed that the early adulthood group was the most prevalent group presenting this habit with 31.3% of patients.

Fifteen percent of the patients in this study presented the nail-biting habit. According to the highest prevalence was found in the childhood group. Our result was not corresponded to the previous study which reported that the occurrence of this habit increased in adolescence<sup>34</sup>. By 21.3% of the nail-biting habit patients in adolescence group, our result was lower than the study in Mexico<sup>13</sup> but it was a significant higher than the studies in India<sup>17</sup> and central part of Thailand<sup>4</sup>.

The prevalence of mouth-breathing in this study was 15.3%. The childhood group was the most prevalent group which presented this habit with 21.3% of patients. This result was lower than many studies<sup>13, 17</sup>, which included the study carried out in Thailand<sup>4</sup>.

Other-object sucking was found only 3.5% of patients. The early adulthood was the most prevalent group which presented this habit. This group was statistically significant higher than the elderly person group who did not exhibit this non-nutritive sucking habit. Other-object biting was also mostly found in the early adulthood group with 12% of patients that was statistically significant higher than all other groups. The reason might be the patients shifted from digit-sucking or pacifier-sucking to other non-nutritive sucking/biting. These two habits were not appeared in previous studies conducted in childhood people, therefore no data to compare. This study showed adolescence group presented this habit 6.5% which was lower than the study in India<sup>15</sup>.

Our study found that the prevalence of Class II molar relationship was 16.0% which was statistically significant higher than the study in India<sup>35</sup> but lower than the study in Pakistan<sup>36</sup>. The prevalence of Class III molar

relationship was shown in a high percentage with 19.2% of patients which was approximate to a systematic review of prevalence of Class III malocclusion that reported the population of Southeast Asian countries presented the high prevalence of Class III malocclusion about 16.0%<sup>37</sup>. Anterior open bite which was the most prevalent malocclusion in this study was found 25.7% of patients. This result corresponded with the highest percentage of tongue-thrust swallowing which had strong association with anterior open bite. Moreover, the prevalence of anterior open bite in this study was higher than many studies<sup>38-40</sup>.

The relationship between abnormal oral habits and malocclusion were report in many studies such as class II molar relationship or distoclusion<sup>41, 42</sup>, labial tipping or protrusion of maxillary incisors<sup>1, 43</sup>, large overjet<sup>6, 18-20, 44</sup>, anterior open bite<sup>1, 2, 45-47</sup>, posterior crossbite<sup>5, 47-49</sup>, spacing of maxillary incisors<sup>20</sup> and lingual collapse of mandibular incisors<sup>1</sup>. Our study found the tongue-thrust swallowing associated with various types of malocclusion included anterior open bite (OR = 11.3), protrusion of maxillary incisors (OR = 2.9), anterior crossbite (OR = 4.3) and Class III molar relationship or mesiocclusion (OR = 3.7) compared with the absence of this habit. Similar results were reported in the study of Hanson and Adrianopoulos who also found anterior open bite<sup>6, 19-21</sup> and the study of Alexander and Sudha who found protrusion of maxillary incisors<sup>7</sup>. Whereas association between tongue-thrust swallowing with anterior crossbite and Class III molar relationship has never been reported. This might be the effect of prevalence of Class III malocclusion which was found in the high percentage in southeast Asian countries<sup>37</sup>. Moreover, we found other-object sucking associated with posterior crossbite (OR = 25.7) which also has never been reported. The reason might be that the other-object sucking was a type of non-nutritive sucking like

pacifier-sucking which a previous study reported it associated with posterior crossbite<sup>47</sup>.

Other types of malocclusion associated with tongue-thrust swallowing which were not found in this study included large overjet<sup>18-20</sup>, Class II molar relationship<sup>19, 20</sup> and posterior crossbite<sup>19</sup>. Most of tongue-thrusters in this study were found their tongues protruded against both maxillary and mandibular incisors, therefore the overjet were not increased. In addition, the frequency and duration of the abnormal oral habits which do have a role to play in developing malocclusion<sup>5, 47, 48, 50, 51</sup>; limitation of this study was the cross-sectional design. Further studies should evaluate the effect of duration and frequency of abnormal oral habits on the presence of malocclusion.

In conclusion, dental patients of the lower northern part of Thailand presented the high prevalence of abnormal oral habits. Tongue-thrust swallowing was the most prevalent habit which associated with various types malocclusion. Therefore, in dental visit, dentists should pay more attention to evaluate and manage the abnormal oral habits which could affect the success or failure of orthodontic treatment.

**Funding:** None

**Competing interests:** None

**Ethical approval:** The study was approved by Naresuan University ethical committee, Phitsanulok, Thailand (IRB no. 405/58)

## References

1. Moyers RE. Etiology of malocclusion. In: Marshall DK, Mitera MC, editors. *Handbook of Orthodontics*. 4th ed. London: Year book medical, INC; 1988: 147-63.
2. Singaraju GS, Kumar C. Tongue thrust habit - A review. *Ann essences dent* 2009; 1: 14-23.
3. Wigdorowicz-Makowerowa N, Grodzki C, Panek H, Ma'slanka T, Plonka K, Palacha A. Epidemiologic studies on prevalence and etiology of functional disturbances of the masticatory system. *J Prosthet Dent* 1979; 41: 76-82.

4. Kaewsutha N, Boonin T, Luangruangrong K, Mapaisarnsin C, Chaiwiriya J. The prevalence and physical factors related to dental caries in children-patients at the faculty of dentistry, Srinakharinwirot university. *Srinakharinwirot University Dental Journal* 2013; 6: 35-47.
5. Warren J, Bishara SE, Steinbock K, Yonezu T, Nowak A. Effects of oral habits' duration on dental characteristics in the primary dentition. *J Am Dent Assoc* 2001; 132: 1685-93.
6. Hanson ML, Andrianopoulos MV. Tongue thrust and malocclusion: a longitudinal study. *Int J Orthod* 1982; 20: 9-18.
7. Alexander S, Sudha P. Genioglossis muscle electrical activity and associated arch dimensional changes in simple tongue thrust swallow pattern. *J Clin Pediatr Dent* 1997; 21: 213-22.
8. Justus R. Correction of anterior open bite with spurs: long-term stability. *World J Orthod* 2001: 219-31.
9. Adrianopoulos MV, Hanson ML. Tongue-thrust and the stability of overjet correction. *Angle Orthod* 1987; 57: 121-35.
10. Fotis M, Melsen B, Williams S. Posttreatment changes of skeletal morphology following treatment aimed at restriction of maxillary growth. *Am J Orthod* 1985; 88: 288-96.
11. Bishara SE. Management of diastemas in orthodontics. *Am J Orthod* 1972; 61: 55-63.
12. Smithpeter J, Covell D, Jr. Relapse of anterior open bites treated with orthodontic appliances with and without orofacial myofunctional therapy. *Am J Orthod Dentofacial Orthop* 2010; 137: 605-14.
13. Oropeza LM, Ocampo AFM, Sánchez RO, Lópezll AF. Prevalence of malocclusions associated with pernicious oral habits in a Mexican sample. *Revista Mexicana de Ortodoncia* 2014; 2: 216-23.
14. Macho V, Andrade D, Areias C, Norton A, Coelho A, Macedo P. Prevalence of deleterious oral habits and occlusal anomalies in a population aged 3-13 years. *Rev Port Estomatol Cir Maxilofac* 2012; 53: 143-7.
15. Pruthi N, Sogi P, Fotedar S. Malocclusion and deleterious oral habits in a north Indian adolescent population: A correlational study. *Eur J Gen Dent* 2013; 2: 257-63.
16. Quashie-Williams R, Dacosta OO, Isiekwe MC. The prevalence of oral habits among 4 to 15 year old School children in Lagos. *Nigerian J Health Biomed Sci* 2007; 6: 78-82.
17. Shetty RM, Shetty M, Shetty NS, Reddy H, Shetty S, ANgrawal A. Oral habits in children of Rajnandgaon, Chhattisgarh, India- A prevalence study. *Int J Public Health Dentistry* 2013; 4: 1-7.
18. Jalaly T, Ahrari F, Amini F. Effect of tongue thrust swallowing on position of anterior teeth. *J Dent Res Dent Clin Dent Prospects* 2009; 3: 73-7.
19. Al-Atabi HS. Prevalence of bad oral habits and relationship with prevalence of malocclusion in Sammawa city students aged (6-18) years old. *Med j Babylon* 2014; 11: 70-83.
20. Melsen B, Stensgaard K, Pedersen J. Sucking habits and their influence on swallowing pattern and prevalence of malocclusion. *Eur J Orthod* 1979; 1: 271-80.
21. Jabur SF, Nisayif D. The effect of bad oral habits on malocclusions and its relation with age, gender and type of feeding. *The Marietta Daily Journal* 2007; 4: 152-6.
22. Vaden JL, Deewood CA. Treatment planning. In: English JD, Paltomaki T, Pham-Litschel K, editors. *Mosby's Orthodontic review*. St. Louis: Mosby, Inc., an affiliate of Elsevier Inc. 2009: 104-27.
23. Speidel TM, Starr CD. A perspective on the role of the tongue in closure of anterior open bite. *Human Communication*. 1977: 83-97.
24. Thumb and finger-sucking habits. *Journal of the New Zealand Dental Therapists' Association* 2001: 9.
25. Weiss CE, Van Houten JT. A remedial program for tongue thrust. *Am J Orthod* 1972; 62: 499-506.
26. Dahan JS, Lelong BA, Celant S, Leysen V. Oral perception in tongue thrust and other oral habits. *Am J Orthod* 2000; 118: 385-91.
27. Prajapati D, Nayak R. Rahsmdeep's method: a novel method to confirm nasal breathing. *J Contemp Dent Pract* 2013; 14: 2-4.
28. Gay SB, Sistrom CL, Holder CA, Suratt PM. Breath-holding capability of adults. Implications for spiral computed tomography, fast-acquisition magnetic resonance imaging, and angiography. *Invest Radiol* 1994; 29: 848-51.
29. Angle EH. *Treatment of malocclusion of the teeth and fractures of the maxillae*. Angle's System. 6th ed. Philadelphia: SS White Dental Mfg Co; 1900.

30. Proffit WR, Fields HW, Sarver DM, Ackerman JL. *Contemporary orthodontics*. 5th ed. St. Louis: Elsevier; 2013.
31. Moyers RE. *Handbook of orthodontics*. Chicago: Year Book Medical Publisher, Inc; 1966: 332-41.
32. Havighurst RJ. *Developmental tasks and education*. New York: McKay; 1972.
33. Bishara SE, Warren JJ, Broffitt B, Levy SM. Changes in the prevalence of nonnutritive sucking patterns in the first 8 years of life. *Am J Orthod Dentofacial Orthop* 2006; 130: 31-6.
34. Tanaka OM, Vitral AW, Tanaka GY, Guerrero AP, Camargo ES. Nail biting, or onychophagia: A special habit. *Am J Orthod Dentofacial Orthop* 2008; 134: 305-8.
35. Sridharan K, Udupa V, Srinivas H, Kumar S, Sandbhor S. Prevalence of Class II malocclusion in Tumkur population. *J Dent Sci Res* 2011; 2: 1-5.
36. Aslam A, Naeem A, Jan HU, Allibukhari G, Abbas Q, Amjad M. Prevalence of Class II malocclusion in Pakistani sample-A study. *Pakistan Oral and Dent J* 2010; 30: 96-100.
37. Hardy DK, Cubas YP, Orellana MF. Prevalence of angle class III malocclusion: A systematic review and meta-analysis. *Open J Epidemiol* 2012; 2: 75-82.
38. Ngan P, Fields HW. Open bite: a review of etiology and management. *J Dent Child* 1997; 19: 91-8.
39. Khalid A, SHAH SR, Yayyab M, Hassan A. Prevalence of anterior open bite in sample of Preshawar population-a study. *Pakistan Oral and Dent J* 2015; 35: 231-3.
40. Dae AA, Abuaffan AH. Prevalence of anterior open bite among Yemeni adults. *J Dev Drugs* 2016; 5: 1-3.
41. Rakosi T, Jonas I, Graber TM. Etiology of malocclusion. In: Rateitschak KH, Wolf HF, editors. *Orthodontic-Diagnosis* New York: Thieme Medical Publisher, Inc.; 1993: 85-7.
42. Pădure H, Negru A, Stanciu D. The Class II/1 anomaly of hereditary etiology vs. thumb-sucking etiology. *J Med Life* 2012; 5: 239-41.
43. Abreu RR, Rocha RL, Guerra ÂFM. Prevalence of mouth breathing among children. *J Pediatr (Rio J)* 2008; 84: 467-70.
44. Rao A. Pernicious oral habits. In: Rao A, editor. *Principle and Practice of Pedodontics*. 3rd ed. New Dehli: Jaypee Brothers Medical Publishers (P) Ltd.; 2012: 161-73.
45. Ize-lyamu IN, Isiekwe MC. Prevalence and factors associated with anterior open bite in 2 to 5 year old children in Benin city, Nigeria. *Afr Health Sci* 2013; 12: 446-51.
46. Shahraki N, Yassaei S, Goldani Moghadam M. Abnormal oral habits: A review. *J Dent Oral Hyg* 2012; 4: 12-5.
47. Melink S, Vagner MV, Hocesvar-Boltezar I, Ovsenik M. Posterior crossbite in the deciduous dentition period, its relation with sucking habits, irregular orofacial functions, and otolaryngological findings. *Am J Orthod Dentofacial Orthop* 2010; 138: 32-40.
48. Poyak J. Effects of pacifiers on early oral development. *Int J Orthod* 2006; 17: 13-6.
49. Gale EN, Ager WA. Thumb sucking revisited. *Am J Orthod* 1979; 55: 167-70.
50. Rasheed NA. *Prevalence of thumb sucking habit and its relation to malocclusion in preschool children*. 2009; 7.
51. Brenchley M. Is digit sucking of significance? *Br Dent J* 1991; 171: 357-62.