**ORIGINAL ARTICLE** POJ 2020:12(2) 71-76

# Influence of tonsillar grade on the dental arch measurements

Nofil Ahmad[a], Mir Hadi Faisal[b], Kanwal Zulfiqar[c], Muhammad Ahmed[d], Hajirah Afridi[e], Ulfat Bashir Raja[f]

## Abstract

**Introduction**: Waldeyer's ring hypertrophy can possibly have a negative impact on the inter arch and intra arch dental anomalies. Previous studies have been carried out to investigate the extent of impact but it still remains controversial. The aim of this study is to seek a correlation between the tonsillar grade of patients and their respective inter arch transverse dimensions.[1]

**Material and Methods**: A cross sectional study of 70 patients, aged between 8 and 12, was conducted at the Department of Orthodontics, Islamic International Dental Hospital, Islamabad. The patients were divided into 5 subgroups according to the Brodsky and Koch Tonsillar grading scale.[4] The maxillary and mandibular inter premolar width was measured on their respective casts and subsequently the inter arch transverse dimension was calculated. The correlation between the tonsillar grade and the inter arch transverse dimension was evaluated using the Spearman Correlation Coefficient using the SPSS 16.0.

**Results**: The mean age of patients was 10.51 ± 1.36 years. There were 42(60%) male and 28(40%) female cases. There were 1(1.4%) cases who had Grade0, 11(15.7%) cases had Grade 1, 31(44.3%) cases had grade 2, 25(35.7%) cases had Grade 3 and 2(2.9%) cases had Grade 4. The mean maxillary Inter first premolar width was 44.84 ± 8.37 (mm), the mean mandible Inter first premolar width was 45.18 ± 9.89 (mm) and mean interarch transverse dimension was 0.39 ± 1.96 (mm). The correlation between Tonsillar Grades &Inter arch transverse dimension was calculated to be -0.682, p-value < 0.001, which was highly significant.

**Conclusions**: There is a significant negative correlation between Tonsillar Grades and Inter arch transverse dimension which implies greater the tonsillar grade, lower the transversal dimension of both the arches, leading to a tendency for posterior crossbite. Therefore, prevention programs for orthodontic anomalies must be taken into consideration that arise due to tonsillar hypertrophy early on during development of the dental arches.

**Keywords:** Dental arch; hypertrophy; tonsils

## Introduction

The Waldeyer's Ring named after the anatomist Heinrich Wilhelm Gottfield Waldeyer, consists of the tonsils and adenoids situated at the entrance of the upper respiratory tract and alimentary tract.It also includes the tubal tonsils and lingual tonsils. These tonsils comprise of immunologically reactive lymphoid tissue and are constantly exposed to antigens.[1]

Facial growth coincides with tonsillar and adenoidal growth. The tonsillar and adenoidal growth peaks around the age of 6 and then enters into a stage known as

[a] BDS, MDS. Demonstrator Department of Orthodontics, Frontier College of Dentistry, Abbottabad, Pakistan.
[b] BDS, MDS. Type-D hospital, Khanpur, KPK, Pakistan.
[C] Corresponding Author; BDS, FCPS, M Orth RCSEd (UK). Assistant Professor, Department of Orthodontics, Islamic International Dental Hospital.
Email: kanwal.swati@gmail.com
[d] BDS, MDS(OMFS). Shaheed Zulfiqar Ali Bhutto medical University.
[e] B.D.S. Islamic International Dental Hospital.
[f] BDS, MCPS, FCPS, MHPE. Professor of Orthodontics. Islamic International Dental College.

regression or involution.[2] Excessive adenoidal growth can severely affect normal functions such as breathing, leading to abnormal breathing patterns, obstructive sleep apnea and abnormal facial growth. Patients' with enlarged tonsils have been noted to have increased vertical dimensions of the face which in turn is caused by an increase in the gonial angle of the mandible or by posterior maxillary dentoalveolar excess.[3] The maxilla however, appears to be narrow in the transverse plane.[4-6]

Waldeyer's ring hypertrophy can possibly have a negative impact on the inter arch and intra arch dental anomalies. Previous studies have been carried out to investigate the extent of this effect, but it remains controversial. A number of studies have carried out 2-dimensional cephalometric assessment of the diameter of the pharynx. But on the contrary, the size of the tonsils that occupy the pharynx have shown to cause more of an impact on the inter and intra arch transverse dimensions. For this reason, Brodsky and Koch established a grading scale that describes the enlarged tonsils based on how much space they occupy in the pharynx. According to a previous study carried out by Samba et al, using the Brodsky and Kotch tonsillar hypertrophy grading scale, they concluded that for maxillary inter first premolar width (P=0.003) and the maxillary inter first molar width(P=0.007), greater the tonsillar grade, lower the transverse dimension of the maxillary arch with correlation coefficient of 0.340.[1]

Therefore, the aim of the present study is to seek a correlation concerning the tonsillar grade of patients and their respective inter arch transverse dimensions. As there is evidence that rapid maxillary expansion or tonsillectomy done at an early age can significantly improve interdental measurements and effects of nasal breathing, this study will help in supporting a prevention program for orthodontic anomalies that arise due to tonsillar hypertrophy early on during their development.[1,21]

## Material and Methods

The patient sample consisted of 70 patients, including 42 boys 28 girls. The inclusion criteria included children aged 8 to12 of either gender. While the exclusion criteria included children who previously had undergone surgical removal of the tonsils, any history of orthodontic treatment, patients with chronic allergic rhinitis, patients with hypertrophy of lingual tonsils or having nonnutritive sucking habits. The selected patients were asked to lie in a supine position, with their mouth wide open continuously pronouncing the phoneme /r/. The patient's tonsil size was divided into 5 subgroups according to the standardized Brodsky and Kotch tonsillar grading scale, which is based on the ratio of tonsils occupying the space in the oropharynx as shown in Figure 1. After tonsillar grading was carried out, impressions of the patients were taken and the intra arch and then subsequently inter arch transverse dimensions were measured on their respective dental casts in millimeters using an electronic vernier caliper and was recorded on the proforma.[1] The maxillary inter premolar width measurement was taken as the distance between the buccal cusp tips of the right and left maxillary 1$^{st}$premolars in mm. While the mandibular inter premolar width was measured as the distance of the embrasure between the right and left mandibular 1$^{st}$ and 2$^{nd}$premolars in mm. The inter arch transverse dimension was the difference between maxillary and mandibular inter first premolar widths in mm.

Data analysis was carried out using Statistical Package for the Social Sciences (SPSS version 16.0, Chicago, SPSS Inc). The Qualitative variables i.e., Gender, Tonsillar grade was measured as frequency and percentage. The Quantitative variables i.e., age, transverse dimension was measured as mean ± standard deviation. The correlation between the

tonsillar grade and the inter arch transverse dimension was evaluated using the Spearman Correlation Coefficient. The P value ≤ 0.05 was significant. Effect modifier like age, gender was addressed, post stratified correlation coefficient was applied, taking p-value < 0.05 as significant.

## Results

The mean age of patients was 10.51 ± 1.36 years with minimum and maximum age as 8 and 12 years. There were 42 (60%) male and 28 (40%) female cases, with higher male to female ratio. There was 1 (1.4%) case having Grade 0, 11(15.7%) cases had grade 1, 31(44.3%) cases had grade 2, 25(35.7%) cases had grade 3 and 2(2.9%) cases had grade 4.

The mean maxillary Inter first premolar width was 44.84 ± 8.37 (mm), the mean mandibular inter first premolar width was 45.18 ± 9.89 (mm) and mean inter arch transverse dimension was 0.39 ± 1.96 with minimum and maximum value as -6.03 and 4.82 mm (Table I, II & III).

The correlation between Tonsillar Grades Inter arch transverse dimension was -0.682, p-value < 0.001 (Table IV).

**Table I: Descriptive Statistics maxillary inter first premolar width (mm)**

| Maxillary Inter first premolar width (mm) | |
|---|---|
| *Mean* | 44.84 |
| *S.D* | 8.37 |
| *Range* | 29.60 |
| *Minimum* | 28.53 |
| *Maximum* | 58.13 |

**Table II: Descriptive statistics of Mandibular premolar width (mm)**

| Mandibular Inter first premolar width (mm) | |
|---|---|
| *Mean* | 45.18 |
| *S.D* | 9.89 |
| *Range* | 60.89 |
| *Minimum* | 29.04 |
| *Maximum* | 89.93 |

**Table III: Descriptive Statistics of Inter arch Transverse Dimension(mm)**

| Inter arch transverse dimension(mm) | |
|---|---|
| *Mean* | 0.39 |
| *S.D* | 1.96 |
| *Range* | 10.85 |
| *Minimum* | -6.03 |
| *Maximum* | 4.82 |

**Table IV: Correlation between Tonsillar Grade versus Inter arch transverse dimension**

| | |
|---|---|
| *Pearson Correlation* | -0.682 |
| *P-value* | <0.001 |
| No. of cases | 70 |

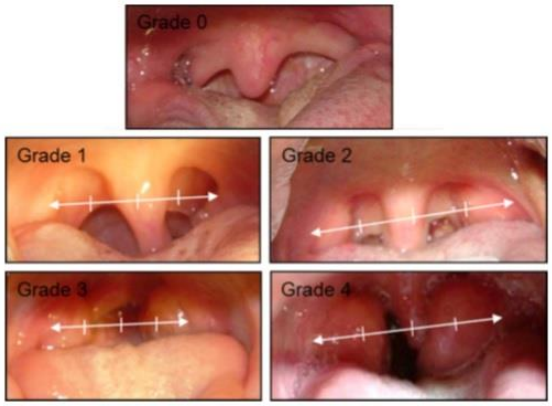


**Figure 1: Grade 0: Tonsils limited to the tonsillar fossa, Grade 1: Tonsils occupying up to 25% of the space between the anterior pillars in the Oropharynx, Grade 2: Tonsils occupying> 25-50% of the space between the anterior pillars, Grade 3: Tonsils occupying>50-75% of the space between the anterior pillars, Grade 4: Tonsils occupying >75-100% of the space between the anterior pillars.[4]**

## Discussion

Genetic and environmental factors direct the pattern of facial growth after birth, which is a multifunctional and intricate phenomenon. Similarly, numerous studies indicate that environmental influences have the ability to modify the development of facial structures, but as the unusual environmental factor is

removed, the changes could be reversed to a certain extent.[7-9]

As the impact of environmental factors has been mentioned earlier, different studies proved the correlation between an obstructed airway and undesirable variations of the facial form. Reasons for an obstructive airway can be enlarged adenoids or tonsils, allergic rhinitis and choanal atresia. [10, 18-20]

Adenoids are a cluster of lymphatic tissue located in the posterior nasopharynx, the size of which differs among children and different times during development.[11]Normally, the adenoids are to reduce in size as the growth of the nasopharynx takes place. However, this mass of lymphatic tissue can possibly hypertrophy, consequently occupying more space in the nasopharynx. This in turn leads to detrimental consequences effecting the airway thereby constricting it, along with diminished nasal respiration and lastly development of an altered respiratory pattern.[8]This has been proven in various studies which associate breathing dysfunctions with abnormal dentofacial growth.[9] "Adenoid facies", Long- face syndrome or Respiratory obstruction syndrome, is a sign of abnormal craniofacial development, which is known to be caused by an undesirable respiratory pattern leading to mouth breathing.[10] Features such as increased lower facial height, narrow alar bases, lip incompetence, constricted arches, V shaped palatal vault with protruding teeth and abnormal relation between both the upper and lower jaws, describe this syndrome.[11]

Dental arch dimensions and their measurements play a crucial role in orthodontic diagnosis and treatment planning, which in turn is influenced by factors like race, ethnicity, genetics, and environment. [12]It is imperative to ascertain the failure of which may lead to a high chance of relapse and a poor prognosis of treatment.[9,13]

Adenoidectomy or the surgical removal of adenoids has been devised as a treatment for altered respiratory patterns. The effects of which were observed in a study carried out by Linder-Aronson et al. The results demonstrated improvement in the gonial angle of the mandible, consequently becoming less steep, along with improvement in the transverse dimension of the maxillary arch and mandibular incisors returning to normal inclination 5 years after adenoidectomy. [14]Similarly in a study carried out by Petraccone Caixeta et al. concluded that children who were mouth breathers and who were treated with adenotonsillectomy demonstrated better maxillary transverse development as compared to untreated controls.[10,15]

According to the current study a negative significant correlation was found i.e. the correlation between Tonsillar Grades Inter arch and transverse dimension was -0.682, p-value < 0.001. According to a previous study carried out by Samba et al, using the Brodsky and Kotch tonsillar hypertrophy grading scale, they concluded that for maxillary inter first premolar width (P=0.003) and the maxillary inter first molar width(P=0.007), the higher the tonsillar grade, the lower was the transverse dimension of the maxillary arch with correlation coefficient of -0.340 .[4] The results reported by Samba et al are similar to the findings of the current study where the transverse dimensions of both the arches and subsequently the inter arch transverse dimension had decreased as tonsillar grade increased. Recently a study was performed in Ile-Ife, Nigeria, to study the consequences of enlarged adenoids on the dental arch dimensions in children. Ninety patients who were attending the Otorhinolaryngology Clinic at Obafemi Awolowo University Teaching Hospital, ages ranging from three to twelve years were recruited in the study. These children were identified as having hypertrophied adenoids. Whereas ninety children from the Child Dental Health Clinic were included in the control group. Different dimensions of the maxillary and mandibular arch were taken which included total arch

length, inter-canine, inter-premolar, and inter-molar widths, palatal length, palatal heights measured at three levels and palatal volume were determined for both groups from dental casts. The maxillary arch dimensions showed to be smaller in the adenoid group as compared to the control group. However, only total maxillary arch length was significantly shorter ($p=0.049$). Similar results were demonstrated for the mandibular arch dimensions except for inter-molar width which was significantly shorter in the adenoid group ($p< 0.05$). Steep palatal vaults with increased heights were observed in patients with hypertrophied adenoid subjects with reduced palatal volume compared to the control subjects ($p< 0.05$). Consequently, this leads to the conclusion that the group with hypertrophied adenoids exhibited smaller maxillary and mandibular arch dimensions in contrast to the control subjects.[16]

Similarly, another cross-sectional study was performed in order to determine a relationship between the size of the palatine tonsils and the dental arch dimensions. A group of children who were subdivided into 5 groups according to the Standardized tonsillar hypertrophy grading scale were studied. Various measurements taken from the dental casts were documented for each subject. The chi- square test was used for the comparison of qualitative variables. The results of this study demonstrated that as the tonsil size or grade increased, the depth of the upper arch also increased depth of the upper arch was noted. At the same time, as the tonsil grade increased different transverse dimensions such as the maxillary intercanine, interpremolar, and intermolar widths significantly decreased. Class II malocclusions were found to be more prevalent in children with Grade 4 tonsils along with a posterior crossbite and functional lateral deviation of the mandible. These studies bring us to the conclusion that if we carry out early evaluation of the size of the palatine tonsils, not only would it help in preventing malocclusions but also spare patients of more aggressive treatments later on in life. Aggressive treatments would involve [4,17]

A limitation of this study was that reproducibility of the recorded measurements could not be assessed. In order to enhance reproducibility, the dental arch measurements should have been measured at different times by different readers to increase reproducibility.

## Conclusions

It can be concluded from this study that there is a negative significant correlation between Tonsillar Grades and Inter arch transverse dimensions suggesting that higher the tonsillar grade, lower the transversal dimensions of the maxillary and mandibular arches along with the inter arch transverse dimensions. Decreased dental arch measurements lead to a predisposition towards developing a posterior crossbite subsequently leading to complicated malocclusions. Preventive measures including a timely referral to otolaryngologist and appropriate treatment for orthodontic anomalies must be taken into consideration that arises due to tonsillar hypertrophy at an initial stage of dental arch development.

## References


1. Diouf JS, Ngom PI, Sonko O, Diop-Bâ K, Badiane A, Diagne F. Influence of tonsillar grade on the dental arch measurements. Am J OrthodDentfacailOrthop. 2015;147(2):214-20.
2. Kaur R, Gandikota C, Mody DR, Poornima K, Juvvadi SR. An insight into relationship of hypertrophied adenoids and tonsils and dentofacial form. IOSR J Dent Med Sci. 2014;13:48-54.
3. Mahony D, Williams K. The effects of enlarged adenoids on a developing malocclusion. Dent Trib Unit Kingdom Edition. 2008:19-23.
4. Diouf JS, Ngom PI, Sonko O, Diop-Bâ K, Badiane A, Diagne F. Influence of tonsillar grade on the dental arch measurements. Am J Orthod Dentfacail Orthop. 2015;147(2):214-20.
5. Howes AE. A polygon portrayal of coronal and basal arch dimensions in the horizontal plane. Am. J. Orthod. 1954;40(11):811-31.
6. Sarver D, Jacobson RS. The aesthetic dentofacial analysis. Clin Plast Surg. 2007;34(3):369-94
7. Shanker S, Fields HW, Beck F, Vig P, Vig K, editors. A longitudinal assessment of upper respiratory

function and dentofacial morphology in 8-to 12-year-old children. Semin Orthod; 2004: Elsevier.
8. Townsend G, Richards L, Messer LB, Hughes T, Pinkerton S, Seow K, et al. Genetic and environmental influences on dentofacial structures and oral health: studies of Australian twins and their families. Twin Res. Hum. Genet. 2006;9(6):727-32.
9. Nie X. Cranial base in craniofacial development: developmental features, influence on facial growth, anomaly and molecular basis. Acta Odontol. Scand.. 2005;63(3):127-35.
10. Caixeta ACP, Andrade Jr I, Pereira TBJ, Franco LP, Becker HMG, Souki BQ. Dental arch dimensional changes after adenotonsillectomy in prepubertal children. Am J Orthod Dentofacial Orthop. 2014;145(4):461-8.
11. Major MP, Flores-Mir C, Major PW. Assessment of lateral cephalometric diagnosis of adenoid hypertrophy and posterior upper airway obstruction: a systematic review. Am J Orthod Dentofacial Orthop. 2006;130(6):700-8.
12. Aluko I, Isiekwe M. Dental arch widths in the early and late permanent dentitions of a Nigerian population. Nig Dent J. 2009;17(1):23-28.
13. Kook Y-A, Nojima K, Moon H-B, McLaughlin RP, Sinclair PM. Comparison of arch forms between Korean and North American white populations. Am J Orthod Dentofacial Orthop. 2004;126(6):680-6.
14. Linder-Aronson S, Woodside D, Hellsing E, Emerson W. Normalization of incisor position after adenoidectomy. Am J Orthod Dentofacial Orthop. 1993;103(5):412-27.
15. Muhamad A-H, Nezar W, Azzaldeen A. The curve of dental arch in normal occlusion. Sci. J. Clin. Med .2015;3(2):47-54.
16. Stellzig-Eisenhauer A, Meyer-Marcotty P. Interaction between otorhinolaryngology and orthodontics: correlation between the nasopharyngeal airway and the craniofacial complex. GMS Curr Top Otorhinolaryngol Head Neck Surg. 2010;9:1-8.
17. Gohilot A, Pradhan T, Keluskar KM. Cephalometric evaluation of adenoids, upper airway, maxilla, velum length, need ratio for determining velopharyngeal incompetency in subjects with unilateral cleft lip and palate. J Indian Soc Pedod Prev Dent. 2014;32(4):297-298
18. Ogunleye A, Isa A, Awobem A. Adenoids in Ibadan, Nigeria. Nig J Surg Res. 2004;6(8):93- 98
19. Brasil DM, Kurita LM, Groppo FC, Haiter-Neto F. Relationship of craniofacial morphology in 3-dimensional analysis of the pharynx. Am J Orthod Dentofacial Orthop. 2016;149(5):683-91.
20. Wysocki J, Krasny M, Skarżyński PH. Patency of nasopharynx and a cephalometric image in the children with orthodontic problems. Int J PediatrOtorhinolaryngol. 2009;73(12):1803-9.
21. Osiatuma VI, Otuyemi OD, Kolawole KA, Amusa YB, Ogunbanjo BO. Dental Arch Dimensions of Nigerian Children with Hypertrophied Adenoids. Turkish J Orthod. 2017;30(2):42-9.