Panoramic Radiographic Evaluation of the Nasal Cavity in Children with Mouth Breathing

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Abstract

OBJECTIVE: as regards to prevalence of mouth breathing and its complications, The panoramic view of children with mouth breathing as a routine initial accessible radiographic examination, was assessed in the present study; considering Confounding factors such as the magnification, dimensional changes, type of the x-ray machine and head position during imaging. We tried to innovate new standardization of nasal cavity analysis in panoramic radiography, in addition to creating specified and reliable new parameters, and investigate if there are significant differences between these parameters in mouth breathing patients than in those with nasal breathing.

METHODS: This wasa control and analytical study which assessed 30 patients with Mouth breathing and 30 patients with nasal breathing, in the range of 9-12 years old with equal numbers of both sexes, in both groups. After tracing panoramic radiographs, five angular and proportional variables was created and measured, T-test was performed and the level of significance was evaluated. For investigation of nasal septum deviation, we used Chi-square test.

RESULT: "NL" and "NL/B" parameters and unclear irregular view ofnasal cavity ininternal structures, showed significant differences in mouth breathing group (P.Value < 0.5). Right and left nasal cavity width in each patient, separately in two groups- mouth breathing and normal breathing- showed no significant differences.

CONCLUSION: Due to availability and benefits of panoramic radiography,the proportional and angular parameters used, were reliable for assessment of nasal cavity in mouth breathing children and could be developed in future studies for diagnosis of mouth breathing children.

Keywords: Mouth Breathing, Nasal Cavity, Panoramic Radiography

Mouth Breathing (MB)is defined by remarkable breathing through mouth or mixed breathinginstead of nasal breathing (NB). This term includes functional, structural, positional, biomechanicaland behavioral deficiencies[1].Breathing type is diagnosedby monitoring air flow through mouth, measuring nasal resistance, evaluation of lip-seal function and obtaining information by questionnaires about etiologic factors and mouth breathing symptoms[2].

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New techniques such as CBCT evaluation show the size of oral airway is much bigger in people with nasal breathing(NBvs.MB) [3]. Old radiographic methods such as panoramic radiography are still clinically favorable methods for both patients and dentistsuseful for diagnosis and evaluation of patients with dentomaxillofacial problems.These methods reduce expenses and irradiation risks [4] and specially are used for primary diagnosis regardless of presence or absence ofMBat first patient visit.Despite all these benefits, the most important disadvantages of this radiography is vertical magnification,although we can achievemore precise evaluation by means of proportional

and angular variables rather than linear variable [5,6].

In 2001 Kjear.I and Colleague [7] used panoramic radiography for evaluation of nasal cavity, dentition and nasal septum morphology in patients with SMMCI(Solitary Median Maxillary Central Incisor).He classified all the case subjects (10 patients) in"Narrow Nasal Cavity" group. Also he found 1 patient with nasal septum malformation and 1 patient with nasal septum asymmetry.In 2002 Hansen and Colleagues [8] investigated the effect of isolated soft tissue cleft lip on "Nasal Cavity" and "Supranumory Laterals". Panoramic radiography of these patients was analyzed for assessment of situation of nasal cavity floor.In 2007 Azevedo and Colleagues [9] discussed image of NFF/HP(Nasal Fossa Floor/Hard Palate)in panoramic radiography to specify anatomical structures responsible for upper image.In 1986 Larheim and Colleagues [6] explained precision and reliability of angular and linear variables in panoramic radiography and found acceptable precision in angular measures of mandible in panoramic radiography. Although, there was no statistically meaningful differences between measures of left and right side in each patient and approximate magnification for vertical measures was 18-21% [6]. Generally, all studies have ever evaluated vertical changes in MB and The literature is still scarce in articles investigatingho rizontal analysis in MB patients,particularly in nasal cavityin panoramic view.

In the present study, according to the prevalence and complications of mouth breathing and advantages of panoramic radiography as a primary accessible tool, considering confounding factors such as magnification and dimensional changes(which is characteristic in panoramic radiography) [10],We tried to innovate standardization of nasal cavity analysis in panoramic radiography, in addition to creating specified and reliable parameters.These variable should be truly defined and not to be corrupted by confounding factors such as dimensional changes, X-Ray machine type, imaging by different technicians and head position during imaging(the most important).By achievement of these factors we'll investigate if there aresignificant differences between these parameters in MB vs. NB patients.

Methods

This wasaControlled Analytical study and was conducted inOrthodontics department of Tehran University of Medical Sciences, School of Dentistry, Tehran, Iran. Case subjects with panoramic radiography were sampledrandomly in range of 9-12 years old. They were examined and evaluated clinically to confirm breathing type,information records andacceptable panoramic radiographyto have essential criteria. So all variables in subjects records were reassessed first and then entered the study.All patients with incomplete data records inmedical and dental history,were excluded from study. Other exclusion criteria were as follows:unacceptable view of upper hard palate structuresor presence of artifacts in panoramic radiography.

After verbal consent, examination was performedwith regard to hygiene principles such as use of masks and gloves to assess the adequacy of nasal breathing by asking them to breathe through their nose for one minute after putting water in their mouth; to breathe deeply that most of MB patients had breath through mouth but normal breathing people had breath through nose; to close their lips and take a deep breath through nose that NBpeople had good control on nasal flare muscles and could open them. Although mouth breathing patients could

breathe through nose but they couldn't change form or size of nasal flares [11]. Being fogged or condensation of mirror which was placed both near nose and mouth simultaneously was observed. Also we investigated the breathing situation with no patient awareness;MB patients had no lip competence but NB people had lip competence at rest. In addition, below instances were assessed and questioned from parents and rechecked according to patient records:1.Deep palate 2.Posterior Cross-Bites 3.Lip Competence 4.Oral habits 5.History of Allergy, Asthma or Allergic Rhinitis6.Adenoid hypertrophy 7.presence of Snoring, Sleep Apnea 8.History of Recurrence of Common Cold, Otitis and Pharyngitis. Then panoramic radiography of patients were analyzed and traced.Before performing analysis, a tracing paper were placed on each panoramic radiographyabove negatoscope. The main points, lines and anglesas landmarks were drawn by a sharp pen, precise protractor and metal ruler with accuracy of 1.4mm. Because of reliability, all of the tracing processes were done twice by the same person and the mean valuewas selected as the measure to reduce bias.

For drawing and measurements, we followed these stages (Figure 1):

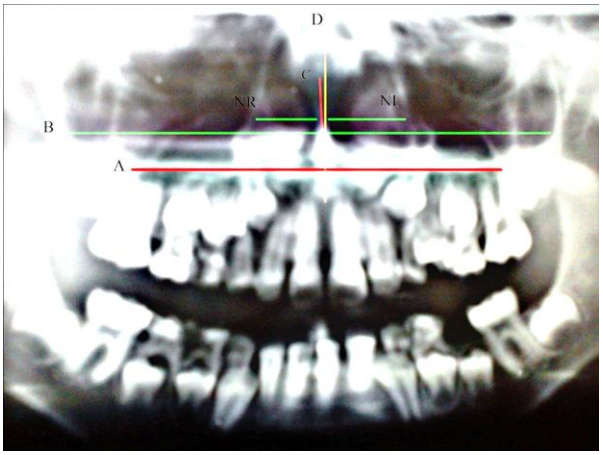


Figure1: A, B, C, D, NL, NR parameters in nasal cavity. new landmarksfor analysis of panoramic view

The radiography was placed on negatoscope so the right part of the picture was the same as right part of the patient's mouth.

We marked the A-lineas the reference which was the lower limit of opaque line in the lowest areaof NFF/HP. The inferior part of left & right borders of hard palate(A,A) were marked and then be connected by a ruler. The A-line was the horizontal reference.

The deepest points of curve made by connecting floor and posterior wall of maxillary sinuses in each side, were marked(B,B) and then be connected to each other by a line named B-line. The length ofB-line was measured (Figure 2).

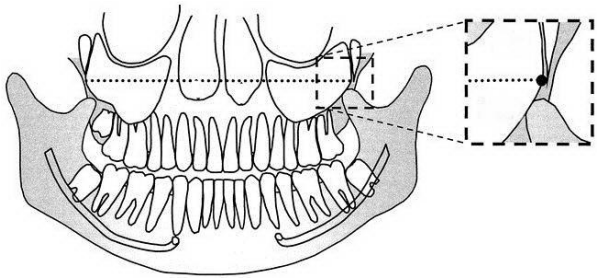


Figure 2: B-line parameter obtained by connecting the deepest points of curve made by floor and posterior wall of maxillary sinuses in each side

We drew a line from the most opaque area of upper and lower limit of nasal septum and called it C-line. As the nasal septum.

The angle between A-line and C-line was called C-angle. The zero degree was on the right side of protractor. Acute angle was equal to Deviated Septum to left and obtuse angle was equal to Deviated Septum to right.

From the lowest opacity of nasal septum, we drew a perpendicular line to A-line and called it D-line.

From the deepest part of nasal septum, we drew a perpendicular line to D-line and continued it to nearest opacity. In current study Opacity refers to the most opaque area that has at least 1mmwidth.We used this line

as nasal cavity width scale in both left and right sides and called it NL(nasal left) and NR(nasal right). We also measured the length of these lines by a ruler.

Considering above stages, we reported the outcome of final stage as a proportional fraction that is NL and NR divided to B and called NL/B and NR/B. So we could use a proportional parameter instead of a linear parameter. Finally the newparameters were innovated in this study including:C, NL/B and NR/B parameters.

After creatingmentioned parameters, to evaluate nasal septum deviation in both groups(MB and NB), we used Chi-Square test. To compare NL, NR, NL/B, NR/B, B parameters which were used for subsequent tracing of panoramic view, we used independent T-test. But only for NL/B and NR, because of nonequivalence of variances, we used "Equal Variance not assumed" choice. We used Paired T-test to compare left and right side of each people in each group and also SPSS 11.5 for statistical analysis while P-value<0.5 was meaningful.

Results

The study sample included 60 children. Of those, 30 (50%) presented with MB and 30(50%) presented with NB with equal numbers of both sexes in both groups(18 females and 12 males). 40 case subjects both MB and NB group had nasal septum deviation as 80% (24 patients) in NB group and 3/53% (16 patients) in MB group.Of those, 7/26% (16 patients) had septum deviation to the right and 7/6% (4 patients) to the left.InMB group according to the Chi-square test value, septum deviation value significantly was higher than the normal group (P=036/0).

The mean value of «B» line, which was intended as a reference, in MB group, was117.9 mm and standard deviationwas 13.06. Respectivelyin NB group, was117.61 and 25.62 and no significant differences was seen(P= 0.952). The mean value of NRwas 9.5 mm and standard deviation was 5.14 in MB group.In normal group respectively was 11.42 and 3.04, so no significant differences was seen(P= 0.132). But the mean value of NL was 7.69 mm and standard deviation was 4.03 in MB group. In normal group respectively was 11.37 and 3.13, so significant differences was seen (P= 0.001). The mean value of NR/Bwas18.81 and 16.49 as a standard deviation in MB group. In normal group respectively was 15.31 and 22.63 and showed significant differences(P= 0.532). Also the mean value of NL/B was 25.24 and 25.63 as a standard deviation in MB group. In normal group respectively was 10.9 and 2.93 and showed significant differences (P= 0.014).

Since we only indexed proportional parameters such NL/B and NR/B, The NL/B showed significant differencesinMB Vs. NB group(P=0/014).In other words, the width of the left nasal cavity in MB compared with NB was lower. Also significant differences was seen in the NL which is a linear index (P=0/001).In the right nasal cavity of MB group no differences was assessed. Also, only in 21 cases of 30 case subjects with MB, nasal cavity had a "clearly defined"view with no interference caused by overlapping opaque structures of lower conchae or the superimposition of deviated septum and Vumer.In other words, of total of 60 subjects studied, 9 cases of "MB" with a view of the "unclear" were seen in one or both sides of the nose.While in the group with "NB", only 2 cases with a view of the unclear was reported.Unclear view, in MB group, with a ratio of 4/5 times higher (9 vs. 2 cases) was observed.Therefore, bilateral unclear view, was seen only in patients with MB, while in NB group, only "one side" (right or left) unclear view was seen.Based on T-Test, generally in MB group, there were 21 subjects with the clearly defined

and marked measurable nasal cavityon both sides.28 cases with a clear view on both sides of the nasal cavity was seen In NB group.According to Paired T. Test, two groups in bothMB and NB within the left and right nasal cavityshowedno significant differences (p= 0.184).

Discussion

Panoramic radiography is routinely used for primary diagnosis of dentomaxillofacial problem and is very helpful to evaluate dentition and jaws. But also has some deficiencies.This radiographic view includes "Real Image" and "Ghost image" that real image can be single or double, depend on target [12-14]. Vertical magnification is another deficiency in panoramic view. Based on Samfors and Colleagues study in 1974 [15], magnification value varies in different parts of radiography and ranges between 17-28% [8]. So it is necessary to use parameters that give us a true scale of needed variables. In panoramic radiography we'll have the most accuracy if use angular and relative variables instead of linear variables [5,6].

In 2001 Azevedo and Colleagues [9] had finished all doubts about determination of exact location of NFF/HP. He offered use of lower opaque line(that is more clear) as the basein double images. Although Rejnen and Colleagues [16] stated thatthere is usuallysingle image because of superimposition of different anatomic areas. We used the same procedure during analysis in current study and choose A-line in way of Azevedo to have horizontal reference. NL and NR should be evaluated based on a line perpendicular to the horizontal level that lead to proportional parameters including NL/B and NR/B.

According to study of Damenteand Colleagues [17] in 1998, we can see multiple shapes of nasal cavity floor because of different head position during imaging: 1.Parallel to Frankfort plan 2. Chin Up 3.Chin Down. In different positions of head, the shape of nasal cavity floor, width of nasal cavity and length of NFF/HP could be increased or reduced. Based on Damante's statements, shape of NFF/HP could be presented as follows : "V", "W", "Wide-Angle V", "Wide-Angle W", "Straight", "Convex Arc", "Concave Arc".(Figure 3)

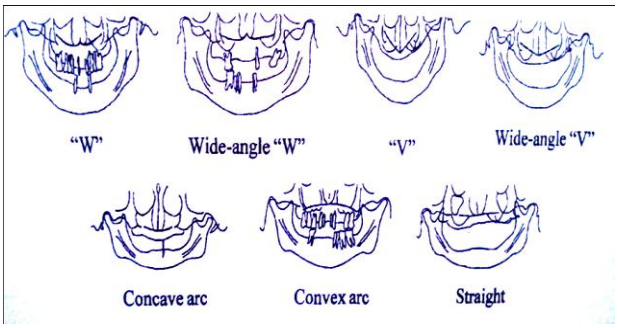


Figure 3: Shapes of nasal fossa floor and hard palate NFF/HP according to head position during panoramic imaging.

By dividing NL and NR to B-line we caneliminate the effects of confounding factor such as different types of X-ray machine, radiography technicians, magnification and not exactly the same head position [17]. So we caninnovate relative parameters instead of linear parameters, called NL/R and NL/B. So the width of nasal cavity can be assessed independent of all factors which may affect it and evaluated with accuracy and reliability.To achieveB-line, in the first step, we performed the same procedure that Hansen and colleagues [8] did in 2002 for evaluating the effect of Isolated Soft palate Clefton nasal cavity in panoramic radiography. He used this scale to measure the amount of nasal cavity bulge down in each side.Although in his study, this line was only a measure of the horizontal line but the exact amount was not measured. In the present studyanother

advantage of using B-line is that it is horizontal aslike as nasal cavity width and alsowithin the same area. Therefore, any factor that might influence the parameter B is equally effectiveon NL and NB parameters.I.Kjear and Colleagues [7] in 2001 evaluated SMMI patients. He used panoramic radiography but didn't consider any specific parameters. The sample group was 10 patients.He classified 9 of them in "Narrow Nasal Cavity" group without expressing a defined Scale to achieve this result. Only one patient was described as "Unknown Nasal Cavity Structure". Although in his study the conclusions were only based on observing and patient characteristics such as frenum inexistence, Arch-Shape of Upper Lip, nasal septum deviation and nasal obstruction [18]. It seemsthe narrowing width of the nasal cavity was quite obvious without need of any comparison with the control group or using any proportional or linear variable in his study.

C-parameter was another factor used to investigate septum deviation.It wasangular type parameterso had remarkable accuracy in panoramic radiography. When shadow of septum is wider andclearer, it is because of the overlapping image of septum cartilage and bones.It means that possiblythe septum is deviated from midline and Vomer plate is curved [10].Types of classification and scale for evaluation of septum deviation differ in several studies [20]. Because, the points on septum were used as scale differ in each one. So the way of classification and definition of septum deviation may be completely different.In present study, in MB patients, measure of nasal septum deviation was meaningfully more than normal group(P=0.036) and based on R.Rubens and Colleagues [19] study in 2008, prevalence of septum deviation in MB people is about 72%.

After innovating and designating relative and angular parameters, analysis was performed and results obtained.The term "unclear view" refers to the ghost and shadow images caused by inferior conchae or bone structures or deviated septum and vumer, not in all structures of nasal cavity and sinuses (structures above the palate), butonly was visible in Nasal cavity.Differentiation of lateral wall borders compared with internal structures may not be possible.In other words, it is possible to view the foggy anatomy of inferior conchae that is probably extended in a shorter distance than the septum (due to hypertrophy and etc.) [10]. Conchae often occupy different amounts ofnasal cavity internal areas. According to a survey in 2001 was performed by Filho and colleagues [24] to determine the lower and middle turbinate hypertrophy, cephalometery has high sensitivity and lower specificity than nasopharyngeal endoscopy.Also in the differential diagnosis between the nasal cavity and sinuses septums,borders of nasal cavity are typically larger and wider than thin delicate cortical bone of sinuses in panoramic.

The sampling method withinitial examination of patients before diagnosis of MB subjectswas enrolled in this study, because referringthem to the radiology department for taking panoramic radiography conflict with our default such as imaging by different technicians and X-ray machines. In deed one of the main objectives of this study was conducting panoramic analysis independently so be able to achieve precise and measurable absolute parametersAccording to ethics. If we examined patient first and refer them to have panoramic radiography after diagnosis, they could be rejected from university reception system so the panoramic radiography was not useful for patients anymore. In addition, panoramic radiography is not necessary in

all dentistry procedures and often after six months should be renewed. So we selected another way to avoid extra irradiation according to ALARA principles [10] for Reducing x-ray Exposure in dentistry. So in current procedure, every patient already had panoramic radiography which was taken before or had been taken during routine treatment plan providing essential specificities to enter the study.Next appointment was set to return back the panoramic radiography to patient [10].Another advantage of this method of sampling is that if there is doubt on the accuracy of diagnosis of MB, or a panoramic radiographs need to be reassessed, the patient conventional therapy on schedule was done as routine.Although in some studies,diagnosis of MB is limited only on questionnaires from parents and predictive factors of MB symptoms such as snoring, deeppalate and etc. [9] . In other studies,some diagnosis methods such mirror test is used for confirmation of mouth breathing [21].

The main advantage of choosing case subjects in the range of 9-12 yearsold, is to make sure large pharyngeal tonsils, adenoids, and general lymphoid tissue do not affect the diagnosis of MB. Because it is a Normal variation in childhood and has closed relationwith breathing transmission from nasal to oral routeand lead to Partial closure of the respiratory pathways. According to The Scamon curve,growth of lymphoid tissue is completed at these ages and also transverse dimension is the first that reaches the adult level.[22,23]

Conclusion

In this study, according to obtainednew proportional parameters, width of the left nasal cavity was less in MB group. Unclear view of nasal cavity was seen morein MB Vs. NB group but Bilateral unclear view of nasal cavity was only in MB group. So, irregularity of internal nasal structures and septum deviation was more seen in panoramic view ofMB group.Right and left nasal cavity width in two groups of each MB and NB, showed no significant differences.Based on the findings, it seems, the new angular and proportional parameters used in the evaluation of the nasal cavity in MB childrenpanoramic, are reliable and can be a good parameter for evaluating the view of the nasal cavity in patients with MB. Due to availability and benefits of panoramic radiography,these new parameters should be developed in the future for the analysis of the nasal cavity of MB patients in panoramic radiography

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