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Prevalence of Sleep Disordered Breathing in Orthodontic Patients and its Effect on Quality of Life and Craniofacial Morphology

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Abstract:- Sleep Disordered Breathing is a common problem associated with constricted airway. Before it worsens and hampers the quality of life, it can be diagnosis early and hence treated without any extensive procedures. Children who present with signs and symptoms of SDB and poor quality of life often show an altered craniofacial morphology. By treating the craniofacial structures in growing age we can hence provide a better lifestyle.

Keywords:- *Sleep disordered breathing, Obstructive sleep apnea, Constricted airway, Quality of life, Orthodontics and airway.*

I. INTRODUCTION

Sleep is a spontaneously occurring state of mind and b ody, marked by altered consciousness, sensory activity that i s relatively suppressed, decreased muscle tone and suppressi on of voluntary muscles . It is a tightly regulated and well-organized biologic process affecting our daily functioning.

Children aged 6 to 12 years should sleep at least 9 to 12 hours, and teenagers aged 13 to 18 years are advised to sleep 8 to 10 hours per night, for our body to completely recover and for proper physiological functioning. It is estimated that 4% of males and 2% of females suffer from obstructive sleep apnoea (OSA) and the majority of patients are thought to be undiagnosed early in life.[2,3]Quality of life is a multidimensional concept encompassing the physical, psychological, and social wellbeing, all of which may be influenced by sleep. Deficit sleep interferes with the learning of the children and their behaviour. The prominent morbidities of deficit sleep in children include neurobehavioral defects, like inattentiveness, hyperactivity behaviour and daytime sleepiness, thus affecting their quality of life.[6]

An elevated risk of heart disease, kidney disease, high blood pressure, diabetes, and stroke is associated with contin uous sleep deficiency.

Early diagnosis of SDB is imperative in order to promote normal facial development. Smaller pharyngeal dimensions which are established in early stages of life may be a predisposing factor to later cause SDB or even OSA, when subsequent changes like soft tissue alteration by ageing, obesity , or any genetic predisposing factor , may further reduce the patency of oropharynx.

Lateral cephalograms is a useful tool to diagnose constricted dimensions of oropharynx and also helps in identifying decreased pharyngeal dimensions which is a striking characteristic of OSA. [7]

A correlation is seen between sleep disordered breathing and altered craniofacial morphology. Cephalometry enables the analysis of dental and skeletal anomalies as well as soft tissue structures and form. Many studies in the past have assessed airway by means of cephalometry in subjects with obstructive sleep apnoea,in various malocclusions, and also in patients following orthodontic treatments but none of them has corelated the change in the morphological alterations with the severity of the disease as determined by their quality of life.[18,19]

The present study was conducted to evaluate the prevalence of sleep disordered breathing in orthodontic patients and its effect on quality of life and craniofacial morphology.

II. MATERIAL AND METHOD

An overall sample of 300 children aged were selected for the study. Inclusion criteria includes no history of previous orthodontic treatment or any syndrome, patient aged 9-17 with good general health. Exclusion criteria includes any history of previous orthodontic treatment, previous trauma or any craniofacial anomaly.

Pediatric Sleep Questionnaire, PSQ-21 was discussed on a one on one basis with patient's parents/guardian.On the Paediatric Sleep Questionnaire, the response categories of all the questions were in "Yes" or "No". The cut-off value to identify patients at high risk for sleep disordered breathing was 0.33 (33%). A proportion of "Yes" responses greater than or equal to 0.33 (33%) indicated a high risk of sleep disordered breathing and a lower percentage indicated a low risk.

Based on evaluation of result, the high-risk patients were further assessed for their quality of life by the Quality of Life questionnaire,OSA-18. The subject's quality of life was assessed based on the answers their caregivers gave. This questionnaire consists of 18 items grouped into five domains. Each of them was given a score ranging from one to seven.

Total OSA-18 score ranges from 18-126 and was categorized into three groups depending on the level of impact upon quality of life, as follows: small (under 60), moderate (60-80) and major (above 80) . The more frequently each of the domain items occur, the higher is the score and so the adverse repercussions upon quality of life.

In addition to the questionnaire, the pre-treatment cephalogram of the subjects at high risk was examined for the altered craniofacial morphology.

A. QUESTIONNAIRE 1: PEDIATRIC SLEEP QUESTIONNAIRE

PEDIATRIC SLEEP QUESTIONNAIRE
PATIENTS UNDER 18 YEARS OF AGE

Last Name ..... First Name ..... Age ..... Date .....

Please answer on behalf of your child for the past month.
If you don't know, circle "?"

While sleeping, does your child . . .

1. snore more than half the time? ..... Yes / No / ?
2. always snore? ..... Yes / No / ?
3. snore loudly? ..... Yes / No / ?
4. have trouble breathing, or struggle to breathe? ..... Yes / No / ?
5. have "heavy" or loud breathing? ..... Yes / No / ?
6. have you ever seen your child stop breathing during the night? ..... Yes / No / ?

Does your child . . .

7. tend to breathe through the mouth during the day? ..... Yes / No / ?
8. have a dry mouth on waking up in the morning? ..... Yes / No / ?
9. occasionally wet the bed? ..... Yes / No / ?
10. wake up feeling unrefreshed in the morning? ..... Yes / No / ?
11. have a problem with sleepiness during the day? ..... Yes / No / ?
12. has a teacher commented that your child appears sleepy during the day? ..... Yes / No / ?
13. is it hard to wake your child up in the morning? ..... Yes / No / ?
14. does your child wake up with headaches in the morning? ..... Yes / No / ?
15. did your child stop growing at a normal rate at any time since birth? ..... Yes / No / ?
16. is your child overweight? ..... Yes / No / ?

My child often . . .

17. does not seem to listen when spoken to directly. ..... Yes / No / ?
18. has difficulty organizing task and activities. ..... Yes / No / ?
19. is easily distracted by extraneous stimuli. ..... Yes / No / ?
20. fidgets with hands or feet or squirms in seat. ..... Yes / No / ?
21. is 'on the go' or often acts as if 'driven by a motor'. ..... Yes / No / ?
22. interrupts or intrudes on others (e.g. butts into conversations or games) ..... Yes / No / ?

B. QUESTIONNAIRE 2: QUALITY OF LIFE QUESTIONNAIRE

	Never	Almost never	A few times	Sometimes	Many times	Most of the times	All the time
1. Sleep disorder							
Loud snoring?	1	2	3	4	5	6	7
Periods at night when you held your breath or stopped breathing?	1	2	3	4	5	6	7
Gagging noise or panting while sleeping?	1	2	3	4	5	6	7
Restless sleep or frequent awakenings during sleep?	1	2	3	4	5	6	7
2. Physical distress							
Nasal breathing because of nasal obstruction?	1	2	3	4	5	6	7
Frequent colds or upper airway infections?	1	2	3	4	5	6	7
Nasal secretion or a running nose?	1	2	3	4	5	6	7
Difficulty feeding?	1	2	3	4	5	6	7
3. Emotional distress							
Mood change or anger fit?	1	2	3	4	5	6	7
Aggressive or hyperactive behavior?	1	2	3	4	5	6	7
Discipline problems	1	2	3	4	5	6	7
4. Daily problems							
Excessive daytime sleepiness or frequent naps?	1	2	3	4	5	6	7
Little concentration or attention?	1	2	3	4	5	6	7
Difficulty to wake up in the morning?	1	2	3	4	5	6	7
5. Concern of the caretakers							
Make you worry about your child's general health?	1	2	3	4	5	6	7
Create the concern that your child is not breathing enough air?	1	2	3	4	5	6	7
Impact on your capacity to execute your daily activities?	1	2	3	4	5	6	7
Make you feel frustrated?	1	2	3	4	5	6	7
Total score OSA(18-126)							

III. STATISTICAL ANALYSIS

Data was entered into Microsoft Excel spreadsheet and then checked for any missing entries. It was analysed using Statistical Package for Social Sciences (SPSS) version 21. Categorical variables were summarized as frequencies and continuous variables will be summarized as Means & SD. Graphs were prepared on Microsoft Excel.

Inferential statistics were performed using **Independent t test** and **one-way ANOVA. Independent t test** is used to compare two means. **One-way ANOVA test** is used to compare more than two independent means. The level of statistical significance was set at 0.05.

IV. RESULTS

The prevalence in this study design as estimated from PSQ-21 questionnaire was found to be 12% i.e., 38 patients out of 300 had high risk of sleep disordered breathing. However, the sex variation was found to be insignificant as compared by independent t-test.

The high risk group was then assessed for their quality of life. The degree of impact on quality of life verified in the OSA-18 survey was small in 3 (8%), moderate in 22 (58%) and major in 13 (34%) cases, i.e., maximum number of children enrolled in the study had moderate to major levels of impact on QOL.

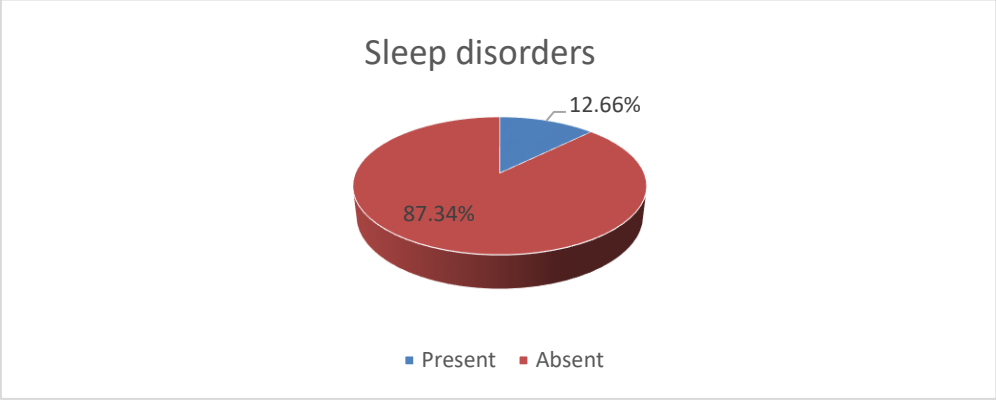
Further, we investigated the alteration in craniofacial morphology and the pharyngeal airway dimensions in 38 high risk patients with the help of lateral cephalometric radiographs to determine whether altered morphology exists that may predispose the patient to develop sleep disordered breathing.

Mean values of Go to GnAr to GoS to GoPNS to point BGo to point B, t point & p point were found to be significantly lower among subjects having sleep disorders as compared to that among normal subjects. These results indicate a decreased length of the body of the mandible, decreased posterior facial height, retrusive mandible and narrowing of the airway.

Mean values of ANS-PNS to GoGn, N to point BGo to PhW S to H, Go to H, Phw to H,S-N to ArH, GoGn to H, uvula length & uvula width were found to be significantly higher among subjects having sleep disorders as compared to that among normal subjects. These results indicate downward movement of the mandible, increased anterior facial height, posterior displacement of posterior pharyngeal wall, anteroinferior position of hyoid and large uvula.

- Results:

Prevalence of sleep disorders	12.66%



Graph 1: Prevalence of sleep disorders

Independent t test

GENDER	NORMAL	MEAN	STD. DEVIATION	P VALUE
FEMALE	15	10.0667	1.83095	0.848 NS
MALE	23	10.2174	2.62776	

Table 1: Prevalence of sleep disorders and sex distribution

Risk as assessed by PSQ22		
	Frequency	Percent
Small	3	7.9%
Moderate	22	57.9%
Major	13	34.2%
Total	38	100.0%

Table 2: Distribution of study population according to Risk as assessed by OSA-18

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Independent t test

	Subjects having Sleep disorders (n =38)		NORMAL (n=12)		P value
	Mean	Std. Deviation	Mean	Std. Deviation	
Go to PNS	48.5263	2.47950	49	6	0.2142, NS
ANS to Point B	53.4737	2.35655	49	7	**0.002, S**
PNS to point B	67.4737	1.89931	69	5	**0.0136, S**
Go to point B	70.2632	1.44604	73	4	**0.0007, S**
ANS-PNS to GoGn	25.1842	1.99804	21	4	**<0.0001, S**
Go to Gn	70.6316	2.66530	75	6	**0.008, S**
N to point B	105.5526	2.36754	102	6	**0.004, S**
Ar to Go	68.8158	3.44733	73	9	**0.0017, S**
S to Go	95.2368	2.67556	100	11	**0.0086, S**
Go to PhW	18.3158	3.84219	13	5	**0.0002, S**
Go to H	39.3158	3.18871	35	9	**0.0145, S**
Gn to H	52.6842	1.09311	53	9	0.8383, NS
Phw to H	41.0263	4.32770	35	5	**0.0002, S**
S to H	102.3947	6.51211	85	11	**<0.0001, S**
Go-Gn to H	128.1053	5.68920	122	7	**<0.0001, S**
S-N to Ar-H	30.3158	4.56843	20	5	**<0.0001, S**
ulength	40.1579	5.06459	36	8	**0.0001, S**
uwidth	13.8684	1.29805	11	2	**<0.0001, S**
tpoint	10.4474	3.53895	17.4	4	**<0.0001, S**
ppoint	7.8158	2.03822	12	4	**<0.0001, S**

Table 3: Overall cephalometric analysis result

V. DISCUSSION

Sleep disordered breathing characterized by upper airway obstruction, ranges from the cardinal symptom of snoring to cessation of the oxygen flow. The impact of this disease on patients, families, and the health care system warrants increased attention, and the orthodontist has an integral role in the diagnosis and management of SDB.

In the present study, the first criteria was to check the prevalence of SDB in orthodontic patients of age group 9-17 years. The reason for selection of the particular age group for sample selection was that older patients in this group may not sleep in the same shared space as their parents, so lack of parent awareness of SDB symptoms may have influenced how questions were answered. The target age group mostly seek orthodontic treatment and early diagnosis can help to detect and intervene the disorder, thus preventing the severity of the disease. Early screening of these patients who may be at high risk for SDB but unaware of their condition can provide a more comprehensive health care service by potentially identifying and properly diagnosing SDB patient.

The total prevalence of Sleep disordered breathing in this study was calculated to be 12.66%.Variations in the study design and data reporting contributed to differences of SDB prevalence in child populations. According to Mitchell et al , prevalence estimates have ranged from 0.7% (low) to 13% (moderate). The reason why the results differ from our study is that they have used solely oxygen saturation.

The second criteria was to evaluate quality of life in high risk group using OSA-18 questionnaire. The degree of impact on quality of life verified in the OSA-18 survey was small in 3 (8%), moderate in 22 (58%) and major in 13 (34%) cases. These results are consistent with other studies by Franco et al [26], Michell and Kelly[38], Goldstein et al and Silva et al[20]. Quality of life is majorly recognized as an important factor in clinical practice. However, the impact of SDB on the QOL of children has been underestimated.

Further, we investigated the alteration in craniofacial morphology and the pharyngeal airway dimensions in 38 high risk patients.

On comparison with the average mean values 31 , Posterior facial height was not found to be significant, however an increased Anterior facial height was observed(Go-PNS = 53.47 mm) .The overall features included steep mandible (PNS-point B = 67.47 mm), short body of the mandible (Go-Gn = 70.63 mm) , a vertical growth pattern (Ar-Go = 68.81 mm, S-Go= 95.23 mm) ,increased distance between mandible and posterior pharyngeal wall (mean value 41.02 mm, increase in the length and width of uvula (40.15 mm and 13.86 mm respectively) and narrowing of the airway (reduced T point = 10.44 mm and P point = 7.81 mm). The posterior wall of the pharynx was more posterior and also an altered position of hyoid bone was observed.

Increased anterior facial height is a result of steep mandibular plane angle which is same as the study done by Golmes et al.

In this study we observed an increased length and width of the uvula. Chang et al assessed the relationship of uvula and OSA. They concluded that larger Uvula size appears to be associated with snoring and OSA.

Additionally, the position of hyoid bone in sleep disordered breathing group was found to be more antero-

inferiorly (Phw-H= 41.02 mm, S-H= 102.39 mm). These results were in accordance with other studies that have related the hyoid bone position to the mandibular plane and concluded that it was positioned more inferior in OSAS patients when compared with non-OSAS subjects.[10,11]

The precise aetiological mechanism related to the relatively inferior positioning of hyoid bone remains unclear. Presumably, the location near pharyngeal structures is an indicative for its strong co relationship to narrowing of the airway. Probably similar to the pathogenesis of upper pharyngeal airway constriction in OSAS patients, the inferiorly positioned hyoid bone is also influenced by an interaction of anatomical and physiological changes in the upper airway.

The present results for airway indicate that most of the cephalometric measurements of the upper airway are significantly different in patients with sleep disordered breathing than the average values. Narrowing of the airway (reduced T point = 10.44 mm and P point = 7.81 mm) was the most striking feature noted in patience with sleep disordered breathing, which is in accordance with the study done by Rohra et al.

Airway focused orthodontics is a philosophy which triumphs everything else in contemporary orthodontics. The theory focuses on the practise of clinical orthodontics aimed at achieving the ideal relationship between the jaw, establishing normal oral function and efficiency, and improving airway and respiration which is a core aspect of physiology and function.

VI. LIMITATIONS

- Cephalograms were taken in upright, fully awake patients according to the standardized parameters and hence may not describe the anatomic conditions present in supine position during obstructive phase of sleep apnoea. Also, the pathophysiology of SDB is still thought to be, in large part, related to the decrease in muscle tone that occurs in the progressively deeper stages of sleep. Therefore, it is a disadvantage that cephalometric parameters are evaluated in upright position and at the time when pharyngeal tone is normal.

- On the basis of our results, the size of the oral cavity, as measured by determining its cross-sectional areas on cephalometric tracings were similar in SBD group and the norms.1 The added information that could be provided by determining the volumetric calculations was difficult to obtain and was not attempted in this study.

VII. SUMMARY AND CONCLUSION

The present study was conducted to evaluate the prevalence of Sleep Disordered Breathing in orthodontic patients and to co-relate its effect on quality of life and craniofacial morphology. A sample of 300 orthodontic patients, aged 9-17 years were taken as a sample. The two questionnaires used were PSQ-22 and OSA-18. Cephalometric analysis was also done to assess craniofacial morphology.

Following salient conclusions can be drawn from this study;

- The prevalence of sleep disordered breathing in the study sample was 12.66% .
- The high-risk sample of 12.66% were further categorized into 34% major, 58% moderate and 8% small group on the basis of quality of life questionnaire.
- An altered craniofacial morphology was assessed using pre-treatment cephalometric parameters. The changes observed were decreased length of the body of the mandible, decreased posterior facial height, retrusive mandible, narrowing of the airway, downward and backward movement of the mandible, increased anterior facial height, posterior displacement of posterior pharyngeal wall, anteroinferior position of hyoid and large uvula.
- The difference in the cephalometric parameters in all three groups i.e., small, moderate and major were found to be non-significant. This indicates a small variation in altered craniofacial morphology in all three groups.
- It can be safely concluded that screening for orthodontic patients who are at high risk for sleep disordered breathing is practical, feasible and need of the hour.

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