Association of upper airway dimension and sleep disordered breathing in subjects with TMD - a pilot study

Authors
1.Maitreyi Shekhar Mahajan Intern,Oral Medicine and Radiology, SDM college of dental sciences and Hospital,Dharwad, India
2.Dr. Kruthika S Guttal, Professor,Oral Medicine and Radiology, SDM college of dental sciences and Hospital,Dharwad, India
3.Dr. Atul P Sattur Professor,Oral Medicine and Radiology, SDM college of dental sciences and Hospital,Dharwad, India
4.Dr. Kirty Nandimath Professor and Head of the department, Oral Medicine and Radiology, SDM college of dental sciences and Hospital,Dharwad, India.

Corresponding author:
Maitreyi Shekhar Mahajan Intern,Oral Medicine and Radiology, SDM college of dental sciences and Hospital,Dharwad, India
E-mail : maitreyimahajan99@gmail.com
Mobil Phone : 8152963212

ABSTRACT

Background -Sleep-disordered breathing (SDB) is a condition that refers to partial or complete cessation of breathing that occurs during sleep. Among the various contributing factors the anatomic constraints have a major contribution. Also there has been increasing evidence of association of this and temporomandibular disorders. The present study is a prospective observational study to correlate the above said disorders.

Methods- Subjects reporting with symptoms of TMD were examined and diagnosed according to DC TMD criteria. Ten patients diagnosed with TMD were subjected to radiographic evaluation of TMJ with the use of cone beam computed tomography of TMJ of both sides. Following which subjects were subjected to Cephalometric radiography for airway analysis. In addition all subjects were assessed for sleep disordered breathing with the use of Epworth sleepiness scale.

Results- there was negative correlation observed with pharyngeal space when compared with sleepiness scores amongst the various parameters assessed.

Conclusions- there is a definite correlation of reduced airway space and occurrence of TMD which needs to be quantified in a larger sample of subjects, which will help to comprehensively manage the subjects with TMD.

Introduction

Temporomandibular disorders comprise a group of disorders that affect the TMJ and cause musculoskeletal pain.1This painful condition influences the quality of life as well. Experimental studies have established that sleep disruption and pain occur in a bidirectional relation.2It is advised that other than polysomnography studies, best way to screen obstructive sleep apnea or sleep

disordered breathing is questionnaires. The various factors causative of TMD include age, genetic factors, gender predisposition, stress, anxiety, occlusion, poor posture, rheumatoid arthritis, and dysfunctional breathing.3 Cephalometric films can provide details on Structural narrowing depicting the anterior- posterior dimension of the airway, this will aid in the early recognition of obstructions leading to sleep apnea.

Sleep apnea (SA) happens to be the most common type of sleep-disordered breathing, which presents wirh repetitive shallow breathing and cessation of breaths during sleep.4,5 Polysomnography (PSG) stands out as the confirmatory investigation for establishing the diagnosis of SA .6 SA is known to be related to a plethora of diseases including diabetes mellitus, hypertension, arrhythmia, ischemic heart disease, stroke, metabolic syndrome, chronic kidney disease, erectile dysfunction, hormonal dysfunction, and dementia.3 Various studies in the past have shown the association between sleep disorders and TMD while only few of them discussed the association between the two.3,5 Sleep-disordered breathing (SDB) has been rising among various populations and is a matter of concern. It can be associated with Comorbidities like hypertension, myocardial infarction, stroke, memory loss, diabetes, depression, insomnia, and daytime drowsiness.7. The present study aims to correlate the degree of radiographic changes of temporomandibular disorders with sleep disordered breathing assessed by Epworth's Sleepiness scale8 and lateral cephalometric analysis of pharyngeal space.

The objectives of this, study is to explore and associate the pharyngeal airway dimensions and the position of the TMJ in subjects with sleep disordered breathing (SDB- assessed by Epworth's Sleepiness scale).

The specific objectives include (1) assessment of upper airway dimensions in SDB on a cephalogram, (2) determine the TMJ condylar positions in SDB (3) investigate the association between upper airway dimensions and TMJ condyle position.

Materials and Methods

Study Design and participants - The design of the present study is a cross- sectional prospective one where in patients were recruited from outpatient section of department of oral diagnosis in a dental school in a span of 10 months.

The study was initiated following the ethical clearance from Institutional review board of XXX Institute with reference number IRB No. 2020/UG/OM/62 issued on 03.02.2020. Informed consent was sought from all participants which was in accordance with human ethics approval from Institutional review board. 10 patients presenting with symptoms of TMD were selected for the study.

Study setting- The study was conducted over a span of 10 months from 1-01-2020 to 31-10-2020. The subjects reporting to the department of Oral medicine & Radiology, fulfilling the inclusion criteria were further evaluated for sleep disordered breathing with Epworth sleepiness scale questionnaire, cephalometric assessment of airway, and CBCT assessment of bilateral Temporomandibular joints.

Data collection

The following data were collected for all subjects: demographic data (age, gender, ethnicity), status of any deleterious habits, physical factors, and features relating to sleep

disturbances and temporomandibular joint disorders.

All patients were assessed with Sleep Disordered breathing questionnaire (SDB).8 All the subjects will be assessed for sleep disordered breathing with the use of Epworth's Sleepiness scale.

Participants-

INCLUSION/Eligibility CRITERIA-Patients presenting with signs and symptoms of TMD diagnosed with DC TMD Criteria4 and willing to participate in the study.

Exclusion Criteria –

1.Patients unwilling for investigations.

2.Pregnant women

Sample selection - Sample of ten participants was selected based on the feasibility of the time duration of the study

Data sources/ measurement- Radiographic analysis with CBCT - CBCT images of both the TMJs were pro cured for analysis. Images were obtained from Kodak 9000C. The technical parameters used were: 90 kV, 8 mA, 10.8 seconds, scan time < 12 s, and field of view (FOV) of 4 × 6 cm. The maximum dose of exposure was 231 mg/cm2. The imaging was performed in an upright position to facilitate, a natural head position, and ensuring teeth were in light contact in a closed mouth position. The obtained images were assessed for linear measurements and osseous changes using built in software within the machine: CS Imaging software (CS imaging patient browser 7.0.18.5.d11, CS data manager 4.2.9.0).

The linear measurements included:

1. condylar height
2. condylar length
3. condylar width.

Osseous changes included: Flattening, erosion and osteophytic changes. Medial axial and lateral axial space measurements were also included. (Fig 1)

In addition all subjects were subjected to Cephalometric radiograph for airway analysis. Lateral cephalometric radiographs were taken using a standardized technique (jaws in centric relation, teeth occluding, lips relaxed and the head in natural head position).

1. The following variables were measured which included 12 linear measurements: (Fig 2) Tongue in sagittal dimension length Height of the tongue
2. The soft palate length
3. Thickness of the soft palate
4. Position of the vallecula in horizontal plane
5. Position of the vallecula in vertical plane
6. Depth of the hypopharyngeal airway space
7. Position of hyoid bone in horizontal plane
8. Position of the hyoid bone in vertical plane

The four area measurements included

1. tongue area
2. Soft palate area
3. Oral area
4. Nasopharyngeal area

area measurements were calculated on jpeg images of Cephalograms using GIMP software.

Study size - Sample size was not estimated at the beginning of the study. A sample of 10 was taken based on feasibility.

Statistical Analysis: All the cephalometric linear measurements were tabulated and descriptive statistics like mean and standard deviation were calculated. Correlation

between pharyngeal space and sleepiness score was analyzed by
Pearson's correlation coefficient. Probability value of less than 0.05 was considered as statistically significant. Software used SPSS (Statistical Package for Social sciences version 20.0, IBM Corp., Armonk, NY:IBM Corp)

Results

The values of cephalometric measurement data is depicted in Table 1. The various parameters regarding TMJ is depicted in Fig-3. Amongst the various areas assessed there was negative correlation observed with pharyngeal space when compared with sleepiness scores. The correlation coefficient was -0.1905 (p-value 0.59) which shows a non significant negative correlation indicating that pharyngeal space may be inversely correlated to sleepiness (Fig-4). The comparison of various areas assessed and the sleepiness score has been depicted in Fig-5.

Table 1

Linear measurements	**Mean**	**Standard Deviation**
Tongue in sagittal dimension vt	75.3	10.68
Height of the tongue	36.61	2.11
Soft palate length	35.82	3.59
Thickness of the soft palate	10.86	0.55
Position of the vallecula in horizontal Plane	17.02	4.75
Position of the vallecula in vertical plane	78.82	8.55
Depth of the hypopharyngeal airway space	16.59	5.35
Position of the hyoid bone in horizontal Plane	32.22	5.61
Position of the hyoid bone in vertical plane	83.17	8.42
Area measurements		
Oral area	24.61	8.99
Soft palate area	2.26	0.62
Tongue space	6.64	2.38
Pharyngeal space	3.50	2.23

Discussion

There has been increased evidence based correlation of inter relation and co-existence of TMD & sleep disordered breathing.2

Dysfunctional TMJ may comprise of many problems, comprising teeth grinding, headaches, ear pain and sleep disturbances. A disordered emporomandibular joint may be attributed for sleep apnea owing to position of tongue influenced by the alignment of the upper and lower teeth; this malpositioned can block the airway leading to disturbed sleep cycle.[3] Yeon-Hee Lee[10] et al in a detailed review suggest that OSA can have typical presentations in orofacial region and that OSA in patients with Sleep Related Breathing Disorders may co-occur with TMD through several mechanisms. Radiographic screening of the upper airway will substantiate data delineating the anatomy and degree of constrictions at different levels along the airway track. [5,9] To the Authors' knowledge this is a first of its kind study attempting to evaluate the relationship of TMD and sleep disordered breathing in local population. Truong L et al[5] in their study emphasized that there was an association between airway volume and minimum crosssectional dimensions (area) implying that the constricted airway's cross-section

significantly determining upper airway dimensions and also with regards to the TMJ, condyles were more posteriorly seated condyle positioned, in SDB patients.

Although the study had a minimal sample size, there was a negative correlation observed with pharyngeal space when compared with sleepiness scores which implies the coexistence of these diseases. The significance of the present study lies in the fact that sleep disturbance may enhance sensitivity to pain in subjects with chronic pain conditions. This inturn triggers a self-perpetuating cycle of disturbed sleep, heightened pain, and depression.

Amongst the various mechanisms linking these two disorders, inadequate and/or altered sleep might heighten pain sensitivity, leading to hyperalgesia, a key feature in majority TMD patients.[11]

The shortcomings of the present study were non inclusion of BMI and the position of condyle needs to be established on a larger sample size.

It's also important to educate the patients regarding the early recognition of symptoms of SDB to prevent complications. The study supports the fact that simple radiographs such as cephalograms can support the identification of SDB with certain assessments. This will not only aid in quantifying and correlating the severity of the disease, but also aids in educating the patient and making them aware of the existing problems. The authors would suggest long-term assessments in larger set of populations, with correlation clinical/ orofacial features along with relevant radiographic manifestations, the data of which will add clarity to the coexistence of these two disorders.

In view of the results from the study the authors would suggest that – It is imperative to reassess the airway parameters in patients reporting with TMD symptoms, so oral physicians or dentists should investigate for the comprehensive picture in patients presenting with TMDs.

- TMDs can crop up or get initiated during certain treatments such as orthodontic treatments or in situations when occlusion is not restored appropriately, hence airway assessments should be a part of structured assessment requisites in addressing TMDs.
- When complete assessment of sleep disordered breathing or sleep apnea is not feasible, use of questionnaire to evaluate the patient's status initiates the process for further investigations.

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Figures Legends

Fig1- Linear measurements recorded on lateral cephalogram

Fig 2- Dimensions of the TMJ as per DVT measurements

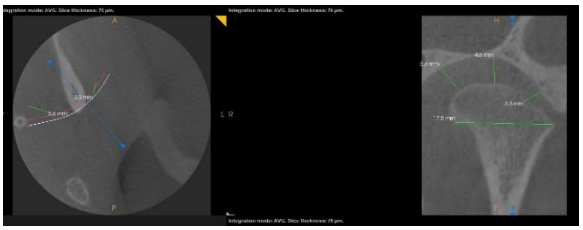

Fig 3 -Comparison of area measurements of various spaces with sleepiness score.

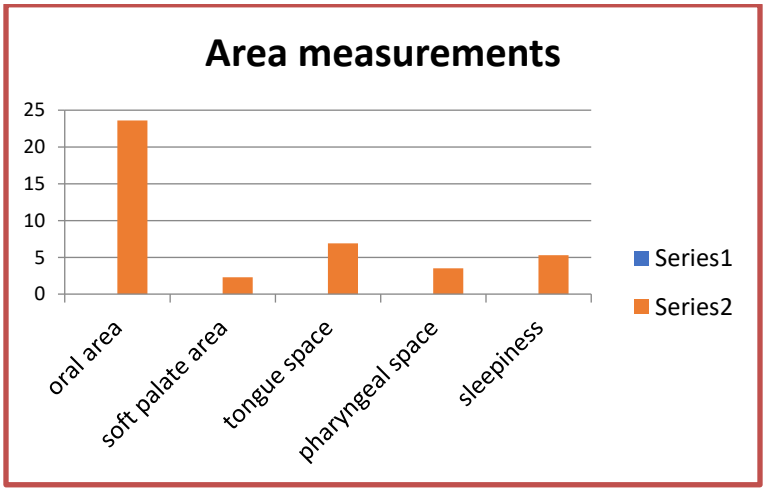

Fig 4- The dimensions of TMJ on CBCT

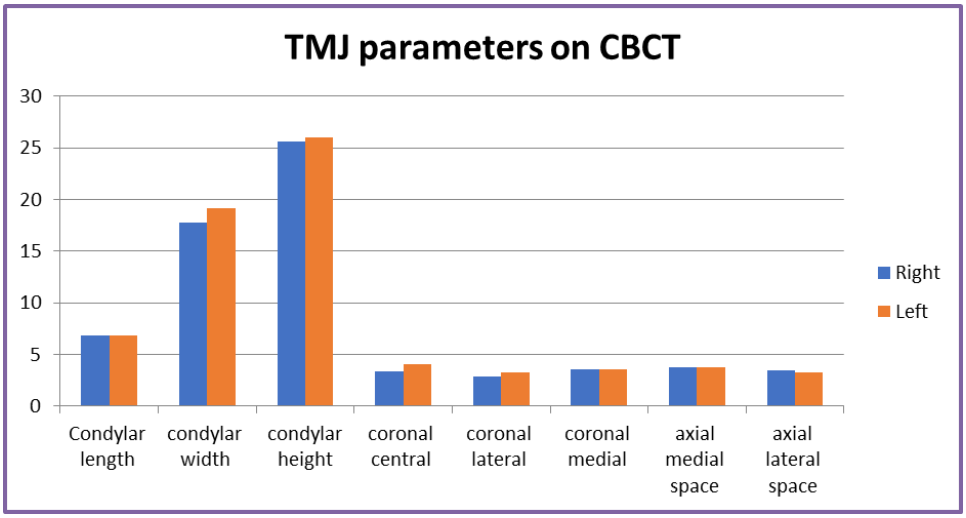

Fig 5 Correlation of pharyngeal space with sleepiness score.