Condylar morphological variants and its association with age, TMD and dentition status: A digital panoramic study

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Abstract

Introduction: The temperomandibular joint is one of the most complex joints in the body, and the normal functioning of the masticatory system depends on its harmonious functioning. Morphologic changes of condyle occur due to development variations, age changes, clinical signs & symptoms of TMD, dentition status, etc. The Panoramic Radiography is simple, low costed method to evaluate the gross bony changes of condyles.

Aims & Objectives: The present study was undertaken to evaluate the prevalence of radiographic changes in the condylar morphology & its association with age, clinical signs & symptoms of TMD & dentition status & also to evaluate the intraexaminer & interexaminer reliability in assessing condylar changes using panoramic radiographs.

Materials & Methods: A total of 60 subjects were recruited in the study with mean age of 20 to 80 & categorised into three groups as Group A(20 -40), Group B(41-60), Group C (61 -80) were evaluated clinically & subjected to digital panoramic radiograph. Different types of condyles were evaluated, radiographic changes in condyle were recorded as small round, evacuated, ossicle, flattening, osteophyte, sclerosis, erosion, ely's cyst. A normal condyle was given a score of 0 & 1 for abnormal condyle.

Results: The prevalence of radiographic condylar changes were seen maximum in group C, compared to group A & group B. Flatenning & osteophyte were the most commonly observed condylar morphologies. Although there were statistical insignificant between reported signs & symptoms, dentition status with condylar morphology, but radiographic changes of condylar morphologies were observed. Interexaminer & Intraexaminer reliability was perfect in assessing the panoramic radiographs.

Conclusion: Radiographic abnormalities in the mandibular condyle increased with age & were seen more frequently in patients with clinical signs & symptoms & patients with loss of teeth. Interexaminer & Intraexaminer reliability was perfect in assessing the panoramic radiographs.

Keywords: Condyle, TMJ, TMD, Panoramic radiograph, condylar morphology

Introduction

Temporomandibular joint is one of the most complex articulations of the human body working bilaterally and simultaneously connecting the mandible to the cranium referred to as craniomandibular articulation/ ginglymoarthrodial joint.[1] The features that differentiate and make this joint unique are its articular surface covered by fibrocartilage instead of hyaline cartilage. Human condyles differ greatly in their shapes and dimensions. It is believed that TMJ growth is affected by ageing, state of occlusion, functional jaw movement during opening and closing the mouth.

The term "temporomandibular disorders" (TMD), is a collective term embracing a number of clinical problems that involve the masticatory musculature, the temporomandibular joint (TMJ) and associated structures, or both. These disorders are characterized by facial pain in the region of the TMJ and/or the muscles of mastication, limitation or deviation in the mandibular range of motion, and TMJ sounds during jaw movement and function.

The appearance of mandibular condyle varies among different age groups & individuals. These variations may be in form of like flattening, osteophyte, erosion, sclerosis, ely's cyst (sub cortical cyst), small round, excavated, ossicle have been reported in symptomatic as well as asymptomatic patients. Several studies on bone changes in patients with TMD are conducted but limited literature exists on prevalence of bone changes of condyles and their variations among people with different age groups, gender and occlusal condition in asymptomatic TMJs particularly among Indian population.

Digital panoramic radiography is used for TMJ screening when the clinical examination suggests some form of joint pathology,[2] and also for determining gross bony changes in the condyle.[3] It is a simple, low-cost method to evaluate the bony structures of the TMJ and is one of the most commonly used techniques by dentists and dental specialists.[4] It has also been shown that there is consistency and accuracy with digital radiographs of the condylar area.

Morphologic changes may occur on the basis of simple developmental variability as well as remodelling of the condyle to accommodate developmental variations, malocclusion, trauma, endocrine disturbances and radiation therapy. Genetic, acquired, functional factors, age groups, individuals also have a role in morphologic changes in shapes and sizes of condyle.[3] Thus variability in the shapes and sizes of condyles should be considered as an important factor in diagnosing the disorders of temporomandibular joint among asymptomatic patients. Prevalenceof minor bone changes in condyles of patients with asymptomatic TMJs

serve as a predictor for future TMJ problems as a person advances with age.

Hence our study intends to assess the variations in the condylar morphology & its association with age, TMD & dentition status.

Aims & Objectives

1. To evaluate the prevalence of radiographic changes in the condylar morphology & its association with
   i. Age
   ii. Clinical signs & symptoms of TMD
   iii. Dentition status
2. Intraexaminer & Interexaminer reliability in assessing condylar changes using panoramic radiographs.

Materials and Methods

Source of the data: Out Patients visiting the Department of Oral Medicine and Radiology of Al-Badar Rural dental college & Hospital Kalaburgi.

Study population: The study consists of 60 individuals & categorized into 3 groups according to age: 20-40, 41-60 & 61-80 years with 20 patients in each group.

Method of collection of data: Patients visiting the department of Oral Medicine and Radiology, Al-Badar Rural Dental College & Hospital, Kalaburgi-Karnataka, were subjected for digital panoramic radiographs & appropriate candidates were considered for study after obtaining theirconsent.

Inclusion criteria:

1. All patients clinically diagnosed with or without TMDs & not on any treatment for TMDs with no history of systemic diseases & drugs known to cause TMDs, age groups between 20 to 80 yrs.

Exclusion criteria:

1. Patients with history of mandibular fractures and surgery of mandible
2. Patients with developmental anomalies affecting the jaw or syndromes of craniofacial structures
3. Patients who had undergone orthodontic treatment.
4. Patients with history of parafunctional habits like bruxism.
5. Patients with limited mouth opening due to oral submucous fibrosis, space infections or malignancies of the oral cavity
6. Patients whose OPGs do not show a clear TMJ or the TMJ of poor density will be excluded.
7. OPGs showing incidental findings of pathologies involving the jaws.

Method of the study: Informed consent was taken from the patients prior to the history, clinical, & radiographic examination. A Questionnaire designed to record the symptoms was used. Clinical examination was performed to record signs of temporomandibular dysfunction.

Questionnaire Included the Following Questions.

1. Do you have difficulty in mouth opening?
2. Do you have pain in front of ears?
3. Do you feel pain in muscles of mastication/ accessory muscles?
4. Do you hear sounds in front of ears?
5. Do you have any history of joint pain the body?
6. Do you have history of clenching/ grinding?
7. Are you a denture wearer, if yes is it fit/not?
8. Do you use one sided biting habit?
9. Do you consider your bite as normal?
10. Do you suffer from neck or shoulder pains?
11. Do you get frequent headaches?

After questionnaire the patients underwent a detailed clinical examination for mouth opening, deflection, deviation, lateral movements of the mandible. Muscles of mastication were palpated for any tenderness. Temporomandibular joint was palpated, extraauricularly & intraauricularly for any tenderness. Temporomandibular sounds if any were recorded with stethoscope.

Dentition status was clinically evaluated using ***Eichner Index*** & classified into 3 classes. The molar and premolar contacts define the classification: **Class A** where patients had dental support in all four support zones, **Class B** where patients had dental support in one to three support zones, at least one contact in the molar or premolar area or contact in the front area only, and **Class C** where patients had no support zones at all, although a few teeth can still be remaining. Denture wearers were asked regarding the fit of the denture and its efficiency in chewing.

After detailed clinical assessment, the patients were subjected to panoramic radiograph. Panoramic images were taken using KODAK 8000C machine in a standard manner. The images will be viewed on a flat screen compaq TFT-LCD monitor with a resolution of 2906 x 2304 pixels in JPEG format with 24- bit grayscale.

Radiographic changes in the condyle were recorded according to the Muir and Goss[5], Akerman et al.,[6] Flygare[7] & Yale et al.,[8] with a score of 0 for normal condyle & 1 for abnormal condyle.

The different radiographic morphologies of the condyles were recorded as follows:

1) Flattening
2) Osteophyte
3) Erosion
4) Sclerosis
5) Ely's cyst
6) Small round
7) Excavated
8) Ossicle

Evaluation of the intraobserver & interobserver reliability was done by randomly selecting 10

radiographs in each age group (a total of 30 radiographs) and re-examined after a time gap of 1month by the same observer and another oral & maxillofacial radiologist.

Statistical Analysis

Data analysis was done using SPSS software 11.5 version. Chi square test was utilized for determining the number of subjects and number of condyles associated with radiographic changes in the condylar morphology & to analyse the association between radiographic changes in the condylar morphology with clinical signs and symptoms of temporomandibular dysfunction. Reliability of intraexaminer and interexaminer was assessed using Kappa test and statistically were interpreted as <0 = poor agreement, 0.00–0.20 = slight agreement, 0.21–0.40 = fair agreement, 0.41–0.60 = moderate agreement, 0.61–0.80 = substantial agreement, 0.81–0.99 = almost perfect agreement, and 1.00 = perfect agreement. *P* value equal to or less than 0.07 was considered statistically significant. Association between radiographic changes in condylar morphology and dentition status was done using Fisher's exact test.

Results

The study comprised of total 60 subjects and divided into three groups, each group comprising of 20 subjects (33.3%) (Table 1). In group A (20-40 years) 9 subjects (21.4%), in group B (41-60 years) 14 subjects, in group C(61-80 years) 19 subjects(45.3%) showed condylar changes. (Table 2).

Among three groups, 37(92.5%) condyles in Group C showed more condylar changes, whereas in group A & B there were 13(32.5%) and 24 (60.0%) condyles affected respectively. (Table 2).

Table 1: Distribution of study subjects according to group wise

Categories	No. of Patients	Total%
Group A (20-40 years)	20	33.3
Group B (41-60 years)	20	33.3
Group C (61-80 years)	20	33.3
Total	60	100

Table 2: Prevalence of radiographic condylar changes & no. of condyles effected in each group

Age Group	No. of Patients with condylar changes	Total %	No. of condyles affected	Total %
Group A (20-40 years)	09	21.4	13	32.5
Group B (41-60 years)	14	33.3	24	60
Group C (61-80 years)	19	45.3	37	92.5
Total	42	100	74	187

Condylar radiographic changes in each group:19 (31.7%) subjects had normal condyle, 6 (10%) subjects had normal condyle on right side, 2 (3.3%) subjects on left side, 32 (53.3%) subjects showed abnormal in both condyles, 35 (53.3%) subjects had abnormal condyle on right side, 39 (65%) subjects showed abnormal condyle in left side.(Table 3)

Table 3: Condylar radiographic changes in each group

Condyles	Group A	Group B	Group C	Total	%
Normal in both	11	06	02	19	31.7
Normal in Right	02	04	00	06	10
Normal in Left	02	00	00	02	3.3
Abnormal in both	04	10	18	32	53.3
Abnormal in Right	07	10	18	35	58.3
Abnormal in Left	07	14	18	39	65.0

Radiographic condylar variants among three groups: Flattening was most commonly seen condylar morphology in 25 (41.7%) subjects, followed by ostoephyte in 10 (16.7%) subjects, sclerosis in 9 (15.0%) subjects, small rounded in 7 (11.7%) subjects, excavated in 7 (11.7%) subjects, ossicle in 3 (5.0%) subjects, ely's cyst in 3 (5.0%) subjects & erosion 1 (1.7%) subject.(Table 4)

Table 4: Radiographic condylar variants among three age groups

Radiographic findings	Group A	Group B	Group C	Total	%
Small round	1	5	1	7	11.7
Excavated	1	2	4	7	11.7
Ossicle	0	2	1	3	5.0
Flattening	5	4	16	25	41.7
Osteophyte	0	3	7	10	16.7
Erosion	0	0	1	1	1.7
Sclerosis	1	4	4	9	15.0
Ely's cyst	0	2	1	3	5.0

Association between clinical symptoms with condylar morphological changes: 13(21.6%) subjects reported with TMJ sounds(clicking), 9(15.0%) subjects complained with pain in ear while closing and opening the mouth, 6(10.0%) subjects reported with shoulder or neck pain, 2(3.3%) subjects with one sided biting, 1(1.6%) subject with frequent headache, 1(1.6%) subject complained of joint pain in the body, 1(1.6%) subject reported with ill-fitting denture. No subjects reported with difficulty in mouth opening, clenching or grinding of teeth, bite as normal, which were statistically not significant.(Table 5)

Table 5: Association between symptoms and radiographic changes in condyles

Symptoms	No. of patients	Normal condyle	Abnormal condyle	% of patients	P- value
Difficulty in mouth opening	0	0	0	0	-
Pain in front of ear while opening, closing, yawning & chewing	9	2	7	15	0.216
Clenching /grinding of teeth	0	0	0	0	-
Frequent headaches	1	0	1	1.6	0.99
TMJ sounds(clicking)	13	0	13	21.6	0.16
Bite as normal	0	0	0	0	-
One sided biting	2	1	1	3.3	0.19
Denture wearer(normal/ill fitting)	1	0	1	1.6	0.99
Neck/ shoulder pain	6	0	6	10.0	0.53
Joint pain in body	1	0	1	1.6	0.99

Association between clinical signs with condylar morphological changes: 13(21.7%) subjects reported with TMJ sounds(clicking), 5(8.3%) subjects reported with deviation of mandible, 3(5.0%) subjects with deflection of the mandible, 2(3.3%) subjects complained with tenderness in muscles of mastication, 1(1.6%) subject reported with reduced inter-incisal mouth opening, which was statistically not significant.(Table 6)

Table 6: Association between clinical signs and radiographic changes in condyles

Signs	No. of patients	Normal condyle	Abnormal condyle	% of patients	P-value
Reduced inter-incisal mouth opening	1	0	1	1.6	1.0
Deviation of mandible	5	4	1	8.3	0.64
Deflection of mandible	3	1	2	5.0	0.74
TMJ sounds(clicking)	13	0	13	21.7	0.16
Tenderness of muscles of mastication	2	0	2	3.3	0.83

Correlation between radiographic changes in comdyles & dentition status: The incidence of abnormal condyles were seen less in group A in 17(47%) subjects as compared to group B in 10 (83.3%) subjects & group C in 12 (100%) subjects, which were statistically insignificant.(Table 7)

Table 7: Correlation between radiographic changes in condyles and dentition status

Dentition status	Normal condyle	Abnormal condyle	Total	%
Group A (20-40years)	19 (53%)	17 (47%)	36	60%
Group B (41-60years)	2 (16.7%)	10 (83.3%)	12	20%
Group C (61-80years)	0 (0.0%)	12 (100%)	12	20%
Total	21 (35%)	39 (65%)	60	100%

Assessment of the Intraexaminer & Inter examiner reliability: The intraexaminer & interexaminer reliability with radiographic condylar morphology showed high reliability of perfect agreement with small round, excavated ossicle, osteophyte, erosion, ely's cyst condylar morphology and almost perfect agreement with flattening (0.92 & 0.87) & sclerosis morphology of condyle.(Table 8 & 9)

Table 8: Intraexaminer reliability

Radiographic Findings	Intraclass co-efficient
Small round	1
Excavated	1
Ossicle	1
Flattening	0.92
Osteophyte	1
Erosion	1
Sclerosis	0.87
Ely's cyst	1

Table 9: Interexaminer reliability

Radiographic Findings	Intraclass co-efficients
Small round	1
Excavated	1
Ossicle	1
Flattening	0.96
Osteophyte	1
Erosion	1
Sclerosis	0.89
Ely's cyst	1

Discussion

Osseous changes such as flattening, sclerosis and osteophyte were detected in the symptomatic population and the control population as well. The study done by Kambylafkas et al.,[9] and other authors have reported that Panoramic radiographs (PR) can be used to determine the condylar changes in asymptomatic TMJs.

In the present study, the samples were collected in such a way that the subgroups are sufficient to detect differences.

In our study the predominance of condylar changes was more in individuals above 60 years (45.3%) than that of below 60 years(33.3%), as the age increased the number of condyles affected was more.

Group B & Group C showed more condylar changes compared to Group A, which were similar observations reported by Mathew et al,[10] Muir & Goss,[5] Huumonen et al,[11] &Takayama et al[12] and incongruity with Crow et al study,[4] which showed condylar changes in younger age group.

It was observed that, as the age increased, the number of condyles affected also increased. This observation is in agreement with the observations of Muir and Goss,[5] Huumonen et al.,[11] and Takayama et al.,[12] that absence of morphologic variation was much more common in the younger age group and age is a factor that determines the degree of remodeling, though there is no direct linear relationship. Because the adaptive or degenerative changes in the temporomandibular Joints appear over a long period of time, it is understandable that the condylar changes increase with advancing age. However the findings of our study were not in accordance with the observations of a few studies (Sato et al[13], Jagur et al[14]) which showed condylar changes to be more prevalent in younger age groups or showed condylar changes in all age groups.[15]

Group C showed more abnormal condyles findings. In contrast with right condyle, left side condyle was more affected, which was in accordance with Mathew et al.,[10] &Takayama et al.[12]

The right condylar shapes has found to be quite incongruous in different age-groups. These variations or abnormalities may be congenital or arise from injury, disease, excessive function, or parafunction. Despite the absence of subjective symptoms, these variations or abnormalities may act as predisposing factors and may give rise to symptoms following stress, trauma, or iatrogenic insult.

Flattening was the most common finding followed by osteophyte, sclerosis, small round, excavated, ely's cyst, ossicle & erosion. Flattening was more observed as age increased followed by the osteophyte. Osteophytic changes showed higher prevalence with Group C, which was contradictory with Mathew et al.,[10] study. Erosion, Ossicle & Ely's cyst showed lower prevalence in our study, which was contradictory with Shetty et al.,[16] study as in their study the most common finding was erosion followed by flattening & osteophyte. In our study one subject had erosion in Group C & three subject had ossicle & elys's cyst.

Among 60 subjects, 33 subjects (54.7%) reported with signs & symptoms of TMD such as tenderness in front of year, TMJ clicking, Tenderness in muscles of mastication, deflection & deviation of mouth. There was statistically insignificant association between reported signs & symptoms of TMD and radiographic condylar changes, which was in accordance with the studies reported by Mathew et al.,[10] Sato et al.,[13] Hiltunen et al.,[17] Crow et al.,[4] Hansson et al.,[18] Bush et al.,[19] Huumonen et al.,[11] & contradictory with Flygare et al.,[7] &Takayama et al.[12]

In association between dentition status & condylar morphology, the prevalence of abnormal condylar changes was less in Group A, compared to Group B & Group C, due to occlusal discrepancies which may tend to cause micro trauma to the TMJ & leading to condylar bony changes.

Our study showed statistically insignificant relation between the dentition status & condylar morphology and conflicted with the studies reported by Mathew et al.,[10] Hiltunen et al.,[17] Pereira et al.,[20] Sato et al.,[13] but not in agreement with the study of Al-Sadhan et al.,[21] because their study showed statistically significant correlation between occlusion status and condylar degeneration.

The interexaminer & Intraexaminer reliability were 1 & it was perfect agreement for flattening, small round, excavated, erosion, ossicle, ely's cyst condlyar morphology & almost perfect agreement for osteophyte & sclerosis condylar changes.The prevalence of our study results had similar observations made by Mathew et al.,[10] & Crow et al.,[4] & and dissimilar with Vidra et al.,[22] study as in their study it was poor agreement.

Conclusion

The radiographic condylar abnormalities increased with age factor & were seen more often in patients with TMD's & disturbed occlusion due to loss of teeth. Intraexaminer and interexaminer reliability was perfect indicating an excellent reliability in assessing the condylar changes using panoramic radiograph. Limitations of the sample size & further advanced TMJ imaging modalities have to be undertaken to assess an assortment of condylar morphologies.

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