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RADIOGRAPHIC STUDY OF OSSEOUS CHANGES ACROSS AGE GROUPS, INCLUDING YOUNG ADULTS

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ABSTRACT

Background: *The purpose of this study was to assess the prevalence of radiographic changes in the temporomandibular joint (TMJ) using plain X-rays in an adult population. The study also aimed to investigate the potential associations between TMJ osseous alterations and patient-related factors, including age, sex, dental status, and medical history.*

Methods: *A total of 50 patients aged 20 to 79 years were evaluated using plain X-rays of the TMJ. Patients were categorized into three age groups. Radiographic assessments focused on identifying osseous changes in the TMJ, including condylar flattening, erosion, and osteophyte formation. Statistical analyses, including chi-squared tests and general estimating equations, were conducted to determine the prevalence of TMJ changes and their correlation with demographic and clinical factors.*

Results: *Data were collected from 50 patients, with 30% in the 20-39 years age group, 40% in the 40-59 years group, and 30% in the 60-79 years group. The majority of participants were female (60%), and the mean age was 48.3 ± 16.2 years. Regarding BMI, 52% were classified as having a normal weight, 36% were overweight, and 12% were obese. Common symptoms reported included pain (80%), limited jaw movement (36%), and clicking (30%). Additionally, 80% of patients had no chronic illnesses, while 20% had conditions such as arthritis.*

Conclusions: *TMJ osseous changes detected on plain X-rays are common and increase also with age, reflecting potential functional or degenerative processes. These findings highlight the need for clinicians to assess TMJ radiographs carefully, particularly in older adults, to identify possible degenerative changes or parafunctional habits that may contribute to joint alterations.*

INTRODUCTION

The human skeletal system, which provides structural support and protection to vital organs, undergoes continuous development and remodeling throughout an individual's life. All the processes starting from birth, growing through childhood, adolescence, and adulthood up to the stage where the bones start to decline, are governed by sophisticated biochemical and mechanical signals [1]. Despite going through a fine and dense phase during youth and early adulthood, bones start to transform part of the aging process. These changes may also differ with age and this can be reflected in the aspect of bone aspect, functionality, and disease susceptibility [2].

Plain radiography is as effective as any other diagnostic modality at revealing structural and compositional alterations in the bony skeleton. Diagnostic procedures including radiography, computed tomography, and magnetic resonance imaging provide the clinician with an opportunity to assess osseous structure, diagnose disorders, and evaluate the dynamics of osseous conditions [3]. Consequently, radiography as a technique to measure skeletal changes over time is invaluable in both clinical settings and research. From such pictures, the investigators may assess changes in the skeleton with age, determine bone mass, and recognize diseases like osteopenia, osteoporosis, and osteoarthritis [4]. The bone mass achieves near maximal levels in the skeletal system of the young adults which is those found between the ages of 18 and 35 years. Skeletal development is considered to be at peak during the mid-twenties when the epiphyseal or the growth plates disappear and the bones become mature in terms of length and bulk [5]. There is stability during this period as the process of bone remodeling is in harmony with resorption and deposition. However, during this phase, certain, subtle age-related changes can be observed in collections of radiographic images, for example, bone density differences, or the first signs of joint deterioration, or mild skeletal dysplasias that were not observed earlier. During middle age, bone resorption and formation rates are not equal as people approach the age of 40 - 60 years [6]. Bone mineral density decreases at a rate of 0.5 to 1% per annum, and the decline is especially keen in women after menopause because of hormonal changes and particularly estrogen deficiency. Tubularizing and the initiation of trabecular bone loss might be radiographically apparent as a thinning of the cortex and the beginning of diminution of bone mass especially if the lesion preferentially affects the axial and appendicular skeleton. Such manifestations may not be seen on the plain radiology but are important pointers towards osteoporosis to clinicians for timely management [7].

In elderly patients which are widely determined as older people then 65 years radiologic examination reveals a much clearer image of bone wear and low bone density. The tenderness of the bone decreases, the rates of bone mass loss and bone structure deterioration accelerate, and the risk of fractures rises as well. Pathologies such as osteoarthritis which involves joint space narrowing, marginal osteophytes and reduced cartilage are also more frequent and demonstrable by X-ray [8]. Older people’s bones may look Hag ward, weak and prone to fractures even when subjected to gentle forces. These changes include vertebral fractures, hip fractures, and other changes associated with aging are commonly demonstrated in radiologic surveys of the elderly. CT or MRI changes in the cervical spine progress with aging and can manifest as ageing variants [9]. Cervical degenerative disease is on of the most frequent neurological disorders that are being noticed with increasing prevalence in the elderly. This disease might be caused by cervical spondylosis, disc herniation, and so on. Patients often present with clinical signs of: neck pain, radiculopathy and myelopathy. Because degeneration is common in elderly people, history and physical examination should be done thoroughly. Imaging findings can then be correlated to these findings [10]. Of course, computed tomography and magnetic resonance imaging have helped to implement a revolution in the diagnosis of cervical disorders. However plain radiographic assessment which involves AP, lateral, and flexion extension views is mandatory and is the first line of investigation in cervical spine pathology hence remaining the gold standard. Plain films are assessed with position, height of the disc spaces, satisfaction or presence of spurring, size of the spinal canal, and any increased movement. Many investigations have been carried out for ordinary roentgenograms to define the normal morphology and dynamic motion of the cervical spine [11].

Objective

The purpose of this study was to assess the prevalence of radiographic changes in the temporomandibular joint (TMJ) using plain X-rays in an adult population.

Methodology

This retrospective study was conducted at private hospitals of Karachi during 2023 to 2024. A total of 50 patients aged 20 to 79 years were included in the study.

Inclusion Criteria:

- Patients aged between 20 and 79 years.
- Individuals presenting with symptoms related to the temporomandibular joint, such as pain, clicking, or limited jaw movement, were eligible for inclusion.
- Participants who had not previously undergone significant surgical interventions or treatments affecting the TMJ, ensuring that the observed osseous changes were representative of natural aging processes or mild degenerative changes.

Exclusion Criteria:

- Patients younger than 20 years or older than 79 years, to avoid any confounding effects of early developmental or extreme age-related skeletal changes.
- Individuals with a history of trauma to the TMJ, such as fractures or dislocations, which could result in post-traumatic bone alterations not related to age or natural degeneration.
- Patients with known systemic diseases or conditions, such as rheumatoid arthritis or metabolic bone disorders (e.g., osteomalacia, hyperparathyroidism), which may introduce bone changes independent of age-related processes.

Data collection

The patients were categorized into three age groups based on their age at the time of imaging:

1. **Young Adults (20-39 years)** – Representing the group in the peak phase of skeletal health, where bone remodeling is balanced and no significant degenerative changes are expected.
2. **Middle-Aged Adults (40-59 years)** – Individuals in this group were expected to show early signs of joint degeneration, such as mild flattening or the first appearance of osteophytes.
3. **Older Adults (60-79 years)** – This group was expected to demonstrate more significant osseous changes, such as pronounced condylar flattening, widespread erosion, and extensive osteophyte formation, which are characteristic of age-related degenerative joint diseases like osteoarthritis.

Demographic and clinical data, including gender, history of TMJ disorders, and the presence of systemic conditions (e.g., rheumatoid arthritis), were also collected for each patient. In analysis, these factors were used to try to compare these variables to the seen radiographic changes. MRI of TMJ and plain X-rays were there to assess the osseous changes in the joint. Magnetic imaging resonance was useds because it is a common imaging modality that is cost effective for delivering good images of the bony structures of the TMJ. The conventional radiographic views which include lateral and anterior/posterior views were taken for each subject. All the X-ray images were, therefore, analysed by experienced radiologist to check for the characteristic changes in the osseous structure of the TMJ commonly seen in arthritis such as flattening, erosion and osteophyte formation on the condyle.

Statistical Analysis

Data were analyzed using SPSS v27. The analysis was performed using chi-squared tests to examine the association between age group and the frequency of TMJ changes. Additionally, general estimating equations (GEEs) were applied to account for potential correlations between observations within the same patient, ensuring robust results despite the clustered nature of the data.

Results

Data were collected from 50 patients, with 30% in the 20-39 years age group, 40% in the 40-59 years group, and 30% in the 60-79 years group. The majority of participants were female (60%), and the mean age was 48.3 ± 16.2 years. Regarding BMI, 52% were classified as having a normal weight, 36% were overweight,

and 12% were obese. Common symptoms reported included pain (80%), limited jaw movement (36%), and clicking (30%). Additionally, 80% of patients had no chronic illnesses, while 20% had conditions such as arthritis.

Table 1: Demographic and Baseline Characteristics of Study Participants

Characteristic	Value
Total Number of Patients	50
Age Group Distribution	20-39 years: 15 (30%)
	40-59 years: 20 (40%)
	60-79 years: 15 (30%)
Gender	Female: 30 (60%)
	Male: 20 (40%)
Mean Age (years)	48.3 ± 16.2
BMI (Body Mass Index)	Normal: 26 (52%)
	Overweight: 18 (36%)
	Obese: 6 (12%)
Symptoms Reported	Pain: 40 (80%)
	Clicking: 15 (30%)
	Limited Jaw Movement: 18 (36%)
Medical History	No Chronic Illness: 40 (80%)
	Chronic Illness (e.g., arthritis): 10 (20%)

The incidence increases significantly with age, with only 13.3% of patients in the 20-39 years group exhibiting condylar flattening, compared to 40% in the 40-59 years group, and 80% in the 60-79 years group. Overall, 44% of all patients in the study showed some degree of condylar flattening, highlighting its increasing prevalence with aging.

Table 2: Prevalence of Condylar Flattening by Age Group

Age Group	Number of Patients with Condylar Flattening	Percentage with Condylar Flattening
20-39 years (Group 1)	2/15 (13.3%)	13.3%
40-59 years (Group 2)	8/20 (40%)	40%
60-79 years (Group 3)	12/15 (80%)	80%
Total	22/50 (44%)	44%

Osteophytes were present in 20% of patients in the 20-39 years group, 50% in the 40-59 years group, and 86.7% in the 60-79 years group. Overall, 52% of all patients in the study showed osteophyte formation, indicating that this bony change becomes significantly more common with age, suggesting its potential association with degenerative joint changes, particularly osteoarthritis.

Table 3: Prevalence of Osteophyte Formation by Age Group

Age Group	Number of Patients with Osteophytes	Percentage with Osteophytes
20-39 years (Group 1)	3/15 (20%)	20%
40-59 years (Group 2)	10/20 (50%)	50%
60-79 years (Group 3)	13/15 (86.7%)	86.7%
Total	26/50 (52%)	52%

The percentage of patients with osteophytes increases significantly with age, with 20% in the 20-39 years group, 50% in the 40-59 years group, and 86.7% in the 60-79 years group. Overall, 52% of the study population exhibited osteophyte formation, suggesting that osteophytes are common and become more prevalent as individuals age, potentially reflecting degenerative processes such as osteoarthritis.

Table 4: Prevalence of Osteophyte Formation by Age Group

Age Group	Number of Patients with Osteophyte Formation	Percentage with Osteophyte Formation
20-39 years (Group 1)	3/15 (20%)	20%
40-59 years (Group 2)	10/20 (50%)	50%
60-79 years (Group 3)	13/15 (86.7%)	86.7%
Total	26/50 (52%)	52%

The severity of all osseous changes increased with age, with the 60-79 years group (Group 3) exhibiting the highest average severity for each condition: condylar flattening (4.1), erosion (3.6), and osteophyte formation (4.3). Overall, the average severity of changes across all participants was 2.6 for condylar flattening, 2.4 for erosion, and 2.8 for osteophyte formation, reflecting a clear trend of increased joint degeneration with aging.

Table 5: Correlation Between Age and Severity of Osseous Changes

Age Group	Average Severity of Condylar Flattening (Scale 1-5)	Average Severity of Erosion (Scale 1-5)	Average Severity of Osteophyte Formation (Scale 1-5)
20-39 years (Group 1)	1.2	1.1	1.3
40-59 years (Group 2)	2.5	2.4	2.8
60-79 years (Group 3)	4.1	3.6	4.3
Total	2.6	2.4	2.8

Discussion

The findings of this study provide valuable insights into the radiographic changes observed in the temporomandibular joint (TMJ) across various age groups. Thus, it only revealed the general direction of osseous changes, for example, condylar flattening, condylar erosions, and osteophyte formation, with age progression. These results are in tune with current literature and more studies show that TMJ undergoes extensive degenerative changes with age wherein considerable alterations to the structure of the joint are seen [12]. Miss ED was closely associated with age; condylar flattening became more frequent along with

age. According to the present study Group 1, that is the 20-39 year age group, only 13.3 % of individuals had mild condylar flattening about the TMJ and it can be hypothesized that these young adults were healthy and had well-formed TMJ [13]. While increasing age did not directly correlate with an increased incidence of condylar flattening, Group 2 subjects over the age of 45 years (OAI Group 2) had a condylar flattening incidence of 40 percent, while OAI Group 3 had an incidence of 80 percent [14]. The changes seen here conformed to what would be expected from a degenerative joint, which is acted sign by age-related wear and tear changes in biomechanics, and a decline in the ability of the bone to repair and regenerate itself. Osteoarthritic changes are common in condylar flattening and this might be the actual reason why the smooth concave surface of the condyle becomes flattened [15]. A decrease in the condylar surface was reported in a smaller number of patients depending on the age of the patient. In the first group, condylar erosion was limited to mild, and observed in only 6.7% of the patients; however, in the second and third groups, condylar erosion was seen in 25% and 46.7% of the patients, respectively. These results imply that, at least in cases of joint degeneration, signs of surface wear are possibly revealed only at a later higher level of osteoarthritis or other inflammatory processes [16]. If the condyle is eroded this could negatively affect the joint and lead to such features as pain, stiffness and reduced mouth opening. Since these changes are progressive, it could be crucial to detect them early and manage them thereof to avoid further deterioration of the results, especially of the patients. Similar results were observed for osseous changes where age-related increased was rated using a 1-5 scale [17]. Overall, condylar flattening, erosion, and osteophyte formation within Group 1 had a mild level of severity; the average score was 1.2, 1.1, and 1.3, respectively. On the other hand, patients in Group 3 were found to have higher overall mean average scores, with severity scores of 4.1, 3.6, and 4.3 for the same alterations [18]. These osseous changes may be symptomatic and should be treated conservatively, by pain control, physical therapy, and changes in lifestyle [19]. Where the pathology is more severe, the surgeon might recommend the reconstruction procedures like joint replacement or arthroplasty to fix the problem and get rid of the pain [20]. In addition, the results of the present study highlighted age as a significant determinant of TMJ degeneration, it therefore underlines the importance of regular follow-ups with individual treatment plans that will successfully address the changes in the joint due to age. Any clinician dealing with TMJ disorders should factor in age as a critical component while making diagnoses and recommendations about how to halt or minimize the degenerative changes in the joint.

Conclusion

It is concluded that osseous changes in the temporomandibular joint, including condylar flattening, erosion, and osteophyte formation, become more prevalent and severe with age. These findings highlight the natural progression of degenerative changes in the TMJ, emphasizing the importance of early detection and management, particularly in older adults. Further studies are needed to explore the clinical significance of these radiographic changes and their potential impact on TMJ function.

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