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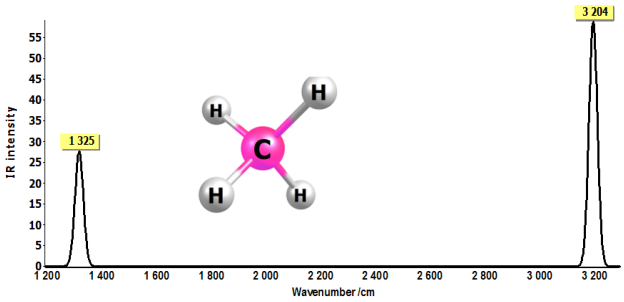

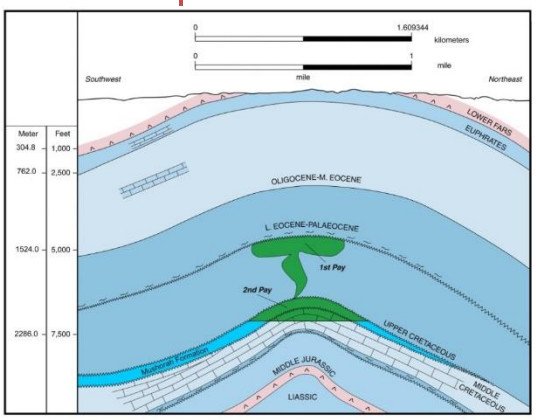

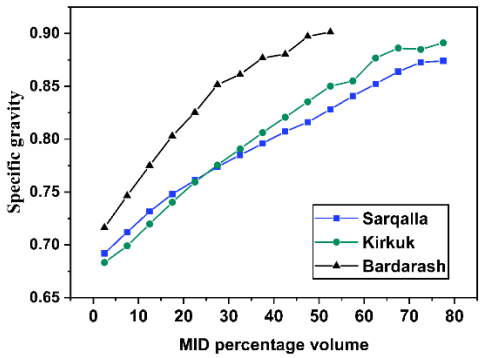

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Assessment of dimensions of mandibular condyles and their correlation with jaw movements in rheumatoid arthritis patients

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Abstract

Objectives: The aim of this study is to assess the condylar dimensions in Rheumatoid Arthritis (RA) patients and compare them to condylar dimensions of healthy persons and try to find out correlations between dimensional condylar changes and jaw movements in RA patients. **Methods:** This case-control study was performed on 40 RA patients with ten healthy adults (control cases). Clinical examination with Cone Beam Computerized Tomography (CBCT) was done for participants. Independent and paired t-tests with correlation coefficient tests were used for data analysis by the SPSS program. **Results:** There was a significant difference between RA and controls regarding the means of their unassisted and assisted maximum mouth opening and the mean of right lateral jaw excursion also. The mean condylar length in RA patients was 6.88 mm while in control cases was 7.61, and the mean condylar width in RA was 16.77 and in controls was 16.53 mm, and the mean condylar height was 18.02 mm in RA and 21.14 mm in controls without significant difference between both groups. There was a positive correlation between the condylar dimensions and the jaw movements. **Conclusions:** Condylar height and width were decreased in RA patients in comparison to the control group, indicating bony changes in the upper condylar surface. In addition, RA patients have decreased range of jaw movements like mouth opening, which might result from bony changes and reduction in condylar dimensions.

Introduction

Rheumatoid arthritis (RA) is a chronic, inflammatory autoimmune disease of unknown etiology, that affects several body joints, usually symmetrically and bilaterally; it affects women 2 to 3 times more than men at any age but usually between the fourth and sixth decades of life (1, 2). This disease is characterized by inflammation of the synovial tissue, which leads to the destruction of the cartilage and resorption of bone of the involved joint. Destruction of bone of the joint may occur 2 to 3 years after the onset of RA and may progress rapidly after this period and may lead to loss of function. As a result, patients with RA usually have persistent synovitis, swelling, and tenderness. In addition, clinical manifestations may have exacerbations and remissions, leading to loss of function and pain (1, 3-5).

The temporomandibular joint (TMJ) is considered one of the most important human body joints responsible for the mandible's movement during chewing, swallowing, and speech. TMJ involvement in RA is usually diagnosed in more advanced cases, and at this stage, patients already have symptoms and tomographic findings compatible with bone changes (degeneration) (6, 7). Depending on the progression of TMJ involvement, bone wear (resorption) may occur that causes changes in the vertical dimension of the mandible, resulting in anterior open bite, deficiency in masticatory capacity, and, in more severe cases, temporomandibular ankylosis. Therefore, early diagnosis of TMJ involvement is essential to avoid bone changes and their possible sequelae (8–10).

Many radiographic techniques have been used to examine the TMJ, including panoramic radiography, magnetic resonance imaging, ultrasound, computed tomography (CT), and cone-beam computed tomography (CBCT). Nowadays, cone-beam computed tomography (CBCT) is considered the gold standard for assessing bone components of the TMJ because it provides three-dimensional and multiplanar images with high resolution and minimal distortion. Furthermore, without overlapping bone structures, thus allowing a precise evaluation of possible changes that can indicate their degree of involvement; in addition, it has a lower radiation dose than conventional computed tomography (11–14).

Several Studies have shown that CT images can be remarkably accurate for linear (15-17), geometric, (17), and volumetric (18) measurements within the maxillofacial region. Therefore, in this study, we aimed to assess the dimensional changes of condyles in RA patients using CBCT and compare them to condylar dimensions of healthy persons and find correlations between dimensional condylar changes and jaw movements in RA patients.

Materials and Methods

Study setting

Forty patients (38 females and 2 males) aged 30-74 years previously diagnosed with RA by a rheumatologist were included in this study. This big difference in the female-to-male ratio is due to the high prevalence of RA in females, which was stated in previous studies also. Besides that, ten healthy females who visited the dental radiology center to take CBCT were also included as the control group. Participants were allocated into 2 groups. The 1st group (A) includes the patients that had RA, and the 2nd group (B) includes healthy participants (Table 1).

Table 1. Age range and means of the participants.

Group	No.	Age (Years)		
		Minimum	**Maximum**	**Mean ±SD**
A	40	30	74	50.6±10.45
B	10	30	47	37.5±6.18
Total	50			

A: RA patients, B: Control group, SD: Standard Deviation

Inclusion criteria

Patients diagnosed by a rheumatologist with RA, those without any other systemic diseases, chronic infection or heavy medication, and those willing to participate were included in this study. Healthy

females without systemic disease, missing teeth, TMD, and Class II and Class III occlusions were included in this study as a control group.

Exclusion criteria

Patients with psoriatic arthritis, osteoarthritis, history of juvenile RA, taking medication for other systemic diseases (hypertension, diabetes mellitus, hypocholesteremia, and cancer), pregnant women, and patients unwilling to participate.

Clinical examination

The mouth opening and lateral excursion of the jaw were measured and recorded by an oral medicine specialist following Research Diagnostic Criteria (RDC/TMD) (19). The patient sat in an upright position on the dental chair with the back straight and the maxilla parallel to the floor of the room. Then told to open the mouth normally (unassisted opening), and the distance between the incisal edge of the upper central incisors and lower central incisors was measured, then told the patient to open their mouth as much as possible (maximum unassisted mouth opening), after that the clinician help the patient in opening the mouth to the maximum ratio (assisted opening), after that the patient informed to move (deviate) the mandible to the right side then the horizontal distance between midline of maxilla and midline of mandible was measured (right lateral excursion), the same procedure repeated with left side deviation of the mandible (left lateral excursion). The findings were recorded in a pre-designed clinical examination form.

CBCT examination

CBCT examination was performed with the participant's closed mouth in an occlusal situation with the selected field of view (8.5 cm x 8.5 cm) and 98 kV, 10 mA, and 14 seconds exposure time using Sirona 3D machine (Galileos Comfort, Germany). Later on, contiguous sectional images in 3 planes, including the sagittal plane (vertical to the long axis of the condylar head), coronal plane (parallel to the long axis of the condylar head), and axial (horizontal) plane, were done in a Multiplanar Reconstruction (MPR) with a slice thickness of 1 mm using CBCT software Sidex XG (Gallileos viewer).

Condylar measurement

A condylar length or AP dimension (linear distance between posterior and anterior mandible condyles in the sagittal plane) (Figure 1A), a condylar width or ML dimension (linear distance between medial and lateral mandible condyles in the coronal plane) (Figure 1B,) and a condylar height (perpendicular linear distance from superior mandible condyle to tangent constructed between the most inferior point of coronoid sigmoid notch perpendicular to the tangent of the posterior surface of ramus in the sagittal plane) (Figure 1C) were measured. The measurement methodology that we used in this study was described by Hilgers et al., 2005 (20) and Al-koshab et al., 2015 (21).

Ethics approval and consent to participate

This study followed relevant guidelines and regulations belonging to Helsinki's declaration for using human tissues. This research was registered in the German Clinical Trials Register (DRKS) and belonged to the World Health Organization (WHO) clinical trial registration official with ID No. (DRKS00024167) on the 8th of February 2021. Additionally, our study protocol was approved by the Ethical committee of the College of Medicine, University of Sulaimani, the Republic of Iraq, with No.105 on 27/1/2020. Furthermore, informed written consent was obtained from all participants.

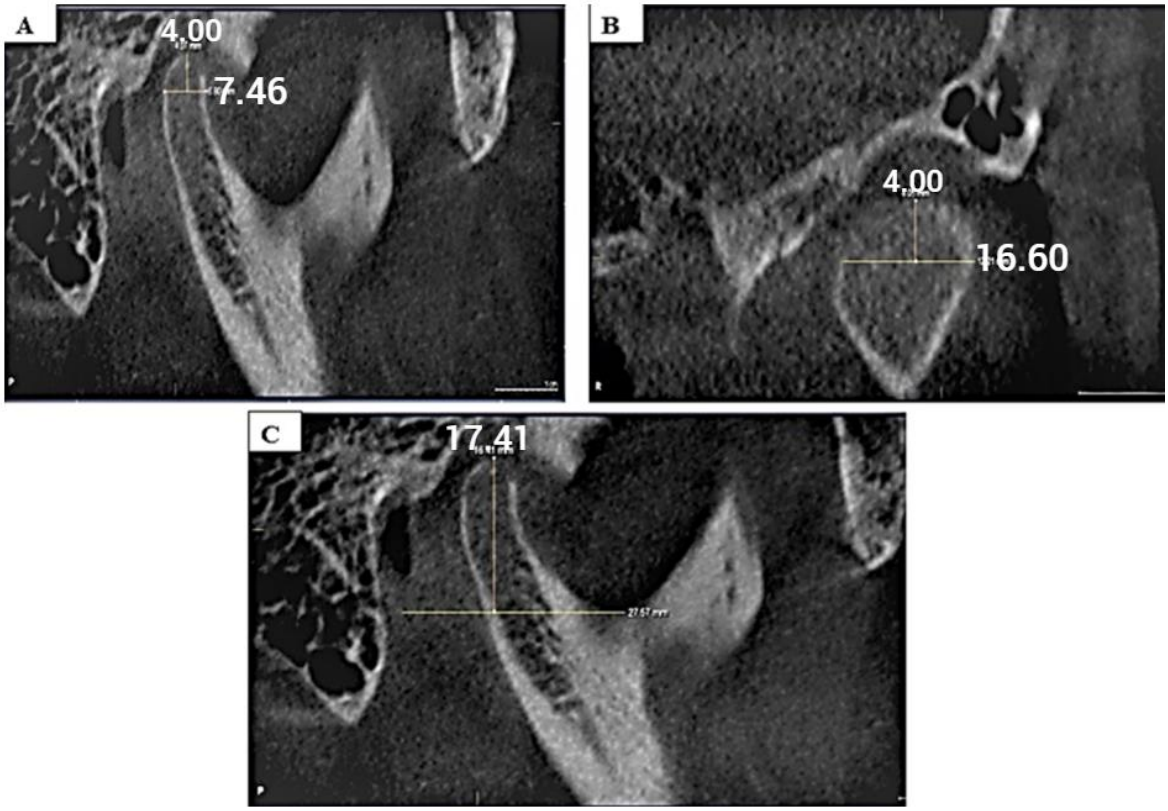

Figure 1. Measurements of condylar dimensions. Condylar length (A), condylar width (B), and condylar height (C).

Statistical analysis

The data were analyzed using Statistical Package for Social Sciences, version 26.0 (Chicago, USA). The Shapiro-Wilk test tested numerical data for the normality of their distribution. Qualitative data were presented as numbers and percentages. Quantitative data were presented as mean and standard deviation. A student t-test was used for parametric data; an Independent t-test was used for comparison between groups. Pearson correlation coefficients were used to find out correlations between variables. Statistically significant data was considered when probability values of less than 0.05 were obtained.

Results

Clinical Examination

Regarding the mean of maximum unassisted mouth opening in RA and control groups, there were significant differences between both groups (P=0.008), 39 mm in the RA group and 44.5 mm in the control group. Similarly, a significant difference (P=0.012) in the mean of maximum assisted mouth opening was observed between both RA and control groups (39.6 mm in group A and 44.8 mm in the control group). Additionally, the mean of right lateral jaw excursion was 5.67 mm in group A, 5, and 9.5 mm in group B, with a significant difference (P=0.002) between RA and control cases. Moreover, the mean left lateral jaw excursion was 5.62 mm in group A and 7.2 mm in group B without a significant difference (P=0.952) between the RA group and the control group (Table 2).

Table 2. Mean and standard deviation of mouth opening and lateral excursions of participants.

Group	Unassisted Opening		Maximum Unassisted Opening		Maximum Assisted Opening		Right lateral excursion		Left lateral excursion	
	Mean±SD	P-value	Mean±SD	P-value	Mean±SD	P-value	Mean±SD	P-value	Mean±SD	P-value
A	39.02±7.54	0.008*	39.02±7.54	0.008*	39.65±8.29	0.012*	5.67±3.18	0.002*	5.62±3.54	0.952
B	44.5±1.9		44.5±1.9		44.8±1.99		9.5±0.7		7.2±3.61	

*Significance level set at 0.05

Condylar measurements

Table 3 shows that the mean condylar length in group A was 6.88 mm, and in the group, B was 7.61 without a significant difference between them (P=0.215). Likewise, the mean condylar width in group A was 16.77, and in group B, it was 16.53 mm without a significant difference (P=0.844). Finally, the mean condylar height was 18.02 mm and 21.14 mm in groups A and B, respectively, without significant differences (P=0.219).

Table 3. The mean and standard deviation of condylar dimensions on the CBCT of participants.

Group	Condylar Length/mm		Condylar Width/mm		Condylar Height/mm	
	Mean ±SD	P-value	Mean ±SD	P-value	Mean ±SD	P-value
A	6.88±1.09	0.215	16.77±2.02	0.844	18.02±1.96	0.219
B	7.61±0.71		16.53±1.71		21.14±1.51	

Correlation of condylar dimensions with jaw movements in RA patients

Table 4 shows that the condylar length positively correlated with all movements except right lateral excursion and mandibular protrusion, and the condylar length and height positively associated with all movements.

Table 4. Correlation of condylar dimensions with Jaw movements.

Condylar dimensions	Unassisted opening		Maximum unassisted opening		Maximum assisted opening		Right lateral excursion		Left lateral excursion	
	*r	P-value	*r	P-value	*r	P-value	*r	P-value	*r	P-value
Length	0.014	0.933	0.014	0.933	0.049	0.766	-0.077	0.638	0.093	0.570
Width	0.196	0.226	0.196	0.226	0.225	0.163	0.105	0.519	0.061	0.707
Height	0.038	0.815	0.038	0.815	0.084	0.604	0.151	0.353	0.339	0.032

*Pearson correlation coefficient

Discussion

In this study, we aimed to evaluate the dimensional changes of condyles in RA patients to find correlations between dimensional condylar changes and jaw movements. As a result, the mean of unassisted opening and maximum unassisted opening of mouth was decreased in RA patients (39 mm) compared to the opening in control cases (44.5 mm). Furthermore, the mean of maximum assisted mouth opening also was less in RA patients (39.6 mm) than opening in control cases (44.8 mm), which was higher than the results found by Ardic et al. (2006) (22), who reported unassisted opening to be 37.5mm in RA patients, however, they reported higher range of assisted opening (44.3 mm) in RA patients. Additionally, we found that the mean of right lateral jaw excursion was 5.6 mm in Group A and 9.5 mm in Group B. The mean of left lateral jaw excursion was 5.6 mm in group A and 7.2 mm in group B. These findings were lower than the results of a study that reported a right excursion of 6.7 mm in RA and left excursion of 6.9 mm in RA patients Ardic et al., (2006) (22). Most studies show a decreased range of motion in RA patients, which might be caused by reduced joint space, sclerosis, or changed condylar positioned as an adaptive procedure.

The mean condylar length was 6.88 mm in RA patients and 7.61 mm in control cases, which was lower than Youssef et al., 2020 who found 8.66 mm in RA and 8.27 mm in control groups (23). Our results for control cases were close to the results of a study done in Malaysia (21) (7.50 mm in Malays and 7.20 mm in Chinese). The mean condylar width was 16.77 mm in RA patients and 16.53 mm in control cases which were slightly lower than the results reported by other researchers (23) and (21), who found 17.89 mm in RA 17.99 mm in controls and 17.18 mm in Malays and 17.80 mm in Chinese, respectively but was higher than the results reported by Manja and Rajaduray (2019) (24) who found 11.67 mm in patients with clicking and 11.18 mm in patients without clicking. Results of our study show that the Rheumatoid arthritis patients showed reduced height and width of the mandibular condyle in comparison to the control group, which indicates the presence of erosion or bone destruction in the upper condylar surface.

Consequently, in this study, the mean condylar height was 18.02 mm in RA patients and 21.14 mm in control cases which are close to the results found by Manja and Rajaduray (2019) (24), who found 18.9 mm in patients with clicking and 22.81 mm in patients without clicking and by Al-koshab et al. (2015) (21) (17.0 mm in Malays and 18.37 mm in Chinese). On the other hand, our results are much higher than Youssef et al. (2020) (23) (4.3 mm in RA and 4.87 mm in control cases). These drastic differences might be related to the height measurement method that is almost done from the most superior point of the condylar head down to the line of measuring the ML dimension of the condyle. The only decreased measurement was in the condylar height of RA patients concerning control cases that indicate bone changes in the upper condylar surface with fewer or no damage on the other sides.

There was a positive correlation between condylar dimensions (length, width, and height) and vertical and horizontal jaw movements (mouth opening and lateral jaw excursion), which means that the decrease in condylar dimensions will lead to the reduction in the range of mouth opening and lateral jaw excursion.

Conclusions

Rheumatoid arthritis patients showed reduced height and width of the mandibular condyle in comparison to the control group, indicating bony changes in the upper condylar surface. In addition, RA patients have decreased range of jaw movements like mouth opening, which might result from bony changes and reduction in condylar dimensions. The limitation of the study was the sample size due to the COVID-19 lockdown and MRI device availability at the hospitals. Also, CBCT is an ionizing radiation technique that should be used with caution only in necessary and urgent cases.

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