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Investigation of Temporomandibular Joint by Clinical Findings and Dental Volumetric Tomography Method in Patients with Rheumatoid Arthritis and Systemic Lupus Erythematosus

Yeşiltepe S[1*] and Yilmaz AB[2]

[1]*Assistant Professor, Department of Oral and Maxillofacial Radiology, Faculty of Dentistry, Adnan Menderes University, Turkey*

[2]*Professor, Department of Oral and Maxillofacial Radiology, Faculty of Dentistry, Ataturk University, Turkey*

[*]**Corresponding author:** Yeşiltepe S, Assistant Professor, Department of Oral and Maxillofacial Radiology, Faculty of Dentistry, Adnan Menderes University, Turkey, Tel: +905058282990, E-mail: dt_selin@yahoo.com

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Abstract

Aim: The purpose of this study is to compare clinical and cone beam computerized tomography (CBCT) findings of the temporomandibular joint in patients with rheumatoid arthritis (RA) and systemic lupus erythematous (SLE) with those of a control group.

Material and Method: Individuals with 44 rheumatic diseases and 50 control groups were included in the study. Subjective and objective symptoms, CBCT findings related to temporomandibular joints of these individuals were evaluated.

Results: In patients with RA and SLE, subjective symptoms were found to be higher than the control group. Objective symptoms, such as deviation, crepitation, pain in palpation of temporomandibular joints and chewing muscles were found higher than the control group. In the patient group, CBCT findings such as sclerosis, erosion, subchondral cyst in the condylar head, flattening and sclerosis in the articular eminence were found higher than the control group.

Conclusion: Routine examinations of patients with RA and SLE should include an assessment of TMJ involvement. Findings of TMJ involvement in these patients can facilitate early diagnosis and treatment of temporomandibular disorders.

Keywords: Temporomandibular Joint; Tomography; Rheumatic Diseases

Introduction

TMJ disorders may be related not only to the masticatory system but also to the effects of systemic diseases on the joints. TME involvement is high in individuals with rheumatologic diseases. Rheumatoid arthritis (RA) and systemic lupus erythematosus (SLE) are common rheumatic diseases, which may cause temporomandibular joint (TMJ) disorders by affecting the masticatory system [1,2]. RA, an autoimmune, systemic, chronic inflammatory disorder, affects periarticular structures, such as synovial membranes, capsules, tendons and ligaments. Although RA can occur at any age, symptoms usually first appear between the ages of 30 and 50 years, and its prevalence increases with age. According to a previous study, the incidence of RA was two to three times higher in females than males [3].

In RA, TMJ involvement was first reported in 1874 by Garrod. Symmetric involvement varies, with an incidence of 34 to 75% reported [4]. The first symptoms and findings in the joint are tenderness in the masticatory muscles, in addition to restricted movement of the jaw due to decreased translational movement of the mandibular condyle. Deep preauricular pain during function is the most common clinical complaint. RA-related TMJ disorders are also characterized by morning stiffness of the joints, palpation tenderness, joint sounds and decreased bite strength [5]. The most frequent radiographic finding in RA patients is irregular erosion of anterior and medial surfaces of the condyle, with these findings seen in two-thirds of RA patients. Destruction of the condyles can lead to narrowing of the joint space. The condyle can be completely eroded in some patients. Radiographic findings in patients with RA include osteoporotic changes in bone and osteophyte formation [4]. In addition, the articular eminence may be flattened, and erosion of the ceiling of the mandibular fossa may be observed [6].

SLE is a connective tissue disease, characterized by autoantibody production and immunocompetence. It can affect many organs and may be chronic or associated with remission and exacerbations [1]. In the general population, SLE is nine times more common in males than females [7]. In 65% of cases, patients are diagnosed with SLE between the ages of 16 and 55 years [8]. Arthritis is common in the majority of SLE patients, but TMJ disorders associated with SLE are less severe than those observed in cases of RA [9]. Although radiographic bone erosion of the TMJ is less common than erosion of other joints in SLE, changes in condyles in SLE patients are similar to those observed in RA patients [10].

Various imaging methods can be used to investigate the influence of rheumatologic diseases on the TMJ. Cone beam computerized tomography (CBCT) has been developed as an alternative method to better visualize bone structures in the maxillofacial region and to remove the disadvantages of computed tomography. CBCT can be used to determine pathological changes, such as osteophyte formation, erosion, fractures, ankylosis and developmental anomalies, in the TMJ, in addition to the position of the condyle in mouth open and closed positions [11].

Identifying possible effects of diseases on the stomatognathic system in a patient group versus a control group would provide useful data that could be used to reduce the severity of the effect. The purpose of this study is to compare clinical and CBCT findings of the TMJ in patients with RA and SLE with those of a control group.

Materials and Method

All patients provided informed written consent, and the study was approved by the ethics committee of Atatürk University, Faculty of Dentistry. The patient group (n = 44, 7 males and 37 females) was composed of individuals who were diagnosed with RA (*n* = 30) and SLE (*n* =14) according to the American College of Rheumatology 1987 revised criteria and American College of Rheumatology classification criteria, respectively, in the Department of Rheumatology at Ataturk University Medical School. The control group (*n* = 50, 14 males and 36 females) consisted of individuals older than 25 years without rheumatologic disturbances who underwent an examination in the radiology department of Atatürk University, Faculty of Oral and Maxillofacial Dentistry due to various dental and periapical disorders and in whom CBCT was performed for different reasons. The average age of the individuals in the control group was 42 years, in the patient group was 46.

Stomatognathic examination

Information was obtained from the subjects in the patient and control groups on the current situation, parafunctional habits, previous treatments and general systemic conditions. Information on subjective symptoms was obtained through detailed questioning. All the participants underwent a routine stomatognathic examination in the clinic to detect signs of TMJ involvement. In the TMJ examination, mandibular active movements were first assessed, and the type of movement (i.e. symmetrical or deviated) was recorded. In addition, deflection and pain during motion were noted. Vertical motion of the mandible were evaluated. After assessing the jaw movements, tenderness and joint sounds in the joint region were assessed. TMJ sounds (i.e. clicking and crepitation) were recorded from each side. Palpation of the condyle was performed laterally from the anterior region of the external ear canal and from the external auditory canal, the mouth closed, and opening and closing movements. Subjective disturbance and tenderness were noted after palpation. Following palpation of the joint, masticatory and neck muscles were examined, and the presence of pain and triggers was recorded.

Radiographic examination

Lateral panoramic radiography was performed in all the participants. Lateral panoramic TMJ radiographs (Kodak CS 9000, Eastman Kodak Company, New York) were obtained at 70 kVp, 10 mA for 13.9 s, with the subject's mouth in open and closed positions. The radiographs of the subjects in the patient and control groups were evaluated without knowledge of the clinical findings. Condylar motion was evaluated by lateral panoramic radiography, with the motion classified as normal (Figure 1a), nearly normal (Figure 1b), almost no motion (Figure 1c), hypomobility (Figure 1d) and hypermobility (Figure 1e). In the statistical analyses, nearly normal joint motion was assessed as normal.

CBCT was performed in all patients and controls. CBCT imaging was performed using flat-panel CBCT equipment (NewTom 3G®; Quantitative Radiology, Verona, Italy). The device was operated at 110 kVp and a maximum of 15 mA, as standard. The voxel size was 0.16 mm, and the typical exposure time was 5.4 sec. QR-NNT® (version 2.21) software (Quantitative Radiology) was used to evaluate the CBCT images. Sagittal and coronal sections (1 mm thickness) and axial sections (0.5 mm thickness) of the condyle was evaluated. Condyle morphology (flattening and deformation) was recorded, including degenerative changes of compact and spongious bone in the condyle and articular eminence, osteophyte formation and subchondral cysts. Changes in fossa morphology were also recorded. All radiological images (lateral panoramic radiography and CBCT images) evaluated by two radiologist (Figure 2a,b,c,d,e,f,g and h).

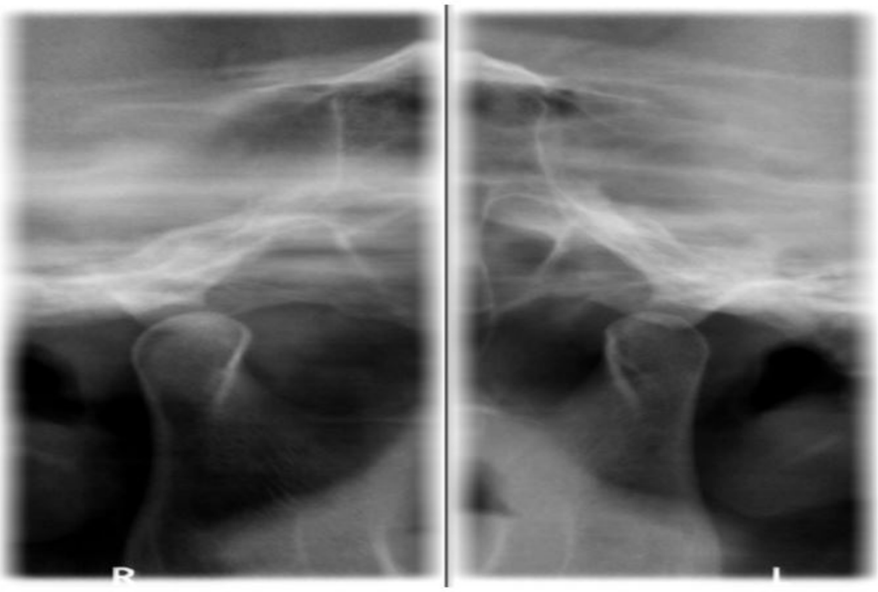

Figure 1a: Normal motion

Figure 1b: Nearly normal motion

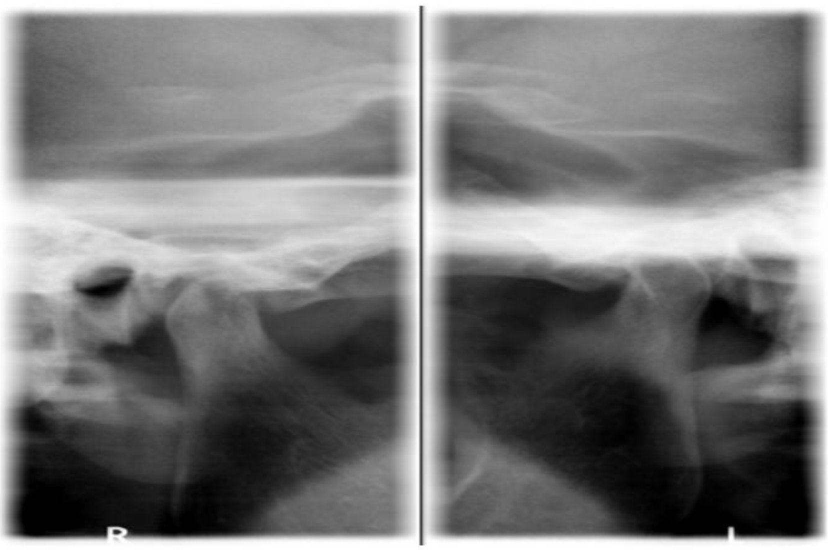

Figure 1c: Almost no motion

Figure 1d: Hypomobility

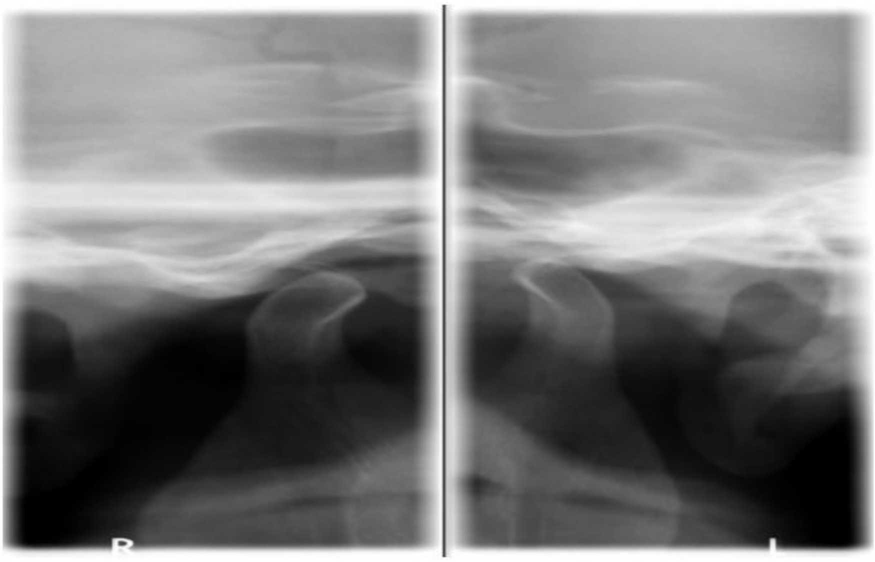

Figure 1e: Hypermobility

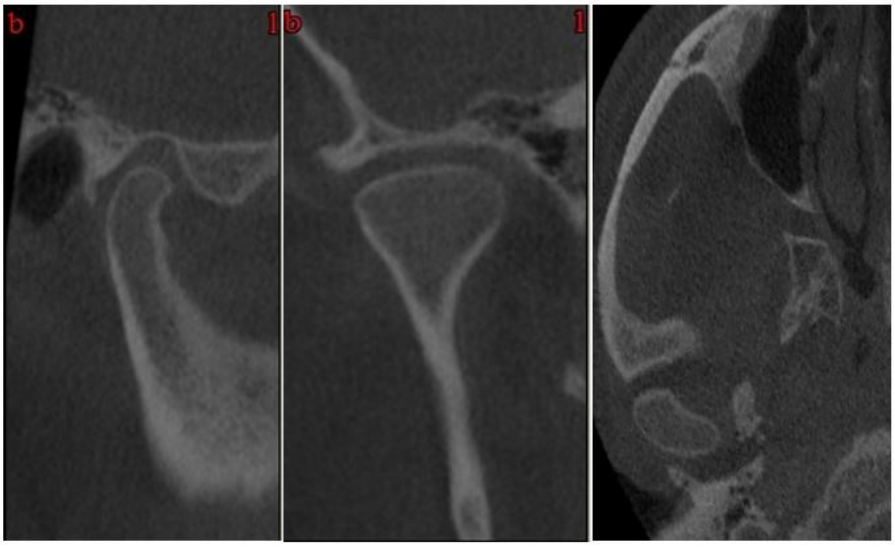

Figure 2a: There is no erosion at the condyle head on sagittal, coronal, axial sections

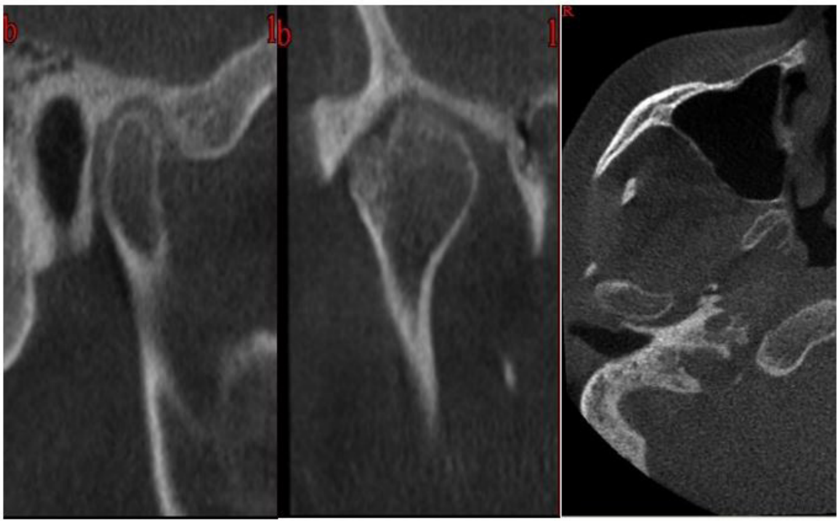

Figure 2b: Light erosion at the condyle head on sagittal, coronal, axial sections

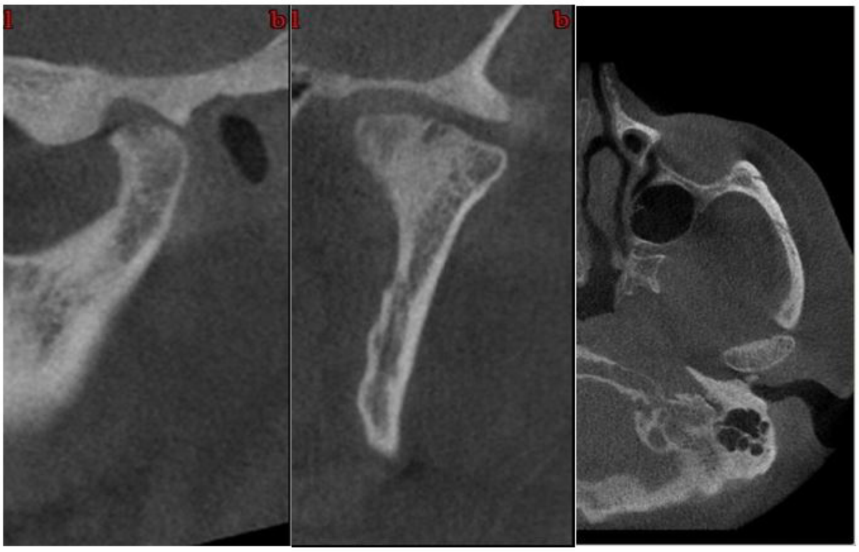

Figure 2c: Significant erosion at the condyle head on sagittal, coronal, axial sections

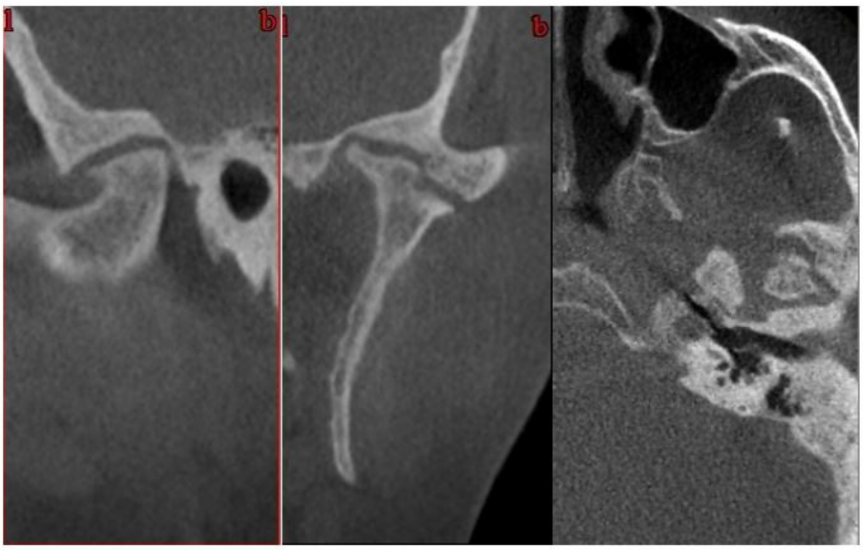

Figure 2d: The condyle head almost completely eroded on sagittal, coronal, axial sections

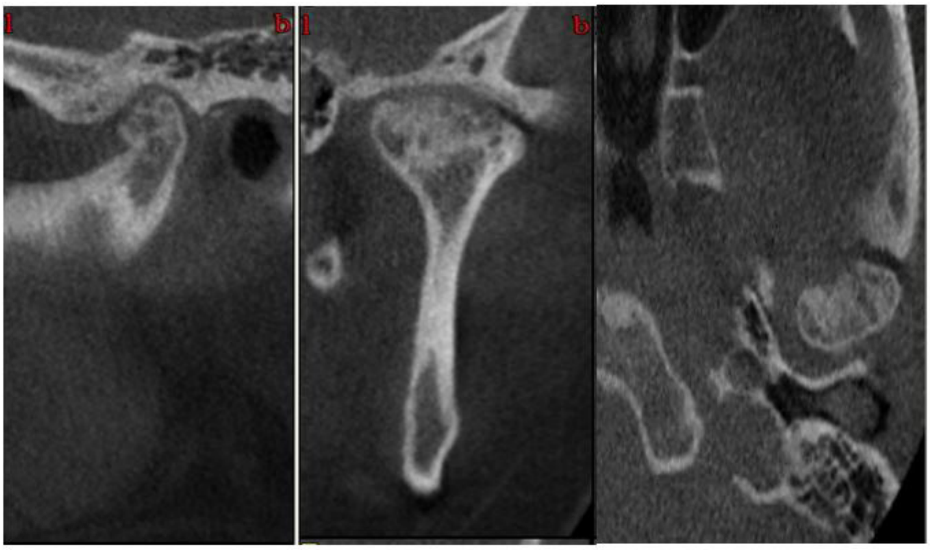

Figure 2e: Subchondral cysts at the condyle head on sagittal, coronal, axial sections

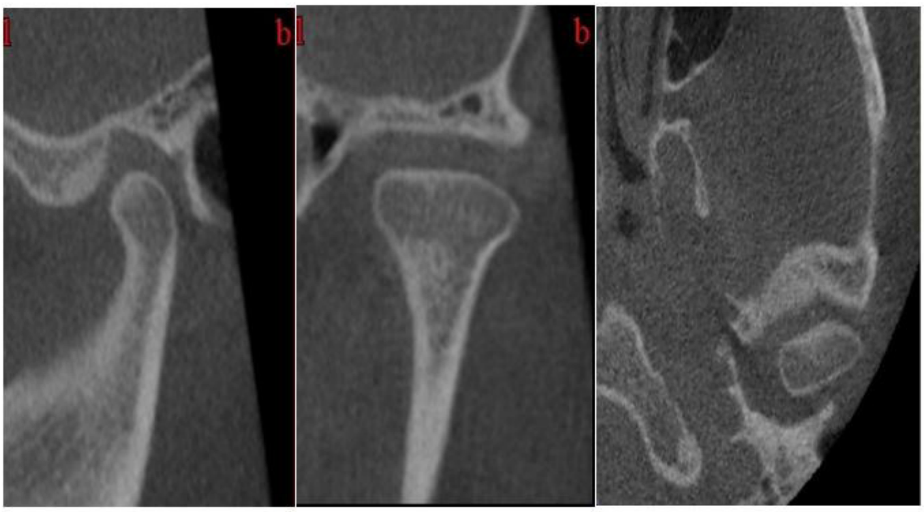

Figure 2f: Increase in sclerosis at the condyle head and articular eminence on sagittal, coronal, axial sections

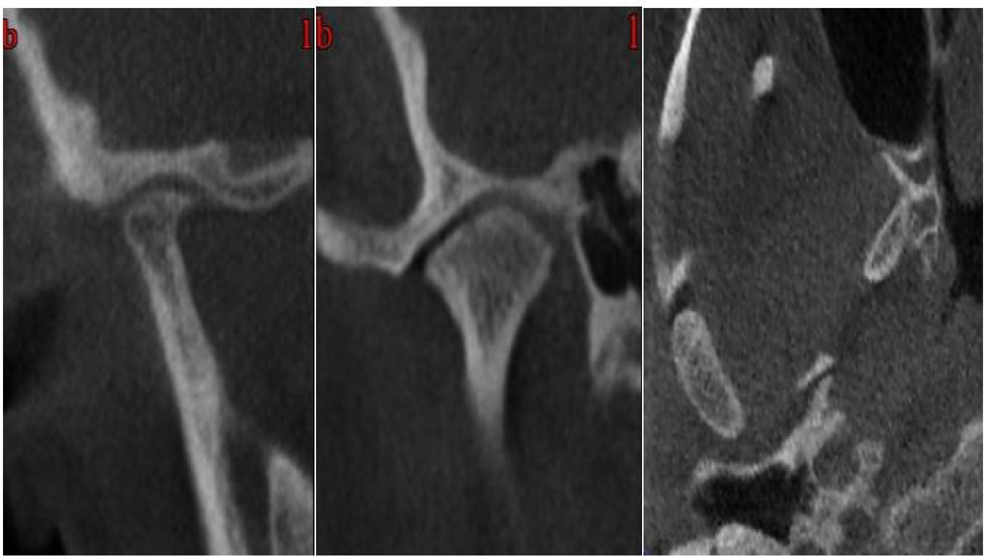

Figure 2g: Flattening at the condyle head and osteophyte formation on sagittal, coronal, axial sectionstions

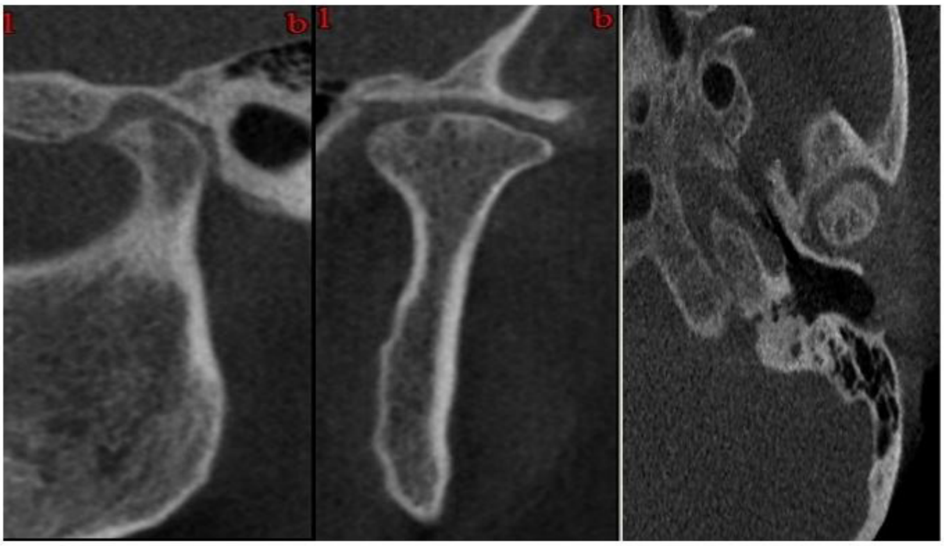

Figure 2h: Subchondral cyst at the condyle head and flattening at the articular eminence on sagittal, coronal, axial sections

Statistical analysis

X^2 (chi-square) test and Fisher's exact test were used as dependency tests among the variables with categorical data in the statistical analysis. To comparison between variables with numerical data, the type of distribution was determined by the Kolmogorov–Smirnov test, and a one-way analysis of variance (ANOVA) was performed.

Results

There was no statistically significant difference in the age or sex of the patients and controls (Table 1). The distribution of subjective symptoms in the patient and control groups is shown in Table 2. Table 3 presents the answers of the patients and controls to questions regarding parafunctional habits, history of trauma and emotional stress. By the assessment of mandibular movements, the mean maximum mouth opening was lower in SLE patients as compared with that of non-SLE patients. There was no statistically significant between-group difference in average mouth opening. Limitations in mouth opening (< 40 mm) were found in 23.3% of RA patients, 33.3% of SLE patients and 30% of controls. The distribution of objective symptoms in the patient and control groups is shown in Table 4. Table 5 presents the lateral panoramic radiography findings of the patients and controls, and Table 6 displays the CBCT findings of the two groups. In 5 of 15 RA patients who had erosion of the condylar head, erosion was significant, with almost all the condylar head eroded in one case.

Gender	RA		SLE		CONTROL	
	n	%	n	%	n	%
Male	7	23,3	0	0	14	28
Female	23	76,7	14	100	36	72
Total	30	100	14	100	50	100

Table 1: Distribution of patient and control group individuals by gender

Subjective symptoms	RA		SLE		CONTROL	
	n	%	n	%	n	%
Frequent headache	14	46,7	9	64,3	18	36
Ear symptoms	12	40	7	50	17	34
Difficulty in mouth opening	3	10	5	35,7*	3	6
Difficulty in mouth opening in the morning	5	16,7	2	14,3	4	8
Sound in the jaw joint	11	36,7	7	50*	10	20
Muscle fatigue during chewing	11	36,7	7	50	14	28
Jaw lock	3	10	2	14,3	2	4
Pain in the jaw joint	10	33,3	5	35,7	11	22
Total	25	83,3	13	92,9*	34	68

*Statistically significant difference between patient and matched controls, $p<0.05$

Table 2: Distribution of subjective symptoms in the patient and control groups

Parafunctions, trauma, emotional states	RA		SLE		CONTROL	
	n	%	n	%	n	%
Trauma	1	3,3	1	7,1	0	0
Bruxism	7	23,3	9	64,3*	12	24
Sleep problem	18	60*	6	42,9	9	18
Oral habits	3	10	0	0	3	6
Stress	23	76,7*	13	92,9*	27	54

*Statistically significant difference between patient and matched controls, $p<0.05$

Table 3: Distribution of parafunctional habits, history of trauma and emotional situations in the patient and control groups

Objective symptoms	RA		SLE		CONTROL	
	n	%	n	%	n	%
Deviation	3	10	2	14,3	1	2
Deflection	2	6,7	0	0	1	2
Single click	3	10	3	21,4	8	16
Reciprocal click	1	3,3	3	21,4	3	6
Crepitation	15	50*	3	21,4	10	20
Pain in palpation in TME	12	40	7	50*	11	22
Pain in palpitation in chewing muscles	13	43,3	10	71,4*	18	36

*Statistically significant difference between patient and matched controls, $p<0.05$

Table 4: Distribution of objective symptoms in the patient and control groups

Lateral panoramic radiography findings	RA		SLE		CONTROL	
	n	%	n	%	n	%
Hypermobility	14	46,7*	4	28,6	11	22
Normal/ Almost normal	11	36,7*	7	50	30	60
Almost no movement	2	6,7	1	7,1	0	0
Hypomobility	3	10	2	14,3	9	18

*Statistically significant difference between patient and matched controls, $p<0.05$

Table 5: Distribution of lateral panoramic radiography findings in the patient and control groups

CBCT findings	RA		SLE		CONTROL	
	n	%	n	%	n	%
Flattening at the condyle head	25	83,3	12	85,7	44	88
Increase in sclerosis at the condyle head	15	50*	8	57,1*	14	28
Erosion at the condyle head	15	50*	7	50*	6	12
Osteophyte formation at the condyle head	17	56,7	5	35,7	25	50
Subchondral cyst at the condyle head	16	53,3*	6	42,9*	5	10
Flattening at the articular eminence	19	63,3	9	64,3	31	62
Cortical degeneration at the articular eminence	12	40	3	21,4	12	24
Increase in sclerosis at the articular eminence	16	53,3	10	71,4	22	44
Cortical degeneration at the mandibular fossa	2	6,7	0	0	1	2

*Statistically significant difference between patient and matched controls, $p<0.05$

Table 6: Distribution of CBCT findings in the patient and control groups

Discussion

TMJ disorders may be related to the effects of systemic diseases on the joint. High rates of TMJ involvement have been reported in individuals with rheumatologic diseases [12]. Many previous studies of the TMJ reported changes in the masticatory system and occlusion in RA patients [5,12-16]. Research also reported that many SLE patients had arthritis [17]. However, much less emphasis has been placed on TMJ findings than on RA. Jonsson, *et al* [18]. found that the TMJ was commonly affected in SLE patients. In the present study, we included patients over 25 years to exclude juvenile RA. The mean age of the patients and female:male ratio were consistent with those reported in the literature [2,7,8,15,16,19].

Some studies reported that subjective symptoms of the TMJ were higher in rheumatologic patients as compared with those in a control group [12,20]. In the present study, subjective symptoms of the TMJ in RA and SLE patients were high as compared with those of the control group, consistent with the findings of studies in the literature. Many of the RA and SLE patients reported headaches and ear sypmtoms. Previous studies reported that headache and earache and ringing in the ears were common complaints in cases of TMJ dysfunction [21]. Aliko, *et al*. found that TMJ symptoms and clinical manifestations were significantly higher in individuals with systemic sclerosis, RA and SLE as compared with those of a control group [20].

Subjective TMJ symptoms or clinical findings depend on the aetiology of TMJ disorders. On the other hand, some subjective symptoms may occur in the absence of TMJ findings. For example, in the present study, 68% of the control group reported subjective TMJ symptoms. This finding was in accordance with that of some previous studies [22]. In the current study, the ages of the subjects in the patient and control groups were similar. The high prevalence of subjective TMJ symptoms in the control group may be explained by aetiological factors and age, which is associated with TMJ degeneration. Previous research reported that inflammatory changes in joints in rheumatologic diseases may lead to degeneration of the TMJ and that the severity of the disease and degeneration may lead to clinical manifestations [23]. However, some studies reported that the TMJ was less affected than other joints in patients with rheumatologic diseases [13,16,24].

When parafunctional habits, stress and sleeping problems of the two groups were evaluated, these findings were higher in the patient group than control group. A previous study reported that many individuals with chronic pain complaints reported emotional distress [24]. Based on the findings of the present study, stress and sleep-related problems seem to be common in individuals with rheumatologic disease.

In the present study, limitations in mouth opening (< 40 mm) were found in 23.3% of RA patients, 33.3% of SLE patients, and 30% of the control group. Lin, *et al.* reported limitations of mouth opening in 23.2% of RA patients, similar to the results of the present study [15]. Contrary to the results of this study, Goupille, *et al.* and Ogus reported that the majority of RA patients showed a significant limitation in mouth opening [14,25]. Furthermore, Aliko, *et al.* observed limited mouth opening in most patients with systemic sclerosis but in very few patients with RA [20].

In the current study, pain on palpation of the TMJ, pain on palpation of the masticatory muscles and deviation were found mainly in SLE patients. However, the rates of deviation and deflation in the present study were considerably lower than those in studies by Koh, *et al.* and Lin, *et al.*, both of whom reported that deviations were high in patients with RA [15,26].

In the present study, crepitation was detected in 50% of RA patients, 21.4% of SLE patients, and 20% of controls. Crepitation denotes irreversible degenerative changes in the TMJ. However, a previous study reported that remodelling of articular surfaces, without tissue loss resulted in structural changes but not crepitation [26]. Ettala-Ylitalo, *et al*. reported clicking sounds in 53.3% of RA patients and crepitation in 21.7% of RA patients [27]. In contrast, Lin, *et al.* found clicking sound in 14.3% of RA patients and crepitation in 69.6% of cases of RA [15].

Pain on palpation of the TMJ and masticatory muscles in the RA and SLE patients in the present study was greater than that of the controls. These results were similar to those found in earlier studies, which reported TMJ sensitivity in 17–77% of RA patients [15,26]. In patients with rheumatologic diseases, masticatory muscles are susceptible to palpation, and this is a marker of impaired TMJ function [13]. In the present study, as shown by lateral panoramic radiography of mandibular movements, hypomobility was low in individuals with rheumatologic diseases. This finding suggested that TMJ degeneration may not greatly affect mandibular function due to the special structure of the TMJ disc.

Various imaging methods can be used to examine the influence of rheumatologic diseases on the TMJ. However, radiographic changes in the TMJ are not usually observed on imaging in the early stages of rheumatologic diseases. CBCT has been widely used in recent studies of the TMJ. A series of studies investigated the diagnostic accuracy of CBCT in detecting osseous abnormalities of the mandibular condyle [28,29]. In the present study, CBCT of the TMJ revealed mild erosion of the condylar head in nine RA patients, significant erosion of the condylar head in five RA patients and almost complete erosion of the condylar head in one patient. Slight erosion was detected in seven SLE patients and six controls. Voog, *et al*. used CT in radiographic evaluations of 20 RA patients with TMJ pain and found that 50% of patients had condylar erosion, 30% had flattening of the condylar head, 75% had sclerosis of the condylar head, 30% had subchondral pseudocysts and 10% had osteophyte formation [30].

All the patients in the present study had received regular treatment at rheumatology clinic. Five of the six RA patients with marked condylar erosion had RA for more than 7 years, and one patient had RA for 2 years. Five SLE patients with mild condylar erosion had been diagnosed over 7 years ago. In a previous study, adequate treatment started within 3–6 months of the onset of RA markedly reduced incapacity in patients and resulted in long-term improvements in health status [31]. Previous studies suggested that TMJ involvement was more frequent when the disease duration was longer than 5 years [20,15]. Based on this finding, the duration of the disease in patients in the present study may explain TMJ involvement and significant erosion. In patients with rheumatologic diseases, the TMJ influence was higher than that of the control group. However, it is thought that if the patients are under treatment, the TMJ effect may be reduced.

Only a few studies have examined TMJ involvement in SLE patients [18,20]. In the present study, significant signs and symptoms of TMJ involvement were observed in SLE patients. Routine examinations of patients with RA and SLE should include an assessment of TMJ involvement. Although patients with rheumatologic diseases may seek treatment by a rheumatologist, they are less likely to consult a dentist with complaints affecting the TMJ and masticatory muscles. Findings of TMJ involvement in these patients can facilitate early diagnosis and treatment of temporomandibular disorders.

Note: All procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration of 1964 and later versions. Informed consent was obtained from all patients for being included in the study.

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