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RADIOGRAPHIC AND CLINICAL ASSESSMENT OF EFFECT OF ORTHODONTIC TREATMENT ON THE TEMPOROMANDIBULAR JOINT SPACE IN ORTHODONTICALLY TREATED YOUNG ADULTS

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ABSTRACT

Aim and objective: Currently, the probable association between joint space, temporomadibular joint disorders (TMD) and orthodontic treatment is a focus of great interest. The present study was conducted to estimate and compare the radiographic joint space in orthodontically treated class II malocclusion subjects.

Materials and Methods: The radiographic joint spaces (AJS, SJS, PJS, MJS and LJS) were measured in 28 orthodontically treated class II malocclusion young patients before and after orthodontic treatment and compared according to age, gender, side of TMJ, type of malocclusion and type, appliance and duration of treatment using digital volumetric tomography (DVT).

Results and Conclusion: The comparisons between the pretreatment and post treatment measurements for PJS in 11-20 years age group and females on right side were significant. For coronal joint spaces, MJS were significant for right and left side, in 11-20 years age group and in males on right side and LJS in females on left side. The further study with larger sample size may be needed to substantiate the findings of present study.

KEYWORDS :

Introduction

The Orthodontic treatment is assumed to bring changes in joint space by affecting the condylar morphology and its position by altered biomechanics of temporomandibular joint (TMJ), that in turn may lead to TMD.[1-5]

Temporomandibular disorders have been quite prevalent in children and adolescents with reported prevalence raging between 23-67.7%. Moreover; about 30 per cent of this group receives orthodontic treatment during this period. In this context, the issue of orthodontic treatment may be a predisposing factor for the occurrence of TMD has been raised.[6-11]

During orthodontic treatment or parafunctional habits the forces applied may be in horizontal or in direction other than vertical. These forces may not be dissipated effectively and in turn may increase the likelihood of damage to both teeth and supporting system including TMJ.[12-14] The remodelling of the articular structures of the TMJ such as condyle, joint space and articular eminence is reported when orthodontic-orthopedic forces are applied in adolescents and young adults.

The association of orthodontic treatment and TMD is studied at length previously but merely in terms of clinical manifestations; only few studies have paid the attention to the morphological alterations of TMJ that may be the intermediate or interlinked factor to lead to TMD in patients who underwent orthodontic treatment. Also, the studies conducted were largely incomparable due to differences in methodology and have not considered the influence of adjuvant or confounding factors existing simultaneously that may crucially influence the outcome of the studies. Hence, the lack of clear evidence promotes the need for further study.

- **Objectives**
- To estimate and compare the radiographic joint space in orthodontically treated class II malocclusion patients before and after orthodontic treatment according to age, gender, side of TMJ, type of malocclusion, orthodontic appliance, mode and duration of orthodontic treatment using digital volumetric tomography (DVT)

Material and Methods

The present ethics committee approved prospective study was conducted in the department of Oral Medicine and Radiology, SPDC, (DMIMSDU), Sawangi-Meghe**,** Wardha district in Maharashtra state, India.

Inclusion criteria

- Study subjects with class II malocclusion in the age range of 16-30 years
- For orthodontically treated study group, only the finished cases were included in the study

Exclusion criteria

- Patients suffering from systemic diseases and anomalies impacting on bone
- Subjects with confounding factors such as parafunctional habits, harmful chewing habits, dietary habits and abnormal chewing patterns and sleeping postures
- Previous history of TMD, orthodontic treatment or trauma to the face or chin.
- Poor compliance for orthodontic treatment
- The subjects with clinical and radiographic findings or signs and symptoms of TMD at the entry level

Overall, 60 patients were recruited but on applying the inclusion and exclusion criteria, only 28 patients could be included in the study as exclusively the effect of orthodontic treatment on joint space was to be studied excluding the confounders. The further categorization of the study subjects is depicted in Table 1, accordingly comparisons were done.

The study subjects have undergone extraoral, intraoral and TMJ examination; this was followed by radiographic examination using DVT imaging.

For volumetric imaging, the Phillips Allura Xper FD20 3D RA, Digital Subtraction Angiography unit (Netherlands) was used for DVT images. The three dimensional (3D) DVT images were obtained using Exper 3D CT software at computer work station in closed and open mouth positions in identical machine settings and patient position. The images were cropped as per the requirements of joint space measurements in sagittal and coronal views of TMJ, the measurements were recorded in millimeters (mm).

Temporomandibular Joint space measurements in sagittal and coronal views (mm)

The anterior (AJS), superior (SJS) and posterior joint spaces (PJS) were measured on sagittal images of TMJ and the medial (MJS) and lateral joint spaces (LJS) were measured on coronal view of TMJ as per the criteria.[15-18]

To measure the joint spaces, the perpendicular lines from the most prominent points on the condylar anterior, superior, posterior, medial and lateral aspects were drawn to the glenoid fossa and these perpendicular distances were measured (Figure 1,2)

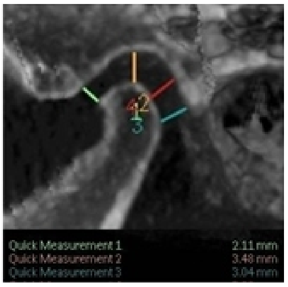

Figure 1: Joint space (AJS, SJS, PJS) measurements (sagittal view)

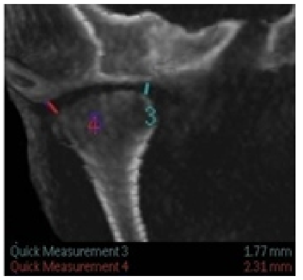

Figure 2: Joint space (MJS, LJS) measurements (coronal view)

The clinical and radiographic assessments were performed before and after the orthodontic treatment. The comparison of pretreatment and post treatment measurements was done for joint spaces.

The data was analyzed using SPSS software version 21. For other intergroup and intragroup comparisons, Chi-square and students paired test was applied. The correlation of joint space with age and duration of treatment was explored by using Pearson`s Correlation.

Results

In the present study, the various intragroup and intergroup comparisons of pretreatment and post treatment measurements were made for variables such as age, gender, side of TMJ, class II subdivision (division 1 and 2), treatment (extraction and non-extraction) and duration (≤24 months and >24 months groups) of orthodontic treatment.(Table 1)

Table 1: Distribution of Class II malocclusion patients according to age, gender, subdivision, treatment type and duration

Age Group (yrs)	n(%)	Gender	n(%)	Sub division	n (%)	Treatment type	n(%)	Duration	n(%)
11-20	20 (71.4)	Male	9 (32.1)	Division 1	13 (46.4)	Extraction group	22 (78.6)	≤24 moths	23 (82.14)
21-30	8 (28.5)	Female	19 (67.8)	Division 2	15 (53.6)	Non-extraction group	6 (21.4)	>24 moths	5 (17.86)
Total	28(100)	Total	28 (100)	Total	28 (100)	Total	28 (100)	Total	28 (100)

Joint space measurements in Sagittal and Coronal views of TMJ

I. Sagittal joint spaces (Table 2)

In intragroup comparisons within pretreatment measurements and within post treatment measurements, when the mean values of the sagittal joint spaces were compared according to side of TMJ and age groups, the differences were found to be non-significant. The gender-wise comparisons between males and females were found significant only for SJS. For comparisons between extraction and nonextraction group, the mean difference was significant for PJS, while duration wise comparison was non-significant.

When compared between Class II division 1 and 2 groups, the differences were significant for AJS in 21-30 years age group on right side, AJS in 11-20 years age group and SJS in 21-30 years. The comparisons for gender, treatment (except for AJS in non-extraction group) and for duration (except for AJS in ≤24 months duration group) were non-significant.

The intergroup comparisons between the pretreatment and post treatment measurements for side of TMJ, age (except for PJS in 11-20 years age group on right side) and gender (except for PJS in females on right side) were found to be non-significant. (Table 3,4)

ii. Coronal joint spaces (Table 2)

For intragroup comparisons, when the mean values of the coronal joint spaces were compared according to side of TMJ (except for MJS in pretreatment measurements), gender (except for LJS in pretreatment measurements), and age groups, the differences were found to be non-significant. The treatment wise comparison between extraction and non-extraction group (except for LJS in post treatment measurements), and duration wise comparisons were non-significant.

When the joint spaces were compared between Class II subdivision 1 and 2 groups, the observations were non-significant when compared according to age, treatment and duration of orthodontic treatment except for MJS in females.

The intergroup comparisons between the pretreatment and post treatment measurements for MJS were significant for right and left side and for LJS were non-significant. Age wise comparisons for MJS were significant for 11-20 years age group Gender wise comparisons for MJS were significant in males on right side and LJS in females on left side. (Table 3,4)

Table 2: Mean values of Joint Spaces and their comparisons between pre and post treatment measurements and between right and left side

		Left side			Right side			Right Vs Left Pre treatment	Right Vs Left Post Treatment
Sagittal		Mean	Std. Deviation	p-value	Mean	Std. Deviation	p-value	p-value	p-value
AJS	Pre t/t	1.81	0.50	0.76	1.72	0.53	0.54	0.378,NS	0.124,NS
	Post t/t	1.83	0.44		1.67	0.49			
SJS	Pre t/t	2.77	0.93	0.55	2.71	0.99	0.64	0.648,NS	0.418,NS
	Post t/t	2.83	0.89		2.76	0.90			
PJS	Pre t/t	2.27	1.12	0.25	2.25	1.12	0.17	0.910,NS	0.956,NS
	Post t/t	2.17	1.02		2.17	1.12			
Coronal									
MJS	Pre t/t	2.16	0.71	0.04	2.58	0.92	0.006	0.002,S	0.16,S
	Post t/t	2.28	0.73		2.37	0.89			
LJS	Pre t/t	2.50	0.94	0.11	2.17	.98	0.14	0.09,NS	0.20,NS
	Post t/t	2.38	0.78		2.29	0.82			

AJS- anterior joint space, SJS- superior joint space, PJS- posterior joint space, MJS-medial joint space, LJS- lateral joint space

Table 3: Age wise comparison of Joint Spaces in study subjects between pre and post treatment measurements

Sagittal	Age(yrs)		Mean	Std. Deviation	p-value	Coronal	Mean	Std. Deviation	p-value
AJS Right Side	11-20 yrs	Pre t/t	1.72	0.55	0.59	**MJS Right Side**	2.70	0.97	0.017
		Post t/t	1.66	0.54			2.49	0.98	
	21-30 yrs	Pre t/t	1.72	0.50	0.77		2.27	0.78	0.19
		Post t/t	1.68	0.35			2.08	0.57	

SJS Right Side	11-20 yrs	Pre t/t	2.74	1.04	0.81	**LJS Right Side**	2.29	1.00	0.61
		Post t/t	2.76	0.97			2.33	0.90	
	21-30 yrs	Pre t/t	2.63	0.93	0.70		1.88	0.94	0.14
		Post t/t	2.77	0.76			2.18	0.59	
PJS Right Side	11-20 yrs	Pre t/t	2.42	1.21	0.016	**LJS Left Side**	2.21	0.79	0.008
		Post t/t	2.28	1.25			2.41	0.78	
	21-30 yrs	Pre t/t	1.84	0.77	0.65		2.05	0.50	0.23
		Post t/t	1.91	0.69			1.96	0.48	

Table 4: Gender wise comparison of Joint Spaces in study subjects between pre and post treatment measurements

Sagittal	Gender		Mean	Std. Deviation	p-value	Coronal	Mean	Std. Deviation	p-value
AJS Right Side	Male	Pre t/t	1.98	0.47	0.30	**MJS Right Side**	2.66	1.01	0.008
		Post t/t	1.90	0.57			2.39	1.02	
	Female	Pre t/t	1.59	0.52	0.78		2.54	0.91	0.08
		Post t/t	1.56	0.42			2.36	0.85	
SJS Right Side	Male	Pre t/t	3.40	0.75	0.85	**LJS Right Side**	2.87	1.14	0.93
		Post t/t	3.37	0.68			2.88	0.93	
	Female	Pre t/t	2.38	0.94	0.57		1.84	0.72	0.11
		Post t/t	2.48	0.86			2.01	0.60	
PJS Right Side	Male	Pre t/t	2.69	1.29	0.84	**LJS Left Side**	2.89	0.73	0.40
		Post t/t	2.66	1.22			2.96	0.63	
	Female	Pre t/t	2.05	1.01	0.05		2.31	0.99	0.035
		Post t/t	1.94	1.02			2.10	0.69	

Discussion

The present study was undertaken to estimate the sagittal and coronal joint space in orthodontically treated class II malocclusion patients to compare them before and after the orthodontic treatment.

Sagittal joint spaces

In the present study, the mean sagittal joint spaces were greater than that observed by Coskuner H and Ciger S.[19]The mean values were insignificantly increased after orthodontic treatment similar to that in the previous study except for PJS which was lower in post treatment measurements.[19] In general, nonextraction had higher mean values for all joint space measurements and the mean difference was significant for PJS with greater measurements in non-extraction group. This may suggest the retruded condylar position in extraction group as compared to non-extraction group. Previously, studies evaluated the condylar position in premolar extraction versus non extraction cases, the insignificant alterations in the joint spaces were without posterior condyle positioning [20] while Artun J et al, 1992, revealed a higher frequency of posteriorly positioned condyles on right side and in patients with clicking.[21]

When compared for durations, the observations were insignificant with greater mean values in ≤24 months group than >24 months group in SJS and reverse were the observations for PJS. In general, division 1 group showed greater measurements as compared to division 2 except for duration were the measurements were variable amongst the joint spaces.

Coronal joint spaces

The joint spaces were either increased or decreased in post treatment measurements when observed for side, age and gender. Though insignificantly right side, 11-20 years age group and males had higher mean values. The present study could not reveal significant differences between extraction and nonextraction group for joint spaces except for LJS. Previously, Artun J et al revealed a higher frequency of medially positioned condyles on right side and in patients with clicking. [21] Duration wise, mean values were insignificantly greater in ≤24 months group than >24 months for MJS and reverse were the observations for LJS.

Overall, taken together the sagittal and coronal joint spaces, the males had greater values than females and Non-extraction group had higher values than extraction group. For sagittal joint spaces, the Class II division 1 group had higher values than division 2 while reverse were the observations for coronal joint spaces. In sagittal joint spaces, the post treatment measurements were greater than pretreatment measurements for AJS and SJS while reverse was the case for PJS. In coronal joint spaces, the findings were variable for MJS and LJS. Altogether, the variations in the joint spaces between pretreatment and post treatment measurements were in the range 0.02-0.21mm.

The correlation of sagittal and coronal joint space with age of the patients, appliance and duration of treatment and the clinical findings were found to be nonsignificant.

Previously, most of the studies evaluated the joint spaces either before or after the orthodontic treatment, there may be only few studies that have evaluated the joint space both before and after the orthodontic treatment in class II malocclusion cases.[19-21] The assessment of effect of orthodontic therapy on the joint space and mandibular condyle without concurrent pre and post treatment evaluation would be untenable. It is to be noted that the cases included in previous studies were in prepubertal and pubertal growth period where the condyle growth is yet to complete, such growing condyle would be more amenable to alterations, and hence the assessment may not be reliable. Contrarily, the present study included the subjects in the age 16 years and above as the condyle growth is completed by 16^{th} years of age anticipating the more appropriate results.

Conclusion

In the present study, the mean differences between pretreatment and post treatment measurements were insignificant except for MJS. Combining the significant observations between pre and post treatment comparisons, it appeared that the PJS and MJS were affected more in joint spaces, while in other variable the right side, female gender and age group of 11-20 years showed greater variations.

The study has provided the insight into the joint space alterations in TMJ; however the further study with larger sample size would be needed to substantiate these observations.

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