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RESEARCH ARTICLE

POSTEROANTERIOR CEPHALOMETRIC ANALYSIS OF FACIAL ASYMMETRY IN TEMPOROMANDIBULAR JOINT DISORDERS

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ABSTRACT

Facial asymmetry is commonly seen in patients with temporomandibular disorders. Temporomandibular disorders have an impact on facial asymmetry and the degree of facial asymmetry in turn has effects on temporomandibular disorders. The present study was conducted to estimate the degree of facial asymmetry in subjects with temporomandibular disorders. The study was done in 60 patients divided into 30 patients of 2 groups each. Group 1 comprised of patients with temporomandibular joint disorders and group 2 comprised of age and sex matched patients without temporomandibular joint disorders. The mean age of the patients in the study was 28 ± 8 years and 56.7% males and 43.3% females. Facial asymmetry was seen in 87.1% of patients with temporomandibular disorder and 84.8% of patients without tempromandibular disorder. Our results show that temporomandibular disorders are associated with significant changes in posteroanterior cephalometric measurements. Temporomandibular disorders account for greater amount of facial asymmetry, indicating that when analyzing tempromandibular disorders, evaluation of symmetry of face should also be done.

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INTRODUCTION

Temporomandibular disorders (TMD) is a umbrella term embracing various conditions affecting temporommandibular joint, jaw muscles and associated structures characterized by pain and dysfunction (Melita Valentić-Peruzović, 2010). The increased incidence of facial asymmetry in temporomandibular disorders indicates disturbance in mandibular posture with resultant disequilibrium and occlusal imbalance causing an anti – symmetrical growth of the jaw and the joint (Fushima *et al*., 1999). These aspects highlight the importance of evaluating the symmetry of hard and soft tissues in patients with masticatory disorders, necessitating early care and prevention of temporomandibular disorders. The purpose of this study is to quantify the changes in posteroanterior cephalometric variables with temporomandibular disorders to assess facial asymmetry (Ahn *et al*., 2005).

MATERIALS AND METHODS

Institutional ethical clearance was obtained to perform this study. This study was conducted over a period of 1 year (2014 - 2015) in the Department of Oral Medicine and Radiology, JSS Dental College and Hospital, JSS University, Mysore, Karnataka.

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This study comprised of 60 patients, of either gender divided into two groups comprising of 30 patients with temporomandibular disorders and 30 age and sex matched patients.

Study group Inclusion Criteria

- Adult individuals with clinically diagnosed temporomandibular disorders of either gender aged between 18 – 60 years.
- Subjects willing to be a part of the study and sign the informed consent.

Study group Exclusion Criteria

- Patients with developmental or congenital disorders of maxillofacial region
- Any past or present history maxillofacial trauma
- Any central pathology affecting maxillofacial region
- Pregnant individuals and patients in whom radiography is contraindicated.

Control group inclusion criteria

- Normal healthy individuals of either sex aged between 18 – 60 years
- Subjects willing to be a part of the study and sign the informed consen**t**

Control group exclusion criteria

- Pregnant individuals
- Patients in whom radiography is contraindicated.

After obtaining the informed consent to participate in the study, each subject was evaluated clinically for tempromandibular disorder according to axis I of the research diagnostic criteria (RDC/TMD). Each patient was then subjected to posteroanterior cephalometric radiograph to analyze for facial asymmetry using 10 linear and 3 angular bilateral measurements. The landmarks used in the study are Condyle (Co), Gonion (Go), Antegonion (Ago), Chin (Ch), Menton (Me), Anterior nasal spine (ANS), Internal sphenoid margin (ISM), O Point (middle of the line connecting the right and left internal sphenoid margin)

Two reference planes will be constructed to calculate the asymmetry index: Horizontal plane is constructed by connecting the right and left internal sphenoid margin; Vertical reference plane: constructed by drawing a line through the middle of the horizontal reference plane (O point) and through the ANS

The following distances are measured: (Figure 1)

- The right and left distances from
- Condyle to Antegonial notch (Co - Ago)
- Condyle to Menton (Co- Me)
- Gonion to O point (Go- O pt)
- Chin to O point (Ch- O pt)
- Horizontal plane to Condyle (Co-HP)
- Horizontal plane to Antegonial notch (Ago-HP)
- Vertical plane to Antegonial notch (Ago- VP)
- Vertical plane to Condyle (Co -VP)
- Vertical plane to Gonion (Go –VP)
- Vertical plane to chin (Ch -VP)

The following angles would be calculated

- Condyle – Antegonion - Menton angle (Co-Ago-Me)
- O point - Gonion - Gonion' angle (O pt- Go- Go')
- O point - Chin - Chin' angle (O pt – Ch - Ch')

To assess the facial asymmetry, the asymmetry index for bilateral measurements is calculated using the formula: (Almasan *et al*., 2013). Asymmetry index (%) = [(R-L) / (R+L)] x 100, Where R = the value on the right side; L = value on the left side. The measurements thus obtained were tabulated and analysed using Crammer's V test, direct and indirect samples T test to determine the association between two groups. A 'p' value of .05 or less was considered statistically significant

RESULTS

In our study, comprising of 60 subjects, divided into two groups of 30 individuals each; the mean age of participants in group 1 was 28.1 ± 8.91 years having an age range of 18 - 43 years. The distribution of subjects in different ages is as shown in Table 1. The total study comprised of 34 male (56.7%) and 26 female (43.3%) subjects with 17 males (56.7%) and 13 females (43.3%) per group. Cramer's V test was used to find the association between age and gender in group 1 and group 2, the values obtained were .061 for age with a significance factor of .974 and .000 for gender with significance factor of 1.000 indicating no statistical significant difference between the age and gender in group 1 and group 2. (Table 1,2)

Table 1. Overall distribution of different age groups

			Group		Total
			Group 1	Group 2	
Ages	18-20	Count	6	7	13
		% within group	20.0%	23.3%	21.7%
	21-30	Count	13	13	26
		% within group	43.3%	43.3%	43.3%
	31-40	Count	7	7	14
		% within group	23.3%	23.3%	23.3%
	41-45	Count	4	3	7
		% within group	13.3%	10.0%	11.7%
Total		Count	30	30	60
		% within group	100.0%	100.0%	100.0%

Table 2. Gender distribution in group 1 and group 2

			Group		Total
			Group 1	Group 2	
Gender	Male	Count	17	17	34
		% within group	56.7%	56.7%	56.7%
	Female	Count	13	13	26
		% within group	43.3%	43.3%	43.3%
Total		Count	30	30	60
		% within group	100.0%	100.0%	100.0%

Table 3. Distribution of Temporomandibular disorder patients in group 1

Diagnosis			
		Frequency	Valid Percent
Valid	MPD	12	40.0
	IDD	18	60.0
	Total	30	100.0

Table 4. Gender distribution among TMD patients

	Males	Females	Total
IDD	12 (70.58%)	6 (46.15%)	18 (60%)
MPDS	5 (29.4%)	7 (53.84%)	12 (40%)
Total	17(100%)	13 (100%)	30 (100%)

Among the 30 participants in group 1, 12 participants (40%) were diagnosed of myofascial pain dysfunction syndrome and 18 participants (60%) were diagnosed with internal disc derangement.

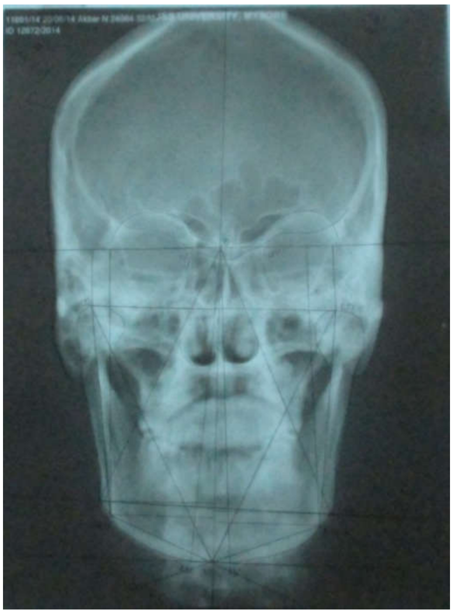

Figure 1. posteroanterior cephalogram showing the facial asymmetry analysis in a patient with temporomandibular disorder

The distribution of gender according to tempormandibular disorder and the distribution of sites affected are as shown in Table 4 and 5 respectively. Pearson's chi-square test was used to determine the statistical significance between patients with temporomandibular disorder and myofascial pain dysfunction syndrome. The pearson's chi-square value was .274 which is greater than .05, indicating no statistical significant difference between patients with internal disc derangement and myofascial pain dysfunction syndrome (Table 3,4,5)

Table 5. Distribution of TMD participants based on site affected

		MPDS	IDD	Total
U/L	Right	2 (28.5%)	5 (62.5%)	15 (50%)
	Left	5 (71.4%)	3 (37.5%)	
B/L		5 (33.33%)	10 (66.66%)	15 (50%)
Total		12 (30%)	18 (60%)	30 (100%)

Among the 60 participants in the study, 51 participants (85.12%) was found to have asymmetry, with 26 participants (87.17%) in group 1 and 25 participants (84.87%) in group 2 found to be having asymmetry after the postero-anterior cephalometric analysis. After analysing the data, it is observed that TMJ disorders lead to facial asymmetry.

There was considerable amount of facial asymmetry in both group 1 and 2 as shown in Table 6. Paired samples test was applied to find the level of statistical significance between the measures of the right and left sides among group 1 participants. The following parameters were found to be statistically significant: Condyle to Menton (Co-Me), Chin to O point (Ch - O pt), Gonion to Vertical plane (Go-VP), Condyle - Antegonion - Menton angle (CO-Ago-Me) O point - Chin - Chin' angle (O-Ch-Ch') as shown in Table 7.

Paired samples test was applied to find the level of statistical significance between the measures of the right and left sides among group 2 participants. The parameters Antegonion to Vertical plane (Ago-VP), Condyle to Vertical plane (Co-VP), Condyle to Menton (Co-Me), Gonion to Vertical plane (Go-VP), Chin to Vertical plane (Ch-VP) were found to have a statistical significant difference in participants of group 2 as shown in Table 8.

DISCUSSION

The study comprised of 60 participants, aged 18 - 45 years with mean age of participants in our study being 28 ± 8 years. In a similar study conducted on 187 subjects by Buranastiporn *et al*. 2006 to see the relationship between internal derangement and asymmetry, the mean age of the study was 23 years, ranging from 18 - 45 years and the mean age of subjects suffering from temporomandibular disorders was 25 years in a study conducted in Korea by Kwon *et al*., in 2013 which included 293 subjects. This dispartity in the mean age of the population suffering from Temporomandibular disorders could be due to the differences in the sample size, geographic variations in the population under study (Buranastidporn *et al*., 2006; Ho-Beom Kwon *et al*., 2013). Our study comprised of 56.7% males and 43.3% females respectively. This is in accordance with a study conducted by Pow Eh *et al*. (2001) in Chinese population where 33.4% of the subjects were males and 32.5% of the subjects were females who reported to have complaints of temporomandibular disorders, but in contrast to other studies conducted by Buranastiporn *et al*., and OC Almasan *et al*., who reported a higher incidence of temporomandibular disorder in females.

Increased incidence of male reporting with temporomandibular disorder in our study, could be attributed to increased awareness about the importance of health among the subjects (Pow, 2002; Buranastidporn *et al*., 2006; Almasan *et al*., 2013). The Axis I of the RDC/TMD was used to evaluate temporomandibular disorders. In 2008, Manfredini and Guarda nardini *et al*. evaluated the correlation between the clinical research diagnostic examination (AXIS I of RDC-TMD) and magnetic resonance imaging findings of temporomandibular joint disc position, in 116 patients of clinically symptomatic temporomandibular disorders and found good to excellent agreement between clinical and magnetic resonance imaging for diagnosing temporomandibular disorders and hence only clinical examination using RDC-TMD axis was used to establish our diagnosis, avoiding higher imaging modalities of MRI to establish our diagnosis, as MRI is not readily available, thus cannot be advised as a routine diagnostic procedure for all temporomandibular disorder patients and MR imaging is a costly procedure which cannot be afforded by many patients (Manfredini *et al*., 2008).In our study, 18 subjects (60%) were diagnosed with internal disc derangement with reduction and 12 subjects (40%) were diagnosed with myofascial pain dysfunction syndrome.

Table 6. Table showing the mean asymmetry index of group 1 and group 2

	Group 1		Group 2		T test	
	Mean	SD	Mean	SD	Sig. (2-tailed)	Mean Difference
CO_HP	.0771	8.54532	2.8336	5.90838	.152	-2.75653
AGO_HP	1.1986	1.85790	.3045	1.46136	.043	.89410
AGO_VP	1.1773	5.00504	.6610	4.86614	.687	.51630
CO_VP	3.0095	4.08048	2.8887	4.66109	.915	.12083
CO_AGO	1.6009	3.16390	-.2859	1.95139	.007	1.88677
CO_ME	.7853	1.82812	8.9408	46.70074	.343	-8.15553
GO_OPT	.3368	2.46907	-.1320	3.52229	.553	.46880
GO_VP	1.6973	4.72124	1.0592	3.67006	.561	.63810
CH_OPT	-29.3396	161.42061	.3511	.99200	.318	-29.69077
CH_VP	-.5221	9.96376	.3214	10.43326	.750	-.84350
CO_AGO_ME	.1028	2.00592	.7767	1.51539	.147	-.67393
OPT_GO_GO	-.8633	3.23463	-.2139	2.05080	.357	-.64940
OPT_CH_CH	-.6709	2.84972	-.1124	3.11087	.471	-.55850

Table 7. Comparing the means of right and left sides in group 1

	Right		Left		Paired T test	
	Mean	SD	Mean	SD	Sig. (2-tailed)	Mean
CO_HP	2.2100	.47803	2.2667	.39421	.414	.05667
AGO_HP	9.0100	.75400	9.0533	.68619	.549	.04333
AGO_VP	4.0000	.32163	3.9267	.35227	.288	-.07333
CO_VP	4.8367	.65151	4.6900	.36892	.251	-.14667
CO_AGO	6.8900	.71648	6.9100	.68549	.820	.02000
CO_ME	9.8833	.79267	9.7600	.71756	.074	-.12333
GO_OPT	9.6900	.74619	9.3533	1.88693	.332	-.33667
GO_VP	4.6333	.50537	4.4667	.46263	.012	-.05667
CH_OPT	10.8933	.89286	10.8367	.88648	.042	-.16667
CH_VP	.9533	.25829	.9067	.23771	.025	-1.93333
CO_AGO_ME	122.3333	6.06478	120.4000	5.29541	.138	-.04667
OPT_GO_GO	62.1000	3.12222	61.4000	3.22276	.360	-.70000
OPT_CH_CH	83.9667	2.69717	85.8667	2.71310	.041	1.90000

Table 8. Comparing the means of right and left sides in group 1

	Right		Left		Paired T test	
	Mean	SD	Mean	SD	Sig. (2-tailed)	Mean
CO_HP	2.2500	.46294	2.3133	.47397	.227	.06333
AGO_HP	9.0667	.55357	9.1433	.55936	.124	.07667
AGO_VP	4.1633	.36434	3.9867	.36268	.014	-.17667
CO_VP	5.0300	.36403	4.7933	.38050	.013	-.23667
CO_AGO	6.8833	.56329	6.8933	.48773	.845	.01000
CO_ME	10.0767	.83074	9.8933	.73856	.011	-.18333
GO_OPT	9.6633	1.03106	9.5933	1.14919	.229	-.07000
GO_VP	4.8567	.90466	4.7233	.88227	.814	-.01000
CH_OPT	11.0200	.71216	11.0100	.76670	.033	-.13333
CH_VP	1.0367	.23265	.9100	.16682	.401	-.63333
CO_AGO_ME	121.7333	6.15284	121.1000	5.96166	.002	-.12667
OPT_GO_GO	63.1333	11.54820	63.3667	11.09670	.646	.23333
OPT_CH_CH	84.6667	3.23060	85.5667	2.68692	.352	.90000

Our study is accordance with the study conducted in Sweden in 2009, Abrahamsson *et al.* to estimate the frequency of temporomandibular disorder. Their study found that in a population of 121 subjects, myofascial pain without limited opening accounted for 6% - 12.9% of all temoromandibular disorders and disc displacement with reduction comprising of 8.9% - 15.8% of all temporomandibular disorders were the most frequent diagnoses indicating myofascial pain to be more common than disc derangements as shown in our study (Abrahamsson *et al.*, 2009). Postero-anterior cephalometric radiograph helps evaluate facial asymmetry better by depicting the overall view of facial skeleton in frontal profile and also helps better correlation between the right and left halves simultaneously.

Lateral cephalogram which was widely used in previous studies is useful for analyzing the anteroposterior or vertical displacement of the mandible, but it cannot accurately account for symmetries because the right and left landmarks are averaged. Hence postero-anterior cephalometric radiographs were used in our study to analyse facial asymmetry (Ahn *et al.*, 2005). The postero-anterior cephalometric radiograph was analysed for facial asymmetry using 10 linear measurements and 3 angular measurements which were measured bilaterally and asymmetry index was calculated. Facial asymmetry was found in 87.17% of subjects with temporomandibular disorder and 84.87% of subjects without temporom and ibular disorders. Our results are in accordance with study conducted by OC Almasan *et al.,* in 2013 where they established that temporomandibular disorders were associated with significant changes in posteroanterior cephalometric measurements and that in comparison to controls, temporomandibular disorders account for greater amount of facial asymmetry which was also shown by our study (Almasan *et al*., 2013).

Although subjects with temporomandibular disorders showed greater degree of facial asymmetry than the normal counterparts, the degree of facial asymmetry was not statistically significant between the groups. Therefore pairwise analysis was done to determine the significance between the 10 linear and 3 angular measurements contributing towards facial asymmetry. It was found that among the 13 measurements; overall 10 measurements were statistically significant and contributing towards facial asymmetry. When they were analysed further for group wise assessment, it was found that 5 parameters were significant in group 1 and 5 in group 2.

The parameters significant in group 1 were measurements from Condyle to Menton (Co- Me) having a mean value of 9.8833 ± .792 and p value of .074, Chin to O point (Ch – O pt) mean value of 1.8933 ± .89286 and p value of .012, Gonion to Vertical plane (Go – VP) was 4.6333 ± .50537 and p value of .042, Condyle to Antegonion (Co-Ago) was 122.333 ± 6.06 and p value of .025, and O point – Chin – Chin' angle (O pt- Ch- Ch') having a mean value of 85.866 ± 2.713 and p value of .041. The parameters significant in group 2 were Antegonion to Vertical Plane (Ago – Vp) with mean values 4.16 ± .364 and p value of .014, Condyle to Vertical Plane (Co-Vp) having a mean value of 5.03 ± .364 and p value of .013, Condyle to Menton (Co- Me) having a mean value of 10.076 ± .83 and p value of .011, gonion to vertical plane (Go- VP) having a mean of 4.856 ± .904 and p value of .033 and chin to vertical plane (Ch- Vp) whose mean value was 1.036 ± .232 with p value of .002 The findings in our study was found to be in contrast to the study conducted by Almasan *et al*., who found the factors contributing towards asymmetry to be Antegonion to horizontal plane, antegonion to vertical plane, condyle to vertical plane, gonion to O point, gonion to vertical plane, chin to vertical plane and condyle – antegonion – menton angle, O point – gonion – gonion' angle, O point – chin-chin' angle (Almasan *et al*., 2013).

The difference in the results could be attributed to following factors: Our study comprised of patients with myofascial pain dysfunction syndrome and patients with internal disc derangement with reduction, whereas the study group of Alamsan *et al*. comprised of myofasical pain dysfunction syndrome and internal disc derangement without reduction. Differences in the clinical protocols used to establish TMD diagnoses may be responsible for the high variability of results between studies. The difference in the results could also be due to difference in the geographical population under study and difference in the subgroup of temporomandibular disorder in the study (Almasan *et al*., 2013).

Conclusion

Our results show that temporomandibular disorders are associated with significant changes in posteroanterior cephalometric measurements and that in comparison to controls, temporomandibular disorders account for greater amount of facial asymmetry, indicating that when analysing tempromandibular disorders, evaluation of symmetry of face should also be done. Underdiagnosing the interrelation between temporomandibular disorder and facial asymmetry can worsen with delay in diagnosis and make the treatment more complex.

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