European Journal of Molecular & Clinical Medicine
ISSN 2515-8260 Volume 07, Issue 10, 2020

Evaluation of Vertical Mandibular Asymmetry in TMD patients: An Orthopantomographic Study

Sarika K[1], Parvathy Ghosh[2], Sapna Varma N.K[3], Ajith V.V[4], Lekshmi Anand[5]

[1] *Junior Research Fellow, Dept of Orthodontics, Amrita School of Dentistry, Amrita Vishwa Vidyapeetham, Kochi, India.*
[2] *Assistant Professor, Dept of Orthodontics, Amrita School of Dentistry, Amrita Vishwa Vidyapeetham, Kochi, India.*
[3] *Professor & HOD, Dept of Orthodontics, Amrita School of Dentistry, Amrita Vishwa Vidyapeetham, Kochi, India.*
[4] *Professor, Dept of Orthodontics, Amrita School of Dentistry, Amrita Vishwa Vidyapeetham, Kochi, India.*
[5] *UG student, Amrita School of Dentistry, Amrita Vishwa Vidyapeetham, Kochi, India.*
Mail id : [1]sarikaranjith9@gmail.com

Abstract: ***The evaluation of asymmetry is important for aesthetic and functional evaluation of the maxillofacial region. Aetiology of mandibular asymmetry is multifactorial. Even though there are different techniques available for assessing asymmetry, OPG is relatively inexpensive and one of the most commonly used radiographs. Thus aim of this study was to evaluate the vertical mandibular asymmetry in TMD patients using orthopantomography. The study included OPG's of 136 patients each in TMD positive and TMD negative group. Condylar asymmetry, ramal asymmetry and total mandibular asymmetry (Condyle + ramus) in vertical plane were assessed. The data was statistically analysed using Mann Whitney U Test. Condylar asymmetry, ramal asymmetry and total mandibular asymmetry (condyle + ramus) was highly prevalent in females of both TMD positive and TMD negative group and it was statistically significant. Condylar asymmetry was highly prevalent in TMD positive group but the results was not statistically significant. No statistically significant difference were found in vertical mandibular asymmetry between TMD positive and TMD negative group. However vertical condylar asymmetry, ramal asymmetry and total mandibular asymmetry was significantly higher females than in males.***

Keywords: Condylar asymmetry, Mandibular asymmetry, Orthopantomogram, Temporomandibular disorder.

1. INTRODUCTION

The aim of orthodontic treatment is to develop a functional occlusion in harmony to dentition, masticatory muscles and temporomandibular joints.[1] The evaluation of

asymmetry is important for aesthetic and functional evaluation of the maxillofacial region.[2] Facial asymmetry can occur in vertical, transverse and sagittal planes. When comparing the asymmetries of cranial base and maxillary arch, the mandibular asymmetry is highly prevalent in the human skull.[3] The aetiology of asymmetry of mandible is large and can be due to association of environmental and genetic influences. Common causes include infections, trauma, myogenic problems, developmental abnormalities, joint pathologies like rheumatoid arthritis and syndromes such as Treacher Collins syndromes and occlusal disturbances. [4]

Asymmetry is the lack of equilibrium between the left and right-side structures, divided by the midline acting as a symmetrical plane. As the temporomandibular joint is bilateral joint, any change in its equilibrium will lead to microtraumas. Mandibular asymmetry must be diagnosed earlier because proper functioning of the stomatognathic system depends on the balance or equilibrium of all the structures that are involved in it. [5]

Asymmetries of mandible can be assessed using postero-anterior cephalogram, computed tomography, submentovertex, magnetic resonance imaging. [6,7,8] But these techniques are expensive and cannot be used for routine orthodontic treatment. However, orthopantomograph's (OPG) are relatively inexpensive and one of the commonly used radiographs for all patients before the start of orthodontic treatment. The primary advantage of OPG include broad and bilateral coverage of facial bones and teeth including the temporomandibular joint with less radiation exposure to the patients. Several studies on panoramic radiography have founded that if the patients head is positioned properly angular and vertical measurements are acceptable but because of nonlinear magnification variation in magnification at different object depth, the horizontal measurements are considered to be unreliable. [9,10]

Various studies on mandibular asymmetry and temporomandibular disorder had shown contradictory findings. Buranastidporn et al, did a study on 187 Japanese subjects and correlated asymmetry of mandible with temporomandibular joint internal derangement[11]. Purbiati et al has found that the temporomandibular disorder is the main predisposing factor of mandibular asymmetry [12]. Karic et al [13] investigated on the association between vertical asymmetry of the condyle and ramus of mandible in TMD patients and found a greater frequency of asymmetry in TMD patient, and also identified an association between condylar asymmetry and mouth opening index. Maglione et al [14] identified that all patients having condylar or facial asymmetry also presented with articular disc displacement. However study by Säglam et al [9] did not find statistically significant association between the TMD and asymmetry of condyle. Based on these conflicting opinions the objective of this study was to investigate the vertical mandibular asymmetry using asymmetry index among TMD patients from Orthopantamogram.

2. MATERIALS AND METHOD

This retrospective study was done in department of orthodontics, Amrita school of Dentistry after getting the approval of institutional research ethics committee (IRB-AIMS-2020-114), Amrita institute of medical science. Sample size was calculated based on results of a previous

study. [9] With an effect size of 0.65 and 80% power, the minimum sample size was estimated to be 136 in each group.

OPGS of patients having full complement of teeth excluding third molar, with mild to moderate crowding, without any history of facial trauma and previous orthodontic treatment were included in this study. 136 OPGs satisfying the inclusion criteria were selected each in TMD positive and TMD negative group. TMD positive group consist of 53 males and 81 females, TMD negative group consist of 72 males and 64 females with an age range of 18-35 years. TMD positive group includes OPG'S of patients and having at least one sign and symptom of temporomandibular disorder and TMD negative group include OPGs of patients without any signs and symptoms of temporomandibular disorder (TMD). Inadequate or poor-quality films like, films with brown or yellow stains, dark or light radiographs, exposure cuts were excluded for this study

The landmarks are shown in figure1 & 2. The borders of the condyle, neck, ramus and corpus of mandible were traced bilaterally. A line was drawn such that it is tangent to the ramus (line B) and that it contacted the most lateral point (L1) of the condyle and the ascending ramus (L2). To the tangent of the ramus a perpendicular line (line A) was drawn such that it passes through the superior most point of the condyle. The height of the condyle (condylar height-CH) was measured as the perpendicular distance between L1 and Line B. The distance between L1 and L2 was the ramal height (RH). All the measurements were measured using vernier caliper with an accuracy of 0.1mm and the reading were recorded.

All the films were traced and analyzed by two investigators independently to determine the inter examiner reliability. The tracing was done on the acetate paper and the mean condylar, ramal and total mandibular (condyle + ramus) asymmetry were calculated according to the method given Habbet et al. [26]

Condylar Asymmetry Index = [CH Right-CH Left]/ [CH Right +CH Left] ×100

Ramal Asymmetry Index = [RH Right-RH Left]/ [RH Right+ RH Left] ×100

Total Asymmetry Index (condyle + ramus) = [(CH+RH) Right - (CH+RH) Left] / [(CH+RH) Right+(CH+RH) Left] ×100

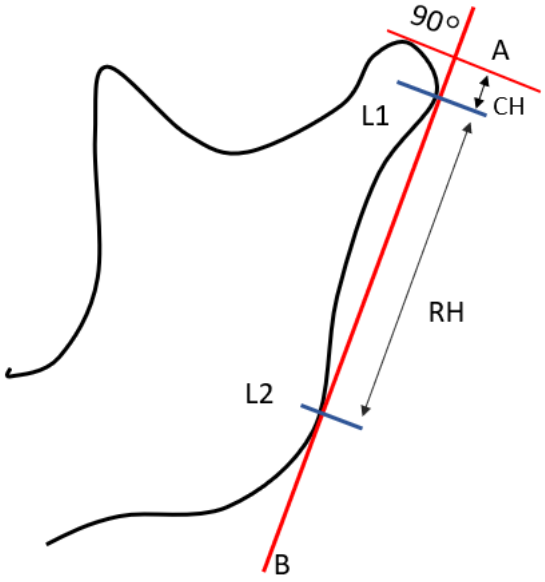

Fig 1: Landmarks; Line B- Tangent to the ramus, Line B- Perpendicular from line B to the most superior part of the condyle, CH- Condylar height, RH- Ramal height, L1 & L2- Most lateral point of the image

Fig 2: Tracing on an OPG

Statistical Analysis

Data was analyzed using IBM SPSS software version 20. Normality of Data was assessed using Shapiro-Wilk test. As the Data did not show normal distribution, non-parametric test (Mann Whitney U test) was used for analysis between study groups. p value <0.05 shows statistically significant

3. RESULTS

Mean condylar asymmetry was 3.29± 2.30 in females and 3.19±2.3 in males in TMD positive group. Mean ramal asymmetry was 1.82±1.64 in females and 1.62±1.69 in males and total asymmetry (condylar asymmetry + ramal asymmetry) was 1.61±1.41 in females and 1.42±1.48 in males. (Table 1)

Comparison of study group based on gender shows that there was significant asymmetry of the condyle, ramus and total asymmetry (condyle + ramus) in females of both TMD positive and TMD negative groups and it was statistically significant($p<0.05$). Ramal asymmetry was present in males of both TMD positive and TMD negative group and the results was significant statistically ($p<0.05$). Evaluation of the condylar and total asymmetry(condyle + ramus) in males of TMD positive and TMD negative group was not statistically significant (Table 2). Comparison of TMD positive and TMD negative study group showed significantly higher asymmetry in TMD positive group but it was not statistically significant. (Table3) Inter-examiner reliability was assessed using Cronbach's alpha 0.8 showing good agreement.

Table 1- Descriptive statistics

GROUP	GENDER	STUDY VARIABLES	MEAN	Std. Deviation
TMD positive group	Female	Total asymmetry	1.61	1.45
		Condylar asymmetry	3.29	2.30
		Ramal asymmetry	1.82	1.64
	Male	Total asymmetry	1.42	1.48
		Condylar asymmetry	3.19	2.33
		Ramal asymmetry	1.62	1.69
TMD negative group	Female	Total asymmetry	0.72	0.64
		Condylar asymmetry	2.29	2.63
		Ramal asymmetry	0.57	0.74
	Male	Total asymmetry	0.86	0.75
		Condylar asymmetry	2.65	2.34
		Ramal asymmetry	0.75	0.91

Table 2 -Comparison of study groups based on gender

GENDER		**GROUP**	**N**	**Mean Rank**	**Sum of Ranks**	**p value**
Males	Total Asymmetry	TMD positive	53	68.59	3635.50	0.137
		TMD negative	72	58.88	4239.50	
	Condylar Asymmetry	TMD positive	53	68.13	3611.00	0.170
		TMD negative	72	59.22	4264.00	
	Ramal Asymmetry	TMD positive	53	74.01	3922.50	0.003*
		TMD negative	72	54.90	3952.50	
Females	Total asymmetry	TMD positive	81	84.29	6827.50	< 0.001*
		TMD negative	64	58.71	3757.50	
	Condylar asymmetry	TMD positive	81	82.48	6680.50	0.002*
		TMD negative	64	61.01	3904.50	
	Ramal asymmetry	TMD positive	81	87.78	7110.00	< 0.001*
		TMD negative	64	54.30	3475.00	

* p value significant at less than 0.05

Table 3- Comparison of gender based on study groups

GROUP		**GENDER**	**N**	**Mean Rank**	**Sum of Ranks**	**p value**
TMD positive	Total asymmetry	Males	53	63.80	3381.50	0.368
		Females	81	69.92	5663.50	
	Condylar asymmetry	Males	53	65.96	3496.00	0.709
		Females	81	68.51	5549.00	
	Ramal asymmetry	Males	53	63.90	3386.50	0.380
		Females	81	69.86	5658.50	
TMD negative	Total asymmetry	Males	72	72.69	5234.00	0.187
		Females	64	63.78	4082.00	
	Condylar	Males	72	72.04	5187.00	0.257

	asymmetry	Females	64	64.52	4129.00	
	Ramal asymmetry	Males	72	71.59	5154.50	0.298
		Females	64	65.02	4161.50	

4. DISCUSSION

The temporomandibular joint (TMJ) is a bilateral joint, where left and right joints are joined by the mandible and work simultaneously for a proper functioning of the stomatognathic system. [15] Mandibular asymmetry can be described as the degree of disagreement on the right and left side of the mandible. This asymmetry, does not always correspond to the presence of temporomandibular disorder but can be considered as a risk factor for the development of a temporomandibular disorder. Mandibular asymmetry influences normal structure and function of TMJ, and any alteration in structure and function of TMJ can also lead to development of mandibular asymmetry. Similarly, skeletal and dental discrepancies can alter the normal balance of the TMJ. Such alteration in balance may affect the intra-articular pressure and act as a trauma to the TMJ structures, leading to the development of TMD. On the other hand, TMD itself may affect the normal growth which in turn can result in asymmetry of the mandible. [6]

Diagnosis of asymmetry of mandible is a complex process as it has a multifactorial etiology. Traditionally asymmetry of mandible is analysed by a combination of diagnostic tools such as clinical examination, analysis of photographs and routine radiographs like postero-anterior cephalogram, submentovertex view (SMV), CT, stereometry with or without implant, technetium 99, scintigraphy etc. However these radiographs involve increased radiation exposure and expensive. However OPG is used in our daily clinical practise, with acceptable cost and minimum radiation exposure and provides acceptable results. [16,17] Studies on posteroanterior cephalometric films has shown that there are some have some impediments in its reliability and methodology. [18, 19] Many studies have for the cephalometric assessment of asymmetry SMV view is a better alternative but for SMV can have significant distortion as the mandible is positioned farthest from the film plane radiographs, especially for the analysis of asymmetry of mandible. [20,21,22,] If the patient's head is positioned properly in the equipment the reproducibility of angular and vertical measurements on panoramic radiographs is acceptable.[23,24]

Habets et al [25] had found that when an OPG is evaluated the head must be positioned centrally in the head holder and head holder must be attached to the device. Unequally magnified image in horizontal dimension can be seen if there is failure in positioning of midsagittal plane in the rotational midline of the machine.[26] All radiographs used in this study were taken by qualified and experienced technician in ideal conditions (the midsagittal plane centred in the image layer of the x-ray unit).

Vertical mandibular asymmetry in this study was assessed using the method described by Habet et al [25]. Saglam et al [9] also investigated the asymmetry of condyle using the

method described by Habet et al and found no statistically significant differences in condylar asymmetry index values in patients with TMD and in patients without TMD. Leila Khojastepour et al [27] investigated on the possible corelation between the condylar asymmetry and temporomandibular disorder and they concluded that patients with condylar asymmetry were more prone to TMD but it was not statistically significant. In this study also we observe a significantly higher values of condylar asymmetry index, ramal asymmetry index and total mandibular asymmetry index in TMD positive group than the TMD negative group but the result was not statistically significant. This could be because we included OPG's of patients with mild signs and symptoms of temporomandibular disorder in TMD positive group. Patients with moderate to severe signs and symptoms of temporomandibular disorder can have higher values of vertical condylar asymmetry, ramal asymmetry and total mandibular asymmetry (condyle + ramus). However more studies including cases with moderate to severe signs of TMD are required to confirm this finding.

Most of the Literature studies on mandibular asymmetry did not evaluate the data between the gender [28,29,30,31,32]. Saglam, investigated asymmetry of mandible in different skeletal patterns and indicated that condylar asymmetry and ramal asymmetry measurements were significantly affected by gender [33]. B. Bal et al [34] investigated on mandibular ramal asymmetry and indicated that ramus asymmetry was observed more frequently in females but the difference was not statistically significant. Fuentes et al [35] obtained a prevalence of asymmetry more in females than in males by Habet's method. Similar finding were also present in the study. OPG's of female patients in TMD positive group and in TMD negative group were showing statistically significant increase in condylar asymmetry index, ramal asymmetry index and in total asymmetry index (condyle + ramus). This shows an indirect relation between mandibular asymmetry and temporomandibular disorder in females.

5. CONCLUSION

Frequency of vertical mandibular asymmetry was more in TMD positive group than the TMD negative group but the results was not statistically significant. However OPGs of female patients were showing significant asymmetry of the condyle, ramus, and total (condyle + ramus) and the results was statistically significant. Therefore more studies with OPGs of patients having moderate to severe signs and symptoms of TMD is necessary and further research are required to find out the association between mandibular asymmetry and temporomandibular disorder in female patients.

ACKNOWLEDGMENT

The support of all staffs and colleagues of Department of Orthodontics and Department of Public Health Dentistry, Amrita School of Dentistry is gratefully acknowledged.

Funding Support: The authors declare that they have no funding support for this study.

*Conflict of Interest***:** The authors declare that they have no conflict of interest for this study.

6. REFERENCES

[1] Ingervall B: Functionally optimal occlusion: The goal of orthodontic treatment. *Am J Orthod.* 1976; 70(1): 81–90

[2] Agrawal M, Agrawal JA, Nanjannawar L, *et al.*: Dentofacial Asymmetries: Challenging Diagnosis and Treatment Planning. *J Int Oral Health.* 2015; 7(7): 128–31

[3] Severt TR, Proffit WR: The prevalence of facial asymmetry in the dentofacial deformities population at the University of North Carolina. *Int J Adult Orthodon Orthognath Surg.* 1997; 12(3): 171–176]

[4] Dana C. Van Elslande, Shawn J. Russett,Paul W. Major, and Carlos Flores-Mir. Mandibular asymmetry diagnosis with panoramic imaging. Am J Orthod Dentofacial Orthop 2008; 134:183-92

[5] Luz V. Mendoza-García, Irene A. Espinosa de Santillana, Victor Hernández Vidal. Temporomandibular disorders and mandibular vertical asymmetry. The Journal of Craniomandibular & Sleep Practice 2018

[6] Persson M, Mandibular asymmetry of heriditory origin. Am J Orthod.1973;63:1-11

[7] Schmid W, Mongini F, Felisio A.A computer based assessment of structural and displacement asymmetries of the mandible.Am J Orthod Dentofacial orthop.1991;100:19-34.

[8] McCormick SU. The Facial asymmetry. The diagnostic challenge. Atlas Oral Maxillofac Surg Clin North Am 1996;4:1-18

[9] Saglam A. A & Sanli G. Condylar asymmetry measurements in patients with temporomandibular disorders. J. Contemp. Dent. Pract.,5(3):59-65, 2004.

[10] Tronje G, Welander U, McDavid WD, Morris CR. Image distortion in rotational panoramic radiography. IV. Object morphology; outer contours. Acta Radiol Diagn (Stockh). 1981;22:689-96

[11] Buranastidporn B, Hisano M, Soma K: Temporomandibular joint internal derangement in mandibular asymmetry. What is the relationship? *Eur J Orthod.* 2006; 28(1): 83–88

[12] Purbiati M, Purwarnegara MK, Kushandy L, *et al.*: Prediction of Mandibulofacial Asymmetry using Risk Factor Index and Model of Dentocraniofacial Morphological Pattern. *J Int Dent Med Res.* 2016; 9(3): 195–201

[13] Karic VV, Miller VJ, Nehete SR, et al. The temporomandibular opening index and condylar asymmetry in myogenous TMD and non-TMD patients: report of a pilot study. Quintessence Int. 2013 Jan;44(1):E141–E145.

[14] Maglione HO, de Zavaleta LA, Laraudo J, et al. Temporomandibular dysfunction: internal derangement associated with facial and/or mandibular asymmetry. Cranio. 2013 Oct;31(4):276–282.

[15] Jeffrey P. Okeson. Management of temporomandibular disorders and occlusion. 6th edition 2013. Elsevier.

[16] Akcam MO, Altiok T, Ozdiler E. Panoramic radiographs: A tool for investigating skeletal pattern. Am J Orthod Dentofacial Orthop. 2003;123:175-81.

[17] Kambylafkas P, Murdock E, Gilda E, Tallents RH, Kyrkanides S. Validity of panoramic radiographs for measuring mandibular asymmetry. Angle Orthod 2006;76:388-93.

[18] Cook JT. Asymmetry of the craniofacial skeleton. Br J Orthod 1980;7:33-8.

[19] Richardson ME. The reproducibility of measurements on depressed posteroanterior cephalometric radiographs. Angle Orthod 1967;37:48-51
[20] Berger H. Problems and promises of basilar view cephalograms. Angle Orthod 1961;31:237-45. 30.
[21] Forsberg CT, Burstone CJ, Hanley KJ. Diagnosis and treatment planning of skeletal asymmetry with the submental-vertical radiograph. Am J Orthod 1984;85:224-37
[22] Williamson EH, Simmons MD. Mandibular asymmetry and its relation to pain dysfunction. Am J Orthod 1979;76:612-7.
[23] Larheim TA, Svanaes DB. Reproducibility of rotational panoramic radiography: mandibular linear dimensions and angles. Am J Orthod Dentofacial Orthop 1986;90:45-51.
[24] Larheim TA, Svanaes DB, Johannessen S. Reproducibility of radiographs with the orthopantomograph 5: tooth length assessment. Oral Surg Oral Med Oral Pathol 1984;58:736-41.
[25] Habets LL, Bezuur JN, VanOoij CP, Hansson TL. The orthopantomogram, an aid in diagnosis of temporomandibular joint problems. I. The factor of vertical magnification. J Oral Rehabil 1987;14: 475-80.
[26] White SC, Pharoah MJ. Oral radiology. 5th ed. St Louis: Mosby; 2004. p. 197-8.
[27] Leila Khojastepour , Mahsa Omidi , Mahroo Vojdani ,Khashayar Bagheri. Investigating possible correlation between condylar asymmetry and clinical dysfunction indices in patients with temporomandibular dysfunction using Cone-beam computed tomographic. J Craniomaxillofac Surg. 2019 Mar;47(3):438-442.
[28] Lam PH, Sadowsky C, Omerza F. Mandibular asymmetry and condylar position in children with unilateral posterior crossbite. Am J Orthod Dentofacial Orthop 1999;115:569-75.
[29] Miller VJ, Smidt A. Condylar asymmetry and age in patients with an Angle's Class II division 2 malocclusion. J Oral Rehabil 1996; 23:712-5.
[30] Miller VJ, Bodner L. Condylar asymmetry measurements in patients with an Angle's Class III malocclusion. J Oral Rehabil 1997;24:247-9.
[31] O'Byrn BL, Sadowsky C, Schneider B, BeGole EA. An evaluation of mandibular asymmetry in adults with unilateral posterior crossbite. Am J Orthod Dentofacial Orthop 1995;107: 394-400.
[32] Pinto AS, Buschang PH, Throckmorton GS, Chen P. Morphological and positional asymmetries of young children with functional unilateral posterior crossbite. Am J Orthod Dentofacial Orthop 2001;120:513-20.
[33] Saglam AM. The condylar asymmetry measurements in different skeletal patterns. J Oral Rehabil 2003;30:738-42.
[34] B. Bal, I. Dikbas, O. Malkondu, K. Oral Radiological study on mandibular ramus asymmetry in young population. Folia Morphol.2018; 77(4): 724–29.
[35] Fuentes, R, Engelke, W, Bustos, L, Oporto, G, Borie, E, Sandoval, P, Garay, I, Bizama, M. & Borques P. Reliability of tow radiographic methods to assess condylar asymmetry. *Int. J. Morphol* 29(3):694-701, 2011.