DOI: https://doi.org/10.53350/pjmhs202317853

ORIGINAL ARTICLE

Assessment of Mandibular Asymmetry Using the Orthopantogram and Posteroanterior Cephalogram: A Comparative Study

NOVAIRA WASEEM[1], ZUBAIR HASSAN AWAISI[2], AMNA MALIK[3]
[1]PGR orthodontics, Nishtar institute of dentistry, Multan
[2]Associate Professor, HOD orthodontics, Nishtar institute of dentistry, Multan
[3]PGR orthodontics, Nishtar institute of dentistry, Multan
Correspondence to: Novaira Waseem, Email: novairawaseem@gmail.com

ABSTRACT

Aim: The objective of this study is to assess and correlate the measurements of mandibular asymmetries using a posteroanterior (PA) cephalogram and an orthopantomogram (OPG). .

Materials & Methods: A comparative cross-sectional study was conducted in the Department of Orthodontics, Nishtar Institute of Dentistry, Multan. Orthopantomograms and posteroanteriorcephalograms were obtained from 66 patients aged between 12 and 35 years. Linear mandibular measurements were then identified and evaluated for discrepancies between the two imaging techniques. The comparison of orthopantomograms and posteroanteriorcephalograms involved a paired t-test to assess all linear mandibular parameters. To further compare orthopantomograms and posteroanteriorcephalograms, an independent sample t-test was conducted using SPSS version 22.0.

Results: The mean age of the patients was 22.65 years, with a standard deviation (SD) of 1.68 years. The age range of the patients varied from 12 to 35 years, with the majority falling into two age groups: 12–25 years, which comprised 38 patients (58.46%), and 26–35 years, which included 28 patients (42.54%). In terms of gender distribution, 36 patients (54.55%) were male, while 30 patients (46.15%) were female. The mean length of the condyle (Co-Snp) on OPG was 1.3±0.92, whereas it was 2.05±1.683 on the PA céphalogram. The mean difference between the two methods was 0.09±0.19, and this difference was not statistically significant with a p-value of 0.432. Similarly, for the length of the ramus (Co-Go), the mean on the OPG was 1.85±0.90, while it was 2.40±0.95 on the PA Cephalogram. There was a moderate to strong positive correlation between the measurements of these mandibular features.

Practical Implication: This suggests that asymmetry indices for the mandibular posterior regions can be reliably calculated from OPG data in the vertical dimension. However, it is essential for clinicians to be mindful of potential radiographic machine distortions when evaluating these measurements

Conclusion: This study suggests that asymmetry indices for the mandibular posterior regions can be reliably calculated from OPG data in the vertical dimension. However, it is essential for clinicians to be mindful of potential radiographic machine distortions when evaluating these measurements

Keywords: Orthopantomogram, Posteroanteriorcephalogram, Linear mandibular measurements, mandibular asymmetry,

INTRODUCTION

Mandibular asymmetry holds significance in both facial aesthetics and the proper functioning of the maxillofacial complex. [1] Various factors, including age, gender, skeletal growth patterns, alterations in dental occlusion, and muscle activity, can influence the emergence of mandibular asymmetry. Among craniofacial asymmetries, mandibular asymmetry is particularly noteworthy due to its relatively high prevalence. [2,3]

While perfect craniofacial symmetry is not naturally found, asymmetry can vary from being imperceptible clinically to presenting as a significant abnormality. The etiology of mandibular asymmetry is multifactorial, stemming from a combination of genetic and environmental factors.Simplifying the diagnosis of mandibular asymmetries, with a particular focus on distinguishing conditions like condylar hyperplasia (CH), hemimandibular hypertrophy (HH), hemimandibular elongation (HE), and coronoid hyperplasia, can be facilitated through the use of panoramic radiographs (OPGs). Additionally, assessing dental compensations such as changes in the axial inclination of teeth is feasible to some extent. Condylar hyperplasia, or condylar hyperactivity as referred to by Obwegeser, represents a pathological condition marked by the excessive growth of the condylar process, leading to varying degrees of abnormal mandibular and facial asymmetry.[5]

Conventionally, the diagnosis of mandibular asymmetry involves a comprehensive approach, encompassing clinical examinations alongside the capture of photographs from different angles and the use of radiographic techniques including posteroanterior and posteroanterior cephalograms, oblique mandibular radiographs taken at a 45° angle, and panoramic radiographs. [6] The orthopantomogram (OPG) is a standard tool in daily clinical practice, offering a biposteroanterior view and valuable vertical measurements. [7,8] For decades, posteroanterior cephalometry has been the primary method for assessing and quantifying facial asymmetry. In regions where 3D imaging is not readily accessible, 2D radiographs like the PA cephalogram remain foundational for diagnosing craniofacial asymmetry. [9,10]

Hence, there is a pressing need for a reliable and reproducible method to evaluate facial asymmetry, which holds clinical significance in everyday orthodontic practice. Detecting facial asymmetry in young, growing patients can proactively mitigate further facial deformities that might otherwise result from natural growth as individuals approach adolescence. Given that an orthopantomogram is a standard radiographic assessment for all orthodontic cases, the ability to identify asymmetry at any stage during diagnosis and treatment planning proves advantageous, particularly in the early growth phase. Treating asymmetry at a young age is not only less distressing for patients but also more manageable for clinicians, as growth can be harnessed as an auxiliary tool to aid in treatment.

MATERIALS AND METHODS

After approval from the hospital's ethical review board (ERB), this study was conducted at the Department of Orthodontics, Nishtar Institute of Dentistry, Multan. Before the study, every participant received detailed information regarding the study's objectives, and written consent was duly obtained from each of them. The sample size was determined through the utilization of Open Epi Software, considering the mean ramus height as 57.27±6.54 mm on the posteroanteriorcephalogram and 60.63±6.47 mm on the orthopantomogram. A comprehensive sample of 66 patients was chosen, ensuring a 95% confidence interval and 80% statistical power, employing a non-probability consecutive sampling approach. [10]

Participants aged between 12 and 35 years, possessing high-quality pre-treatment posteroanteriorcephalograms and orthopantomograms acquired with the same X-ray machine, Natural Head Position, and standard exposure settings, and displaying clearly visible craniofacial structures on both radiographs (OPG and posteroanteriorcephalogram), were eligible for the study. All permanent teeth erupted up to the 1st molar, stable occlusion, clinically visible facial asymmetry, visible chin deviation off the facial midline, and patients with posterior crossbite were also included. Patients with a history of prior orthodontic treatment, orthognathic surgery, orofacial trauma, facial asymmetries, craniofacial anomalies, and syndromes were excluded. Patients with syndrome, genetic disorder, TMJ disorder, CO-CR shift, and mixed dentition period were also excluded. All posteroanteriorcephalograms and orthopantomograms were obtained using the KODAK 9000C X-ray machine, adhering to the manufacturer's recommended exposure parameters. A single operator standardized the radiographs, traced all images on 0.003-inch-thick 8x10-inch acetate matte tracing paper, and meticulously located landmarks, drew lines, and measured the required variables using a ruler (see Figures 1 and 2).

The mandibular measurements shown in Figures 1 and 2 were measured as follows: Mandibular ramus height (Co-Go): The linear distance between the condylion (Co) and gonion (Go) in millimeters, measured on both the orthopantomogram and posteroanteriorcephalogram. Mandibular body length (Go-Me): the linear distance from gonion (Go) to menton (Me) in millimeters, measured on both the orthopantomogram and posteroanteriorcephalogram. Total mandibular length (Co-Me): The linear distance from condylion (Co) to menton (Me) in millimeters, measured on both the orthopantomogram and posteroanteriorcephalogram.

To assess the reliability of the measurements, posteroanteriorcephalograms and orthopantomograms of 25 patients were retraced and remeasured by the same investigator after a 4-week interval. A paired t-test was employed to compare the two sets of measurements, and no significant differences were observed ($p > 0.05$). The method error, calculated using the Dahlberg formula, ranged from 0.11 to 0.30 mm for the linear mandibular measurements.

Statistical analysis was conducted using SPSS software (IBM; SPSS, version 26.0) with a significance level set at $p \leq 0.05$. Mean and standard deviation values for ramus height (Co-Go), mandibular body length (Go-Me), and total mandibular length (Co-Me) were computed from orthopantomograms and posteroanteriorcephalograms. A paired t-test was used to compare these linear mandibular measurements between the right and left sides on orthopantomograms, and an independent t-test was utilized to compare these measurements between orthopantomograms and posteroanteriorcephalograms.

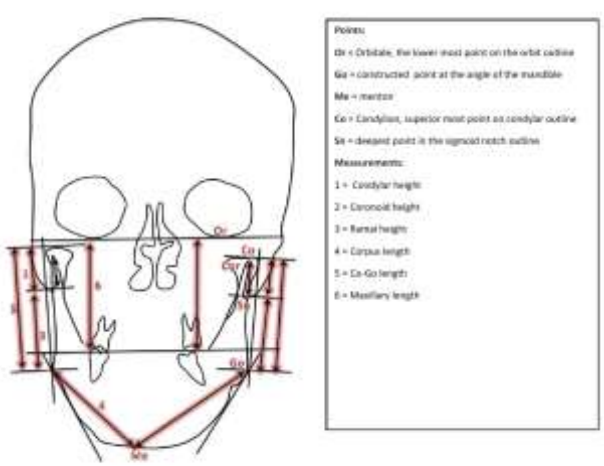

Figure 1: A diagrammatic representation of a PA cephalogram tracing provides a visual analysis of facial and skeletal structures, depicting key anatomical landmarks and measurements to aid in orthodontic and oral surgery diagnostics and treatment planning.

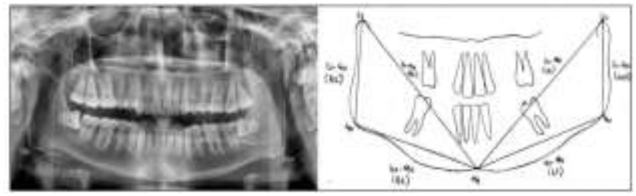

Figure 2: Illustration depicting orthopantomogram features, showcasing ramus height (Co-Go), mandibular body length (Go-Me), and total mandibular length (Co-Me) on both sides.

RESULTS

The mean age of the patients was 22.65 years, with a standard deviation (SD) of 1.68 years. The age range of the patients varied from 12 to 35 years, with the majority falling into two age groups: 12–25 years, which comprised 38 patients (58.46%), and 26–35 years, which included 28 patients (42.54%). In terms of gender distribution, 36 patients (54.55%) were male, while 30 patients (46.15%) were female, as shown in Table 1.

The table displays a comparison of various mandibular measurements between the OPG (orthopantomogram) and PA cephalogram, along with their respective mean differences and p-values. The mean length of the condyle (Co-Snp) on OPG was 1.3±0.92, whereas it was 2.05±1.683 on the PA céphalogram. The mean difference between the two methods was 0.09±0.19, and this difference was not statistically significant with a p-value of 0.432. Similarly, for the length of the ramus (Co-Go), the mean on the OPG was 1.85±0.90, while it was 2.40±0.95 on the PA Cephalogram. The mean difference in this case was 0.11±0.21, and no significant difference was observed with a p-value of 0.467. For the length of the corpus (Go-Me), OPG had a mean of 2.10±1.81, while PA Cephalogram had a mean of 2.60±1.63. The mean difference was 0.211±0.41, and the p-value was 0.980, indicating no significant distinction between the two methods. In terms of total length (Co-Me), OPG showed a mean of 2.60±1.46, whereas PA Cephalogram displayed a mean of 2.15±1.61. The mean difference was 0.20±0.42, and the p-value was 0.021, suggesting a statistically significant difference.

Furthermore, the comparison of gonial angle (Co-Go-Me) between OPG and PA Cephalogram revealed a mean of 2.50±1.16 for OPG and 2.35±1.49 for PA Cephalogram. The mean difference was 0.12±0.26, and the p-value was 0.456, signifying no significant variance between the two measurements. Lastly, the mandibular 1st molar angulation showed a mean of 2.55±1.93 on the OPG and 3.35±1.49 on the PA céphalogram. The mean difference was 0.10±0.21, and the p-value was 0.898, indicating that no significant differences existed. In summary, the data demonstrates that, for these specific mandibular measurements, there were no significant differences between the OPG and PA cephalogram methods, as shown in Table 2.

Table 3 shows that values generally range from 0.61379 to 0.92716, indicating that there is a moderate to strong positive correlation between the measurements on the left and right sides for these mandibular features. This suggests that OPG and posteroanterior cephalograms can be reliable methods for assessing biposteroanterior mandibular characteristics and identifying any existing discrepancies.

Table 1: Age and gender distribution of enrolled patients, n=66

Variables	Characterstics	No. of Patients
Age	Mean ± SD	22.65±1.68
	Range	12-35 years
	12-25 years	38(58.46%)
	26-35 years	28(42.54%)
Gender	Male	36(54.55%)
	Female	30(46.15%)

Table 2: Assessment of condylar, ramus, corpus length, and gonial angle measurements on both OPG and PA cephalograms for comparative analysis

Variable	OPG Orthopantomogram Mean±SD	PA Cephalogram Mean±SD	Mean Difference Mean±SD	P-Value
Length of condyle (Co-Snp)	1.3±0.92	2.05±1.683	0.09±0.19	0.432
Length of ramus (Co-Go)	1.85±0.90	2.40±0.95	0.11±0.21	0.467
Length of corpus (Go-Me)	2.10±1.81	2.60±1.63	0.211±0.41	0.980
Total length (Co-Me)	2.60±1.46	2.15±1.61	0.20±0.42	0.012
Gonial angle (Co-Go-Me)	2.50±1.16	2.35±1.49	0.12±0.26	0.456
Mandibular 1st molar angulation	2.55±1.93	3.35±1.49	0.10±0.21	0.898

Table 3: Evaluation of correlation coefficients for identifying discrepancies between individuals through OPG and posteroanterior cephalogram

Variable	Pearson correlation coefficient (r)
Length of condyle	0.72843
Length of ramus	0.61379
Length of corpus	0.78954
Total length	0.85472
Gonial angle	0.69532
Mandibular 1st molar angulation	0.92716

DISCUSSION

Mandibular asymmetries often manifest as irregular features in orthodontic and orthognathic patients, necessitating a comprehensive assessment of both sides of the mandible for diagnosis and treatment planning. Orthopantomograms offer a practical means to measure and compare the right and left sides of the mandible. As orthopantomograms are routinely employed in orthodontic practice, they enable an initial, broad-level assessment of features like the shape of the mandibular ramus and condyle on both sides. [12] In contrast, the cephalometric posteroanterior (PA) projection proves invaluable for gauging asymmetry between right and left structures, as they are equidistant from the X-ray source and the film.[13]

In our present study, we compared the mean values of ramus height, mandibular body length, and total mandibular length between orthopantomograms and cephalograms. The results indicated that there was no statistically significant difference between orthopantomograms and cephalograms when evaluating the vertical parameter of the mandible, specifically the ramus height (Co-Go) ($p = 0.467$). However, we did observe significant differences when assessing mandibular body length (GoMe) and total mandibular length (Co-Me) ($p = 0.012$). These findings align with a study conducted by Kumar et al. (2017) and Faryal et al. (2022), where they compared two linear mandibular measurements (ramus height and body length) between orthopantomograms and posteroanteriorcephalograms. They reported no statistically significant differences in ramus height ($p = 0.756$, $p = 0.839$), suggesting that orthopantomograms can accurately determine the vertical mandibular measurement (ramus height) when compared to posteroanteriorcephalograms. However, they recommended caution when utilizing orthopantomograms to measure horizontal mandibular dimensions (mandibular body length) due to the observed significant differences ($p = 0.021$, $p = 0.012$). [11,12]

Several studies have explored the precision and reliability of orthopantomograms (OPGs) in comparison to posteroanteriorcephalograms, yielding varying results. A study by Atahi et al.[13] involved an assessment of mandibular dimensions obtained from dry skulls, OPGs, and posteroanteriorcephalograms, finding a high correlation between OPGs and posteroanteriorcephalograms for ramus height but a weaker correlation for mandibular body length. Juma et al.[14] concluded in their study that OPGs could provide detailed and accurate information for sagittal and vertical analysis of facial skeletal patterns, making them a frequently used screening tool in clinical practice. In a study by [15], the reliability of linear measurements on OPGs was assessed, with vertical measurements being considered more predictable and accurate than horizontal measurements, especially when the patient's head position was appropriate.

The author [16] evaluated mandibular asymmetry in molar Class II subdivision malocclusion subjects using OPGs and found that sufficiently accurate results could be obtained. However, [17] argued that OPGs provide acceptably accurate results for vertical craniofacial dimensions but are less reliable than posteroanteriorcephalograms due to lower predictability percentages.

The author [18] suggested that OPGs could assess vertical posterior mandibular asymmetry by determining the total ramal height but highlighted the potential for underdiagnosis. In contrast,. [19] conducted a study using human dried skulls and reported that OPGs were as accurate as posteroanteriorcephalograms for all vertical and horizontal mandibular measurements. However, [20] reached a different conclusion, stating that OPGs cannot be considered a reliable tool for evaluating vertical facial and dentoalveolar parameters, despite their adequacy in approximating the situation depicted in posteroanteriorcephalograms. These contrasting findings indicate the need for further research to ascertain the precise utility and limitations of OPGs in orthodontic assessment.

Additional research is essential to validate the precision and dependability of conventional panoramic radiographs by juxtaposing them with the presently favored three-dimensional data, acknowledged as the gold standard for precise diagnoses. Should conventional panoramic images prove to be accurate, especially in particular regions, healthcare providers can confidently employ them for assessing those specific areas, free from concerns about image distortion or magnification discrepancies. The early identification of skeletal asymmetry in growing patients presents an opportunity for timely intervention that can enhance long-term treatment outcomes. Furthermore, two-dimensional (2D) images offer greater ease of sharing among healthcare practitioners compared to three-dimensional (3D) data, which necessitates specialized software for viewing and subjects patients to additional radiation exposure associated with tomography.

CONCLUSION

Significant correlations were observed between asymmetry indices, including condyle, ramus, Co-Go distance, and maxilla asymmetry indices, as well as the condylar ratio, derived from vertical measurements on both OPG and PA cephalogram images.

REFERENCES

1. Di Blasio C, Di Blasio M, Vaienti B, Di Francesco F, Lanza A, Minervini G, Segù M, Di Blasio A. Planning the Aesthetics of the Mandibular Angles in Orthognathic Surgery: Traditional vs. Virtual 3D Articulators. Applied Sciences. 2022 Nov 25;12(23):12064.
2. Hernández-Alfaro F, Valls-Ontañón A. Aesthetic Considerations in Orthofacial Surgery. Oral Maxillofac Surg Clin North Am. 2023 Feb 1;35(1):1-0.
3. Babczyńska A, Kawala B, Sarul M. Genetic factors that affect asymmetric mandibular growth—A systematic review. Symmetry. 2022 Feb 28;14(3):490.
4. van Riet TC, Klop C, Becking AG, Nolte JW. Management of asymmetry. Oral Maxillofac Surg Clin North Am. 2023 Feb 1;35(1):11-21.

5. Pravallika A, Menon S, Sham ME, Archana S, Mathews S. Condylar Hyperplasia: Case Report and Literature Review. J Oral Maxillofac Surg. 2023 Jan 6:1-1.
6. Harun NA, Adam KB, Abdullah NA, Rusli N. Is a symmetrical face really attractive?. Int. J. Oral Maxillofac. Surg.. 2023 Jun 1;52(6):703-9.
7. Khan MA, Haider A, Noman M. Utility of Panoramic Radiograph for Assessment of Mandibular Asymmetry as Compared with Posteroanterior Cephalogram. Pakistan J. Medical Health Sci.. 2022 Oct 22;16(08):828-.
8. Alkis HT, Pekince KA. Comparison of the asymmetry index determined on digital panoramic radiographic images and on posteroanterior cephalometric images: a retrospective cross-sectional study. J Orofac Orthop. 2023 Jan 12:1-7.
9. Piya A, Shrestha BV, Khapung A, Bhattarai P. Comparison of accuracy of panoramic radiograph and posteroanteriorcephalogram in determining linear mandibular measurements among orthodontic patients in tertiary dental care center of KathmanduJ. Coll. Med. Sci. Nepal. 2023 Oct 3;25(3):217-22.
10. Khan M, Akhtar FN, Jan A, Hamid F, Tariq S. Gonial angle determination; a comparison between posteroanteriorcephalogram and both hemispheres of orthopantomogram. Pakistan Armed Forces Medical Journal. 2021 Aug 27;71(4):1460-63.
11. Kumar SS, Thailavathy V, Srinivasan D, Loganathan D, Yamini J. Comparison of Orthopantomogram and PosteroanteriorCephalogram for Mandibular Measurements. J Pharm Bioallied Sci 2017;9(Suppl 1):S92–5.
12. Faryal A, Shaikh A. Reliability Of Orthopantomogram In Comparison To PosteroanteriorCephalogram For Linear Mandibular Measurements. J Ayub Med Coll Abbottabad. 2022 Dec 2;34.
13. Fattahi H, Babouee A. Evaluation of the precision of panoramic radiography in dimensional measurements and mandibular steepness in relation to posteroanteriorcephalomerty. J Mashhad Dent Sch 2007;31(3):223–30
14. Juma A, Tattan M, Duarte C. The alternative use of a nonconventional orthopantomograms analysis technique for facial skeletal assessment. Int J Oral Maxillofac Surg 2018;3(2):26.
15. Tronje G, Welander U, McDavid WD, Morris CR. Image Distortion in Rotational Panoramic Radiography:VI. Distortion Effects in Sliding Systems. Acta Radiol Diagn (Stockh) 1982;23(2):153–60
16. Kurt G, Uysal T, Sisman Y, Ramoglu SI. Mandibular asymmetry in Class II subdivision malocclusion. Angle Orthod 2008;78(1):32–7.
17. Akcam MO, Altiok T, Ozdiler E. Panoramic radiographs: a tool for investigating skeletal pattern. Am J Orthod Dentofacial Orthop 2003;123(2):175–81.
18. Kambylafkas P, Kyrkanides S, Tallents RH. Mandibular asymmetry in adult patients with uniposteroanteriordegenerative joint disease. Angle Orthod 2005;75(3):305–10
19. Ongkosuwito EM, Dieleman MM, Kuijpers-Jagtman AM, Mulder PG, van Neck JW. Linear mandibular measurements: comparison between orthopantomograms and posteroanteriorcephalograms. Cleft Palate Craniofac J 2009;46(2):147–53.
20. Nohadani N, Ruf S. Assessment of vertical facial and dentoalveolar changes using panoramic radiography. Eur J Orthod 2008;30(3):262–8.

This article may be cited as: Waseem N., Awaisi HZ., Malik A.: Assessment of Mandibular Asymmetry Using the Orthopantogram and Posteroanterior Cephalogram: A Comparative Study. Pak J Med Health Sci, 2023; 17(8): 53-56.