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**Dr. Diksha Koushal**
Ex PG Student, Department of Oral Medicine and Radiology, Govt. Dental College and Hospital Srinagar, Jammu and Kashmir, India

**Dr. Altaf Hussain Chalkoo**
Professor and HOD, Department of Oral Medicine and Radiology, Govt. Dental College and Hospital Srinagar, Jammu and Kashmir, India

**Corresponding Author:**
**Dr. Diksha Koushal**
Ex PG Student, Department of Oral Medicine and Radiology, Govt. Dental College and Hospital Srinagar, Jammu and Kashmir, India

# Comparison of orthopantomogram and lateral cephalogram for mandibular measurements

**Dr. Diksha Koushal and Dr. Altaf Hussain Chalkoo**

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**Abstract**
**Aim:** The aim of the study is to clarify the possible applications of orthopantomogram (OPG) for evaluating craniofacial specifications such as angular and linear measurements of the mandible by comparing with lateral cephalogram.
**Materials and Methods:** OPG and lateral cephalogram were taken from 100 patients of age-group 16-35 years from Department of Oral Medicine and Radiology, Govt. Dental College and Hospital, Srinagar, J&K. Linear measurements (body length and ramus height) and angular measurements(gonial angle) were assessed both in lateral cephalogram and OPG. Independent t-test was performed for comparison of OPG and lateral cephalogram using SPSS with a probability level of $p<0.05$ considered to be statistically significant.
**Results:** The results of the study show that there is no statistically significant differences in ramus height and gonial angle when compared between OPG and lateral cephalogram while statistically significant difference exits for body length between OPG and lateral cephalogram.
**Conclusion:** It may be concluded that panoramic radiography can be used to determine the gonial angle and ramus height as accurately as a lateral cephalogram. However, clinicians should be vigilant when predicting horizontal measurement from OPG.

**Keywords:** Orthopantomogram, lateral cephalogram, mandibular measurements

## Introduction
Professor Yrjo Paatero, in 1961, first introduced the Orthopantomography (OPG) [1]. Panoramic radiography is an extra oral radiography technique that provides two-dimensional information about the teeth and the maxillofacial skeleton. It is a valuable adjunct for diagnosis and treatment planning as it facilitates one-time imaging of all teeth, the mandible, parts of maxilla including a large part of the maxillary sinus, hard palate and temporomandibular joints (TMJs). Indications for panoramic radiography imaging are: Periodontal disease with simultaneous evaluation of all teeth and the extent of periodontal bone defects, Orthodontic evaluation including presence of teeth germs, developmental stage of the dentition and the presence of retained, supernumerary or impacted teeth, Impacted third molars, Dental age estimation, Lesions such as tumors, cysts, and other bone diseases that cannot be entirely imaged by periapical radiographs, Mandibular trauma, Implant planning [2].
In 1931, the emergence of lateral cephalogram by Broadbent in United States and Hofrath in Germany provided both a clinical and a research tool to assess the underlying skeletal disproportions.
A lateral cephalogram is another radiographic technique used when cephalometric measurements are made. This radiograph provides a lateral view of skull and it is used for orthodontic planning. Although this imaging technique is useful to evaluate patient's cephalometry, it is not used for evaluating pathology of teeth and surrounding tissues as a panoramic radiograph is used, because in lateral cephalograms, bilateral structures superimpose with each other [3].
Various cases of asymmetry require accurate measurements of structures on each side such as hemifacial microsomia, unilateral condylar hyperplasia, so that a proper diagnosis can be achieved and therefore these conditions can be properly treated by any type of surgery or distraction osteogenesis.

For this purpose, lateral cephalograms cannot be reliably used. However, OPGs does not show this difficulty.
For detecting asymmetry in the cases, Posterioanterior cephalogram can also be used. But it is less reliable due to the problem posed by the superimposing structures and the difficulty in reproducing natural head posture.
On OPG, right and left side structures can be studied easily, avoiding any overlapping or superimposing structures found on the lateral cephalogram. However, measurements on panoramic radiographs have been called into question because of considerable methodological errors.
The accuracy of cephalometric measurements when determined on an OPG is still doubtful. Thus, the purpose of this study is to clarify the possible applications of OPG for evaluating craniofacial specifications such as angular and linear measurements of the mandible by comparing with lateral cephalogram.

## Materials and Methods

The ethical committee clearance has been obtained from the Institutional Ethical Committee of Govt. Dental College and Hospital Srinagar on 11/03/2022.The ethical committee clearance number is ECC-GDC/0063
This prospective study included OPG and lateral cephalogram of 100 patients of age group 16-35 years that reports to the Department of Oral Medicine and radiology

### Inclusion criteria

- Healthy patients without any history of systemic diseases
- Patients in the age group of 16-35 years.
- Patients advised for lateral cephalometric radiographs for orthodontic treatment.

### Exclusion criteria

- Individuals with congenital defects in the craniofacial region like clefts and malformations
- History of craniofacial fractures
- Patients suffering from disorders of bone, nutritional deficiencies and endocrinal disturbances.

All the radiographs selected were of high quality and sharpness and were taken by the same apparatus with standard exposure conditions and in the Natural Head Position (NHP). The selected radiographs were traced, landmarks located, lines, and angles were drawn, and the following variables measured [Figures 1a and b, 2a and b].

### Linear measurements

1. Body length - condylion-gonion (cm)
2. Ramus height - gonion-menton (cm).

### Angular measurement

**Gonial angle (degrees):** Angle formed by the intersection of the tangent drawn to lower border of mandible and tangent drawn to ramus. Both the linear and angular measurements were assessed in lateral cephalogram and OPG by the single investigator. Mean and standard deviation were calculated for all the parameters from OPG and lateral cephalogram.

### Statistical Methods

The recorded data was compiled and entered in a spreadsheet (Microsoft Excel) and then exported to data editor of SPSS Version 20.0 (SPSS Inc., Chicago, Illinois, USA). Continuous variables were expressed as Mean ±SD. Student's independent t-test was employed for comparing continuous variables. A P-value of less than 0.05 was considered statistically significant.

## Result

### Comparison between right and left sides of orthopantomogram

Mean values and standard deviation of left and right sides of OPGs were calculated and tabulated [Table 1] for all the parameters. No statistically significant difference was found. Thus, there is no difference in the right and left side values of the OPG parameters.

### Comparison of gonial angle, ramus height, and mandibular body length between lateral ceph and orthopantomogram (right and left sides)

Mean and standard deviations were calculated for the gonial angle, ramus height, and mandibular body length measured from lateral ceph, OPG are tabulated in Tables 2 and Table 3. Mean values of each of the three parameters on the left side of the OPG was compared with the lateral ceph and the same was done for the right side of the OPG. P-value is calculated for all three parameters between lateral cephalogram and right and left OPG separately. No statistically significant difference was found between OPG and lateral ceph for gonial angle and ramus height. A significant difference was found when the panoramic measurement is compared with lateral cephalogram for body length.

**Table 1:** Comparison of various parameters between left and right sides of OPG

| Parameter | OPG Left [n=100] | | OPG Right [n=100] | | P-value |
|---|---|---|---|---|---|
| | Mean | SD | Mean | SD | |
| Ramus height (mm) | 53.78 | 5.92 | 56.18 | 6.29 | 0.259 |
| Body length (mm) | 85.49 | 6.54 | 85.54 | 7.95 | 0.983 |
| Gonial angle (degree) | 120.66 | 6.50 | 122.15 | 8.88 | 0.581 |

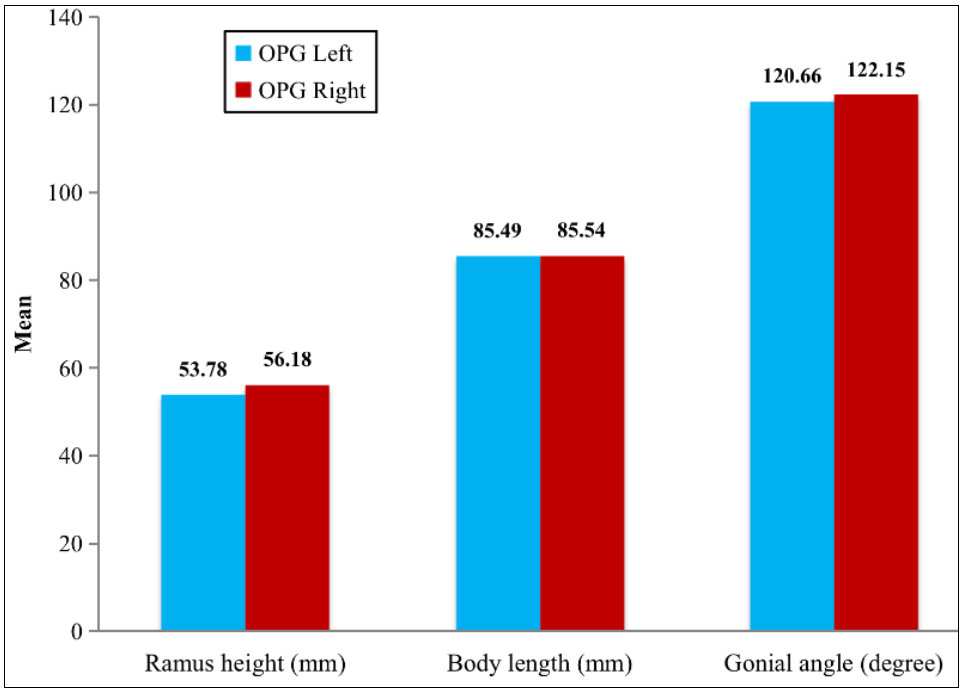


**Fig 1:** Comparison of various parameters between left and right sides OPG

**Table 2:** Comparison of various parameters between left side of OPG and lateral Ceph

| Parameter | OPG Left [n=100] | | Lateral Ceph [n=100] | | P-value |
|---|---|---|---|---|---|
| | Mean | SD | Mean | SD | |
| Ramus height (mm) | 53.78 | 5.92 | 53.48 | 6.36 | 0.887 |
| Body length (mm) | 85.49 | 6.54 | 68.26 | 3.89 | <0.001* |
| Gonial angle (degree) | 120.66 | 6.50 | 122.51 | 7.70 | 0.445 |

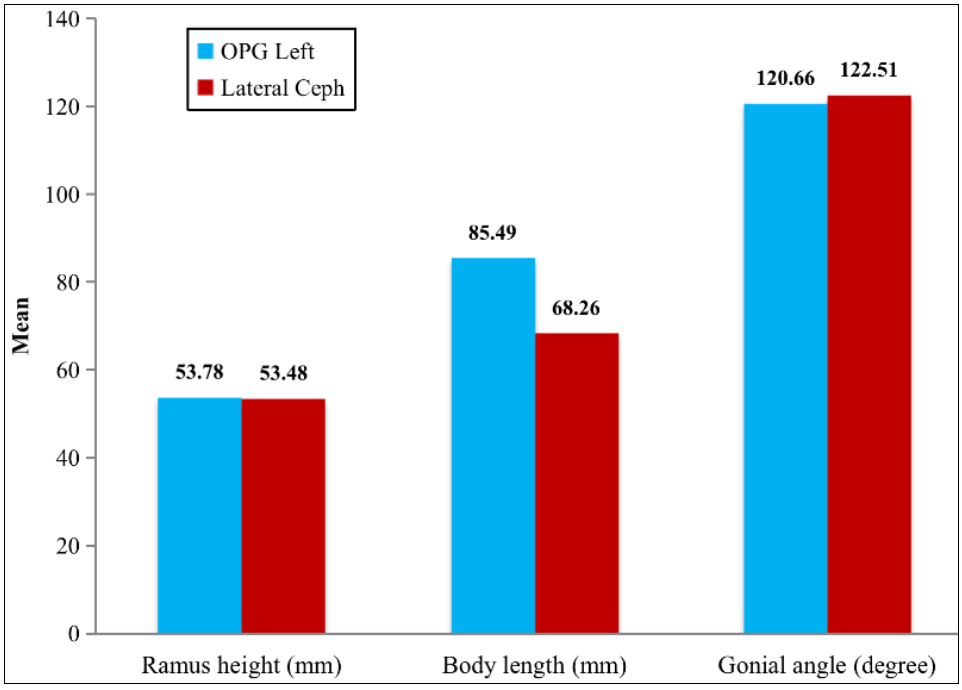


**Fig 2:** Comparison of various parameters between left and right sides OPG

**Table 3:** Comparison of various parameters between right side of OPG and lateral Ceph

| Parameter | OPG Right [n=100] | | Lateral Ceph [n=100] | | P-value |
|---|---|---|---|---|---|
| | Mean | SD | Mean | SD | |
| Ramus height (mm) | 56.18 | 6.29 | 53.48 | 6.36 | 0.210 |
| Body length (mm) | 85.54 | 7.95 | 68.26 | 3.89 | <0.001* |
| Gonial angle (degree) | 122.15 | 8.88 | 122.51 | 7.70 | 0.897 |

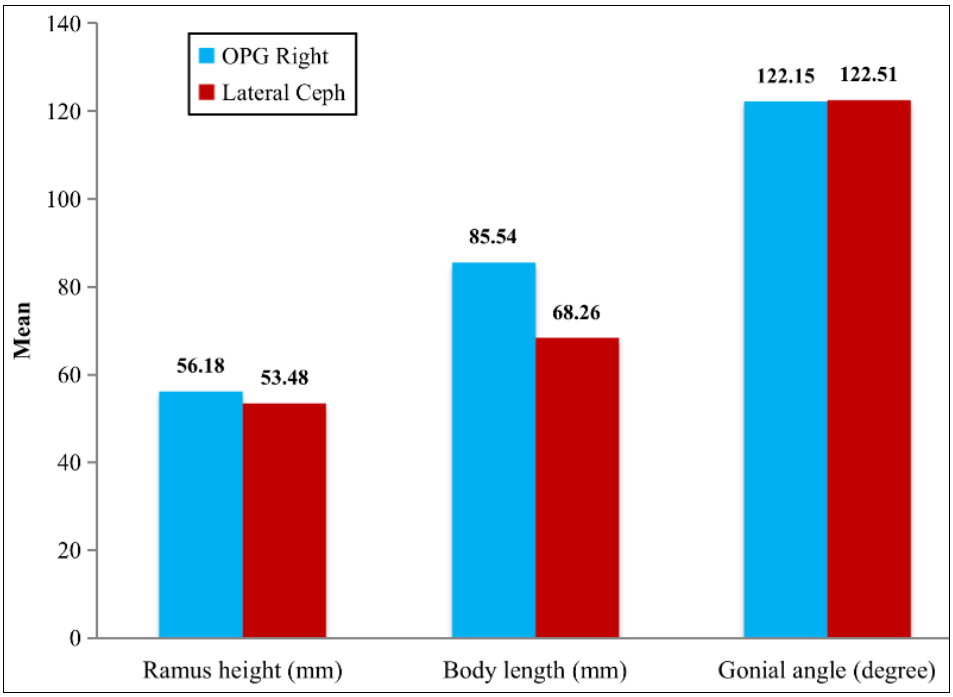


**Fig 3:** Comparison of various parameters between left and right sides OPG

## Discussion

This study was performed to compare both the mandibular linear and angular measurement between OPG and lateral cephalogram in randomly selected samples. Even though, there are many studies comparing gonial angle measurements between OPG and lateral ceph there are only a few reported studies comparing linear mandibular measurements between OPG and lateral cephalogram.

The results of our study show that there is no statistically significant difference in ramus height and the gonial angle between OPG and lateral cephalogram. Whereas, statistically significant difference exists for body length between OPG and lateral ceph. Thus, OPG can be used to measure the gonial angle and vertical measurements individually on the right and left sides while it may not be reliably used for horizontal measurements, which is in agreement with previous studies.

Mattila *et al*. 1977 [4] in took measurements of gonial angle on cephalograms, panoramic radiographs and dried skulls. They reported that right and left gonial angles from panoramic images were equal to the angles measured on dry skulls. They also reported that the right and left gonial angles can be quite easily determined individually from orthopantomogram, thus avoiding the disturbing influence of the superimposed images found on lateral cephalograms. They concluded that the orthopantomogram is more obvious choice for determination of the gonial angles.

Tronje *et al*. 1981 [5] concluded that on films exposed with rotational panoramic radio graph, distortion effects are often apparent. The distortion of the outer contour of three-dimensional model objects has been analyzed mathematically. The applied mathematical expressions for coordinate transformation between object and film were confirmed experimentally. The distortion of the outer contour is dependent on the basic form of the object; the more rounded the object is, the less marked is! The distortion. It is concluded that for practical clinical purposes the correctly exposed pan oramic film is reliable when the form of rounded objects is assessed.

Fischer-Brandies *et al*. 1984 [6] stated that in the orthopantomogram a reproducible determination of the gonial angle is possible. When comparing two orthopantomograms of the same patient, which were taken during routine clinical examination, a variation of the arithmetic mean of the gonial angle by 1 degrees was found. The value of the gonial angle measured in the orthopantomogram is 2.2 degrees to 3.6 degrees smaller than in the lateral cephalometric radiograph. In single cases, however, a wider range occurred. Therefore in determining the gonial angle, the lateral cephalometric radiograph should be preferred.

However, Larheim and Svanaes 1986 [7] indicated that lateral cephalograms did not permit reliable registration of the gonial angle, and the superimposed images created difficulties in recognition and measurement of the individual angles, whereas the gonial angle assessed from a panoramic film was almost identical to that measured on the dried mandible.

Turp *et al*. 1996 [8] compared the vertical linear measurements on the condyle and the ramus obtained from OPGs of 25 macerated skulls with true values obtained from the direct measurement of the skull and found a low correlation between the two Akcam *et al*. 2003 [9] concluded that The FHP can be used reliably for dentoskeletal measurements performed on panoramic radiographs. Clinicians should always keep in mind that mandibular condyles can be asymmetric, so that possibility must be considered when using panoramic radiographs. With standard exposure conditions and high image quality, panoramic radiographs can provide information on the vertical dimensions of craniofacial structures; however, they are not reliable enough to give acceptably accurate additional information compared with lateral cephalograms. Fatahi and Babouei 2007 [10] revealed that all the five measurements (except length of the body of the mandible) in panoramic radiographs were close to actual degrees in dry skulls. Correlation tests showed the highest correlation between panoramic and cephalometric radiographs in gonial angle ($r=0.89$, $p<0.001$) whereas the least correlation was seen in the length of mandibular body. In different growth patterns, it was seen that gonial angle and ramus height showed the highest correlation between the two radiographs Nohadani and Ruf 2008 [11] compared longitudinal vertical facial and dentoalveolar changes using

panoramic radiographs with measurements on lateral cephalometric
radiographs and reported that panoramic radiographs cannot be recommended for evaluating vertical facial parameter changes during time though OPG delivers a moderate approximation to the situation depicted on lateral cephalogram.

Kurt *et al.* 2008 [12] concluded that acceptable results can be achieved with panoramic radiographs. They studied to evaluate the condylar and ramal mamndibular asymmetry in a group of patients with class II subdivision malocclusion to identify possible gender differences between male and female subjects.

Kambylafkas *et al.* 2006 [13] studied to evaluate the accuracy of panoramic radiographs for diagnosing the vertical asymmetry of the posterior mandible. This study suggested that the panoramic radiographs can be used to evaluate vertical posterior mandibular asymmetry, but there will be some under diagnosis Ongkosuwito *et al*. 2009 [14] studied the dry skull and concluded that an OPG is as reliable as a lateral cephalogram for linear measurements of the mandible, with vertical measurement having a better correlation than horizontal.

Katti G *et al.* 2016 [15] studied to investigate whether OPGs can be used as an alternative to lateral cephalogram for measuring the gonial angle. They concluded that panoramic radiography can be used to determine the gonial angle as accurately as lateral cephalogram. In addition, it is easy to determine the right and left gonial angles of a patient in an OPG without interferences due to superimposed images of anatomical structures in lateral cephalogram

Zangouei-Booshehri M *et al*. 2012 [16] concluded that panoramic radiography can be used to determine the gonial angles accurately as a lateral cephalogram. Furthermore, in panoramic radiography the right and left gonial angle scan is measured easily without superimposition of anatomic landmarks, which occurs frequently in a lateral cephalogram. Therefore, it seems that panoramic radiography which is a simple, inexpensive and available radiologic technique can be used for determination of the left and right gonial angles.

Kumar, *et al.* 2017 [17] concluded that panoramic radiography can be used to determine the gonial angle and ramus height as accurately as a lateral cephalogram. However, clinicians should be vigilant when predicting horizontal measurement from OPGs.

Pillai Devu Radhakrishnan *et al*. 2017 [18] concluded that panoramic radiography can be considered reliable for measuring the gonial angle, particularly in cases where the outlines of the 2 sides are not clearly visible on a lateral cephalogram and in patients presenting with asymmetry, as the right and the left gonial angles can be accurately visualized in a panoramic radiograph without any interference due to superimposed images.

Horizontal measurements have been shown to be particularly unreliable because of the nonlinear variation in the magnification at different object depths. In panoramic radiography, the focus of projection in the horizontal dimension differs from that of the vertical dimension. In the horizontal dimension, the rotation center serves as the functional focus, whereas in the vertical dimension the X-ray source serves as the focus. Shape and size distortion of the radiographic images in the vertical plane is function of projection factors. These include factors such as alignment of film, object and X-ray source, object to X-ray source and film to X-ray source distances. Since the X-ray source serves as the functional focus, the vertical dimension is unaffected by the rotation of the beam in the horizontal plane. In the horizontal dimension; however, both projection and motion factors influence size and shape distortion.

## Conclusion

Panoramic radiographs may not always have pinpoint accuracy in measuring the angular and vertical measurements, but they do have the advantage of giving a higher diagnostic yield on a single film when compared to lateral cephalogram. They showed an increased coverage of the dental arches with reduced radiation exposure to the patients. Furthermore, OPG being an easier tool for measuring the right and left side of the patient without any interference due to superimposed structures it may be a better choice, especially in asymmetry cases. Though panoramic radiographs are as reliable as a lateral cephalogram for vertical and angular measurements of the mandible, clinicians should be vigilant when predicting horizontal measurement from OPGs.

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## References

1. White SC, Pharaoh MJ. Oral radiology: principles and interpretation. (4th edn.), Mosby, St. Louis, USA; c2000, p. 205-206.
2. Rozylo-Kalinowska I. Panoramic radiography in dentistry. Clin Dent Rev. 2021;5(1):26. https://doi.org/10.1007/s41894-021-00111-4
3. Sassouni V, Nanda S. Analysis of dentofacial vertical pro-portions. Am J Orthod. 1964;50(11):801-823.
4. Mattila K, Altonen M, Haavikko K. Determination of the gonial angle from the orthopantomogram. Angle Orthod. 1977;47(2):107-10.
5. 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(4):689-96.
6. Fischer-brandies H, Fischer-brandies E, Dielert E. The mandibular angle in the orthopantomogram. Radiologe. 1984;24(12):547-9
7. Larheim TA, Svanaes DB. Reproducibility of rotational panoramic radiography: Mandibular linear dimensions and angles. Am J Orthod Dentofacial Orthop. 1986;90(1):45-51
8. Turp JC, Vach W, Harbich K, Alt KW, Strub JR. Determining mandibular condyle and ramus height with the help of an orthopantomogram: A valid method? J Oral Rehabil. 1996;23(6):395-400.
9. Akcam MO, Altiok T, Ozdiler E. Panoramic radiographs for investigating skeletal pattern. Am J Orthod Dentofacial Orthop. 2003;123:175-81.
10. Fattahi HR, Babouei EA. Evaluation of the precision of panoramic radiography in dimensional measurements and mandibular steepness in relation to lateral cephalomerty. J Mashhad Dent Sch Fall. 2007;31(3):223-30.
11. Nohadani N, Ruf S. Assessment of vertical facial and dentoalveolar changes using panoramic radiography. Eur J Orthod. 2008;30(3):262-8.
12. Kurt G, Uysal T, Sisman Y, Ramoglu SI. Mandibular asymmetry in class II subdivision malocclusion. Angle Orthod. 2008;78(1):32-7.
13. Kambylafkas P, Murdock E, Gilda E, Tallents RH,

Kyrkanides S. Validity of panoramic radiographs for measuring mandibular asymmetry. Angle Orthod. 2006;76(3):388-93.
14. Ongkosuwito EM, Dieleman MM, Kuijpers-Jagtman AM, Mulder PG, van Neck JW. Linear mandibular measurements: Comparison between orthopantomograms and lateral cephalograms. Cleft Palate Craniofac J. 2009;46(2):147-53.
15. Katti G, Katti C, Karuna, Shahbaz S, Khan M, Ghali SR. Reliability of panoramic radiography in assessing gonial angle compared to lateral cephalogram in adult patients with Class I malocclusion. J Indian Acad Oral Med Radiol. 2016;28(3):252-5.
16. Zangouei-Booshehri M, Aghili HA, Abasi M, Ezoddini-Ardakani F. Agreement between panoramic and lateral cephalometric radiographs for measuring the gonial angle. Iran J Radiol. 2012;9(4):178-82.
17. Kumar SS, Thailavathy V, Srinivasan D, Loganathan D, Yamini J. Comparison of orthopantomogram and lateral cephalogram for mandibular measurements. J Pharm Bioall Sci. 2017 Nov;9(Suppl 1):S92.
18. Pillai Devu Radhakrishnan, Nilambur Kovilakam Sapna Varma, Vallikat Velath Ajith. Dilemma of gonial angle measurement: Panoramic radiograph or lateral cephalogram Korean Academy of Oral and Maxillofacial Radiology Imaging Science in Dentistry. 2017;47(2):93-7.