# ORIGINAL ARTICLE

# Assessing Validity of Printed Panoramic Radiographs Films for Dental Anomaly Detection

Nahwan Kamal Bahoudela, Siti Noor Fazliah Mohd Noor, Husniyati Roslan

Craniofacial and Biomaterial Sciences Cluster, Advanced Medical and Dental Institute, Universiti Sains Malaysia, 13200, Bertam, Penang, Malaysia

## ABSTRACT

**Introduction:** The interpretations of printed panoramic radiographs film frequently depend on personal judgements analysis by observers. The findings correlations between more than two observers must consider statistical tool which can determine that sometimes the observers will agree or disagree merely by chance. Intraclass Correlation Coefficient (ICC) generally measures the degree of similarity among individuals within a cluster. Kappa statistic is the most frequently applied statistical analysis for this reason. This study aims to determine the validity of utilising printed panoramic radiographs for assessing dental anomalies and inter-examiner reliability in detecting dental anomalies observed within the panoramic radiographs. **Methods:** Twenty samples of printed versions of orthopantomogram (OPG) were arbitrarily selected from the AMDI Dental Clinic. Radiographic analyses were conducted twice, Trial 1 and Trial 2, with two-week intervals in between. Ten (10) printed OPG films were used in each session. During both assessments, incidence of dental anomalies was determined. All twenty OPGs were examined and analysed by the principal investigator and two independent examiners according to the inclusion and exclusion criterias. The data analysis was carried out using SPSS version 23. **Results:** The results of ICC for Trials 1 and 2 were 0.961 and 0.984, respectively. **Conclusion:** The outcomes demonstrated that the printed OPG films can be used to detect dental anomalies and inter-examiner dependability was in very good assertion for both trials, hence printed OPG films that satisfy the inclusion and exclusion criterias can be utilised for assessing dental anomalies as shown by the reliable ICC values in this study.

**Keywords:** Dental anomalies, Orthopantomogram, Kappa coefficient, ICC

**Corresponding Author:**
Husniyati Roslan, MClinDent
Email: husniyati@usm.my
Tel: +604-5622247

## INTRODUCTION

The number and complexity of statistical procedures reported in medical research are gradually increasing with time. Application of the principles and methods associated with evidence-based practice has led to the need for researchers to estimate the agreement between issues, procedures, equipment and materials used in the research field.

Validity determines whether the research conducted truly measures the factors that need to be measured, hence reflecting the accuracy of the results obtained. In other words, the research tool permits the researchers to achieve the aim and objectives of the research study and subsequently obtain reliable and valid results. Researchers commonly determine validity by expecting a series of questions, and will frequently search for the answers in the research of conducted by other researches.

The panoramic radiography also known as orthopantomogram is the most common radiological method used to generate a single representation of the facial structure, comprising dental arches with their supporting structures. It has several benefits that include the wide coverage of teeth and low exposure of patients to radiation (1). It is also considered as an exceptional diagnostic tool that provides additional information concerning dental developmental defects (2).

The panoramic radiograph can cover huge regions or the entire body, and also able to determine multiple abnormalities (3). In order to diagnose the dental anomalies, besides clinical observations and examinations, paraclinical investigations such as radiography are essential and play an important role in the differential diagnoses of these anomalies. The early detection of dental anomalies is very important for therapeutic purposes. In addition, there are many complications with these anomalies and early detection of them is most important to avoid undesirable complications.

Advanced methods for assessing dental developmental defects include Computed Tomography (CT) Scan and Cone Beam Computed Tomography (CBCT). However, not many centres have the luxury of possessing these equipments. Cone-beam computerised tomography (CBCT) presents a series of technical differences in comparison with those of conventional radiograph, but it is dynamically used in the maxillofacial area due to several advantages. CBCT takes up less space, needs lower cost to set up, has a quicker scanning time, produces less radiation and is easier to measure exact dimensions.

Over the past years, various types of dental anomalies have been observed in the routine radiographic examination. The dental anomalies can be classified in terms of tooth number (hypodontia and supernumerary) and in terms of dental structures (consist of the complex or compound type of odontome). Some of the common dental anomalies alter the normal evolutional growth of dental structure, such as the alteration in the number of teeth, less number of the teeth or hypodontia, extra number of tooth or supernumerary teeth, odontogenic jaw tumours or odontome.

The aim of this study was to determine the validity of utilising printed panoramic radiographs for assessing dental anomalies and inter-examiner reliability in detecting dental anomalies observed within the panoramic radiographs.

## MATERIALS AND METHODS

### Materials
This study utilised 20 printed panoramic radiographs (OPG) obtained from the database and were randomly selected from the AMDI Dental Clinic based on the inclusion criterias such as the OPG must be taken from subjects aged between 5 to 17 years old, good quality radiographs and all upper and lower teeth must be included in the OPG except the third molar (wisdom tooth). Poor quality radiographs and OPG with distortion or elongated images of the teeth were excluded. The availability of printed OPG in the database was limited since AMDI has adopted to use digital version of OPG in 2010 and these OPGs will also be utilised in the actual study, hence, it was decided to use only 10 OPGs for Trial 1 and 10 new OPGs for Trial 2.

### Methods of assessment
All the examiners in this pilot study were dentists with working experience of more than ten years. The occurrence of hypodontia, supernumerary teeth and odontome was examined in the OPGs by the principal investigator and two independent examiners. The examinations were performed in two sessions; Trial 1 and Trial 2 and performed in two-week intervals between both trials. During each trial, there were the same set of the examiners. No more than ten OPGs were

examined in a single day in each trial to minimise the errors due to examiner fatigue.

The details of all subjects involved in this study were soundly examined in order to collect all data needed (i.e. name, a registered number, date of birth, date of OPG taken, gender) and also to check their medical status. Each OPG was placed on an X-ray view box (LumiVision LED Illuminators) and adapted correctly. The same X-ray view box was used to assess all OPGs for Trials 1 and 2, to confirm the homogeny of the procedures (Fig. 1).

The data and information obtained from the OPGs were recorded in the data collection sheets. Every dental anomaly was identified in the OPGs by its presence and non-presence. The information derived from the OPGs was documented in the data collection sheet of all examiners for Trials 1 and 2. All the information was documented, managed and analysed by SPSS version 23. The data were analysed using the ICC analysis to determine the agreement between the investigators with the Kappa coefficient.



**Figure 1: The example of orthopantomogram (OPG) radiograph on the X-ray view box**

### Statistical Analysis
To evaluate inter-observer reliability, 20 OPGs were randomly selected and manually examined as mentioned above. The Intraclass Correlation Coefficient (ICC) was performed, and all the measurements presented coefficient greater than 0.9. A measurement with a reliability coefficient greater than 0.7 is generally regarded as acceptable.

Data analysis was performed using SPSS version 23 (IBM, USA), where inter-examiner reliability was evaluated with internal consistency and reliability measurements by using ICC of investigators for both trials (Trial 1 and Trial 2). The Kappa coefficient was used to assess the score of the reliability of the investigator. The Kappa values were interpreted in Table I (4). The results obtained will also be used to determine the usefulness and reliability of utilising panoramic radiographs for assessing dental developmental anomalies.

## RESULTS

Analyses using printed OPG for the ICC results for inter-

**Table I: Kappa values and their interpretations (Adapted from Landis and Koch, 1977).**

| Value of Kappa | Strength of agreement |
|---|---|
| <0.20 | Poor |
| 0.21 – 0.40 | Fair |
| 0.41 – 0.60 | Moderate |
| 0.61 – 0.80 | Good |
| 0.81 – 1.00 | Very good |

examiner reliability for Trials 1 and 2 showed to be in very good agreement. The ICC result for Trial 1 shows that the inter-examiner reliability was between 0.953 to 0.968 for the single measure and between 0.984 to 0.989 for the average measure.

The ICC result for Trial 2 shows that the inter-examiner reliability was between 0.980 to 0.986 for the single measure and between 0.993 to 0.995 for the average measure. The data layouts of both trials are shown in Tables II and III.

**Table II: The Intraclass Correlation Coefficient's result for Trial 1**

| | Intra-class Correlation | 95% CI | | F Test with True Value 0 | | | *p* value |
|---|---|---|---|---|---|---|---|
| | | Lower Bound | Upper Bound | Value | df1 | df2 | |
| **Single Measures** | 0.961 | 0.953 | 0.968 | 75.133 | 319 | 638 | 0.000 |
| **Average Measures** | 0.987 | 0.984 | 0.989 | 75.133 | 319 | 638 | 0.000 |

CI=confidence interval; df=degree of freedom

**Table III: The Intraclass Correlation Coefficient's result for Trial 2**

| | Intra-class Correlation | 95% CI | | F Test with True Value 0 | | | *p* value |
|---|---|---|---|---|---|---|---|
| | | Lower Bound | Upper Bound | Value | df1 | df2 | |
| **Single Measures** | 0.984 | 0.980 | 0.986 | 180.361 | 319 | 638 | 0.000 |
| **Average Measures** | 0.994 | 0.993 | 0.995 | 180.361 | 319 | 638 | 0.000 |

CI=confidence interval; df=degree of freedom

## DISCUSSION

There are several drawbacks such as additional or less exposure of the rays and movement of the beam of the X-ray device, which may result in image distortion that can adversely affect the quality of panoramic radiograph. In this validation study, there were only 20 samples of printed OPGs recruited due to limitation of the available good quality printed OPGs. AMDI Dental Clinic has adopted to use digital version of OPG in 2010, hence reducing the total available number of printed OPGs.

The cluster randomised trials have become progressively popular in most research especially in the medical field. Individual within a cluster may be more similar than individuals across clusters. This study was conducted to determine the agreement between the investigators

in the same research and to determine the validity of the principal investigator to proceed with actual study project which needs the scanning and detecting dental anomalies by using panoramic radiograph.

The Kappa statistic corrects for the chance agreement and states how much of the possible agreement over and above chance the reviewers have achieved (5). The assessment of the Kappa statistic needs the number of assessments where positive (abnormal) and negative (normal), to be noted for all reviewers.

The Kappa statistic is progressively recommended for utilisation in reliability studies as the most appropriate method of analysis for agreement between reviewers or cases when the data are categorical (6). It applies not only to tests such as radiographs but also to items like physical exam findings where Kappa gives a numerical rating of the degree to which this arises (7). Researchers often report only the mean and median of Kappa or a range of Kappa values even though Kappa is calculated using ordinal or categorical data.

The radiographs quality may reduce with time especially when they are not properly stored. Since one of the purposes for conducting this trial is to identify the feasibility of using the available printed copies of OPG for actual data collection, the ICC results obtained highlighted that the printed OPGs can still be used and included in the actual study.

In addition, ICC is also a universally used parameter to measure the degree where the individuals within a cluster are related to one another (8). The variance between the cluster tends to be small if the sample is relatively homogeneous (8). Likewise, in community trials, the unit of randomisation is a group of people rather than an individual because the intervention is applied to all people in a group (9).

## CONCLUSION

The measurements obtained with the printed panoramic radiograph analysis program used in the present study were shown to be reliable. The results exhibited that the inter-examiner dependability was in a very good assertion for both trials, thus allowing the actual study to proceed in using printed OPG films. A panoramic radiographic analysis should have a high value of reproducibility. Future study should look into using electronic OPG and compare it with the use of printed OPG in detecting dental anomalies.

## ACKNOWLEDGEMENTS

The authors declare that there is no conflict of interest.

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