Original Research Article

ACCURACY IN THE DIMENSION OF EXTRACTED TOOTH WITH INTRAORAL PERIAPICAL RADIOGRAPH: A COMPARATIVE STUDY

ABSTRACT

Introduction - Because of its simplicity, cheaper cost, lower radiation exposure, and easy availability in a dental clinical setting, intraoral periapical radiographs (IOPAR) are frequently utilised for preoperative planning and evaluation for most minor oral surgical procedures.~~Intraoral periapical radiographs (IOPAR) are widely used for the preoperative planning and evaluation for most minor oral surgical procedures owing to its simplicity, significantly lower cost, less radiation exposure and easy availability in a dental clinical set-up.~~ **Aim** – The Aim of this study is to Assess the Accuracy and Reliability of Intraoral Periapical Radiograph with the extracted teeth. **Methodology** – The study is comprised of 54 patients. For each extracted tooth, the actual measurements for tooth length will be measured with a Vernier caliper with a least count of 0.01mm. After obtaining the actual length of the tooth with the Vernier Caliper, the Length of the tooth will be measured from the Intraoral Periapical Radiograph using a Vernier caliper. **Result** – By comparing the length of the actual tooth with that of an IOPAR, it was found out that the difference that was obtained is statistically significant. **Conclusion-** There is significant overestimation in the dimension of the tooth.

Keywords: Intraoral Periapical Radiograph, Reliability of IOPA, Dimension of Tooth, Extraction of tooth, Paralleling Technique

1. INTRODUCTION

The ability to recognize tooth length measurement is critical in dentistry, particularly in Oral and Maxillofacial surgery and Endodontics. Modern diagnostic imaging techniques are many, but pricing, availability, and radiation exposure remain issues. Because of their simplicity, low cost, low radiation dose, and availability in a dental clinical setting, intraoral periapical radiographs are frequently utilized for preoperative planning and evaluation for most minor oral surgical procedures [1]

According to Mah and Hatcher, if the goal is to increase the quality, efficiency, and accessibility of craniofacial treatment, accurate and effective imaging techniques are critical. The clinical gold standard for determining tooth length is a periapical radiograph utilizing the paralleling technique [2] The accuracy of radiographic data as a predictor of true bone loss is a point of contention. Using an intraoral paralleling technique with alignment systems, periapical radiographs and bitewings can be used to get more exact recordings of crest bone in respect to the tooth root and changes in bone

density[8].~~There is a disagreement about the accuracy of radiographic measurements as an indicator of real bone loss. Both periapical radiographs and bitewings, made with an intraoral paralleling technique with alignment systems, allow for obtaining more accurate records of crest bone in relation to the tooth root and bone density changes[8].~~

The quality and accuracy of a radiograph determine its value in dental practice. The degree of precision varies depending on the radiography projection. Radiographs taken for dental measurements must be more precise than those taken for diagnostic purposes. The ability to determine tooth length from a radiograph is very useful in extraction instances and localization procedures [3]

The main drawback of intraoral radiography technique is the overlapping of anatomic structures and the lack of three dimensional information. This hinders the differentiation of the buccal and the lingual cortical plates and hence complicates the evaluation of bony defects [5]. The emergence of CT scans alleviated the lack of three-dimensional information about the dentition, but the increased radiation exposure and high expense were the main drawbacks. [7] The teeth, maxillofacial skeletal region, and relationships among anatomical elements can all be evaluated in three dimensions using CBCT [6]. Periapical radiographs are the most common radiographic examinations nowadays, although they have several limitations, such as 3D anatomical modification, geometric compression, and the possibility of anatomical structures overlapping, which might conceal the area of interest. ~~Lack of three-dimensional information of the dentition was overcome by the introduction of CT scan, however the increased radiation exposure and high cost was its main disadvantage.[7] CBCT permits a detailed three-dimensional evaluation of the teeth, maxillofacial skeletal district, and relation among anatomical structures [6]. The periapical radiographs is nowadays the main radiographic investigations used but presents some limits as 3D anatomic alteration, geometric compression, and possible anatomical structures overlapping that can obscure the area of interest.~~

Apart from CBCT, there are new modalities of imaging techniques that help obtain an accurate three dimensional representation of the face. The Total face approach 3D cephalometric analysis is one such method that was introduced in 2021. The TFA 3D cephalometry provides for the evaluation of certain bones not only individually but also in relation to others. The 3D perspective enables the detection of a disharmonious relationship when viewed from the vertical dimension, with special emphasis paid to total verticality or sagitality. [9]~~One such method that was introduced in 2021 is the Total face approach 3D cephalometric analysis. The TFA 3D cephalometry allows the assessment of various bones not only singularly but also considering the right proportion with others. The 3D view allows the identification of a disharmonious relation analyzed from the point of view of the vertical dimension paying particular attention to the total verticality or sagitality.[9]~~

2. MATERIAL AND METHODS

The study is being carried out in the Department of Oral and Maxillofacial Surgery of Yenepoya Dental College, Mangalore. The study is being conducted on patients who have a tooth/teeth that is indicated for extraction. The sample size for the study is 54.

Inclusion Criteria

Patients between the age group of 18 to 60 years.
Patients willing to participate in the study.
Anterior and posterior tooth/teeth are included in the study
Patients with tooth/teeth that is indicated for extraction with Intraoral Periapical Radiograph. Indications include:

1. Periodontally compromised tooth
2. Orthodontic extraction

Population of Karnataka and Kerala.

Exclusion Criteria

Grossly decayed tooth.
Root Stumps.

Procedure An Intraoral Periapical radiograph of the tooth that is indicated for extraction is taken using a RINN XCP film holder by means of the Paralleling technique (figure 1)

Figure 1: The IOPAR of left Central Incisor (21).

After Extraction of the indicated tooth, it will be cleaned of any adherent soft tissue, bone. These teeth will be placed in a container with 5% sodium hypochlorite solution. The cleaned tooth will be collected and stored. The tooth length from the Incisal/Occlusal edge till the root tip is measured with a Vernier caliper with a least count of 0.01mm (Figure 2)

Figure 2: Measurement of the extracted 22 using a Verner calliper

The following landmarks will be used to make the measurements:
Root apex: is the most apical portion of the root
Cusp tip: It is the most occlusal point of cusp.
Incisal Edge: The cutting edge of an anterior tooth
Total tooth length will be measured from the Root Apex to cusp tip/Incisal Edge.

After obtaining the actual length of the tooth with the Vernier Caliper, the Length of the tooth is measured in the Intraoral Periapical Radiograph using a Vernier caliper with a least count of 0.01mm (Figure 3).

Figure 3: Measuring the length of 22 from the IOPAR using a Verner calliper.

The Intraoral periapical radiograph will be taken using a RINN XCP film holder and the technique used is Paralleling technique. The obtained measurements will be recorded in millimeters.

3. RESULTS AND DISCUSSION

Independent t test was done for inter group comparison (Table 1) for 54 patients and the mean value obtained for length of the extracted tooth is 19.85 with a standard deviation of 3.10 and the mean value obtained for the IOPAR group is 20.77 with a standard deviation of 2.95. The *P* value obtained is 0.191 and is not statistically significant.

Table 1: Intergroup Comparison using independent t Test.

	N	**Mean**	**Standard Deviation**	***P*-value**
Length of Extracted Tooth	54	19.85	3.10	0.191
Length in IOPAR	54	20.77	2.95	
P-value based on Independent-t-Test * = Statistically Significant (*P* < 0.05)				

In the Accuracy and reliability statistics (Table 2), the Cronbach's alpha value obtained was 0.992 and the intra class correlation coefficient is 0.985 with a *P* value of less than 0.001, hence the value obtained is statistically significant.

Table 2: Accuracy and Reliability Statistics.

	Cronbach's Alpha Value	**Intra-class Correlation Coefficient**	***P*-value**

Length of Extracted Tooth	0.992	0.985	< 0.001*
Length in IOPAR			
P-value based on Two-way-mixed effects model using Intra-class Correlation Coefficient Reliability Statistics * = Statistically Significant (*P* < 0.05)			

Figure 4: Mean length of tooth after extraction and in IOPAR

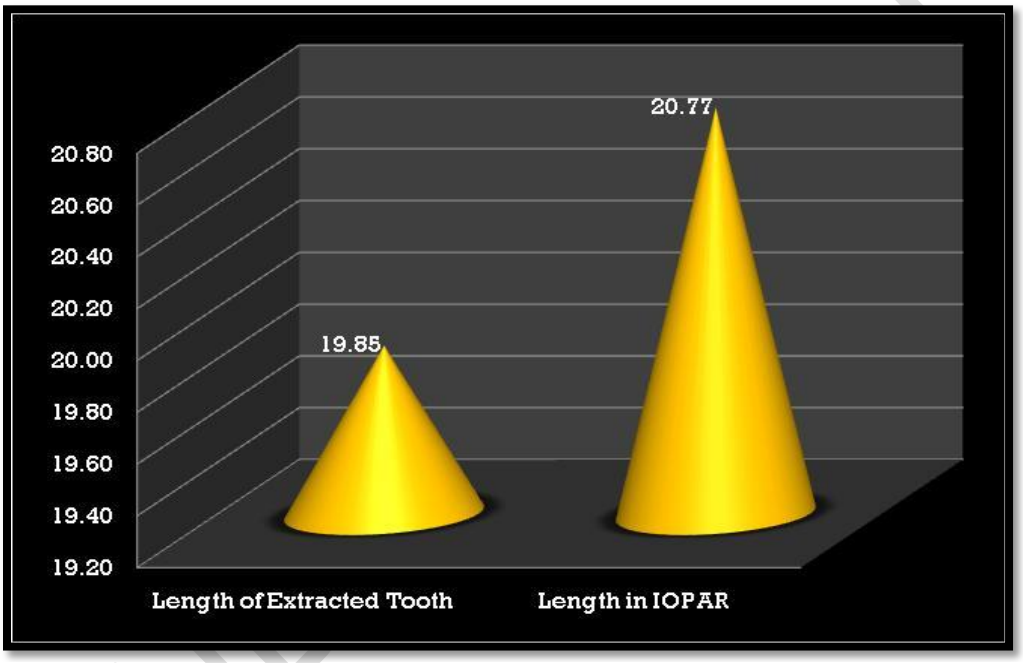
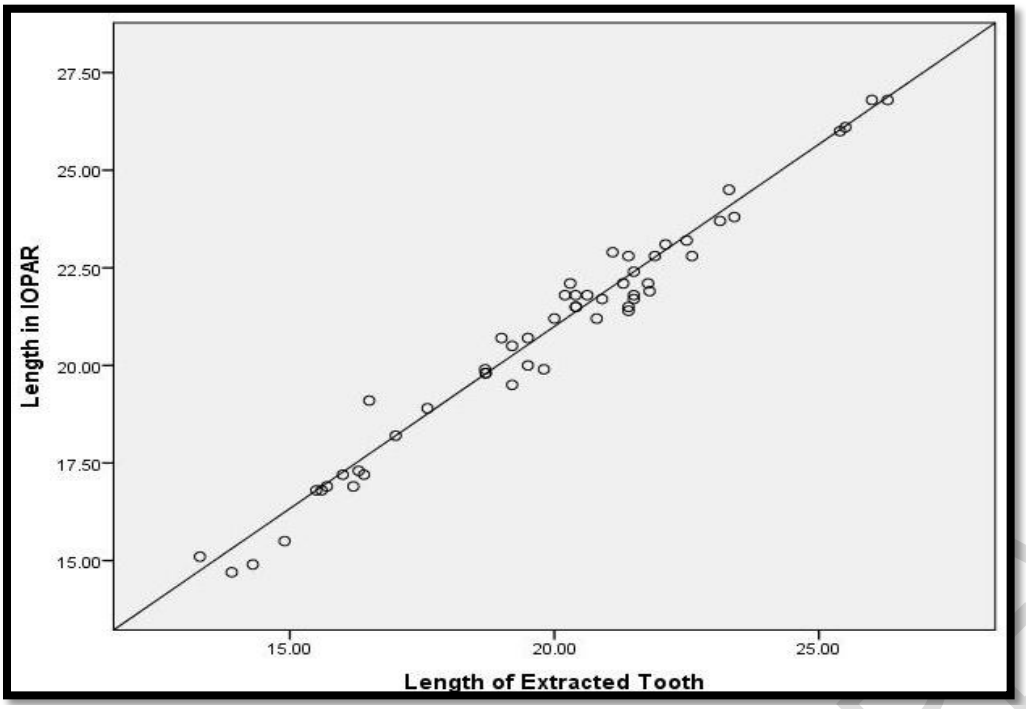


Figure 5: Accuracy and Reliability Graph (Scatter Plot)



In dentistry, a radiographic examination is an important aspect of the diagnostic process, and tooth length is also known to play a vital role in many fields. The orthodontic treatment effects of root resorption, development, and anchoring can all be evaluated using radiographic tooth length. In terms of endodontics, it aids in determining the working length.~~A radiographic examination is an essential part of the diagnostic process in dentistry, and it is also known that tooth length plays an important role in many branches of dentistry. Radiographic tooth length is useful in evaluating the orthodontic treatment effects such as root resorption, development and anchorage. Endodontically, it helps in assessing the working length.~~ In prosthetics it helps in making better judgment about the selection of abutment, in periodontics it helps in comparing tooth length or root length and alveolar crestal levels and in Oral and maxillofacial surgery for determining the length of the root or sinus approximation of roots. There are several methods for evaluating tooth length, but the most common approach for determining root canal length is using radiographs, primarily intraoral periapical radiography [1].~~Several methods of determining tooth length exists, but most preferred way of determining the root canal length is by radiographs mainly by the intraoral periapical radiography [1]~~

Bihan. H Et al in 2015 conducted a study that compared the precision of several radio diagnostic methods used in dentistry for measurement of peri implant bone. The author compared periapical radiographs obtained with the parallel as well as the bisecting angle technique, digital and conventional panoramic radiographs and concluded that the most precise peri implant bone measurements can be obtained from periapical radiographs by using the parallel technique.[10]
The intraoral periapical radiograph technique with paralleling technique has certain limitation such as small horizontal and vertical angulation of the x ray beam with the film, less defined interproximal area of the tooth, inability to assess the bone defects. These limitations should be avoided to reduce evaluation and diagnostic errors inherent in all periapical radiographs.[8] There are studies done by Van Vorde & Bjorndahl 1969, Forsberg 1987, Gound et al. 1994 in which the use of the paralleling technique has been compared with the bisecting angle technique. Each of these studies, however, has confirmed the superiority of the paralleling technique.

The study by Vandenberghe B et al., showed that although CBCT image measurements of periodontal bone levels were comparable to those by digital intraoral radiography, both techniques under and overestimated actual linear measurements.[4] Adarsh K et al [1] in 2018 conducted a study to evaluate the accuracy and reliability of tooth length measurements using conventional and cone-beam computed tomography (CBCT) imaging techniques and reported that the tooth, root, and crown lengths was found to be significantly different when measured with the Vernier caliper and on CBCT, OPG, and Intraoral periapical radiograph. The Intraoral periapical radiograph overestimated tooth length by an average of 0.8 mm and root length by 0.5 mm. OPG underestimated tooth length by about 0.8 mm and root length by 0.6 mm.
In a study conducted by MS Nabeel Althaf et al in 2019 , the author compared the linear measurements of periodontal defects using CBCT to clinical probing, Intraoral radiographs and open bone measurements and it was concluded that CBCT allowed more accurate assessment of horizontal, angular bony defects and furcation involvements than IOPA and

clinical probing and it was also mentioned that since IOPA couldn't identify the buccal and lingual cortical plates, it cannot be used as a reliable tool for measuring bone loss in the midbuccal, midlingual/midpalatal areas [7]

Direct radiography, in comparison to CBCT, is a 2D imaging technique that cannot detect 3D skeletal abnormalities. Direct radiography have a hard time detecting and interpreting maxillary trifurcations. CBCT has been found to have a radiation exposure 15 times lower than traditional radiography, just 4-15 times that of a standard panoramic image [5]. Beyond accuracy, radiographic repeatability is crucial because it allows for the replication of the targeted region over a short period of time and comparison of those repeated exams, which is extremely useful when assessing and treating osseous abnormalities in a clinical setting. [8]~~When compared with CBCT, direct radiography remains a 2D imaging technique, which cannot visualize 3D bony defects. Maxillary trifurcations could hardly be detected or interpreted by direct radiographs. The radiation dose of CBCT has been reported to be 15 times lower than conventional radiography, only 4-15 times the dose of a standard panoramic image [5]. Beyond accuracy, the radiographic repeatability is important because it permits reproduction of the targeted region over a short period of time and allows for a comparison of those repeated examinations, which is of great value in assessing and controlling osseous defects in a clinical setup.[8]~~

In the current study, it was noted that there was a significant difference in the length of the tooth when measured in an IOPAR and measurement of the tooth after extraction.

4. CONCLUSION

The tooth length when measured after extraction is significantly different from when it is measured in an intraoral periapical radiograph. IOPA overestimated tooth length by an average of 0.9 mm.
Instead of heading towards higher conventional radiographs (RVG) and CBCT Imaging techniques for identification of length of a fractured tooth segment or a fractured implant, Intraoral periapical radiographs can be used

ETHICAL APPROVAL (WHERE EVER APPLICABLE)

Ethical Clearance obtained from Yenepoya Ethics Committee, DCGI REGISTRATION NO.:ECR/1337/INST/KA/2020. Protocol number is YEC2/703.

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