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A Comparison of Three Different Radiographic Techniques to Evaluate Their Reproducibility Concerning Periapical Structures – An Experimental Pilot Study

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Abstract: ***The assessment of periapical structures, inflammation and healing process state many questions concerning diagnostic, characteristics of healing and bone repair in apical stricture. The reproducibility of different x-ray techniques is very important from clinical point of view. Contemporary endodontic treatment requires precise and reliable measurement of periapical lesion and their suspectable healing. Intra-oral bisecting angle technique is no longer a method of choice. The purpose of this study is to compare three different techniques – intra-oral bisecting angle, intra-oral parallel and intra-oral parallel with bite registration. Bite registration is of great importance for taking reproducible periapical x- rays in studying the dynamic processes in apical periodontal zone.***

Keywords: diagnostic, intra-oral x-ray, periapical lesions, radiographic examination, reproducibility.

1. Introduction

The introduction of sophisticated radiographic techniques has provided an invaluable supplement to endodontic radiography [2].Diagnosis of periapical lesions and assessment of bone repair or progression of lesions after non-surgical endodontic treatment of teeth with chronic apical periodontitis is usually monitored in a subjective manner using conventional radiographs, which does not assure the precise identification of periapical lesion changes or their extension [5].

The assessment of periapical structures, inflammation and healing process state many questions concerning diagnosis, characteristics of healing and bone repair in apical stricture.

The European Society of Endodontology describes failure of endodontic treatment as when symptoms persist, or when a radiographic lesion appears or increases in size following endodontic therapy or has not resolved after a 4-year period [4]. Many cases proceed asymptomatically but when we use imaging tools for diagnostic, follow ups present lesions with increased size.

The diagnosis of periapical disease is greatly facilitated by the use of radiograph. However, the intraoral, periapical radiograph remains the standard for radiological diagnosis of apical periodontitis [1,2].

Radiographic image formation is based on the principle of projecting a three-dimensional object onto a two-dimensional image plane, and therefore this technique also has limitations. Cone beam computed tomography (CBCT) has been specifically designed to produce undistorted three-dimensional information of the maxillofacial skeleton, including the teeth and their surrounding tissues with a significantly lower effective radiation dose compared with conventional computed tomography (CT). Periapical disease may be detected sooner using CBCT compared with periapical views and the true size, extent, nature and position of periapical and resorptive lesions can be assessed [8,9]. This technology can improve endodontic practice efficiencyby giving information about real geometry of periapical lesions.

Radiographic interpretation of the periapical region is considered to be inconsistent, with a wide variation between observers, because of that the reproducibility of radiographic examination is of the great importance for long-terms follow-up. There are not many studies, which describe reproducibility of radiographic images. Due to these characteristics of radiographic image formation, the orientation of the x-ray beam toward the object is a factor that is very important for the resulting x-ray image.

A different orientation of the projection results in an altered image, which in its turn may affect the interpretation and diagnosis based on that radiograph. It is for that reason standardization and reproducibility of different x-ray techniques are very important from clinical point of view. This affords an opportunity in the

assessment of the periapical status of the teeth using the PAI. Contemporary endodontic treatment requires precise and reliable measurement of periapical lesions and their healing. Geometric standardization requires the use of some type of beam-guiding device in order to facilitate alignment and realignment of the source, object and film.

A method which has proven useful in dental applications employs an occlusal registration as a means of repositioning the film. The intra-oral bisecting angle technique is not preferred for endodontic radiography. This technique is used in areas where the parallel technique is impossible due to poor access, making the angle between tooth and film more than 15 degrees. Parallel technique produces the most accurate periapical radiograph for endodontic purpose. To achieve this parallel orientation it is often necessary to position the film away from the tooth, towards the midline of the hard palate, especially when the rubber dam clamp is in position. But existing a little variation between elements of x-ray examination: central beam, aligning device, object of investigation and recipient of image create a modification of this method [7].

Analyzing the outcomes of treatment we made rely a lot on the linear measurements on subsequent periapical x-rays, taken in different periods during and after the treatment.

These measurements are unfortunately highly relative, having in mind the variety of position combinations between elements of x-ray examination: central beam, aligning device, object of investigation and recipient of image.

Ethical concerns regarding multiple exposures to X-rays are likely to prohibit the realization of radiographic studies *in vivo*, because of that this study was realized on phantom.

The aim of this experimental study is to compare three different intra-oral techniques on phantom – Bisecting Angle Technique (BAT), Parallel Technique (PT) and Parallel with Bite Registration Technique (PBRT).

2. Materials and Methods

The radiographs were taken on phantom head for Radiology courses by Morita/Japan, using aligning devices by *Kerr* /anterior and posterior/ (Figure1, 2).

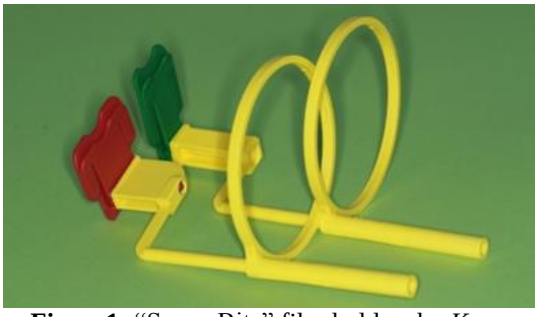

Figure1: "Super-Bite" film holders by *Kerr*.

Figure 2: Phantom head for Radiology courses by *Morita/Japan*

A phantom was placed in the sit up straight position on a dental chair with the occlusal plane parallel to the floor, and five intraoral periapical radiographic examinations for each technique , in the anterior and posterior regions of the maxilla and mandible were performed.Bite blocks were made from silicon impression material (Virtual, IvoclarVivadent) for individual positioning for intra-oral parallel technique with bite registration (Figure 3).

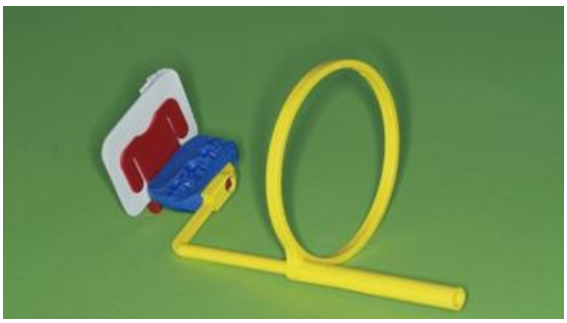

Figure 3: Film holders with silicon bite registration for individual positioning

All radiographs were taken using the same radiographic unit /Siemens/ at the same radiographic conditions /60kV; 0, 16 sec; 7mA/ and Kodak films – speed E/F. All radiographs were digitized with Cannon 30D. In this study we used six different groups as follows:

I group - maxillary molars
II group - maxillary premolars
III group - maxillary incisors
IV group - mandibular molars
V group - mandibular premolars
VI group - mandibular incisors.

The VixWin PRO/Gendex/ software was used for measurements. Medio-distal distance in area of CEJ was used to calibrate length measurements. We made five x-rays for each technique on each tooth group and the exposions were made in five subsequent days avoiding chances for remembering film position and x-ray beam direction.

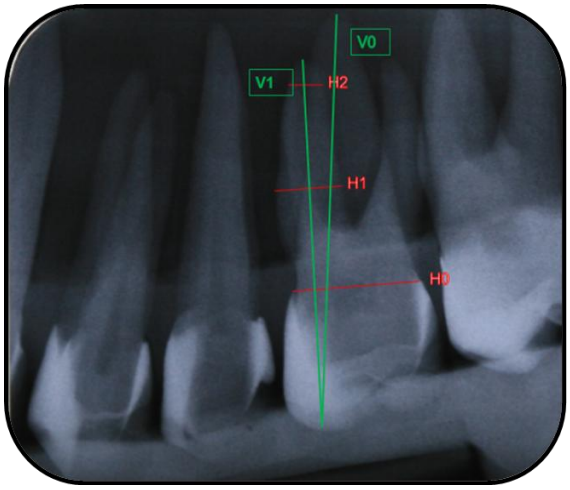

Figure4: Presentation of five different distances measured for each x-rays.

These measurements were compared in each group for each technique to detect differences. There were created six tables to record a data for each technique.

We compared five different distances for I group / maxillary molars/:H0, H1, H2, V0 and V1 in millimeters/mm/ as follow:
H0 – sagittal measurement of cemento- enamel junction/CEJ/
H1 – sagittal measurement of half of mesiobuccal /MB/ root length
H2 – sagittal measurement on 2mm of the apexof MB root
V0 – axial measurement of distance from mesiobuccal tubercle /MBT/ to apex of palatal/P/root
V1 – axial measurement of distance from MBT to apex of MB root.

3. Results

In this paper we chose to show table for I group. For both horizontal and vertical measurements significant reliability was found between five consequent x-rays with one day interval. The horizontal and vertical measurements between selected unchanged reference points in each radiographs as well as the mean and standard deviation /SD/ for each series were calculated and recorded (Table 1).

Table 1: Presentation of horizontal and vertical measurements for ***I group***

Bisecting Angle Technique																									
I radiograph					II radiograph					III radiograph					IV radiograph					V radiograph					
H0	H1	H2	V0	V1	H0	H1	H2	V0	V1	H0	H1	H2	V0	V1	H0	H1	H2	V0	V1	H0	H1	H2	V0	V1	
8.0	4.9	3.5	28.0	22.1	7.4	3.5	2.2	27.1	18.1	8.5	4.0	3.0	27.3	24.0	8.6	4.5	3.0	27.9	21.0	7.9	3.2	3.9	26.0	21.0	
Parallel Technique																									
I radiograph					II radiograph					III radiograph					IV radiograph					V radiograph					
H0	H1	H2	V0	V1	H0	H1	H2	V0	V1	H0	H1	H2	V0	V1	H0	H1	H2	V0	V1	H0	H1	H2	V0	V1	
8.0	4.0	2.2	25.1	22.0	8.2	4.2	2.3	25.3	22.1	8.2	4.2	2.5	25.1	22.2	7.9	3.8	2.1	25.0	22.0	8.2	4.2	2.5	25.0	22.0	
Parallel with Bite Registration Technique																									
I radiograph					II radiograph					III radiograph					IV radiograph					V radiograph					
H0	H1	H2	V0	V1	H0	H1	H2	V0	V1	H0	H1	H2	V0	V1	H0	H1	H2	V0	V1	H0	H1	H2	V0	V1	
8.0	4.0	2.5	25.0	21.5	7.9	3.9	2.4	24.5	21.2	8.0	4.0	2.5	25.0	21.5	8.0	4.0	2.5	25.0	21.5	7.9	4.1	2.6	24.5	21.2	

The comparison of three different techniques shows that intra-oral parallel periapical radiographs with bite registration give us high percentage of reproducibility (Figure5).

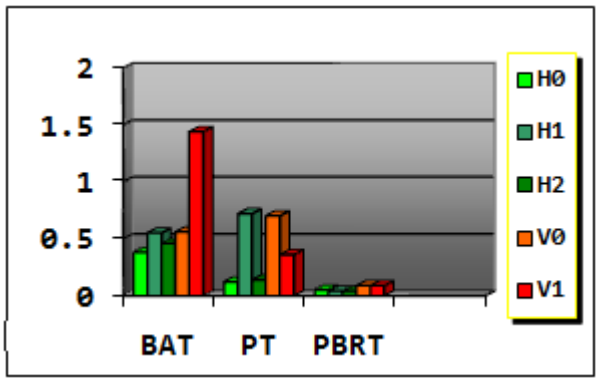

Figure 5: Correlation among the five distances /H0, H1, H2, V0, V1/ measured at three compared techniques.

4. Discussion

The reporting of success rates in endodontic literature can be confusing because of the definition of "success/failure", the time period that the outcome was measured over, the type of endodontic procedure and the unit of measurement[10].

The subjectivity and non-reproducibility of radiographic assessment of endodontic failure or success have been demonstrated repeatedly in different studies, and the tendency has been to denounce x-ray analyses of root-filled teeth as an adequate basis for scientific research [3,6].

To overcome this difficulty it has been investigated the possibility of making the radiographic diagnosis more objective and reproducible by applying a scoring system.

Bite registration is of the great importance for taking reproducible periapical x- rays in studying the dynamic processes in apical periodontal zone. The ability to accurately evaluate periapical lesions is of importance for treatment planning and good clinical outcome.

5. Conclusion

The use of film holders with bite registrations greatly facilitates reproducible exposure geometry, and parallel film placement in relation to tooth, reduces superimposition by neighboring structures.

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References

[1] Broon NJ, Bortoluzzi EA, Bramante CM. Repair of large periapical radiolucent lesions of endodontic

origin without surgical treatment. Aust Endod J. 2007 Apr;33(1):36-41.
[2] Dixon DA, Hildebolt CF. An overview of radiographic film holders. Dentomaxillofac Radiol2006;34:67-73.
[3] Duckworth JE, et al .A method for the geometrical and densitometric standardization of intraoral radiographs. J Periodontol 1983 Jul;54(7):435-40.
[4] European Society of Endodontology. Quality guidelines for endodontic treatment: consensus Report of the European Soceity of Endodontology. International EndodonticJournal 2006; 39:921-930.
[5] Gundappa M, Ng S, Whaites E. Comparison of ultrasound, digital and conventional radiography in differentiating periapical lesions.Dentomaxillofac Radiol 2006;35:326-333.
[6] Khojastehpour L et al .The Effect of Bite Registration of the Reproducibility of Parallel Periapical radiographs Obtained with Two Month Intervals, J Dent 2006;3(2):87-91.
[7] Lee Sam-Sun et al.Development and evaluation of digital subtraction radiography computer program Oral Surg Oral Med Oral Pathol OralRadiol Endod 2004;9:471-475.
[8] Patel, S. New dimensions in endodontic imaging: Part 2. Cone beam computed tomography. – Int. Endod. J., 2009, 42, 463–475.
[9] Patel, S., A. Dawood, E. Whaites, T. Ford Pitt. New dimensions in endodontic imaging: part 1. Conventional and alternative radiographic systems. Int Endod J 2009;42:447–462.
[10] Van der Stelt PF. Modern Radiographic Methods in the Diagnosis of PeriodontalDisease,Adv Dent Res1993; 7(2):158-162.

Authors Profile

Dr. Angela Gusiyska received her degree in Dentistry (Dr. med. Dent) from the Faculty of Dental Medicine, Medical University of Sofia, Bulgaria in 1997 and she specialized in Operative Dentistry and Endodontics at the same University in 2003. Since 1998 she is Assistant Professor at the Department of Conservative Dentistry, FDM – Medical University, Sofia. Her research interests are in the area of regeneration of periapical zone, nanotechnology and bioceramics in endodontics and esthetic rehabilitation of dentition. Dr. Gusiyska presents her scientific papers on national and international dental meetings. Her practice is focused on microscopic endondontic treatments. She developed her PhD thesis titled "Orthograde Treatment of Chronic Apical Periodontics – Biological Approaches: in 2011. She is currently a member of the Bulgarian Dental Association, Bulgarian Scientific Dental Association, Bulgarian Endodontic Society, Bulgarian Society of Aesthetic Dentistry, International Team for Implantology, Bulgarian Society of Oral Implantology.

Dr. Dora Kishkilova graduated in Medical University of Plovdiv, Bulgaria in 1996 as a Dentist (Dr.Med.Dent). She worked as a dentist practitioner in Municipal Hospital in Rakovski following three years. In 1999 she became part of the Maxillo Facial Radiology Department in the Faculty of Dentistry, Medical University of Sofia as an Assistant Professor. Her research interests are in the field of Jaw Pathology, optimizing the diagnosing protocols concerning oral and maxilla facial diseases. Lately she is working on the use of CBCT in Dentistry.