SHORT COMMUNICATION

Accuracy of scanography using storage phosphor plate systems and film for assessment of mandibular third molars

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Objectives: The aim of this study was to compare the diagnostic accuracy of two digital photostimulable storage phosphor (PSP) systems and film for assessment of mandibular third molars before surgery.

Methods: 110 patients were referred to have both their mandibular third molars removed. Each patient underwent a radiographic examination with scanography using either Digora (Soredex, Helsinki, Finland) and film or VistaScan (Dürr Dental, Beitigheim-Bissingen, Germany) and film in a randomized paired design. Two observers examined the following variables on the scanograms: bone coverage, angulation of the tooth in the bone, number of roots, root morphology and the relationship to the mandibular canal. In 75 of the pairs (Digora/film pair = 38 and Vista/film pair = 37) both third molars were eventually removed. During and after surgery the same variables were assessed, which served as reference standard for the radiographic assessments. The Wilcoxon signed-rank test tested differences in accuracy (radiographic compared with surgical findings) between Digora/film and between Vista/film.

Results: There was no statistically significant difference between the diagnostic accuracy of film and either of the two digital receptors for assessment of mandibular third molars before surgery ($P > 0.05$), although Digora obtained a higher accuracy than film.

Conclusions: Scanography is a valuable method for examination of mandibular third molars before removal and the PSP digital receptors in this study were equal to film for this purpose. *Dentomaxillofacial Radiology* (2011) 40, 306–309. doi: 10.1259/dmfr/68783877

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Introduction

Before removal of a mandibular third molar, it is important to assess the relationship between the mandibular canal and the roots of the third molar. Panoramic radiography has been advocated as the method of choice.¹ If the roots of the mandibular third molar overproject the mandibular canal on the initial image, projections from different angles or planes are usually needed from intraoral eccentric projections, scanography, posterior–anterior open mouth, conventional tomography or CT scanning.²

Digital receptors for panoramic imaging of the third molar have previously been evaluated (both charge-coupled device (CCD) sensors and photostimulable

storage phosphor (PSP) plate systems) and it was concluded that five digital systems were equally useful for third molar treatment planning and had similar diagnostic accuracy.^{3,4} One study, however, demonstrated that a CCD-based device was less accurate than PSP systems and film for diagnosing morphological changes in the temporomandibular joint (TMJ).⁵ Previous studies using conventional film have evaluated scanograms for assessment of mandibular third molars and concluded that scanography was a useful method for evaluating the buccolingual relations between the mandibular canal and the roots of the molar.^{6–8} However, no study has compared the diagnostic accuracy of conventional film and digital PSP systems for assessment of mandibular third molars using scanography.

The aim of this study was to evaluate the accuracy of scanography with PSP systems compared with conventional film for assessment of mandibular third molars.

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Materials and methods

110 patients (36 men and 74 women; mean age 25.7 years (range 17.9–66.7 years)) were referred for assessment of 2 mandibular third molars. Three radiographic receptors were used for scanography: Digora storage phosphor plate system (Digora PCT plate in a Digora PCT imaging plate cassette, PCT scanner, Soredex, Helsinki, Finland), VistaScan storage phosphor plate system (Dürr Dental plate in a Digora PCT imaging plate cassette, VistaScan scanner, Dürr Dental, Beitigheim-Bissingen, Germany) and a conventional film (Agfa-Gevaert N.V. HT-G in a cassette with Kodak lanex regular screens). The study was a matched pairs design, matching a PSP plate system with film in the same patient. Every second patient was assigned to the Digora/film pair group and the rest to the Vista/film pair group. A lot was drawn between the right and left side to determine in which side of the mandible the film exposure should be performed and in which side the digital exposure should be performed. All receptors were exposed in a Scanora unit (Soredex). The scanograms consisted of a series of four images which imaged the third molar in one orthogonal and one disto-eccentric projection and two projections cranial to these. In both cases the tube shift angle was 4°. This technique allows for viewing in stereopsis,^{6,9} but the tube-shift rule can also be used.

Two observers, a dental radiologist and a dentist (PhD student in oral radiology), viewed all images and assessed the following five variables: bone coverage (BC, full bony coverage (yes/no)); angulation (ANG, vertical/mesio-angulated/disto-angulated/inverted/transverse/horizontal); number of roots (NR, 1/2/>2); root morphology (RM, no bending/bending on one root/bending on both roots); and relationship to the mandibular canal (RC, in close contact with the canal/no close contact with the canal (superior/buccal/lingual)). The dental radiologist had more than 10 years of experience and the PhD student had 5 years of experience of reading scanograms of lower third molars. The observers were calibrated, *i.e.* they routinely read scanograms together. Digital images were exported from their dedicated software and imported into general software (Digiview PACS, Digisonics, Houston, TX) with possibilities to use zoom function and image enhancement such as brightness, contrast and gamma curve functions.¹⁰ Digital images were assessed on a flat panel 19 inch or 20 inch quality monitor (Samsung SyncMaster 203B, (Cheonan City, Korea) or Olorin VistaLine (Olorin AB, Kungsbacka, Sweden)) and film on a light box with a 2× magnifying viewer. The two observers were not blinded to the diagnostic method since the origin of an image was obvious.

After the radiographic examination, the patients underwent a clinical examination by a specialist in oral surgery who determined which third molars were to be removed. The operations were performed by the specialist or the dental student with help from the

specialist. The criteria for removal of a third molar were recurring pericoronitis, damage to the mandibular second molar, a caries lesion without the possibility for a restoration or a cyst in relation to the third molar. If one of the molars in a pair was not removed, the pair was omitted from the sample. Thereafter, 150 third molars in 75 pairs were included in the project; there were 38 patients in the Digora/film pair group and 37 patients in the Vista/film pair group. During and after surgery the same five tooth-related variables as described for the radiographic assessment were recorded, except that a close relationship to the alveolar inferior nerve was registered as: visible alveolar inferior nerve in the empty bone socket (yes/no) and/or grooves in the root complex of the removed tooth formed by the canal (yes/no). The operative findings were all validated by one trained observer (not the surgeon) who was present at all operations and served as the reference standard. The radiographic and operative findings were compared with respect to the five variables recorded for each molar and a score between zero (none of the radiographic recordings agreed with the reference standard) and five (all radiographic recordings agreed with the standard) was given to each molar. This score defined the overall accuracy of the radiographic recording for a molar. The Wilcoxon signed-rank test tested differences in accuracy between Digora and film (number of pairs = 38) and differences between Vista and film (number of pairs = 37). Further, the Wilcoxon signed-rank test was used to test differences in accuracy between the two observers for the three receptors (film, Digora and Vista).

Results and discussion

Table 1 lists the percentages of the agreement between the radiographic and operative findings for each of the five variables and the overall agreement in the pairs Digora/film and Vista/film. Digora PSP seemed to obtain a higher accuracy than film for all of the five variables, with the exception of the BC variable where the accuracy was the same for observer 1 and the accuracy for film was higher than for Digora for observer 2; however, the differences were not statistically significant between film and the PSP system for either observer (observer 1: $P = 0.179$; observer 2: $P = 0.082$). Vista PSP and film performed almost equally since for some variables film had a higher accuracy and *vice versa* for both observers (observer 1: $P = 1.0$; observer 2: $P = 0.901$).

In general, observer 2 obtained a higher accuracy percentage than observer 1 for Digora PSP and film and this was statistically significant (Digora PSP $P = 0.040$; film $P = 0.014$). For Vista PSP there was no significant difference between the two observers' accuracy ($P = 0.666$).

No previous study has evaluated current PSP systems used for scanography compared with film. Previous

Table 1 Percentage agreement between radiographic and operative findings for the pairs film/Digora and film/Vista

	<i>BC</i>		<i>ANG</i>		<i>NR</i>		<i>RM</i>		<i>RC</i>		<i>Overall</i>	
	<i>Obs 1</i>	<i>Obs 2</i>	<i>Obs 1</i>	<i>Obs 2</i>	<i>Obs 1</i>	<i>Obs 2</i>	<i>Obs 1</i>	<i>Obs 2</i>	<i>Obs 1</i>	<i>Obs 2</i>	<i>Obs 1</i>	<i>Obs 2</i>
Film Digora	92.1	100	62.9	68.6	55.3	57.9	42.9	45.7	62.2	75.7	63.4 ^a	69.6 ^b
	92.1	97.4	67.7	79.4	71.1	73.7	56.8	64.9	70.3	78.4	71.7 ^a	78.8 ^b
Film Vista	94.6	97.3	63.9	55.6	78.4	81.1	48.6	57.1	63.9	75.0	70.2 ^c	73.5 ^d
	94.6	94.6	60.6	54.6	70.3	75.7	62.2	59.5	64.9	75.7	70.7 ^c	72.4 ^d

BC, full bony coverage; ANG, angulation; NR, number of roots; RM, root morphology; RC, relationship to the mandibular canal; Obs, observer

^a*P* = 0.179; ^b*P* = 0.082; ^c*P* = 1.0; ^d*P* = 0.901

studies have compared solid state sensors (2 systems, 52 and 93 teeth) and PSP systems (3 systems, 62, 104 and 77 teeth) with film for panorama imaging assessing third molars before removal and found that accuracy differed little for most of the variables evaluated, although two of the three PSP systems had significantly lower accuracy than film for assessing the relationship to the canal.⁴ Those PSP systems were not included in the present study.

Even though the number of patients included in our study was rather small, the design was strong compared with other studies on accuracy of third molar assessment since it was paired and the diagnostic methods under evaluation were randomly assigned to the left and right side in each patient. We evaluated five variables for each tooth and the variables were treated equally and given the same weight in the statistical analysis, although it may be stated that the relationship between the roots of the mandibular third molar and the canal is the parameter of greatest importance for the surgeon. However, this parameter also has the most uncertain "reference standard", which has been discussed elsewhere.⁷ All three radiographic methods in our study seemed to be more accurate according to the reference standard for this parameter (overall agreement in 63%–78%) than in previous studies, in which agreement has been around 50% with scanography.⁷ One observer assessed more accurately than the other for two of the systems; however, both observers obtained higher accuracies than in previous studies.

Cone beam CT (CBCT) scanning may be an applicable method to assess the relationship between the mandibular canal and the lower third molar, but

there are only a few studies on its accuracy. A recent study examined the reliability of CBCT in 18 third molars using the same reference standard as in the present and our previous study.⁷ CBCT was very reliable in that study in assessing the relationship to the canal and the number of roots of the third molar compared with panoramic and conventional cross-sectional tomography.¹¹ A second report demonstrated that CBCT was superior to panoramic images in predicting exposure of the neurovascular bundle after extraction of a mandibular third molar in 142 cases.¹² However, more studies are needed in this field.

In our clinic, radiographic guidelines are followed before removal of a third molar: a panoramic radiograph is the first method of choice and serves two purposes: to assist in determining whether or not the molar should be removed and, if so, whether more radiographic methods are needed before removal. If the molar overprojects the canal in the panoramic radiograph, a scanogram is recorded. A radiologist reads the scanogram and determines the relationship between the tooth and the canal by means of stereopsis.⁹ Only when the radiologist is uncertain in determining this relationship is a CBCT examination performed. We estimate that this is the case in about 25% of lower third molars in our clinic. Scanography has previously been shown to be superior to an examination with three intraoral projections with respect to assessing the variables evaluated in the present study.⁷ Scanography has a place in third molar evaluation,² and we conclude that the two commonly available storage phosphor plate systems used in our study are as accurate as conventional film for this purpose.

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