

Diagnostic predictability of digital versus conventional panoramic radiographs in the presurgical evaluation of impacted mandibular third molars

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Abstract. Panoramic radiographs are the most widely used radiological diagnostic technique in dental practice, offering full vision of the maxillas and adjacent regions, but there are shortcomings regarding detailed dentoalveolar exploration. This study compared the precision of digital versus conventional panoramic radiographs in the presurgical evaluation of impacted lower third molars. 390 mandibular third molars were studied in 287 patients; their position, morphology and surgical technique used were recorded. 84 molars were evaluated with digital panoramic radiographs, and 306 with conventional panoramic radiographs. Four observers compared the presurgical data with the surgical findings and the diagnostic precision was established. There were statistically significant differences between the techniques; digital panoramic radiographs were more precise than conventional radiographs in providing the correct presurgical evaluation of the impacted third molars. Surgeon experience had a statistically significant influence on planning the presurgical study. Panoramic radiographs distort the position and morphology of the lower third molar, which may affect the presurgical strategy used. In this context, and because of their lesser experience, first year residents consider the operation to be more complicated, and tend to act less conservatively and cause increased trauma. In conclusion, digital panoramic radiographs offer significantly greater diagnostic precision than conventional panoramic radiographs.

Keywords: panoramic radiographs; digital panoramic radiographs; presurgical study; impacted third molar.

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Panoramic radiographs are the most widely used complementary radiological diagnostic technique in dental practice and oral surgery⁶. Their multiple diagnostic applications include the presurgical study of impacted third molars. The technique has a number of limitations, since it generates a two-dimensional image of three-dimensional structures. As a result, it is often necessary to request complementary radiological studies such as intraoral radiographs or computed tomography scans.

In the last 10 years, advances in panoramic radiology have improved image quality and digital radiology has almost replaced conventional panoramic radiographs. It has not been determined whether the quality of digital images affects the diagnostic impression compared with the images afforded by conventional panoramic radiographs. Such a comparison is essential when a new procedure is introduced into daily clinical practice. The authors designed a prospective study to compare the diagnostic predictability of conventional panoramic radiographs with digital panoramic radiographs in application to the presurgical evaluation of impacted third molars⁷.

Material and methods

A prospective consecutive study was made of 287 patients (125 males and 162 females) referred to the Service of Oral Surgery (University of Barcelona Dental Clinic, Barcelona, Spain) for the surgical removal of one or more impacted mandibular third molars. The study sample consisted of 390 molars (84 examined with digital panoramic radiographs, and 306 with conventional panoramic radiographs).

The study included impacted third lower molars with full root formation and no added pathology presenting radiological manifestations. The teeth were in a submucosal position or exhibited total or partial impaction in bone. Patients with uncontrolled systemic disease or signs and symptoms of active local infection were excluded. Erupted third molars or molars with incomplete root formation were also excluded.

The panoramic radiographs were examined with a 35 cm x 50 cm negatoscope by

Table 1. Percentage concordance according to the type of panoramic radiograph technique employed, in relation to each of the study variables.

Variable	Panoramic radiograph technique	Frequency	Percentage
Number of roots	Conventional	1018	74
	Digital	347	78
Root curvature	Conventional	825	60
	Digital	295	66
Direction of roots	Conventional	917	66
	Digital	328	74
Relationship between roots	Conventional	1013	73
	Digital	333	75
Surgical technique	Conventional	985	71
	Digital	383	86

four previously calibrated observers with different degrees of surgical experience: a first year resident, a second year resident, a third year resident and an experienced oral surgeon. The study variables were divided into morphological and surgical types. The morphological variables were: number of roots (1, single root; 2, two roots; 3, multiple roots); root curvature (1, straight; 2, curved mesial; 3, curved distal; 4, curved in opposite directions); direction of the roots (1, parallel; 2, convergent; 3, divergent); relationship between roots (1, separate; 2, fused). The surgical variables were: ostectomy (yes or no); dental sectioning (1, no sectioning; 2, sectioning of the crown; 3, sectioning of the crown and roots; 4, coronoradicular sectioning).

Diagnostic precision was established as the concordance between the observer data and the surgeon's findings during the operation. All the operations were undertaken by oral surgeons with the same level of surgical experience (second or third year residents). The assessors were the surgeons who extracted the mandibular third molar. The results were processed with the Statistical Package for the Social Sciences (SPSS version 12.0; SPSS, Chicago, IL, USA; license of the University of Barcelona). The differences in diagnostic precision between the digital and conventional panoramic radiographs were analysed for each observer using the Mann-Whitney U-test and the Kruskal-Wallis test. Statistical significance was set at $p < 0.05$.

Results

Third lower molars were studied in 287 patients (125 males and 162 females) with a mean age of 27.95 years (standard deviation

9.33). A final sample of 390 lower third molars was included (84 examined with digital panoramic radiographs and 306 with conventional panoramic radiographs).

Table 1 shows the percentage concordance and frequency for all the study variables according to the type of panoramic radiographs used (conventional versus digital). In all cases, percentage concordance was greater when the digital technique was used. The differences between the two techniques only reached statistical significance in the case of the variables root curvature, direction of the roots and surgical technique (Table 2).

On examining the percentage concordance and frequency of each of the observers, a rising trend with growing experience was seen for all variables except the surgical technique, in which the second year resident showed a higher concordance rate than the third year resident. In all other cases, the first year resident was the observer with the least percentage concordance, while the experienced oral surgeon showed the greatest concordance (Table 3).

To determine which variables proved significant according to the type of observer involved, comparisons were made between each pair of observers. On contrasting these differences (Table 4), the association was seen to be statistically significant for all comparisons between the different observers in relation to all variables except the number of roots.

Discussion

A statistically significant relationship was observed between the experience of the

Table 2. Statistical contrast data^a for the type of panoramic radiograph technique.

	Number of roots	Root curvature	Direction of roots	Relationship between roots	Surgical technique
Mann-Whitney U-test	292926	285960	283614	301476	260760
Z	-1.852	-2.506	-2.923	-0.664	-6.298
Asymptotic signif.	0.064	0.012	0.003	0.507	0.000

^a Grouping variable: type of panoramic radiograph technique.

Table 3. Percentage concordance and frequency according to the observer, in relation to each of the study variables.

Variable	Observer	Frequency	Percentage
Number of roots	Resident 1	328	72
	Resident 2	339	74
	Resident 3	346	76
	Experienced oral surgeon	352	77
Root curvature	Resident 1	252	55
	Resident 2	267	59
	Resident 3	297	65
	Experienced oral surgeon	304	67
Direction of roots	Resident 1	286	63
	Resident 2	313	69
	Resident 3	314	69
	Experienced oral surgeon	332	73
Relationship between roots	Resident 1	321	70
	Resident 2	332	73
	Resident 3	336	74
	Experienced oral surgeon	357	78
Surgical technique	Resident 1	316	69
	Resident 2	348	76
	Resident 3	337	74
	Experienced oral surgeon	367	80

Table 4. Statistical contrast data^{a,b} for the variable 'observer'.

	Number of roots	Root curvature	Direction of roots	Relationship between roots	Surgical technique
χ^2	3.710	16.813	10.912	7.718	15.921
Degrees of freedom (df)	3	3	3	3	3
Asymptotic signif.	0.295	0.001	0.012	0.052	0.001

^a Kruskal–Wallis test.^b Grouping variable: observer.

observer and study variable concordance. This is because the greater experience of the oral surgeon causes presurgical planning to be more precise. The first year resident showed the lowest concordance in relation to surgical technique, and was the observer indicating the greatest need for osteotomy and tooth sectioning during extraction of the impacted molar when conducting the presurgical study. This is due to the lesser experience of first year residents causing them to view the operation as being complicated. They tend to be less conservative and use a more traumatic surgical technique.

The authors have found no studies in the literature that support or contradict their findings in relation to the surgical variables. A comparison could be made between their data relating to the morphological study variables and the results of other authors. In the present study, root curvature was the variable showing the least concordance among all the observers. This may be because the two-dimensional nature of panoramic radiographs makes it difficult to establish the spatial location of the roots precisely.

Regarding the number of roots, Benediktsdottir et al.² reported no statistically significant differences according to the type of panoramic radiographs used, or

the observer (a general dentist and an oral surgeon), when the mandibular third molars presented two or more roots. When the lower molar presented a single root, digital panoramic radiographs proved more precise. In the present study, all the observers showed increased concordance in relation to the number of roots when using the digital technique, regardless of the number of roots involved.

Differences can also be found on examining different modalities of digital panoramic radiographs. In this sense, Benediktsdottir et al.³ found that photographic paper printing and transparent film facilitate the presurgical study compared with on-screen images, though the differences were not statistically significant. In the present study, all the panoramic radiographs were examined printed on paper.

Panoramic radiographs distort the position and morphology of the molar, which may cause a modification of the presurgical study⁷. By obtaining intraoperative impressions, Sant' Ana et al.⁷ demonstrated a mean difference of -5.37° between the true position of the molar and the image on the panoramic radiographs. Despite the degree of distortion, they considered panoramic radiographs to be the complementary radiological tech-

nique best suited for the diagnosis and planning of third molar extraction.

Bell et al.¹ reported statistically significant differences between the preoperative radiological study and the intraoperative findings regarding the anatomy of the third molar. They considered panoramic radiographs to be useful for determining the position, depth and type of molar impaction, but noted that the oral surgeon must be aware of the scant diagnostic precision afforded in terms of the morphology of the third molar.

Not all investigators have reported superior precision of digital panoramic radiographs over the conventional technique. Molander et al.⁵ found the quality of both types of panoramic radiographs to be similar for most purposes, though they considered the digital images to be poorer than the conventional images, and noted that improvements in image quality are needed.

The low radiation dose associated with digital versus conventional panoramic radiographs is one of the advantages of the digital technique. The possibility that such a reduction in radiation dose can impair the quality of the images is the subject of controversy. Da Nnewitz et al.⁴ reported that panoramic radiographs obtained at a lower milliamperage dose yielded poorer quality images, with no

statistically significant differences versus standard panoramic radiographs.

In conclusion, the two systems evaluated in this study allow adequate presurgical evaluation of impacted mandibular third molars. Digital panoramic radiographs offer greater diagnostic precision than conventional panoramic radiographs. The experience of the oral surgeon is a significant factor when planning a strategy for the surgical removal of impacted lower third molars.

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Competing interests

None declared.

Ethical approval

Not required.

References

1. BELL GW, RODGERS JM, GRIME RJ, EDWARDS KL, HAHN MR, DORMAN ML, KEEN WD. The accuracy of dental panoramic tomographs in determining the root morphology of mandibular third molar teeth before surgery. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod* 2003; **95**: 119–125.
2. BENEDIKTSÐÓTTIR IS, HINTZE H, PETERSEN JK, WENZEL A. Accuracy of digital and film panoramic radiographs for assessment of positions and morphology of mandibular third molars and prevalence of dental anomalies and pathologies. *Dentomaxillofac Radiol* 2003; **32**: 109–115.
3. BENEDIKTSÐÓTTIR IS, WENZEL A. Accuracy of digital panoramic images displayed on monitor, glossy paper, and film for assessment of mandibular third molars. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod* 2004; **98**: 217–222.
4. DA NNEWITZ B, HASSFELD S, EICKHOLZ P, MÜHLING J. Effect of dose reduction in digital dental panoramic radiography on image quality. *Dentomaxillofac Radiol* 2002; **31**: 50–55.
5. MOLANDER B, GRÖNDAHL H-G, EKES-TUBBE A. Quality of film-based and digital panoramic radiography. *Dentomaxillofac Radiol* 2004; **33**: 32–36.
6. RUSHTON VE, HORNER K, WORTHINGTON HV. Screening panoramic radiology of adults in general dental practice: radiological findings. *Br Dent J* 2001; **190**: 495–501.
7. SANT'ANA LF, GIGLIO FP, FERREIRA Jr O, SANT'ANA E, CAPELOZZA AL. Clinical evaluation of the effects of radiographic distortion on the position and classification of mandibular third molars. *Dentomaxillofac Radiol* 2005; **34**: 96–101.

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