

Incidental Findings of Pathology and Abnormality in Pretreatment Orthodontic Panoramic Radiographs

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Abstract: Panoramic radiographs, in combination with a clinical examination, are routinely used as an aid to orthodontic diagnosis and treatment planning. The aim of this study was to evaluate the prevalence and location of incidental findings of pathology and abnormalities in pretreatment orthodontic panoramic radiographs. A total of 496 patients (232 girls and 264 boys; mean age 11.2 years, SD 2.33) were randomly selected from the Orthodontic Clinic at the Faculty of Odontology, University of Malmö, Sweden. All radiographic examinations were performed between 1999 and 2003 at the Department of Oral Radiology, Faculty of Odontology, University of Malmö, Sweden. Two independent examiners analyzed the radiographs for abnormalities and diagnoses of pathology. However, caries and findings related to the orthodontic treatment plan, such as eruption disturbances and missing or supernumerary teeth, were not recorded. All radiographs with positive findings were reexamined by a third examiner, a specialist registrar in oral radiology. A total of 56 findings in 43 patients (8.7%) were recorded, and significantly more findings were detected in girls ($P = .007$). The most common findings were radiopacities (idiopathic sclerosis) in alveolar bone ($n = 22$), thickening of mucosal lining in sinus maxillaris ($n = 15$), and periapical inflammatory lesions ($n = 10$). The majority of the periapical lesions and radiopacities were found in the mandible. In most cases, the findings had no consequence for the orthodontic treatment plan and did not require medical or odontological management. However, the clinician should be aware of the potential to detect pathology and abnormality in pretreatment orthodontic panoramic radiographs. (*Angle Orthod* 2006;76:98–102.)

Key Words: Orthodontics; Pretreatment panoramic radiographs; Pathology; Abnormality

INTRODUCTION

Radiographs are routinely included in the diagnostic battery for orthodontic treatment planning.^{1,2} It has been reported that more than 90% of orthodontists order lateral head radiographs and panoramic radiographs for their patients³ and that panoramic radiographs are the most commonly requested radiographic

examination.⁴ The lateral head radiograph provides quantitative data concerning the dentofacial hard and soft tissue morphology and its contribution to malocclusion.

On the other hand, panoramic radiographs are primarily used to detect missing and supernumerary teeth and to evaluate the eruption pattern and malposition of teeth. The panoramic radiograph is also an instrument for detection of hard and soft tissue pathology.^{5–9} The expected frequency with which an orthodontist can make incidental findings of pathology or abnormality in an orthodontic patient is of special interest to the clinician because in many cases such findings may require medical or odontological management.

Very few studies have analyzed the prevalence of different pathologic or abnormal findings in radiographs ordered primarily for orthodontic purposes.⁹ No study has separately evaluated the prevalence of pathologic and abnormal findings in panoramic radiographs in children or adolescents for whom orthodontic treatment is planned. Thus, the objective of this

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TABLE 1. Radiographic Criteria Used for Recording of Pathology/Abnormalities (Modified From White and Pharoah¹¹)

Location	Finding	Criteria
Tooth/Tooth associated	Altered morphology	Radiographically unusual shape or size of the tooth.
	Dentigerous cyst	Radiolucent zone of more than 3 mm with well-defined borders around the crown of an unerupted tooth, epicenter just above the crown, and the cyst attaches at the cemento-enamel junction.
	Periapical inflammatory lesion	Radiolucent or radiopaque change in association with a tooth apex with radiographically interrupted lamina dura.
	Marginal bone loss	Distance between the cemento-enamel junction and the alveolar bone crest larger than 2 mm.
Alveolar bone	Cyst	Centrally located radiolucency within the bone, round or oval, and with well-defined borders and corticated thin radiopaque line.
	Idiopathic osteosclerosis	Radiopaque change, ie, dense trabeculae calcifications with well- or ill-defined borders in the surrounding bone.
Sinuses	Thickening of mucosal lining	Density along the sinus floor or generalized density of the maxillary sinus or cystic (oval, well defined) density in any area of the sinus.

study was to evaluate the prevalence and location of incidental findings of pathology and abnormality in pretreatment orthodontic panoramic radiographs.

MATERIALS AND METHODS

The subjects of the study were 496 randomly selected patients, comprising 232 girls and 264 boys, with a mean age of 11.2 years (SD 2.33). The patients were selected from the Orthodontic Clinic at the Faculty of Odontology, University of Malmö, Sweden, and the investigation included one pretreatment panoramic radiograph from each patient. None of the patients had a known systemic disease, syndrome, or developmental defect. All panoramic radiography was performed between 1999 and 2003 at the Department of Oral Radiology, Faculty of Odontology, University of Malmö, Sweden. The X-ray unit used until the year 2000 was Ortophos CD (Siemens, Bensheim, Germany), using voltage setting 60 kV at 9 or 10 mA (exposure time 14.1 seconds). From 2001 onwards, Cranex 3+ Ceph (Soredex Co, Helsinki, Finland) was used with voltage setting 65 or 67 kV at 6 mA (exposure time 16 or 19 seconds). The screen/film combination used was Lanex medium/T-mat G (Eastman Kodak Co, Rochester, NY). The films were processed in an automatic processor (Curix HT-330U, AGFA, Mortsels, Belgium) with a developing time of two minutes.

The radiographs were table mounted, suitably masked, and studied under standardized conditions using Mattsson's binoculars¹⁰ with a 2× magnification. Radiographs were evaluated from not more than 30 patients at a time to minimize the risk of doubtful assessments caused by fatigue.

Two independent observers (Drs Jeppsson and Lindh-Ingildsen) analyzed the radiographs systematically according to White and Pharoah¹¹ and recorded the detected findings according to predefined criteria listed in Table 1. Findings such as caries, missing/supernumerary teeth, and eruption disturbances were not recorded. Interobserver conflicts were resolved by discussion of each radiograph to reach a consensus. In a second step, all radiographs with findings of pathology or abnormality were reexamined by a specialist registrar in oral radiology. From a set of 38 radiographs, agreement percentages and kappa indices for inter- and intraexaminer variations were calculated.¹²

The chi-square test was performed to determine the statistical significance of differences in prevalence of findings between the sexes.

RESULTS

Reliability

The intraexaminer agreement for the two observers for detecting pathologic and abnormal findings was 100% (kappa 1.00) and 94.7% (kappa 0.72), respectively. The overall interexaminer agreement was 87%, corresponding to a kappa index of 0.64. After a consensus with the third observer, 13 positive findings were assessed as artifacts or normal variations and excluded.

Pathologic and abnormal findings

Of the 496 radiographs examined, findings were reported for 43 patients (8.7%), and a total of 56 findings were detected. The radiographs of 33 patients had

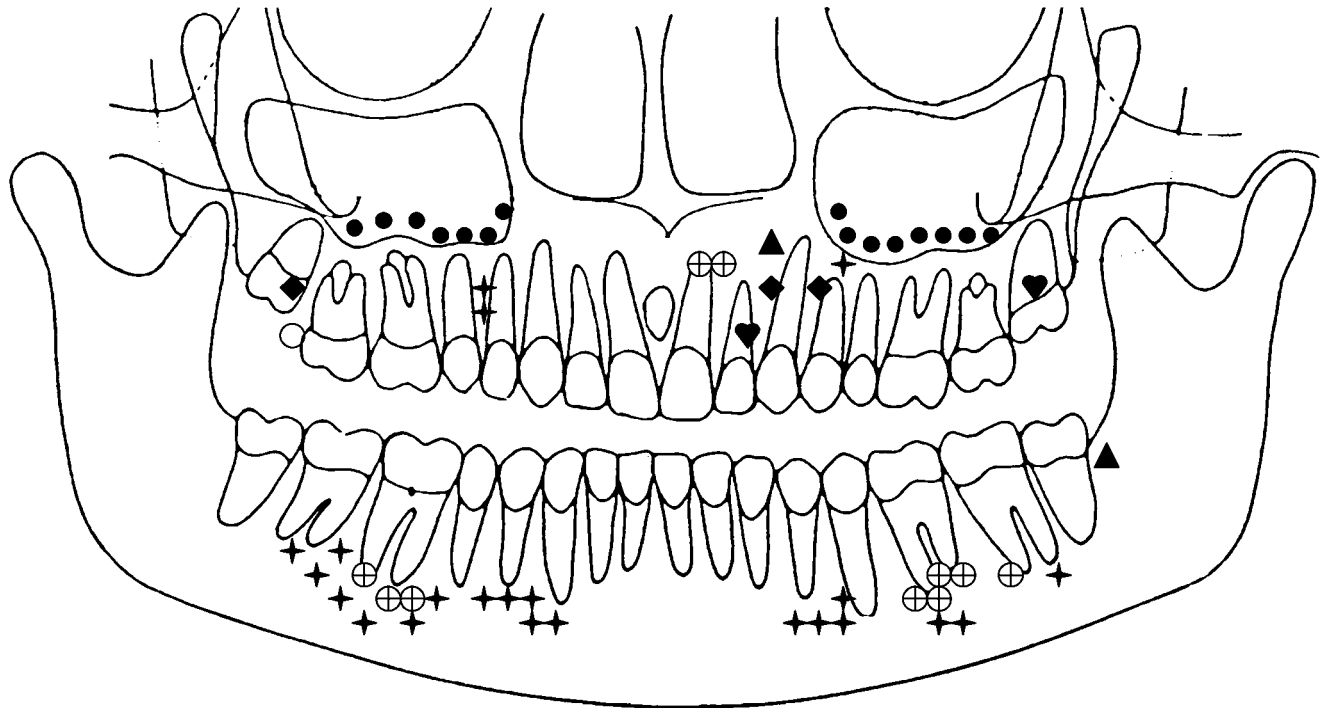


FIGURE 1. The anatomic location for pathologic and abnormal findings (N = 55). Interdental bone loss is excluded (N = 1).

TABLE 2. Numbers and Percentages of Findings for Boys, Girls, and All Patients

Findings	Boys	Girls	Total
Radiopacities	7 (12.4%)	15 (26.8%)	22 (39.2%)
Thickening of mucosal lining in sinus	6 (10.7%)	9 (16.1%)	15 (26.8%)
Periapical inflammatory lesion	3 (5.3%)	7 (12.6%)	10 (17.9%)
Dentigerous cyst	0 (—)	3 (5.3%)	3 (5.3%)
Cyst within alveolar bone	1 (1.8%)	1 (1.8%)	2 (3.6%)
Odontoma	2 (3.6%)	0 (—)	2 (3.6%)
Altered tooth morphology	1 (1.8%)	0 (—)	1 (1.8%)
Marginal bone loss	0 (—)	1 (1.8%)	1 (1.8%)
Total	20 (35.6%)	36 (64.4%)	56 (100%)

one finding, seven patients two findings, and three patients three findings. Figure 1 summarizes the anatomic locations of the findings. Numbers and percentages of findings for boys, girls, and all patients are shown in Table 2. It can be noted that 64.4% of the findings were detected in girls and 35.6% in boys ($P = .007$).

The most common findings were radiopacities in the alveolar bone (4.4%), mostly diagnosed as idiopathic sclerosis (Figure 2); thickening of mucosal lining in sinus maxillaris (3.0%); and periapical inflammatory lesions (2.0%). The prevalence of dentigerous cysts was 0.6%, and for cysts within alveolar bone and odontomas, 0.4% respectively. Altered tooth morphology was found in 0.2% and marginal bone loss in 0.2% of patients.

The majority of the radiopacities (19 of 22) and periapical inflammatory lesions (8 of 10) were found in the

mandible. No significant difference between the left and the right side of the jaws was found (Figure 1).

DISCUSSION

The kappa indices for inter- and intraexaminer variables were in the range of acceptable to very good, and thus, indicated that the results are reliable. Moreover, efforts were made to minimize the number of false-positive findings by reassessment of all findings by an observer experienced in oral radiology. Because the criteria for recording of radiographic findings were predefined, this was also considered a strength in respect to reproducibility. However, it can be pointed out that the detection of pathology and abnormalities was made from radiographs only, and therefore, burdened with the uncertainty that comes with all radiographic assessments made without clinical examinations.



FIGURE 2. Below the mesial root apex of the first right permanent molar is an incidental finding diagnosed as an idiopathic osteosclerosis.

The patient material in this study was considered representative of a general population of orthodontic patients. The main result of this study was that almost every 10th patient about to undergo orthodontic treatment showed pathology or abnormal findings on routine orthodontic panoramic radiographs. The frequency of findings demonstrated that it is important for the clinician or the orthodontist to carefully analyze the panoramic radiographs not only from an orthodontic perspective, but also for incidental findings of pathology or abnormality, or both.

The most common findings reported were radiopacities in alveolar bone, thickening of the mucosal linings in the maxillary sinus, and periapical inflammatory lesions. Of these findings, the periapical lesions require odontological management. Thickening of mucosal lining in the maxillary sinus is frequently regarded as nonpathologic even if it in some cases can be associated with symptoms. A majority of the radiopacities was diagnosed as idiopathic osteosclerosis, ie, asymptomatic, uniformly radiopaque foci of dense bone, usually with distinct outlines, that are apparently not the sequelae of infection or systemic disease.¹³ It has also been claimed that many radiopacities described as idiopathic sclerosis may be developmental variations of normal bony architecture, unrelated to lo-

cal stimuli, which can arise at any age and at any location in the jaws.¹³

Thus, in most cases, our findings would not require medical or odontological management. However, in 18 of 56 cases, the findings (32.1%), ie, the periapical inflammatory lesions, the cysts within alveolar bone, the dentigerous cysts, the interdental marginal bone loss, and the odontomas, usually require odontological management regardless of orthodontic treatment.

A significantly higher prevalence of findings for girls was found, but the reason is not known, and this result has not been reported before. Overall, it has been difficult to compare the results of this study with previous studies because of differences in the selection of patients and because no previous study has primarily focused on incidental findings of pathology and abnormality in panoramic radiographs of orthodontic patients. Despite this, limited comparisons can be permitted. Interestingly, Kuhlberg and Norton⁹ found that 6% of orthodontic patients had significant findings in radiographic examinations, ranging from a lateral head radiograph and a panoramic radiograph to a full-mouth series (periapicals and bitewings). Thus, a nearly similar prevalence was found, as in this study. In two other studies,^{8,13} the prevalence and localization of idiopathic osteosclerosis were studied. In the year-group 10 to 19, a prevalence of 5% idiopathic osteosclerosis was found in panoramic radiographs and computed tomographs,⁸ and Geist and Katz¹³ found 5.4% prevalence in periapical films that adequately showed the tooth-bearing areas of both jaws. The percentages of sclerosis found in these studies were somewhat higher than the percentages found in this study (3.8%). However, the most common location of the idiopathic osteosclerosis, the premolar region of the mandible, was in accordance with this study. Regarding the prevalence of changes in the maxillary sinuses, Peltola⁶ reported 16% in 392 individuals aged between 14 and 17, which was much higher than that found in this study (3.0%).

The panoramic radiographs have well-known limitations in detecting caries, and therefore, such findings were not recorded in this study. Moreover, the aim of this study was to assess panoramic radiographs for findings of pathology and abnormality, and thus, not expected findings related to the orthodontic treatment plan such as eruption disturbances, missing and supernumerary teeth. Naturally, these findings would have been overrepresented in a material selected from an orthodontic clinic.

A higher prevalence of radiopacities and periapical inflammatory lesions was found in the mandible than in the maxilla. This might partly be explained by the fact that when panoramic radiographs are examined and assessed, there are fewer problems with super-

imposition of anatomic structures in the mandible than in the maxilla.

With the intention to reduce the exposure to ionization radiation, most of the panoramic radiographs did not depict the temporomandibular joint, and therefore it was not possible to assess the prevalence of findings of pathology and abnormality in this region.

The exposure to ionizing radiation when making a panoramic radiographic examination is fairly low and considered equivalent to an exposure of approximately four periapical intraoral films. The risk from the radiation dosages that a patient receives is reported to be small.¹⁴

Nevertheless, because some risk is involved, it is important to obtain the maximum amount of diagnostic information from each radiograph. On the basis of the relatively low probability that orthodontic panoramic radiographs may reveal unsuspected pathology, panoramic radiographs should of course not be ordered for screening purposes.

CONCLUSIONS

The clinician should be aware of the potential to detect pathology and abnormality in pretreatment orthodontic panoramic radiographs because:

- 8.7% of patients about to undergo orthodontic treatment show findings of pathology or abnormality.
- The most common findings were radiopacities in alveolar bone diagnosed as idiopathic osteosclerosis, thickening of mucosal lining in maxillary sinuses, and periapical inflammatory lesions.
- Thickening of mucosal lining in maxillary sinuses and idiopathic osteosclerosis are frequently regarded as nonpathologic; however, 32.1% of the findings, ie, periapical inflammatory lesions, the cysts within alveolar bone, dentigerous cysts, marginal bone loss, and odontomas, require odontological management regardless of orthodontic treatment.

REFERENCES

1. Nolan PJ, West KS, Lovett CR. The clinical examination. In: McNamara JA Jr, Burdon WL, eds. *Orthodontics and Dentofacial Orthopedics*. Ann Arbor, Mich: Needham Press Inc; 2001:13–30.
2. Proffit WR, Ackerman JL. *Contemporary Orthodontics*. St Louis, Mo: Mosby Yearbook; 1993:160–162.
3. Atchison K. Radiographic examinations of orthodontic educators and practitioners. *J Dent Educ*. 1986;50:651–655.
4. Bruks A, Enberg K, Nordqvist I, Stöckel Hansson A, Jansson L, Svensson B. Radiographic examinations as an aid to orthodontic diagnosis and treatment planning. *Swed Dent J*. 1999;23:77–85.
5. Ignelzi MA, Fields HW, Vann WF. Screening panoramic radiographs in children: prevalence data and implications. *Pediatr Dent*. 1989;11:279–285.
6. Peltola JS. A panoramatomographic study of the teeth and jaws of Finnish university students. *Community Dent Oral Epidemiol*. 1993;21:36–39.
7. Peltola JS, Wolf J, Mannik A, Russak S, Seedre T, Sirkel M, Vink M. Radiographic findings in the teeth and jaws of 14- to 17-year-old Estonian schoolchildren in Tartu and Tallinn. *Acta Odontol Scand*. 1997;55:31–35.
8. Yonetsu K, Yuasa K, Kanda S. Idiopathic osteosclerosis of the jaws: panoramic radiographic and computed tomographic findings. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod*. 1997;83:517–521.
9. Kuhlberg A, Norton L. Pathologic findings in orthodontic radiographic images. *Am J Orthod Dentofacial Orthop*. 2003;123:182–184.
10. Mattsson OA. Magnifying viewer for photofluorography films. *Acta Radiol*. 1953;39:412–413.
11. White SC, Pharoah MJ. *Oral Radiology. Principles and Interpretation*. 5th ed. St Louis, Mo: Mosby Inc; 2004:191–209.
12. Fleiss CL, Cohen E. Large sample standard errors of kappa and weighted kappa. *Psychol Bull*. 1969;72:323–327.
13. Geist JR, Katz JO. The frequency and distribution of idiopathic osteosclerosis. *Oral Surg Oral Med Oral Pathol*. 1990;69:388–393.
14. Freeman JP, Brand JW. Radiation doses of commonly used dental radiographic surveys. *Oral Surg Oral Med Oral Pathol*. 1994;77:285–289.