



ISSN: 0976-3376

Available Online at <http://www.journalajst.com>

ASIAN JOURNAL OF  
SCIENCE AND TECHNOLOGY

Asian Journal of Science and Technology  
Vol. 6, Issue 06, pp. 1539-1543, June, 2015

## RESEARCH ARTICLE

# INCIDENTAL FINDINGS ON PANORAMIC RADIOGRAPHS FOR PRE-EXTRACTION ASSESSMENT OF THIRD MOLARS

<sup>1,\*</sup>Fatima M. Jadu and <sup>2</sup>Ahmed M. Jan

<sup>1</sup>Department of Oral Diagnostic Sciences, Division of Oral and Maxillofacial Radiology, King Abdulaziz University, P.O. Box 80200, Jeddah 21589, Saudi Arabia

<sup>2</sup>Department of Oral and Maxillofacial Surgery, King Abdulaziz University, P.O. Box 80200, Jeddah 21589, Saudi Arabia

### ARTICLE INFO

#### Article History:

Received 28<sup>th</sup> March, 2015  
Received in revised form  
03<sup>rd</sup> April, 2015  
Accepted 19<sup>th</sup> May, 2015  
Published online 29<sup>th</sup> June, 2015

#### Key words:

Panoramic Radiograph,  
OPG,  
Incidental findings,  
Panoramic image

### ABSTRACT

**Introduction:** Panoramic radiographs are complex tomographic images that are often used to examine third molars prior to their extraction. Because of the relatively large area covered by panoramic radiographs, incidental findings are common.

**Objectives:** The aim of this study was to report the frequency and nature of incidental findings in panoramic radiographs made specifically for pre-extraction assessment of the third molars.

**Materials and Methods:** The cross sectional study included a total of 121 panoramic radiographs from the university-based practice of a single oral and maxillofacial surgeon over a three-month time period, from January 1<sup>st</sup> to April 1<sup>st</sup> of 2015. Data were collected from the imaging reports generated for these radiographs. The imaging reports were prepared by a board-certified specialist in oral and maxillofacial radiology.

**Results:** Every other panoramic radiograph had incidental findings. The findings spanned a number of structures and disease categories but the most common was styloid process elongation or calcification of the stylohyoid ligament. Most findings were indolent, however, some required further investigation.

**Conclusions:** Incidental findings on panoramic radiographs are common. Most findings were considered variations of normal, while others required immediate attention. Analyzing panoramic radiographs in a systematic fashion ensures that all incidental findings are recorded and addressed accordingly.

Copyright © 2015 Fatima M. Jadu and Ahmed M. Jan. This is an open access article distributed under the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

## INTRODUCTION

Panoramic radiographs are two-dimensional complex tomographic images of the jaws and dentition. They provide a general overview of both jaws and their dentition in addition to surrounding structures, such as the temporomandibular joints, cervical vertebrae, and the inferior portion of the orbital cavity. They utilize relatively low doses of radiation [approximately 20  $\mu$ Sv] compared to a full mouth series [approximately 171  $\mu$ Sv] as per the American National Standards Institute [using F speed film and round collimation]. (Ludlow *et al.*, 2008) Unfortunately, panoramic radiographs are inherently low-resolution images that are unsuitable for examining details or detecting carious lesions.

\*Corresponding author: Fatima M. Jadu,

Department of Oral Diagnostic Sciences, Division of Oral and Maxillofacial Radiology, King Abdulaziz University, P.O. Box 80200, Jeddah 21589, Saudi Arabia

General dentists and dental specialists frequently prescribe panoramic radiographs for a multitude of purposes. These purposes include but are not limited to examining the developing dentition, third molars, and pathological conditions. When used to assess the third molars, panoramic radiographs provide useful information, such as depth and angulation of impaction, in addition to the relationship to adjacent structures. However, the interpretation of panoramic radiographs is commonly described by many as challenging and difficult, which is due to the complexity of these images, overlapping structures, distortion [unequal magnification] and ghost images that cannot be completely eliminated. Incidental findings that are not related to the reason the images were requested for are noted in panoramic radiographs because of the large area covered by these images. Identification and reporting of such findings is of paramount importance because they may necessitate medical and/or dental intervention (Bondemark *et al.*, 2006). The aim of this study was to report the frequency and nature of incidental findings identified in

panoramic images obtained specifically to examine the third molars before extraction. We also commented on the significance of the incidental findings to emphasize the importance of using a systematic approach to the interpretation of panoramic radiographs.

## MATERIALS AND METHODS

Data collection commenced in April 2014 after ethical approval from the Research Ethics Board at the Faculty of Dentistry, King Abdulaziz University was obtained for this cross sectional chart review study. Data were extracted from radiographic reports of 121 panoramic images requested by a single oral and maxillofacial surgeon over a three month time period extending from January 1<sup>st</sup>, 2014 to April 1<sup>st</sup>, 2014. All panoramic images were requested for assessment of the third molars prior to extraction, and all radiographic reports were prepared by a board certified specialist in oral and maxillofacial radiology. The panoramic radiographs were acquired digitally using one of the two panoramic machines available at the Faculty, the Care stream 8000 digital panoramic imaging system and the Care stream 8000C digital panoramic and cephalometric system [Care stream Dental, Atlanta, GA, USA]. Standard exposure factors, as recommended by the manufacture, were used. The radiographs were then viewed on one of the many available workstations at the faculty using a Dell E1709W widescreen flat panel monitor [Dell Inc., Round Rock, TX, USA]. An imaging report was generated and saved in PDF format.

The data collected included basic demographics, such as subject's age and gender, in addition to all of the incidental findings. Incidental findings in this study were defined as any finding that was not related to the patient's chief complaint and/or the indication for which the panoramic radiograph was requested. Such findings as caries and periodontal bone loss were not recorded. Panoramic radiographs with positioning or magnification errors were excluded. Simple descriptive statistics in the form of counts and percentages, mean, range and variations were calculated using SPSS version 22.0 [Statistical Package, Chicago, IL]. Furthermore, to establish the relationship between demographics and incidental findings, the Chi-Square test was used for gender and the t-test for age. A  $p$ -value  $<0.05$  was used to reject the null hypothesis.

## RESULTS

The age of our subjects ranged from 14 to 77 years with a mean of 36.5 years. Gender distribution was equal with 50.4% males and 49.6% females. No statistically significant difference in the frequency of incidental findings was found relative to age [ $p = 0.156$ ] or gender [ $p = 0.117$ ]. Incidental findings were found in approximately half of the panoramic radiographs [65, 53.7%], and of those only 19 [29%] were thought to need further investigation. The frequencies of the incidental findings are summarized in Table 1. The most common incidental finding was elongation of the styloid process or calcification of the stylohyoid ligament (Figure 1). It was also noted that bilateral elongation or calcification was more common than unilateral affection. The second most common incidental finding was dense bone island [DBI]. Ten panoramic radiographs were reported to have some form of

soft tissue calcification, such as vascular calcifications, tonsillolith, sialolith, or phlebolith. Interestingly, two of the panoramic radiographs that demonstrated vascular calcifications also demonstrated another form of soft tissue calcification [either tonsillolith or sialolith]. Retention pseudo cysts were identified in eight images, one of which had two pseudo cysts bilaterally. Within the maxillary sinuses, other incidental findings included: opacification of the sinus, mucosal thickening, and a missing cortical boundary. Incidental pathologies ranged from apical scars to a bone pattern query for multiple myeloma. Dental anomalies included a supernumerary tooth, microdontia, root dilacerations, enamel pearl and external root resorption. Seven imaging reports listed two incidental findings, five of which listed styloid process elongation or stylohyoid ligament calcification with another incidental finding.

## DISCUSSION

Panoramic radiographs are the most commonly prescribed imaging examination.(2) At our institution, it is routinely performed for third molar extraction treatment planning. The frequency of incidental findings in this study indicates that approximately every other panoramic image for the assessment of third molars will have an incidental finding. This fact highlights the importance of carefully and systematically analyzing panoramic images for incidental findings. Styloid process elongation or calcification of the stylohyoid ligament was the most common incidental finding. This finding is common among many populations, including the Saudi population, as has been documented in many studies (Sudhakara Reddy *et al.*, 2013; Shaik *et al.*, 2013; Alpoz *et al.*, 2014). Most patients are asymptomatic, although the condition may be symptomatic in 1%-5% of cases (Khandelwal *et al.*, 2011). The symptomatic form of this condition is termed Eagle's syndrome and was first documented by Dr. Eagle in 1948 when he correlated symptoms of pain on swallowing or turning the neck with elongation of the styloid process or calcification of the stylohyoid ligament (Eagle, 1948).

Studies that examined the prevalence of this finding in panoramic radiographs, reported a prevalence that ranged between 29% and 64%, which is even higher than the one reported by the this study (Alpoz *et al.*, 2014; Mandian and Tadinada, 2014; Roopashri *et al.*, 2012). While unilateral involvement was more common in the current study, bilateral involvement was reported at a rate of 55% in cases with Eagle's syndrome (Khandelwal *et al.*, 2011). It seems plausible that with bilateral involvement, the likelihood of developing symptoms increases. It would be interesting to follow patients with unilateral involvement prospectively to monitor if they eventually develop bilateral involvement. The second most common incidental finding was dense bone island [DBI], also known as enostosis or idiopathic osteosclerosis (Pharoah *et al.*, 2013). It is a hamartoma that usually presents as a relatively well-defined area of dense bone (Pharoah *et al.*, 2013; Ramesh and Ganguly, 2010). It may vary in shape and size but it is asymptomatic, pathognomonic radiographically and should not be biopsied because it lacks an adequate blood supply to granulate (Ramesh and Ganguly, 2010). In panoramic radiographs prepared for orthodontic purposes, it is reported as the most common incidental finding (Bondemark *et al.*, 2006). 2013

**Table 1. Summary and frequency of the incidental findings reported for panoramic radiographs.**

Incidental finding	Number of radiographs	Percentage of radiographs
Styloid process elongation or stylohyoid ligament calcification	29	24%
• Unilateral [18, 62.1%]		
• Bilateral [11, 37.9%]		
Dense bone island	13	10.7%
Soft tissue calcification	10	8.2%
• Vascular calcification [5, 50.0%]		
• Tonsillolith [2, 20.0%]		
• Sialolith [2, 20.0%]		
• Phlebolith [1, 10.0%]		
Maxillary sinus findings		
• Retention pseudocyst [8, 61.5%]	13	10.7%
• Sinus opacification [3, 23.0%]		
• Mucosal thickening [1, 7.7%]		
• Missing cortical boundary [1, 7.7%]		
Pathology	7	
• Apical scar [2, 28.6%]		5.8%
• Radicular cyst [1, 14.3%]		
• Residual cyst [1, 14.3%]		
• Periapical cemento-osseous dysplasia [1, 14.3%]		
• Bone pattern query of multiple myeloma [2, 28.6%]		
Foreign objects	4	3.3%
Dental anomalies		
• Supernumerary [1, 20%]	5	4.1%
• Microdontia [1, 20%]		
• Root dilaceration [1, 20%]		
• Enamel pearl [1, 20%]		
• External root resorption [1, 20%]		
Temporomandibular joints	2	1.7%
• Degenerative joint disease [1, 50%]		
• Cystic lesion [1, 50%]		

**Figure 1. Panoramic radiograph showing calcification of the left stylohyoid ligament (arrow)****Figure 2. Panoramic radiograph demonstrating calcifications in the right carotid artery (large arrow) and a left submandibular sialolith (thin arrow)**

The most common soft tissue calcification identified in this study was vascular calcification. Although vascular calcifications can potentially affect any artery, on panoramic images, they are usually encountered in the carotid arteries, especially at the furcation area at the level of cervical vertebrae 3 and 4 (Mandian and Tadinada, 2014). Several studies have examined the efficacy of panoramic images at detecting carotid artery calcification and have found the sensitivity and specificity to be poor to moderate (Mandian and Tadinada, 2014). The authors believe that the same sensitivity and specificity findings can be extended to other forms of soft tissue calcifications in panoramic images. The important question, however, is whether a patient with incidental carotid calcifications is at greater risk of cardiovascular or cerebrovascular incidents and should be referred for further investigation. The answer to that question remains controversial but the overwhelming majority believes that it is necessary to refer for further investigation (Friedlander, 2007; Griniatsos *et al.*, 2009; Pornprasertsuk-Damrongsri and Thanakun, 2006; Ohba *et al.*, 2003; Ertas and Sisman, 2011).

Tonsilloliths, like vascular calcifications, are more often than not asymptomatic and are discovered only incidentally. Their significance, however, is not comparable to vascular calcification, and they often do not require any further investigation. Sialoliths, on the other hand, are a different situation because they often present in symptomatic patients and this is well documented in many publications, including a recent one by Jadu and Lam in 2014 (Jadu, 2014). Finally, phleboliths are a form of vascular calcification found in veins, venules, or the sinusoidal vessels of hemangiomas. (10) Phleboliths are often associated with hemangiomas and definitely require further investigation to confirm the presence, location, and extent of the hemangiomas (Pharoah *et al.*, 2013).

In a similar study that examined incidental findings in 496 panoramic images made for orthodontic purposes, among the more common incidental findings were mucosal thickening and retention pseudocysts in the maxillary sinuses. (2) Mucosal thickening is a sign of inflammation of the sinus mucosa that is often observed in asymptomatic patients (Mallya, 2013). Similarly, retention pseudocysts are usually asymptomatic and self-limiting, requiring no further investigation or management (Mallya, 2013). The other two incidental findings reported in relation to the maxillary sinuses in the current study required immediate attention. Both sinus opacification and lack of a sinus cortical boundary may be signs of a malignant tumor and require further investigation and advanced imaging of the sinuses. Not surprisingly, periapical inflammatory lesions were among the more commonly reported incidental findings. This category includes radicular cysts, residual cysts, and apical scars. Although some may be easily identified on panoramic radiographs, additional imaging in the form of periapical radiographs is usually recommended to confirm the finding and to establish a baseline for future follow-up. Bone pattern changes are generally difficult to assess because of the diversity of the normal bone patterns. It seems reasonable, however, to use panoramic radiographs as a starting point from which further imaging or additional investigations can be made or requested when there is doubt about bone pattern.

Most dental anomalies are considered rare in their occurrence and this is reflected in the findings of this study. In spite of this, their radiographic features are characteristic and making their identification in radiographs relatively easy. Similarly the detection of foreign bodies is a relatively easy task because of the significantly high density of these objects in radiographs. Panoramic radiographs can be generally used to obtain a broad overview of the temporomandibular joints, to compare the right and left sides and to detect gross osseous changes (Perschbacher, 2013). Unfortunately, they fail to provide information on the glenoid fossa, articular eminence, condylar position, and range of motion (Perschbacher, 2013). It must be emphasized that if the patient is symptomatic then specific imaging of the temporomandibular joints using cone beam computed tomography [CBCT], computed tomography [CT], or magnetic resonance imaging [MRI] must be performed. Additionally, if positive findings are identified in panoramic radiographs, advanced imaging is strongly recommended.

Most of the incidental findings in the current study did not require further investigation or any management. This does not undermine the importance of identifying and reporting all incidental findings. This is best established by reviewing panoramic radiographs in a systematic fashion for this significantly enhances the ability to perceive abnormalities (Pharoah, 2013). Future recommendations would be similar studies but with larger sample sizes to establish the prevalence of incidental findings in panoramic radiographs in the Saudi population. The findings of these studies should be used to direct the educational process to ensure that dental graduates are familiar with the radiographic features of the more common incidental findings.

## REFERENCES

- Alpoz, E., Akar, G.C., Celik, S., Govsa, F. and Lomcali, G. 2014. Prevalence and pattern of stylohyoid chain complex patterns detected by panoramic radiographs among Turkish population. *Surgical and radiologic anatomy*, SRA. 36(1):39-46.
- Bondemark, L., Jeppsson, M., Lindh-Ingildsen, L. and Rangne, K. 2006. Incidental findings of pathology and abnormality in pretreatment orthodontic panoramic radiographs. *The Angle orthodontist*, 76(1):98-102.
- Eagle, W.W. 1948. Elongated styloid process; further observations and a new syndrome. *Archives of otolaryngology*, 47(5):630-40.
- Ertas, E.T. and Sisman, Y. 2011. Detection of incidental carotid artery calcifications during dental examinations: panoramic radiography as an important aid in dentistry. *Oral surgery, oral medicine, oral pathology, oral radiology, and endodontics*, 112(4):e11-7.
- Friedlander, A.H. 2007. Atheromas on panoramic radiographs often denote stenotic lesions and portend adverse vascular events. *Oral surgery, oral medicine, oral pathology, oral radiology, and endodontics*, 104(4):451-2; author reply 2-4.
- Griniatsos, J., Damaskos, S., Tsekouras, N., Klonaris, C. and Georgopoulos, S. 2009. Correlation of calcified carotid plaques detected by panoramic radiograph with risk factors for stroke development. *Oral surgery, oral medicine, oral pathology, oral radiology, and endodontics*, 108(4):600-3.
- Jadu, F.L., EWN. 2014. The mystery of meal time swellings revealed. *Oral Health*, 104(2):33-5.

- Khandelwal, S., Hada, Y.S. and Harsh, A. 2011. Eagle's syndrome - A case report and review of the literature. *The Saudi dental journal*, 23(4):211-5.
- Ludlow, J.B., Davies-Ludlow, L.E. and White, S.C. 2008. Patient risk related to common dental radiographic examinations: the impact of 2007 International Commission on Radiological Protection recommendations regarding dose calculation. *Journal of the American Dental Association*, 139(9):1237-43.
- Mallya, S.L.A. 2013. In: White SC PM, editor. Oral Radiology: Principles and Interpretation. St Louis, Missouri: *Elsevier Mosby*, p. 167-83.
- Mandian, M. and Tadinada, A. 2014. Incidental findings in the neck region of dental implant patients: a comparison between panoramic radiography and CBCT. *Journal of the Massachusetts Dental Society*, 63(2):42-5.
- Ohba, T., Takata, Y., Ansai, T., Morimoto, Y., Tanaka, T. and Kito, S. *et al.* 2003. Evaluation of calcified carotid artery atheromas detected by panoramic radiograph among 80-year-olds. *Oral surgery, oral medicine, oral pathology, oral radiology, and endodontics*, 96(5):647-50.
- Perschbacher S. 2013. In: White SC PM, editor. Oral Radiology: Principles and Interpretation. St Louis, Missouri: *Elsevier Mosby*, p. 473-505.
- Pharoah, M. 2013. In: White SC PM, editor. Oral Radiology: Principles and Interpretation. St Louis, Missouri: Elsevier Mosby, p. 366-404.
- Pharoah, M. 2013. In: White SC PM, editor. Oral Radiology: Principles and Interpretation. St Louis, Missouri: *Elsevier Mosby*, p. 257-69.
- Pornprasertsuk-Damrongsri, S. and Thanakun, S. 2006. Carotid artery calcification detected on panoramic radiographs in a group of Thai population. *Oral surgery, oral medicine, oral pathology, oral radiology, and endodontics*, 101(1):110-5.
- Ramesh, A. and Ganguly, R. 2010. Incidental dental radiographic findings: dense bone islands. *Journal of the Massachusetts Dental Society*, 59(3):48-9.
- Roopashri, G., Vaishali, M.R., David, M.P. and Baig, M. 2012. Evaluation of elongated styloid process on digital panoramic radiographs. *The journal of contemporary dental practice*, 13(5):618-22.
- Shaik, M.A., Naheeda, Kaleem S.M., Wahab A, Hameed S. 2013. Prevalence of elongated styloid process in Saudi population of Aseer region. *European journal of dentistry*, 7(4):449-54.
- Sudhakara Reddy, R., Sai Kiran, C., Sai Madhavi, N., Raghavendra, M.N. and Satish, A. 2013. Prevalence of elongation and calcification patterns of elongated styloid process in south India. *Journal of clinical and experimental dentistry*, 5(1):e30-5.

\*\*\*\*\*