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Idiopathic Osteosclerosis among UiTM Dental Centre Patients: A Retrospective Study

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ABSTRACT

Idiopathic osteosclerosis (IO) represents asymptomatic radiopaque masses within the jaw. IO is commonly found as an incidental finding in panoramic radiographs. The purpose of the present study is to determine the prevalence of IO among Universiti Teknologi MARA (UiTM) Dental Centre patients and to investigate the radiographic parameters of IO located in the maxilla-mandibular region. Panoramic radiographic images of patients attending UiTM Dental Centre from 2016 to 2020 were examined. Parameters such as gender, age, site, shape, size, and association with tooth were evaluated. The data obtained were analysed using SPSS version 27. Pearson chi-square test was used to evaluate the relationship between the parameters. IO was identified in 108 (9.67%) out of 1,117 panoramic radiographic images that were reviewed. There was a slightly higher prevalence of IO in female patients with 58 (53%) over male patients. Most of the radiographically identified IO were located in the posterior mandibular region, constituting 83% of the cases. Pearson chi-square test revealed a significant relationship between size and gender (p-value < 0.05). Significant associations were found between site and gender and association with tooth and foci (p-value < 0.01). The prevalence of IO among UiTM Dental Center patients was observed to be low at 9.67%. There was a higher occurrence of IO in female patients compared to males, and the posterior mandibular region emerged as the most common site where IO was radiographically identified. The accurate radiographic identification of IO is essential for providing a precise diagnosis and formulating an appropriate treatment plan.

Keywords: *Dental implant; idiopathic osteosclerosis; orthodontic treatment; panoramic radiograph; radiopaque mass*

INTRODUCTION

Idiopathic osteosclerosis (IO), previously known as dense bone island, bone eburnation, bone whorl, bone scar, enostosis, and focal periapical osteopetrosis, has radiographic features of focally increased bone density (Sisman *et al.*, 2011). The term idiopathic, occurring due to unknown aetiologies, has excluded this lesion from any inflammatory, dysplastic, neoplastic, or systemic disorder (de Souza Tolentino *et al.*, 2014).

IO is commonly detected incidentally during routine radiographic investigations, especially in the panoramic radiograph. Radiographically, IO is seen as a well-defined radiopacity with diameters ranging from 0.2 mm to 2.0 cm (Sisman *et al.*, 2011). This lesion is also commonly seen in the mandibular premolar region, associated with the root of tooth apex and in between teeth or separate from teeth may be seen (Khurana *et al.*, 2011). As an asymptomatic lesion with a non-expansile nature, IO can be diagnosed radiographically by detailed analysis of the lesion's morphology (de Souza Tolentino *et al.*, 2014).

IO is not pathologically harmful, however, it may hinder dental treatment as reported by previous literature, such as orthodontic treatment and the success of dental implants. There are also reports that IO may cause impaction of teeth, tooth displacement, or root resorption (Oshima *et al.*, 2010). Hence, IO can be considered as one of the differential diagnoses of lesions that show similar features of IO such as well-defined radiopacity, ranging from 0.2 mm to 2.0 cm in diameter, however, diameter may vary.

Thus, the purpose of the present study was to measure the prevalence of IO among patients attending the Universiti Teknologi MARA (UiTM) Dental Centre and the frequency and distribution of IO according to panoramic radiograph findings. The associated variables that were collected were age, gender, site, and association with tooth and foci (either unilocular or multilocular). The awareness of IO is of significant importance for clinicians for reasons such as accurate diagnosis that could prevent unnecessary anxiety and invasive procedures for the patients. Furthermore, IO requires important consideration whereby the dense area might affect treatment strategies such as tooth extraction, orthodontic treatment, and implant placements. Awareness of IO can ultimately improve patient care and contribute to the overall quality of care that is provided.

MATERIALS AND METHODS

A total of 1,117 panoramic radiographs were taken from the Department of Oral and Maxillofacial Radiology, UiTM Dental Centre dated from 2016 to 2020, were randomly selected through a list generated by the Faculty of Dentistry Integrated Dental Records Management System (iDeRMS). Research ethics was approved and granted by the UiTM Research Ethics Committee [Ref. No.: REC/06/2021 (UG/MR/581)]. All the panoramic radiographs were observed for the presence and evaluation of IO by two inter-examiners. These radiographs were digitally captured using the two types of orthopantomogram machine with the brand Model of Instrumentarium (OP200 and OP300) (Instrumentarium Dental, Finland) and Carestream (CS9000 and CS 9300) (Carestream Health, New York, USA), respectively. The software that was used to view the radiographic image was Cliniview and Dental Imaging Software (Danaher Corporation, USA). All the digital radiographic images were viewed under normal room lighting.

Inter-examiner calibration was done to reduce variability during data collection by the examiner and to prevent data error in the present study. Two examiners had viewed the orthopantomogram (OPG) separately. Then, data were collected in a structured datasheet. Comparisons were made among the examiners. In the case of disagreement

and doubtful findings, examiners were consulted for data confirmation and validation. Due to the irregularities of the shape of the IO, the measurement of the IO lesion was done using the calibrated ruler from the radiograph viewer software Cliniview and Dental Imaging Software (Danaher Corporation, USA) and the measurement orientation with the greatest diameter value was taken.

The inclusion criteria of the panoramic radiographs for the present study include those that captured the image of the entire maxilla and mandible including the structure of condyles. In addition, the radiographic images should have no distortion, no asymmetry, and no error that is due to inadequate patient positioning.

The IO criteria for the examiners to use in reviewing the panoramic radiograph were based on the recommendation provided by Sisman *et al.* (2011). The panoramic radiograph that presented with a radiopaque lesion can be classified as follows:

1. Interradicular, if the sclerotic area was confined between roots and interrelated with the adjacent teeth lamina dura.
2. Interradicular and separate, if the sclerotic area was confined between the roots and not interrelated with the adjacent teeth lamina dura.
3. Apical and interradicular, if the radiopacities were at the apices and showed significant extension between the roots.
4. Apical, if the lesion were located around the apices of the roots.
5. Separate, if the masses were located apically and separated from teeth and lamina dura.

Panoramic radiographs that had a questionable IO and met the following criteria were excluded from the present study:

1. Radiopacities which were directly related to teeth with large restoration or deep caries.
2. Patients with diseases associated with metabolic bone disorder.
3. Characteristics associated with complex lesions such as periapical cemental dysplasia, odontoma, and fibrous-osseous lesions.
4. Remaining roots of primary or permanent teeth in the jaw which are clearly distinguishable.
5. Thickening of lamina dura.
6. Radiopacities related to salivary gland stones, exostoses, lymph node calcification, and tonsillitis (according to radiographic of the lesion).
7. Radiopacities around malpositioned teeth or long-term abutments for a fixed prosthesis which may have thickened lamina dura.

Statistical Analysis

The obtained data were analysed using SPSS 27 software (SPSS Inc., Chicago, IL, USA). The categorical variable was compared using chi-square test in to determine the frequency and distribution of IO and the significance between age, the size of IO, and the site IO. The result from the data is considered statistically significant only when the p-value < 0.05.

RESULTS

From the data collected for the present study, 108 out of the 1,117 panoramic radiographs had shown IO, in which, 58 of them were females (53.70%) and 50 were males (46.30%) as shown in Table 1. Thus, the incidence of this lesion is 9.67%. In the present study, the lesions were all seen on the mandible (Fig. 1), and no IO was detected on the maxilla. Thus, the occurrence of IOs is likely to occur on mandibles. As for the

site, there are 17 (15.74%) for anterior and 91 (84.26%) for posterior (Table 1). The distribution of the present study, based on age, had ranged from 11 years old to 75 years old and the highest distribution of the lesion incident were found between the second and fourth decades (Fig. 2). Additionally, the sizes of the lesion found from the panoramic radiograph were varied from 2.5 mm to 21.5 mm with the highest frequency of lesion was found around ~5.0 mm (Fig. 3).

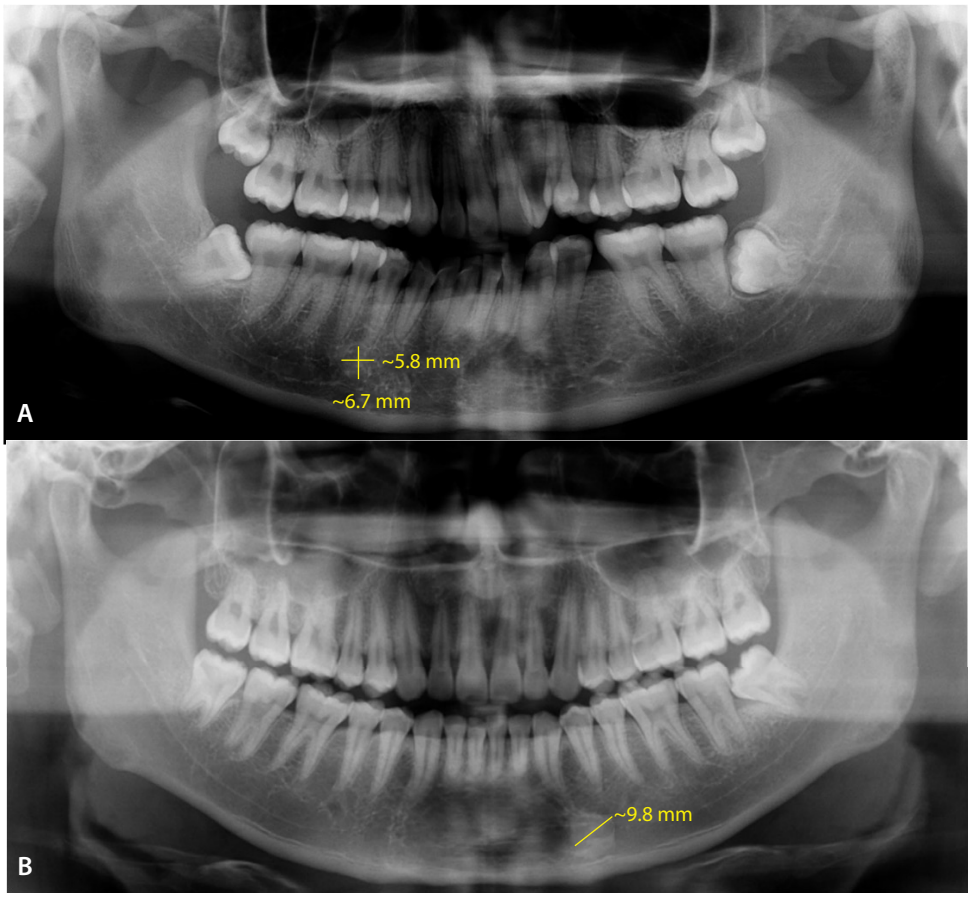

Fig.1 Localisation of IOs with their shapes and sizes both found in the mandible (A) located on right body of mandible overlapping with mental foramina, and (B) located on left parasymphisis of mandible.

Table 1 The frequency of the IO occurrence for variable gender and site

Variable	n	%
Gender		
Male	50	46.30
Female	58	53.70
Total	108	100.00
Site		
Anterior	17	15.74
Posterior	91	84.26
Total	108	100.00

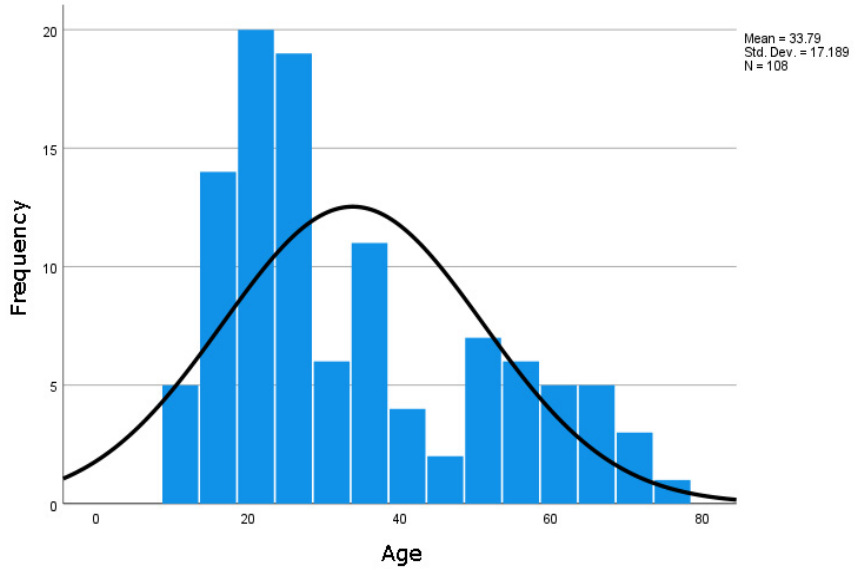

Fig. 2 Distribution of IO by age.

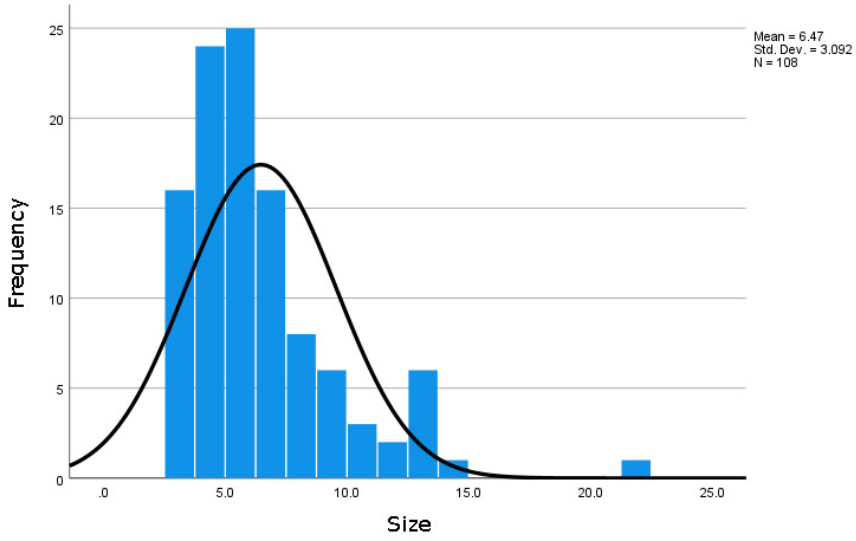

Fig. 3 Distribution of IO by size.

There is a statistically significant association between site and association with tooth ($p < 0.001$) as presented in Table 2; out of 108, there were 41 panoramic radiographs that showed IOs associated with tooth on the posterior region of the mandible. A tooth that is most likely associated with IOs are premolar tooth (22 out of 46, which includes posterior and anterior tooth association), followed by a molar tooth (19 out of 46). There is also statistical significance between site and foci ($p < 0.001$); out 108, 85 panoramic radiographs had showed unilocular IOs on the posterior region of the mandible. However, there is no significance between age and gender ($p > 0.05$).

Table 2 The chi-square tests relationships between age, size and site variables

Variables		Value	df	*p*-value
Age	Age and association of with tooth	1.943	3	0.584
	Age and foci	5.371	3	0.147
	Age and gender	1.985	3	0.575
Size	Size and association of tooth	3.875	3	0.275
	Size and foci	1.850	3	0.604
	Size and gender	16.216	6	0.013
Site	Site and association of tooth	113.054	4	< 0.001
	Site and foci	110.569	4	< 0.001
	Site and gender	112.290	6	< 0.001

Note: The Chi-square tests showed statistically significant relationships between size and gender, site and tooth association, site and foci, and site and gender.

DISCUSSION

The present study found that 9.67% of patients at the UiTM Dental Centre have IO, a prevalence that falls within the spectrum observed in previous literature, which range from 4% to 31% (Sisman *et al.*, 2011). The variation in prevalence may be due to different definitions of IO. Some studies had included radiopacities due to local stimuli or traumatic occlusion, while others exclude these etiologies. In the present study, any suspected radiopacities around the apex of the tooth that present with heavy restoration, thickened lamina dura, radiopacities related to salivary gland diseases, radiopacities around malpositioned teeth or long-term abutment such as fixed prosthesis were excluded. Another exclusion criterion included in the present study was the radiopacity of deciduous or permanent retained roots that are distinguishable. White and Pharoah (2009) stated that IO might be the result of retained deciduous molar roots that have been resorbed and replaced by sclerotic bone. Another study by Gupta *et al.* (2016) also suggested that the lesion might originate from mild inflammation during the transition of the deciduous tooth in the developmental phase to the permanent tooth. Multiple studies have suggested that IO can be characterised as a developmental variation (de Souza Tolentino *et al.*, 2014). The range of prevalence could be influenced by the selection of radiographic images used for diagnosing IO. Some researchers chose periapical radiographs, but this might limit their ability to identify the lesion. Some studies used cone-beam computed tomography (CBCT) to diagnose the IO (de Souza Tolentino *et al.*, 2014). Panoramic radiograph records from the Dental Imaging Unit, UiTM Dental Centre, and UiTM from 2016 to 2020 were chosen as the study's materials. Panoramic radiographs were selected because the lesion is typically detected incidentally, and they also offer a broader range of perspectives. This facilitated better measurement by inter-examiners and easier detection of multilocular IOs.

IO can be misinterpreted as various other lesions, including condensing osteitis, complex odontoma, cemento-osseous dysplasia, and numerous other radiopaque foci lesions (de Souza Tolentino *et al.*, 2014). In some cases, IO has been misinterpreted as an impacted canine due to its buccally mimicked shape and retained root appearance, resulting in unnecessary surgical procedures (Yusof *et al.*, 2020). IO is a non-inflammatory pathology, as it is considered a developmental variation of jaw bone architecture that is unrelated to local stimuli (Sisman *et al.*, 2011). Hence, it is important to classify IO separately from lesions of inflammatory, neoplastic, or dysplastic origin. There is evidence of an association between the increasing

occurrence of IO and colorectal cancer or adenoma (Yusof *et al.*, 2020). The size and diameter of this lesion may vary; however, it is most commonly found at the root apices, in the premolar or molar region, with a higher likelihood of occurrence in the lower jaw (Sisman *et al.*, 2011). Moreover, IO typically remains unchanged, with no detected expansion of cortical bone. This could be attributed to factors such as the skeletal maturity of the patient. Numerous studies suggested the radiographic monitoring of this lesion since surgical removal of the IO could lead to unnecessary treatment or procedures (de Souza Tolentino *et al.*, 2014). In some reported instances, the lesion recurred a few months after surgical removal.

In this study, it was discovered that IO is more likely to occur in the mandible compared to the maxilla, which aligns with findings from a previous study by Naser and Roshanzamir (2016). Another study reported a significantly higher incidence of IO lesions in the mandible compared to the maxilla, with a prevalence of 98.9% (Miloglu *et al.*, 2009). The present study also discovered equal percentages of IOs that were associated with a tooth in proximity and those without any association with any tooth in proximity.

Numerous studies have indicated that IO commonly manifests in the molar region, with the premolar region being the second most affected area (Naser & Roshanzamir, 2016). In the present study, the highest occurrence of IOs were in the premolar region, with 20 IOs detected, followed by the molar region with 19 IOs. Conversely, the anterior region had the lowest occurrence, with only 5 IOs found. This finding is consistent with Geist and Katz (1990), which also noted the highest incidence of IOs in the premolar region. Therefore, it can be concluded that IOs are most likely to occur in the premolar and molar regions.

During the data collection process, any potentially abnormal radiopacity identified in the anterior region will be excluded. Such radiopacities may arise from the superimposition of other anatomical structures, commonly known as ghost images. For example, the cervical spine has the potential to obscure any odontogenic lesions, particularly in the incisor region (White & Pharaoh, 2009). These ghost images are considered suspicious because they can closely resemble actual lesions. These images are produced by structures located outside the intended focus area but are adequately attenuated by the X-ray beam, resulting in the formation of distorted radiographic images (Ramos *et al.*, 2016).

Regarding the size of the lesions in the present study, 54 IOs were measured between 5.1 mm to 10 mm. This finding aligns with a prior study, which observed IOs ranging from 2 mm–3 mm to 7 mm, with the largest lesion measuring 1.8 cm (de Souza Tolentino *et al.*, 2014). The variability in lesion size prevalence could be attributed to adjustments in panoramic image magnification during analysis (MacDonald-Jankowski, 1999). In the present study, panoramic radiograph images were analysed using calibrated rulers in the software to ensure a 1:1 magnification ratio. However, the lesion size did not exhibit significance, potentially due to distortion and differential magnification inherent in panoramic radiographs (Petrikowski & Peters, 1997).

The present study was conducted to assess the prevalence of IO, which assists clinicians in identifying asymptomatic, non-expansible radiopaque lesions in both the maxilla and mandible. These radiopaque lesions can impede tooth root formation and eruption (Oshima *et al.*, 2010). In some cases, the lesions may require removal to facilitate the eruption of impacted teeth and prevent tooth movement during the fixed appliance phase (Huang *et al.*, 2019). However, recurrence of certain lesions has been reported as early as five months after removal (Petrikowski & Peters, 1997). Therefore, non-invasive procedures such as radiographic monitoring of the lesion have been recommended

(Oshima *et al.*, 2010; de Souza Tolentino *et al.*, 2014; Huang *et al.*, 2019).

There have been reported cases where IO may impact orthodontic treatment and dental implants. IO, often found in the premolar areas, can impede orthodontic tooth movement, potentially affecting the progress of treatment. For instance, Huang *et al.* (2019) documented a case where IO caused tooth impaction and hindered tooth movement. In this case, the impacted premolar was addressed by extracting the adjacent premolar tooth. In another study, it was reported that spacing between the premolar and canine was observed only following the surgical extraction of the lesion, located between the periapical regions of both teeth. However, the lesion recurred five months after the surgical procedure (Petrikowski & Peters, 1997). The recurrence of IO could be associated with developmental abnormalities in normal bone turnover (MacDonald-Jankowski, 1999). Tooth movement within the sclerotic area would require a longer duration despite the completion of the remodelling process, as there are fewer surfaces available for osteoclast activity (Consolaro & Consolaro, 2012). Marques-Silva *et al.* (2007) described another rare complication related to the localisation of IO lesions near a tooth, potentially causing root resorption and interfering with orthodontic treatment. Moreover, IO can disturb the normal root formation of premolar teeth, leading to curved root structures despite abnormal root development (Oshima *et al.*, 2010).

In another study, implants were placed in two different patients to investigate implant stability in the presence of IO lesions after surgical removal and direct implant placement on the lesion area (Lin *et al.*, 2017). It was noted that implant placement following lesion removal achieved stability both clinically and radiographically after six months, with favourable bone density for implant placement observed in the fifth month. The study also found that placing implants directly in IO lesions yielded similar outcomes compared to the previous case, with stability reported in both the implant and peri-implant areas (Marques-Silva *et al.*, 2007).

Although it was clear that IO is not of inflammatory, neoplastic, or dysplastic origin, any radiopaque foci that are associated with large restoration or deep caries, edentulous area, and long-term fixed prosthesis, IO must be excluded before commencing any clinical management. Consequently, a thorough examination and diagnosis need to be done to make a holistic approach in treatment planning for IO lesion-related cases. IO should not be overlooked, as awareness and accurate diagnosis are vital in ensuring optimal care delivered to patients. Understanding such conditions contributes to better treatment planning, communication, and avoidance of unnecessary clinical management. It is important to understand the nature of this asymptomatic lesion, and surgical removal may have been one of the management options, however not necessarily to be done.

CONCLUSION

In summary, based on the analysis of 1,117 panoramic radiographs, the research findings indicate that 108 (9.67%) exhibited evidence of IO, primarily localised in the mandibles. The distribution of IOs within the mandible revealed 17 (15.74%) in the anterior region and 91 (84.26%) in the posterior region, notably concentrated around the premolar or molar region. The absence of gender predilection was observed, as IO identified across a wide age range (11 years old to 75 years old). The highest incidence of lesions occurred between the second and fourth decades of life. Additionally, the size of IO varied from 2.5 mm to 21.5 mm, with a prevalent size of around 5.0 mm. Although the occurrence of IO among patients at the UiTM Dental Centre may be relatively small, the implications of these findings remain of paramount importance.

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