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Original Article

Longitudinal investigation of idiopathic osteosclerosis lesions of the jaws in a group of Chinese orthodontically-treated patients using digital panoramic radiography

Situo Wang [1], Laiqing Xu [1], Chuan Cai, Ziwei Liu, Liang Zhang, Chenglong Wang **, Juan Xu*

Department of Stomatology, The First Medical Center, Chinese PLA General Hospital, Beijing, China

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KEYWORDS
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Abstract *Background/purpose:* Idiopathic osteosclerosis (IO) is an intraosseous lesion of asymptomatic, non-expansive, radiopaque. The study aimed to investigate the prevalence and morphometric parameters of IO in orthodontic patients and variations in longitudinal observations and to assess the relationship between IO and orthodontic treatment.
Materials and methods: Five hundred and seventy-one orthodontically-treated patients were reviewed. A cross-sectional study was performed with the evaluated parameters, including the age and sex of patients, as well as the number, shape, location and morphometric data of IO observed in panoramic radiography. Long-term behaviour of IO and orthodontic tooth movement were also observed. Also, a control group was set up for comparisons.
Results: Sixty-eight (11.3%) patients had 78 lesions all in the mandible with premolar/molar preference and no sex predilection. Lesions were located more commonly at apical and separate sites related to teeth. A large majority of lesions enlarged in the 10–19 years old group, while most lesions had no change in the 30–39 years old group. Hindrances of tooth movement and external root resorption around IO were not found in affected patients.
Conclusion: IO is labile lesion that may develop in early stages of life, with little change occurring once the affected individual is mature and being relatively stable in the middle stage of life. Our study supports the hypothesis that IO may be developmental anatomic variations of normal bone. However, no obvious association between IO and orthodontic treatment was

* Corresponding author. Department of Stomatology, the First Medical Center, Chinese PLA General Hospital, Fuxing Road 28#, Beijing, 100853, China.
** Corresponding author. Department of Stomatology, the Fifth Medical Center, Chinese PLA General Hospital, Xisihuan Middle Road 100#, Beijing, 100039, China.
E-mail addresses: 66937964@163.com (C. Wang), newxj@hotmail.com (J. Xu).
[1] Situo Wang and Laiqing Xu contributed equally to this work.

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found in patients, which may be due to the limitations of two-dimensional shooting of panoramic radiography and the sample size.

Introduction

Idiopathic osteosclerosis (IO), also called bone island, enostosis, bone scarring, bone whorling, and focal periapical osteopetrosis, is intrabony, asymptomatic, nonexpansive, radiopaque lesion that is localized increment of compact bone tissue that develop in cancellous bone tissue with unknown aetiology.[1,2] IO lesions occur not only in the jaws but also in the pelvis, femur and other long bones.[3] Jaw lesions are usually accidental findings in radiographic examinations taken for other reasons, preferring to develop in the molar and premolar regions and primarily in the mandible. These lesions can be round, elliptical and irregular in shape with a ground glass/stippled appearance and are usually a few millimetres to 1—3 cm in diameter.[4,5] Some scholars, however, have reported large bone islands with diameters of 2.5—7.0 cm.[4]

In recent years, a large number of studies on IO have been published, with an estimated prevalence varying between 2.3% and 11.8%.[1,6—9] Idiopathic osteosclerosis in the jaw can be observed in children, adolescents and adults without sex differences, although a female preference has been expressed in some studies.[10] Idiopathic osteosclerosis may occur more often in some races including Africans, Chinese, Japanese and Indo-Chinese than in Western populations.[7—11]

The biological behaviour of IO is not well understood and has several suggested theories. IO may be attributed to reactive origin explained as minor inflammation and occlusal trauma during tooth replacement,[10] while some scholars have proposed a developmental aetiology in which IO may be caused by developmental error in the process of normal bone occurring in endochondral bone that changes the normal turnover or maturation of bone with excessive bone deposition.[12,13]

There are few longitudinal studies of IO published compared with the majority of previous studies regarding the distribution and morphometric radiographic parameters of idiopathic osteosclerosis, which are cross-sectional investigations. In previous studies, some researchers followed a group of young people from orthodontic patients for 1—10 years,[1] while two studies examined the development of IO lesions in an adult population, with one having an average time of 10.4 years and the other having periods of 20—27 years.[12,14] The results of studies show that idiopathic osteosclerosis is variable lesion that develops during adolescence and is relatively stable in middle-aged to older adults.[1,12,14] The objective of this study was to evaluate the features and developmental potential of IO lesions in radiographs obtained from orthodontic patients at different periods of time and to assess the relationship between IO and orthodontic treatment.

Materials and methods

Study patients

This longitudinal study with 571 subjects was performed in the Department of Orthodontics of the Chinese PLA General Hospital, Beijing, China, from 2014 to 2020. The study materials were obtained from the documents of patients taking several panoramic radiographs for orthodontic treatment. Demographic information, including age and sex, treatment records, panoramic radiographs, and dentition models, was recorded in the patient documents. All subjects had at least one pretreatment radiograph, and approximately 96% of all subjects received follow-up radiographs 1—5 years after their pretreatment radiograph. In addition,a control group with only one panoramic radiographs of 625 dental patients was set up for comparisons of prevalence. All digital panoramic radiographs were observed and reviewed by two trained oral radiologists, resolving any disagreements through negotiation and discussion.

Diagnostic criteria for idiopathic osteosclerosis

The diagnosis of IO was based on radiological criteria and clinical symptoms. The inclusion criteria involved lesions with the following features:

- Well-defined, non-expansive, the presence of round, elliptical or irregular, radiopaque/hyperdense lesions associated with normal bone and healthy teeth.
- Asymptomatic and cannot be attributed to other causes in clinical examination.
- Clear imaging and good quality in panoramic radiograph.

Lesions with the following features were excluded:

- Radiopaque lesions around tooth apices with deep caries or large restorations.
- Identifiable remnants of deciduous or permanent teeth.
- Mixed radiopaque and radiolucent lesions, such as diffuse sclerosing osteomyelitis.
- Other benign fibro-osseous lesions of periodontal ligament origin, such as periapical cemental dysplasia.
- Solitary radiopacities located in edentulous areas probably indicating residual condensing osteitis.
- Increased thickening of the lamina dura around teeth that showed marked malposition or served as abutments for fixed bridges or partial dentures.

- Radiopacities clarified as tori or exostoses, salivary calculus, tonsiloliths, calcified lymph nodes or mineralized styloid ligaments.
- Multiple radiopaque areas were interpreted as Gardner's syndrome.
- Patients with other diseases associated with bone metabolism disorders.
- Patients with a history of trauma and surgery in jaws.

Assessment parameters of idiopathic osteosclerosis

The assessment parameters of IO lesions included the age and sex of the subjects and the shape, number, location, and relationship to the teeth of the lesions. Other morphometric parameters, such as the area, width and length of the lesions, were also used to evaluate their characteristics and developmental potential.

- Shape: round, elliptical or irregular.[5]
- Anatomical site: maxilla or mandible; right or left; anterior, anterior-premolar, premolar, premolar-molar, molar or retromolar.
- Relationship to the teeth: The criteria based on the Geist and Katz study[10] were used to consider the relationship to the teeth: (1) "interradicular" if the masses were limited to the area between the roots (Fig. 1a); (2) "interradicular and apical" if lesions found at the apices exhibited significant extension between the roots (Fig. 1b); (3) "apical" if the radiopacities were predominately located around the root apices (Fig. 1c); and (4) "separate" when the lesions were apical to and clearly separated from the teeth and lamina dura (Fig. 1d).
- Morphometric parameters: ImageJ software (version 1.48) was used to measure area, width and height (Fig. 2). First, an oral implant-measuring calliper (accuracy of the calliper is 0.1 mm) was manipulated to measure the mesiodistal crown width of the tooth nearest to the lesion, and the examiner recorded the data regarding the tooth. Second, a reference line was drawn from the mesial point to the distal point of the tooth nearest to the lesion conducted as a reference to set scale. Finally, the polygonal selection tool of the software was used to measure the area of the lesion, and the width and length of the lesion were analysed via straight lines.

Statistical analysis

Although we chose the nearest tooth to the IO to serve as a reference for standardized radiographic measurements, other random errors, such as distortion and differences in projection direction in panoramic images and measurement error, might exist, which may have an influence on determining the change in IO. Therefore, an amount of change in a value of a ratio was required when assessing the occurrence of a definite change in IO. The amount of change beyond 30% was a definite change in IO size in the Petrikowski and Peters study.[1] Since the measurement errors were smaller than those in previous studies due to standardized conduction, when comparing whether a definite change in morphometric parameters of IO occurred, we determined that a change in values of more than 10% was a definite change.

The data were analysed using statistical software (SPSS 22.0; Chicago, IL, USA). The chi-squared test was used to determine the prevalence of IO and to compare the distribution regulation of age groups, sex, shape, location, relation to teeth and variation values of the morphometric parameters. Comparisons of morphological parameter data between pretreatment and posttreatment were analysed by the rank-sum test. Data on pretreatment morphometric parameters were analysed with boxplot graphs to better observe their distribution. A $p < 0.05$ was regarded as statistically significant.

Ethics statement

Our study was approved by the ethics and research committee of Chinese PLA General Hospital (IRB No. S2021-025-01).

Results

The prevalence of IO in pretreatment radiographs

Once the diagnostic criteria were established, five hundred and seventy-one orthodontically-treated patients aged 4–53 years old (mean age: 20.5 ± 7.6 years) were included in this study. The prevalence of IO was 11.2%, in which a total of 72 lesions were found in 64 patients aged 10–37 years old (mean age: 19.8 ± 6.7 years), among which 56 had one IO lesion and eight had two IO lesions.

Even though a large majority of lesions were in females, there was no sex no statistically significant difference in the prevalence between sexes ($P = 0.682$). Females made up 72.9% of the observation population, while 75.0% of affected patients were female. The distributions of affected patients and age groups in the observed population are shown in Fig. 3, in which we found that a large majority of affected patients (92.2%) were people in the second and third decades of life. Specifically, 53.1% of affected patients were in the second decade (10–19 years), with the highest prevalence, 39.1% in the third decade (20–29 years), and 7.8% in the fourth decade (30–39 years). No statistically significant difference in the prevalence of IO was found among the different age groups ($P = 0.377$).

The distribution of lesions in terms of shape varied; 18 (25.0%) cases were round, 22 (30.6%) elliptical and 32 (44.4%) irregular. Regarding the location of lesions, all cases were observed in the mandible; 37 (51.4%) were on the left side, 34 (47.2%) on the right side and one (1.4%) in a middle position. Moreover, four lesions (5.6%) were observed in the anterior tooth area, five (6.9%) in the canine-premolar area, 25 (34.7%) in the premolar area, eight (11.1%) in the premolar-molar area, 29 (40.3%) in the molar area and one (1.4%) in the retromolar area. In accordance with their classification based on the lesion's relationship to teeth, the apical position was the most common position with the prevalence of 54.2% (39 cases), 24 (33.3%) cases were observed in a separate position, four (5.6%) in an interradicular position, and five (6.9%) in interradicular and apical positions. There was no significant

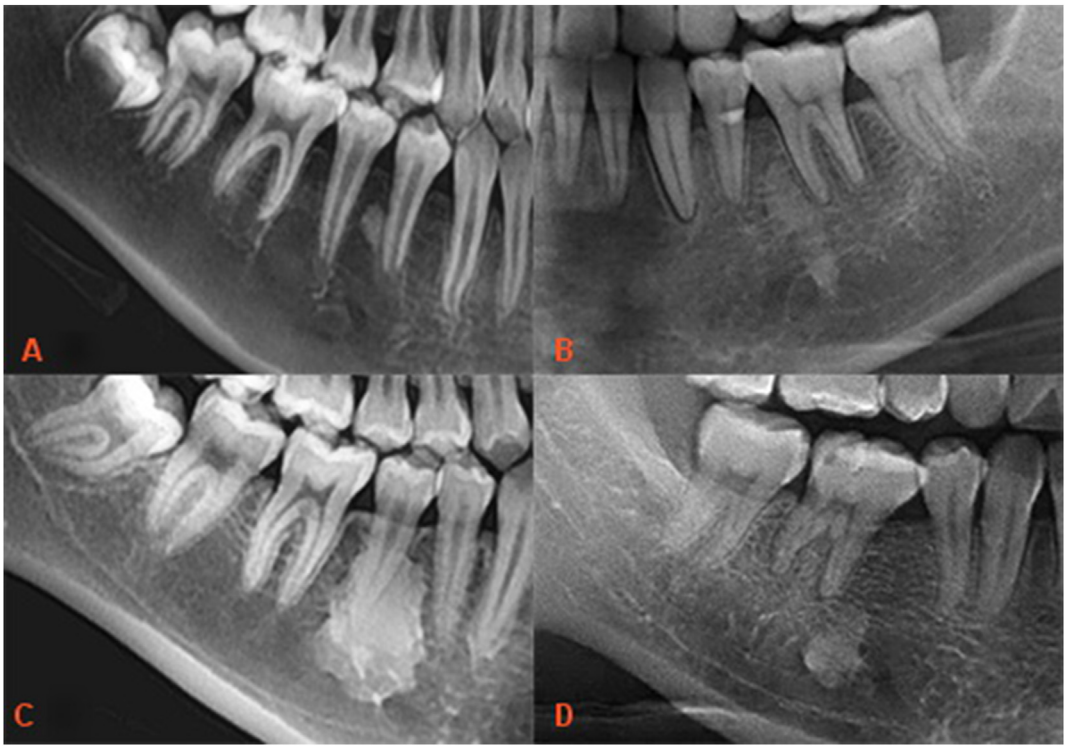

Figure 1 Classification of IO lesions considering the relationship to the teeth: (A) Interradicular. (B) Interradicular and apical. (C) Apical. (D) Separate.

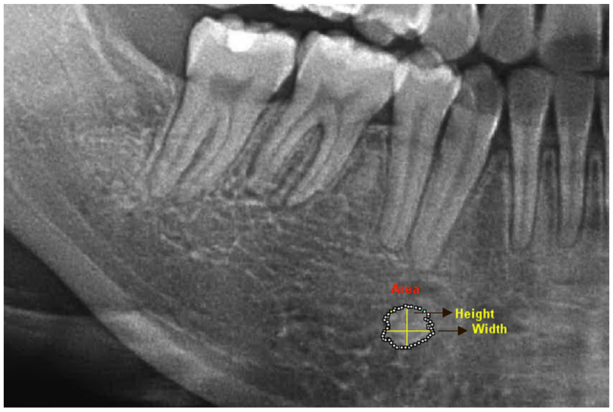

Figure 2 Morphometric parameters of IO lesions using ImageJ: area, width, and height.

difference when examining the location and the relationship to teeth ($P = 0.407$) (Table 1).

Morphometric analysis

Data on the morphometric parameters of IO are analysed below. The area of the IO in pretreatment panoramic radiographs varied, ranging from 3.7 to 161.6 mm^2, with a mean of 40.4 ± 31.7 mm^2 among the 72 lesions. The values of the area parameter presented a non-normal distribution, with a median value of 29.8 mm^2 (Q1: 19.3 mm^2; Q3: 51.5 mm^2). Regarding the width and height of lesions in pretreatment radiographs, both values presented non-normal distributions; the median value of width was 6.0 mm (Q1:4.7 mm; Q3:7.9 mm), and the median value of height was 6.7 mm (Q1:4.4 mm; Q3:8.7 mm). The width of IO presented a mean of 6.8 ± 2.7 mm, with values ranging from 2.2 to 14.5 mm. Additionally, the heights of IO ranged from 1.8 to 17.7 mm, with a mean of 6.8 ± 3.0 mm.

Sixty-eight lesions were observed in posttreatment panoramic radiographs due to a lack of posttreatment information for four patients. The IO ranged from 10.7 to 222.5 mm^2 in area with a non-normal distribution, in which the median value was 38.92 mm^2 (Q1: 24.2 mm; Q3: 59.9 mm^2), and the mean area was 46.6 ± 35.3 mm^2. The width had a mean of 7.5 ± 3.1 mm, ranging from 2.9 to 18.7 mm with a non-normal distribution, with a median value of 7.03 mm (Q1: 5.5 mm; Q3: 8.7 mm). The mean height was 7.06 ± 2.56 mm, and the data showed a normal distribution, with a median of 7.03 mm (Q1: 4.88; Q3: 8.99 mm) (Fig. 4).

Even with an increase in mean values for each morphometric parameter of IO, no statistically significant size difference was presented (area: $P = 0.161$; width: $P = 0.131$; height: $P = 0.407$).

Changes in area in different age groups

Follow-up data were available for 68 IO lesions after 1—5 years with an average observation time of 36 months. Fig. 5a shows the area changes of IO lesions among different age groups. In all cases, 38 (55.9%) enlarged in area (mean change, $51.07 \pm 53.72\%$; max change: 206.42%), seven (10.3%) decreased (mean change, $23.45 \pm 5.42\%$; max change: 32.07%) and 23 (33.8%) remained static. Most lesions (26 cases, 76.5%) in patients between the ages of 10

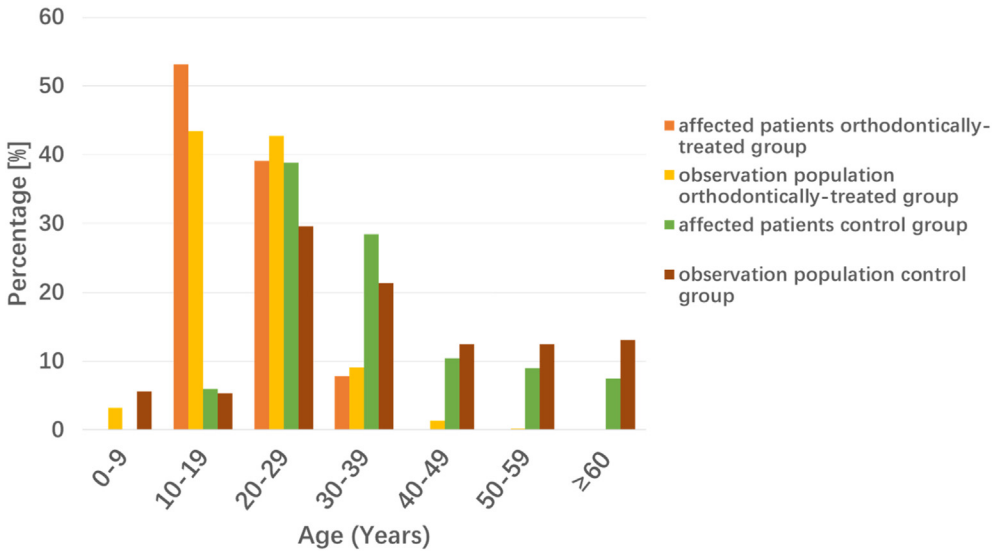

Figure 3 Age distribution of affected patients and the observed population.

Table 1 Distribution of IO cases in patients according to tooth relation and location.

Relation to teeth Location		Interrad-icular (%)	Apical and Interradicular (%)	Apical (%)	Separate (%)	Total (%)
Orthodontically-treated patients group	Anterior	0 (0)	1 (1.4)	1 (1.4)	2 (2.8)	4 (5.6)
	Canine–premolar	0 (0)	1 (1.4)	3 (4.2)	1 (1.4)	5 (6.9)
	Premolar	2 (2.8)	1 (1.4)	13 (18.1)	9 (1.4)	25 (34.7)
	Premolar–molar	1 (1.4)	2 (2.8)	4 (5.6)	1 (1.4)	8 (11.1)
	Molar	1 (1.4)	0 (0)	18 (25.0)	10 (13.9)	29 (40.3)
	retromolar	0 (0)	0 (0)	0 (0)	1 (1.4)	1 (1.4)
	Total	4 (5.6)	5 (6.9)	39 ((54.2)	24 (33.3)	72 (100)
Control group	Anterior	0 (0)	0 (0)	3 (4.2)	1 (1.4)	4 (5.6)
	Canine–premolar	1 (1.4)	2 (2.8)	0 (0)	5 (7.0)	8 (11.3)
	Premolar	1 (1.4)	4 (5.6)	10 (14.1)	12 (16.9)	27 (38.0)
	Premolar–molar	2 (2.8)	3 (4.2)	0 (0)	0 (0)	5 (7.0)
	Molar	1 (1.4)	0 (0)	16 (22.5)	9 (12.7)	26 (36.6)
	retromolar	0 (0)	0 (0)	0 (0)	1 (1.4)	1 (1.4)
	Total	5 (7.0)	9 (12.7)	29 ((40.8)	28 (39.4)	71 (100)

and 19 years increased, three (8.8%) decreased and five (14.7%) remained static. In the age group of 20–29 years old, 42.9% of lesions in patients between the ages of 30 and 39 years enlarged, 10.7% decreased and 46.4% remained static. In comparison, 20% of lesions in patients between the ages of 30 and 39 years showed reduced areas, while 80% were unchanged. There was a statistically significant difference in the area changes among the different age groups. These results may indicate that idiopathic osteosclerosis has a tendency to increase during adolescence and is relatively stable in adulthood.

Changes in width and height among the different age groups

Of the lesions observed during the follow-up examination, 31 (45.6%) became larger in width and 23 (33.8%) in height, 10 (14.7%) decreased in width and 13 (19.1%) in height, and 27 (39.7%) had no change in width or 32 (47.1%) in height. The mean width changes of lesions were as follows: $32.3\% \pm 26.3\%$ increased and $17.3\% \pm 6.3\%$ decreased. Moreover, the mean changes in height were as follows: $27.4\% \pm 12.1\%$ increased and $9.2\% \pm 29.2\%$ decreased.

In the age group of 10–29 years old, 20 (57.1%) cases increased in width and 15 (42.9%) in height. In comparison, the majority of lesions (60.0%) remained stable in both width and height in the age group of 30–39 years old. No significant difference (width: $P = 0.243$; height: $P = 0.312$) was found in either the width or height changes among the different age groups (Fig. 5b and c).

Assessment of the relationship between IO and orthodontic treatment

In our study, hindrance of tooth movement and external root resorption around the lesions of IO were not found in

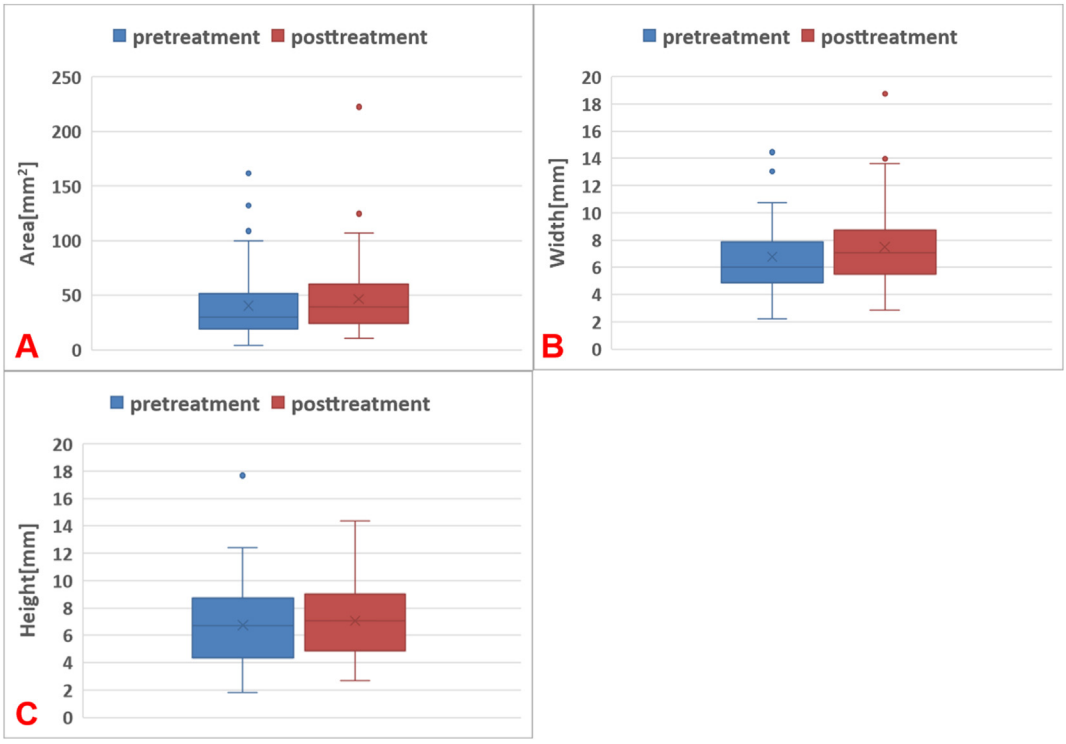

Figure 4 (A) Area distribution of IO cases. (B) width distribution of IO cases. (C) height distribution of IO cases.

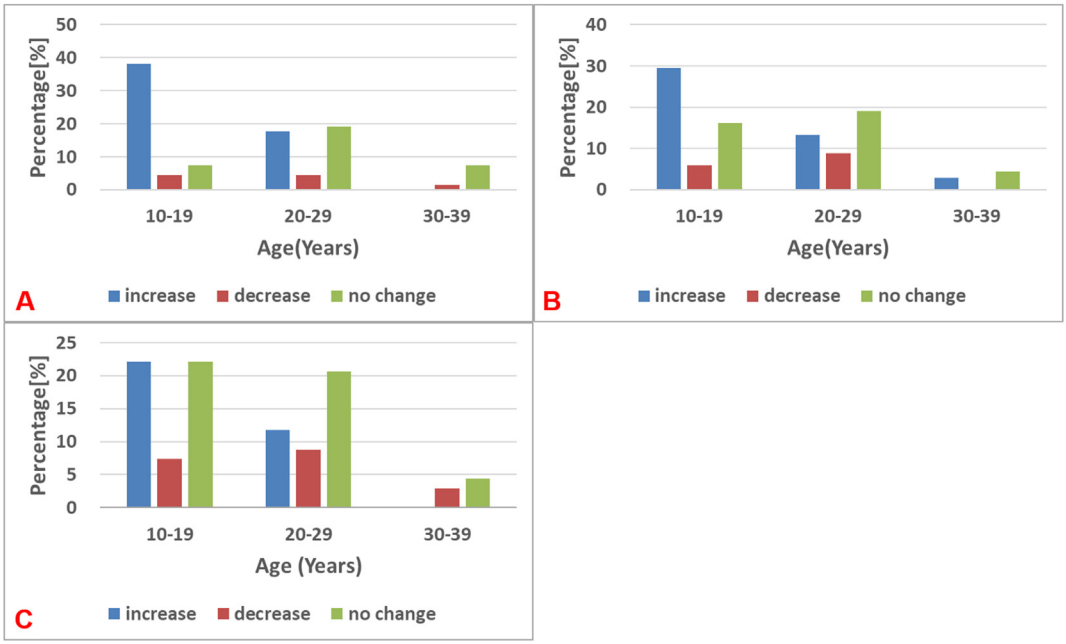

Figure 5 (A) Age distribution according to area changes of IO lesions. (B) Age distribution according to width changes of IO lesions. (C) Age distribution according to height changes of IO lesions.

affected patients. The phenomenon that the presence of IO prolonged the treatment time and complicated orthodontic treatment was also not observed. In addition, our attempts to relate the area changes and locations of IO to teeth, as noted in Table 2, were negative, which indicated that the change in IO was not affected by orthodontic force ($P = 0.097$).

The prevalence of IO in control group

Six hundred and twenty-five dental patients aged 4—77 years old (mean age: 37.02 ± 17.4 years) were included in control group. The prevalence of IO in control group was 10.7%, in which a total of 71 lesions were found in 67 patients aged 12—69 years old (mean age: 34.70 ± 14.2

Table 2 Distribution of IO cases according to area changes and tooth relation.

Tooth relation	Area changes of IO lesions			Total (%)
	Increase (%)	Decrease (%)	No change (%)	
Related to teeth	24 (35.3)	4 (5.9)	18 (26.5)	46 (67.6)
Separate from teeth	14 (20.6)	4 (5.9)	4 (5.9)	22 (32.4)
Total	38 (55.9)	8 (11.8)	22 (32.4)	68 (100)

years), among which 63 had one IO lesion and four had two IO lesions.

Males made up the majority of 59.8% of all subjects in control group, while 59.7% of affected patients were male. Therefore, there was no sex no statistically significant difference in the prevalence between sexes ($P = 0.982$). The distributions of affected patients and age groups in the observed population of control group are shown in Fig. 3, in which we found that a large majority of affected patients (67.2%) were people in the third and fourth decades of life. Specifically, 6% of affected patients were in the second decade, 38.8% in the third decade, 28.4% in the fourth decade, 10.4% in the fifth decade, 9% in the sixth decade and 7.5% in the age group of 60 or older. No statistically significant difference in the prevalence of IO was found among the different age groups ($P = 0.162$).

The distribution of lesions in control group in terms of shape varied; 21 (29.6%) cases were round, 21 (29.6%) elliptical and 29 (40.8%) irregular. Regarding the location of lesions, all cases were observed in the mandible; 37 (52.1%) were on the left side, 34 (47.9%) on the right side. Moreover, a large majority of lesions were in the premolar and molar area with a ratio of 38.0% and 36.6%, respectively. In accordance with their classification based on the lesion's relationship to teeth, the apical and separate position were the most common positions with the prevalence of 40.8% and 39.4%, respectively (Table 1).

Discussion

Previous cross-sectional studies on the frequency and distribution of idiopathic osteosclerosis of jaws were mainly conducted in adult populations. The subjects in this study were primarily adolescents who underwent orthodontic treatment with a period of 1–5 years, providing an opportunity for us to observe the longitudinal behaviour of idiopathic osteosclerosis. A control group was set up in order to reduce the age limitation of the orthodontically-treated patients. The prevalence of IO in this study was relatively high compared with previous literature. This variation in prevalence with other reports may be due to race and age factors in the observed population. Approximately 86% of the observed populations in our study were in the second and third decades of life, in which the occurrence of sclerotic lesions is more common. The prevalence of IO in orthodontically-treated patient group was 11.2% which was higher than that of control group (10.7%), because there were more children and adults in control group. Moreover, this study was conducted in a Chinese population, in whom the prevalence of IO is relatively high among races.[7,11]

Our results were generally consistent with the previous findings that IO had an inclination toward premolar and molar regions with mandibular predilection and no sex preference and were located more commonly at apical and separate sites related to teeth. Round and irregular shapes were the more frequent forms of IO recorded in a few recent studies, which partially agreed with our study, in which irregular shapes had a higher incidence.[15] The orthodontically-treated subjects of this study mainly consisted of adolescents and young adults, similar to the previous study by Petrikowski and Peters,[1] making it difficult to compare the prevalence rates among people of different ages. No significant difference was found in the prevalence of lesions in the affected population between 10 and 37 years old. However, some studies reported that IO lesions were most prevalent in the first three decades of life,[8,9] which was roughly consistent with the results of the control group showing that IO lesions were relatively prevalent in the first four decades of life.

In addition to the research on the frequency and distribution of idiopathic osteosclerosis, this study also measured the morphological parameters of sclerotic lesions and compared the data in the pretreatment and posttreatment radiographs. To accurately measure the morphological parameters of IO in panoramic images with magnification and distortion, the nearest tooth to the lesion was chosen to serve as a reference for standardized radiographic measurements. The morphological parameters of this study included area, width, and height, with wide variations presented in data of different lesions, while most previous studies only described linear parameters. In pretreatment radiographs, the mean value of area was $40.4 \pm 31.7\,mm^2$, and the mean values of width and height were similar, at $6.8 \pm 2.7\,mm$ and $6.8 \pm 3.0\,mm$, respectively. The results of our study presented similarity to a previous report in which the mean values of area, width and height were $33.9 \pm 20.1\,mm^2$, $6.6 \pm 3.1\,mm$ and $7.7 \pm 3.1\,mm$, respectively.[15] The data of 68 lesions in posttreatment radiographs (four less than the pretreatment radiographs due to the lack of available materials) revealed an increase in each morphological parameter, indicating that idiopathic osteosclerosis may be labile lesion with an enlargement trend in the early stages of life. In addition, 55.9% of lesions increased in area, 10.3% decreased and 33.8% remained static after a period of 1–5 years; the majority of lesions showed changes in both width and height, while partial lesions showed no changes. This instability of lesions was most pronounced in adolescence and showed an increasing trend. Conversely, a large majority of lesions that occurred in adulthood remained static, although a few had changed. Additionally, significant differences were found in the area changes among the different age groups. The results suggest that IO is variable lesion that developed in early age and was relatively stable in middle age, consistent with some previous studies.[1,14]

In our study, we initially speculated that the lesions of IO may be affected by orthodontic force because the locations of some IO lesions were undergoing orthodontic tooth movement. Unfortunately, the attempt to correlate the location of the lesion with the change in area failed, and no

significant difference was found when comparing the area changes between the teeth-associated lesions and lesions separated from teeth. In addition, no lesion was found to hinder the movement of teeth. The results of our study appeared not to be agreed with some previous studies that indicated that IO lesions may influence orthodontic tooth movement and even lead to tooth heterotopia and external root resorption.[2,14,16] The difference in the results of studies may be due to limitations in two-dimensional panoramic radiographs that cannot display the specific positional relationship between the lesion and the tooth and that the sample size is not large enough. In addition, our results cannot conclude that there is no relationship between IO and orthodontic treatment due to the limitations of the study.

In the past, there have been many theories regarding the origin of idiopathic osteosclerosis. Idiopathic osteosclerosis is considered the result of resorption and replacement of the residual roots by sclerotic bone.[17] Histopathological examinations that may provide information about dental residues are rare due to few clinical indications for removal of these lesions and ethical factors that one cannot rely solely on scientific indications for histopathological examination. Another explanation for IO is traumatic occlusion and traumatic movement of teeth that lead to bone deposition.[18] Some sclerotic lesions around malpositioned teeth were observed in our subjects, and 54.2% of lesions were associated with root apices, which may explain the unbalanced occlusal force. However, most lesions did not decrease but increased in size after orthodontic alignment of teeth, which contradicted this explanation. In some literature, IO is considered to be developmental anatomic variations.[12,13,19] The finding that IO developed in an early stage of life in our study supported the possibility that IO may be an anatomic variation.

Correct differential diagnosis of idiopathic osteosclerosis from other radiopaque lesions is essential to dentists. IO is benign, asymptomatic lesion that develops in early life, and little change occurs once the affected individual is mature.[1,14] They do not require any treatment under normal conditions. First, IO should be distinguished from some destructive diseases that may occur in jawbones. Osteoma is a benign tumour characterized by the deposition of dense cortical or cancellous bone, which is a different entity than IO. Once radiopaque lesions present the symptoms of expansion, displacement or continuous growth, osteomas should be considered with further histopathology to confirm the diagnosis.[20] Multiple IO lesions or osteomas of the jaws are a feature of Gardner syndrome that may be related to adenomatous intestinal polyps with the possibility of malignant transformation.[21]Moreover, some patients with Gardner syndrome are characterized by dental abnormalities such as supernumerary teeth, hypercementosis and odontomas.[22] In addition, IO must be discriminated from condensing osteitis stemming from teeth and other sclerosing diseases associated with roots, such as focal cemento-osseous dysplasia and focal sclerosing osteitis, which may affect tooth movement and space closure and may prolong treatment time in orthodontic treatment due to bone disorganization or lack of microcirculation in sclerotic regions.[21] Therefore, we should consider employing reinforcing anchorage in advance and even avoiding orthodontic treatment when sclerosing osteitis is observed in radiographs before orthodontic treatment.

Declaration of competing interest

Authors do not have any conflict of interest. Authors have no financial affiliation (e.g., employment, direct payment, stock holdings, retainers, consultantships, patent licensing arrangements or honoraria), or involvement with any commercial organization with direct financial interest in the subject or materials discussed in this manuscript, nor have any such arrangements existed in the past three years. Any other potential conflict of interest is disclosed.

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