

Article

Application of Orthopantomography in the Analysis of Bone Mineral Density in Patients with Osteogenesis Imperfecta

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Abstract: Osteogenesis imperfecta is a disorder characterized by osteopenia and bone fragility. Considering that orthopantomography is a routine diagnostic test in growing patients, it can be used to analyze bone density in these patients. The study sample consisted of 21 child patients diagnosed with OI, under medical treatment with antiresorptives and for whom orthopantomography was available, analyzed and compared with 20 healthy children. The panoramic radiographs were analyzed and the radiomorphometric indices and fractal dimension were measured after first selecting the areas of interest to be studied. The results showed that fractal dimension of the basal cortical bone was lower in the study group, and MCW was lower in patients with osteogenesis imperfecta. In addition, MCW and fractal dimension were lower with higher number of treatment cycles received. In light of the results obtained, we can conclude that panoramic radiography can be useful in analyzing changes in bone mineral density in these patients throughout the course of treatment.

Keywords: osteogenesis imperfecta; biphosphonates; orthopantomography; bone diseases; fractal dimension



Citation: García-Boedo, L.; Burgueño-Torres, L.; de Nova-García, M.J. Application of Orthopantomography in the Analysis of Bone Mineral Density in Patients with Osteogenesis Imperfecta. *Appl. Sci.* **2024**, *14*, 1954. <https://doi.org/10.3390/app14051954>

Academic Editor: Rossella Bedini

Received: 24 January 2024

Revised: 20 February 2024

Accepted: 26 February 2024

Published: 27 February 2024



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1. Introduction

Osteogenesis imperfecta (OI), also known as “Brittle Bone Disease”, is a congenital hereditary disorder caused by an alteration in collagen synthesis (insufficient or defective formation) and characterized as loss of bone mass (osteopenia) and an increase in bone fragility after minimal trauma or with no apparent known cause. It results in significant morbidity due to pain, immobility, skeletal deformities (long bones and spine), and growth deficiency [1–8].

The estimated incidence of OI is approximately 1:10,000 and 1:15,000 births, according to studies performed in Europe and the USA, affecting sexes, races, and ethnic groups equally, being categorized within the group of rare diseases [1,6,9–12].

It is estimated that about 85% of OI cases are caused by autosomal dominant mutations in the COL1A1 or COL1A2 genes, on chromosomes 7 and 17, respectively, resulting in reduced production or abnormal formation of type I collagen, and, thus, leading to bone fragility. The main mutations are usually glycine substitutions in the GlyXY repeat of collagen, leading to structural defects in the normal collagen triple helix, resulting in moderate, severe, or lethal OI [1,4,5,11,13,14].

In 1979 Sillence et al. [3] proposed a numerical classification of OI into four types, based on clinical, radiographic, and genetic criteria of the patients. It has been progressively extended to include the new types, numbering them successively in the classification. This expanded classification will accommodate histological factors, heredity, and genetic findings. Despite this discovery, it is recommended to continue using the universally accepted Sillence classification for OI, based on phenotypic features of disease and molecular genetics [5–7].

The remaining cases are autosomal recessive, caused by pathogenic variants in non-collagenous genes, encoding proteins involved in collagen biosynthesis, or transcription

factors and signaling molecules related to bone cell (osteoblast) differentiation and mineralization [4,5,12,14,15].

Preliminary diagnosis is based primarily on clinical and radiographic findings. Depending on the severity of the disease, the age of the patient, and the heterogeneity of presentations, the manifestations of the disease vary. Oral manifestations include dentinogenesis imperfecta, impacted teeth, ectopic eruption, dental agenesis, lack of jaw growth, and hypotonia of the masticatory muscles.

As for treatment, there is no curative therapy, only supportive therapy, so a multidisciplinary, varied, and individualized treatment strategy is required depending on the severity of OI, degree of disability, and age of the individual [9]. Pharmacological treatment is mainly aimed at reducing osteoclastic activity and favoring bone formation [10]. Bisphosphonates are primarily used, as well as, less frequently, RANKL inhibitors and Catk inhibitors. Oral and intravenous bisphosphonates are currently the most promising pharmacological therapy and are routinely used for OI, as multiple studies have demonstrated improvements in bone mineral density (BMD) in patients with OI [8–14].

Analysis of bone mineral density in patients with OI is indispensable throughout the treatment of these patients. Double X-ray densitometry (DEXA) is necessary on multiple occasions, especially in children, because of the low exposure and speed of the procedure [4,11,15,16]. Since panoramic radiographs are considered a fundamental part of the diagnosis of dental conditions and are especially relevant in growing patients, several studies have proposed the use of panoramic radiographs as a diagnostic factor to predict low bone mineral density in adult patients and as an early diagnosis of skeletal osteopenia or osteoporosis, since osteoporosis affects the structure of the mandible [2–5,7,8,12,17–20].

Panoramic radiographs are considered a part of the most frequent and useful radiographic examination in the diagnosis of dental conditions and for assessing the general oral health status in the routine dental practice. Several studies have proposed the use of panoramic radiographs as a diagnostic factor to predict low bone mineral density in adult patients and as an early diagnosis of skeletal osteopenia or osteoporosis, since osteoporosis affects the structure of the mandible [1,3–9,11–13,20].

Different radiomorphometric indices have been proposed over the years, applied mainly in studies in adult patients without OI, to allow for quantification of the mandibular bone mass and identification of osteopenia [21]. The correlation between mandibular BMD and body bone mass can be verified using panoramic radiographs. In 2014, Sindeaux et al. [19] used fractal dimension (FD) analysis, observed in other studies, finding that it is efficient to evaluate bone quality in the mandible and trabecular architecture (structural patterns), correlating it with mandibular cortical width (MCW), verifying if there were differences in FD and MCW in panoramic radiographs.

Most studies to date were performed mainly on adult patients, and there are practically no studies on pediatric patients with OI receiving bisphosphonate treatment where it was checked if there were changes in the cortical bone. Recently, studies have been published on child and adolescent patients with OI treated with bisphosphonates, such as Apolinario et al. in 2015 and Pantoja et al. in 2021, which highlight changes in the mandibular cortex and cortical bone after treatment with bisphosphonates [1,9,22–25].

The present research work was based on the analysis of dental panoramic indices and fractal dimensions to evaluate the trabecular and cortical bone in panoramic records of child patients with OI, in comparison with a control group of healthy children, and to analyze the influence of treatment with bisphosphonates. In addition, the present study aims to corroborate with an easily accessible program whether visible changes in bone mineral density are observed in panoramic radiographs routinely used in dental practice.

2. Materials and Methods

2.1. Ethical Aspects

After obtaining approval from the Ethics Committee of the San Carlos Clinic Hospital (registration number 21/316-O_M_OD), a retrospective cross-sectional study was carried

out, analyzing panoramic radiographs of patients with OI who were treated in the “Specialist in Integrated Dental Care for Children with Special Needs” postgraduate program at the Faculty of Dentistry of the Complutense University of Madrid.

2.2. Study and Control Samples

2.2.1. Inclusion Criteria

All patients included in the study sample were required to have a diagnosis of OI, be aged between 5 and 15, and be receiving treatment with bisphosphonates, in addition to having a good-quality panoramic radiograph and providing signed informed consent from parents/guardians for participation in the study.

2.2.2. Exclusion Criteria

Patients with or without systemic diseases or disorders that could affect BMD who were not treated with antiresorptive drugs, who had panoramic records of poor quality that made it impossible to carry out the study or for whom these were not available, or who did not provide informed consent from the parents or guardians, were excluded.

A total of 21 children were included in the study sample (13 boys and 8 girls), who were matched for age and sex with the control sample, which consisted of 20 healthy children (11 boys and 9 girls) who did not present OI or BMD defects.

2.3. Research Systematics

The measurements evaluated in the orthopantomographies were the dental panoramic indices and the fractal dimension. The dental panoramic indices used were mandibular cortical index (MCI), visual estimation of cortical width (SVE), and mandibular cortical width (MCW). For the fractal dimension (FD) analysis, some areas of interest (ROIs), two of the trabecular bone and one of the cortical bone to be evaluated, were selected using ImageJ 1.54d software (Java 1.8.0_345(64-bit)) (Figure 1):

- ROI 1: 25 × 25 pixel square in the trabecular bone at the geometric center of the mandibular ramus.
- ROI 2: 25 × 25 pixel square in the trabecular bone at the geometric center of the angle of the mandible.
- ROI 3: Rectangle in the basal cortical bone, starting distal to the mentonian foramen and amplifying distal to the mesial root of the first permanent molar, encompassing only the cortex of the mandible. This measurement is performed by applying the polygon tool of the ImageJ program.

The measurements of ROIs were performed in the right mandibular region.

The dental panoramic indices analyzed were MCW, MCI, and SVE (Figure 2). The MCW measures mandibular cortical width by drawing a line parallel to the long axis of the mandible and tangential to the inferior border of the mandible. The MCI describes the appearance of the mandibular lower cortex by classifying it among three types: C1, normal cortex with smooth and continuous endosteal margin; C2, endosteal margin with semilunar defects or endosteal cortical debris; C3, endosteal cortical debris and porous and permeable layer. Finally, the SVE refers to the simple visual estimation of the width of the mandibular inferior cortex, classified as thin if less than 3 mm and not thin if greater than 3 mm.

As independent variables, age, gender, type of OI according to the classification of Sillence et al. in 1979, and treatment with antiresorptive drugs were considered. One of the variables evaluated was the influence on the cycles of bisphosphonates administered, for which two groups were established according to the number of cycles administered.

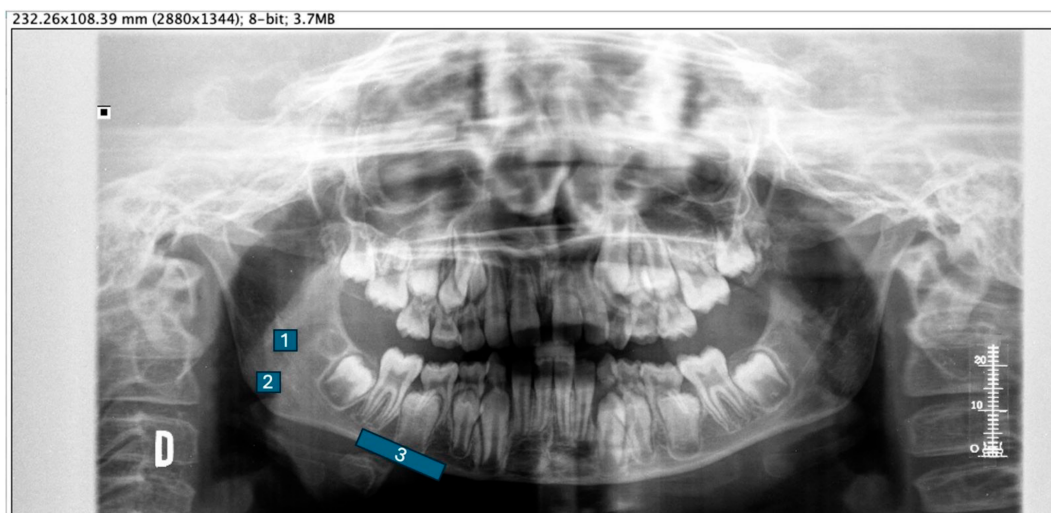


Figure 1. Regions of interest (ROIs) of fractal dimension analysis selected in a panoramic radiograph: ROI 1, ROI 2 and ROI 3.

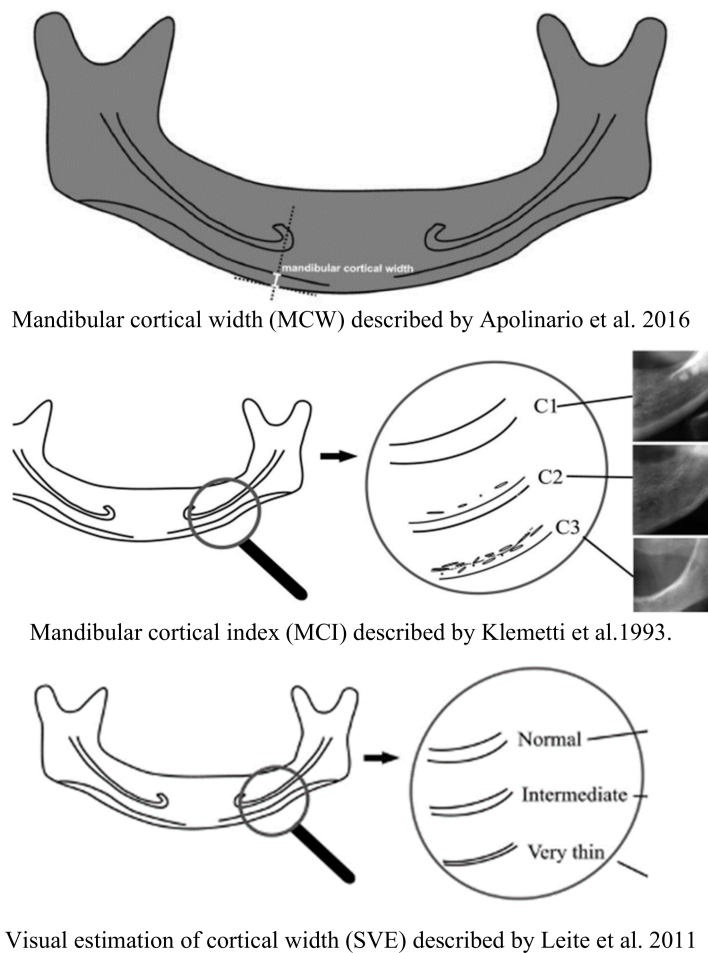


Figure 2. Dental panoramic indexes analyzed [1,26,27].

All the panoramic radiographs were taken using the Gendex Orthoralix S Orthopantomograph, and the image was recorded by means of phosphor plates processed on Konica Minolta Regius 110 model equipment (saved in JPEG format). All the panoramic radiographs were evaluated by the principal researcher, who chose the one with the highest quality in the case of duplicated images. Once the reference points had been acquired

in each of the orthopantomographies of the study, the measurements were plotted and calculated. The pixel was the unit of measurement used as a reference. For better understanding of the study, pixels were converted to millimeters using the ruler shown on the panoramic radiograph. Each cohort of measurements was stored on an Excel spreadsheet and distributed according to the study and control sample. Once the measurements of all radiographic records were completed, to assess intraexaminer reliability, the procedures were repeated on 20% of the sample.

2.4. Statistical Analysis

Statistical analysis of the data was carried out using IBM SPSS Statistics v 25.0 for Windows 10. The statistical methods used for qualitative variables (nominal) were frequency distribution and percentages. In quantitative variables, data exploration was performed with a Q–Q plot of normality fit, histogram, skewness, and kurtosis/height coefficients together with the Shapiro–Wilk goodness-of-fit test and description with the usual tools of centrality (mean, median) and variability (standard deviation and range). In addition, the chi-square test was performed for the comparison of categorical variables, and, for the difference of means, the Student’s test and 1-factor ANOVA were performed. Effect size was estimated and Pearson’s correlation coefficient was calculated. The significance level set was the usual 5% (significant if $p < 0.05$) except in the KS goodness-of-fit test, where only serious deviations were considered significant, i.e., at 1% ($p < 0.01$).

3. Results

Table 1 summarizes the descriptive characteristics of the sample. The study consisted of 41 patients, aged between 6 and 15 with a median age of 11. Although there was a greater presence of boys in the study sample, the differences between the two groups did not reach statistical significance (chi-square test: $p > 0.05$, a little more than 1.5 years). Consequently, we can conclude that the two groups were sufficiently balanced in terms of age and sex, which rules out the possible influence of these factors in any future analyses.

Table 1. Descriptive and comparative analysis. Demographic variables.

Variable	Total Sample (n = 41)	Group		Contrast Test	
		O.I. (n = 21)	Control (n = 20)	Value	p-Value
SEX				0.20	0.654
Boys	58.5% (24)	61.9% (13)	55.0% (11)		
Girls	41.5% (17)	38.1% (8)	45.0% (9)		
AGE (years)					
Median (SD)	10.5 (2.7)	9.7 (2.7)	11.3 (2.6)	1.98	0.055
Rank	6/16	6/16	7/16		

3.1. Fractal Dimension Measurements

The fractal dimension measurements made in the trabecular bone (ROI 1 and 2) behaved as a constant, presenting the same value in all the subjects of the sample and between both groups. As for the fractal dimension measured in the basal cortical bone (ROI 3), as shown in Figure 3, a slightly lower mean was observed in the group of OI children (1.8750 vs. 1.8916), which did not reach statistical significance in the contrast test ($p > 0.05$) and which had a small effect size (3%). These data do not provide sufficient statistical evidence to indicate that the fractal dimension differs between OI cases and cases with normal BMD.

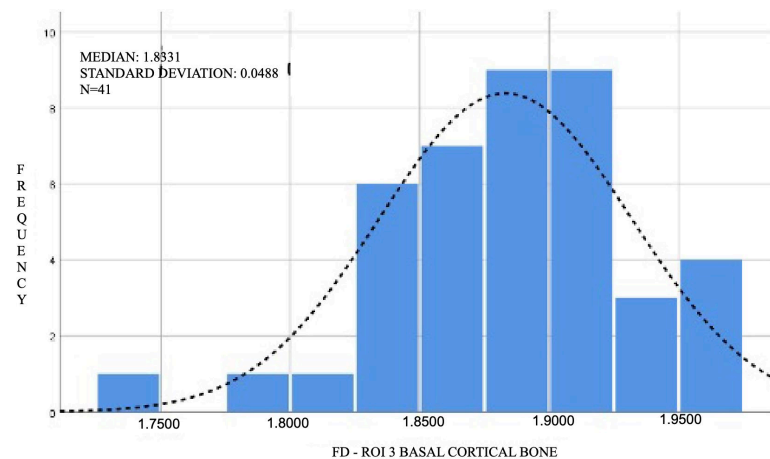


Figure 3. Fractal dimension (FD) in basal cortical bone (n = 41).

3.2. Dental Panoramic Indices

Each of the dental panoramic indices was analyzed. The FD variable was correlated with the MCW variable in both groups. There was no statistical evidence of any kind to suggest a relationship between the two variables, so it was considered that there was no relationship whatsoever.

The variables of these clinical parameters were compared between the groups established in the sample. Table 2 shows a summary of the intergroup analysis of the different variables according to the presence of OI, highlighting that the SVE hardly presents any difference between the two groups that could allow for a diagnosis of BMD from the panoramic radiograph. However, there are statistical differences in the MCI, with the C1 type being higher in children with normal BMD versus OI, the C2 type being similar in both groups, and C3 being higher in the OI group. The MCW value is lower in the OI group, indicating a possible relationship. In reference to MCW values and in light of the results, the OI group presents, in general, lower MCW values than children with normal BMD.

Table 2. Intergroup analysis. Differences in radiological parameter variables, depending on the presence of OI.

Variable	Total Sample (n = 41)	Group		Contrast Test		Effect Size R ²
		O.I. (n = 21)	Control (n = 20)	Value	p	
SVE				0.20	0.655	0.005
Thin	73.2% (30)	76.2% (16)	70.0% (14)			
Not thin	26.8% (11)	23.8% (5)	30.0% (6)			
MCI				16.35	0.000	0.398
C1	34.1% (14)	9.5% (2)	60.0% (12)			
C2	43.9% (18)	47.6% (10)	40.0% (8)			
C3	22.0% (9)	42.9% (9)	0.0% (0)			
MCW						
Median (SD)	2.8911 (0.6076)	2.7361 (0.7319)	3.0255 (0.4197)	−1.40	0.170	0.048
Rank	1.43/4.16	1.43/4.16	2.42/3.86			

SD: Standard deviation.

3.3. Relationship between FD and MCW

Subsequently, the FD variable was correlated with the MCW variable, both in the total group and in the presence/absence of OI subgroups.

In Figure 4, the dot plot suggests the absence of a relationship between these variables. Along the same lines, the value of the correlation coefficient is very low (0.098) and is far from reaching statistical significance (p -value = 0.542).

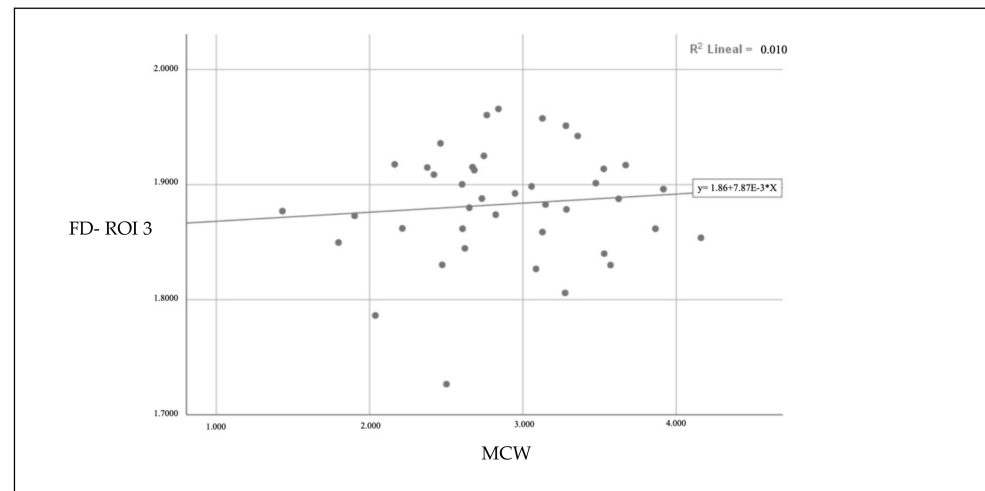


Figure 4. Relationship between fractal dimension index and mandibular cortical width ($n = 41$).

3.4. Analysis of OI Severity

Regarding severity of the disease, types III and IV were found to be the most severe when all the above mentioned parameters were analyzed, and the least severe was type I (Table 3). When analyzing the MCW, no statistically significant differences were obtained, but the effect size is a good sign of a possible relationship. The mean values indicate that MCW would be greater in Type III compared to the other types. In relation to MCI, C3 appeared mainly within type III (55.6%) and type IV (40.0%) compared to type I. Analyzing the differences in SVE, no significant differences were obtained, but the data showed a thinner visual estimate in OI type I (85.7%), compared to OI type III (60.0%)

Table 3. Intergroup analysis. Differences in radiological parameter variables, depending on the severity of OI.

Variable	OI Severity			Contrast Test		Effect Size R^2
	Type I	Type III	Type IV	Value	p	
SVE				1.08	0.581	0.052
Thin	85.7% (6)	77.8% (7)	60.0% (3)			
Not thin	14.3% (1)	22.2% (2)	40.0% (2)			
MCI				2.50	0.646	0.059
C1	14.3% (1)	0.0% (0)	20.0% (1)			
C2	57.1% (4)	44.4% (4)	40.0% (2)			
C3	28.6% (2)	55.6% (5)	40.0% (2)			
MCW						
Median (SD)	2.5439 (0.6384)	3.0399 (0.6185)	2.5718 (1.000)	1.14	0.340	0.113
Rank	1.90/3.67	1.80/3.92	1.43/4.16			

3.5. Influence of Bisphosphonate Cycles

To consider the intake of drug cycles, OI patients were classified into two groups, depending on the cycles of bisphosphonates administered (Table 4). However, in the light of the results obtained, differences can be observed that should be considered from the clinical point of view, and it is relevant to study them further by increasing the study sample.

Table 4. Intergroup analysis. Differences in radiological parameter variables as a function of the number of OI treatment cycles.

Variable	Treatment Cycles		Contrast Test		Effect Size R ²
	Few (n = 5)	Many (n = 8)	Value	p-Value	
SVE			0.44	0.506	0.034
Thin	80.0% (4)	62.5% (5)			
Not thin	20.0% (1)	37.5% (3)			
MCI			2.30	0.317	0.176
C1	20.0% (1)	12.5% (1)			
C2	60.0% (3)	25.0% (2)			
C3	20.0% (1)	62.5% (5)			
MCW					
Median (SD)	2.8234 (0.4044)	2.7834 (0.9745)	1.14	0.933	0.001
Rank	2.46/3.36	1.43/4.16			

SD: Standard deviation.

3.6. Age and Gender Differences

In terms of gender, the results found were that there is no statistical evidence to suggest that gender is a differential factor that produces any difference in these variables (Table 5).

Table 5. Intergroup analysis. Differences in the radiological parameter variables, according to the sex of the participants (n = 41).

Variable	Total Sample (n = 41)	Group				Contrast Test	
		Girls (n = 17)		Boys (n = 24)		Value	p-Value
		OI (n = 8)	Control (n = 9)	OI (n = 13)	Control (n = 11)		
SVE						1.06	0.303
Thin	73.2% (30)	62.5% (5)	66.67% (6)	84.62% (11)	72.73% (8)		
Not thin	26.8% (11)	37.5% (3)	33.33% (3)	15.38% (2)	27.27% (3)		
MCI						0.32	0.851
C1	34.1% (14)	0%	66.67% (6)	15.38% (2)	54.55% (6)		
C2	43.9% (18)	62.5% (5)	33.33% (3)	38.47% (5)	45.45% (5)		
C3	22.0% (9)	37.5% (3)	0%	46.15% (6)	0%		
FD							
Median (SD)	1.8831 (0.0488)	1.8874 (0.0340)		1.8800 (0.0575)		−0.48	0.635
MCW							
Median (SD)	2.8911 (0.6076)	2.9258 (0.5927)		2.8665 (0.6294)		−0.30	0.763

SD: Standard deviation.

According to age, this factor was dichotomized by the median, obtaining two groups: the first with 27 participants up to 11 years of age and the second with participants 12 years of age and older (Table 6). Significant differences in panoramic dental indices were found in younger patients, in whom a thinner SVE index and a more frequent C2-type MCI index were observed. However, older patients presented a wider SVE index and a C1-type MCI index.

Table 6. Intergroup analysis. Differences in the radiological parameter variables, according to the age of the participants (n = 41).

Variable	Total Sample (n = 41)	Group				Contrast Test	
		≤11 Years (n = 27)		≥12 Years (n = 14)		Value	p-Value
		OI (n = 17)	Control (n = 10)	OI (n = 4)	Control (n = 10)		
SVE						9.95	0.002
Thin	73.2% (30)	94.12% (16)	80% (10)	0%	60% (6)		
Not thin	26.8% (11)	5.88% (1)	20% (2)	100%(4)	40% (4)		
MCI						8.67	0.013
C1	34.1% (14)	5.88% (1)	40% (4)	25% (1)	20% (2)		
C2	43.9% (18)	52.94% (9)	60% (6)	25% (1)	80% (8)		
C3	22.0% (9)	41.18% (7)	0%	50% (2)	0%		
FD–Cortical Bone							
Median (SD)	1.8831 (0.0488)	1.8788 (0.0543)		1.89152 (0.0363)		−0.76	0.450
MCW							
Median (SD)	2.8911 (0.6076)	2.7885 (0.5308)		3.0889 (0.7130)		−1.53	0.135

SD: Standard deviation.

4. Discussion

To the authors' knowledge, the first study that evaluated radiomorphometric indices in orthopantomographies as well as fractal dimension performed in children with OI and compared to children with normal BMD was that by Apolinario et al. in 2015 [25] and in 2016 [1]. However, over the years, multiple studies have addressed the correlation between adult BMD on panoramic radiographs [19–21,28–30], postulating that this is a feasible screening tool for bone mass identification but requiring further investigation to include a child population with low BMD.

The present study is comparable to the one performed by Apolinario et al. in 2015 [25] and 2016 [1]. It uses similar methodology but is applied to a Spanish child population, with the aim of evaluating radiomorphometric indices and fractal dimension in children with OI to check for possible alterations in mandibular cortical in reference to treatment received with pamidronate. One of the limitations of the present study is that it was retrospective in time, which conditioned data availability.

The study groups and control group were balanced with respect to age and gender, ruling out any undesirable correlations that might influence the result.

The researchers of the present study highlight that, in the research conducted by Apolinario et al. in 2015 and 2016, the orthopantomographies of the patients with OI included in the study were taken at different times in the patient's life, during the pamidronate cycle, and indicate possible bone alterations before and after treatment with more or fewer cycles in the radiographs.

In general, the results of the present research show that the relationship between FD and MCW in the OI group is conducive to a relationship of mild intensity, in which the statistical evidence is insufficient, and less so in the control group.

Apolinario et al. in 2016 [1] point to the existence of a relationship between FD and MCW but not in all age groups (less significant in the group aged 11 to 14). Their explanation is that, in that age range, the patients had received more cycles of pamidronate than at the beginning of the treatment.

The statistically insufficient relationship between FD and MCW found in the results of the present study can be explained by the smaller size of study sample and the small amount of data on drug intake administered.

However, with respect to MCW in relation to OI, a lower mean value was found in this group of subjects compared to the control group. This suggests a possible tendency for subjects with OI to generally present lower MCW values than children with normal BMD. It should also be noted that there is an indication of a relationship between severity of the disease and the MCW value, with higher MCW values in type III OI. This is contrary to the study by Apolinario et al., whose MCW value increased more and with greater variability for type IV [1].

Regarding the measurement of FD in the trabecular bone (ROI 1 and 2), it was observed that it was a constant in all the subjects, since they presented the same value in the whole sample and were excluded from the study.

As in the study by Apolinario et al. [25], the results presented were not statistically significant between types of OI with respect to trabecular bone, concluding that there are two factors that could explain this effect: the first is the probability that the trabecular bone does not reflect the microarchitecture of the jaw, as in other bones, and, further, that the main effect of antiresorptive drugs is on the width of cortical bone, with little effect on the thickness of the trabecular bone. This is also supported by the research of Sindeaux et al. 2014, whose results suggest that measurements in cortical bone are more reliable than measurements in trabecular bone in discriminating between patients with normal BMD and osteoporotic patients [19].

Consequently, in our study, the FD measurement in the basal cortical bone (ROI 3) had a slightly lower mean value in the group of OI children, but not enough to accept that FD differs between OI cases and cases with normal BMD. Even less likely is a correlation with the type or severity of OI suspected.

As for the qualitative indices, SVE and MCI, statistically significant differences were found with respect to the presence or absence of OI, the severity of the disease, the intake of cycles of antiresorptive drugs, and according to age.

In most of the sample, the SVE is thin and the MCI presents more cases of C2, followed by C1 and less present C3, whereas, in the study of Apolinario et al. 2016, the SVE was mostly not thin as a consequence of the intake of several cycles of pamidronate, stating that mandibular cortical thickness increases after the first years of administration.

In the present research, the SVE did not present statistically significant differences that allow us to differentiate the OI cases from the control group subjects, which we can justify by the fact that since it is a child population, the width of the lower mandibular cortex is thinner, especially in younger children, due to mandibular growth.

However, there is an indicator of a possible relationship between the thinner SVE and the severity of the disease, mostly found in type I and III, respectively.

In contrast, MCI does correlate with the presence of OI, with type C2 being much more frequent in the study group, while type C1 is much more common among children in the control group. Depending on the severity of the disease, C3 cases appear mostly within type II and IV compared to type I. Type C2 subjects are similar in both groups.

The collection of a simple visual estimation (SVE) and the measurement of the mandibular cortical index (MCI), without the need to use sophisticated tools or programs, can suggest which will be the expected bone alterations in relation to antiresorptive treatment in children with OI, seen in serial panoramic radiographs over time [31].

The results obtained according to the intake of antiresorptive drugs show that there is no statistically significant evidence pointing to a relationship between the number of cycles administered to patients with OI and the mean values of the fractal dimension of the cortical bone and the mandibular cortical width. We find slightly lower values in these variables in the patients who had received more cycles in comparison with those who had ingested less or who had not received treatment directly. Our explanation for this finding is that the patients with OI who were receiving treatment with bisphosphonates presented

lower MCW and FD values, because their disease severity required abundant cycles that, in the long term, might lead to improvements in the variables, with a longer-term follow-up being necessary.

Regarding the study by Pantoja et al. in 2021 [24], the results were obtained that the DF analyzed in the right and left condyles was lower in the group of patients with OI than in the control group, as in our study in the ROI 3 parameter, in the analysis of the basal cortical bone.

Regarding the amount of drug administered, in the study by Pantoja et al. [24], they observed that there was a relationship between childhood patients who started their treatment for OI with bisphosphonates from early childhood and an improvement in the microarchitecture of the condylar bone.

5. Conclusions

In light of the results obtained, differences in the panoramic indices between the two groups can be observed. The FD of the basal cortical bone and the average value of the MCW were lower in children with OI compared to the control group.

There is a correlation between the amount of drug administered in the OI group and the MCW and FD variables in ROI 3. Another long-term study should be performed with a larger number of patients to evaluate the evolution of the antiresorptive drugs administered for the treatment of OI in each study subject and to find any resulting bone changes in the orthopantomographies and obtain more notable differences.

Bearing in mind that the oral alterations present in children with OI justify a protocolized panoramic X-ray at the beginning of the mixed dentition period, we consider that this examination could be used to study the bone effects of the antiresorptive medications they receive. This would make it possible to estimate the progress of the treatments and to consider how they relate to other diagnostic procedures such as densitometry.

Author Contributions: Conceptualization, M.J.d.N.-G. and L.B.-T.; methodology, L.G.-B. and L.B.-T.; software, L.G.-B.; validation, L.G.-B. and L.B.-T.; formal analysis, M.J.d.N.-G.; investigation, L.G.-B. and L.B.-T.; resources, M.J.d.N.-G.; data curation, L.B.-T.; writing—original draft preparation, L.G.-B.; writing—review and editing, L.B.-T.; visualization, M.J.d.N.-G.; supervision, M.J.d.N.-G.; project administration, M.J.d.N.-G. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Institutional Review Board Statement: The study was conducted in accordance with the Declaration of Helsinki, and approved by the Ethics Committee for Research with Medicines of the San Carlos Clinic Hospital (registration number 21/316-O_M_OD) for studies involving humans (13 May 2021).

Informed Consent Statement: Parents or legal guardians of all subjects participating in the study signed an Informed Consent Form, in which they agreed to participate in the research and allowed publication of data and images.

Data Availability Statement: The data presented in this study are available on request from the corresponding author upon reasonable request. The data are not publicly available due to privacy restrictions.

Acknowledgments: This study was made possible thanks to the support of the AHUCE Foundation which, by sponsoring research into Osteogenesis Imperfecta, contributes to improving both the quality of life and the care of these patients. The authors of the present work thank all the patients and their tutors for their participation in this research.

Conflicts of Interest: The authors declare no conflicts of interest.

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