

Prevalence of Impacted Incisors in Schoolchildren in Quito, Ecuador. A Cross-Sectional Study *

Prevalencia de incisivos retenidos en escolares de Quito, Ecuador. Estudio de corte transversal

Prevalência de incisivos impactados em escolares de Quito, Ecuador: um estudo transversal

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ABSTRACT

Background: The prevalence of impacted incisors varies between 0.01% and 16.92%. This variability may be due to differences in sampling and assessment methods. **Purpose:** To identify the prevalence and characteristics of impacted incisors by analyzing digital panoramic radiographs in patients with dental age 6 to 12 years, treated between January 2016 and August 2021 in Quito, Ecuador. **Methods:** Cross-sectional study. 8,000 digital panoramic radiographs from a radiology center in southern Quito were reviewed; 758 met the inclusion and exclusion criteria. Dental age, sex, presence of impacted incisors, type, number, height, angle, and distance from the midline, and associated alterations were recorded. The data were entered into a matrix and analyzed using SPSS v25. Descriptive statistics and the chi-square test were applied, with a 95% confidence level. **Results:** The prevalence was 11.9% (95% CI). It was more frequent in males (7.5%) and in the 8.0–8.9 year age group (4.3%). Tooth 21 was the most frequently affected (32%). In 67% of cases, a single impacted incisor was observed. Fifty percent were located 6–10 mm above the midline. Seventy-five percent presented an angle <20° with respect to the midline. Ninety percent had a distance greater than 0 from the midline. **Conclusions:** The prevalence of impacted incisors was higher in males and in dental ages between 7.0 and 8.9 years. Sex and age were associated with the presence and characteristics of dental impaction.

Keywords: dentistry; impacted teeth; incisors; mixed dentition; oral epidemiology; orthopantomography; prevalence; Quito, Ecuador

RESUMEN

Antecedentes: La prevalencia de retención de incisivos varía entre 0,01% y 16,92%. Esta variabilidad puede deberse a diferencias muestrales y métodos de evaluación. **Objetivo:** Identificar la prevalencia y las características de incisivos retenidos mediante el análisis de ortopantomografías digitales en pacientes con edad dental de 6 a 12 años, atendidos entre enero de 2016 y agosto de 2021, en Quito Ecuador. **Métodos:** Estudio de corte transversal. Se revisaron 8000 ortopantomografías digitales de un centro radiológico del sur de Quito; 758 cumplieron criterios de inclusión y exclusión. Se registraron edad dental, sexo, presencia de incisivos retenidos, tipo, cantidad, altura, ángulo y distancia respecto a la línea media, y alteraciones asociadas. Los datos se consignaron en una matriz y se analizaron en SPSS v25. Se aplicó estadística descriptiva y prueba de Chi cuadrado, con 95% de confianza. **Resultados:** La prevalencia fue 11,9% (IC 95%). Fue más frecuente en hombres (7,5%) y en el grupo de 8,0 a 8,9 años (4,3%). El diente 21 fue el más afectado (32%). En el 67% de los casos se observó un solo incisivo retenido. El 50% se ubicó a 6–10 mm de altura. El 75% presentó un ángulo <20° con respecto a la línea media. El 90% tuvo una distancia mayor que 0 respecto a la línea media. **Conclusiones:** La prevalencia de

incisivos retenidos fue mayor en hombres y en edades dentales entre 7,0 y 8,9 años. El sexo y la edad se asociaron con la presencia y con características de la retención dental.

Palabras clave: dientes retenidos; dentición mixta; epidemiología oral; incisivos; odontología; ortopantomografía; prevalencia; Quito, Ecuador

RESUMO

Antecedentes: A prevalência de incisivos impactados varia entre 0,01% e 16,92%. Essa variabilidade pode ser atribuída a diferenças nos métodos de amostragem e avaliação. **Objetivo:** Identificar a prevalência e as características de incisivos impactados por meio da análise de radiografias panorâmicas digitais de pacientes com idade dentária de 6 a 12 anos, tratados entre janeiro de 2016 e agosto de 2021 em Quito, Equador. **Métodos:** Estudo transversal. Foram revisadas 8.000 radiografias panorâmicas digitais de um centro de radiologia na zona sul de Quito; 758 atenderam aos critérios de inclusão e exclusão. Foram registrados idade dentária, sexo, presença de incisivos impactados, tipo, número, altura, ângulo e distância da linha média, além de alterações associadas. Os dados foram inseridos em uma matriz e analisados utilizando o SPSS versão 25. Foram aplicadas estatísticas descritivas e o teste qui-quadrado (confiança = 95%). **Resultados:** A prevalência foi de 11,9% (IC 95%). A impactação foi mais frequente em homens (7,5%) e na faixa etária de 8,0 a 8,9 anos (4,3%). O dente 21 foi o mais afetado (32%). Em 67% dos casos, observou-se um único incisivo impactado. Cinquenta por cento estavam localizados de 6 a 10 mm acima da linha média. Setenta e cinco por cento apresentavam um ângulo <20° em relação à linha média. Noventa por cento apresentavam uma distância maior que 0° da linha média. **Conclusões:** A prevalência de incisivos impactados foi maior em homens e na faixa etária dentária entre 7,0 e 8,9 anos. Sexo e idade estiveram associados à presença e às características da impactação dentária.

Palavras-chave: dentes impactados; dentição mista; epidemiologia oral; incisivos; odontologia; ortopantomografia; prevalência; Quito, Equador

INTRODUCTION

Tooth impaction is defined as the condition in which a tooth remains retained within the maxillary arches after reaching its expected time of eruption (1). According to the National Clinical Guidelines for the treatment of unerupted maxillary incisors in children from the School of Dental Surgery of the Royal College of Surgeons of England, incisors are considered unerupted when eruption of the contralateral incisor occurred more than six months earlier; when maxillary incisors remain intraosseous for more than one year after the eruption of mandibular incisors; or when there is a significant discrepancy from the usual eruption timing (2).

In Colombia, the overall prevalence of tooth impaction reported by Castañeda *et al.* is 9.70% (3). However, several studies show notable differences depending on the region and the age range evaluated. In the United States (4), China (5), and Cuba (6), impacted incisors have been reported with prevalences ranging from 0.02% to 6.2%. In Mexico, the percentage of impacted incisors was 10.7% (7). In Argentina, a study based on panoramic radiographs of children aged 6 to 15 years reported a prevalence of 16.92% (8). Fardi *et al.* (9) stated that discrepancies between their findings and those of other studies could be attributed to the geographic area from which the sample was drawn.

Regarding sex, a higher prevalence of impacted incisors has been reported in males (76%) than in females (23.1%) (6). By age, prevalence has been higher among individuals aged 7 to 9 years (2). Several studies have indicated that maxillary incisors are the teeth most affected by this type of impaction (5,6,10). In addition, it has been reported that, in general, 83% of individuals with impaction present a single impacted incisor (10). The etiology has been associated with hereditary factors such as cleidocranial dysostosis; endocrine disorders and bone diseases; local factors such as supernumerary teeth, odontomas, cleft lip and palate, abnormal tooth–tissue relationships, malformations, microdontia, gingival fibromatosis, and delayed eruption chronology; and environmental factors such as dilacerations, ectopic positions, retained primary dentition or early exfoliation, trauma, and cysts (1,5).

It should be considered that incisor impaction is more frequent at younger ages and requires timely treatment. These teeth are important for facial aesthetics (11) and may have psychosocial impact.

Therefore, parents of children with tooth impaction often seek professional care early to improve their children's quality of life. Early treatment is associated with a better prognosis (12). In addition, certain features of impacted incisors may influence the therapeutic approach chosen by specialists (13), making treatment more complex and prolonged. Tooth impaction may also be associated with complications such as midline deviation, rotations, and root resorption, among others (14).

For this reason, studies are needed to investigate tooth impaction from early ages. In addition, it is important to note that in Ecuador and other Andean countries there are no studies focusing exclusively on impacted incisors. Based on the above, the following research question was formulated: "What is the prevalence and what are the characteristics of impacted incisors on panoramic radiographs of patients with a dental age between 6 and 12 years, evaluated in radiology services in southern Quito, during the 2016–2021 period?"

MATERIALS AND METHODS

An observational cross-sectional study was conducted. Approximately 8,000 digital panoramic radiographs were analyzed from individuals who attended a radiology center in Quito during the 2016–2021 period. The center is located in the urban southern area of Quito and serves a population predominantly from middle and lower-middle socioeconomic level, according to the Quito Urban Information Center (CIUQ). This enabled access to a large sample of the population using services in the city. CIUQ was selected based on accessibility and coverage criteria because it was the only facility that provided access to panoramic radiographs at no cost per record. This allowed the collection of a large sample in an ethical and feasible manner. In addition, CIUQ receives patients referred from multiple dental clinics and private dental offices in southern Quito, which supports case diversity.

Radiograph collection and analysis were performed by a general dentist from Universidad Central del Ecuador, who received prior standardized training from an oral surgeon and faculty member at the same university in applying the Demirjian method and identifying impacted incisors according to the defined criteria. Training sessions were conducted on the use of Scanora 5.2.6 software. Formal intra- and inter-observer calibration using the kappa index was not performed. However, a joint review procedure was implemented for discrepant cases to reach consensus. In addition, agreement (κ) was estimated for the measurements (height, angle, and distance) and for impaction identification to ensure result consistency.

From an approximate total of 8,000 digital panoramic radiographs archived between 2016 and 2021, a data-cleaning process was conducted based on inclusion criteria, exclusion criteria, and an operational review. In the first phase, only radiographs from patients with a dental age between 6 and 12 years, according to the Demirjian method (15), were selected, provided they had adequate diagnostic quality and a recorded sex. Next, the exclusion criteria were applied, and radiographs with technical errors, inconsistent records, or duplicates were removed, as well as those in which sex could not be determined due to the presence of unisex names. After completing this systematic process, 758 panoramic radiographs met all predefined criteria and were included in the final analysis.

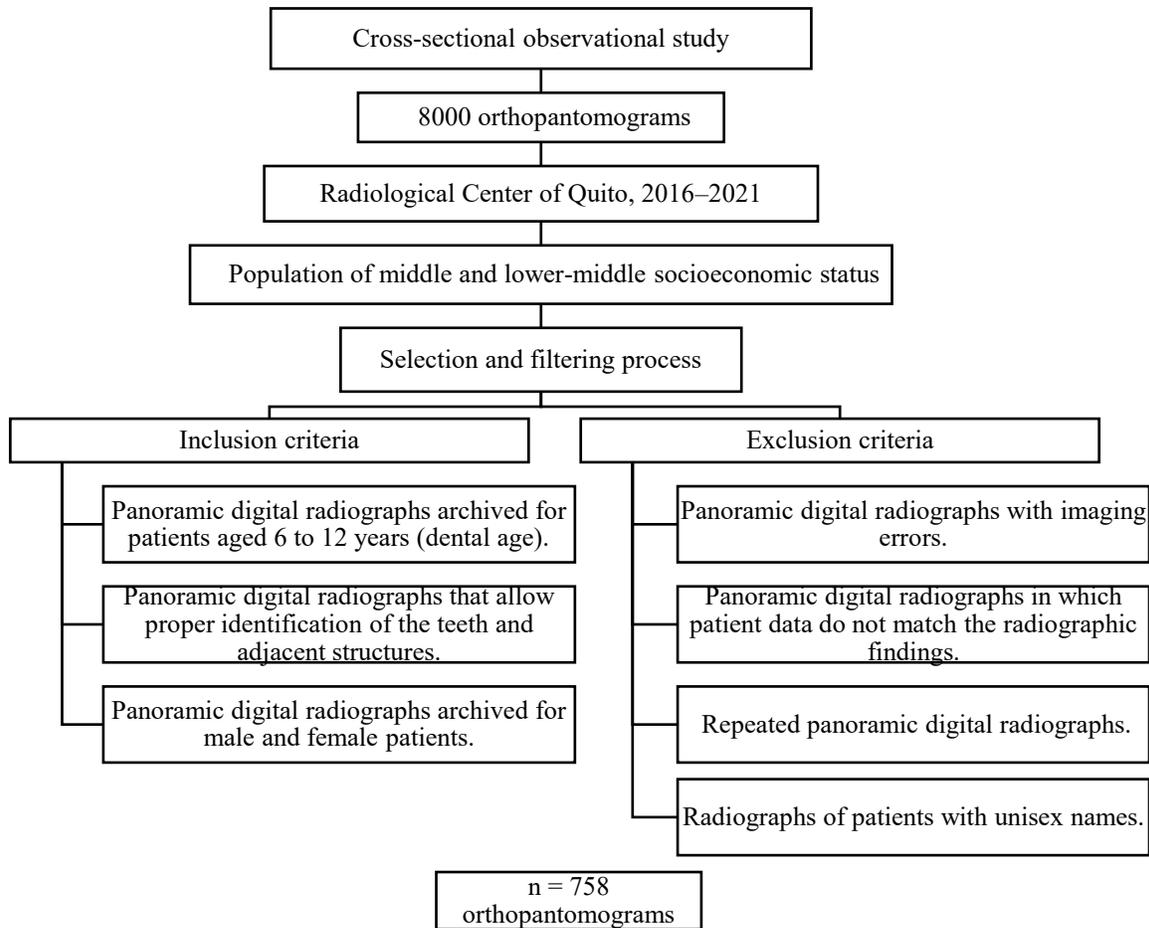


FIGURE 1
Flowchart for Selection and Purification of the Radiographic Sample
Prepared by: Researcher

Subsequently, panoramic radiographs showing impacted incisors were selected. Sex was then identified and recorded according to the information documented on the radiograph as female or male. Dental age was obtained using the Demirjian method, based on the analysis of seven permanent mandibular left teeth. According to the total sum of the stages assigned to each evaluated tooth, the radiographs were classified within a dental age range of 6 to 12 years.

The Demirjian method is among the most widely used approaches for estimating dental age from panoramic radiographs because of its accuracy and reproducibility (16). This method assesses the permanent left mandibular teeth using maturation stages categorized from A to H, which are defined according to changes in the shape and development of the tooth (15) (Figure 2).

Each stage has a different score depending on sex, female or male. The sum of the values assigned to each tooth allows dental age to be estimated, which is determined by the intersection of the total score with the corresponding curve, as shown in Figure 3, as described by Demirjian et al. (15).

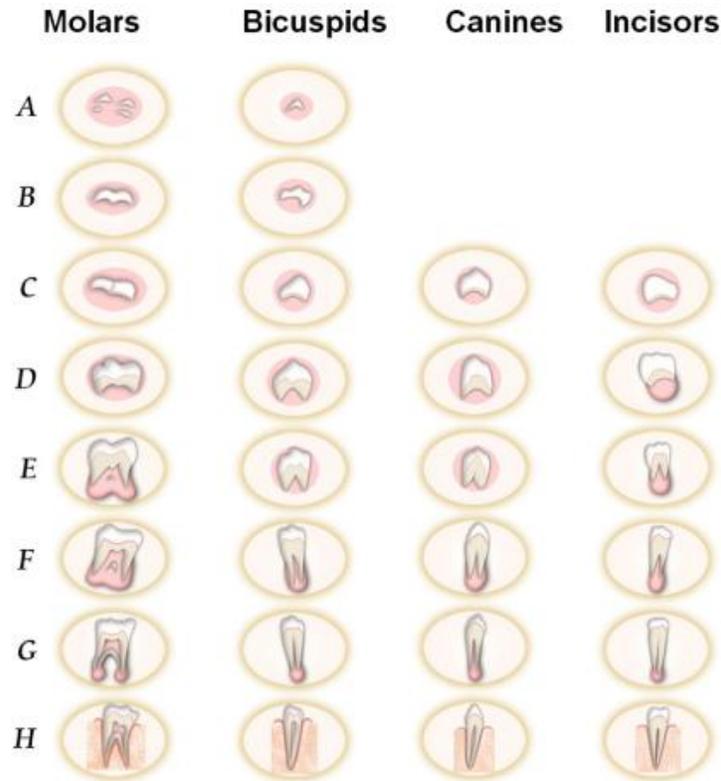


FIGURE 2
Dental Mineralization

Taken from Vasconcelos et al., (17). A) Calcification of some occlusal points without fusion; B) Fusion of mineralization points with defined occlusal dental contour; C) Conclusion of enamel formation and beginning of dentin deposition; D) Formation of the crown up to the cementoenamel junction; E) The root length is shorter than the crown height; F) The root length is equal to or greater than the crown length; G) Root formation is complete; apex remains open; H) Closure of the apex.

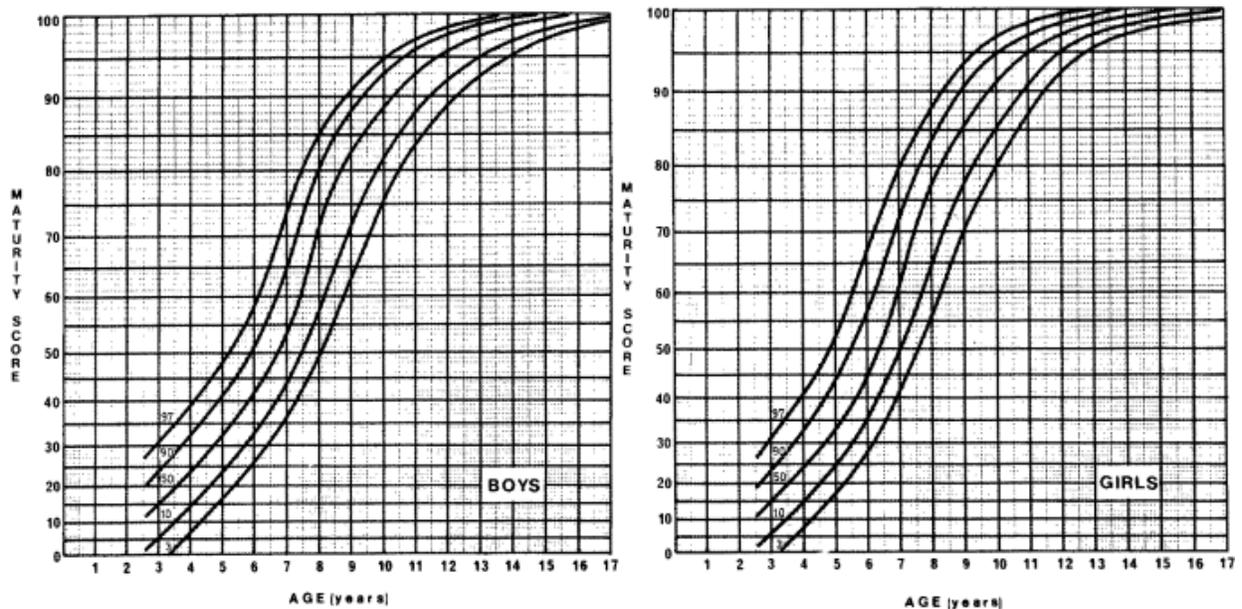


FIGURE 3
Percentage of Dental Maturation in Boys and Girls
Taken from Demirjian et al., (15).

TABLE 1
Conversion of maturation score to dental age in boys (7 teeth)

Age	Score	Age	Score	Age	Score	Age	Score
3	12.4	0.5	29.5	8	71.6	0.5	90.6
0.1	12.9	0.6	30.3	0.1	73.5	0.6	91
0.2	13.5	0.7	31.1	0.2	75.1	0.7	91.3
0.3	14	0.8	31.8	0.3	76.4	0.8	91.6
0.4	14.5	0.9	32.6	0.4	77.7	0.9	91.8
0.5	15	6	33.6	0.5	79	11	92
0.6	15.6	0.1	34.7	0.6	80.2	0.1	92.2
0.7	16.2	0.2	35.8	0.7	81.2	0.2	92.5
0.8	17	0.3	36.9	0.8	82	0.3	92.7
0.9	17.6	0.4	38	0.9	82.8	0.4	92.9
4	18.2	0.5	39.2	9	83.6	0.5	93.1
0.1	18.9	0.6	40.6	0.1	84.3	0.6	93.3
0.2	19.7	0.7	42	0.2	85	0.7	93.5
0.3	20.4	0.8	43.6	0.3	85.6	0.8	93.7
0.4	21	0.9	45.1	0.4	86.2	0.9	93.9
0.5	21.7	7	46.7	0.5	86.7	12	94
0.6	22.4	0.1	48.3	0.6	87.2	0.1	94.2
0.7	23.1	0.2	50	0.7	87.7	0.2	94.4
0.8	23.8	0.3	52	0.8	88.2	0.3	94.5
0.9	24.6	0.4	54.3	0.9	88.6	0.4	94.6
5	25.4	0.5	56.8	10	89	0.5	94.8
0.1	26.2	0.6	59.6	0.1	89.3	0.6	95
0.2	27	0.7	62.58	0.2	89.7	0.7	95.1
0.3	27.8	0.8	66	0.3	90	0.8	95.2
0.4	28.6	0.9	69	0.4	90.3	0.9	95.4

Prepared by the authors, based on Demirjian et al., (15).

Note. The points represent the sum of the mineralization stages assigned to each tooth, which indicates the dental age corresponding to the total score in male children.

TABLE 2
Conversion of maturation score to dental age in girls (7 teeth)

Age	Score	Age	Score	Age	Score	Age	Score
3	13.7	0.5	33	8	78.8	0.5	93.2
0.1	14.4	0.6	34	0.1	80.2	0.6	93.5
0.2	15.1	0.7	35	0.2	81.2	0.7	93.7
0.3	15.8	0.8	36	0.3	82.2	0.8	94
0.4	16.6	0.9	37	0.4	83.1	0.9	94.2
0.5	17.3	6	38	0.5	84	11	94.5
0.6	18	0.1	39.1	0.6	84.8	0.1	94.7
0.7	18.8	0.2	40.2	0.7	85.3	0.2	94.9
0.8	19.5	0.3	41.3	0.8	86.1	0.3	95.1

0.9	20.3	0.4	42.5	0.9	86.7	0.4	95.3
4	21	0.5	43.9	9	87.2	0.5	95.4
0.1	21.8	0.6	45.2	0.1	87.8	0.6	95.6
0.2	22.5	0.7	46.7	0.2	88.3	0.7	95.8
0.3	23.2	0.8	48	0.3	88.8	0.8	96
0.4	24	0.9	49.5	0.4	89.3	0.9	96.2
0.5	24.8	7	51	0.5	89.8	12	96.3
0.6	25.6	0.1	52.9	0.6	90.2	0.1	96.4
0.7	26.4	0.2	55.5	0.7	90.7	0.2	96.5
0.8	27.2	0.3	57.8	0.8	91.1	0.3	96.6
0.9	28	0.4	61	0.9	91.4	0.4	96.7
5	28.9	0.5	65	10	91.8	0.5	96.8
0.1	29.7	0.6	68	0.1	92.1	0.6	96.9
0.2	30.5	0.7	71.8	0.2	92.3	0.7	97
0.3	31.3	0.8	75	0.3	92.6	0.8	97.1
0.4	32.1	0.9	77	0.4	92.9	0.9	97.2

Prepared by the authors, based on Demirjian et al., (15).

Note. The points represent the sum of the mineralization stages assigned to each tooth, which indicates the dental age corresponding to the total score in female children.

Therefore, after analyzing each panoramic radiograph using the Demirjian method, 758 met all inclusion and exclusion criteria. From the total sample, a subsample of 90 panoramic radiographs with impacted incisors was identified. In this subsample, detailed analyses were performed for the type of affected tooth, height, angle, distance to the midline, and associated alterations.

The height variable was collected based on the article “Retrospective analysis of factors influencing the eruption of delayed permanent incisors after supernumerary tooth removal” (18). The vertical distance between the anterior nasal spine (ANS) and the incisal edge of the impacted tooth was recorded in millimeters (mm). Height was classified using the intervals 0–5 mm, 6–10 mm, 11–15 mm, and >15 mm, according to the ranges proposed in the same study (18). The authors defined these cutoffs because the vertical position of the impacted tooth is a clinically relevant predictor of eruption time after removal of local obstacles. In that study, these intervals allowed the severity of impaction to be categorized and its relationship with the likelihood of spontaneous eruption and treatment duration to be analyzed (18).

Measurements were performed using the digital millimeter ruler in Scanora 5.2.6 software, which automatically calibrates the scale of each panoramic image according to the radiographic unit’s acquisition parameters. This ensures accurate and reproducible linear measurements. Anatomical reference lines were drawn within the program, including the midline traced from ANS and the tooth’s long axis. In this way, the measurement points reliably corresponded to the anatomical structures.

The angle relative to the midline was collected based on the article “Impacted central incisors: Factors affecting prognosis and treatment duration” (13). For this analysis, the angle between the long axis of the impacted tooth and the midline, drawn perpendicular to the occlusal plane and passing through the ANS, was measured. This variable was classified according to the same author’s criteria (13) into two categories: <20° and >20°.

Because Scanora 5.2.6 does not include an integrated angle-measurement tool, the reference lines were digitally drawn within the software. The angle formed between them was then measured using a manual protractor placed directly on the screen. This procedure is methodologically valid because the software allows precise straight lines to be drawn, calibrated to the image magnification, even though it

does not automatically calculate angular measurements. By aligning the protractor at the intersection point of the two lines, an exact reading of the angle is obtained, ensuring agreement between the manual measurement and the previously drawn digital lines.

The distance-to-midline variable was defined based on the article “Impacted central incisors: Factors affecting prognosis and treatment duration” (13). On panoramic radiographs, it was measured as the distance between the most mesial portion of the crown of the impacted tooth and the midline. It was classified as <0 mm, when the crown crossed the midline, or >0 mm when it did not. Associated complications were identified by observation and classified according to the article “Unerupted permanent incisors and associated dental anomalies” by Tan *et al.* (14).

Data were recorded in an Excel database with range validation to minimize errors and were then analyzed using SPSS statistical software, version 25.0. Descriptive statistics were performed to estimate the prevalence of impacted incisors. To compare categorical variables, such as sex (male/female) and dental-age groups, the chi-square test was applied because it allows assessment of associations between qualitative variables. For all prevalence estimates and inferential analyses, a 95% confidence interval (95% CI) was used, corresponding to a 5% margin of error and a statistical significance level set at $p < 0.05$.

Because the study did not include *a priori* sample size calculation, a *post hoc* power analysis was performed. For prevalence estimation and for the main association assessed with the chi-square test, with a significance level of $p < 0.05$ and a 95% confidence interval (95% CI), *post hoc* statistical power was adequate based on the effect size observed in the data. The identification of associations with $p < 0.05$ supports that the final sample ($n = 758$) had sufficient power to detect true differences among the evaluated variables, despite the absence of a prior sample size calculation.

The study was approved by the Research Ethics Committee of the Centra University of Ecuador’s School of Dentistry under Project No. 2020-2021, with approval dated February 10, 2022. Secondary data from panoramic radiographs were used, and anonymization was ensured before analysis to protect patient identity. The data were stored on secure electronic media with access restricted to the research team. They were retained for one year exclusively for research purposes. All procedures adhered to the bioethical principles of beneficence, non-maleficence, justice, and autonomy. In addition, applicable national and international regulations were followed. No conflicts of interest or personal relationships with the institution or its staff were declared.

RESULTS

Data were analyzed using descriptive statistics to obtain absolute and relative frequencies. To assess associations between variables, the chi-square test was used with a significance level of 0.05 and a 95% confidence level (95% CI), with a 5% margin of error. The findings described below correspond to users of an urban radiology center in southern Quito.

TABLE 3

Percentage distribution of the prevalence of impacted incisor teeth according to demographic variables, sex and age

Variables	N	Frequency (%)		Cum. %	\bar{X}	SD	95% CI
		Presence	Absence				
Analyzed orthopantomograms	758	90(11.9)	668(88.1)	100 %	-	-	
Sex							
Male	375	57(7.5)	318(42.0)	49.4 %	-	-	
Female	383	33(4.4)	350(46.1)	100 %			
Dental age (Demirjian method)							
6-6.9	39	2(0.2)	37(4.8)	5.15 %	9.58	1.78	9.21 – 9.95
7-7.9	141	21(2.7)	120(15.8)	23.75 %			
8-8.9	147	33(4.3)	114(15.0)	43.14 %			

9-9.9	115	18(2.3)	97(12.8)	58.31 %
10-10.9	100	5(0.6)	95(12.5)	71.50 %
11-11.9	141	8(1.1)	133(17.6)	90.11 %
12-12.9	75	3(0.4)	72(9.5)	100.00 %
Total	758	90(11.9)	668(88.1)	

\bar{X} : Mean (average of a data set). SD: Standard deviation (dispersion of the data relative to the mean)

Prepared by: Researcher

Table 3 shows that, among the 758 panoramic radiographs analyzed, 11.9% presented dental impaction (95% CI). Of the total cases, 7.5% corresponded to males. According to dental age estimated using the Demirjian method, the group with the highest proportion of dental impaction was 8.0 to 8.9 years, at 4.3%. At the extremes, ages 6 and 12 years showed proportions of 0.2% and 0.4%, respectively. Clinically, early diagnosis of dental impaction and characterization of its findings influence treatment prognosis because they are considered relevant predictors of the likelihood of spontaneous eruption and treatment duration.

TABLE 4

Percentage distribution of the 111 impacted incisor teeth according to incisor type, quantity, height (mm), angle and distance with the midline, and alterations in orthopantomograms

Clinical variables	Frequency (percentage)	Cumulative percentage	\bar{X}	SD
Type of incisor*				
11	18(16,2)	16.2	-	-
12	17(15.6)	31.5		
21	36(32.4)	64.0		
22	25(22.5)	86.5		
31	2(1.8)	88.3		
32	10(9.0)	97.3		
41	0(0.0)	97.3		
42	3(2.7)	100		
Number of incisors				
1	74(66.7)	67.7	1.42	0.65
2	27(24.3)	91.0		
3 or more	10(9.0)	100		
Height				
0-5	37(33.3)	33.3	7.11	3.92
6-10	56(50.5)	83.8		
11-15	15(13.5)	97.3		
16-20	3(2.7)	100		
Angle with the midline				
>20	28(25.2)	25.2	-	-
<20	83(74.8)	100		
Distance from the midline				
<0	11(9.9)	9.9	-	-
>0	100(90.1)	100		
Total	111(100)			

* FDI World Dental Federation notation

\bar{X} : Mean. SD: Standard deviation

Prepared by: Researcher

Table 4 shows that the most frequently impacted incisor was tooth 21 (32%) (FDI World Dental Federation notation), followed by tooth 22 (23%) and tooth 31 (2%). No cases were recorded for tooth 41. In total, 111 impacted incisors were identified. In addition, 67% of the panoramic radiographs showed a single impacted incisor, 24% showed two impacted incisors, and 9% showed three or more impacted incisors.

Of the 111 impacted incisors identified, 50% were located at a height between 6 and 10 mm, with a mean height of 7.11 mm. Regarding the angle relative to the midline, 75% of the impacted incisors showed an angle of less than 20°. With respect to distance to the midline, 90% of the impacted incisors had a distance greater than 0, whereas 10% had a distance less than 0. This shows a negative deviation relative to the midline.

TABLE 5
Percentage distribution of the 203 associated alterations present in impacted incisor teeth in orthopantomograms

Associated alteration	Frequency (percentage)	Cumulative percentage
Midline deviation	57(28.1)	28.10
Ectopic position, displacements, rotations	55(27.1)	55.20
Early exfoliation	4(2.0)	57.20
Space loss	75(36.9)	94.10
Root resorption	1(0.5)	94.60
No alterations	11(5.4)	100.00
Total	203(100.0)	

Prepared by: Researcher

Table 5 presents the associated alterations, with a total of 203 findings. Space loss was the most frequent alteration (36.9%), followed by midline deviation (28.1%), and ectopic positions, displacements, and rotations (27.1%). Cases with no associated alterations accounted for only 5.4%.

TABLE 6
Analysis of the presence of dental retention with sex and age; age and angle with the midline

Variable	Category	Presence of Retention N (%)		Absence of Retention N (%)		n	P	
Sex	Male	57 (7.5)	318 (42.0)	375	0.007			
	Female	33 (4.4)	350 (46.1)	383				
Dental Age	6-6.9	2 (5.1)	37 (94.9)	39	<0.001			
	7-7.9	21 (14.9)	120 (85.1)	141				
	8-8.9	33 (22.4)	114 (77.6)	147				
	9-9.9	18 (15.7)	97 (84.3)	115				
	10-10.9	5 (5.0)	95 (95.0)	100				
	11-11.9	8 (5.7)	133 (94.3)	141				
	12-12.9	3 (4.0)	72 (96.0)	75				
Angle with Midline	Dental Age							
		6-6.9	7-7.9	8-8.9	9-9.9	10-10.9	11-11.9	12-12.9
<20	1(1.2)	22(26.5)	35(42.2)	16(19.3)	2(2.4)	6(7.2)	1(1.2)	0,005
>20	1(3.6)	4(14.3)	8(28.6)	5(17.9)	4(14.3)	3(10.7)	3(10.7)	

P = Significance level $p \leq 0.05$

Chi-square test

Source: Research

Prepared by: Researcher

Table 6 shows that the chi-square test between the presence of impacted incisors and sex yielded $p = 0.007$, which is below 0.05. Therefore, both variables are associated with a 95% confidence level. Likewise, the highest frequency of dental impaction was observed in the dental-age group of 8.0 to 8.9 years. The association between the presence of impaction and dental age showed $p < 0.001$, with a 95% confidence level, indicating sufficient statistical evidence of an association. In addition, a higher proportion of cases with an angle $<20^\circ$ was observed in the 8.0 to 8.9 dental-age group. The relationship

between the angle relative to the midline and dental age yielded $p = 0.005$, confirming a statistically significant association between these variables at the 95% confidence level.

TABLE 7

Cross-tabulation of the association of the variables age and sex with the presence of dental retention in orthopantomograms

Retained incisor	Boys aged 7–9 (%)	Boys not aged 7–9 (%)	Girls aged 7–9 (%)	Girls not aged 7–9 (%)	P-value
Absence	108(75.0)	210(91.0)	126(88.0)	224(94.0)	<0,001
Presence	36(25.0)	21(9.0)	18(13.0)	15(6.0)	
Total	144(100.0)	231(100.0)	144(100.0)	239(100.0)	

P = Significance level $p \leq 0.05$

Chi-square test

Source: Research

Prepared by: Researcher

In Table 7, the population is classified into four groups: males and females between 7 and 9 years of dental age, and males and females outside the 7-to-9-year dental-age interval. With this classification, the group of “males between 7 and 9 years” showed the highest incidence of cases with impacted incisors compared with the other groups. The p value of <0.001 , with a 95% confidence level, provided sufficient statistical evidence of an association between the presence of impacted incisors and belonging to the male group aged 7 to 9 years in dental age. This suggests that male sex and a dental age of 7 to 9 years are relevant factors in the presence of dental impaction. Clinically, this finding highlights the importance of early detection of impacted incisors in this age group, which is a critical period for the eruption of permanent incisors. Timely identification supports planning of preventive or corrective interventions, such as radiographic follow-up, extraction of persistent primary teeth, or referral for orthodontic treatment. This approach can help prevent subsequent complications, including malocclusions, displacement of adjacent teeth, and esthetic alterations.

DISCUSSION

The prevalence of impacted incisors reported by Grover *et al.* (4) and Topkara *et al.* (19) was low, ranging from 0.02% to 0.6%. These results were obtained from panoramic radiographs of patients aged 17 years and older, which may explain the lower prevalence observed. One possible reason is that parents generally seek treatment at early ages when their children have dental problems to improve their quality of life. This condition may affect both esthetics and psychological well-being (20). When compared with regional Ibero-American studies, there is a scarcity of research published in scientific journals that focuses exclusively and in detail on the prevalence of impacted incisors in children. In the region, most available studies tend to address impaction of other teeth, such as canines or third molars, or dental anomalies in general. In Ecuador, a bibliographic search did not identify studies on this topic. Therefore, this research aims to contribute information that helps dentists maintain appropriate clinical vigilance in pediatric patients and provide timely referral to a specialist when warranted.

In a study by Tan *et al.* (5), conducted in Hong Kong with a sample of 15,987 subjects aged 7.3 to 13.8 years, 2% presented impacted incisors. According to Borges *et al.* (6), a study in Cuba including 122 patients aged 8 to 18 years reported a 6.5% prevalence of impacted incisors. In Mexico, a study of 148 patients aged 8 to 35 years with at least one impacted tooth found that 10.7% corresponded to impacted incisors (7). In Argentina, a study of 300 panoramic radiographs from children aged 6 to 15 years reported an impacted incisor rate of 16.92% (8). In the present study, based on 758 panoramic radiographs, prevalence was 11.9%, which is close to the figures reported by Borges *et al.* (6), Herrera

et al. (7), and Amado *et al.* (8). According to Castañeda *et al.* (3), these differences may also be explained by the geographic areas where the studies were conducted and, even, by the methodological design used. In addition, at older ages, impacted incisors have likely already been treated.

In the study by Topkara *et al.* (19), conducted in a population aged 13 to 16 years, prevalence of incisor impaction was 0.65%. According to El-Khateeb *et al.* (21), in a population aged 20 to 40 years, prevalence was 0%. In contrast, Borges *et al.* (6) reported that impacted incisors more frequently affected individuals aged 8 to 13 years, which aligns with our study, where the greatest impact was observed between 8.0 and 8.9 years of dental age, at 37%. This may explain the similarity with studies that included younger ages in their samples (6–8). It also suggests that mixed dentition is a critical period for detecting impacted incisors and that timely early treatment is necessary (13,22,23), which improves prognosis. Consequently, studies in populations aged 13 years and older commonly report low prevalence values because many cases were likely treated earlier.

In this study, 758 panoramic radiographs were analyzed. Dental impaction was identified in 11.9% of cases: 7.5% corresponded to males and 4.4% to females, with an approximate ratio of 1:1.7. This finding is consistent with Borges *et al.* (6), who reported greater involvement in males (76%) than in females (23.1%). It also aligns with Topkara *et al.* (19), who observed a higher prevalence in males with a 3.8:1 ratio and attributed it to a possible involvement of sex chromosomes in the etiology of eruption disturbances. In addition, Tan *et al.* (5) suggested that the higher prevalence of supernumerary teeth in males could be related to this difference. However, in this study, supernumerary teeth were recorded in only 9 cases. Although some studies did not find statistically significant differences between sex and dental impaction (19,24,25), this study showed a significant association, with $p = 0.007$ at a 95% confidence level. It should also be considered that a common cause affecting maxillary central incisors is dentoalveolar trauma, which, according to Castro *et al.* (26), has a higher prevalence in males, as do roots with dilaceration (27).

However, although each test was conducted individually with a significance level of 0.05, exploring multiple associations among variables increases the risk of a type I error. Therefore, the results should be interpreted with caution, as some findings may represent false positives due to multiple comparisons.

Regarding the type of incisor most frequently impacted, Grover *et al.* (4) reported that the maxillary central incisor accounted for 75% and the maxillary lateral incisor for 25%. In the study by Bartolo *et al.* (10), impacted maxillary central incisors occurred in 95% of cases, maxillary lateral incisors in 2%, and mandibular lateral incisors in 2%, whereas mandibular central incisors showed no cases (0%). Borges *et al.* (6) reported that the teeth with the highest prevalence were left maxillary incisors, at 69.2%. Tan *et al.* (5) found that maxillary central incisors were the most frequently affected teeth (70.6%), followed by maxillary lateral incisors (22.5%), mandibular lateral incisors (4.1%), and mandibular central incisors (2.8%). In the study by Amado *et al.* (8), maxillary central incisors were also the most affected (72.73%), followed by the right maxillary lateral incisor (18.18%). These findings are consistent with the present study, in which the left maxillary central incisor showed the highest prevalence (32%), followed by the left maxillary lateral incisor (23%) and the right maxillary central incisor (16%). In this series, the only tooth with no impaction cases was the right mandibular central incisor. This may be related to the etiology of impaction, as Tan *et al.* (5) reported that 27.5% of cases were associated with dilacerations, which most commonly affect maxillary central incisors.

Regarding the number of impacted incisors per patient, this study recorded a total of 111 impacted incisors. Of the panoramic radiographs, 67% showed a single impacted incisor, 24% showed two impacted incisors, and 9% showed three or more impacted incisors. These results are consistent with Tan *et al.* (5), who reported that 68.8% of individuals had one unerupted incisor, 26.9% had two, 1.9% had three, and 2.5% had four. In contrast, Bartolo *et al.* (10) reported that 83% of their sample had one unerupted incisor and 17% had two unerupted incisors.

Based on the study by Bryan *et al.* (18), the results of this research showed that 50% of impacted incisors were located at a height of 6 to 10 mm relative to the occlusal plane, followed by 33% between

0 and 5 mm. These findings do not align with those reported by Bryan *et al.* (18), who observed a higher prevalence in the 11-to-15 mm interval. In addition, that study included panoramic, periapical, and occlusal radiographs. Likewise, no similarities were found with Caushu *et al.* (13), who assessed periapical and panoramic radiographs as well as cone-beam computed tomography and reported that most cases were located in the apical third.

Regarding the angle relative to the midline, 75% of the impacted incisors in this study showed an angle of less than 20°. This result differs from Chaushu *et al.* (13), who used panoramic radiographs and tomography and reported a higher frequency of cases with angles greater than 20°. However, it is consistent with Bryan *et al.* (18), whose study was based on panoramic radiographs and found a higher percentage (86.4%) in the group with angles below 30°. In addition, the association between angle and dental age was significant ($p = 0.005$), with more cases showing an angle <20° among those aged 8.0 to 8.9 years in dental age. Regarding distance to the midline, 90% of impacted incisors had a distance greater than 0, whereas only 10% had a distance less than 0. This contrasts with the findings of Chaushu *et al.* (13), who reported that approximately 49% of cases had a distance less than 0 and 50% had a distance greater than 0.

Variations in height, angle, and distance-to-midline measurements between this study and the cited literature suggest a lack of universal standardization in radiographic measurement protocols. Although panoramic radiographs are used, subtle differences in reference points, interpretation of lines or planes, or even software calibration can lead to divergent results. This highlights the need for future research aimed at greater standardization of radiographic measurement methods for impacted incisors. This study acknowledges that panoramic radiography has limitations for accurately determining position and angulation compared with cone-beam computed tomography, which is the most precise method for establishing the location of dental impactions (22). Nevertheless, panoramic radiography is considered the initial diagnostic method of choice for determining mesiodistal and vertical location (23). It is also recognized as a fundamental and indispensable diagnostic tool in routine consultations because it is widely accessible in dental practice. In addition, this study has limitations related to convenience sampling and the use of a single radiology center as the data source, which prevents extrapolation of the findings to the general population. Other limitations include the lack of observer calibration, exclusive use of panoramic radiographs, absence of secondary data such as clinical records, and the potential discrepancy between patients' chronological age and dental age.

The high prevalence of associated alterations (94.6%) observed in this study underscores the complexity of incisor impaction and the need for a comprehensive evaluation. Although Tan *et al.* (14) also reported a high frequency of alterations (75.9%) in unerupted incisors, the most common complication in their study was the group of ectopic positions, rotations, and displacements (46.6%). This differs from the present study, in which space loss was the most prevalent alteration (36.9%). This discrepancy may be explained by specific characteristics of the populations studied or by differences in the timing of diagnosis. Space loss may occur as an earlier or more common consequence in a pediatric population, whereas ectopic positions may represent a primary manifestation or a more advanced complication when diagnosis occurs at later stages.

This study was conducted in a low and lower-middle socioeconomic setting. Therefore, it is important to consider that not all individuals can access all diagnostic tools, such as panoramic radiography, because it is not routinely available in public health centers. Some facilities provide periapical radiographs. However, to receive specialized care, tertiary-level services often require computed tomography as a prerequisite, which is less accessible for low-income populations. Sociodemographic variables have been shown to explain the presence of risk factors and etiologic drivers of health phenomena (28). Likewise, a study conducted in Peru found a statistically significant association between parents' educational level, family responsibility, and occupation and the presence of dental caries in their children in a rural area (29). It has also been reported that low socioeconomic status limits patients' ability to invest in private dental treatment. In addition, individuals with fewer

resources and lower educational attainment have been described as having a higher frequency of edentulism (30). Therefore, it can be argued that the socioeconomic status of families of patients with dental impaction influences access to timely diagnosis and treatment.

Therefore, this research is important because of its direct relevance for understanding and intervening in dental impaction. Consequently, dentists in both the public and private sectors will be more alert and aware that this condition frequently occurs during mixed dentition, which facilitates early diagnosis. This increases the likelihood of a favorable prognosis when prompt and timely treatment is provided (12). The benefit extends to the population affected by this anomaly because it helps prevent complications that not only hinder the management of impacted incisors but can also lead to serious problems such as root resorption of adjacent teeth, dental rotations, and midline deviation.

In Ecuador, there is limited information on impacted incisors, despite the fact that this is one of the forms of dental impaction with the greatest esthetic impact (11). Therefore, this research made it possible to obtain statistical data on the prevalence of this anomaly in our population and to analyze the association between demographic variables and dental impaction. Future studies should investigate etiology to help explain these percentages, particularly with respect to the position of impacted incisors, in order to provide a clearer picture. In this context, clinical records play a fundamental role. Additional studies with larger and more representative samples are recommended to assess the prevalence of impacted incisors in different population groups and their relationship with demographic and clinical variables. Specifically, population-based studies with probabilistic sampling would be useful to generate generalizable data. In addition, standardizing radiographic protocols and measurements of height, angle, and position of impacted teeth is recommended to facilitate comparisons across studies. Finally, exploring the association between socioeconomic factors, access to dental services, and dental impaction is recommended to inform future diagnostic and preventive strategies.

CONCLUSIONS

The prevalence of impacted incisors in a radiology center in Quito, Ecuador, was 11.9%. A higher prevalence was observed in male patients and in the dental-age range of 8 to 10 years. The left maxillary central incisor was the most frequently impacted tooth. In most panoramic radiographs, a single impacted incisor was identified, with a height between 6 and 10 mm relative to the incisal plane, an angle of less than 20°, and a distance greater than 0 relative to the midline. The presence of dental impaction was significantly associated with dental age and sex. Likewise, dental age showed a significant association with the angle relative to the midline.

RECOMMENDATIONS

Timely radiographic screening is recommended in children in mixed dentition when signs of dental impaction are present, in order to detect cases early and refer them promptly. Standardized protocols for measuring and recording incisor impaction should be established to ensure consistent and comparable diagnoses. In addition, population-based studies with probabilistic sampling are suggested to assess prevalence and factors associated with impacted incisors, including sociodemographic variables, to generate evidence that supports prevention and management strategies.

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