vol 11 (special supplement) 2014.

científica dental

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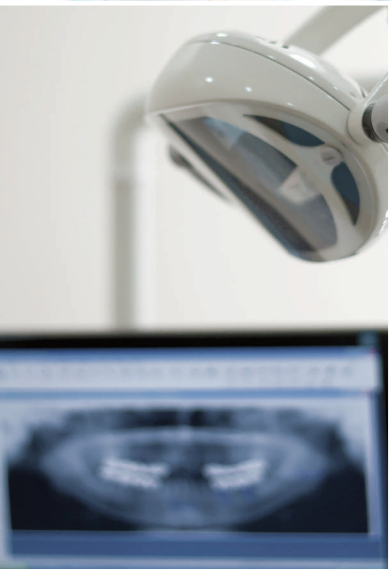

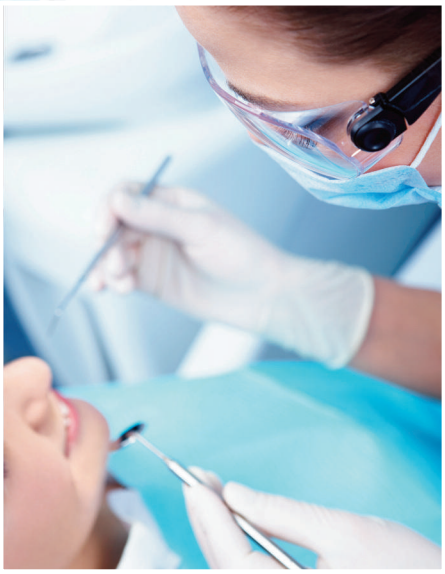

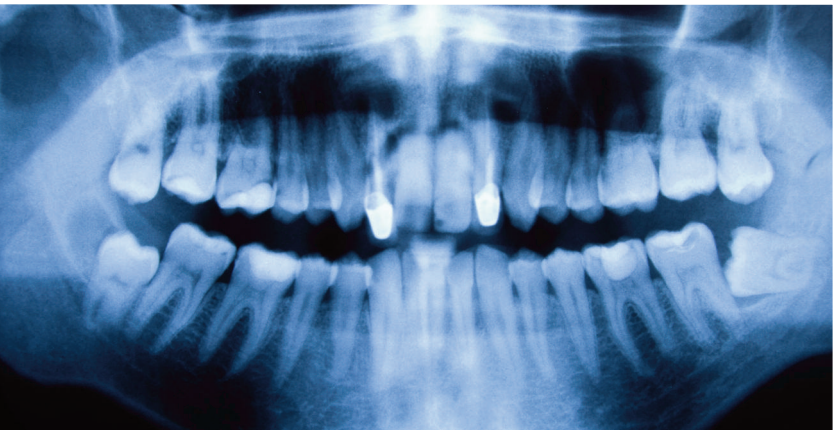

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special supplement 2014
volumen 11

contents

editorial

Dr. Jesús Calatayud Sierra
Editor of Científica Dental.

The Spanish language is in very good health: we know that in 2014 there were 550 million people who spoke Spanish and that it was the mother tongue of 470 million (7% of the world population, while Russian is 2·2% and German and French 1·1%) while it is the 2nd most used language in tweets and the 3rd, after English and Chinese, on the internet. The principal language of international communication and the language of science however is English, and for that reason the Scientific Committee of the COEM decided in 2014 we should publish a special edition each year with the best articles published in our journal in English, and this is the first of them.

Científica Dental awards three prizes every year in three categories (best scientific article, best clinical case study and best first scientific work by a new writer) to the work published in our journal; for that reason in this special edition we present the prize-winning work and the other finalists, and we thus have six fine scientific articles which readers may consult on open access in our website www.cientificadental.es. Readers who wish to may also consult these works in Spanish in the same website as these versions have also been published.

Finally we wish as always to thank all those who make this journal possible and particularly the authors of the works which appear in this edition for their efforts and the quality of their work.

Best wishes.

Original article

Radiographic evaluation of the maxillary sinus by icatvision. a retrospective observational study on the etiological factors of maxillary sinusitis

Published in Spanish Científica Dental Vol. 11. Nº 1. 2014.

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Received: 13 February 2014.
Accepted (or accepted for publication): 4 April 2014.

ABSTRACT

Objective: To identify and evaluate the frequency of the different odontogenic causes that produce maxillary sinusitis and to perform an adequate differential diagnosis by using a Cone Beam Computerized Tomography (CBCT). To indicate the relation between frequency and severity of odontogenic sinusitis.

Patients and Methods: CBCT scans made by means of iCATVision of patients being treated in the Master's Degree Programme of Bucco-facial and Implantology of the UCM in the last 2 years, with radiographic evidence of unilateral or bilateral sinus fluid increase. The radiographic severitywas classified according to the volume of the sinus occupied by means of the Compudent program as: none, mild (less than 33%), moderate (between 33% and 66%) or severe (more than 66%). The causes of sinusitis were dental pathology (chronic periodontitis, acute periodontitis, periapical cysts and dental retention) or iatrogenic causes (root canal treatment, extraction, treatment with implants, sinus lifting, treatment of periodontal disease and oroantral communication).

Result: We studied 153 CBCT, from patients not presenting any systemic pathology considered exclusion criteria, obtaining 40 maxillary sinuses belonging to 32 patients between 37 and 83 years of age. The most common cause of sinus occupation was chronic periodontitis in 19 cases and root canal treatment in 9 cases. Of the cases, 72.5% presented a mild increase in fluid, and only in 10% the increase was severe.

Conclusions: The most common cause is chronic periodontitis, which begins with dental caries in an antral tooth, with greater frequency in the first and second molar. In addition, odontogenic sinusitis produces for the most part mild sinus fluid increases, although a larger sample is needed to corroborate the results.

KEYWORDS

Maxillary sinusitis; Odontogenic infection; Periapical abscess; Oroantral fistula, Iatrogenesis.

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INTRODUCTION

Sometimes patients with symptoms of pain in the maxillary premolar and molar region first go to the dentist's office. Performing a differential diagnosis will be necessary, including maxillary sinusitis as the cause of the possible odontalgia of the patient in order to carry out the adequate treatment in each case.

Maxillary sinus pathology can occur when the mucosa is altered due to diverse causes such as dental infections, traumatism, osteitis, cellulitis or iatrogenic causes such as extractions, endodontic treatment or placement of osseointegrated implants[1-5].

The diagnosis of sinusitis of odontogenic origin requires the evaluation of the patient's symptoms backed by a complete medical history and its correlation with the physical signs found. The pain may present in an acute or latent form, or there may be sensitivity in multiple antral teeth. Thus, it is sometimes difficult to know whether the origin is dental and to proceed to its treatment (endodontia, extraction, etc.). To help us make a good differential diagnosis, we must carry out a series of diagnostic techniques suited to this type of pathology[1,2].

The cone-beam computerised tomography (CBCT) has a high spatial resolution and a lower dose of radiation than the traditional computerised tomography. In addition, it has high precision in diagnosing apical periodontitis and Mucosal thickening in comparison with two-dimension images[6,7].

The unilateral opacification of the maxillary sinus along with ipsilateral symptoms may yield the definitive diagnosis[8].

MATERIAL AND METHOD

In order to prepare this paper, we used the specialised journals in the field of Surgery and Implants available in the Library and Newspaper Archives of the School of Dentistry of the Complutense University of Madrid (UCM).

The base material for this paper consists of the CBCT registers of the patients that went to the Department of Medicine and Bucco-facial Surgery of the School of Dentistry (Master's Degree Programme in Bucco-facial Surgery and Implantology) during the period of 2009 to 2011.

The CBCT registers were selected by means of the iCATVisionwith radiographic evidence of the increase of unilateral or bilateral sinus fluid in maxillary dentate patients or in those in whom an antral tooth had been recently extracted. The CBCT registers of the selected patients and their medical history were studied, with which we assessed whether or not the increase of fluid was due to an odontogenic cause through the different panoramic, cross or axial slices provided by the iCATVision program (Figure 1).

The criteria for inclusion were: Patients over 18 years of age, of both sexes, and with increased sinus fluid.

In the criteria for exclusion, we included those CBCT without maxillary teeth or those performed to evaluate acute traumatic injuries, with a history of nasal polyps, cystic fibrosis, immunocompromised or allergic fungal sinusitis.

The radiographic severity of the sinus fluid was classified according to the volume of the inflamed sinus using the Compudent program. For this, the CBCT obtained by the iCATVision program were transformed in order to be able to study them in Compudent. In the Compudent program, the CBCT were selected to study, tracing the panoramic and paraxial slices of the area of interest, which in this case is the maxillary sinus. We coloured all the slices in which the sinus appears and the program calculated the occupied volume of the sinus and its total volume.

The severity of the sinus occupation was classified as none, mild (less than a third), moderate (between a third and two-thirds) and severe (over two-thirds).

The possible causes of odontogenic sinusitis (OS) were classified as dental causes, such as chronic periodontitis (CP), acute periodontitis, periapical cysts and dental retention, or in iatrogenic causes, such as

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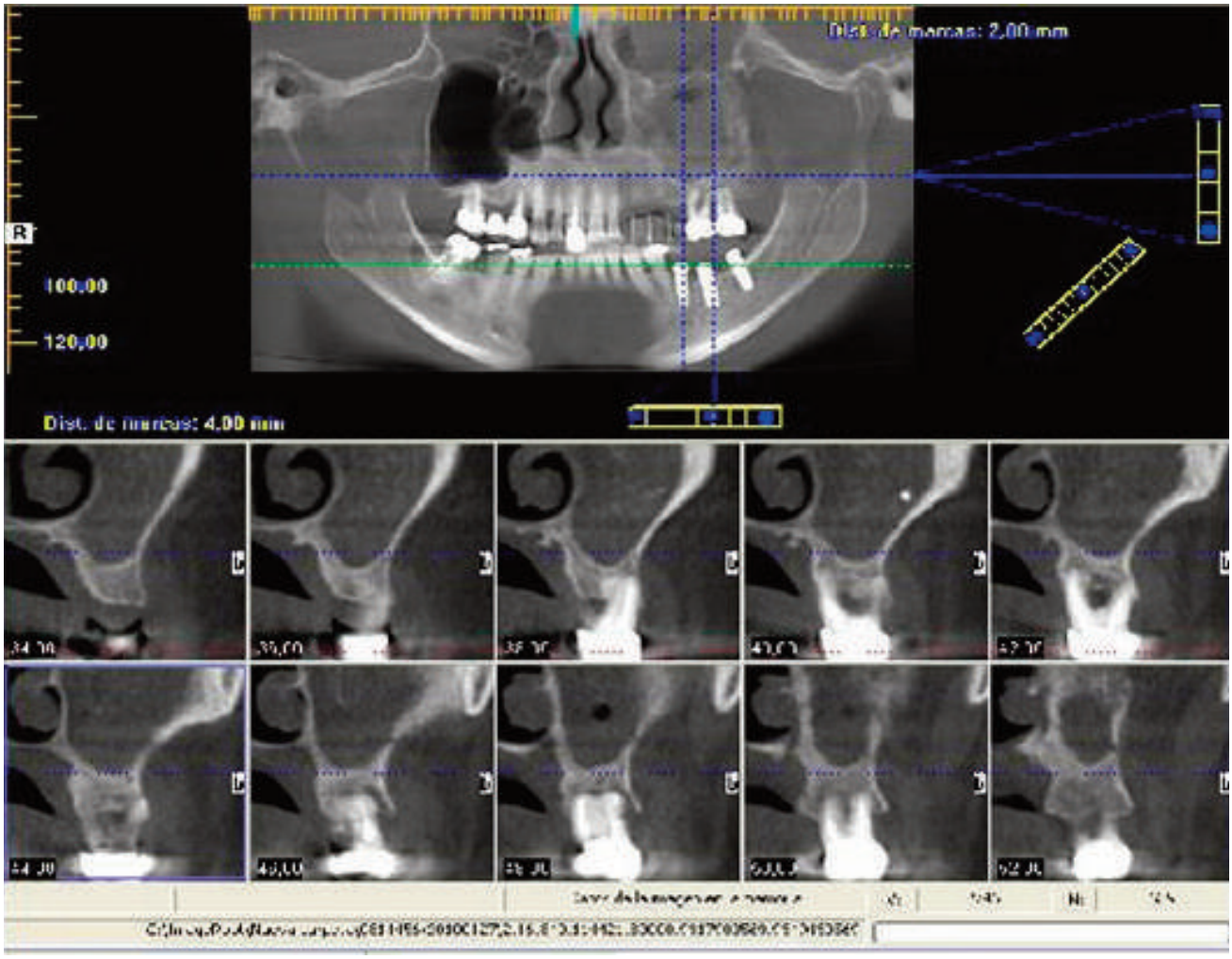

Figure 1. Panoramic view of a CBCT by means of iCATVision with almost complete occupancy of the left maxillary sinus.

tooth extraction, endodontic treatment, treatment with implants, sinus lifting, treatment of periodontal disease and oroantral communication (OAC).

For the obtaining of the results, the statistics program SPSS19 for Windows was used. Contingency tables and the Chi-squared test were performed for qualitative data (cause/occupancy), and one-way ANOVA was calculated for the relation between the percentage of occupancy and its cause.

RESULTS

We studied 153 CBCT of which 61 had increased uni- or bilateral sinus fluid, that is, 39.8%. We ruled out 13 for not having antral teeth and 16 for being of rhinogenic cause. Therefore, the prevalence of odontogenic sinusitis in this study is 20.9% (32/153).

Finally, we obtained 32 CBCT with an increase of sinus fluid and among them, 8 were bilateral; there-

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fore, we obtained 40 maxillary sinuses to study in which the mean age of the patients was 61.4 (37-83 years). As for gender, the sample obtained is 1/1, 16 men and 16 women. No patient had any systemic pathology in their medical history that was within the criteria of exclusion.

The most frequent causes of sinus occupancy were chronic periodontitis as dental pathology in 19 cases (47.5%), and root canal treatment as the iatrogenic cause in 9 cases (22.5%) (Tables 1 and 2).

We differentiate the degree of occupancy as mild (less than 1/3), moderate (between 1/3 and 2/3) and severe (over 2/3). Of the cases, 72.5% (29/40) had a mild increase of fluid, while only 17.5% (7/40) had moderate and 10% (4/40) had severe increases (Table 3).

To study the cause in relation to the degree of occupancy, we prepared some contingency tables and performed the Chi-squared test for qualitative data, finding that there are statistically significant differences in the responses of the cause in the occupancy, (P=0.027).

In chronic periodontitis, the most significant was that there was no case of severe occupancy, while in acute suppurative periodontitis there was no case of mild sinus occupancy; therefore, the difference between them is statistically significant. In dental retention, it should be pointed out that all the cases were classified as moderate. To study whether there are differences between the percentage of occupancy and its cause we conducted an ANOVA test with its corresponding descriptive table. Sinus lifting, treatment with implants and cysts have to be eliminated because there was only one case of each.

Of the rest, ANOVA analysis yielded a P=0.013, therefore, there are significant differences in the occupancy. As we wanted to know what differences may exist, we performed the Bonferroni (post-hoc) test and the only mean difference that was found is between chronic and acute periodontitis for the occupancy percentage, since as we see in the tables, there is no case of severe occupancy in CP, while the same occurs in acute periodontitis but of mild occupancy.

It is likely that we would find differences among other causes, but due to the small sample size in the majority of them there are no statistically significant differences.

Table 1. History of dental pathology

Dental Pathology	Number of cases	%
Chronic periodontitis	19	79.1
Acute periodontitis	2	8.3
Cysts	1	4.1
Dental retention	2	8.3
TOTAL	***24***	***100***

Table 2. Iatrogenic causes of sinusitis

Iatrogenic cause	Number of cases	%
Root canalTX	9	56.2
Exodontia	2	10.5
PD TX	0	0.0
Sinus lifting	1	6.2
Implant TX	1	6.2
OAC	3	18.7
TOTAL	***16***	***100***

Root canal TX = Root canal treatment.
PD TX = Periodontal disease treatment.
Implant TX = Treatment with implants.
OAC = Oroantral communication.

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Table 3. Volume of sinus fluid

Cause	<1/3	1/3-2/3	>2/3
Chronic periodontitis	16	3	0
Acute periodontitis	0	1	1
Cysts	1	0	0
Dental retention	0	2	0
Root canal TX	7	1	1
Exodontia	2	0	0
PD TX	0	0	0
Sinus lifting	0	0	1
Implant TX	1	0	0
OAC	2	0	1
TOTAL	***29***	***7***	***4***

Root canal TX = Root canal treatment.
PD TX = Periodontal disease treatment.
Implant TX = Treatment with implants.
OAC = Oroantral communication.

The maxillary second molar was the tooth that has produced more cases of sinusitis (18/40). However, there is no case coming from the canine or from the first premolar.

DISCUSSION

In our study, we observed a 20.9 % prevalence of odontogenic sinusitis. However, other authors report a 10-12% prevalence[2,9,10] or even lower (5.2%) as reported by Lee[11]. The prevalence of odontogenic sinusitis among the cases of maxillary sinusitis was 52.4%, which coincides with the figures given by Maillet et al., in their retrospective study of 871 CBCT on the radiographic characteristics of the OS[12]. Obayashi et al.[13] also found that 71.3% of cases of dental infection were associated with changes in the maxillary sinus.

According to the cause and frequency of maxillary sinusitis, our results differ from other studies. We found that the most common causes were chronic periodontitis, which occurred in 47.5% of dental pathology cases, followed by root canal treatment in 22.5% of iatrogenic cases. Anavi et al[14] reported a 7-35% complication rate after sinus lifting (13 cases of maxillary sinusitis) while we only found one case out of forty.; therefore, a larger sample is needed in order to study this relationship. Charfi et al[15] did coincide with our results, with 68% of cases of OS represented by chronic periodontitis. Arias-Irimia et al[3] conducted a meta-analysis of 15 articles with at least 10 cases of OS, concluding that the iatrogenic was the most common cause (55.9%), with oroantral communication, exodontia and root canal treatment, while within the dental pathology the most characteristic was chronic periodontitis. Brook I[2]

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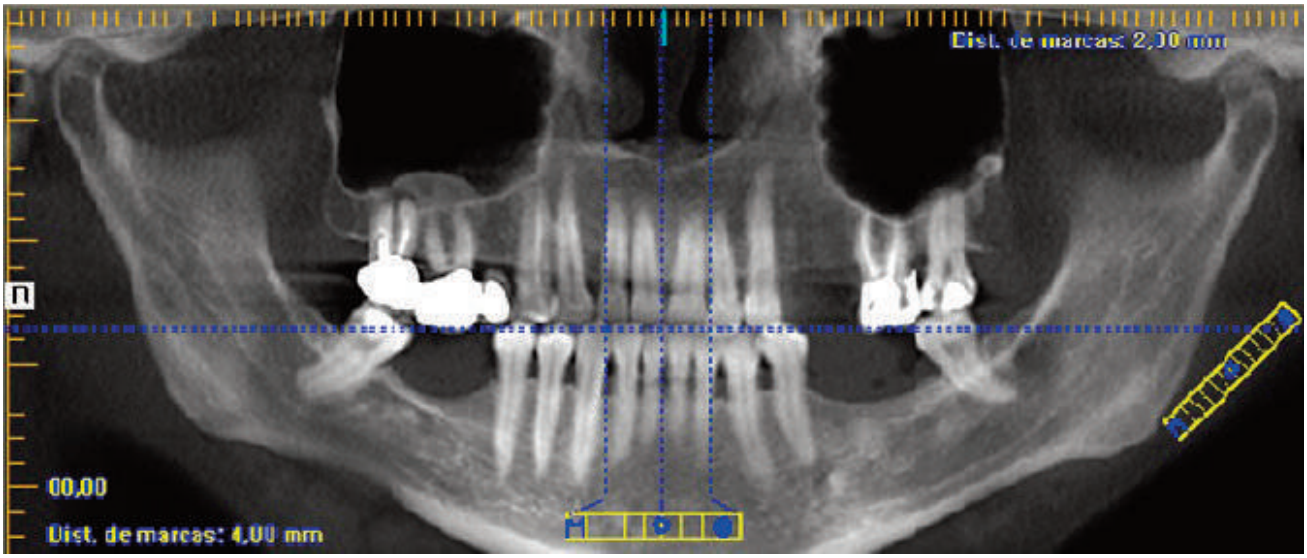

Figure 2. Mild occupancy in right sinus due to an apical process in 17 due to defective root canal treatment.

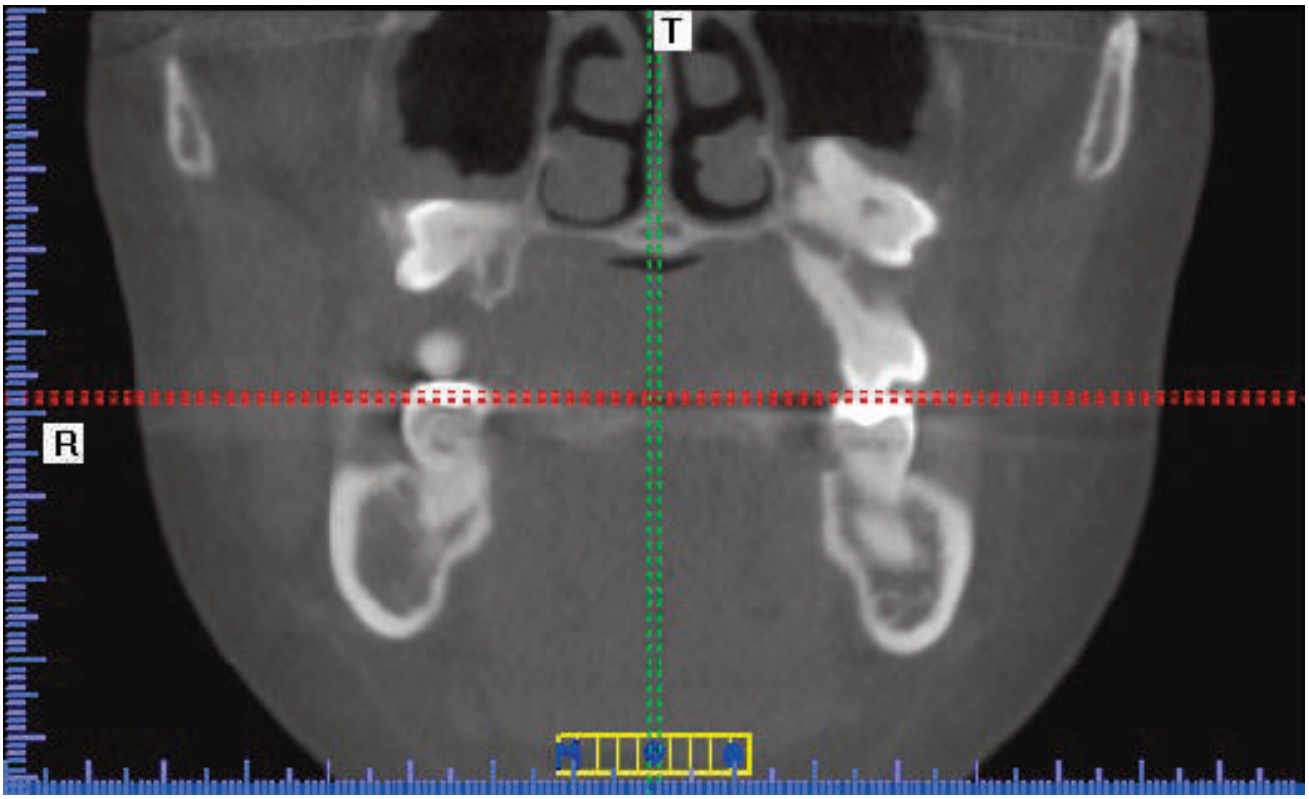

Figure 3. Moderate bilateral occupancy due to both maxillary wisdom teeth inclusion.

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indicated in his review that the most common were chronic periodontitis and dental extraction that includedforeign bodies. Bomeliet al[9] only found statistical differences between oroantral communication and chronic periodontitis. Treatment with implants was the most common cause (10 cases out of 27 patients) as reported by a recent paper[11], (10 cases out of 27), while in our study there was only one case, followed by dental extraction (8/27). Although in our sample we only had two cases of dental extraction, Some authors report a higher incidence of sinus complications, maybe because this type of treatment is very commonly performed in dental clinics. Another recent study of 21 cases of OS found no iatrogenic cause but chronic periodontitis with oroantral fistula in five cases (1%)[15].

The frequency of odontogenic sinusitis decreases as severity increases, with 72.5%mild, 17.5% moderate and 10% severe. However, in the paper by Bomeli et al.[9], the results showed that the sinus fluid can be more attributable to an odontogenic infection as the amount of fluid increases, reaching an incidence of 79% in sinuses with occupancy higher than 2/3. The reason for this difference may be a much greater sample size in their study (166 occupied sinuses) as compared to ours (40 occupied sinuses).

The mean age of all the patients studied was 61.4. But the majority of studies commented that the frequency is greater in the 4th decade of life[3,5,10,11]. Only two papers[9,15] came close to our results with a mean age of 54.9 and 53 years, respectively.

With regard to the patient's gender, some authors report a higher incidence in men while other report the opposite. We obtained a 1:1 ratio sample of 16 men and 16 women.

As in the article by Lee[11], in our retrospective study, the maxillary second molar was the tooth that produced more cases of OS (18/40). We can explain these findings knowing that the second molar is closer to the sinus floor[16] and even that both molars are within the sinus in 2% of the cases[17]. The research by Maillet et al. was the only one that included the root of the causing tooth and obtained that the palatal root of the first molar was the most common followed by the mesio-buccal root of the second molar[12].

Maestre-Ferrín et al.[18] compared the panoramic radiography with computed tomography (CT), confirming that CT was easily available and the safest method for the diagnosis of the maxillary sinus pathology. They chose 30 patients intended for treatment with implants. The prevalence of sinus findings was 38.3%, with mild sinus fluid increase in 23.3% of the cases, moderate in 10% and severe in 5%. However, they did not differentiate whether or not this pathology was of odontogenic cause. Cymerman et al.[19] evaluated the use of the CBCT in a case series and concluded that the thickening of the sinus membrane was identified four times more often than with conventional periapical radiographs, and that it was useful for differentiating the etiology and extension of the oral pathology with respect to the maxillary sinus. Another series of cases stated that the three-dimensional images are an accessible modality, with low cost and dose that aid the diagnosis of odontogenic sinusitis[6]. Shabazian et al.[7] reviewed the diagnostic value of bidimensional and tridimensional images and affirmed that the CBCT with low dose of radiation can be particularly useful in OS, especially when the patient does not respond to treatment, although more research is still needed to validate these results.

It is important to differentiate when the sinusitis is of odontogenic cause since antibiotic therapy differs from that needed in other types of maxillary sinusitis, because of an increased concentration of anaerobic bacteria. Thus, priority is given to the treatment of the dental cause, with either root canal treatment or extraction[2,4,9,20].

CONCLUSIONS

The radiographic image is an important tool for establishing the diagnosis, although not the only one. A CBCT can show the relation of the odontogenic ori-

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gin with the defect of the sinus floor and the affected tissues, differentiating whether it is dental pathology or iatrogenic cause, being able to locate the exact position of a foreign body and the situation and extension of an oroantral communication.

The most common cause is chronic periodontitis due to untreated dental caries producing a periapical abscess and due to the close proximity of the antral teeth, especially the first and second molar, the maxillary sinus can be acutely or chronically affected.

In this retrospective study, we can conclude that sinusitis of odontogenic origin usually produces mild increases of sinus fluid (less than 1/3), although a larger sample would be needed to corroborate these results.

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Original article

Analysis of mandibular bone symmetry by tracing angular lines in children with unilateral crossbite

Published in Spanish Científica Dental Vol. 11. Nº 1. 2014.

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Received: 9 October 2013.
Accepted (or accepted for publication): 23 January 2014.

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ABSTRACT

Introduction: Patients with crossbite can develop skeletal asymmetry in the long term. Considering this premise, we wonder whether crossbite may lead to quantifiable bone changes in children. The main objective of this study is to determine whether the unilateral crossbite can produce quantifiable early bone alterations in the mandibular angle.

Methods: The panoramic radiographs of 217 children aged 6 to 9 years old, with unilateral crossbite and whose dentition stage was mixed first phase were used in the study. The gonial angles of the side of the crossbite and of the side with no crossbite were traced, measured and compared, using the tpsDig2 computer program and subsequently, a descriptive and comparative statistical analysis was performed.

Result: Patients with right unilateral crossbite presented a statistically significant larger mandibular angle on the left side. Patients with left unilateral crossbite also presented a greater left mandibular angle, although not reaching statistical significance.

Conclusions: There was no relation between the side of the crossbite and the mandibular bone size in the mandibular angle in children with mixed first phase dentition.

KEYWORDS

Asymmetry; Children; Orthopantomography; Posterior crossbite.

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INTRODUCTION

The bone growth of the mandible is not only strongly influenced by genetic factors, but it can also be significantly affected by environmental factors such as: nutrition, masticatory function and systemic or localised disease, among others. For some authors, the neuronal excitation occurs during mastication and the developmental response takes place during rest periods[1].

Patients with crossbite present postural and functional alterations: decrease in biting strength, asymmetric muscular activity, articular problems, mandibular deviation towards the side of the crossbite during closing. In addition, if the malocclusion is present throughout the patient's growth, it facilitates the development of skeletal asymmetry[2]. The posterior unilateral crossbite is the most common type[3]; according to some authors it appears for the first time between 19 months and 5 years of age, with a prevalence in the general population between 5.9% and 9.4%[4]. Other authors report a prevalence between 8-22% in deciduous and mixed dentitions[5-7].

There are different opinions on how malocclusion affects mandibular growth and a possible skeletal asymmetry development[8-10]. For this reason and in the need of an early diagnosis and treatment1 we consider whether mandibular bone asymmetries can be observed in orthopantomographies of young children, given that previously published studies were performed in adults.

MATERIAL AND METHOD

Sample

The sample universe included 645 children attended in a radiological diagnostic centre located in Madrid. Previously, a questionnaire about general medical information was given and they all signed a document authorising the use of their records for research purposes, according to the Law of Data Protection.

Inclusion criteria were: patients with unilateral crossbite, in first phase of mixed dentition, without a history of corrective treatments of malocclusion and with photographic and radiographic records of enough quality. Exclusion criteria were: presence of orofacial pathology, dysmorphology as well as syndromes that could cause alterations in the development and/or growth, dental/periodontal alterations and wearers of fixed devices. After applying both criteria, the sample was reduced to 217 children, with a mean age of 7.5 years old (Table 1).

A radiological diagnostic protocol was established for the purpose of visualising the anatomic structures of interest and the mandibular angles were traced corresponding to the variables A1 and A2, which are always pairs, right and left (Figure 1).

- **A1** (R Tangents): angle that is formed by tracing a tangent that passes through the most prominent points of the right mandibular body and another tangent that passes through the most prominent points of the right mandibular branch.

Table 1. Distribution of the sample by age and gender

Age range	Boys	Girls	TOTALS
6-7	27	34	61
7-8	28	37	65
8-9	25	26	51
9-10	17	23	40
6-10	***97***	***120***	***217***

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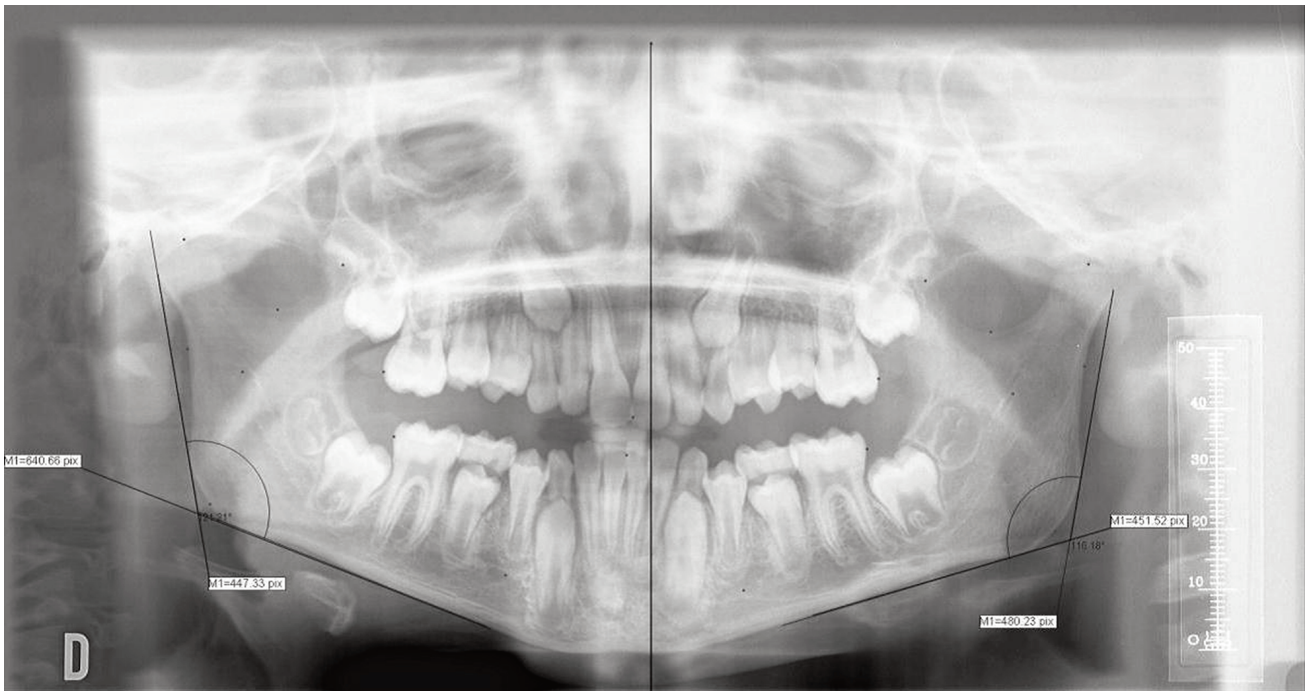

Figure 2. Mild occupancy in right sinus due to an apical process in 17 due to defective root canal treatment.

- **A2** (L Tangents): angle that is formed by tracing a tangent that passes through the most prominent points of the left mandibular body and another tangent that passes through the most prominent points of the left mandibular branch.

A 30" monitor and the tpsDig version-2 computer program were used. The principal researcher evaluated 20 radiographs per session and the measurements were made in degrees.

The program used for the statistical analysis was SPSS 17.0 for Windows. The mean and the standard deviation were calculated for each of the measurements and the Student t test was applied at 95% confidence ($p<0.05$). Twenty days after the last measuremet was taken, the principal researcher randomly selected a 20% of the total images in order to repeat the measurements. A paired t test was performed aiming to detect systematic errors.

RESULTS

In the sample with right crossbite, a greater angulation of the A2 variable corresponding to the left side was found, with respect to the variable A1 of the right side. The results showed that the difference between the right and left angular variables (A1 and A2) was statistically significant, with a p value of 0.000. Analyzing the variables in the entire sample and with the left crossbite, a higher magnitude of the A2 variable corresponding to the left side was found, with respect to A1 of the right side. In this case, the difference between the variables A1-A2 was not statistically significant, with a p value of 0.051 (Table 2).

By studying the angulations in patients with right unilateral crossbite and with an age range of 6-7 years, A2 on the left side was significantly higher than A1; the p value was 0.019. In the sample with left crossbite, A2 was also greater. In this case, the difference was not statistically significant, with a p value of .171 (Table 3).

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Table 2. Descriptive and comparative analysis of the asymmetry of the angular measurements in the total sample with URC and ULC. N= Sample size, X±SD= mean ± standard deviation. t Test. P= Significance. Values in degrees

SAMPLE TOTAL

VARIABLES A1-A2	N	Healthy side X±SD	Crossbite X±SD	t Test	P (Sig)
Unilateral Right Crossbite (URC)	137	130.057 ± 6.5898	128.7220 ± 6.67894	-3.795	0.000
Unilateral Left Crossbite (ULC)	80	128.0325 ± 5.61362	128.842 ± 5.6491	-1.982	0.051

Table 3. Descriptive and comparative analysis of the asymmetry of the angular measurements in the age range of 6-7 years with URC and ULC. N= Sample size, X±SD= mean ± standard deviation. t Test. P= Significance. Values in degrees

AGE RANGE OF 6-7 YEARS

VARIABLES A1-A2	N	Healthy side X±SD	Crossbite X±SD	t Test	P (Sig)
Unilateral Right Crossbite (URC)	39	132.611 ± 5.6981	131.0726 ± 5.25605	-2.441	0.019
Unilateral Left Crossbite (ULC)	22	127.3405 ± 5.56121	128.529 ± 5.3596	-1.417	0.171

By studying the angulations in patients aged 7-8 years with right crossbite, A2 was greater compared to A1. This difference was significant with a p value of 0.034. In the sample with left unilateral crossbite A2 was also greater, but not significantly, p equaling 0.295 (Table 4).

By studying the angulations in patients aged 8-9 years with right crossbite as well as in the sample with left unilateral crossbite, A2 was again greater than A1. In both cases the difference was not statistically significant, with p values of 0.661 and 0,536 respectively (Table 5).

By studying the angulations in patients aged 9-10 years with right crossbite, A2 was greater than A1. The difference between the angular variables was statistically significant, presenting a p value of 0.019 In the sample with left crossbite A2 was also greater but not significantly, p equaling 0.0502 (Table 6).

Regarding gender, when analyzing the angulations boys with right crossbite, again a greater A2 was found with respect to A1. This difference between the right and left angulation was statistically significant, with a p value of 0.07. When the crossbite was on the left, a greater A2 angulation also found, a dif-

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Table 4. Descriptive and comparative analysis of the asymmetry of the angular measurements in the age range of 7-8 years with URC and ULC. N= Sample size, X±SD= mean ± standard deviation. t Test. P= Significance. Values in degrees

AGE RANGE OF 7-8 YEARS

VARIABLES A1-A2	N	Healthy side X±SD	Crossbite X±SD	t Test	P (Sig)
Unilateral Right Crossbite (URC)	46	128.480 ± 6.8057	127.0061 ± 6.78056	-2.189	0.034
Unilateral Left Crossbite (ULC)	19	127.6100 ± 4.98086	128.633 ± 5.4337	-1.078	0.295

Table 5. Comparative analysis of the asymmetry of the angular measurements in the age 8-9 years with URC and ULC. N= Sample size, X±SD= mean ± standard deviation. t Test. P= Significance. Values in degrees

AGE RANGE OF 8-9 YEARS

VARIABLES A1-A2	N	Healthy side X±SD	Crossbite X±SD	t Test	P (Sig)
Unilateral Right Crossbite (URC)	32	130.274 ± 5.6152	129.9863 ± 5.93163	-0.443	0.661
Unilateral Left Crossbite (ULC)	19	127.9075 ± 6.39546	129.933 ± 5.3267	-0.631	0.536

Table 6. Descriptive and comparative analysis of the asymmetry of the angular measurements in the age range of 9-10 years with URC and ULC. N= Sample size, X±SD= mean ± standard deviation. t Test. P= Significance. Values in degrees.

AGE RANGE OF 9-10 YEARS

VARIABLES A1-A2	N	Healthy side X±SD	Crossbite X±SD	t Test	P (Sig)
Unilateral Right Crossbite (URC)	20	128.355 ± 7.8875	126.0625 ± 8.31541	-2.569	0.019
Unilateral Left Crossbite (ULC)	20	127.9075 ± 6.39546	128.348 ± 6.6695	-0.684	0.0502

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ference not statistically significant, since the p value was 0.891 (Table 7).

In the sample of girls with right crossbite as well as with unilateral left crossbite, a greater A2 angulation was found with respect A1. In both cases the difference was statistically significant, with p values of 0.012 and 0.014 respectively (Table 8).

DISCUSSION

There is scarce literature about the degree of asymmetry and quantifiable skeletal changes in the mandibular angle from orthopantomographs. Most of the studies analyze an adult population sample that does not always present a unilateral crossbite.

The first studies investigated the reproducibility of nine mandibular measurements, corresponding to linear dimensions and mandibular angles, as in our research. Radiographs were made on 60 mandibles of adult skulls and an acceptable reproduction of the vertical and angular variables were observed[11].

In 1987, Habets et al., using a model of an adult human mandible and by means of panoramic radiographs of nine different positions of the model, determined that the use of orthopantomography at the

Table 7. Descriptive and comparative analysis of the asymmetry of the angular measurements in the sample of boys with URC and ULC. N= Sample size, X±SD= mean ± standard deviation. t Test. P= Significance. Values in degrees

SAMPLE OF BOYS

VARIABLES A1-A2	N	Healthy side X±SD	Crossbite X±SD	t Test	P (Sig)
Unilateral Right Crossbite (URC)	65	131.484 ± 6.7718	130.0892 ± 6.76752	-2.777	0.007
Unilateral Left Crossbite (ULC)	32	129.4063 ± 5.61334	129.500 ± 6.2043	-0.138	0.891

Table 8. Descriptive and comparative analysis of the asymmetry of the angular measurements in the sample of girls with URC and ULC. N= Sample size, X±SD= mean ± standard deviation. t Test. P= Significance. Values in degrees.

SAMPLE OF GIRLS

VARIABLES A1-A2	N	Healthy side X±SD	Crossbite X±SD	t Test	P (Sig)
Unilateral Right Crossbite (URC)	72	128.768 ± 6.1885	127.4878 ± 6.39585	-2.585	0.012
Unilateral Left Crossbite (ULC)	48	127.1167 ± 5.48121	128.403 ± 5.2687	-2.551	0.014

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level of the branch and mandibular condyle, as they did in their method, can be useful for the diagnosis of condylar asymmetry. These same authors in subsequent studies observed that the group of patients that presented a higher degree of asymmetry were women with craniomandibular disorders[12,13].

The majority of studies try to show the reliability of the panoramic radiographs for the analysis of bone symmetry[11,12, 14-19].

In 2002, Tsai et al. studied the contours of mandibular branches, condyles, coronoid process and the mandibular body on panoramic radiographs of children without pathology in deciduous dentition, in the first phase of mixed dentition and in permanent dentition. They observed that angular measurements decreased with age20. In our study the angular measurements corresponding to the 6-7 age range are greater than those of the 9-10 age range, regardless of the side of the crossbite.

In the year 2005 Liukkonen et al. tried to evaluate the mandibular asymmetry by analysing panoramic radiographs of 182 healthy patients aged 7-16 years. In this study, unlike ours, they found statistically significant differences between the right and left side in relation to the height of the condyle and at the age of 7 years, and in the height of the branch at the age of 16 years. The healthy young patients generally had a mandibular asymmetry, which rarely was clinically singificant[21].

Afterwards, other published studies analyzed young patient samples with different types of crossbites and malocclusions, which also studied condylar and branch asymmetry, with the diagnosis of mandibular asymmetry at young ages being controversial with respect to the results[22-24].

Based on the scarcity of studies on the symmetry of the angle, it is difficult for us to be able to compare our results with those of other similar studies. In the total of the sample from our study and regardless of the side of the crossbite and of the age range, the mandibular angle was in all cases greater on the left side. When the sample was stratified according to gender and regardless of the side of the crossbite, the mandibular angle was also greater on the left side.

CONCLUSIONS

- In this sample, the increase of the angular variables, although not significant, was greater on the left side, regardless of the side of the crossbite.
- Gender does not seem to affect the asymmetry of the mandibular angle.

Also, age does not affect this result and the increase is significant in all age ranges except for children aged 8 years.

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Case report

Applications of fibreglass to reinforce the crown of endodontically-treated molars

Published in Spanish Científica Dental Vol. 10. Nº 3. 2013.

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ABSTRACT

The crown reconstruction of an endodontically-treated molar allows different treatment options, from the classic crown of complete onlay cemented directly on the remaining crown closed with composite or on a cast post-core that restores the crown, to the simple reconstruction with composite. Between both options a wide range of treatment options are described, among which we can highlight the inlay with ceramic or prepolymerised resin overlay retainer. All admit the added insertion of the controversial screw or cemented post or even that which is adhered in the interior of one of the canals. It questions what is the best technique to use and how the decision made, which may always be disputed and even controversial, depends on the remaining crown that has been left in the endodontically-treated molar. Is that molar going to be capable of resisting the masticatory forces? Will the molar resist more if we restore its crown with composite to which we add a fibreglass reinforcement? We are going to show various techniques of crown reconstruction on endodontically-treated molars using Dentapreg® fibreglass.

KEYWORDS

Restoration; Molar, Root Canal; Fibreglass.

Indexed in:
- IME
- IBECS
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Received: 16 July 2013.
Accepted (or accepted for publication): 15 November 2013.

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INTRODUCTION

Once the decision is made to perform a composite reconstruction on a crown of an endodontically-treated molar, we must first decide what treatment guideline we are going to follow and for this various alternatives are posed:

1. Are we simply going to reconstruct the crown with a composite that substitutes all the lost dentin and enamel?
2. Do we first insert a post in the lumen of the widest root?
3. Will we increase the resistance of the crown remnant if we insert fibreglass as an internal ferrule?
4. In what position do we place the fibreglass within the crown?
5. What fibreglass design options do we have?

The objective of this work is to show the technique with application of fibreglass for the crown reconstruction of an endodontically-treated molar.

CLINICAL APPLICATION

Let's start from the beginning with a clinical case that serves as a model on which we can expand on all the questions that we have posed from the preamble.

Ángel comes to the dentist's office, with pain… of course, in the tooth no. 47, for which reason we take a periapical X-ray where a large caries on the distal aspect of the tooth no. 47 is observed with pulp tissue involvement. We perform the root canal treatment on that molar (Figure 1), we extract the wisdom tooth and we wait for its healing with a temporary filling. Since we have the remaining crown on which we have to act and in this case, rendering unnecessary the discussion of other crown restoration techniques and that which we are going to describe, we go on to shape the matrix that is going to bring back the initial anatomy that the crown of the tooth had (Figure 2). We continue using with very good results the classic Automatrix® (Caulk/Dentsply) matrix since it allows us, thanks to its design, the adaptation and subgingival fixation to the dentinal remnant, which is not easy on many occasions due to the crown des-

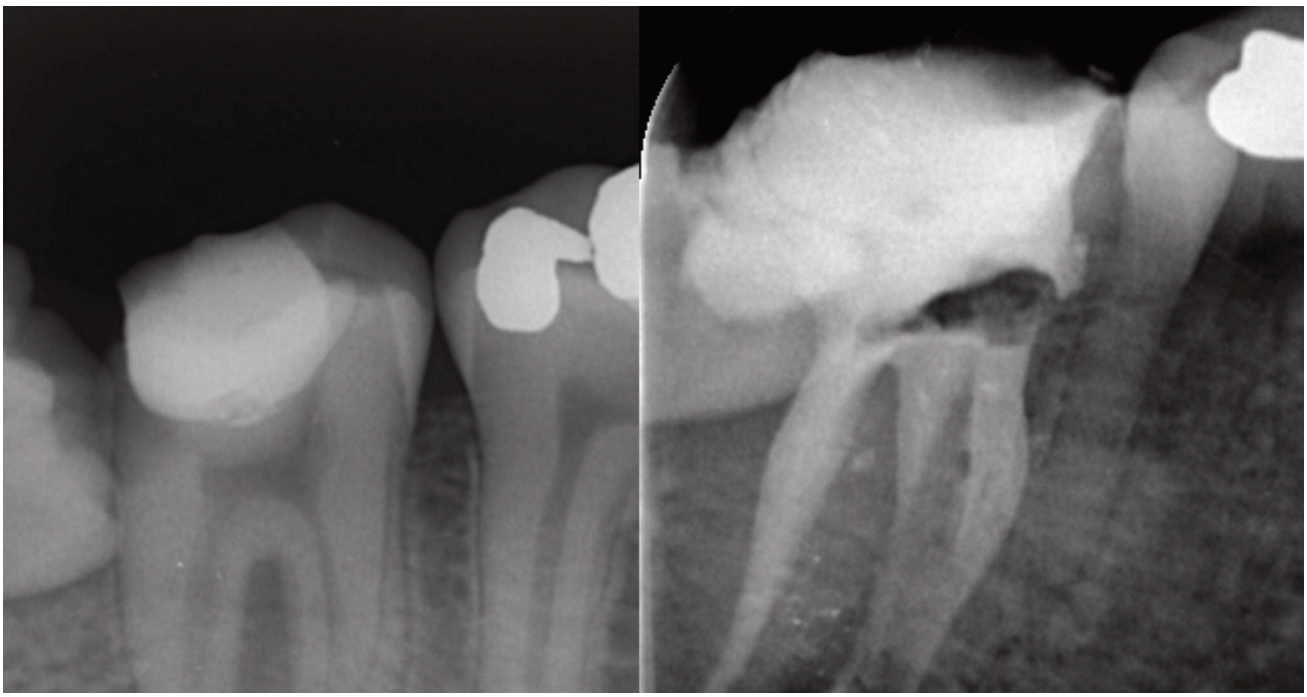

Figure 1. Preoperatory radiograph of the affected molar in ortho-radial direction and the final X-ray of the root canal treatment from mesio-radial direction, before the extraction of the wisdom tooth.

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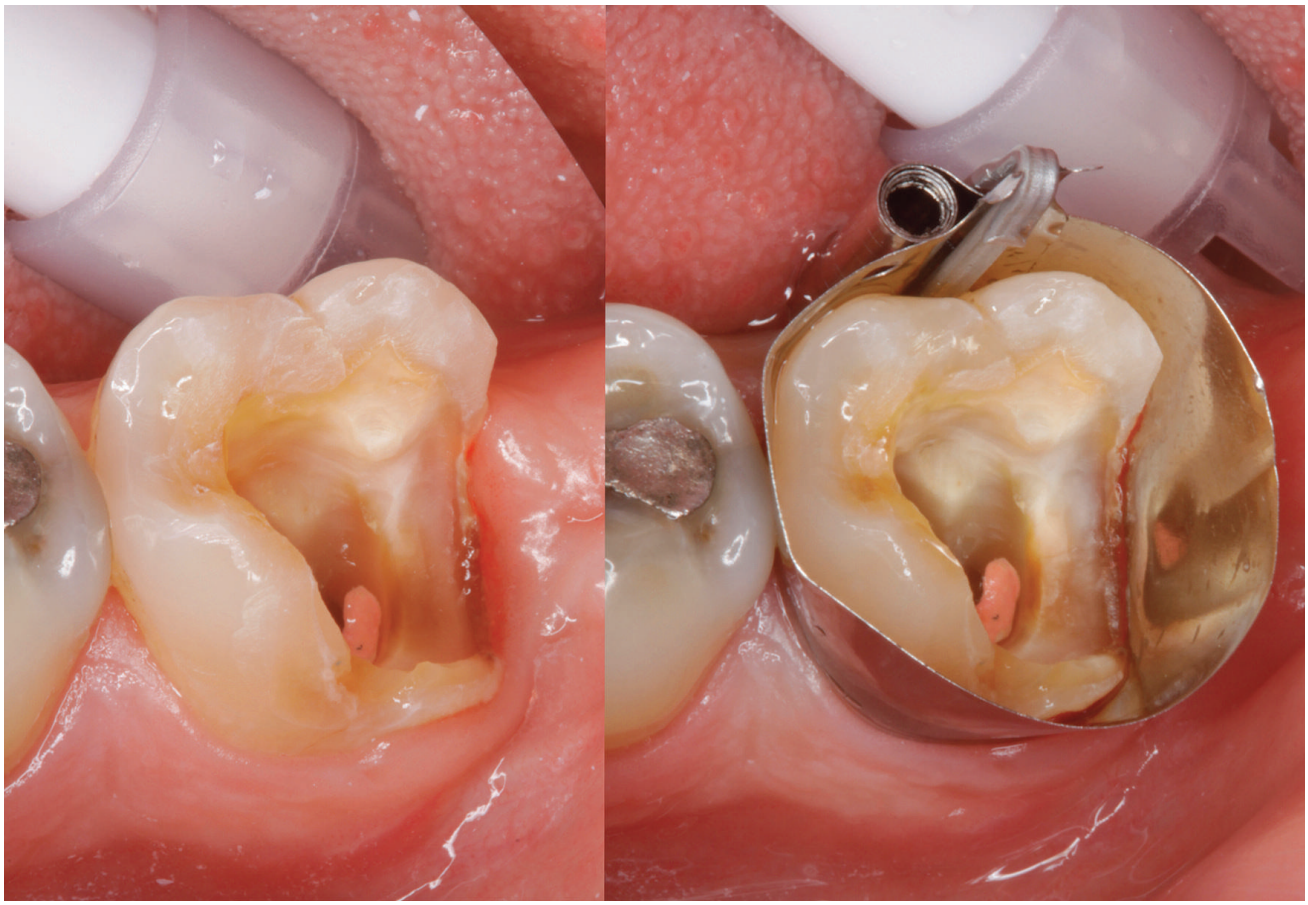

Figure 2. The crown remnant before and once the matrix is placed. Observe the grinding down that was made in the vestibular enamel of the dental wall in order to be able to accommodate the fibreglass and the gingival adaptation of the matrix on the distal aspect.

truction. We miss these matrices not being contoured which would save us having to subsequently carve the restoration, giving convexity to the walls of the crown.

It is important to determine clearly the gingival margin of the restoration, not leaving areas of carious dentin or defects in the isolation that impedes us from using the adhesion technique such as that which we are describing. Given that on occasions and in this one in particular in which the crown of the tooth on the distal aspect has been destroyed very subgingivally, it can be used in an alternative manner, given that the thickness does not interfere with the area of contact due to the absence of the distal tooth, the even more classic copper ring that allows us to place it in a more subgingival position (Figure 3). It is true that this is archaic, but when we have made the decision to restore this type of clinical situation we are facing with composite, we can cut it, deform it, and adapt it until we can get a certain marginal adjustment of the matrix, managing to isolate the compromised gingival margin.

In the case that we are describing as the basis of the presentation, it was decided to use fibreglass as a circular reinforcement of the crown and for this reason, in addition to bevelling the crown margins of the dentinal remnant so that the composite may embrace it, we just make a slight quadrangular carving on the vestibular face, in order to give space to the fibreglass thickness and thus be able to place it out-

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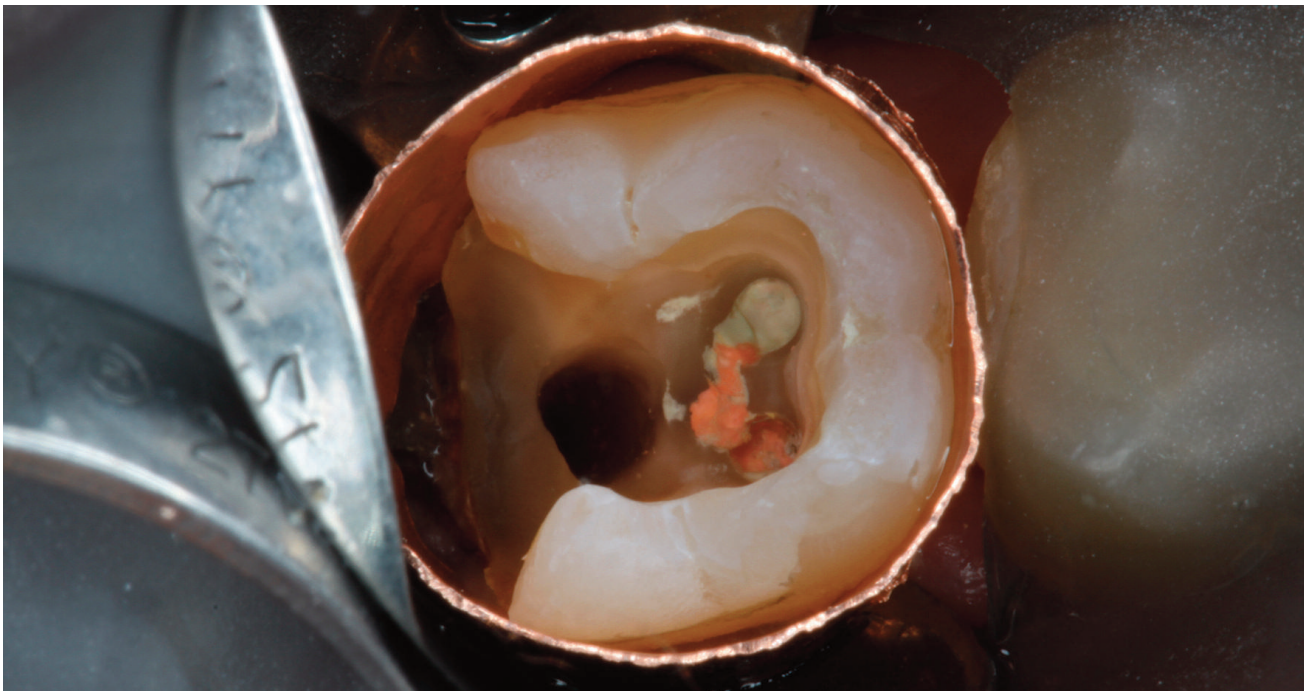

Figure 3. The archaic ring of copper allows shaping when the caries is very subgingival, a profile for the restoration that allows us to isolate relatively the cavity. The placement of the post is always done in the widest and straightest canal.

side the dental wall without increasing the diameter of the original crown of the tooth. In a schematic drawing, one can see what we are trying to explain (Figure 4).

Of course, if we also wanted to insert a post, we should empty the canal and leave it ready to be accommodated before placing the matrix. We leave for now the subject of the post and we are going to focus on the case that concerns us.

Once the matrix is put into position and the complete isolation of the gingival margin is verified, we can begin the systematic adhesion processes, such as the placement of phosphoric acid for 30 to 60 seconds, washing, drying and placement of the adhesion system and its photopolymerisation.

It is a "sine qua non" condition that the fibreglass, regardless of its location, is included completely in the centre of the composite since if it is exposed to the surface, it does not have resistance to wear. For this reason a thin layer of composite is placed over the matrix and it is compacted on it in increments, to avoid contraction of the curing, with a steel ball or spatula (Figure 5). It is now when the fibreglass is placed in the position that we had planned and it remains as shown in the schematic drawing of Figure 6.

The fibre that we are using is permeated in composite so that it is maintained until it is used, in a container opaque to the light, however, it is not an impediment for when we place it as long as it is permeated with a composite that generally is fluid, in order to adapt it well and avoid empty spaces remaining between it and the composite placed previously. One must stress that the fluid composite cannot be placed on the exterior of the tooth, since it resistance to wear is much less due to its composition than that of the restoration composite. And it is now when we must go into depth in the types of fibreglass we can use.

They range from the classic Ribbond® or Connect® (Sybron/Kerr), which can continue being used, per-

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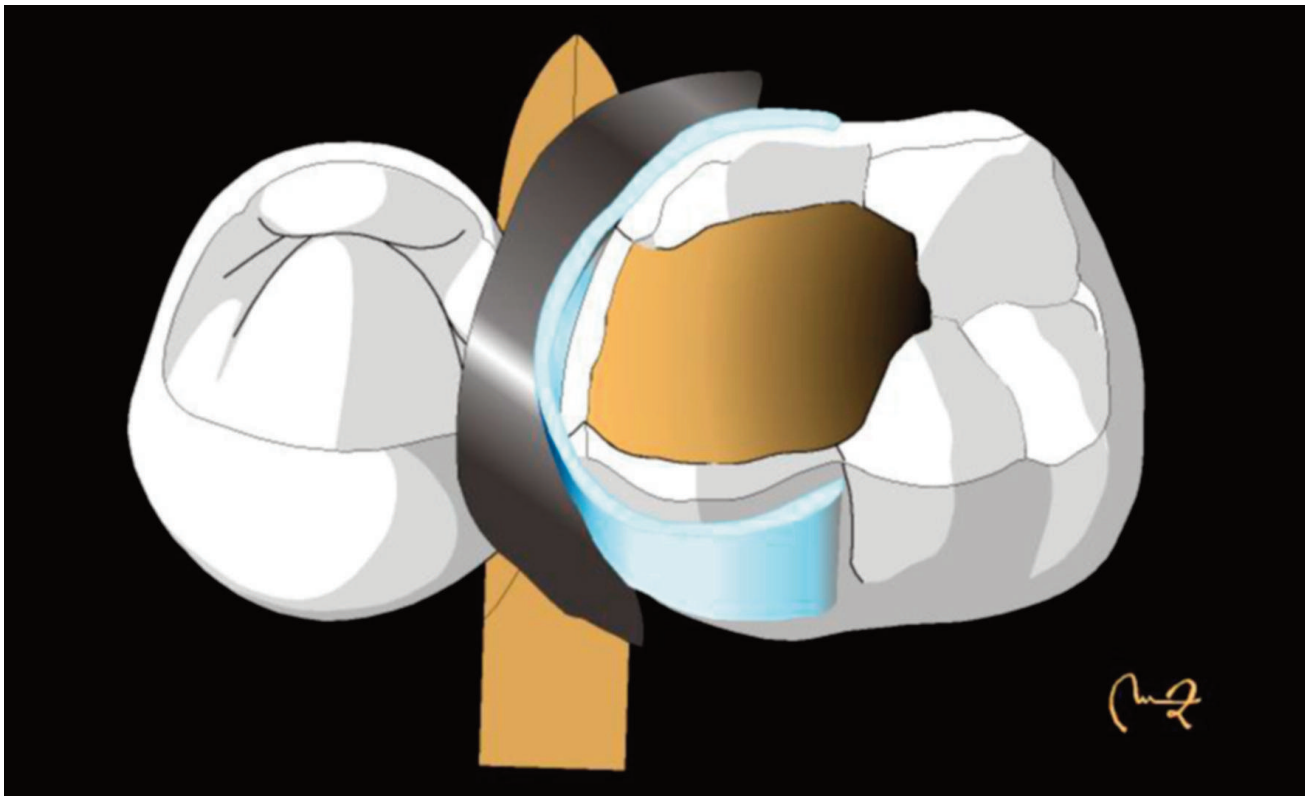

Figure 4. The fibreglass can be placed in this position or in that which is shown in figure no. 6. In both cases, the fibre girths the vestibular and lingual wall of the crown of the endodontically-treated molar.

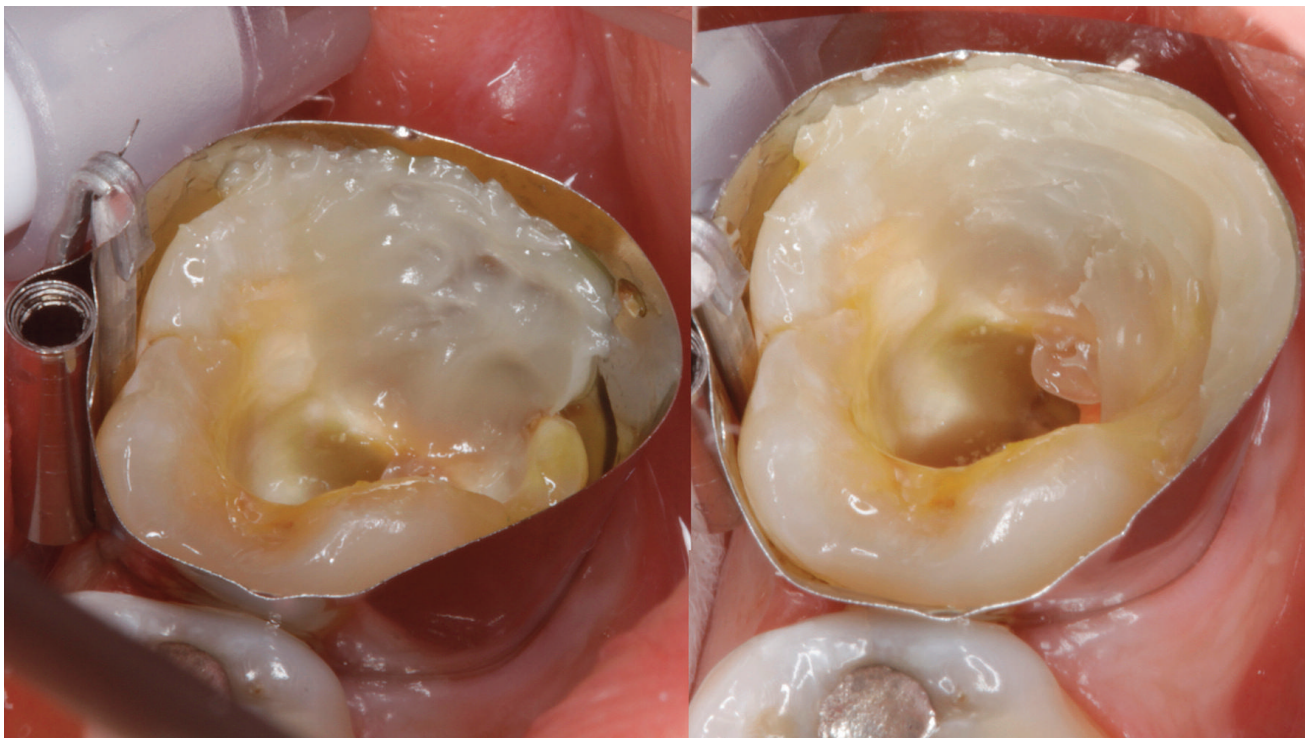

Figure 5. First, place a thin layer of composite adapted to the matrix that remains covering and isolating the fibreglass in the interior of the restoration.

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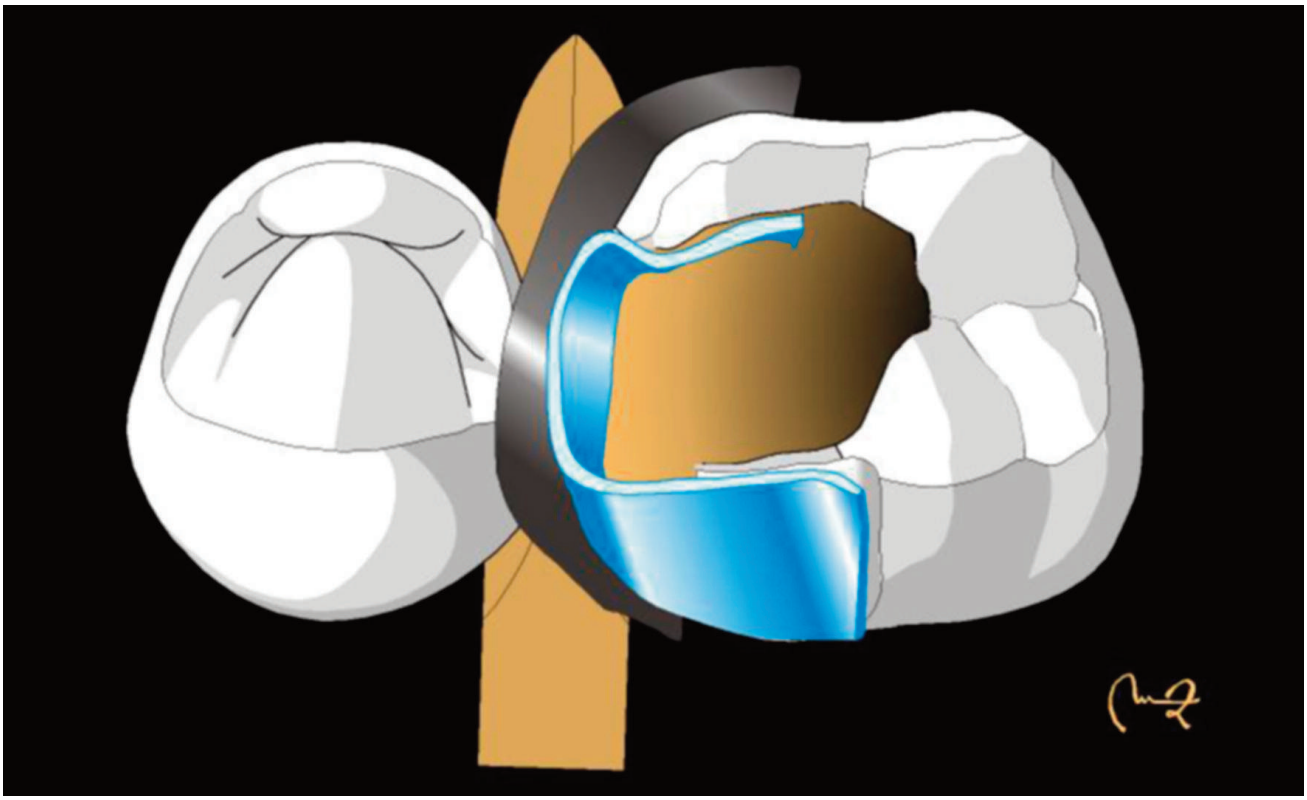

Figure 6. Schematic drawing that shows how we have placed the fibreglass in the clinical case we are describing.

meated as always with a fluid composite, to the now defunct Vectris® (Ivoclar/Vivadent) and the recently presented Dentapreg® which is what we have used (Figure 7). Dentapreg has a great variety in fibreglass design (braided PFM of 3 mm, braided UFM of 6 mm, braided SFM of 2 mm and braided SFU of 2 mm) with specific indications that we are going to omit except in those that we are going to use in the case presented which is going to be the PFU of 2 mm in width with parallel fibres that can be expanded to 3 mm if pressed.

Once the fibre is placed in position, which we adapt to the surface with a steel spatula or with a ball also of thick steel, curing it with light to fixate it in the position and now we observe that the external walls of the crown have been reconstructed but the entire centre of the crown is left empty, for which we must begin the filling of this entire cavity with a composite that can be placed in small increments so that the light is effective throughout its thickness. This requires time since we have to put many layers of composite; it is for this reason that at present composites have been designed that can be cured in thicker layers with the curing light reaching the depths. They are the fluid composites Filtek™ Bulk Fill (3M ESPE) and the SDR™, Smart Dentin Replacement (Dentsply). These are injected in the base of the cavity, removing the needle as they are being inserted and they are placed in a thicker layer and always deep, that is to say, they cannot be exposed to the surface since their resistance to abrasion is less than that of the composite. A short time ago a new composite came out on the market from the firm Ivoclar/Vivadent named Tetric EvoCeram® Bulk which is of a thick consistency, low contraction in curing, good resistance to wear and capable of being polymerised in thick layers of approximately 4 mm. This product can be left on the surface, but one must stress that it is of a thick consistency and not fluid like those described previously.

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Figure 7. Dentapreg® PFM fibreglass of 3 mm is a good option for girthing the crown. Braided fibreglass can also be used.

In this case that we are describing, first the base of the cavity was filled with the composite Filtek™ Bulk Fill (3M ESPE) and then the fibreglass was placed in the crown wall (Figure 8).

We have now restored the crown wall and reinforced with fibreglass which we have placed in a circular form and filled the deepest hollow of the cavity which remained in the centre of the crown. This in itself reinforces the crown of the tooth since we are girthing it, but we can also have additional reinforcement by again adding fibreglass but now placed in the vestibular-lingual sense (Figure 9). This placement of the fibreglass from the buccal wall to the lingual is that which is normally used in clinical practice.

The fibre that we have now used is the PFM of 3 mm in width (Figure 10) which we take to the cavity that we have made before, covered with a composite fluid to achieve a good adaptation to the walls and to avoid empty spaces remaining. We adapt it perfectly in the shape of a U to the vestibular wall, to the base of the cavity and to the lingual wall, applying pressure with a thick steel ball to adapt it perfectly to the walls. Once in position, it is polymerised. Now an important point must be made: taking into account that the fibreglass cannot be exposed to the exterior, we have a first option, which is that of being meticulous in the measurement of the length of the fibreglass so that it does not surpass the crown margin of the vestibular and lingual wall. This is hard to achieve since frequently it each remains buried or surpasses the margin. To avoid making the clinical work difficult, we can first surpass the margin, without going too far, of course, we use the photopolymerisation light to harden it and then we have two options: either eliminate the excess with a diamond bur, making at the same time a bevel as observed schematically in the drawing of Figure 11, or else after filling the remaining cavity and having carved the occlusal anatomy of the molar, we see whether or not part of the fibre has remained exposed. If it has been, a cavity is made with the diamond bur and it is filled with composite leaving the fibre at a depth. With both options one has to make a new acid etching and placement of the adhesive before placing the composite, since it is possible that we may leave the enamel exposed.

Once the fibre is in place, the rest of the cavity is filled with a nanofilled composite which in this case has been the Filtek™ Supreme XTE (3M ESPE) which is placed as always in various triangulated layers to avoid the contraction in curing and to achieve a good hardening in the depth. It can be inserted in small increments of material until the crown anatomy is reconstructed or place an excess and then eliminate the excess with the diamond bur until achieving an appropriate occlusal anatomy (Figure 12).

The matrix is removed and the carving is begun of the crown profile (diamond fissure bur from the firm Komet® Ref. 806 314 250 524 012) as well as the occlusal anatomy (diamond bur with the shape of a rugby ball from the firm Komet® Ref. 806 314 257 524 023) although for this you can use a multitude

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Figure 8. Through the interior of the preliminary wall of the composite adapted to the matrix, the fibreglass is placed, embedded in the classic composite fluid or in the new Bulk Fill (Filtek™ 3M ESPE). We also use this to fill the base of the cavity, avoiding with its injection leaving air bubbles and polymerisation problems in the deepest area.

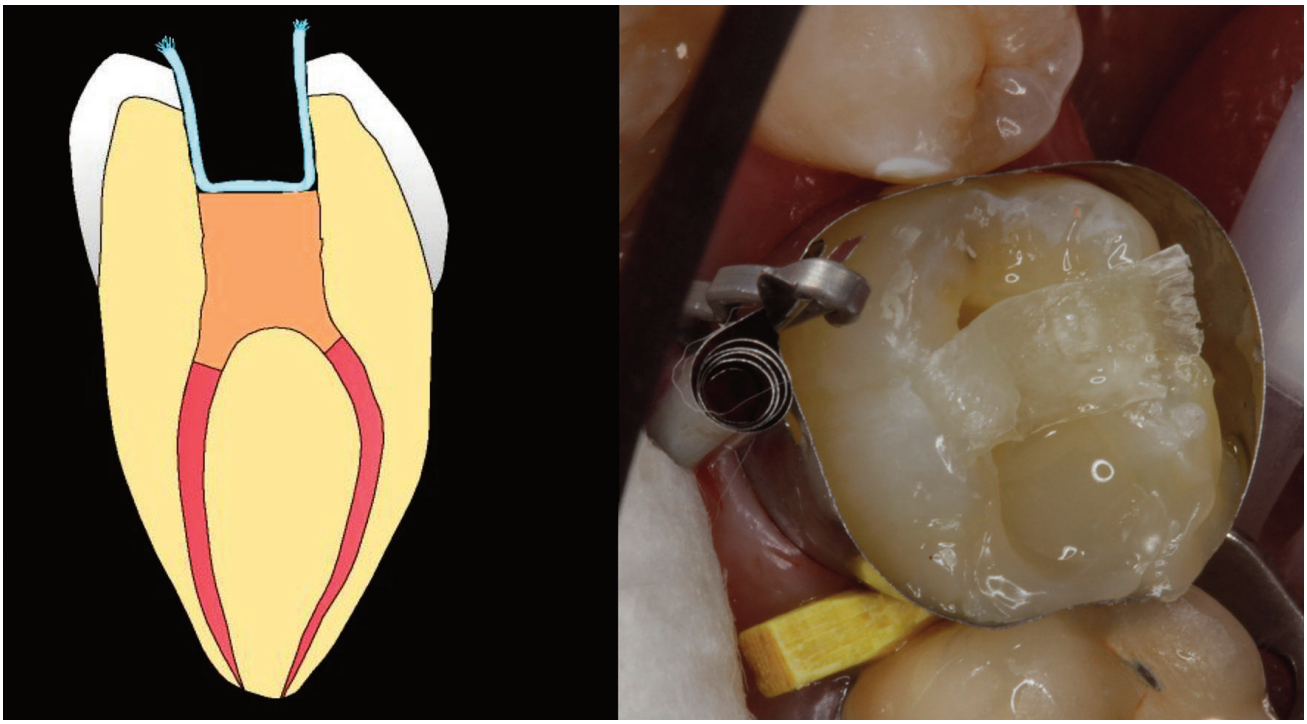

Figure 9. Schematic drawing of the position of the fibreglass placed making a loop from the vestibular wall to the lingual or palatal wall and a clinical case "in vivo" of its placement before being adapted to the walls and to the base of the cavity.

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Figure 10. Dentapreg® braided fibreglass of 3 mm PFM3 and of 2 mm SFM.

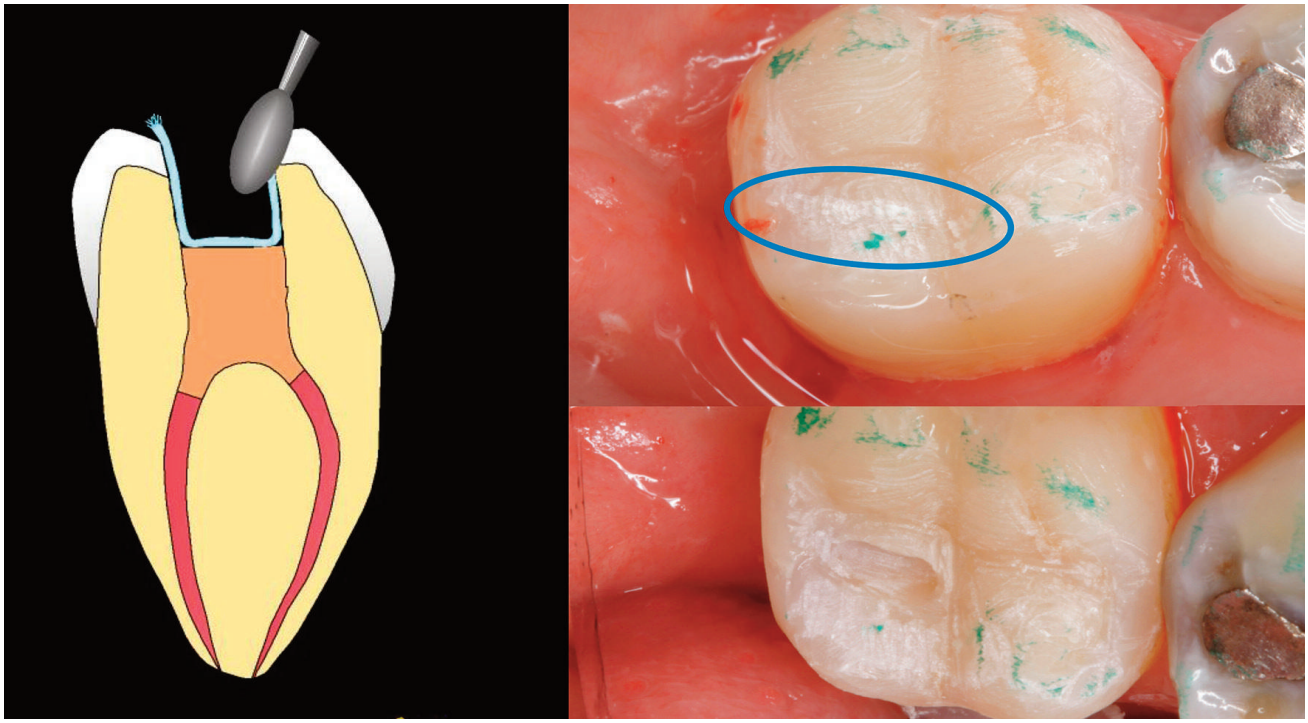

Figure 11. One of the ways of getting the fibreglass to remain included in the restoration is to eliminate the excess with a diamond bur once it is polymerised in its position as described in the drawing and another way is, after carving the occlusal anatomy of the crown and we detect its exposure, to make a micro cavity, eliminating it from the surface and then burying it with a new application of the composite.

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Figure 12. The filling of the cavity is done by layers with a composite of the nanofiller Filtek™ Supreme XTE (3M ESPE) waiting for the final carving.

of bur designs that are available for all the consumers' tastes (Figure 13). We control the occlusion, of course, in centric occlusion and lateralities and afterwards we perform the final polishing which in the molars we usually do with Enhance™ cup-shaped finishers (Caulk/Dentsply) even when the polish can be improved with Prisma Gloss™ (Caulk/Dentsply) polishing paste with felt cups. A polishing system Sof-Lex™ has just been presented by 3M which is ideal for the occlusal faces of the molars which cannot be polished with the classic discs. They are spiral finishing and polishing wheels.

The final radiograph taken from the ortho-radial position shows us the contour of the restoration and the adaptation to the gingival margin. The composite is radiopaque so it is easily distinguished from the dental structure (Figure 14).

DISCUSSION

Once the technique has been described and followed step by step, we still have a series of questions that we had indicated at the beginning of the explanation.

Do we previously insert a post in the lumen of the widest root?

Will we increase the resistance of the crown remnant if we insert fibreglass as an internal ferrule?

If the post does not reinforce the tooth and only serves to retain a core or crown restoration, why do we make an effort to insert it? Is it to be more satisfied, to justify our work or even for reminiscences of past times? The truth is that it is difficult to justify the placement of a metallic post, but it is no less difficult to justify the insertion of one of fibre in those cases of

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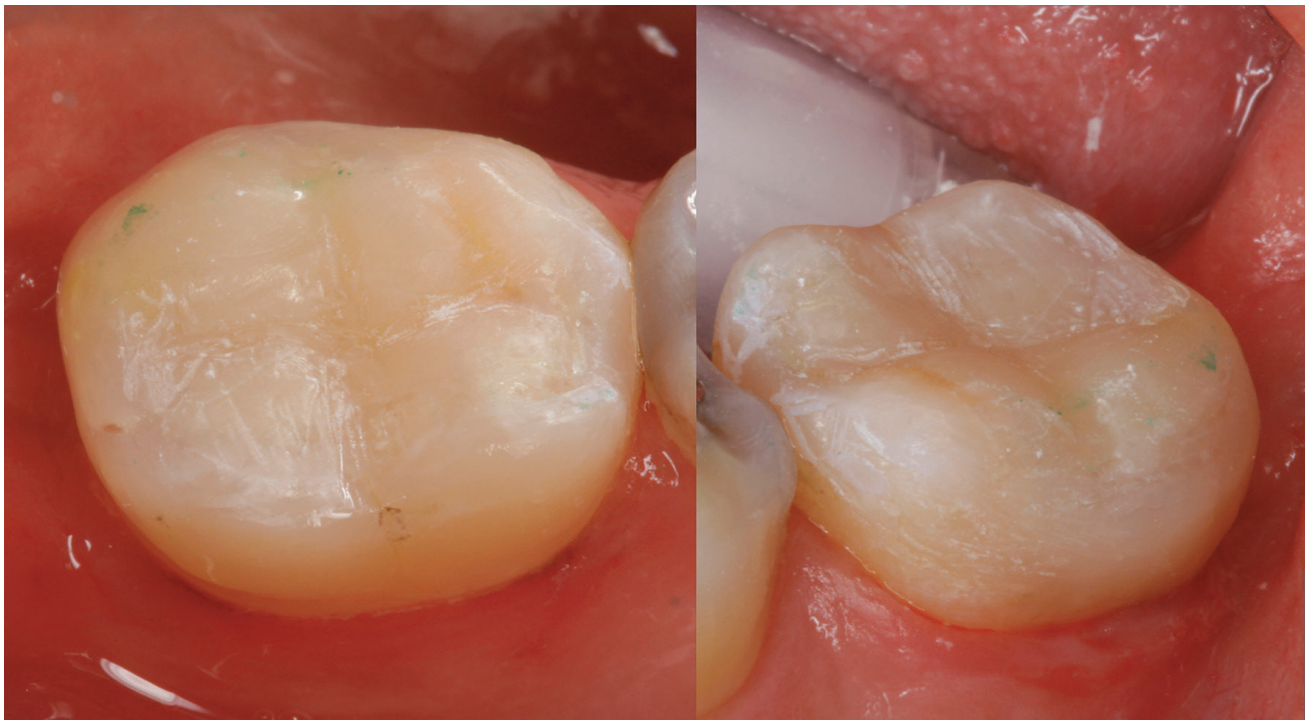

Figure 13. Carved crown.

Figure 14. Final ortho-radial radiograph of the finished crown restoration where we can see its gingival adaptation, thanks to the radiopacity of the composite.

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molar restoration, even when some research papers[1] conclude that the devitalised teeth restored with composite combined with fibre post resist the fatigue trials better.

The indication that makes us be able to decide on the crown restoration with composite instead of other alternatives such as the restoration with a cast post-core and a crown with total onlay is generally established based on two parameters: is there sufficient dentinal structure remaining so that the adhesion of a composite is sufficient? and, can we control the gingival margins of the restoration?

If we want to increase the quantity of dentin exposed, we can rely on that which is in the floor of the pulp chamber, eliminating in this area the gutta-percha that we use to fill the canals. We eliminate then the gutta-percha from the floor of the pulp chamber and we leave then only the gutta-percha filling in the entrance of the canals, freeing all the dentin from the base of the cavity (Figure 15). If we want still more retention it is now when we can place a cemented post inside the canal that is usually the thickest, that is, the distal in the inferior molars and the palatal in the superior molars.

We empty -but do not widen- the canal of the gutta-percha that fills it, using for this the classic Gattes burs (No. 4, 5 or 6) depending on the initial calibre of the canal and we cement the post, whether the current fibre ones or the classic metal ones (Figure 16). It must be stressed as cemented material that this must be dual cured since the light does not reach the apical area of the canal.

The most interesting subject for entering into discussion is the approach made initially. Will we increase the resistance of the crown remnant if we insert fibreglass as an internal ferrule? If we review the published bibliography, as always there are papers in favour[2-7] and against[8], all based on research papers in which their resistance to fracture of our thermal cycled samples are tested and subjected to compressive forces. We lack the long-term monitoring in our experience to verify whether, in fact, the premolar or devitalised molar restored with fibreglass placed in a U shape from the buccal to the lingual wall is clinically more resistant, compared to the classic restoration with only composite. We indeed can certify that over time the classic restoration with only with composite is effective (Figure 17).

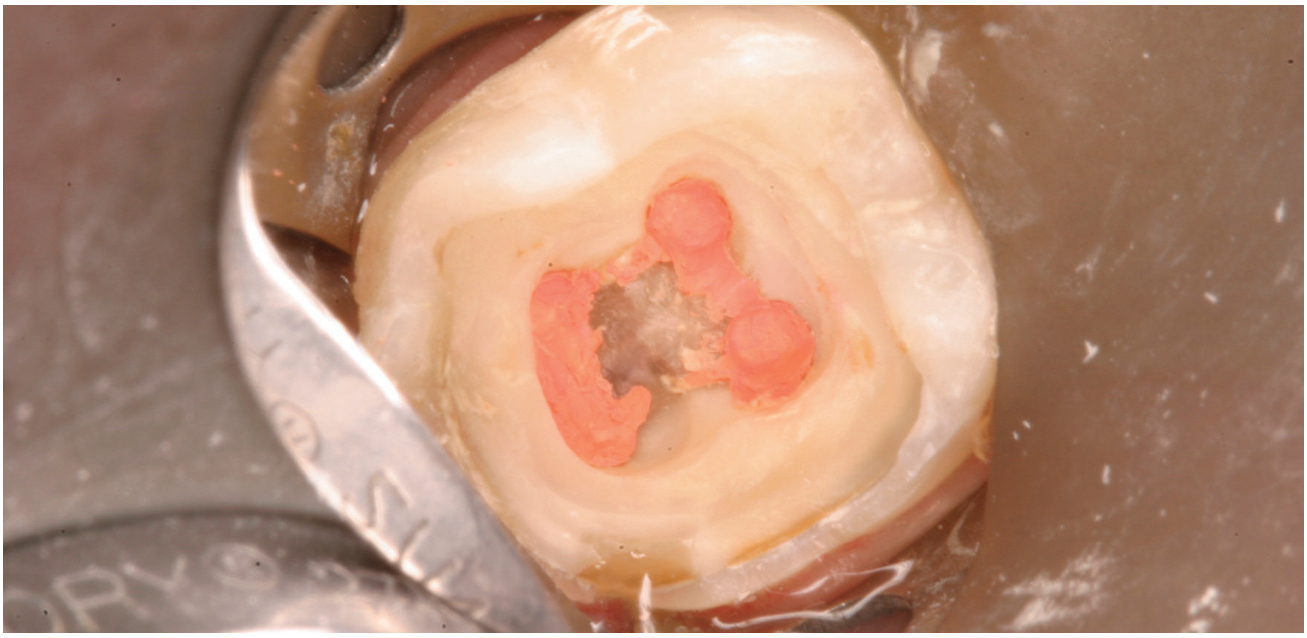

Figure 15. If we need more adhesion to dentin, we eliminate the gutta-percha from the floor of the cavity and from the entrance of the canals.

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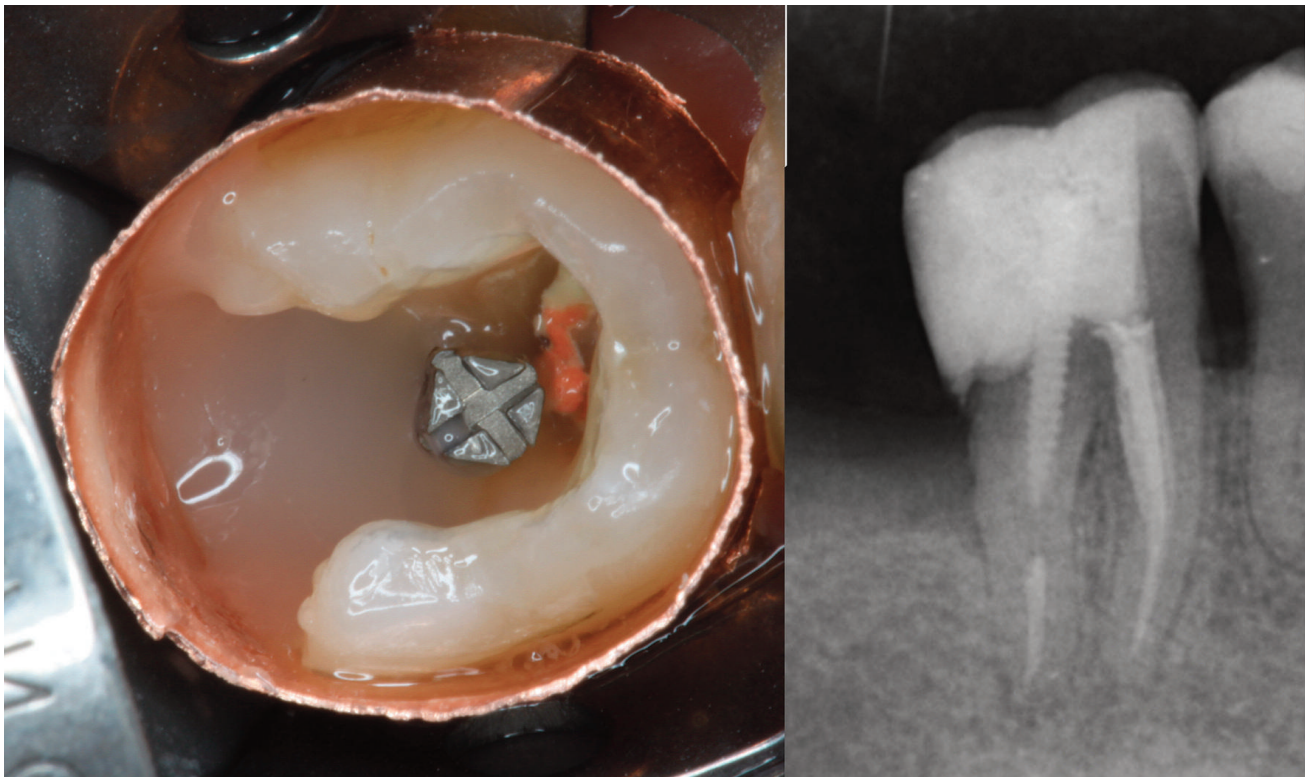

Figure 16. The post is cemented with auto and photopolymerisable composite fluid and the restauration is adapted to the gingival margin, carefully carving it with a bur.

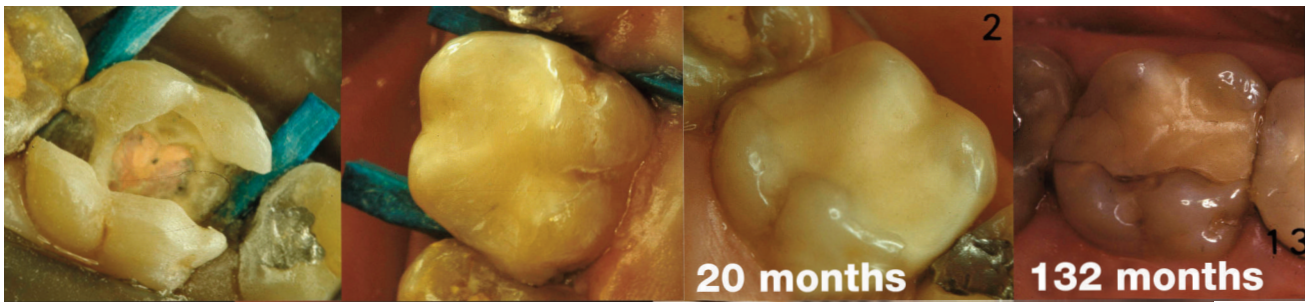

Figure 17. Photographic composition of the preoperative state of the crown of an endodontically-treated first molar (observe the bevelling of the crown margins of the buccal and palatal walls), its final restoration and a check-up at 20 and 132 months.

We also agree with Magne et al.[9], and one must note that it is fundamental to protect the cusps or at least a bevel marked in the crown margins of the cavity so that the retention of the composite is more effective.

We do think that the placement of the fibreglass in a circular sense, when it is possible and, better still, if it embraces, overlapping on the vestibular and lingual sides of the crown walls, increases the resistance to the mastication forces, avoiding a vertical fracture occurring in the dental crown and for this reason we have shown how to do it with a clinical case. We must now wait the necessary time to verify its comportment in the mouth over the years.

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Received: 7 May 2013.
Accepted (or accepted for publication): 30 October 2013.

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Case report

Implant-supported mandibular rehabilitation on microvascularised fibular graft. Use of computer-guided surgery

Published in Spanish Científica Dental Vol. 10. Nº 3. 2013.

ABSTRACT

Introduction: in the treatment of patients affected by malignant tumours of the oral cavity, surgery combines the resection and the immediate reconstruction with the aim of preserving the functions that are concentrated in the oral cavity (articulation, swallowing, mastication, aesthetics). The use of microvascularised flaps consists of a usual practice in those patients in order to replace the resected tissues. Dental rehabilitation in these patients is usually very complex, and the use of guided implant surgery systems avoids many of the problems that are presented in these patients.

Clinical case: a patient subjected to a hemimandibulectomy without reconstruction and adjuvant treatment with radiotherapy who is referred for reconstruction. Initially, a microvascularised fibular flap is practiced that contributes bone and soft tissue. Subsequently, a hybrid prosthesis is used over implants, which are placed by means of a mucosa-supported surgical guide after planning with the FacilitateTM tool.

Discussion: the microvascularised fibular flap is the spearhead in mandibular reconstruction of the oncological patient. Its main disadvantage is the difficulty in placing the dental implants and their subsequent rehabilitation. The use of guided implant surgery avoids many of these problems.

Conclusions: the reconstruction of the oral cavity in oncological patients using microvascularised grafts and the subsequent dental rehabilitation with osseointegrated implants allows offering the patient an acceptable quality of life.

KEYWORDS

Oral cancer; Squamous cell carcinoma of the oral cavity; Microvascularised fibular flap; Dental implants; Guided surgery; Quality of life.

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INTRODUCTION

In recent decades, advances in the treatment of tumours of the maxillae have allowed us to treat and even cure patients that previously were considered untreatable. In this way, today the resection of tumours is as important as the immediate reconstruction of the defects created, which allow offering our patients the sufficient quality of life and to continue performing the typical functions of the removed structures.

In the field of bone reconstruction of the facial skeleton, we must take into account that both the mandible and the maxilla are the carriers of the dental pieces and consequently the preservation of the masticatory function must also be the objective of our surgical treatment.

The placement of implant-supported prostheses on the reconstructed bones offers these patients a definitive solution for the recovery of the masticatory function in addition to helping to improve other sequelae such as labial support[1-3].

The microvascularised fibular flap has been one of the principal options for this bone and dental rehabilitation. The flap was initially described by Taylor and Gilbert at the end of the 1970's and used by Hidalgo in 1989 for mandibular reconstruction. Since then, its use has been generalised, thanks basically to its versatility in offering a long length of bone[4, 5]. Its disadvantage in the dental rehabilitation is that the precise insertion of the implants is complicated in situations in which, after the resection, the occlusal relation has been lost and the morphology of the reconstructed bone is notably different from the original mandible. Therefore, many implants inserted in it cannot then be rehabilitated adequately (Figure 1), and many rehabilitations are complex and lead to dental occlusions that are not very functional[2, 6-8].

Currently the guided implant surgery allows planning and placing implants virtually on a computerised tomography image (CT) that duplicates the bone anatomy of the patient. By means of computer support, a guide is prepared that, supported on the patient's tissues during the surgery, will indicate the precise position of each implant so that it coincides with the planned situation. In addition, it allows us to sketch what the definitive prosthesis will be like, avoiding the problems of malocclusion and non-rehabilitated implants[9].

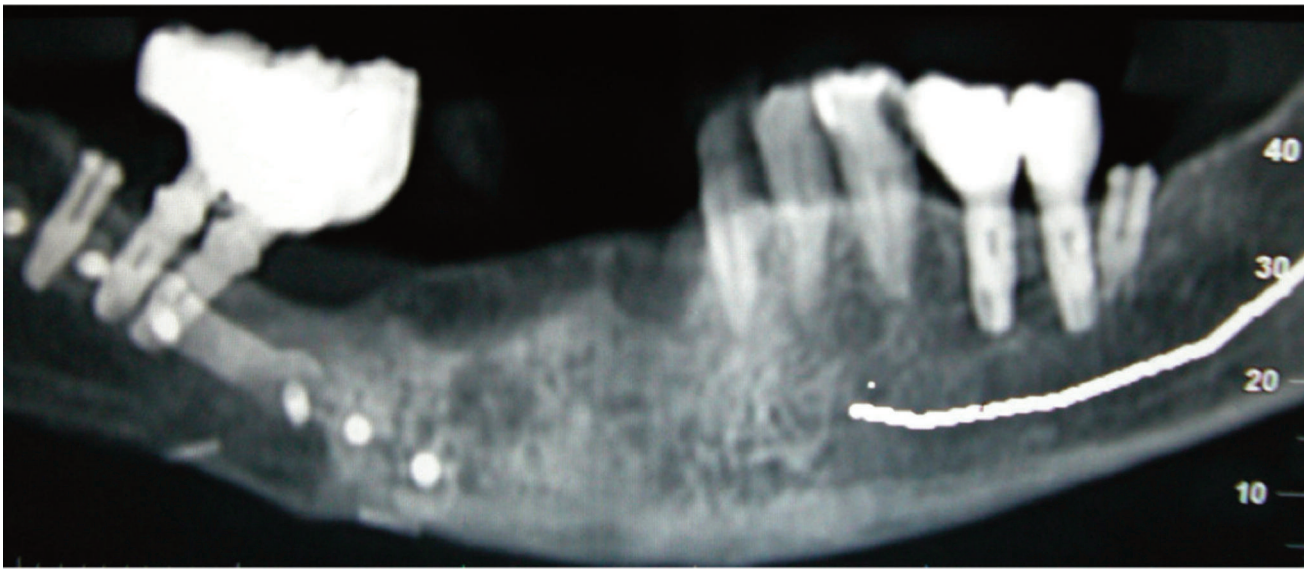

Figure 1. Incomplete oral rehabilitation on microvascularised graft. Implants not rehabilitated.

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CLINICAL CASE

We present the case of a 54 year-old patient who has been subjected to a hemimandibulectomy due to suffering squamous cell carcinoma of the retromolar trigone with extension to the bone. At first no reconstruction of the removed area was performed and the defect was obliterated, suturing the tongue to the mucosa of the cheek after the removal of the left mandibular body. Functional cervical dissection was also performed and post-operative radiotherapy was also indicated.

Three years after the surgery the patient is free of disease, although he has had a very poor quality of life. He depended on gastrostomy for his nutrition, with severe alteration of his articulation, masticatory and swallowing functions. In these conditions he was referred to the Oral and Maxillofacial Surgery Department to improve his clinical situation (Figure 2).

At first the bone reconstruction was performed with a microvascularised fibular flap (fixated with a reconstruction plate) that improved the facial symmetry and articulation and swallowing functions, allowing the removal of the gastrostomy (Figure 3). However, the patient continued subsisting on a soft diet, for which reason the rehabilitation of the masticatory function was posed.

Given that the patient presented mandibular edentulism, a complete prosthesis was prepared, that was very poorly tolerated due to the problems of support and retention related to the complex anatomy of the area. Therefore, the only possibility for achieving satisfactory masticatory function was to make an

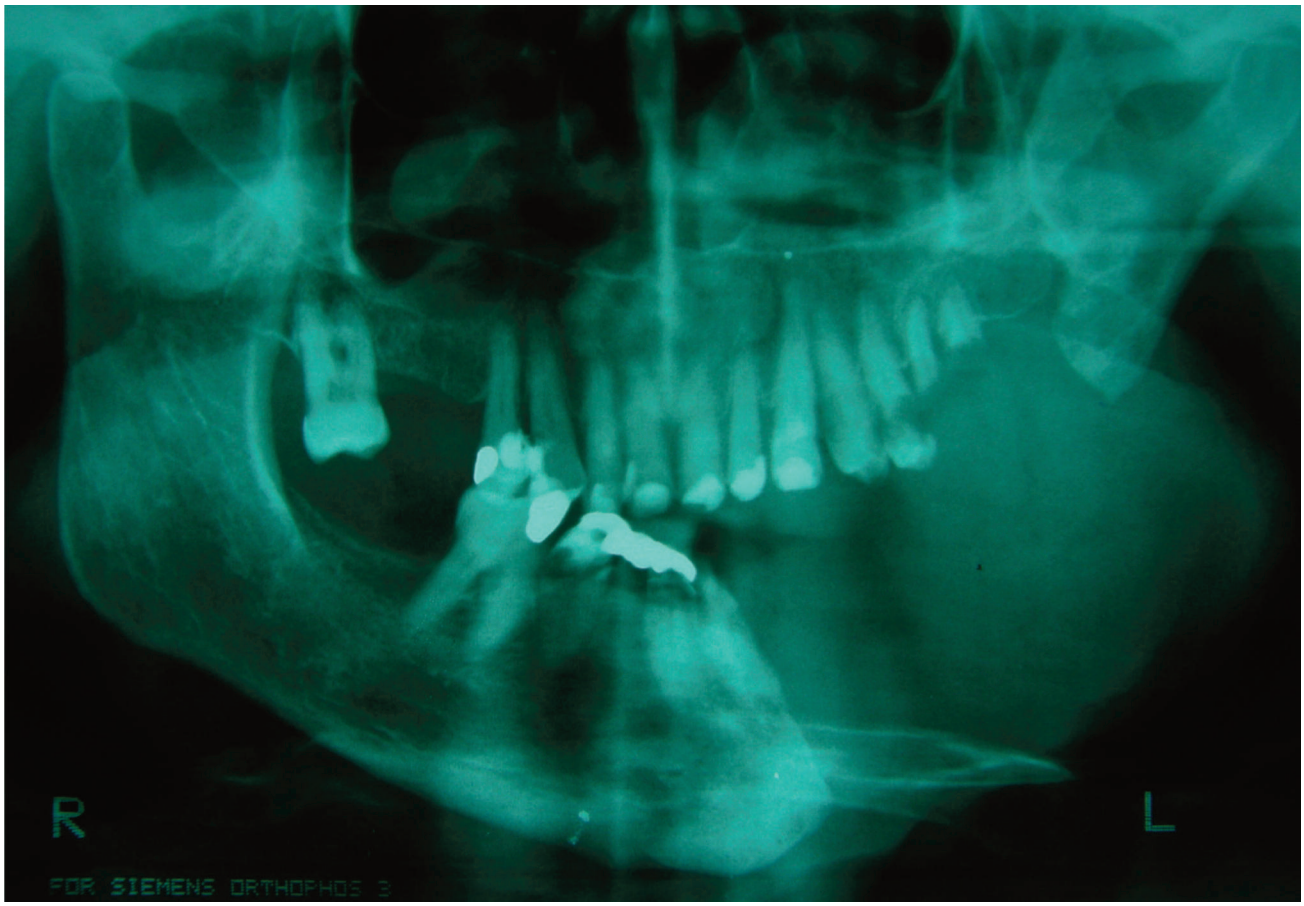

Figure 2. Orthopantomography in which is shown the state in which the patient arrived at our office after segmentary mandibulectomy due to squamous cell carcinoma of the mandibular gum.

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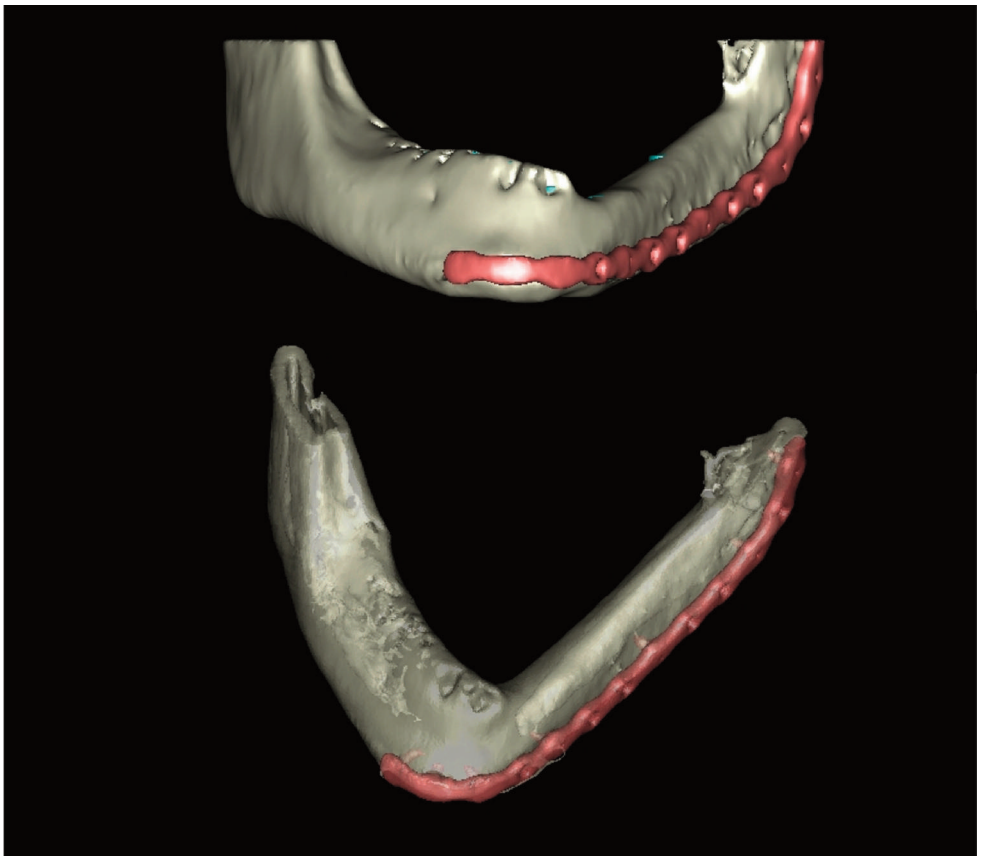

Figure 3. Scanned image after the mandibular reconstruction with microvascularised fibula graft.

implant-supported prosthesis, placing the fixations in the healthy mandible as well as in the fibular section.

It was a case of an unfavourable anatomical situation, worsened by the presence of a titanium plate with many screws that was complicated to remove, for which reason it was decided to carry out a guided implant surgical procedure.

To do this, a radiopaque guide was prepared on a model of the patient. A scan was requested that was processed by the company Materialise (Leuven, Belgium). and on it, using the tool *Facilitate*™ from *SimPlant*™ (Leuven, Belgium) seven implants were planned, 4 mm in diameter and of different lengths *Osseospeed (Astratech, Sweden)*. Of these, three were situated on the native hemimandible and four on the fibula, to make a screwed hybrid prosthesis. Given the good adaptation of the radiological guide on the mandibular edge of the patient, a mucosa-supported surgical guide could be made (Figures 4-8).

The surgery was performed without complications. The seven planned implants were inserted and the cover plugs were placed. After three months, the implants were uncovered, verifying their osseointegration and transepithelial plugs were put into place (Figure 9). Three weeks later, the prosthetic phase began, taking impressions with individual trays, an implant-supported hybrid prosthesis was elaborated. The seven implants could be rehabilitated (Figures 10, 11).

With regard to the antagonist arch and using the remaining teeth, a mixed metal-porcelain prosthesis was made in the anterior sector with attachments to support a skeletal prosthesis and to rehabilitate the posterior maxillary sector.

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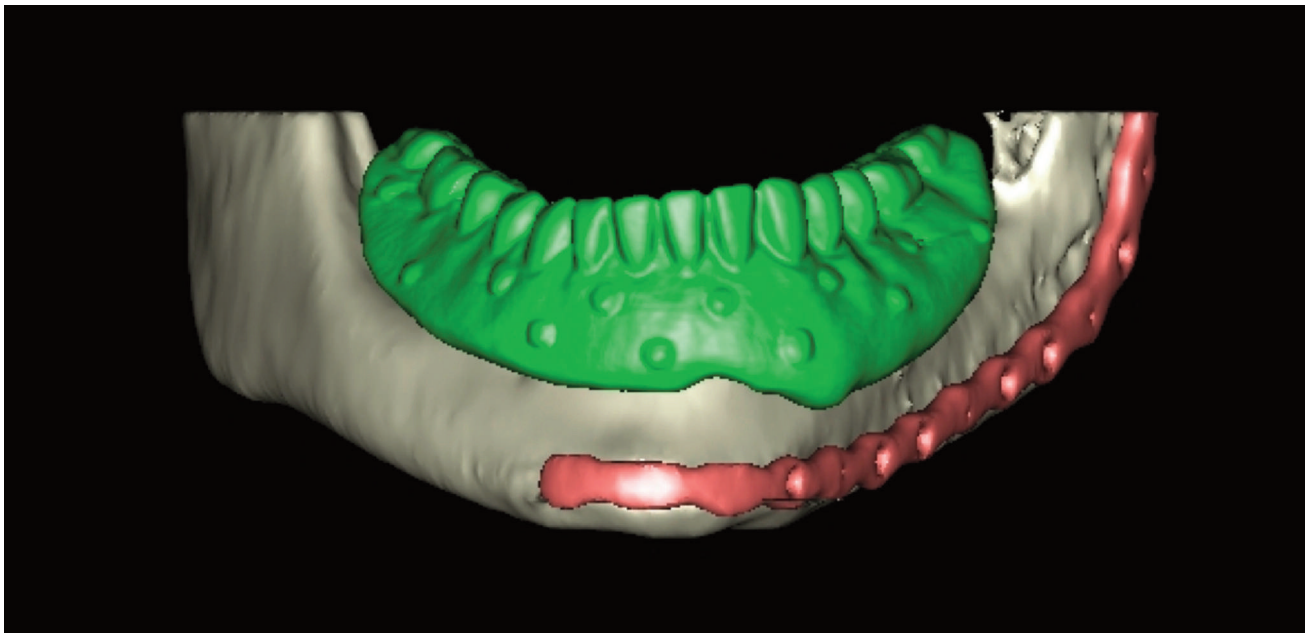

Figure 4. Image of the radiological guide designed for the realisation of the virtual surgery.

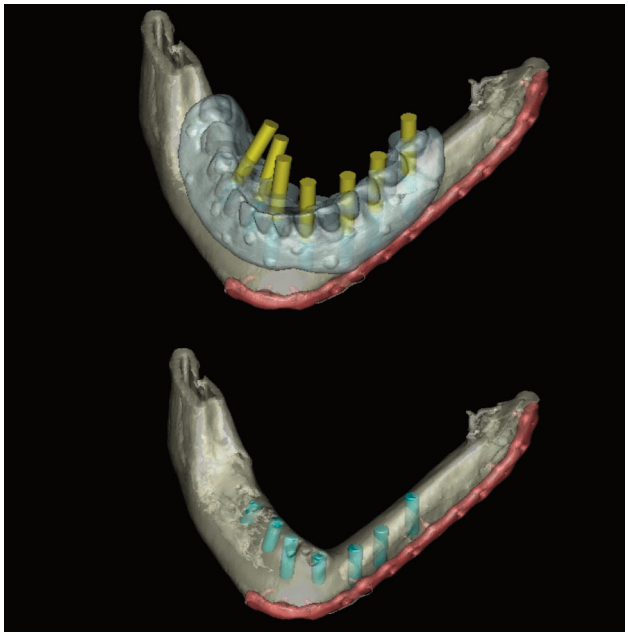

Figure 5. Implants planned on scanned mandibular image using the FacilitateTM tool for Simplant.

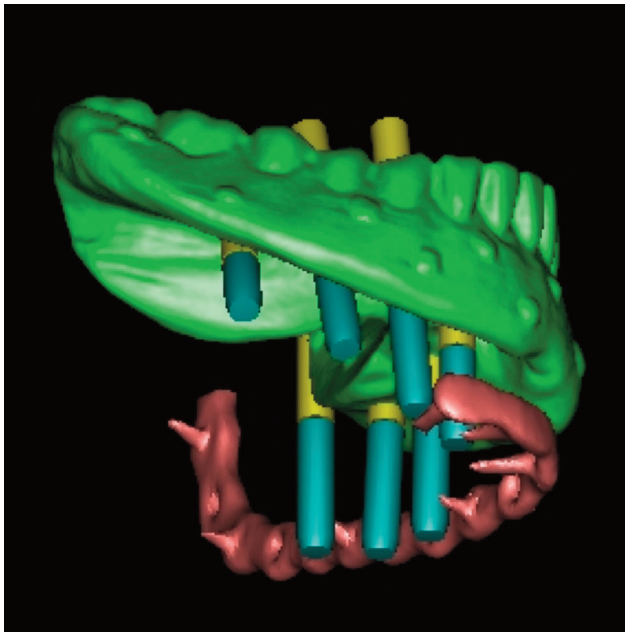

Figure 6. Surgical guide. Details of the placement of the implants, avoiding the screws of the osteosynthesis plate.

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Figure 7. Surgical guide for guided surgery (Surgiguide, SimPlant-FacilitateTM).

Figure 8. Mucosa-supported guide positioned in the oral cavity.

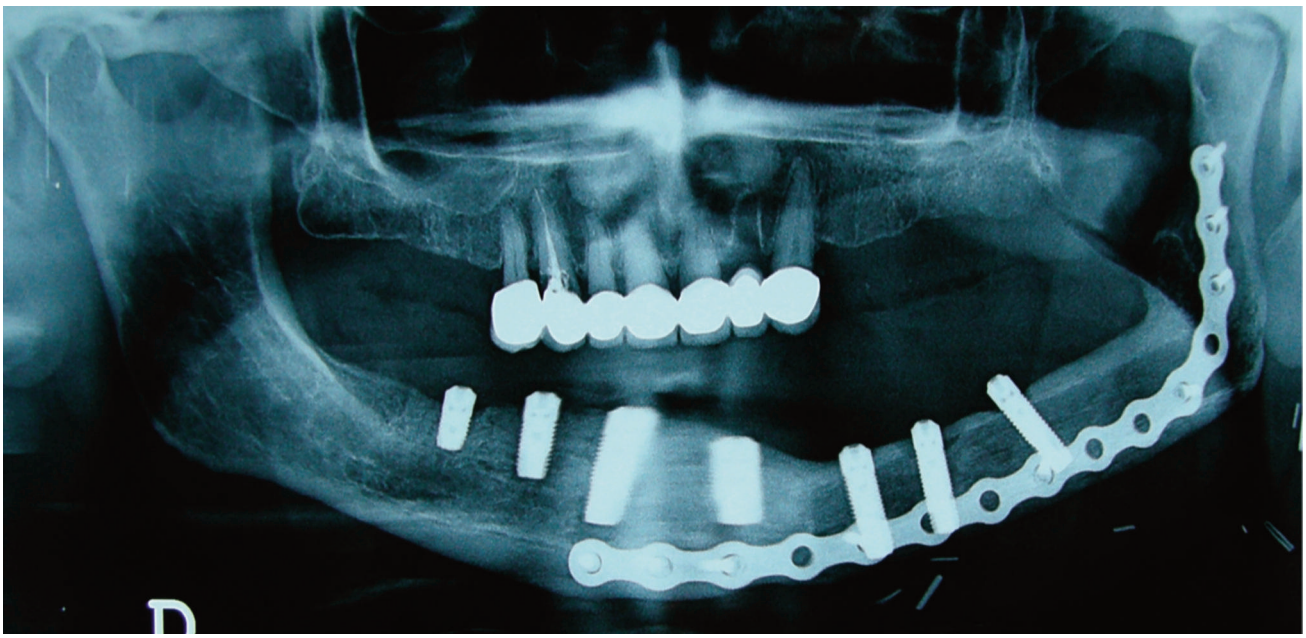

Figure 9. Implants correctly positioned and integrated six months after insertion.

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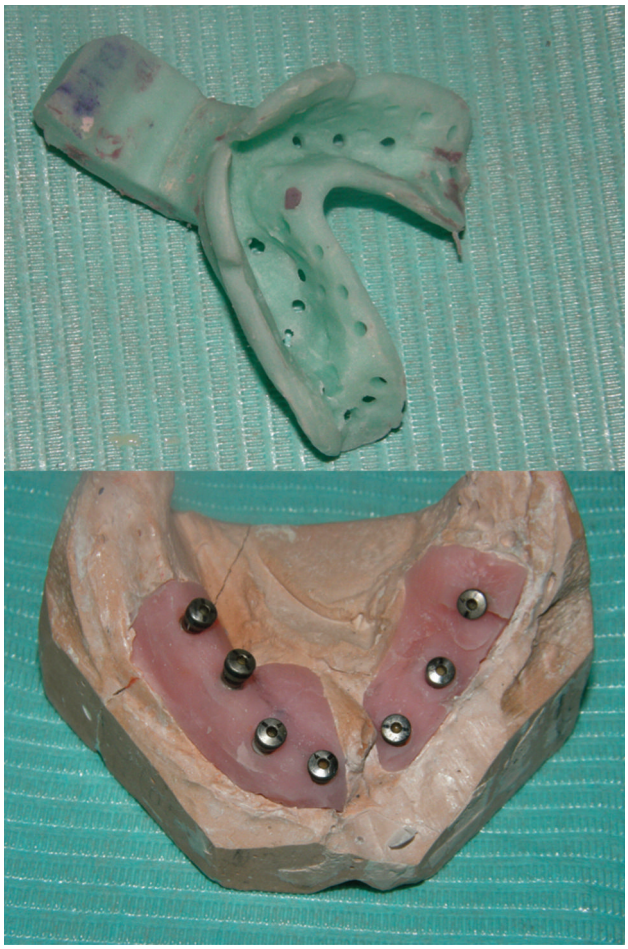

Figure 10. Individual tray and close-up of the working model.

Three years have passed and the prosthesis remains installed and in use. The dental occlusion is correct and the patient has normalised the masticatory function, being able to eat a normal diet (Figure 12).

The lack of saliva related to radiotherapy is an additional problem that makes difficult the management of the bolus, and it has been treated with symptomatic measures (abundant water intake, saliva substitutes, gum…).

Another objective of the reconstruction was the contribution of soft tissues to achieve adequate lingual mobility and to favour swallowing and articulation.

DISCUSSION

The development of reconstructive surgery of the facial skeleton in the recent decades has permitted improving to a great measure the quality of life of cancer patients. Being able to have a normal diet depends directly on the good masticatory and swallowing function. The use of microvascularised flaps and the development of implantology has helped to a great extent to achieve these objectives[5,6].

With respect to the flaps used, the fibula has been shown to be the most versatile in bone reconstruc-

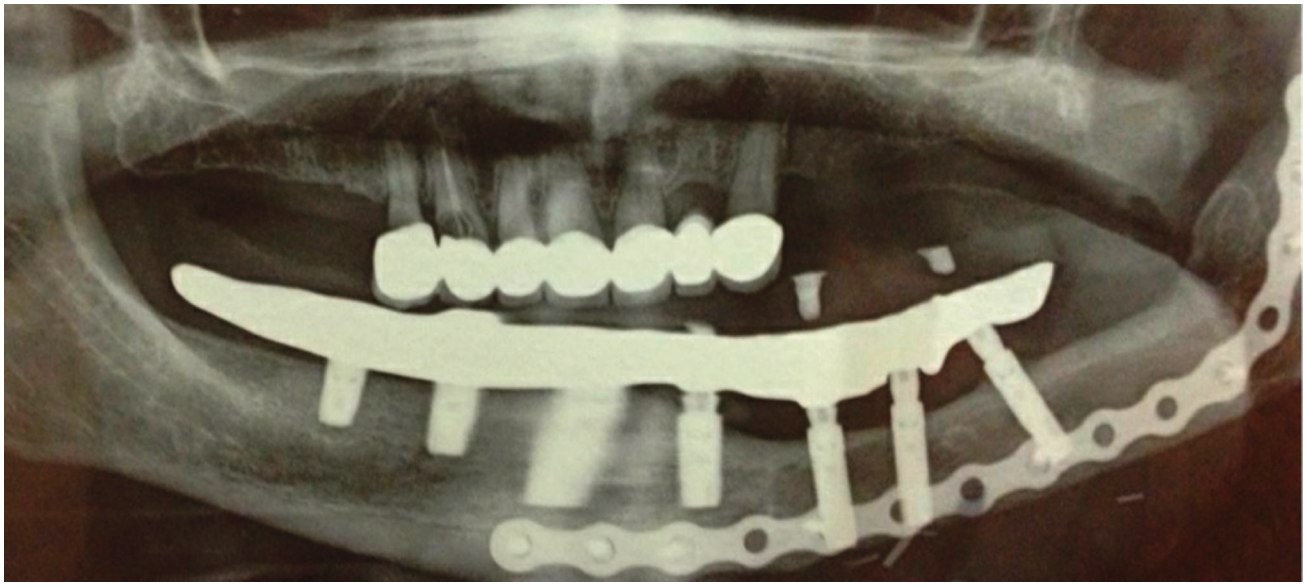

Figure 11. Orthopantomography in which it shows the correct adaptation of the hybrid prosthesis placed on the implants.

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Figure 12. Close-up of the prosthesis placed in the oral cavity.

tion. The principal advantages are: its length, which allows reconstructing defects up to 25 cm, the possibility of moulding it, realising multiple osteotomies, and the minimum morbidity of the donor area. It is indicated, among others, for the mandibular reconstruction associated with important defects of intraoral soft tissues, the reconstruction of symphyseal mandibular defects, either subtotal or total, the reconstruction of the branch and condyle and the reconstruction of posterior maxillary defects[4, 5, 10, 11].

Its major disadvantage is the scant height of the obtained bone that difficults the functional rehabilitation with osseointegrated implants[12], and also have to be placed in staggered form due to the incompati-

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bility with the amount of material for osteosynthesis that is required to fixate the osteotomies[2]. In any case, whenever we have 10 mm of bone height and 5 mm of width, the rehabilitation with implants will be possible if they are placed precisely[12, 13].

As already commented, the final objective of the bone reconstruction is the placement of implants on these vascularised grafts for the rehabilitation of the masticatory function. The principal problem that implantology has posed on flaps has been the precision when situating the implants in the flap in order to achieve a correct emergence of the prosthetic attachments and, in short, a good occlusion. In this regard, it is not infrequent that many of the implants placed cannot be rehabilitated afterwards (Figure 1).

The guided implant surgery has been able to correct many of these problems. The virtual planning allows:

1. Situating the implants where the radiological quality of the bone is optimal, adjusting precisely the length and width of the implants.
2. Planning the emergence of the prosthetic attachments with the aim of the placed implants being able to be rehabilitated.
3. Avoiding the need to remove the osteosynthesis material when placing the implants, if possible, where there are not screws and also avoiding the osteotomy lines.
4. Performing minimally invasive surgery without the need for performing periosteal stripping of the grafted bone.
5. Planning immediate prostheses that can be placed in the postoperatory period, improving the function and the adaptation of the soft tissues[9, 14-16].

In order to perform the guided surgery it is necessary to have:

1. An image from a computerised tomography that allows us to evaluate with precision the maxillary or mandibular bone for the virtual placement of the implants.
2. An appropriate software, a planning program, which in our case has been the Facilitate tool for the SimPlant program of Materialise Dental.
3. A stereolithographic guide that translates the information of the planning from the scanned image to the real patient[14, 17].

In this sequence of necessities, that we must take into account are:

1. Before referring the patient to the radiology room, we must decide the type of support for the surgical guide. If we are going to perform surgery without a flap, which is ideal, the CT on the patient must be done with a barium radiological guide. So that the guide is useful, it must be adjusted precisely to the mucosa of the patient and remain stable so that the thickness of this mucosa can be inferred and the planning is correct with regard to the diameter and length of the implants. This is usually complicated in complete mandibular reconstructions. In case it is impossible to adapt the radiological guide to the mucosa (very frequent in reconstructed patients with alteration of the bone profile and distortion of the soft tissues) the surgical guide will be of bone support. If the patient has dental pieces in the arch to be reconstructed, we can opt for a dental support. In the rest of the cases in which the radiological guide adapts well to the mucosa, that will be the chosen support for the final surgical guide[18-20].
2. As for the planning program, it is necessary to know well its characteristics in order to be able to use all the tools and advantages that it offers.
3. Finally, in reference to the surgical guide, one must take into account that, if we add the height of the guide to that of the housing through which the implants are placed, there is a distance to the bone that requires that the drills be very long, usually between 18 and 25 mm. This can complicate the surgery in the case where we are action on the mandibular region, especially in cancer patients who frequently present limitations in the mouth opening as sequela of the operation and the radiotherapy[14, 17-20].

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In any case, the concordance between the simulated planning and the actual result after the surgery in cases in which we are attentive to all these premises, is very high, with differences of position of less than 1 mm. All of this allows, in these very complex cases, managing to rehabilitate all the implants and achieve acceptable occlusions. In addition, thanks to the stability of the implant-supported prostheses, the complications that the soft tissues poise can be avoided, without the need for complex retouching of the flap or the mucosa of the patient (thinning of the skin paddle, vestibuloplastia, ...)

As for the prognosis of these implants, there are authors that insist that the microvascularised bone flaps statistically accept better the implants than the normal alveolar bone due to their high vascularisation[10].

Finally, the prosthetic solution must be individualised according to each case, with attention to the number of implants that can be placed, the biomechanical situation of the masticatory system, the dentition of the antagonist arch, the sensorial deficits of the patient and his oral hygiene. In free ends we will usually use fixed ceramo-metallic prostheses, while in complete reconstructions we must evaluate that the fixed prostheses require a higher number of implants, a more complex occlusal adjustment and exhaustive hygiene. This usually leads to greater satisfaction for the patient although it is a most costly treatment.

CONCLUSIONS

As a final conclusion of this paper, we have to say that, despite the fact that curing continues being our primary objective, the development of the microsurgical techniques and osseointegrated implantology has ostensibly improved the integral treatment of cancer patients. Therefore, we want to highlight the real possibility that we have to offer to the patients subjected to mandibular bone resections and reconstructed with bone flaps, dental rehabilitation with implant-supported and/or implant-retained prosthesis, which are going to improve facial harmony and quality of life. The index of satisfaction with this type of treatment is very high given that, after surgery and radiotherapy, the majority of patients demand the possibility of having teeth again and recover normal chewing.

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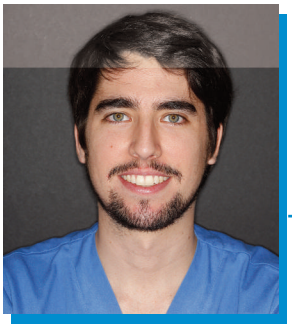

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Received: 15 January 2014.
Accepted (or accepted for publication): 24 February 2014.

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Original article

Shovel incisors: frequency in orthodontic patients of different ethnic groups

Published in Spanish Científica Dental Vol. 11. Nº 1. 2014.

ABSTRACT

Introduction: Shovel teeth, a structural trait observed with great frequency in native Americans and Chinese, can condition the expression and treatment of malocclusions. The objective of this study is to compare their frequency and degree of expression in the samples of Chinese, Native American and Caucasian patients that had requested treatment in an Orthodontics Unit of the Region of Madrid.

Method: 63 patients of both sexes were selected, between 8 and 56 years of age: 15 were of Asiatic-Mongoloid origin, 15 were Amerindians and 33 Caucasian. The presence and degree of the "shovel" trait was evaluated of the teeth 11 and 12 in the plaster models by means of the Arizona State University Scale. For the statistical analysis, the Chi-square and Fisher association tests were used.

Results: The "shovel" trait was present practically in all the Asiatic-Mongoloid patients (100%) and Amerindians (93.3%), being infrequent in the Caucasians (12.1%) (P<0.0001). The degree of expression of the trait was moderate/severe in 66.6% of the Asiatic—Mongoloid patients, in 71.4% of the Amerindians and only in 25% of the Caucasians.

Conclusions: The "shovel" trait was practically constant in the Asiatic-Mongoloid and Amerindian subjects of our series and rare in the Caucasians. Due to the numeric importance of the population of these ethnic groups in our country, the orthodontist should be familiarised with a trait that can impact the treatments.

KEYWORDS

Shovel teeth; Shovel incisors; Dental morphology; Ethnic groups.

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INTRODUCTION

The study of the numeric and morphological variations of teeth is an important instrument in anthropological research. It allows, among other things, revealing patterns of biological filiation that would explain the finding of common traits among different ethnic groups due to migratory movements of the populations produced thousands of years ago.

The interethnic variations are well demonstrated with respect to the alterations of number, size and morphology of the teeth. For example, it is known that the presence of supernumerary teeth is much more common among Asiatic individuals than among the Caucasians[1,2].

Furthermore, the observation of a morphological dental trait called "shovel tooth" (Figure 1), common in native ethnic groups of the American continent and in the northern regions of Asia, has supported the hypothesis of a common genetic origin for these ethnic groups[3] (Figure 2).

The shovel tooth (ST) received diverse definitions from its first observation at the beginning of the 20th century. Hrdlička defines it as a morphological variation characterised by "prominent marginal crests that can even be joined creating a deep fossa at the level of *the cingulum*"[4]. Although one usually speaks of shovel incisors, all the teeth can show an equivalent morphological variation, in particular the upper first premolars and the lower first molars[5].

As it occurs with other morphological dental variations, the etiopathogenesis of the ST respond to a genetic polymorphism not yet clarified. It involves an allele of the receptor (EDAR)[3] whose mutations have also been related to ectodermal dysplasia, which shows a geographic distribution similar to that of the ST[6].

The analysis of this morphological dental variation has not only anthropological value, but its presence can condition the expression of some malocclusions and require, consequently, modification in the treatment plan, which justifies the interest in this trait for the orthodontist. In this regard, the higher frequency of dental crowding has been reported associated with the ST[7].

In our country in recent years, the immigrant population of Latin American and Chinese origin has increased notably, in such a way that at present these collectives constitute a significant proportion of the patients treated in the majority of the orthodontic visits.

This reality leads us to analyse the frequency of the ST (*shovel teeth*) trait in patients that request treatment in the orthodontics unit where a wide population of individuals with representation of the different ethnic groups that inhabit the Autonomous Region of Madrid are assisted.

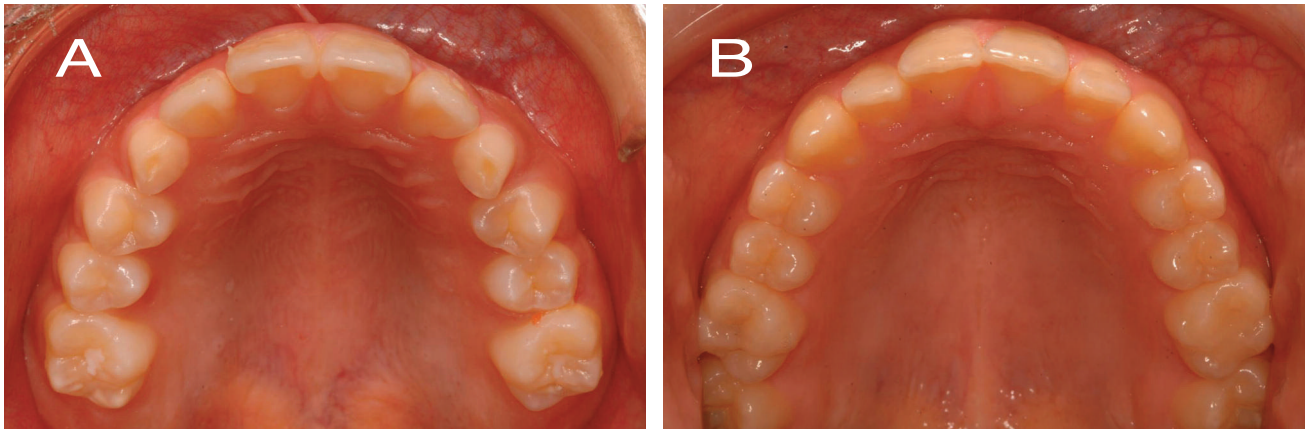

Figure 1. Morphology of "shovel incisors". A) Incisors with "shovel" morphology; B) Incisors without the "shovel" trait.

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Figure 2. The single-race theory of Hrdlička (1908) underscores the facial similarity of the Asiatic-Mongoloid and the Amerindian ethnic groups as a consequence of the migratory flow from Asia towards America in the Pleistocene Epoch, 10,000 years B.C.

OBJECTIVES

To compare the frequency of the morphological dental variation of "shovel incisors" and their degree of expression (mild, moderate or severe) in Asiatic-Mongoloid, Amerindian and Caucasian patients that request treatment in the Orthodontics Unit of the Jiménez Díaz Foundation University Hospital of Madrid.

MATERIALS AND METHODS

A sample of 63 patients of both genders were selected, aged 8 to 56 years that consecutively consulted the Orthodontics Unit of the Jiménez Díaz Foundation: 15 were of Asiatic-Mongoloid origin, 15 Amerindians and 33 Caucasians.

The following exclusión criteria were established: a) presenting any orofacial syndrome, palatal fissure, other congenital morphological and/or numeric alterations of the superior incisors (microdontia/conoid teeth, agenesis, supernumerary teeth); b) traumatisms with loss of substance/restorations of the superior incisors; c) their incomplete eruption and d) consanguinity with another patient included in the sample.

In the plaster models of all the patients, the presence and the degree of expression of the ST trait were evaluated in the teeth 11 and 12 (alternatively 21 and 22). To do this, the Arizona State University Scale (Figure 3) was used, a non-metric, validated visual method, simplifying the six degrees of the original scale into three: 0-2, No ST; 3-4, mild ST, and 5-6, moderate/severe ST[7,8].

The Chi-square and Fisher association tests were used for the statistical analysis.

RESULTS

The ST trait, irrespective of its intensity, was present in practically all the patients of the Asiatic-Mongoloid (100%) and Amerindian (93.3%) ethnic groups, being infrequent in the Caucasians (12.1%) (P<0.0001) (Figure 4).

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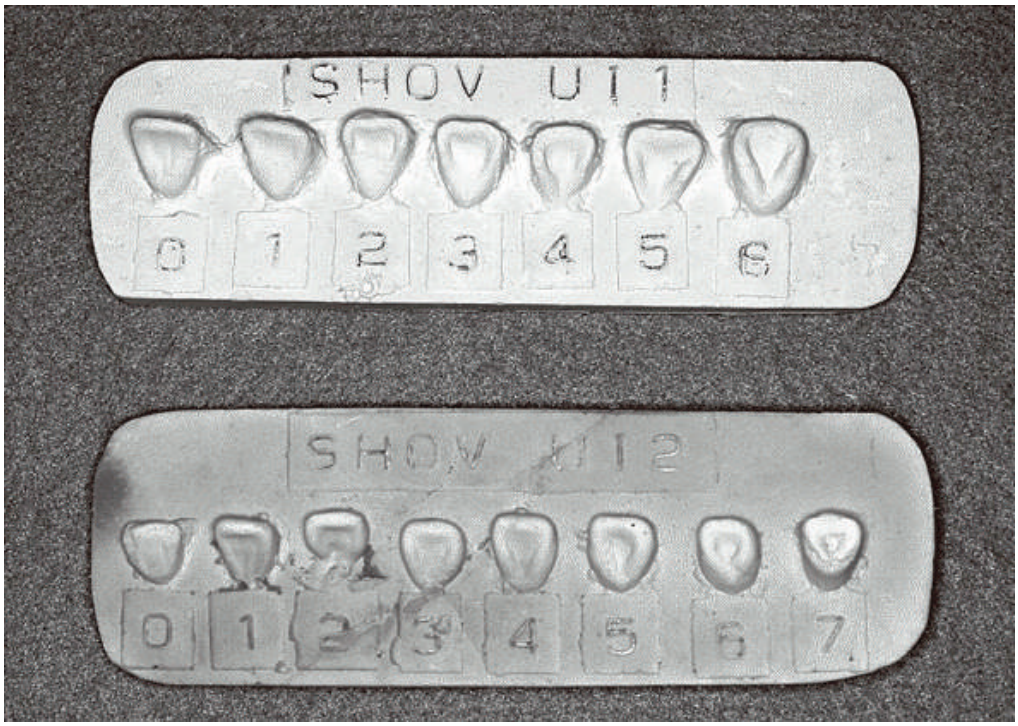

Figure 3. Template used to evaluate the presence and degree of expression of the "shovel" morphology. Method developed by the Arizona State University.

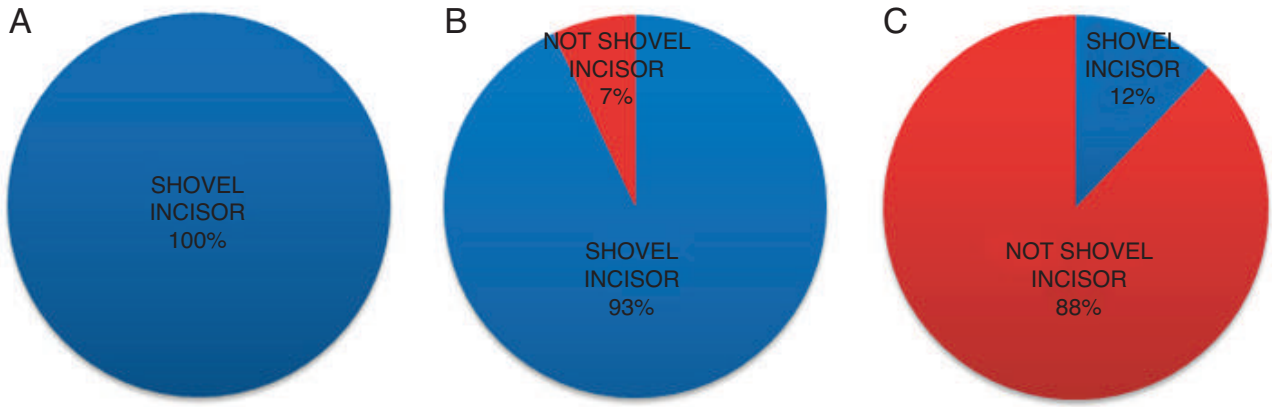

Figure 4. Proportion of the "shovel incisor" trait in the three evaluated ethnic groups. A) Asiatic-Mongoloid; B) Amerindian; C) Caucasian.

As regards the degree of expression of the trait, in the Asiatic-Mongoloid patients it was mild in 33.3% and moderate/severe in 66.6%; in the Amerindians it was mild in 28.6% and moderate/severe in 71.4% and, finally, in the Caucasians it was mild in 75% and moderate/severe in 25%. These interethnic differences regarding degree were not significant.

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DISCUSSION

Our findings confirm the presence of the morphological ST variation in the populations of Amerindians and Asiatic-Mongoloid residents of the Autonomous Region of Madrid analysed in our sample.

The evaluation of this morphological trait as a marker of the interethnic genetic variations has been used in research since the beginning of the last century. However, one must point out that the conclusions of some of them, due to their deficient methodology, are, at the very least, debatable.

Thus, Arkövi in 1903 studied 223 superior lateral incisors in 169 skulls of subjects of multiple origins, from the Roman period to the contemporary age of the author. However, this sample, very heterogeneous, included a large proportion of European subjects and a merely testimonial representation of individuals from Africa and New Zealand. This author, with a methodology lacking scientific foundation, reached the conclusion that the shovel-teeth morphology would show a progressive chronological increment. He argued that in his sample the ST trait was practically absent in the Roman skulls and affected 70% of those pertaining to the Hungarian population of the 19th century and 94% of those corresponding to the same population at the beginning of the 20th century[4]. This finding, if correct, would have an explanation outside the purely evolutionary realm, since it cannot be expected that a morphological change in an anatomical structure will be expressed in such a short period of time. Furthermore, the analysis of the scarce number of Maori and Negroid individuals in his sample led Arkövi to another even more surprising conclusion: the existence of a relation between the presence of the ST trait in the most culturally evolved populations and its absence in the most primitive.

In the classic study of Hrdlička[4], conducted a few years later (1920) using a degree of methodological rigor and a strong bibliographical support, the frequency of the ST trait in better defined populations was analysed. This author observed that the trait was not very common among the white and Negroid Americans, and it occurred in a third of the Hawaiians and in almost all of the Eskimos, Amerindians and in oriental ethnic groups. These findings can be considered quite similar to those of our study, even taking into account that this was done only on three ethnic groups (Caucasians, Amerindians and Asiatic-Mongoloids) compared to the numerous groups evaluated in the Hrdlička study. A fact to highlight is that Hrdlička found the ST trait in nearly 100% of the Japanese subjects of his study, a population not represented in ours.

More recently, several authors have studied the ST trait in native populations of the American continent, with all of them verifying its great frequency in these ethnic groups. Therefore, Dalberg, in 1947 in a study made on Pima Indians, a population of Indians native to Arizona (U.S.A.) and Sonora (Mexico), found that 90% of the subjects presented the morphological variation[9]. In turn, Devoto et al., in 1968, observed it in 100% of the individuals of a sample of Araucanians from northwest Argentina[10], and Bollini et al., in 2004 observed it in 85% of a sample of pre-Colombian skulls of less than 1500 years of antiquity coming from a region of the Argentine Pampas[11]. All these figures are quite compatible with those obtained in our subsample of Amerindian individuals.

Outside the American continent, Moorrees detected the trait in 65% of the individuals in a sample of Aleutians, inhabitants of some Pacific islands located between the southeast of Alaska and the Russian peninsula of Kamchatka[12].

The finding of the ST trait in different ethnic groups with origin in more distant places, located even on different continents, leads to analysing the responsible migratory movements of the populations in these locations. Specifically, the population of the American continent, among whose native Amerindians the ST trait is particularly frequent, has been explained by various theories (Figure 5).

In 1879, the paleontologist Ameghino defended the native origin of the American inhabitants, based on

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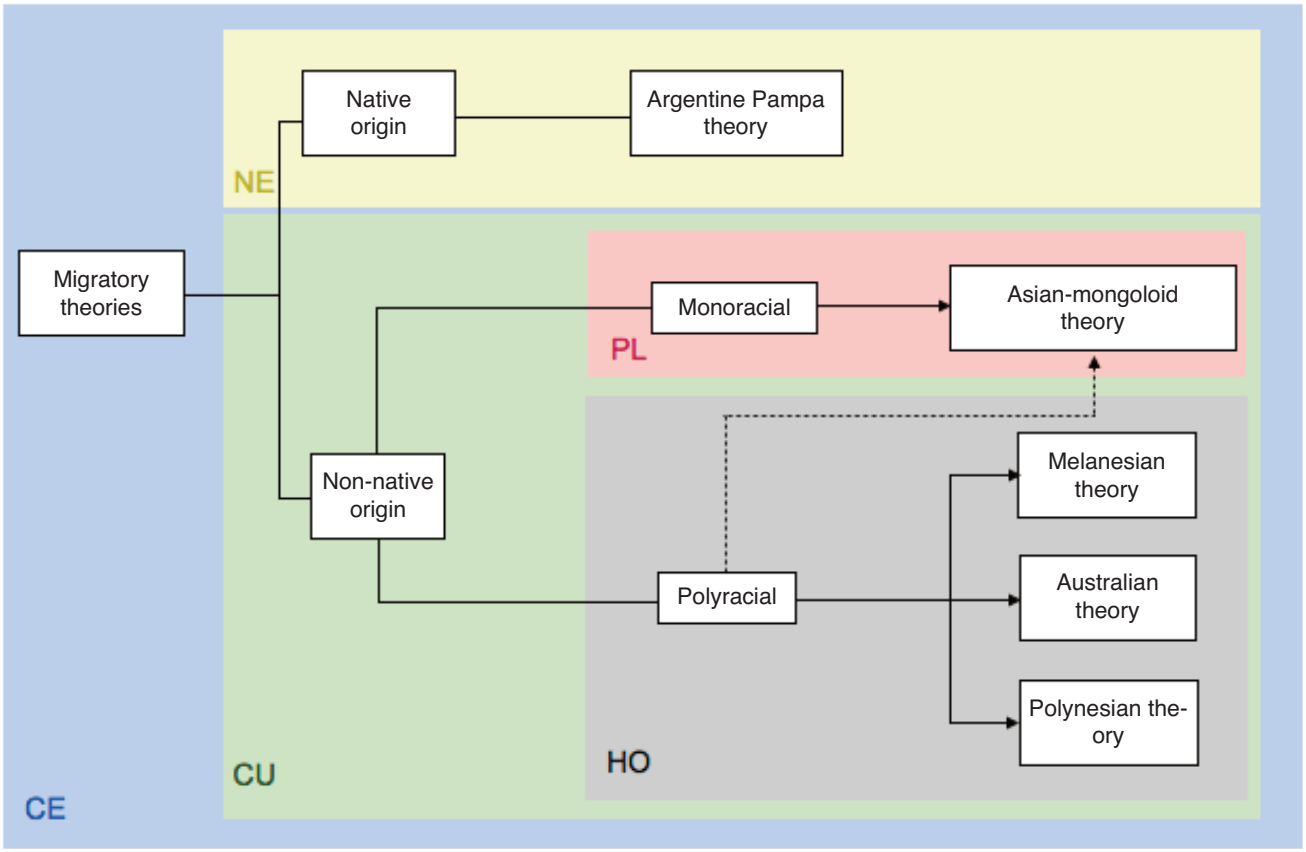

Figure 5. Representation of the different theories of the settlement of America, as well as the authors that posed them, framed within the corresponding Era, Period and Epoch. CE: Cenozoic or Tertiary Era; NE: Neogene Period; CU Quaternary Period; PL Pleistocene Epoch and HO: Holocene Epoch.

the appearance of human remains in the Neogene period in a region of the Argentine Pampas (Homo Pampeanus).

In 1908, Hrdlička[4] posed his single-race theory, according to which there existed migratory currents through the Bering Strait during the last ice age, in the Pleistocene, 10,000 years B.C. Therefore a common Amerindian-Asiatic-Mongoloid core would arise, which would explain the anthropologic-somatic similarities among these ethnic groups.

Later on, Rivet proposed that the settlement of Americans had been produced from multiple ethnic groups in the Holocene Epoch, 5,000 years B.C. In this way it complements the proposal expressed by Hrdlička, defending a multiracial origin with starting points in Polynesia, Melanesia and Australia. The Australian origin was also defended by the Portuguese, Correia. Furthermore, more recent theories mention the migrations coming from Europe, which would be added to the population movements through the Pacific Ocean[13].

All these theories, in short, justify the finding of a certain trait such as the ST in populations linked by this remote common origin (in our case the Amerindians and Asiatic-Mongoloid individuals) and its much lower frequency of other regions with a different origin (in our case, the Caucasian subjects). It would also be interesting to compare the frequency of the ST trait in Spaniards, which reached 25% in our sample, with that of Anglo-Saxon Caucasians, taking into account that the mixture between Spaniards and Amerindians was very significant after the discovery of America, contrary to that which took place between the Native Americans and the Anglo-Saxons.

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Some authors have detected a certain sexual dimorphism of the ST trait with a higher frequency in women[3], a fact that we could not transfer to our series in which the variation affected the majority of the subjects, both males and females.

In reference to the severity of the ST trait's expression, Hrdlička, without using any metric scale, distinguished four degrees in a subjective, visual manner: shovel, semi-shovel, trace shovel and absence of shovel. According to this classification, he found in his series a clear predominance of the semi-shovel expression in white and black American individuals, while in the Chinese and Japanese the accentuated form of the trait was much more frequent[4]. These findings only coincide in part with ours since in our series, the ST trait, evaluated with a validated metric scale, appeared with greater frequency in its more accentuated expression in the Amerindians and in the Asiatic-Mongoloids. In the low proportion of Caucasian subjects that showed the morphological variation, it was much more frequently mild.

CONCLUSIONS

The ST trait was practically constant in the Asiatic-Mongoloid subjects and Amerindians of our series and rare in the Caucasians.

The degree of expression of the trait was more frequently moderate-severe in the individuals of these ethnic groups.

Due to the numeric importance of the population of Chinese or Latin American population in our country, the orthodontist should be familiarised with a trait that could have an impact on the treatments.

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Original article

Osteogenesis imperfecta: oral and medical disorders in children

Published in Spanish Científica Dental Vol. 10. Nº 3. 2013.

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Received: 12 July 2013.
Accepted (or accepted for publication): 4 October 2013.

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ABSTRACT

Introduction: Osteogenesis imperfecta, also called the brittle bone disease, is a condition characterised by a disorder in the connective tissues of the entire body, including the teeth. The objective of the study was to evaluate the presence of fractures and the bones affected, the presence of dentinogenesis imperfecta, the treatment of osteogenesis imperfecta and the type of bisphosphonate administered.

Method: The clinical histories of 17 patients with osteogenesis imperfecta were evaluated.

Results: Of the patients, 81% suffered fractures, 24% in the femur, 53% of the patients presented dentinogenesis imperfecta, 71% of the patients are treated with bisphosphonates and 83% with pamidronate.

Conclusions: The majority of the patients have suffered fractures during their lives, dentinogenesis imperfecta is frequent in these patients and the majority of them are under treatment with bisphosphonates.

KEYWORDS

Osteogenesis imperfecta; Dentinogenesis imperfecta; Bisphosphonates; Fractures.

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INTRODUCTION

Osteogenesis imperfecta (OI) is a hereditary disorder known as the "brittle bone disease". Its incidence is from 6 to 20 for every 100,000 new births.

It is characterised by presenting a disorder in the connective tissues (developed from the mesenchymal cells that are differentiated in osteoblasts, chondroblasts and fibroblasts during the embryonic stage) of the entire body, including dentition.

Collagen is the most common protein of the body and forms part of the connective tissues present in the bones, in the cartilage and in the blood vessels. There are 19 types of collagen, the most common being type I collagen, which is responsible for providing mechanical resistance to the body structures. The disease is the result of mutations in the genes COL-1A and COL-1B which encode type I collagen[1].

The manifestations that the patients suffer can be grouped into skeletal and non-skeletal. Within the first are found mainly bone fragility and the reduction of the mineral bone mass, which condition the occurrence of fractures. The non-skeletal include the bluish colour of the sclera (Figure 1), dentinogenesis imperfecta, ligamentous hyperlaxity and the presence of wormian bones in the sutures of the cranium[2].

In 1979, Sillence et al.[3] proposed a classification of the disease in four types:

- **Type I:** mild, non-deforming. It is an autosomal dominant entity. The subjects belonging to this group are characterised by having blue sclera, scoliosis (without having major deformities at the level of the spine or long bones) and may present dentinogenesis imperfecta. The principal problem of these individuals is their auditory disability, which may be presented before 20 years of age.

- **Type II:** perinatal lethal. It is autosomal recessive. It is the most severe variety, in which neonatal fractures are produced, the ribs present a beaded radiological image and the long bones seem to have been axially pressed.

- **Type III:** severely deforming. It is autosomal recessive. The subjects pertaining to this entity are characterised by having normal sclera and severe deformities of the spine during the last stage of childhood and adolescence, which bring about low stature. Dentinogenesis imperfecta is frequently present and it especially affects primary dentition. The auditory involvement is quite infrequent.

- **Type IV:** moderately deforming. It is autosomal dominant. It is characterised by grouping the majority of subjects that had been historically diagnosed of the Lobstein's disease. The sclera is normal.

The Types I, III and IV may present in congenital or late form. Type II is always congenital.

Glorieux et al.[4] observed that, on occasions, after a fracture or corrective surgery, a hard and painful inflammatory condition may appear, called hyperplastic callus. The authors, in the year 2000, named these cases as Type V OI.

Dentinogenesis imperfecta (DI) deals with a genetic disorder in the formation of the dentin, which involves both the temporary and the permanent dentition. Clinically it is characterised by an opalescent colouring of the teeth, less hardness of the dentin and fractures in the enamel as a consequence of the poor existing dentinal support, which leads to major attrition and the abrasion of the exposed dentin.

DI is classified in three types:

Type I occurs in subjects that suffer OI, being associated with this pathology. Type II is the most common, it is autosomal dominant and is not associated with OI. Type III, also called Brandywine, is the most infrequent, it is autosomal dominant and it only occurs in an isolated area of the State of Maryland, in the United States[5].

The treatment of OI is palliative and has the purpose of promoting the normal function of the individual.

Physical therapy improves muscle strength and resistance.

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Figure 1. Image of the blue sclera.

Surgery is used to correct or reduce the deformities and to stabilise the fractures of the long bones or the spine.

Odontological interventions are based on the prevention of caries and periodontal disease, as well as on the correction of dental defects and occlusion. It is common to find patients with facial alterations, malocclusions and incorrect maxilomandibular positions, such as maxillary retrognathism and mandibular prognathism. The solution of these disorders is based on the combination of orthodontics with orthognathic surgery, whose results are successful in the majority of the cases, although it is not performed frequently.

The medical treatment is based on the use of calcitonin, sodium fluoride, growth hormone, cortisone, anabolic steroids, vitamins C and D, minerals and bisphosphonates. These have turned out to be the most effective medical treatment.

The bisphosphonates minimise the osteoclastic activity and contribute to reduce the pain, to improve the sensation of well-being of the subjects and to increase the mineral bone mass in the vertebrae. The patients must be controlled rigorously due to the possibility of developing osteonecrosis of the maxillae associated with bisphosphonates, although, in the case of children, currently there are not sufficient data that can demonstrate the relation between the treatment with bisphosphonates and the appearance of osteonecrosis.

In paediatric patients it is typical to observe a series of radiological manifestations as a consequence of the treatment with bisphosphonates. The diaphyses of the bones are narrow, however, due to the effect

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of the bisphosphonates on the remodelled bone, the metaphyses are thick, and horizontal white lines appear associated with the administration of the drug, with regular spaces that correspond to the intervals between the treatment cycles, demonstrating the existence of bone growth during the therapy[6,7].

Currently, new treatments are being developed, such as the bone marrow transplant to increase the osteoblastic activity and genetic therapy[1,8].

The objective of the study was to evaluate the presence of fractures and bones affected, the presence of DI, the treatment of the OI and the type of bisphosphonate administered.

MATERIALS AND METHOD

The study began with a sample of 187 patients, which were compiled from the clinical records of the university's own degree "Integrated odontological assistance in children with special needs," of the Stomatology Department IV of the School of Dentistry of the Complutense University of Madrid.

Clinical records were evaluated according to the criteria of inclusion and exclusion, in such a way that of the 187 initial patients, the study was finally conducted for a sample of 17 patients.

Criteria for inclusion:

- patients under 18 years of age
- patients with OI
- patients with presence or absence of DI

Criteria for exclusion:

- Incomplete clinical records
- Patients that did not sign the informed consent form
- Patients with a systemic pathology other than OI

RESULTS

Of the 187 patients of the university's own degree, 17 suffer OI. Regarding them, the following were evaluated through the clinical records:

- Presence of fractures and affected bones
- Presence of DI
- Treatment of the OI
- Type of bisphosphonate administered, in case of receiving this treatment

Of the patients 81% had some type of fracture during their lives. while 19% of the cases did not reflect in the clinical records the history of fractures of the patient.

The bones affected by the fractures, in decreasing order, were the femur in 24% of the cases, followed by the ulna and radius, fingers and the cranium (6% each). Twenty-four percent of the patients suffered multiple fractures and 35% of the cases did not specify the affected bone (Figure 2).

The presence of DI in the patients appeared in 53% of the cases.

In 71% of the cases the patients were treated with bisphosphonates, alone or in combination with calcium, vitamins, calcium and vitamins or vitamins and growth hormone. In 29% of the cases the treatment that the patient receives was not reflected (Figure 3).

The type of bisphosphonate administered was pamidronate in 83% of the cases, followed by alendronate in 8% of the cases. The type of bisphosphonate was not specified in 8% of the patients.

DISCUSSION

In this study, 71% of the patients are undergoing treatment with bisphosphonates, alone or in combination with other drugs.

The benefit of treating OI with bisphosphonates has been sufficiently demonstrated and it is perfectly accepted[8,9].

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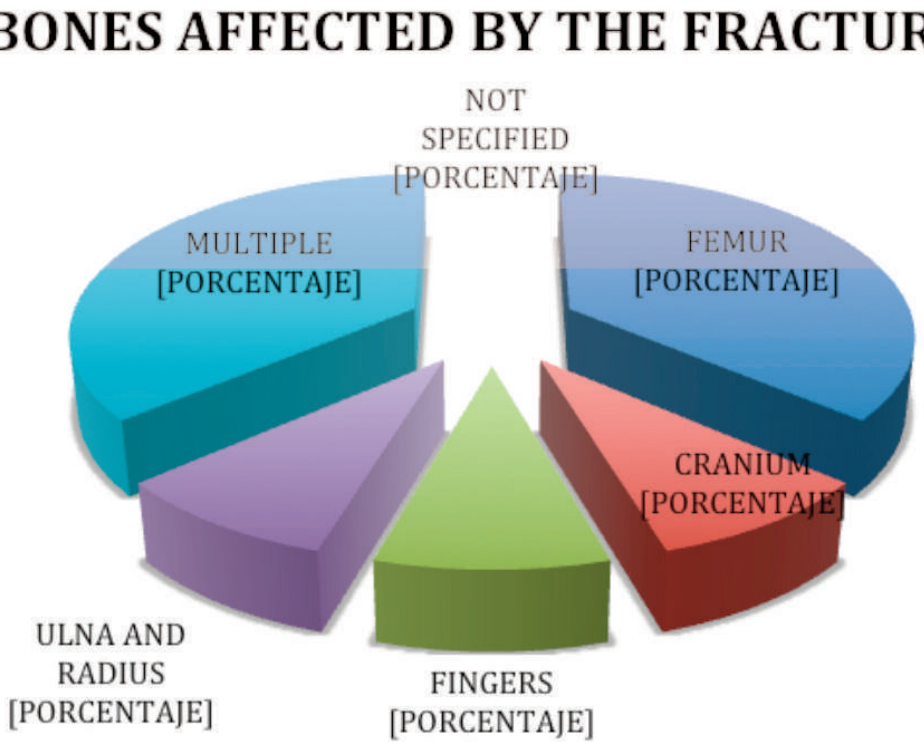

Figure 2. Bones affected by the fractures.

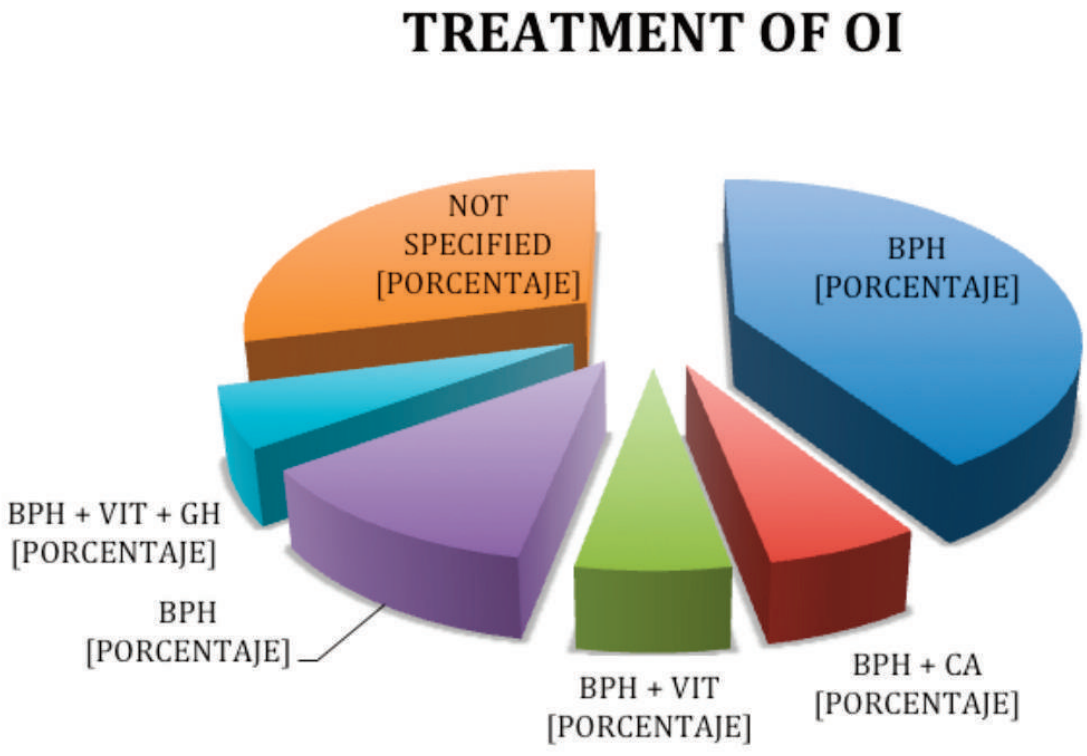

Figure 3. Treatment administered to the patients.

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Cases of osteonecrosis of the long bones have been recorded in children with leukaemia and lymphomas, subjected to intense treatment with chemotherapy and cortisone; however, there is no evidence of osteonecrosis of the maxillae associated with bisphosphonates in children with OI[8,10].

The pathogenesis of the osteonecrosis due to bisphosphonates is not clear today, but it seems that it is due to a defect in the physiological remodelling of the bone or due to the healing process itself[11]. On the other hand, bisphosphonates, which are drugs that inhibit the bone resorption, can be classified according to their strength: thus alendronate and risedronate are considered of low strength, pamidronate of medium strength and zoledronate of high strength. While zoledronate and pamidronate are generally used in intravenous form, alendronate and risedronate are principally used in the form of oral medication[12].

In patients studied in this work, 83% received treatment with pamidronate and 8% with alendronate. It has been demonstrated that treatment with pamidronate, alendronate and zoledronate in children with OI subjected to oral surgery does not produce osteonecrosis[10].

Even so, it is necessary to monitor these patients due to the possible action of the cumulative dose of the drug, especially those that are administered parenterally[8].

Maines et al.[8] proposed the use of neridronate, with a structure similar to alendronate or to pamidronate but less retention time in the body that the other two. and for this reason it contributes to decreasing the risk of developing osteonecrosis.

Malmgren et al.[10] stressed the importance of going to the dentist before and during the OI treatment with bisphosphonates in order to carry out an evaluation of the bucco-dental situation and a subsequent monitoring of the patient.

Eighty-one percent of the patients have suffered, during their lives, some type of fracture, with the fractures of femur and multiple fractures being especially relevant. On occasions, these could be produced by the effect of the bisphosphonates. The case is recorded of a female of 75 years of age with OI and in treatment with alendronate who suffered an atypical fracture of the femur; however, no case in children was recorded[13].

The bisphosphonates seem to be effective in the treatment of OI, reducing the annual incidence of fractures, increasing the mineral bone mass in the lumbar vertebrae and hip, as well as avoiding bone resorption and preserving the vertebral morphology[14,15].

DI was present in 53% of the patients. Muhney and Campbell16 affirm that the prevalence of DI is between 8% and 40% in patients with Type I OI, between 43% and 82% in those with Type III OI and between 37% and 100% in patients with Type IV OI.

The odontological handling of the OI patients that have DI, according to the American Academy of Pediatric Dentistry, is based on the prevention of the attrition resulting from the destruction of the enamel and the dentin, the rehabilitation of the dentition, the aesthetic optimisation and the prevention of caries and periodontal disease[17]. It is important to consider the existence of calcifications in the root canals when performing endodontic treatments[18] and the possibility of producing mandibular fractures when surgical procedures are performed on these patients[17].

Moderate defects can be treated with adhesive techniques; however, it is preferable to use preformed metallic crowns in temporary dentition when the damage is extensive, and onlays in permanent dentition. These treatments not only rehabilitate the tooth, but they also contribute to stabilising dentition and to avoiding the loss of the vertical dimension. In anterior teeth, the use of different types of aesthetic facets is necessary, but they must be placed in late adolescence, when the complete periodontal maturation has occurred[17].

The conclusions obtained were the following:

1. Of the patients evaluated, 81% present some type of fracture.
2. The bone most affected by the fractures is the femur (24%). along with the multiple fractures.
3. Fifty-three percent of the patients present DI.
4. Seventy-one percent of the patients receive treatment with bisphosphonates, alone or in combination with other drugs.
5. The type of bisphosphonate administered in 83% of the cases is pamidronate.

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