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ORIGINAL RESEARCH ARTICLE

Prevalence and characteristics of findings related implant in panoramic X-rays

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ABSTRACT

Introduction: In Colombia, the latest oral health study shows that about 70% of the population suffer from partial edentulism, while 5.2% lose all teeth between the ages of 65 and 79. Implant rehabilitation is an increasingly and widely used option, which requires clinical and X-ray follow-up. Panoramic X-ray examination is a low-cost option. In this case, the area of bone loss, the middle and distal angle of the implant, the relationship with the anatomical structure and the related lesions of periimplant inflammation can be observed. Data on X-ray findings associated with dental implants need to be reported and analyzed to determine risk factors for success in patients using these implants. **Objective:** To determine the prevalence and characteristics of findings related to osseointegrated implants in panoramic X-ray films. **Methods:** Descriptive cross-sectional observation was used to select 10,000 digital panoramic photos from the radiation center in Bogota, Colombia, of which 543 were related to the presence of implants. The position, angle and distance from adjacent structures of each implant were evaluated using program ClínicalView® (Orthopantomograph OP200D, Instrumentarium, USA). **Result:** The X-ray frequency of implants was 5.43%. There were 1,791 implants, with an average of 3.2 X-rays per time. They have a higher proportion in the maxilla and are located on the crest at an angle of 10.3 degrees. 32% of patients had implant/tooth or implant/implant distance below the optimal value. 40.9% of the patients were repaired, and 1.2% of the patients had periodontitis. **Conclusion:** The high proportion of modified implants has a risk factor that affects their long-term survival, whether due to angle, ridge or ridge location, adjacent teeth or other implants, or because they are irreparable.

Keywords: X-ray examination findings; panoramic X-ray film; dental implants

1. Introduction

Tooth loss is a related problem, which not only affects aesthetics and chewing, but also related to tooth position change, bone resorption, tooth extrusion, periodontal disease and pronunciation[1]. According to the National Oral Health Study (ENSABIV)[2], in Colombia, 45% of dental patients who attend dentistry fortooth loss. By age, 3.9% of the teeth in the 15 to19 years old group were missing or suitable for extraction, the tooth loss in the 35 to 44 years old group increased to 8 teeth per person, and the loss in the over 55-year-old group was 16.2 teeth per person. The same study found that the prevalence of edentulity was 25% in both jaws and 7%

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in the lower jaw in Colombia.

There are several methods of clinical treatment for patients with partial or complete edentulosis, using fixed, movable and complete restorations, and its success depends on the location, availability or absence of dental columns. In this sense, implant is considered an option, which can provide a variety of spinal positioning according to the number and quality of patients' bones. The successful placement and rehabilitation of implants depend on the diagnosis and correlation of clinical and imaging results, including CT and panoramic X-ray, to plan the treatment and follow-up of conventional implants[3]. The evaluation before and after implantation includes evaluation of anatomical structure, detection of disease, estimation of bone quantity and quality, angle of alveolar ridge and insertion path close to natural teeth or other traditional oral implants; and these items must be evaluated immediately after surgery[4].

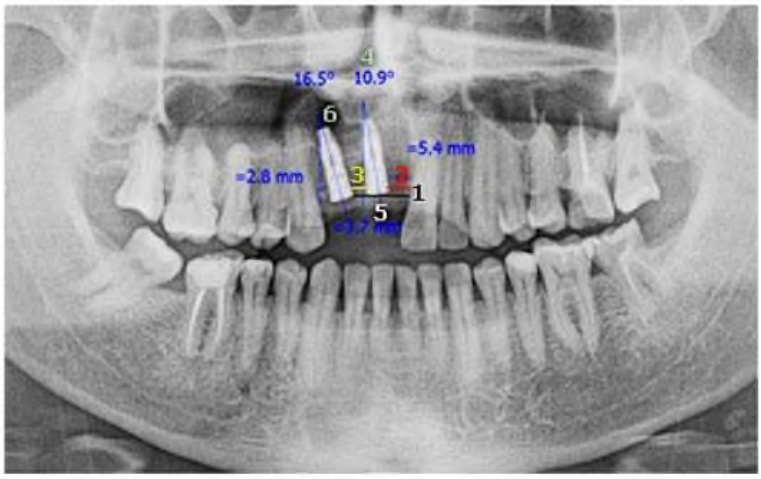
Post implant monitoring is carried out through clinical examination, which examines activity, inflammation, infection and panoramic radiology. Although the sensitivity and specificity of these examinations are limited, they allow the suspicion of related bone injury[5]. It is very useful in long-term research because it shows the data of periimplant inflammation, The relationship between the implant and adjacent teeth or implants, and the proximity to adjacent structures (such as maxillary sinus or mandibular canal)[6,7]. Implant repair should be evaluated to identify and quantify relevant risk factors and their impact on the oral morbidity profile, especially in the context of the increasing popularity of this technology. The aim was to determine the prevalence and characteristics of panoramic X-ray findings associated with osseointegrated implants.

2. Methods

A descriptive observational study was conducted with the approval of the Research and Ethics Committee of the Facultyoff Dentistry of the Pontifica Universidad Javeriana. In order to facilitate sampling, 10,000 digital panoramic X-rays were selected from the radiation center of Bogota, of which 543 were related to the presence of implants. Digital X-rays, including those over 18 years of age, have sufficient density, clarity, contrast or focus. These X-rays show no evidence of vertical and horizontal distortion, nor artifacts such as unremoved prostheses or other injuries that do not allow the correct display of complete images.

The observation was conducted by two researchers, who were maxillofacial surgeons trained in bone integration and used the computer of the school's dental clinic. After the X-ray film is selected according to the inclusion criteria, each digital panoramic X-ray film is systematically and orderly measured and divided into four areas: 1-upper right corner, 2-upper left corner, 3-lower left corner and 4-lower right corner, using the Clinic Viewprogram® 9.3 (Orthopantomograph OP200D, Instrumentarium, USA). This program allows you to measure the image directly from the previously defined points, as shown in the figure. The measures taken were as follows: the distance between the evaluated implant and adjacent teeth or implants and its angle relative to a line parallel to the bone midline drawn through the anterior nasal spine and chin points (**Figure 1**).

The results are listed in an Excel spreadsheet, including general data on age and gender. In addition to recording the number of implants, the following characteristics were studied: implant type (conventional, paraosseous or zygomatic), location (maxillary or mandibular anterior teeth are defined as the area between central and lateral teeth, central teeth, canine and premolar, and posterior molars), angle, presence of periimplant injury (bone loss of more than 2 mm around the implant, distance between the implant and adjacent teeth and implants, rehabilitation of maxilla, mandible or both and complete edentulous jaw). For inter group comparison, chi-square test was used and odds ratio was calculated while seeking the relationship between variables, $P<0.05$ was accepted as significance value.



(1): According to the position of alveolar bone; **(2)**: Distance from adjacent teeth; **(3)**: Distance from adjacent implants; **(4)**: At an angle to the center line; **(5)**: With or without artificial crown; **(6)**: Whether there is peri-implant injury.

Figure 1. Description of the measures taken to describe the characteristics of the implant on the panoramic X-ray film.

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3. Results

Of the 10,000 X-rays analyzed, the average age of the patients was 38.4 years (SD: ± 15.4), male accounted for 42.4%, the lowest age was 18 years old, and the highest age was 92 years old. In the study population, when X-rays showed at least one implant, the prevalence of dental implants was 5.43% (a total of 1,791 implants), with an average of 3.2 implants per X-ray. Of the 543 implant X-rays, 45% were male and 55% were female, with an average age of 52. There was no statistically significant difference between men and women.

In 1,791 implants, the study variables were characterized. According to the type of implant, 98.9% were terminal bones, including cheekbones (18 implants) and 1.1% juxtaposed bones. There were 5 cases of 18 zygomatic implants without pathological changes. Eight patients received 12 juxtaosseous implants, each with changes between 1 and 3, and some showed signs of bone loss.

According to the location, at the maxillary level, 57.62% (1,032) of the implants were mainly located in the premolar area (419 implants). The number of mandibles decreased to 42.38% (759), mainly distributed in the posterior part. The anatomical locations of the implants are summarized in **Table 1**.

Table 1. Locate the implant according to the anatomical area

Anatomical area	N	%
Anterior maxilla	406	22.7
Middle maxilla	419	23.4
Posterior maxilla	207	11.6
Anterior mandible	152	8.5
Middle mandible	238	13.2
Posterior mandible	369	20.6

The analysis of implant angle showed that the average angle of anterior teeth was 10.3°, the standard deviation was ± 8.95°, that of premolars was ± 10.48°, and that of posterior segments was ± 10.88°. 2.06% (37) of conventional implants had an angle greater than 30°; 59.5% of them were located

on the ridge and 40.5% on the ridge; of these, 15 implants have been repaired and 2 have some damage around them. When calculating the odds ratio, it was found that the risk of periimplant inflammation increased by 4.7 times for implants with a mid-distal angle greater than 30 degrees.

The frequency of X-ray examination consistent with the lesions around the implants was 1.22% of the total number of implants. There was no gender difference, but it increased significantly with the increase of patients' age.

Table 2 summarizes the status of implants relative to bones, teeth and adjacent implants. The analysis of these risk factors showed that in terms of tooth spacing, 14.9% of implants were less than 1.5 mm from adjacent teeth, and 21.7% were less than 3 mm from adjacent implants. The X-ray results of four implants were consistent with the surrounding lesions, and the distance between implants and teeth was less than 1.5 mm. The calculation of odds ratio showed that the X-ray findings consistent with peri implant lesions increased by 2.3 times where the ideal distance was not maintained.

Table 2. Relationship between implant location and adjacent structures

Location of	N	%
Suprascrestal	918	51.3
crestal	733	40.9
Infracrestal	140	7.8
Total	1,791	100
Distance between teeth		
Distance < 1.5 mm, far from adjacent teeth	112	6.3
Distance > 1.5 mm, distant teeth	482	26.9
Distance adjacent to mesial teeth < 1.5 mm	156	8.7
Distance > 1.5mm and proximal middle adjacent teeth	611	34.1
No adjacent teeth	430	24
Total	1,791	100
Distance between plants		
Distance < 3.0 mm, distal adjacent implant	153	8.5
Distance > 3.0 mm adjacent to distal implant	478	26.7
Distance < 3.0 mm with adjacent mesial implants	237	13.2
Distance > 3.0 mm with near median adjacent implants	689	38.5
Non adhesive implant	234	13.1
Total	1,791	100

In terms of repair, 40.9% (734) of the implants were repaired, 51.6% were located on the supracrestal, 42.7% on the crestal and 5.7% on the infracrestal. By observing the repaired implants, 89% (655) of the patients had a pair of occlusal relationships, making their functions normal. 96 fixed dentures were found in 543 X-rays, of which 23 were implant supported dentures and 73 were implant supported dentures, although most were repaired separately.

Other studies showed that 4.2% of implant images correspond to the total upper and lower edentulas, who used 1 to 13, with an average of 5.4 implants per patient. 4.9% of patients with total edentulous maxilla used an average of 4.7 implants, ranging from 1 to 12, while 2.9% of patients with lower edentulous maxilla used an average of 4.9 implants, ranging from 1 to 11.

4. Discussion

The National Oral Health Study[2] reported that only 0.17% of Colombians have dental implants, which is due to economic constraints and the existence of other faster and more affordable repair solutions to solve the aesthetic and functional problems of edentulism. In our sample, the frequency of implants increased by 5.43% over the total Colombian population because it analyzed urban areas and individuals with better dental services.

These epidemiological data are important because they are the basis for assessing implant behavior and its impact on oral health for they analyze the risk factors associated with implant loss. Radiological variables[8] related to implant survival and prognosis, such as location, distal angle, bone relationship and periimplant lesions, were observed, of which variables depended on the appropriate distribution of implant anchorage and masticatory force[9].

The placement of the implant in the anterior maxillary region indicates that although the loss of posterior teeth in the maxilla and mandible is greater[2], the patient initially needs to restore its aesthetic part. It is well known that the rehabilitation of posterior sectoris the primary task of occlusal stability and prevention of joint injury, although the results of this study show that these implants sometimes do not have antagonists, resulting in their loss of function.

This evidence proposes angle implants to seek the maximum bone stability and survival of long-term prostheses, which are usually accepted in the range of 30 degrees to 35 degrees; these reports support the high predictability and preservation of implants and protheses supported on them[10]. For cheekbones, the average angle can be between 35 degrees and 45.7 degrees, with high stability and life span[11], when there is a large angle, there is excessive stress at the bone crest-platform interface of the implant, and this loss will gradually disappear if the stress is not reduced[12]. In this study, only the middle and distal angle of the implant can be seen through two-dimensional imaging, which is usually within the acceptable range of evidence supporting masticatory load. It is worth noting that implants with a larger angle also have greater bone loss being at the crestal and supracrestal level. In fact, the possibility of damage around the implant is greater[13].

As for the distance between the tooth and the implant, in order to maintain the integrity of the nipple and obtain the best aesthetic effect, the distance between the two implants should not be less than 3 mm, and the distance between the tooth and the implant should not be less than 1.5 mm[8]. However, animal studies have shown that the distance between implant and tooth can lead to resorption and necrosis of dental pulp. In fact, these are the reasons of lawsuit for malpractice in clinical practice[14,15].

In the sample of this study, the distance between 85.1% of implants and adjacent teeth was greater than or equal to 1.5 mm, and 78.3% of implants and adjacent implants were greater than or equal to 3 mm; The above results show that most implants show a good prognosis due to this factor, especially in the anterior teeth, and the aesthetic results between the final rehabilitation of implants and appropriate nipple formation. Although 21.7% of implant to implant measurements are lower than those in the literature, the absorption of crest bone is controversial over time between implants with a distance of 1.8 mm or less. Considering that the implant bone interface and the height of alveolar bone relative to the implant platform will also affect the ridge or supraridge position of the implant, and may reduce the long-term life of the implant[17–20].

In addition, ridge bone loss, platform exposure and implant thread are the risk factors for the development of peri implant inflammation, which is related to the accumulation of plaque on the implant surface[21–22]. However, within the limitations of the tools used in this study, clinical conclusions cannot be drawn and these findings cannot be clinically relevant.

Another aspect of this study is that the rehabil-

itation rate of these implants is only 40.9% (734%), which may be due to the large cost of repair, or because the implants can correctly integrate the bone, but not necessarily through their position or angle, because one of the limitations of panoramic images is the vestibular tongue analysis of the implants.

The X-ray findings consistent with the periimplant lesions in the top area of the implant were 1.2%, which was consistent with other clinical studies, in which the prevalence of periimplant inflammation was about 1.7%. These may be caused by overheating of bone during milling and damage close to the top of adjacent teeth[23–25]. It is also obvious that the X-ray results related to periimplant increase with age, which confirms the findings of other authors[13].

5. Conclusions

Considering the limitations of being a radiological study, it can be concluded that there are risk factors for the loss of a large number of implants analyzed, such as angle values greater than the repair correctness reported in the literature, position errors in extreme proximity to teeth or implants, and age.

Conflict of interest

The authors declare that there is no conflict of interest in the development of this research project.

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