Length assessment of titanium dental implants using different tomographic images *

Medida do comprimento de implantes de titânio utilizando diferentes imagens tomográficas *

Heraldo LEPÉRA
Doctor Post-Graduate Program in Oral Biopathology - Concentration Area in Dental Radiology – Dental School of São José dos Campos – UNESP - Brazil

Julio Cezar de MELO CASTILHO
Assistant Professor – Doctor in Dental Radiology – Surgery, Periodontology and Dental Radiology Department – Dental School of São José dos Campos – UNESP- Brazil

Edmundo MÉDICI FILHO
Luiz Cesar de MORAES
Titular Professor – Surgery, Periodontology and Dental Radiology Department – Dental School of São José dos Campos – UNESP- Brazil

Gustavo Nogara DOTTO
Post-Graduate Student – Master Degree in Program in Oral Biopathology – Concentration Area in Dental Radiology - Dental School of São José dos Campos – UNESP - Brazil

ABSTRACT

Since the introduction of endosseous dental implant, diagnosis methods using images have been considered of great value. The anatomical structures of the elected area, the wells the relationship with adjacent tissues needs to be completely clears in the planning of implants, so it's necessary to have accurate dimensions in the images of all anatomical structures involved. The aim of the present study was to evaluate different tomographic methods regarding to their precision for assessing the titanium implant length. The radiographs were taken of sixty fixed implants in edentulous areas of five human dry mandibles, using panoramic, film tomography and computerized techniques. The measures were made in all images using a digital paquimeter (Mitutoyo) in order to obtain the vertical dimension (lenght) of the implants. Image data was submitted to the statistical treatment, and it was demonstrated that there was great variation. In other words the same implant present variations in the image lenght comparing to the real dimension, depending upon the technique used. In relation to the accuracy of the technique for showing images closer to the real dimension, the results showed that there was the trend following order: computerized tomography (CT Sytec 3000), film tomography (Tomax) and panoramic (Panoura 10 CSU). The authors concluded that CT performs the best tomographic image of titanium implants followed by the film tomography and panoramic radiography, respectively.

UNITERMS

Dental implants; dental prosthesis, surgery; tomography; radiography dental, computed; titanium, dental implants

INTRODUCTION

The disadvantages of the radiographic exams are due to the own beginnings of the formation of the images. In the mandible the clinical exam is non invasive, but result in limited information about the thickness of the remaining alveolar bone and generally any information on the bony height and the important anatomic structure as mandibular canal and mental foramen. However, the conventional radiography has become limited and the evolution of the technology was responsible for the

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appearance of innovative techniques as tomograms (radiography in plans and cuts). The use of technical alternative radiographic procedures, such as tomography (panoramic, conventional and computerized) has been increased the aid for diagnosis and information for planning the treatment. Precise techniques have been assuring more and more local in better conditions for fixation of the implant without damage for the anatomical spaces and vital structures[2].

The panoramic radiography is important to establish clinical parameters in the correct planning for implant fixation, even so there'll be present magnification and distortion, characteristics associated to the absence of clearness of the image [4,5,9,11,13,18]. Arrested metallic spheres the resin guides, fastened in patients mandibles or macerated mandibles and that after the correction of the amplification it is possible to calculate the height of the remaining alveolar edge, they were used by several authors, using linear tomography[10,12,15,16]. The development of the computerized tomography facilitated the obtaining of three-dimensional (3D) images, being demonstrated that the same is important in the evaluation and surgical planning for dental implants[1]. Along the time other authors made researches as the importance and indication of the computerized tomography (CT). It is proposed in this research to verify the obtained longitudinal dimension of the titanium dental implant, fastened in human dried edentulous mandibles, comparing tomographic images (panoramic, film tomography and CT) with the real dimensions of the same ones.

Material and Methods

In this study were used five dried human mandibles, totally edentulous, alleatory chosen which were examined through tomographies.

In the areas previously chosen for the study were positioned implant of titanium degree 2, of 10mm length, checked one to one, with a digital paquimeter (Mitutoyo) including already closes implants, in a total of twelve for each mandible. The length of the implant was checked and confirmed, one to one, with the digital paquimeter.

The same ones were placed, following the maker's protocol, perpendicular to the remaining alveolar edge, being used for that surgical guides. The occurrence of artifact in the computerized tomography were minimized by the use of titanium degree 2.

Radiographic procedures

For the radiographic exam of the mandibles were selected the extraoral tomographic techniques listed below: panoramic, conventional and computerized.

Panoramic radiographs

The panoramic exams were accomplished using the Panoura orthopantomograph (model 10 CSU, The Dental Yoshida MFG Co. LTDA. Tokyo, Japan).

The films used were Kodak T-Mat G/RA size 15x30cm with Kodak Lanex Regular Screens. During the exhibitions, the mandibles were maintained in the position denominated ortogonal, for taking panoramics by means of elastic maintenance.

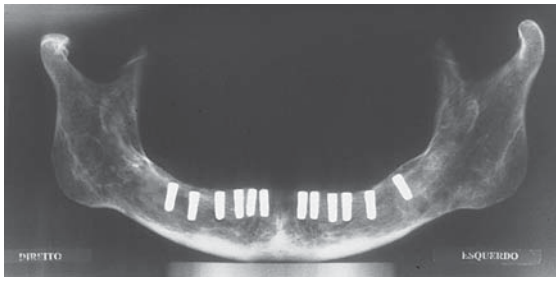

FIGURE 1 – Radiographic result of the panoramic.

Film tomography

The tomographic exam of the studied areas was accomplished using the Tomax Computer Controlled Pluridirection Tomography (Triple I MFG, Co. Inc. Ivyland, SHOVEL, U.S.A.) gauged recently according to the maker's instructions. The unit is equipped with cefalostate for a rigid positioning of the patient's head. The mandibles were fastened to the cefalostato and maintained with elastic.

For orientation of the tomographic cuts it was made an oclusal X-ray of the mandible and the same was put upon to a digitalizer table. The software of the equipment allows us to select the cuts in the desirable areas (previous and posterior areas to the right and the left, where were located the implants). The cuts for all the studied areas had the thickness of 6mm.

The groups of intensifying screens employees in the tomographic exams were the same of the panoramic exams, but now in a chassis with bars.

Computerized tomography

The computerized tomographies were accomplished with a CT scanner of high resolution CT Sytec 3000 (General Electric Company, Milwaukee, Wisconsin, U.S.A.), equipped with a software DentaScan. The unit is equipped with a porch (gantry), work table with control panel, console operator and monitor.

The exams of the mandibles were accomplished with the same ones positioned simulating number decubitus, with the perpendicular base to the table and fastened with adhesive ribbons.

The used factors were: continuous axial courts of 1mm of thickness with interval also of 1mm, with enough number for squad all the thickness of the examined mandible. The DentaScan was used to reform the images successive multiple sections of the mandibles for the obtaining of precise 3D images, perpendicular to the alveolar edge (Figure 3).

The exhibition factors were of 120kVp and 40mA and the time of exhibition for the cuts was 3,0 seconds. In this stage the surgical guides for the vertical mensurations were the dental implants of titanium, degree 2, for not happening the production of artifact.

The measures of the images were accomplished, with a digital paquimeter in the longitudinal sense, with the images under the same illumination conditions. The obtained data were submitted to the statistical analysis, and ordered in Tables and Graphs.

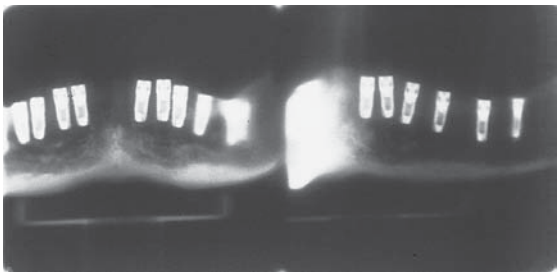

FIGURE 2 – Radiographic result of the film tomography using the *Tomax* (saggital cuts).

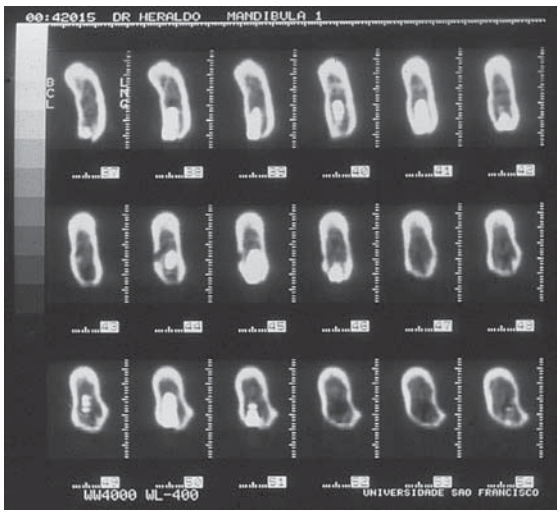

FIGURE 3 – Reformatted oblique axial cuts of the mandibles (CT).

RESULTS

The vertical dimensions of sixty implant fastened in five mandibles were measured in the tomographic radiographs done with three different techniques: panoramic, film tomography and CT and the data were tabulated in the enclosures. With base in those data, the statistical study was accomplished using the descriptive analysis, the trust interval and analyses of parametric variance (ANOVA) and not parametric (Friedman).

As the vertical, real dimension, of the implant is of 10mm, we can notice in the Table 1 that, the averages obtained in the three tomographic techniques, presented larger values than 10mm, demonstrating that there was amplification in the images of the implants. Among the techniques the CT went to that presented smaller amplification (10,95mm), soon after the film tomography came (11,40mm) and the largest amplification happened in the panoramic (12,20mm).

In the graph of columns, Figure 4, the red strip of the graph, corresponds to the values surpluses for 10mm, real longitudinal dimension of the implants, they are of different heights, demonstrating that the amplification in the three tomographic techniques were different.

In the Table 2 we verified that the amplification degree for the panoramic was on the average 22%, for the film tomography were on the average 14% and for the computerized tomography it was on the average 9,5%, confirming once again that the computerized tomography was that showed smaller amplification.

The non-parametric analysis of variance Friedman, Z=96,13; gl - 2; p=0,0001 had demonstrated that the average of the vertical dimension of the implants in the three tomographic techniques were statistically significant.

We could observe that the comparison among mean to each other presented results difference statistical significant.

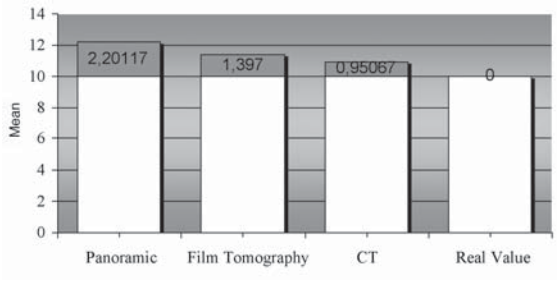

FIGURE 4 - Graph in columns, demonstrating the values surpluses (red) and the real value (white), in the averages (in millimeters) of the longitudinal dimensions of the implant obtained in the three tomographic techniques.

Table 1 - Mean, median, minimum and maximum values for the dimensions of the implants, 1st quartile (25%) and 3rd quartile (75%), in millimeters, according to the three tomographic techniques

Statistics	Panoramic	Film Tomography	CT
Minimum	10.18	10.18	10.18
25%	12.04	11.24	11.03
Median	12.30	11.36	10.82
75%	12.42	11.54	11.32
Maximum	12.65	12.19	12.08
Mean	12.20	11.40	10.95
St.Dev.	0.38	0.30	0.42

Table 2 - Degree of amplification of the three tomographic techniques

Statistics	Panoramic	Film Tomography	CT
% of Amplification	22%	14%	9,5%

Table 3 - Trust interval (95) for tendency measures for the three techniques

Statistics	Panoramic	Film Tomography	CT
Mean	12,10 to 12,23	11,31 to 11,47	10,84 to 11,06
Median	12,20 to 12,38	11,27 to 11,45	10,74 to 11,12

Table 4 - Test of multiple trust of Dunn

Statistics	Mean Post Difference	Z	Z = 2.395
Panoramic X CT	1,76	9,67	S
Panoramic X Film Tomography	1,13	6.20	S
Film Tomography X CT	0,63	3,46	S

Discussion

Panoramic X-ray

The amplification of the longitudinal dimension (length) of the obtained images of panoramic X-rays using as markers, endosseous implant of titanium resembles each other the researches of Reddy et al.[11] (1994); Gher & Richardson[2] (1995); Gomes-Roman et al.[3] (1999), differing meantime of the researches of Klinge et al.[7] (1989); Stella & Tharanon[15] (1990), that were based on the dimensions presented by the images of markers, metallic spheres, with well-known diameter and for the obtained differences, they calculated the percentile of amplification in Lee & Morgano[8] (1994), Todd et al.[17] (1993), that they used metallic threads, accomplishing measures between the images of those radiopaque marks and the one of some own anatomical structures of the examined area, just for orientation during the accomplishment of the radiographic takings.

In this research, on panoramic radiographic exams the longitudinal dimensions (length) of the images of sixty implant, were radiographic demonstrated the amplification, because the average of the dimension of the implant was of 12,20mm, with minimum value of 10,18mm, maximum value of 12,65mm and degree of mean amplification of 22%, these results are similar to the of Stella & Tharanon[15] (1990); Kassebaum et al.[6] (1993); Truhlar et al.[18] (1993); Reddy et al.[11] (1994); Gher & Richardson[2] (1995).

Film tomography

To understand the reports, we should remember the basic axiom of the tomography "those portions

of the object, perpendicular to the tomographic plan are blurry to the maximum, and those parallel structures to the same plan are not blurry more they are merely prolonged". This lengthening of the structures results in images that don't represent an uniform information (STELLA & THARANON[15], 1990; KASSEBAUM et al.[6] 1992; TODD et al.[17] 1993) what confronts with the present study.

We accomplished tomographic exams with the Tomax (hipocicloidal movement) and the tomographic images of the sixty implants presented average of 11,40mm, with minimum value of 10,18mm, maximum value of 12,19 and degree of mean amplification of 14%. The amplification degree differs of Kassebaum et al.[6], 1990 (6 to 10%) and Klinge et al.[7], 1989 (39%).

Computerized tomography

The precision of the CT for the evaluation of the endosseous implant lenght in our research, presents mean value of 10,95mm, minimum value of 10,07mm, maximum value of 12,08mm and amplification degree the same to 9,5%, value this tuneless of the other researched authors.

Although using different proposes the authors find similar results regarding longitudinal amplification in the CT images comparing with several authors mentioned in the specialized literature (ROTHMAN et al.[12], 1988; KLINGE et al.[7], 1989; SCHWARTZ et al.[13], 1989)

Conclusions

The authors concluded that the tomographic techniques: panoramic, film tomography and CT aren't faithful in the evaluation of the implant (10,00mm). The amplification of the obtained image of panoramic, film tomography and CT was respectively of 22% (12,20mm), 14% (11,40mm) and 9,5% (10,95mm). The lowest amplification of the titanium implant image was achieved with the CT Scan.

Resumo

Desde a introdução dos implantes endósseos, os métodos de diagnóstico que utilizam imagens têm sido considerados de grande valor. As estruturas anatômicas da área de eleição, bem como sua relação com os tecidos adjacentes precisa estar clara para o planejamento dos implantes, para isso é necessário ter dimensões precisas nas imagens das estruturas envolvidas. O objetivo do presente trabalho foi avaliar diferentes técnicas tomográficas com relação a precisão da medida na imagem do comprimento do implante de titânio. Foram radiografados sessenta implantes fixos em áreas edêntulas de cinco mandíbulas maceradas, utilizando as técnicas: panorâmica, tomografia convencional e tomografia computadorizada. As medidas foram realizadas em todas as imagens utilizando um paquímetro digital (Mitutoyo) com o objetivo de obter a dimensão vertical (comprimento) da imagem dos implantes. Os dados foram submetidos ao tratamento estatístico, tendo demonstrado uma grande variação. Em outras palavras, o mesmo implante apresentou variação no comprimento da imagem do implante, comparado ao seu comprimento real dependendo da técnica utilizada. Em relação a precisão da técnica para mostrar imagens próximas da dimensão real, os tesultados mostraram a seguinte ordem decrescente: CT (CT Sytec 3000), Tomografia convencional (Tomax) e Panorâmica (Panoura 10 CSU). Os autores concluem que a CT gerou a melhor imagem tomográfica do implante de titânio seguida pela tomografia convencional e panorâmica, respectivamente.

Unitermos

Implantes dentários; prótese dentária cirúrgica; tomografia; radiografia dentária, computadorizada; titânio, implantes dentários

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Endereço para correspondência:
Prof. Dr. Julio Cezar de Melo Castilho
FOSJC/ UNESP
Av. Eng. Francisco José Longo, 777 – Jardim São Dimas
CEP: 12245-000 – São José dos Campos – SP
castilho@fosjc.unesp.br