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Correlation between Radiomorphometric Indexes and Low Bone Quality in the Success of Osseointegration in oral Rehabilitation

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Objective: The aim of this study was to correlate radiomorphometric indices and poor bone quality in osseointegration failures in oral rehabilitation.

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Material and Method: 104 missing implants were evaluated in 74 individuals, verifying in the panoramic radiographs the radiomorphometric indices Mental (IM) and the Mandibular Cortical (ICM).

Results: It was possible to evaluate the correlation (-0.721) for $p<0.001$ inverse correlation between the MI and the MCI. The lower the value found in the MI, the worse the bone quality evaluated in the MCI. It was also possible to verify the relationship (0.275) to $p<0.001$ between MI and the arch where it was evaluated that bone quality in the upper arch showed worse quality when compared to the lower arch. It there was correlation to $p<0.001$ the length of the lost implant and the region (-0.339), smaller length implants were lost in the posterior. Age was correlated (0.198) with the MCI to $p<0.05$ where the older the age the worse the bone quality evaluated. The MCI correlated with the arch (-0.235) for $p<0.05$ a worse bone quality when correlated with the implants lost in the upper arch.

Conclusion: Radiomorphometric indices can be used in the preoperative evaluation to assist in the detection of patients with poor bone quality.

Keywords: low bone quality, radiomorphometric indexes, implants.

I. Introduction

Oral rehabilitation through implants has been growing significantly in recent years and reaching high rates of clinical success. Currently, bone-implant contact is considered predictable, safe, and lasting[1]. The long-term success of dental implants depends on osseointegration[2]. With the advancement of success also comes the problems related to implant dentistry[3].

Failures can be classified as biological, mechanical or iatrogenic or due to insufficient patient adaptation[4].

Among these faults, the most dangerous is the biological fault, which can be defined as the impossibility of bone tissue to establish osseointegration[4,5]. This lack of osseointegration that requires implant removal is considered a biological failure[6].

Biological faults are classified as primary and secondary. If the failure occurs during the osseointegration process, it is considered a primary failure; if it occurs after charging it is a minor fault[3,7]. Primary failures result from lack of bone repair, where the connection between the implant surface and the bone does not occur. Instead, fibrous tissue forms between the implant and bone, causing the implant to lose its stability[5,7,8].

Failures can be prevented by appropriate patient selection; proper treatment planning is critical to successful implant dentistry[9].

Some information has been reported on factors that influence implant osseointegration, such as: biocompatibility, implant design, surface conditions, surgical site, a surgical technique for implant installation, and loads applied to them[10].

Studies relate early loss in short-length implants in posterior regions where space and volume are insufficient[11].

To acquire adequate healing conditions, the implant, after insertion, must exhibit good primary stability, which may correspond to the clinical manifestation of osseointegration. Primary stability is primarily determined by factors related to bone biomechanical properties, implant design, and surgical technique; while secondary stability is also determined by bone tissue response to surgical trauma and implant surface[12]. Primary stability is achieved when the implant locks into the apical or marginal portion of the site due

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a sufficient amount of compact bone or cancellous bone[13].

The world population has been aging over the years and inevitably, the increase in individuals with low bone density[14]. Several studies have shown a positive correlation between low bone density and implant loss[15-18]. The primary stability of the implant, as well as its survival, is affected by low bone density[15,16]. The high rate of implant loss is related to bone type IV when compared to bone type I, II, III[19].

The aim of this study was to correlate radiomorphometric indices and poor bone quality in osseointegration failure in oral rehabilitation.

II. Material and Method

The project was submitted to the Research Ethics Committee (CEP) of the Metropolitan University of Santos and approved. It was used the database of the postgraduate course in implantology of the Metropolitan University of Santos, the data of 104 lost implants of various diameters in 74 individuals aged 33 - 84 years of both genders with an average of 59 years, in addition to their images and clinical records. Individuals with a history of hormone replacement therapy or calcium therapy under the age of six months, and those who did not have all the tests necessary for this study were excluded.

The implants lost in the upper and lower arch in the anterior and posterior regions were separated, also grouped by diameter and length.

All digital panoramic radiographs images used in this study are from a partner institute of the Metropolitan University of Santos and performed by the ORTHOPHOS XG 3D PAN/TELE/TOMO device (Sirona Dental Systems GmbH, Bensheim, Germany) following the same protocol of acquisition: The Panoramic Radiography 69 kV, 15 mA, and exposure time 14.1 s.

In panoramic radiographs, radiomorphometric indices were evaluated. Among, them the mandibular cortical index (MCI)[20] a bilateral evaluation with results established in: C1 - clear and sharp posterior mandibular cortical, C2 - the endosteal surface presents semilunar defects (lacunar resorption),or the surface presents cortical residues, C3 - a cortical layer is extremely porous (Figure 1).

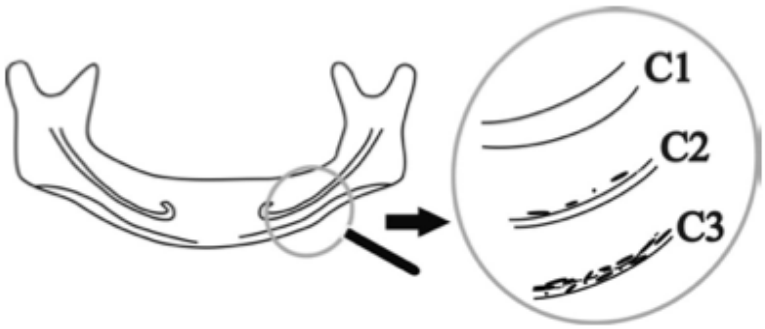

Figure 1: Illustration of the Mandibular Cortical Index

Mental index (MI)[21] bilateral assessment determined by the width of the mandibular cortex, measured on the line perpendicular to the base of the mandible, at the height of the center of the mental foramen (Figure 2).

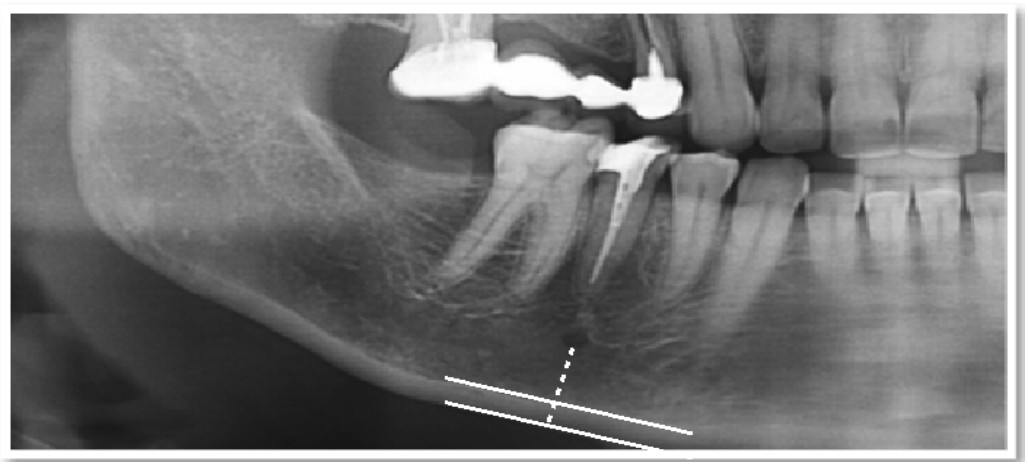

Figure 2: Mental Index Illustration

III. Results

We evaluated data from 104 implants of various diameters in 74 individuals, 48 women and 26 men, aged 33 - 84 years with a mean of 59.4 years. As for the upper and lower arches, 46 implants lost in the lower arch and 58 in the upper arch. We evaluated 76 implants in the posterior region and 28 in the anterior region. Spearman's correlation coefficient test was performed to assess the relationship between the variables of the lost implants (Table 1).

Table 1: Spearman correlation coefficient

	Age	Sex	MI	MCI	ARCADE	Region	Diameter	Lenght
Age								
Sex	R:0,209* P:0,034							
MI	R:-0,106 P:0,282	R: -0,038 P:0,701						
MCI	R:0,198* P:0,044	R:-0,021 P:0,833	R:-0,721** P:0,000					
ARCADE	R:0,214* P:0,029	R:0,052 P:0,597	R:0,275** P:0,005	R:-0,249* P:0,011				
Region	R:0,116 P:0,242	R:0,158 P:0,110	R:0,054 P:0,587	R:0,035 P:0,724	R:0,235* P:0,016			
Diameter	R:-0,028 P:0,779	R:-0,128 P:0,196	R:-0,05 P:0,616	R:0,044 P:0,655	R:0,038 P:0,700	R:0,072 P:0,467		
Lenght	R:-0,032 P:0,751	R:-0,040 P:0,889	R:-0,060 P:0,547	R:0,104 P:0,292	R: -,241* P: 0,014	R:-0,339** P:0,000	R:0,050 P: 0,615	

*p< 0,05 and **p< 0,001

According to the result of the correlation coefficient, it was possible to verify the correlation (-0.721) for p<0.001 inverse relationship between the MI and the MCI. The ratio (0.275) to p<0.001 between MI and the arch where bone quality was evaluated in the upper arch showed worse quality when compared to the lower arch.

It was also correlated (-0.339) to p<0.001 the length of the lost implant and the region, smaller length implants were lost in the posterior region.

Age was correlated (0.198) with the MCI to p<0.05 where the older, the age the worse, the bone quality evaluated.

The MCI correlated with the arch (-0.235) for p<0.05 a worse bone quality when correlated with the implants lost in the upper arch.

IV. Discussion

The use of radiomorphometric indices to assess bone quality is an effective and inexpensive instrument for this detection since the evaluation test is difficult to access and high for the population.

Several studies corroborate our results in the high correlation between radiomorphometric indices evaluated in panoramic radiographs, where these exams may be predictive in helping to assess bone quality[22-24].

Some studies contradict these findings showing that there is inconsistency in the data obtained when in smaller groups, although the mandibular cortical index is among the most reproducible radiomorphometric indices[25,26].

The influence of age with the loss of bone quality was evidenced in this study. Older individuals had worse bone quality when evaluated by the mandibular cortical index. This result was also found in other studies. Zlataric et al. 2002, verified the values of radiomorphometric indices in elderly individuals and showed that the values of these indices decreased in both sexes up to 78 years[27]. Edgerton et al. 1999 evaluated British women and observed that radiomorphometric indices gradually decreased with increasing age[28].

When the arches were evaluated, the upper arch showed worse bone quality compared to the lower arch, implants installed in the posterior regions of the upper arch showed a higher loss rate when compared to the other regions.

It was evidenced in this study when the radiomorphometric indices IM and ICM were evaluated and correlated with the length of the implants and the region where the highest concentration of loss occurred in the posterior maxilla and implants of shorter lengths. These data were also evidenced by other studies where the incidence of loss of short posterior maxillary implants was higher when compared, for example, with the mandible[29-31].

Contrary to the results obtained in this study, implants installed in the posterior maxilla of short length and diameter presented excellent fixation results[32].

V. Conclusion

According to the results of this study, radiomorphometric indices may be used the preoperative evaluation to assist in the detection of patients with poor bone quality.

Bibliographic References

1. Brånemark P I, Zarb G A, Albrektsson T. Tissue integrated prosthesis: osseointegration in clinical dentistry. Chicago: Quintessence; 1985.
2. Matos GRM. Tratamento de superfície de implantes dentários e osseointegração. Rev Dental Press Periodontia Implantol. 2008 out-dez ; 2(4): 40-50.
3. Givol N, Taicher S, Halamish-Shani T, Chaushu G. Risk management aspects of implant dentistry. Int J Oral Maxillofac Implants. 2002; 17(2): 258-62.
4. Buser D, Mericske-Stern R, Bernard JP, et al. Long-term evaluation of non-submerged ITI implants. Part 1: 8-year life table analysis of a prospective multi-center study with 2359 implants. Clin Oral Implants Res. 1997;8:161–172.
5. Esposito M, Hirsch J M, Lekholm U, et al. Biological factors contributing to failures of osseointegrated oral implants. (I). Success criteria and epidemiology. Eur J Oral Sci. 1998; 106: 527–551.
6. Misch C E, Perel M L, Wang H L, et al. Implant success, survival, and failure: The International Congress of Oral Implantologists (ICOI) Pisa Consensus Conference. Implant Dent. 2008; 17: 5–15.
7. Alsaadi G, Quirynen M, Michiles K, et al. Impact of local and systemic factors on the incidence of failures up to abutment connection with modified surface oral im- plants. J Clin Periodontol. 2008; 35: 51–57.
8. Esposito M, Thomsen P, Ericson L E, et al. Histopathologic observations on early oral implant failures. Int J Oral Max- illofac Implants. 1999; 14: 798–810.
9. Smith R S. Long-term complications of osseointegrated implants. In: Kaban B L, Progrel M A, Perrot H D, editors. Complications in oral and maxillofacial surgery. Philadelphia: Saunders; 1997.
10. Albrektsson T, Zarb G, Worthington P, Eriksson A R. The longterm efficacy of currently used dental implants: a review and proposed criteria of success. Int J Oral Maxillofac Implants. 1986 summer; 1(1): 11-25.
11. Baqain Z H, Moqbel W Y, Sawair F A. Early dental implant failure: risk factors. Br J Oral MaxillofacSurg. 2012 Apr; 50(3): 239-43.
12. Sennerby L, Miyamoto I. Insertion torque and RFA analysis of Tiunite and SLA implants. A study in the rabbit. Appl Osseointegration Res. 2000; 1(1): 31-3.
13. Ashley E T, Covington L L, Bishop B G, Breault L G. Ailing and failing endosseous dental implants: a literature review. J Contemp Dent Pract. 2003 May 15; 4(2): 35-50.
14. Reginster J Y, Burlet N. Osteoporosis: a still increasing prevalence. Bone 2006; 38: S4-9.
15. Åstrand P, Billström C, Feldmann H, Fischer K, Henricsson V, Johansson B, et al. Tapered implants in jaws with soft bone quality: a clinical and radio-graphie 1-year study of the Brånemark System Mark IV fixture. Clin Implant Dent Relat Res 2003; 5: 213-8.
16. Busenlechner D, Fürhauser R, Haas R, Watzek G, Mailath G, Pommer B. Long-term implant success at the Academy for Oral Implantology: 8-year follow-up and risk factor analysis. J Periodontal Implant Sci 2014; 44: 102-8.
17. Niedermeier R, Stelzle F, Riemann M, Bolz W, Schuh P, Wachtel H. Implant- supported immediately loaded fixed full-arch dentures: evaluation of implant survival rates in a case cohort of up to 7 years. Clin Implant Dent Relat Res 2017; 19: 4-19.
18. Becker W, Hujoel P P, Becker B E, Willingham H. Osteoporosis and implant failure: an exploratory case control study. J Periodontol 2000; 71: 625-31
19. Lekholm U, Zarb G A. Patient selection and preparation. Tissue integrated prostheses: osseointegration in clinical dentistry. Chicago: Quintessence Pub Co; 1985. p. 199-209.
20. Klemetti E; Kolmakov S; Kröger H. Pantomography in assessment of the osteoporosis risk group. Scand. J. Dent. Res., 1994, Copenhagen, v.102, p. 68-72.
21. Taguchi A, Tanimoto K, Suei Y, Wada T. Tooth loss and mandibular osteopenia. Oral Surg Oral Med Oral Pathol Oral Radiol Endod. 1995 Jan; 79(1): 127-32.
22. Miliuniene E, Alekna V, Peciuliene V, Tamulaitiene M. Evaluation of bone mineral density in postmenopausal women with alterations of the mandible cortical bone. Stomatologija. 2016; 18(3): 86-91.
23. Dutra V, Yang J, Devlin H, Susin C. Radiomorphometric indices and their relation to gender, age, and dental status. Oral Surg Oral Med Oral Pathol Oral Radiol Endod. 2005; 99: 479-84.
24. Drozdzowska B, Pluskiewicz W, Tarnawska B. Panoramic-based mandibular indices in relation to mandibular bone mineral density and skeletal status assessed by dual energy X-ray absorptiometry and quantitative ultrasound. Dentomaxillofac Radiol 2002; 31: 361-7.
25. Mansour S, AlGhamdi A S, Javed F, Marzouk H, Khan E A. Panoramic radiomorphometric indices as reliable parameters in predicting osteoporosis. Am J Med Sci. 2013 Dec; 346(6): 473-8.

26. Akay G, Akarslan Z, Karadag O, Gungor K. Does tooth loss in the mandibular posterior region have an effect on the mental index and panoramic mandibular index? Eur Oral Res. 2019 May; 53(2): 56-61.
27. Zlataric' D K, Celebic' A, Kobler P. Relationship between body mass index and local quality of mandibular bone structure in elderly individuals. J Gerontol A Biol Sci Med Sci 2002; 57: M588- 93.
28. Ledgerton D, Horner K, Devlin H, Worthington H. Radiomorphometric indices of the mandible in a British female population. Dentomaxillofac Radiol 1999; 28: 173-81.
29. Olate S, Lyrio M C, de Moraes M, Mazzonetto R, Moreira R W. Influence of diameter and length of implant on early dental implant failure. J Oral Maxillofac Surg. 2010 Feb; 68(2): 414-9.
30. Machtei E E, Mahler D, Oettinger-Barak O, Zuabi O, Horwitz J. Dental implants placed in previously failed sites: survival rate and factors affecting the outcome. Clin Oral Implants Res. 2008 Mar; 19(3): 259-64.
31. Alsaadi, G. Quirynen, M. & Van Steenberghe, D. (2006) The importance of implant surface characteristics in the replacement of failed implants. *The International Journal of Oral & Maxillofacial Implants* 21: 270–274.
32. Moriwaki H, Yamaguchi S, Nakano T, Yamanishi Y, Imazato S, Yatani H. Influence of Implant Length and Diameter, Bicortical Anchorage, and Sinus Augmentation on Bone Stress Distribution: Three-Dimensional Finite Element Analysis. Int J Oral Maxillofac Implants. 2016 Jul-Aug; 31(4): e84-91.