Available online at www.sciencedirect.com
ScienceDirect
British Journal of Oral and Maxillofacial Surgery 55 (2017) 17–21
BRITISH Journal of Oral and Maxillofacial Surgery
www.bjoms.com

Correlation of radiographic analysis during initial planning and tactile perception during the placement of implants

E.J. Mesquita Júnior[a], A.I. Vieta[a], M. Taba Júnior[b], P.E.P. Faria[a,*]

[a] University of Ribeirao Preto – UNAERP – Ribeirao Preto, Av. Costábile Romano, 2201, Ribeirão Preto, SP CEP 14096-900, Brazil
[b] University of Sao Paulo – USP – Ribeirao Preto, Av. Do Café, s/n, Ribeirao Preto, SP CEP 14096-900, Brazil

Received 17 February 2016; accepted 15 August 2016
Available online 12 September 2016

Abstract

Most of the decisions made in planning treatment with implants rely on the clinician's assessment of the density of the jawbone. However, we know of only a few studies that have evaluated the clinicians' subjectivity and the objective quantitative methods. Our aim was to assess whether the characteristics of the bone seen on preoperative imaging are similar to the features faced during the operation. We collected data about 32 implant procedures done during the Specialisation Course for Implant Dentistry, Universidade de Ribeirão Preto, San Paulo. First, the clinicians evaluated the panoramic radiograph and computed tomographic scans preoperatively, classified the bone density according to the Lekholm and Zarb classification, and marked their subjective evaluation on a visual analogue scale. Postoperatively the surgeons filled out a questionnaire based on their subjective perceptions obtained during the insertion of the implants. Another examiner answered the same questionnaire after looking at the patient's images but without knowing the surgeon's results. There was a good correlation between the surgeons' preoperative classification of the type of bone and their tactile perception ($p = 0.000$), and a good correlation between the surgeon's preoperative classification of the bone and the examiner's findings ($p = 0.000$). We conclude that imaging is an important part of preoperative planning and can predict the quality of the bone when coupled with the opinion of a trained clinician, objective analysis, and standard classification of the bone.

Keywords: Implant planning; Tactile perception; Radiography

Introduction

The quality and volume of available bone are directly related to the success of a dental implant, which is based on well-established planning, osseointegration, and longitudinal followup. Rehabilitation with dental implants involves a plan for treatment that includes imaging, and the evaluation of the quality and quantity of residual bone, gingival phenotype, and biomechanics.[1]

The quality of bone is mainly related to the characteristics of trabecular bone and the cortical portion – that is, the more spaced and thin the bony trabeculae are, the poorer the quality of bone for placing an implant. A thicker cortical portion indicates a better quality of bone.[2]

The density of bone varies from one anatomical region to another, and should be measured accurately at the proposed implant site, as density is directly related to the primary stability of the implant. Several methods have been described for assessing the density, quality, and quantity of bone, such as bone mineral content, bone mineral density, computed tomography (CT),[3] panoramic radiography,[4] counter-torque for implant stability,[5] resonance frequency analysis,[6] the Lekholm Zarb classification,[7] high resolution

* Corresponding author. Tel. +55 16 3603 6717.
E-mail address: pfaria@unaerp.br (P.E.P. Faria).

http://dx.doi.org/10.1016/j.bjoms.2016.08.012
0266-4356/

magnetic resonance imaging, and Periotest®.[8] Most of the studies use panoramic radiographs together with the Lekholm Zarb classification[9] and the surgeon's tactile perception[10] for planning of placement of an implant.

A panoramic radiograph is a prerequisite for preoperative planning of implants, and is widely used because it is both available and accessible. The digital images are based on a two-dimensional array of pixels. Some studies that have investigated the accuracy of digital panoramic radiographs have concluded that a digital system is as useful as one based on conventional film. However, outdated panoramic systems may suffer from distortion, overlapping, and inter-examiner variability.[11]

The quality of bone is associated with its density and they may be synonymous. The classification most commonly used is the Lekholm Zarb, in which bone quality is rated as grades 1–4 according to its composition. Type 1 = residual bone formed by homogeneous cortical bone, type 2 = residual bone formed by a thick layer of dense cortical bone surrounding cancellous bone, type 3 = residual bone formed by a thin layer of dense cortical bone surrounding cancellous bone, and type 4 = residual bone formed by a thin layer of cortical bone surrounding low density cancellous bone.

The quality of bone is also rated as the subjective bone resistance encountered while drilling.[9,12] Some reports have confirmed the validity of the classification of quality by analysing the correlation with histomorphometric results, and measurements of bone and variable mineral density on microCT.[13]

Studies on the effectiveness of methods to assess the density of bone in the jaw before and during placement of implants are rare, and we know of few that have evaluated both subjective and quantitative methods, such as the use of the visual analogue scale (VAS) or bone density measures.[9,14]

Data acquired during preoperative evaluation and planning are of great value in the selection of the type of implant and the surgical technique, particularly when an implant is indicated for a region with poor quality bone. It is therefore important to establish the best plan that correlates with the preoperative radiographic data on type of bone using the Lekholm Zarb classification, bone quality as recorded on the VAS, and the surgeon's tactile perception during operation.

Our aim in this study was to compare the type of bone and classification of density based on preoperative radiographs with the surgeon's tactile perception judged intraoperatively by implant specialists, and to compare the type of bone and its density recorded by implant specialists with the ratings by a trained examiner.

Patients and methods

The study was approved by the Ethics in Research Committee of the University of Ribeirão Preto Committee (no: 36620614.1.0000.5498). Twenty-five patients who sought surgical implant treatment at the Specialisation Course in Implant Dentistry at the University of Ribeirão Preto, San Paulo, Brazil, regardless of the region to be rehabilitated, were included. The inclusion criteria were as follows: appointment for an implant because of the loss of one tooth from one of the jaws and no medical history. The exclusion criteria were: patients whose treatment was contraindicated by coexisting systemic conditions such as diabetes, recent (within 6 months) acute myocardial infarction, serious hypertension (>140/100 mmHg), psychiatric problems, or trouble with movement, poor dental hygiene, or an immunocompromised state.

All panoramic radiographs were standardised using the same apparatus (Cranex™ D; Soredex, Tuusula, Finland) and the same intensity adjustment and exposure time were used for all patients. All radiographs were made in a 1: 1 digital format.

Eight surgeons in the Specialisation Course in Implant Dentistry at the University of Ribeirão Preto answered questions that had been prepared preoperatively about the classification of bone using the Lekholm Zarb scale and bone density using a VAS, based on each patient's panoramic radiograph. The same surgeon answered the same questions postoperatively based on the surgeon's intraoperative tactile perception. Panoramic radiographs that were used for surgical planning were assessed for type of bone in the area to be operated on according to the Lekholm Zarb classification. The surgeon classified the area to be operated on using a value of 1–4 by evaluating the panoramic radiograph before the procedure, and classified the bone on the same 1–4 scale postoperatively, based on the surgeon's tactile perception.

Bone density was assessed before and after operation using the radiograph and the surgeon's tactile perception. A VAS was used to assess bone density – 0 was the least dense and 10 was the most dense. The operating surgeon was questioned postoperatively about his tactile perception, and a value of 0–10 was assigned to the implant area – 0 was the least resistant and 10 was the strongest. The density recorded during the preoperative evaluation was compared with the values for tactile perception obtained postoperatively.

After these data had been collected, a single trained examiner answered the same questionnaire based on the panoramic radiographs but without attending the operation. This was repeated four times on 10 different images as a calibration step, and the results were evaluated using the kappa test and SPSS software (version 16.0, SPSS Inc, Chicago, IL, USA), reaching a score of 0.804.

All data were grouped and the Kolmogorov–Smirnov test used to check normality. We applied Pearson's correlation analysis to assess the significance of differences between the clinical and radiographic variables and compared the values obtained preoperatively and postoperatively as well as the assessment made by the examiner. Probabilities of less than 0.05 were accepted as significant.