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((وعلمك ما لم تكن تعلم وكان فضل الله عليك عظيماً))

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VALIDITY OF DIGITAL PANORAMIC IMAGES -1:1 MAGNIFICATION- IN PREOPERATIVE PLANNING FOR IMPLANT INSERTION IN THE POSTERIOR MANDIBLE

A Thesis submitted to Oral and Maxillofacial Surgery Department, Faculty of Oral and Dental Medicine, Cairo University, for partial fulfillment of the requirements of theMaster Degree in Oral and Maxillofacial Surgery

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DEDICATION

TO MY BELOVED FAMILY

MY FATHER, MY MOTHER

MY BROTHER, MY SISTER

FOR THEIR

CONTINUOUS

SUPPORT

&

LOVE

THROUGHOUT THE YEARS

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ABSTRACT

Objective: This study was conducted to assess the accuracy of digital panoramic images with 1:1 magnification in preoperative planning for implant insertion in the posterior mandible.

Patients and Methods: A total of 11 implants were included in the study. Preoperative digital panoramic images with corrected magnification were taken for each patient to determine available alveolar bone height. Implants were placed in the posterior mandible. The same radiographic image was made postoperatively. Different measurements were taken on the pre- and postoperative images which were compared to each other and to the known real dimensions of the implants (gold standards) to assess the accuracy of the measurements and the reproducibility of the radiographic image. Collected data were analyzed using three different softwares.

Results: Statistical analysis revealed no significant difference between all compared measurements.

Conclusion: Measurements yielded from digital panoramic images with 1:1 magnification are reproducible and valid for preoperative planning for implant placement in the posterior mandible.

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INTRODUCTION

The use of dental implants in the treatment of complete and partial edentulism has become an integral treatment modality in dentistry. The immense popularity of implants and their wide acceptance are due to the fact that they not only replace lost teeth, but are also permanent restorations that do not interfere with oral function, speech or compromise the self-esteem of patients **(Misch, 2008).**

The improvements and developments in the field of oral implantology have been accelerating tremendously. New techniques and systems are being continuously renovated and the materials and surfaces of the implant are in continuous progress.

Alongside the technological development in implant manufacturing is a comparative development in the radiographic modalities which are essential before any implant procedure. The radiographic techniques perceived noticeable progress over the last decade especially with the development of digital radiographs and cone-beam computed tomography **(Holst, 2007).**

All these developments aim at simplifying the procedure to the surgeon, overcoming the disadvantages of the present techniques and improving the quality and accuracy of radiographs.

Among these inventions is the digital panoramic image with corrected 1:1 magnification which would overcome one major disadvantage of the current panoramic images. However, the reliability and accuracy of this new invention is still a matter of debate.

REVIEW OF LITERATURE

Implant placement has now become part of the everyday dental practice. Yet, more challenging than the implant placement procedure remains the proper preoperative planning preceding the surgery. The goal of preoperative planning in dental implantology is to enable the placement of implants of optimum number and size in the most favorable position in order to provide adequate masticatory, phonetic, and esthetic function. **(Engelman et al., 1988; DaSilva et al., 1992)**

Preoperative treatment planning includes the assessment of the quality and quantity of the available bone into which the implants are to be placed. Moreover, waxing up of the final prosthesis is done especially in cases of long span edentulous areas.

In addition, preoperative planning must encompass radiographic assessment of the proposed implant sites. The presurgical radiographic examinations for the treatment with osseointegrated implant give detailed information on the potential area for implantation. It should provide evaluation of morphology, angulations of the alveolar ridge, and quantity and quality of the available bone. The presence of lesions and anatomical landmarks are conditions and structures that may limit the placement of osseous implant. Important anatomical landmarks include the maxillary sinus and nasal cavity in the maxilla and the inferior alveolar canal in the mandible. **(Tyndall and Brooks, 2000; Beason and Brooks, 2001)**

Inferior alveolar neurovascular bundle

The inferior alveolar neurovascular bundle is vulnerable during dental implant surgery, endodontic treatment, and mandibular osteotomies. **(Jääskeläinen et al., 1996; Krogstad et al., 1997; Westermark et al., 1998; Babbush, 1998; Morrison et al., 2002; Willy et al., 2004; Zmener, 2004 Seo et al., 2005)** Thus, knowledge of intraosseous position, course, and branches of the inferior alveolar neurovascular bundle has strategic importance for clinical dental and surgical procedures e.g. implant placement.**(Kilic et al., 2010)**

The inferior alveolar nerve emerges in the infratemporal fossa, posterior to and slightly distal to the lingual nerve. It then passes downward medial to the lateral pterygoid muscle till it enters the mandibular foramen, which is located on the lingual surface of the ramus of the mandible. Accompanying the nerve are the inferior alveolar artery and vein. **(Smith, 1991)** Upon entering the mandibular foramen these three structures traverse a bony canal within the mandible, the mandibular canal, till they reach the area of the mental foramen where they divide into mental and incisive branches.

Several studies were conducted aiming to describe the relation between the inferior alveolar nerve and vessels within the mandibular canal and to try to document a clinically relevant position of the mandibular canal within the mandible. This is to aid in decreasing the risk of inadvertent injury to the inferior alveolar nerve and vessels associated with different surgical procedures.

Nortje et al., 1978, studied the course of the mandibular canal from 3612 panoramic radigraphs and divided the findings into three groups: 47% were high mandibular canals (within 2mm of the apices of the first and second molars), 49% were low, while the other 3% showed other variations including duplication or division of the canal or lack of symmetry. The main conclusion is that the mandibular canals were mostly bilaterally symmetrical and that the majority of hemimandibles contain only one major canal.

Levine et al., 2007, enrolled a sample of 50 patients who underwent mandibular axial computed tomograms and measured the distance from the buccal cortical margin of the canal to the lateral buccal cortical margin of the mandible. Another vertical linear measurement was recorded from the alveolar crest to the superior aspect of the inferior alveolar canal. On average, the buccal aspect of the canal was located 4.9 mm ± 1.3mm from the buccal cortical margin of the mandible and 17.4 mm ± 3.0 from the alveolar crest.

Kilic et al., 2009, studied 46 mandibles of human cadavers. In general, the canal was located closer to the lingual plate than the buccal plate. The mean distance from the buccal cortical plate to the canal was 4.58 ±1.6mm, while the distance between the superior border of the canal and the alveolar crest had an average of 14.06mm ± 1.9mm.

Zoud et al, 1993, described that the inferior alveolar artery travels below the nerve in the main part of the mandibular canal and then superior to the nerve in the distal part of the canal, with the nerve and artery forming an intertwined plexus throughout the mandibular canal.

Kim et al., 2009, studiedhistological sections of 10 mandibles at different locations throughout the mandibular canal. In 8 cases the vessels were located above the nerve, while in 2 cases the nerve was lingual to the vessels. They thus concluded that damage to the superior part of the mandibular canal would also damage this vessel. Hence, transient postoperative numbness may be attributed to indirect damage to the nerve by hematoma rather than to direct damage to the nerve.

The mental nerve and vessels emerge through the mental foramen mostly after a short recurrent intrabony course, creating the so-called anterior loop. The shape, curve, and direction of this terminal segment and the position of the mental foramen are quite variable. **(Niek et al., 2009)** For this reason, the inferior alveolar nerve may be injured when the mandible is violated just below or in front of the mental nerve by trauma or by procedures such as implant placement. **(Zungia, 1995)**

The reported lengths of the anterior loop ranged from as little as 0.5 mm in some studies (**Rosenquist 1996**) to as much as 10mm in others (**Rothman 1998**). While a study by **Kuzmanovic et al., 2003,** reported a range of 0.11–3.31 mm with a mean of 1.20 ± 0.9mm.

Cutright et al., 2003, demonstrated that the mental foramen is located below the second premolar in 51% of the cases. It may also be located between the first and second premolar.