Evaluation of the thickness of the Anterior Maxillary Facial Bone Wall - A Retrospective Radiographic Study Using Cone Beam Computed Tomography.

Dental Science

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ABSTRACT
Implant placement following extraction is commonly done in daily practice. In the anterior maxilla, it presents a considerable challenge to clinicians because of the high esthetic expectations of patients and, at the same time, various local risk factors that can potentially compromise the predictability of treatment outcomes. The thickness of the facial bone wall in the anterior maxilla is of crucial importance for the selection of the appropriate treatment approach. Cone beam computed tomography (CBCT) is a three dimensional imaging technique used in the dental fields of implantology which yields sub-millimeter accuracy for linear measurements. The purpose of this retrospective radiographic study was to analyze the thickness of the facial bone walls of teeth in the anterior maxilla based on CBCT images from 50 patients (including male and female patients) between the ages of 20 to 50 years referred for implant therapy. After analysis, at MP1 (4mm from CEJ), 19.2% had missing facial bone wall, 76.3% had <1mm, 4.3% had ≥1mm. At MP2 (middle of root), 8.3% had missing facial wall, 87.6% had <1mm, 3.85% had ≥1mm.Thick bone wall (≥1 mm) was found in only 4.3% of all examined teeth at MP1 and 3.85% at MP2. Both a missing and thin facial wall requires simultaneous contour augmentation at implant placement because of the bone resorption that occurs at a thin facial bone wall following tooth extraction. Consequently, radiographic analysis of the facial bone wall using CBCT prior to extraction is recommended for selection of the appropriate treatment approach.

INTRODUCTION:

Immediate implant placement in post extraction sites, without waiting for the site to heal, is a treatment modality that has received much attention. Studies have demonstrated that *dimensional alterations occur on the alveolar process following tooth extraction*[1-4]. *After the* healing process is completed, bone loss at the facial aspect of the marginal one-third of the socket is more pronounced than that of the palatal aspect[1]. After implant bed preparation, the facial bone wall should ideally measure at least 2 mm in thickness to ensure proper soft tissue support and to avoid resorption of the facial bone wall following restoration

METHODS AND MATERIALS:

A total of 50 CBCT scans of maxillary anterior region were collected from patients aged 20 to 50 years (including both male and female patients).Consent for the same was taken from each patient before the start of the study. The thickness of the facial bone wall in the respective sagittal scans was measured perpendicular to the long axis of the tooth at two locations: at the crest level (4 mm apical to the cementoenamel junction; MP1) and at the middle of the root (MP2). Image analysis was done by means of image processing software (vision.exe).

The results from the right and left maxillary arches were averaged for each tooth type.

RESULTS:

A total of 258 teeth from 50 CBCT's (including both male and female patients between the ages of 20 to 50 years referred for implant therapy) were evaluated (table 1). After analysis, at **MP1** (4mm from CEJ), 19.2% had missing facial bone wall, 76.3% had <1mm and 4.3% had ≥1mm (Table 2). At **MP2** (middle of root), 8.3% had missing facial wall, 87.6% had <1mm and 3.85% had ≥1mm (Table 3).

Thick bone wall (≥ 1 mm) was found in only 4.3% of all examined teeth at MP1 and 3.85% at Mp2.

Table 1: Specifying Teeth Evaluated For the Study (n=258)

TEETH ANALYZED	13	12	11	21	22	23
TOTAL NO. OF EACH TOOTH ANALYSED (N=258)	43	44	40	51	38	42

Table 2: Frequency distribution (%) of examined teeth according to thickness of the facial bone walls at MP1 (4 mm from CEJ)

Teeth Analyzed	Missing Facial Bone Wall (%)	Facial Bone Wall Thickness < 1 mm (%)	Facial Bone Wall Thickness ≥ 1 mm (%)
Central incisors (11,21)	22/91=24.1	68/91=74.7	1/91=1.1
Lateral incisors (12,22)	16/82=19.5	60/82=73.1	6/82=7.3
Canines (13,23)	12/85=14.1	69/85=81.1	4/85=4.7
Total (n=3)	19.2	76.3	4.3

Table 3: Frequency distribution (%) of examined teeth according to thickness of the facial bone walls at MP2 (middle of root).

| Teeth Analyzed	Missing Facial Bone Wall (%)	Facial Bone Wall Thickness < 1 mm (%)	Facial Bone Wall Thickness ≥ 1 mm (%)
Central incisors (11,21)	12/91=13.1	77/91=84.6	2/91=2.1
Lateral incisors (12,22)	8/82=9.7	72/82=87.8	2/82=2.4
Canines (13,23)	2/85=2.3	77/85=90.5	6/85=7.1
Total (n=3)	8.3	87.6	3.85

METHOD OF STATISTICAL ANALYSIS:

Descriptive statistical analysis was complemented with inferential statistics to detect significant differences in the data sets for the left and right side of the maxilla. The measurements for the two locations in all teeth were grouped into the following categories for descriptive analysis:

1. Missing bone wall (thickness = 0 mm),
2. Bone wall thickness < 1 mm, and
3. Bone wall thicknes >/ 1 mm.

Graphical analysis was done based on the results obtained (Table 1 and 2).
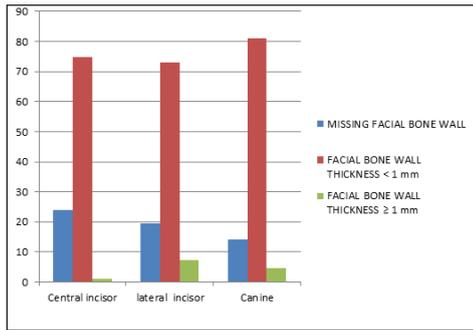
Graph 1 - Frequency distribution (%) of examined teeth according to thickness of the facial bone walls at MP1 (4 mm from CEJ)
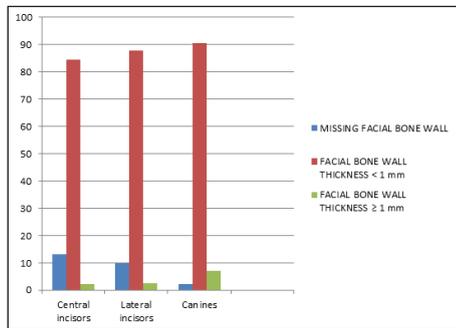
Graph 2- : Frequency Distribution (%) Of Examined Teeth According To Thickness Of The Facial Bone Walls At Mp2 (Middle Of Root).

DISCUSSION:

Over the years, several experimental and clinical studies have shown that peri-implant soft tissues have relatively constant dimensions and that the underlying bone structure plays a key role in the establishment and maintenance of esthetic soft tissue contours. The presence of a facial bone wall of sufficient height and thickness is crucial for the long-term stability of harmonious mucosal margins around implant restorations. The height of the bone wall influences the position of the mucosal margin on the facial aspect, whereas the thickness has an influence on the facial convexity of the alveolar process at the emerging implant crown.

In the present study, CBCT was used to examine the facial bone walls at teeth in the anterior maxilla, the thickness of the facial bone wall was measured at two levels: in the crestal area (MP1) and in the middle of the root (Mp2). For the esthetic outcome of implant restorations on the facial aspect, MP1 is clearly more important than MP2, since the bone in the crestal area supports the mucosal margin and determines the shape of the alveolar process. If that bone structure is missing, mucosal recession is likely to develop, leading to esthetic complications.

The results of the present study show that the facial bone wall in the anterior maxilla is mostly thin. Thick bone wall (≥1 mm) was found in only 4.3% of all examined teeth at MP1 and 3.85% at MP2. A similar study done by Vedrana Braut et al in 2011 and found that there was a statistically significant decrease in facial bone wall thickness from the first premolars to the central incisors. The facial bone wall in the crestal area of teeth in the anterior maxilla was either missing or thin in roughly 90.0% of patients [9].

From a clinical point of view, a missing and a thin facial wall are more or less comparable, since a thin bone wall will be resorbed because of the well-documented ridge alterations that occur after extraction.

Today, the clinician has several options for post extraction implant placement. To achieve a successful esthetic outcome with high predictability, careful preoperative analysis is required to assess local risk factors.

For the selection of an appropriate treatment approach, the use of CBCT can be recommended, since it demonstrates the status of the facial bone wall reliably at the tooth to be extracted.

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