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Assessment of gingival biotype and facial hard/soft tissue dimensions in the maxillary anterior teeth region using cone beam computed tomography

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ABSTRACT

Objective: This study sought to assess the relationship between facial gingival and bone dimensions in maxillary anterior teeth region using cone beam computed tomography (CBCT).
Design: This study assessed 621 maxillary anterior teeth in 144 patients. In the sagittal plane, facial bone thickness (BT) and gingival thickness (GT) were measured at the crestal level and at 2, 4 and 6 mm apical to the cementoenamel junction (CEJ). The dentogingival complex (DGC) dimensions and the distance from the CEJ to bone crest were also measured on CBCT scans. To determine the gingival biotype, GT at 2 mm apical to the gingival margin was measured and GT <1.5 mm was categorized as thin while GT ≥ 1.5 mm was categorized as thick. The data were analyzed using SPSS version 21 via repeated measures ANOVA and the Cochrane's Q, chi-square and independent samples *t*-tests.
Results: The BT around the maxillary central and lateral incisors and canine teeth at 4 and 6 mm apical to the CEJ was significantly different in thick and thin gingival biotypes ($P < 0.05$). The mean GT at 2 and 4 mm apical to the CEJ was significantly different around central and lateral incisors ($P < 0.05$). Thickness of crestal bone was significantly different between the two gingival biotypes around central and lateral incisors ($P < 0.05$).
Conclusion: The two gingival biotypes had significantly different mean BT; different biotypes and their relationship to BT varied around anterior maxillary teeth.

1. Introduction

Gingival biotype is an important parameter, which may affect the success and esthetic results of periodontal plastic surgery and implant treatment in the esthetic zone (De Rouck, Eghbali, Collys, De Bruyn, & Cosyn, 2009; La Rocca et al., 2012) Several classifications have been proposed for gingival biotypes. According to Ochsenbein and Ross (1973), gingiva follows the contour of the underlying bone and tooth shape; accordingly, they described two gingival anatomies namely (I) thin scalloped, which refers to triangular-shaped teeth with scalloped gingival margins and (II) thick flat, which refers to square-shaped teeth with flat gingival margins (Ochsenbein & Ross, 1973). Seibert and Lindhe (1989) described the differences in tooth shapes and heights in relation to the morphology of periodontium and introduced a classification for periodontal biotypes (Seibert & Lindhe, 1989). Kois (1996) categorized two biotypes of thin and thick, depending on the distance from the CEJ to bone crest. The thick biotype referred to cases where the distance from the CEJ to crestal bone was less than 3 mm (Kois, 1996). Later in 1997, Müller and Eger (1997) in their study on 42 individuals described periodontal phenotypes for different shapes of teeth and gingiva as follows: (I) Keratinized gingiva with normal thickness and width in teeth with normal length and width (two-thirds of the subjects); (II) Square-shaped incisors with thick and wide gingiva (21% of the subjects); and (III)

Abbreviations: BT, bone thickness; CEJ, cementoenamel junction; CBCT, cone beam computed tomography; DGC, dentogingival complex; GT, gingival thickness.

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Square-shaped incisors with normal GT and minimal width of keratinized tissue (12% of the subjects) (Müller & Eger, 1997).

De Rouck et al. (2009) revisited gingival biotype in their study and assessed the transparency of the periodontal probe through the gingival margin as a method to differentiate thin from thick gingival biotypes. They evaluated 100 subjects (50 males and 50 females) and reported that approximately one-third of the subjects in their study had clearly thin gingiva associated with slender teeth, a thin band of keratinized tissue and highly scalloped gingival margins previously referred to as thin-scalloped biotype. Approximately two-thirds of the subjects had clearly thick gingiva; half of which had quadratic teeth, wide keratinized tissue and flat gingival margins previously referred to as thick-flat biotype. The other half had thick gingiva along with slender teeth, a thin band of keratinized tissue and highly scalloped gingival margins (De Rouck et al., 2009).

In addition to different classifications, various methods are available to determine the gingival biotype such as visual inspection (Ochsenbein & Ross, 1969; Seibert & Lindhe, 1989) and assessment of the transparency of the periodontal probe through the gingival margin (Y. Kan, Rungcharassaeng, Morimoto, & Lozada, 2009). Eghbali, De Rouck, De Bruyn, and Cosyn (2009) discussed that visual inspection may not be a valuable method to determine the gingival biotype since this. method is associated with misclassification of approximately half of the thin-scalloped cases (Eghbali et al., 2009).

Assessment of gingival biotype is critical prior to restorative and implant treatment planning (Buser, Martin, & Belser, 2003). In addition to optimal function, dental implants must provide favorable esthetics (Stimmelmayr, Allen, Reichert, & Iglhaut, 2010). Achieving maximum esthetics following immediate implant placement depends on three main factors, namely the proper location of implant (Buser et al., 2003), adequate facial bone (Ferrus et al., 2010) and peri-implant soft tissue status (Kan, Rungcharassaeng, Umezu, & Kois, 2003).

Soft tissue recession is a common problem associated with implant treatment in the anterior region (Goodacre, Kan, & Rungcharassaeng, 1999). Immediate implant placement in patients with thick gingival biotype often yields predictable results and long clinical service (Nagaraj et al., 2010). Evidence shows that in patients with thick-flat gingival biotype, papillary height (PH) around implant remains unchanged (Romeo et al., 2008), and this biotype is more favorable for implant placement and yields optimal esthetic results (Nagaraj et al., 2010).

Cone Beam Computed tomography can be used as a non-invasive modality for assessment of gingival biotype and determination of thickness of cortical bone and facial gingiva prior to implant treatment and flap elevation in periodontal surgery. This study sought to assess the relationship between facial gingival biotype and hard/soft tissue dimensions in maxillary anterior teeth using CBCT in patients presenting to a private oral and maxillofacial radiology clinic in 2015.

2. Materials and methods

This descriptive cross-sectional study was conducted on 144 patients who were candidates for dental implants referred to a radiology clinic for CBCT scans. The study protocol was approved by the Ethics Committee of Research Department of Shahid Beheshti Dental School. Patients with a minimum of three maxillary anterior teeth were selected using convenience sampling and written informed consent was obtained from them. Exclusion criteria were:

- Gingival enlargement in the anterior maxilla (Frost, Mealey, Jones, & Huynh-Ba, 2015)
- Gingival recession in the anterior maxilla (Stein et al., 2013)
- Previous or current orthodontic treatment (Ramírez, García-Rodríguez, Murillo-Arocho, Fernández-López, & Elías-Boneta, 2013)
- Crowding in the anterior maxilla (Fischer, Richter, Kebschull, Petersen, & Fickl, 2015)
- History of periodontal surgery in the anterior maxilla (Borges, Ruiz, Alencar, Porto, & Estrela, 2015)
- Teeth with prosthetic crowns or restorations (Jin et al., 2012; Sin et al., 2013), bridge abutments or implants in the anterior maxilla
- Missing (Jin et al., 2012), impacted, broken, endodontically treated (Nahass & Naiem, 2015) or decayed (Jin et al., 2012) teeth and teeth with root resorption (Nahass & Naiem, 2015), rotation or malposition (La Rocca et al., 2012)
- Skeletal descrepancies (Rossell, Puigdollers, & Girabent-Farrés, 2015), cleft lip or palate
- History of trauma to the anterior maxilla
- Smoking (Arora, Narula, Sharma, & Tewari, 2013), pregnancy (Sin et al., 2013), nursing (Sin et al., 2013) or systemic diseases (Arora et al., 2013)

The lips and cheeks were retracted by a sterile plastic retractor. The CBCT scans were obtained using Soredex dental X-ray system (Soredex, Helsinki, Finland) with 12 × 8 cm field of view and 200 μ voxel size. All measurements were made by the same observer. The BT and GT in the sagittal plane were measured at the bone crest and at 2, 4 and 6 mm apical to the CEJ. The DGC dimensions and the distance from the CEJ to bone crest were also measured on CBCT scans (Fig. 1). To determine the gingival biotype, GT at 2 mm apical

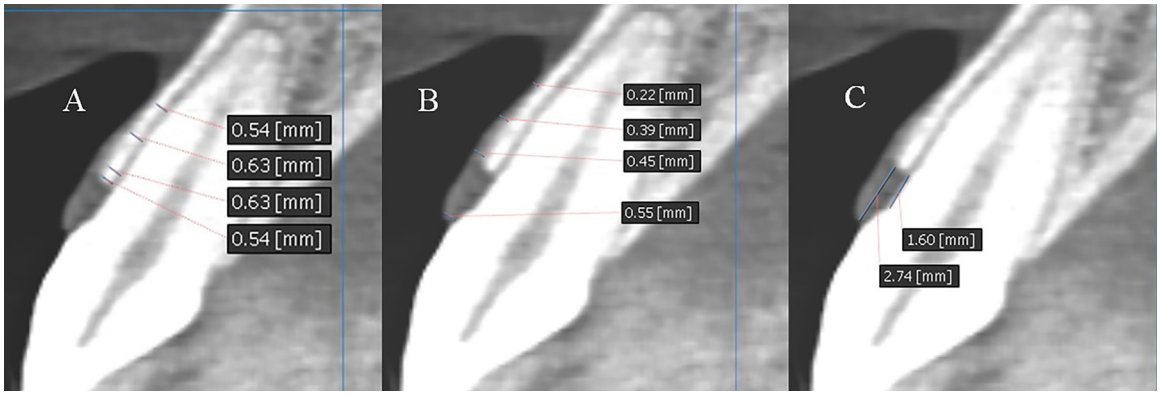

Fig 1. (A) Measurement of BT at the level of bone crest and at 2, 4 and 6 mm apical to the CEJ; (B) GT at the level of bone crest and at 2, 4 and 6 mm apical to the CEJ; (C) DGC dimensions and the distance from the CEJ to bone crest.