



ISSN Print: 2394-7489

ISSN Online: 2394-7497

IJADS 2017; 3(3): 05-07

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www.oraljournal.com

Received: 02-05-2017

Accepted: 03-06-2017

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Soft tissue thickness determination using CBCT in periodontics: A review

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Abstract

Accuracy of facial soft tissue thickness has been an important step in formulating a treatment plan for various procedures in the field of periodontology. There are various methods to measure soft tissue thickness but accuracy of these methods is questionable till date. The aim of this article is to make people aware of the new technology i.e., cone beam computed tomography (CBCT) its role, accuracy and its reliability in measuring the thickness of the oral soft tissues, which will further help in improving the treatment plan followed by better results. Therefore, this review aims to assess the effectiveness of CBCT in determining soft tissues.

Keywords: CBCT, soft tissue, periodontics, three dimensional imaging

Introduction

Three-dimensional (3D) imaging modalities are being explored as an emerging diagnostic tool in periodontal practice. Cone-beam computed tomography (CBCT) introduced in 1971 by Dr. Hounsfield in England is replacing the conventional 2D imaging in current practice. CBCT produces three dimensional anatomical images and also has the ability to collect and generate data at higher resolutions. It provides relatively low radiation dose, which is comparable to a full mouth series of periapical radiographs and fairly below that of conventional CT^[1].

CBCT in periodontology has been used in assessment of periodontal ligament space, for periodontal defect measurements and furcation involvement^[2]. It has also been employed for the evaluation of outcomes succeeding regenerative surgery^[3]. Recently it has been reported that apart from the evaluation of the hard tissues of the maxillofacial complex, CBCT can also be applied for visualizing and precisely measuring soft tissues of the periodontium and dentogingival attachment apparatus^[4]. However, the application of CBCT in discriminating soft tissues is still limited. Hence, the proposed literature review aims to identify the best available evidence for the decision pertaining to the use of CBCT images in assessing soft tissues of the dentogingival unit.

Appraisal of Literature

Table 1 summarizes the studies assessing the accuracy of CBCT in soft tissue evaluation. CBCT is regarded as a tool for solely evaluating hard tissues of the maxillofacial complex, and has been reported that it is not indicated for assessing soft tissues^[5]. However, one investigation recently published that CBCT can be applied for visualizing and measuring soft tissues of the dentogingival unit^[4]. This study developed a soft tissue cone-beam computed tomography (ST-CBCT) to improve soft tissue image quality. ST-CBCT scans were taken with the patients wearing plastic lip retractor and tongues retracted toward the floor of their mouths. ST-CBCT scans permitted a clear visualization, measurement of the dimensions, and analysis of the relationship of the structures of the periodontium and dentogingival attachment apparatus. This technique may benefit clinicians in the planning and implementation of procedures in several dental specialties.

In another publication by Barriviera *et al.* 2009, the same technique with a better retraction of the tongue was applied to obtain the thickness of palatal masticatory mucosa at forty different locations on each patient^[6]. The average thickness of the palatal mucosa was 2.92mm in the canine area, 3.11mm at the first pre-molar, 3.28mm at the second pre-molar, 2.89mm at the first molar and 3.15mm at the second molar.

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These measurements were similar to those reported in previous studies using other methods to assess gingival thickness [7-10]. However, no attempt was made in this study to compare radiographic measurements to clinical measurements.

Retrospective analyses by Yilmaz *et al.* in and Ueno *et al.* in 2015 evaluated the palatal mucosa thickness using CBCT. Both the studies stated that limited contrast resolution of CBCT made the detection of soft tissue structures difficult [11, 12]. Besides the results obtained from one set of population

cannot be generalized to other racial and ethnic groups.

Gupta *et al.* 2015 compared the thickness of the palatal masticatory mucosa as determined on a CBCT scan with bone sounding on 20 patients requiring palatal surgery. No significant differences between the two methods were found¹. This was the first attempt to compare the efficacy of CBCT with conventional methods in assessing the thickness of soft tissue of the palate. However, the inadequate sample size without a proper determination of the same does not permit to generalize the results.

Table 1: Studies assessing the accuracy of CBCT in soft tissue evaluation

Author	Study design	Proband characteristics	Radiographic assessment	Accuracy	Potential benefits
Januário [4] 2008	Cross sectional	Three patients with different periodontal biotypes	Two separate CBCT scans: 1 st scan: standard methods used. 2 nd scan: ST-CBCT	1 st scan: measurements of the distance of the CEJ to the facial bone crest, and the width of the facial alveolar bone ST-CBCT: measurements of the distance of the gingival margin to the CEJ, and width of the facial gingiva.	ST-CBCT scans may allow clear visualization, measurements and analysis of the relationship of the structures of the periodontium and dentogingival attachment apparatus
Barriviera <i>et al</i> [6], 2009	Cross sectional	Thirty-one patients (11 M and 20 F; ages ranging from 19 to 53 yrs)	CBCT scans: thickness of the palatal mucosa was obtained at forty different locations.	Average thickness of the palatal mucosa: 2.92mm in the canine area, 3.11mm at the first pre-molar, 3.28mm at the second pre-molar, 2.89mm at the first molar and 3.15mm at the second molar.	CBCT may allow determination of the dimensions of the palatal mucosa.
Ueno <i>et al</i> [12], 2014	Retrospective	CBCT images of 44 subjects (Japanese population; 22 M, 22 F; age range 19–77 yrs)	Measurements on the coronal plane with 3-mm interval in the canine, 1 st & 2 nd premolar, mid-point between 1 st & 2 nd , 1 st & 2 nd molar	Palatal mucosa: thickest in canine to premolar regions at 9 to 12mm from the gingival margin.	CBCT can be used for evaluating the thickness of palatal mucosa.
Yilmaz <i>et al</i> [11]. 2015	Retrospective	CBCT images of 368 patients (181 male and 164 female) aged from 15 to 69 years	Thickness of palatal mucosa measured. Greater palatine foramen location in relation to the tooth determined.	The mean palatal mucosal thickness from the second molar to the canine teeth was 3.7, 3.3, 3.7, 3 and 3 mm.	The second premolar to second molar zone can be considered a suitable graft site based on the mean palatal mucosal thickness.
Gupta <i>et al.</i> [1] 2016	Cross sectional	20 systemically healthy subjects (10 M, 10 F; ages 19 to 53 years) requiring palatal surgery.	Thickness of the palatal tissue measured at various points using CBCT scans and clinically.	Clinical and radiographic methods comparison showed no significant difference.	CBCT may be used as a non-invasive method to accurately and consistently determine the soft tissue thickness of the palatal masticatory mucosa.

Conclusion

Limited evidences report the use of CBCT for assessing soft tissues of the dentogingival unit, especially for the determination of the thickness of palatal masticatory mucosa. However, imaging using CBCT still offers a higher radiation dose when compared to periapical and panoramic images. Therefore, its use, potential risks and benefits should be carefully considered in each individual case.

Future Directions

Regardless of profuse literature stating the accuracy of Cone beam computed tomography images in determining linear interfacial hard tissue measurements, there has been a lack of publications investigating its accuracy in soft tissue measurements. Most of the publications are *in vitro* studies or retrospective analysis. Also, comparison of CBCT with the clinical and conventional methods in an adequate sample size, for comparing its efficacy of measuring palatal soft tissue thickness is lacking.

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