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Effect of Salvadora persica chewing sticks on maxillary central incisors crown-root angulation in Western-Asian population & correlation with Collum angle on 3D CBCT images

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Abstract: The main aim of the study was to identify the Collum angle classification for maxillary central incisors among individuals use vs not-use chewing sticks which could have beneficial role for immediate implant placement in respective individuals. Additionally, to identify the root-crown positioning and angulation in the Western Asian Saudi Arabian population for chewing sticks user's vs non-users in order to develop guideline for the prosthetic procedures using Cone beam computed tompography (CBCT). A total number of 380 CBCT scans were included in the study for both of the groups based on the inclusion criterion of the patients reporting to the Dental OPD of Riyadh Elm University. The data was analyzed using 3D planner dental imaging software. Initially the teeth were classified based on root position in relation to facial plate of alveolar bone using Jung et al. classification. Additionally, the Collum angle and the root angulation of the maxillary central incisors was evaluated. The data was analyzed using one-way Anova with post-hoc Tuckey-Kramer test for pair-wise comparison. As per the Jung et al. classification, majority of the roots were observed with buccal placement. Based on the Collum angle classification majority of the maxillary central incisors were observed with facial placement (n=170), specially subtype I (n=78). But the root angulation was observed to be independent of Collum angle. Thus, it can be concluded, unlike root angulation, Collum angle has a correlation with root positioning. The angle for the individuals using chewing sticks of Salvadora Persica was similar to the individuals not using the miswak. Collum angle is correlated in all classified position of root. But the root angulation is independent of classification varies between miswak and non-miswak users.

Keywords: *Collum angle, Cone beam computed tomography, Root angulation, Permanent maxillary central incisor.*

1. Introduction

Selvadora persica, is part of the family Salvadoracea. It is also known as a miswak and been used as a customary widely among the individuals of the subcontinent [1]. The beneficial effects of miswak for protection of oral environment are majorly linked to the mechanical movement and the pharmacological effect [2].

In spite of advancements in the field of dental implant-ology, functionally and esthetically correct positioning and angulation of the implant is considered as a challenge for the oral health care

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practitioners. It has been reported, incorrect positioning of dental implant can lead to occlusal/ incisal surface overload leading to its failure attributable to bone loss [3-6]. Thus, it is strongly recommended to place the dental implant in an appropriate angulation and position with respect to the bone and adjacent teeth [7]. Placement of an implant in an appropriate position facio-lingually has a chief influence on the facial profile. Additionally proper positioning is recommended in order to maintain gingival health and to conserve thickness of 1 mm of alveolar bone facially.

Placement of dental implant with increased facial or lingual angulation increases the risk of cortical plate dehiscence and in-turn gingival recession on facial implant placement; and lingual placement leading to bone resorption [8]. Thus, multiple factors should be taken into account before planning placement of the dental implant like, sagittally root positioning and wideness of the facial cortical placement [9,10]. Generally, for a successful immediate implant therapy it its suggested to maintain atleast facial cortical plate 0.1cm thickness [11]. But in the current era, studies have reported continuous bone resorption in the anterior segment post-extraction, leading to prominent bony defect resulting unpleasant esthetic appearance [12-15].

The 3D Cone Beam Computed Tomographic (CBCT) images play a vital role in appropriate positioning of dental implants. These images have a potential to identify the bone -volume, -density and planning for direction of implant placement based on its volume [16,17]. Planning to place dental implants without detailed investigations can lead to loss of sensation in the region of intervention and failure in the osteo-integration due to indecorous procedure while placing the dental implant [18-19].

In order to plan angulation of the dental implants, an angle referred as 'Collum angle' can be used to determine angulation between the facial plate of alveolar bone and the long axis of the crown (superius incisal edge to apex of the root) with respect to cement-enamel junction (CEJ) which is normally considered to be zero [20]. Collum angle has been reported to have a strong role in developing orthodontic straight wire appliances, but its relation with immediate implant placement has not been identified till date. Therefore, the main aim of the study was to evaluate role chewing miswak sticks on Collum angle of the permanent maxillary central incisors. Additionally, to identify the root-crown positioning and angulation for miswak user's vs non-miswak users in the Western Asian Saudi Arabian population for the permanent maxillary central incisors, which could act as a guideline for the clinicians for prosthesis placement.

2. Material and Method

On ethical approval from the Institutional Review Board of Riyadh Elm University, a cross-sectional study was conducted among the patients (after written consent) reporting to the Riyadh Elm University (FUGRP/2024/402). The data of the 380 participants prescribed CBCT scans for dental treatments were included in the study. The number of participants selected were in 2 groups, i) individuals not using miswak sticks (n=190); and ii) participant using miswak sticks for atleast 6 hr a day. The inclusion criterion for selection of the CBCT data was: i) healthy male/females aged between 18-45 years of age; ii) non-carious anterior teeth; and iii) length of alveolar bone height upto the cement-enamel junction. The exclusion criterion set for the selection of CBCT images includes: i) Fractured/ restored anterior tooth; ii) orthodontically treated teeth; and iii) patients with systemic diseases. Data of 465 CBCT images with maxillary central incisors clearly visible were included in the study and analysis was made based on: i) Collum angle classification and ii) angulation of root in relation to alveolar bone. The CBCT images were analyzed using 3D planner dental imaging software (Version 2018).

2.1. Analysis of Collum Angle and Root Positioning/ Angulation

The Collum angle for maxillary central incisors was measured on CBCT images using 3D planner dental imaging software. In order to measure the Collum angle the superius incisal edge point was connected with the middle point of facio-lingual cement-enamel junction (CEJ) depicting the axis of the crown. Later a line was drawn connecting the mid-point of CEJ with apex of the root depicting its longitudinal axis.

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The root positioning was classified based on Jung *et al.*, (2017) [21]. The classification is majorly based on the positioning of root apex. Furthermore, to measure the root angulation, the angle formed between the bisecting lines drawn crossing long axis of the tooth and alveolar bone was measured.

All the statistical analysis was performed using SPSS Version 21 (IBM, Chicago, USA). The mean root angulation and Collum angle was analyzed using one-way Anova with post-hoc Tuckey-Kramer test for pair-wise comparison.

3. Results

The total number of participants was 380 with majority of them females for both of the groups as displayed in Table 1. Based on Yun-Hoa Jung classification for root positioning of the permanent maxillary central incisors, majority of the Group I (non-miswak users) males (n=36) and females (n=37) buccaly/ labially placed roots followed by those with middle and palatally placed roots. It was similar to those miswak users (Group II). Majority of the miswak users had palatally placed roots (n=74) trailed by the roots placed in the middle and facial.

Table 1.
Demographic data of the participants and root positioning of maxillary central incisors.

Gender	**(n)**					
Male	**187**					
Females	**193**					
	Group I (n=190) Non- Salvadora Persica User			**Group II User of Salvadora Persica (n-190)**		
Yun-Hoa Jung classification for root positioning in alveolar bone	**Males**	**Females**	**Total (n)**	**Males**	**Females**	**Total (n)**
Facial type						
- Subtype I	36	37	73	4	1	5
- Subtype II	17	20	37	3	3	6
- Subtype III	3	4	7	23	19	42
Middle type	24	26	50	41	22	63
Palatal type	11	12	23	48	26	74

Later based on the Yun-Hoa classification, Collum angle and root angulation was measured for the permanent maxillary central incisors (Table 2). For both group I and group II, maximum Collum angle was observed in the Saudi population for the participants with facially (type I) place root, whereas least angle was observed for those with facial type III root positioning. On post-hoc one-way Anova statistically significant difference was observed for the participants with facially placed roots (type III).

Furthermore, on evaluating the root angulation based on Yun-Hoa Jung classification no statistically significant difference was observed between facial subtypes, middle and palatal types Table 2.

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Table 2.
Collum Angle and root angulation of maxillary central incisors in relation to Yun-Hua Jung classification.

	Group I ***Non- Salvadora Persica User***					**Group II** ***User of Salvadora Persica***				
Yun-Hoa Jung Classification for root positioning in alveolar bone	**(n)**	**Collum angle Mean ± SD**	**ρ value**	**Root angulation Mean ± SD**	**ρ value**	**(n)**	**Collum angle Mean ± SD**	**ρ value**	**Root angulation Mean ± SD**	**ρ value**
Facial type										
• Subtype I	73	6.8° ± 2.6		15.33° ± 2.5		5	6.7° ± 2.3		15.33° ± 2.5	
• Subtype II	37	6.1° ± 3.1		15.68° ± 2.9		6	6.5° ± 2.9		15.68° ± 2.9	
• Subtype III	7	2.9° ± 1.2	0.006*	16.19° ± 3.2	-	42	3.4° ± 3.1	0.002*	16.19° ± 3.2	-
Middle type	50	5.3° ± 2.1		15.30° ± 3.1		63	5.9° ± 2.5		15.30° ± 3.1	
Palatal type	23	6.4° ± 2.6		16.01° ± 2.3		74	6.4° ± 2.6		16.01° ± 2.3	

Source: *Statistically significant intra-group comparison for Collum Angle and Root angulation.

4. Discussion

The main objective of the study was to identify the root angulation of maxillary central incisor among the users' vs non-users of Salvadora Persica in relation to alveolar bone by identifying the degree of angle formed between crown and bony structure on the 3D CBCT images.

On evaluating the root angulation, majority of the maxillary central incisors in our study had root angulation with facial placement (62.63%) followed by those with middle (26.05%) and palatal (11.31%) root placement. Similarly, Xu and co-authors in a retrospective study on Chinese population using Sze Lok Lau, Kan and Chung classification identified highest number of maxillary central incisors with root angulation towards facial bone followed by middle and palatal placement [22]. The study by Kan and co-workers,[10] suggested higher percentage of root positioning for maxillary central incisors in the middle (13%) than by those in Chinese population (4.4%),[22] but it was in close co-relation to the percent of Western Asian Saudi population to those in current study.

Wang and co-researchers analyzed the facial wall dimensions in relation to root angulation/positioning of incisors, canines and pre-molars [23]. The angulation of the root for the maxillary incisors was observed to be less than 20° which is in correlation to our results for the maxillary central incisors, suggesting that the coverage by the palatal bone of alveolar process is greater in comparison to facial wall at the apex of the root [24].

Similarly, another group of researchers evaluated the thickness of alveolar bone and angulation of maxillary central incisors using 3D CBCT images [21]. They observed majority of the individuals with facial type placement similar to the results in our study. The crown angulation facial subtypes root a reported for facial subtypes ranged from 5.3°±3.0°- 11.5°±4.7° and middle type 1.7°±1.4°, whereas no teeth with palatal crown angulation were reported. In addition, the results for root angulation reported had strong association to those observed among the individuals of the Saudi Arabian population.

Tao and group of researchers evaluated the sagittal root positioning in relation to maxillary central incisors facial plate of alveolar bone and reported observations analogous to our study with majority of the teeth having facial placement, followed by those with middle and palatal positioning [25].

In a study by Lopez-Jarana and co-workers,[26] it is suggested to consider use of customized abutments to reduce the chances of implant failure due to angulation if implant retained crow. They observed a root angulation of 11.67°±6.37° for the maxillary central incisors showing reduced thickness of facial plate of alveolar bone having higher chances of implant failure.

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5. Conclusion

The current data suggest long-term use of miswaks chewing stick due to continuous force can lead to alter the root placement of anterior tooth. Furthermore, it can be interpreted from the observations that the Collum angle tends to have a direct impact on a successful immediate implant placement in all the individuals irrespective if they are user or non-user of Salvadora Persica. Most commonly facial subtype I angulation of maxillary central incisors was observed whereas the facial subtype III was observed to have a low Collum angulation. There was no correlation observed between the Collum and root angulations. The current data will help in precise and successful implant placement in the community of Western Asia particularly among the individuals with higher degree of Collum angles.

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