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Case Report Open Access

Planning Digital Indirect Bonding with Root Awareness

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Abstract

The awareness of the actual position, angulations and inclination of the roots of the teeth as early as the bonding stage, might be a promising upgrade for the finishing stage. The current manuscript describes the image fusion modality between the CBCT and digitally scanned model and the utilization of this procedure during the digital indirect bonding technique. Utilization of the current digital technology in orthodontic bracket placement should improve and simplify the bonding stage and accordingly facilitate and make more accurate the finishing of the orthodontic case. The awareness of the importance of correct root position in orthodontics arose from the study of the normal occlusion population [1] and the orthodontic post-treatment relapse phenomenon due to improper root positioning [2,3].

Case Report

Visualization of the roots of the teeth as early as the bonding stage is an advantage offered by the contemporary digital technology. CBCT is currently the modality whereby the exact root position can be located and accordingly precise bracket positioning parallel to the root long axis could be accomplished. However, one of the inadequacies of CBCT scan is the burning out of the enamel that results. Concomitantly, the current modality of scanning of the orthodontic model of the patient provides an enamel surface that is actual, more realistic and accurate enough for the digital indirect bonding technique. Consequently, fusion of the two aforementioned imaging modalities; CBCT and model scanning, will combine the advantages of both modalities, render accurate, and real enamel surface with proper root visualization.

The current article utilizes the above mentioned imaging modalities for digital indirect bonding. The technique starts by digital scanning of the upper and lower models of the patient using a lab scanner and dedicated software (Figure 1). Employing the teeth surface, registration of the twenty-micron precise digitized model is done on the CBCT of the patient using ortho-analyzer software (Figure 2). The long axis of each tooth is decided on the CBCT (Figure 3). The position of the brackets is located on each tooth with awareness of the root angulations (Figure 4). The brackets are digitally placed on the digital model (Figure 5). The central line of each bracket is adjusted parallel to the long axis of each tooth (Figure 6). Toggling between the model view and the CBCT view allows the operator to inspect and judge the bracket position with respect to the crown and the root long axes interchangeably (Figure 7).

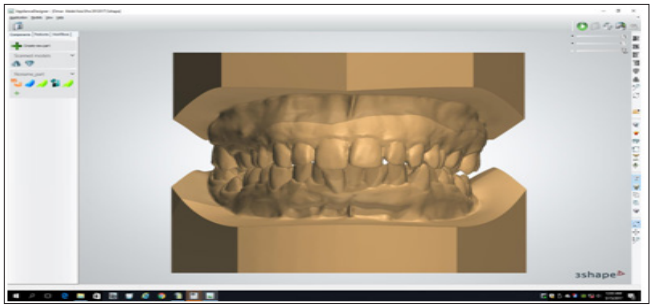


Figure 1: Digital scan of the upper and lower models.

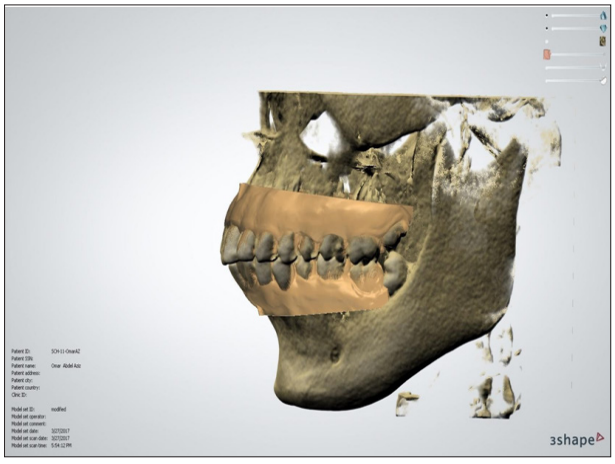


Figure 2: Registration of the digitized model on the CBCT of the patient.

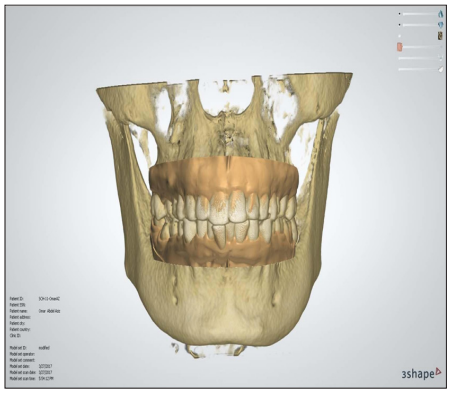


Figure 3: The long axis of each tooth is decided on the CBCT.

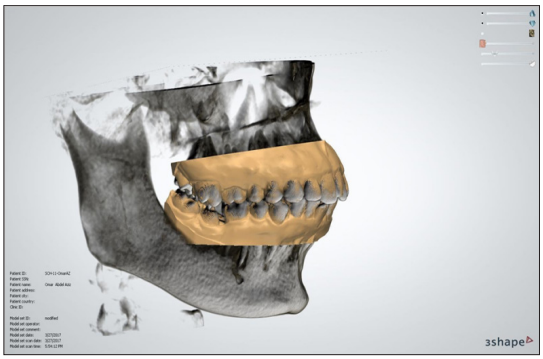


Figure 4: The position of the brackets located on each tooth with respect of the root angulation.

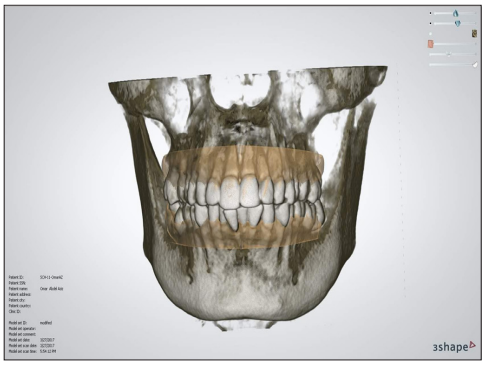


Figure 5: The brackets are digitally placed on the digital model.

Figure 6: The central line of each bracket is adjusted parallel to the long axis of each tooth.

The collision detection option in the software detects the external teeth surface of the scanned model of the teeth. This restricts the bucco-lingual position of the brackets to the external tooth surface and allows precise bracket positioning on the actual tooth surface scanning rather than the tooth surfaces on CBCT done in previous attempts [4]. Visualizing the roots allows accurate bracket placement parallel to the root long axis (Figure 6). The occluso-gingival height of each bracket is individualized according to the clinician's preference (Figure 6). Fine tuning of the mesio-distal tip of the bracket to conform to the long axis of the roots apparent on the CBCT (Figures 7-25) should translate into a more accurate root parallelism at the end of treatment.

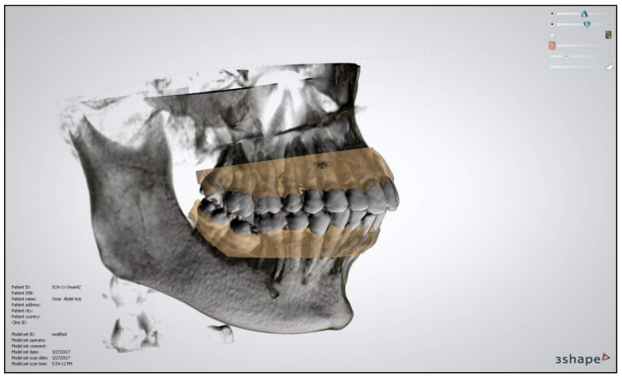
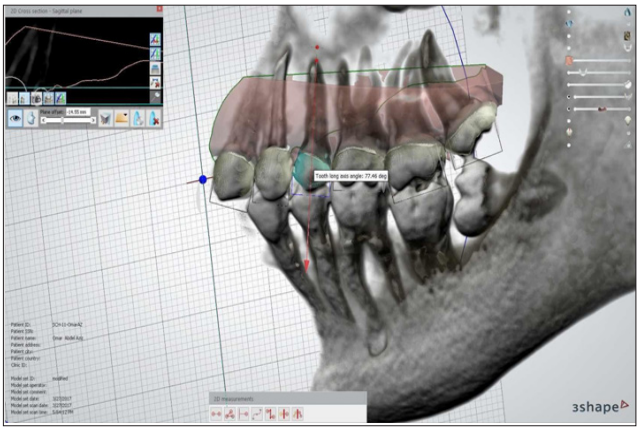


Figure 7: Fine adjustments of the mesio-distal tip of the bracket.



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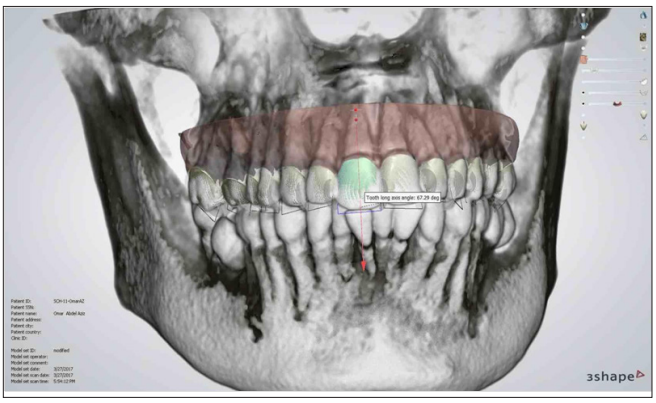

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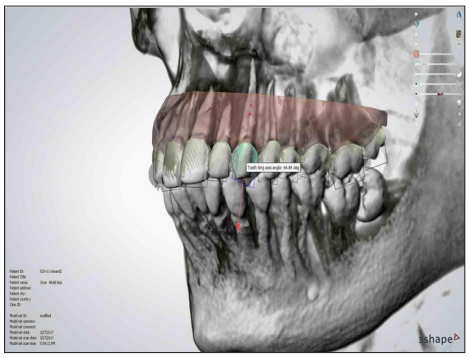

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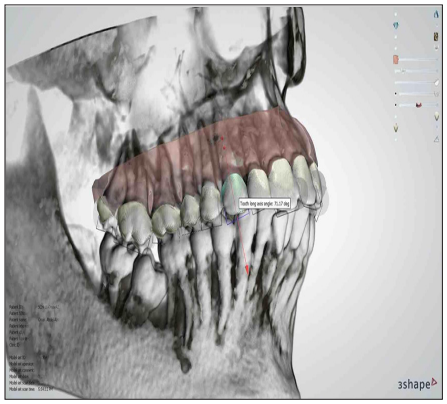

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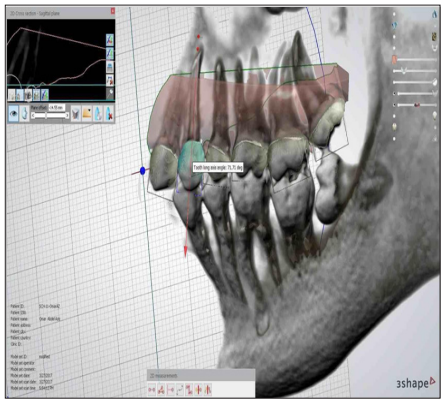

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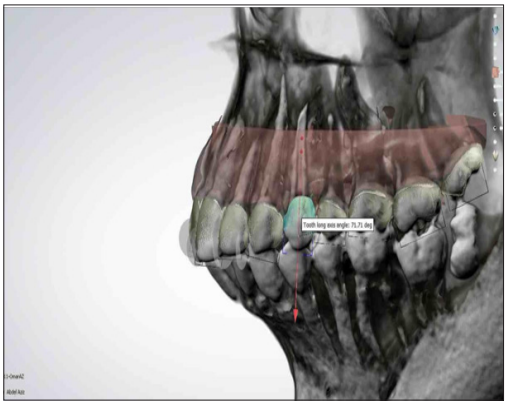

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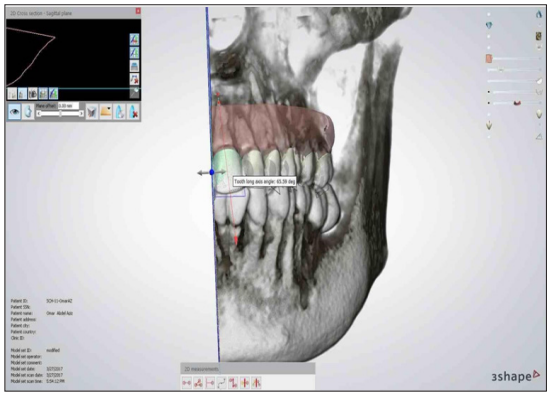

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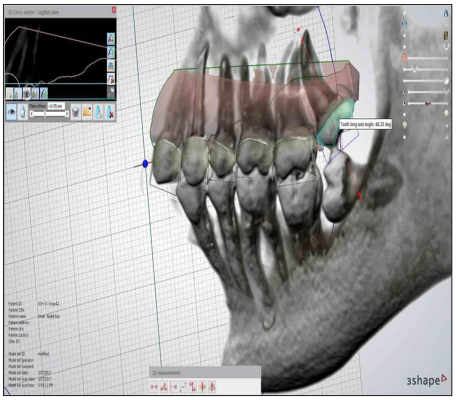

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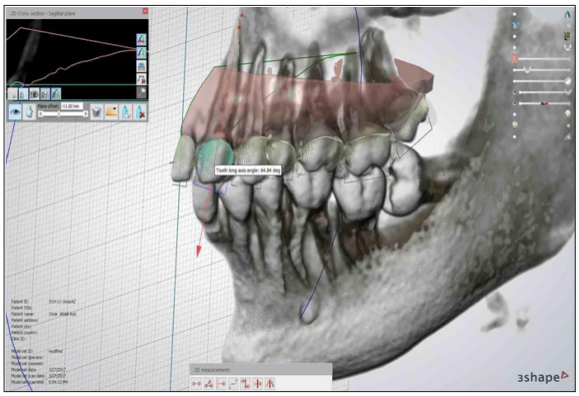

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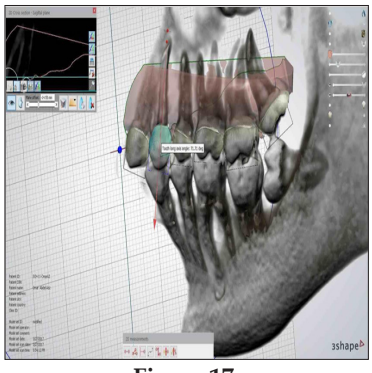

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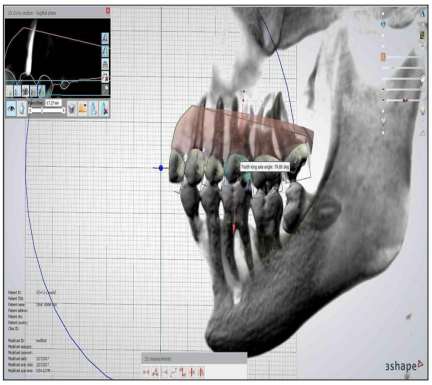

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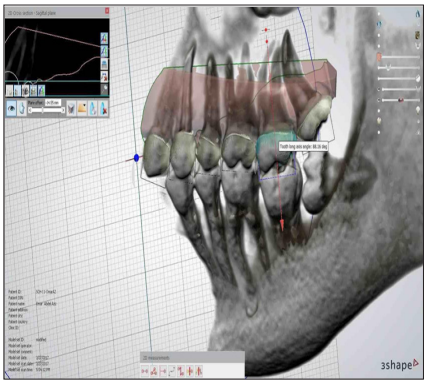

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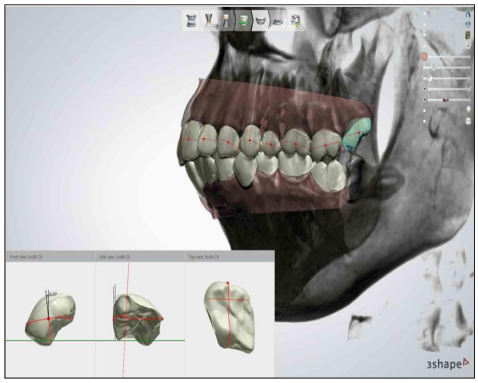

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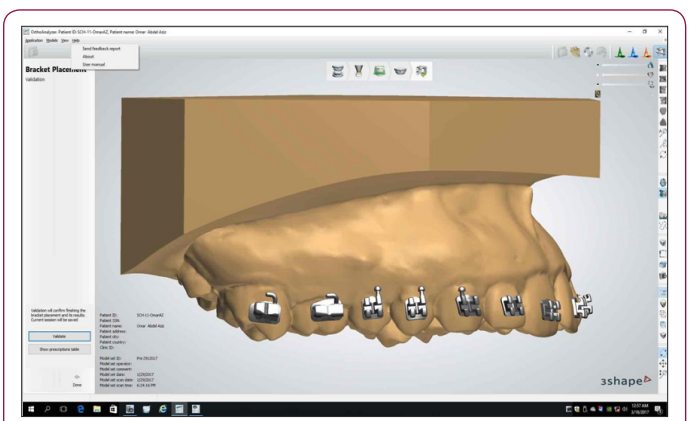

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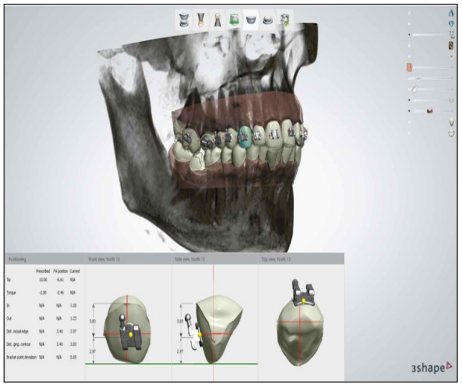

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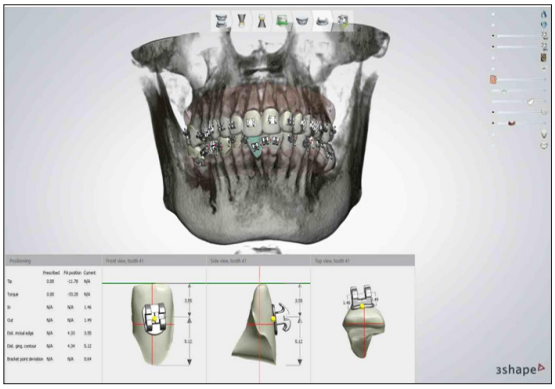

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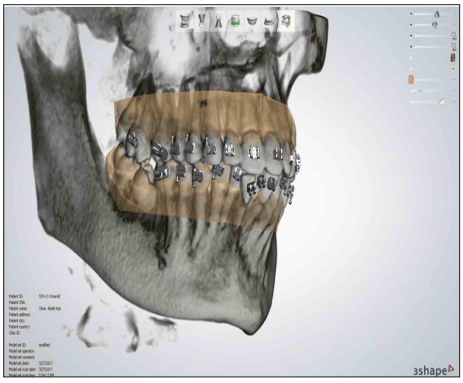

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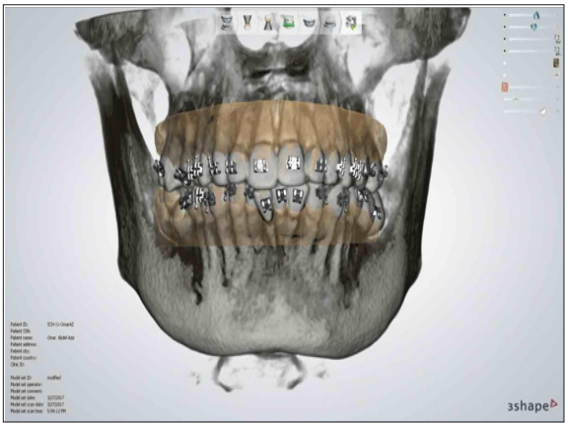

Figure 25.

The current attempt is a modification of a reported attempt for digital indirect bonding of brackets cogitating the root long axis [4]. That technique used the CBCT scan of the patient solely for indirect bonding. Accomplishing indirect bonding on CBCT volumes with inaccurate tooth surfaces due to burned out enamel directly affects the precision of brackets placement particularly in the labio-lingual direction. Besides, the use of scanned orthodontic brackets produced an inaccurate outcome due to the limited voxel resolution of the CBCT scanner which would affect the fitting of the bracket into the indirect bonding tray [5,6]. In conclusion, in the current attempt, integration of the model scanning, CBCT, and computer-aided design (CAD) brackets should render more accurate digital indirect bonding with consideration of the root axis, and accurate fitting of the bracket into the designed transfer tray, which is supposed to simplify the phasing out and finishing of the orthodontic case.

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