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Clinical Study

Computer-Aided Designing and Manufacturing of Lingual Fixed Orthodontic Appliance Using 2D/3D Registration Software and Rapid Prototyping

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The availability of 3D dental model scanning technology, combined with the ability to register CBCT data with digital models, has enabled the fabrication of orthognathic surgical CAD/CAM designed splints, customized brackets, and indirect bonding systems. In this study, custom lingual orthodontic appliances were virtually designed by merging 3D model images with lateral and posterior-anterior cephalograms. By exporting design information to 3D CAD software, we have produced a stereolithographic prototype and converted it into a cobalt-chrome alloy appliance as a way of combining traditional prosthetic investment and cast techniques. While the bonding procedure of the appliance could be reinforced, CAD technology simplified the fabrication process by eliminating the soldering phase. This report describes CAD/CAM fabrication of the complex anteroposterior lingual bonded retraction appliance for intrusive retraction of the maxillary anterior dentition. Furthermore, the CAD/CAM method eliminates the extra step of determining the lever arm on the lateral cephalograms and subsequent design modifications on the study model.

1. Introduction

Advances in digital imaging systems, computer-aided design, and computer-aided manufacturing (CAD/CAM) technology are providing new possibilities in orthodontics. The application of CAD/CAM for establishing a virtual setup and fabricating transfer tray/jigs [1–3] has greatly improved the indirect bonding process. CAD/CAM has also enabled 3D virtual diagnosis, treatment planning, wafer fabrication, and customized bracket design [4–7]. Its use in orthognathic surgery has shown multiple advantages including reducing laboratory time for making surgical splints and improving accuracy for repositioning of the maxilla and mandible. Although the lingual orthodontic appliance provides distinctive esthetic advantages, its use has been limited due to increased chair time and more difficult mechanical control. Application of lingual orthodontic appliances is becoming easier with new technologies such as virtual positioning of the brackets and indirect bonding systems which utilize virtual setup models.

Accurate surface imaging is required to digitally manufacture orthodontic appliances. Even when CBCT scans are used for the diagnosis or design of an appliance, separate surface imaging of the dentition is required to compensate for poor surface rendering in the CBCT. Surface images of the dentition are typically obtained from a 3D optical scanner and