Custom Made Occlusal Plane Analyzer: Fabrication and Technique

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Abstract Planning and executing the rehabilitation of a decimated occlusion is probably one of the most intellectually and technically demanding tasks facing a dentist. Proper management of the occlusal plane is an essential consideration for full mouth rehabilitation cases. When restorations are added to an existing tooth arrangement characterized by rotated, tipped, or extruded teeth, excursive interferences may be incorporated, resulting in detrimental sequelae. The curve of Spee, which exists in the ideal natural dentition, allows harmony to exist between the anterior tooth and condylar guidance. An instrument called the “Occlusal plane analyzer” has been used to assist the Prosthodontist in development of an initial mandibular occlusal plane that is commensurate with the curve of Spee when posterior restorations are designed in diagnostic casts and later as an integral of definitive restorations as well as guidelines for the actual tooth preparations. Many manufacturers of semi adjustable articulators offer no such occlusal plane analyzers for use with their instruments. This article demonstrates the fabrication and use of a custom-made occlusal plane analyzer with a semi adjustable articulator to determine the correct curve of Spee for the occlusal plane.

Keywords Anterior Survey Point; Curve of Spee; Occlusal Plane Analyzer; Posterior Survey Point; Semi Adjustable Articulator

1. Introduction

An occlusal plane analyzer has long been used to assist the operator in the development of an initial mandibular occlusal plane in diagnostic casts and later as an integral part of both the contours of the definitive restorations and the guidelines for the actual tooth preparations [1, 2]. The historical premise of the occlusal plane analyzer is related to Monson’s spherical theory of occlusion [1]. In 1919, Monson formulated a 3-dimensional occlusal philosophy by combining the concepts of Bonwill’s 4-inch triangle and bilateral balanced occlusion, Von Spee’s compensating curve (anterior-posterior and buccal-lingual curvature), and the observances of Balkwill and Christensen on condylar movement [3]. This theory of occlusion is primarily based on anatomic averages and merely serves as a guideline or starting point for the determination of the occlusal plane [4, 5]. An occlusal plane analyzer allows the practitioner to use Monson’s spherical theory of occlusion for the initial development of the anteroposterior and buccolingual curvatures of the occlusal plane. The
Occlusal Plane analyzer is an expensive instrument and has now been adapted to only a few articulator systems, which limits its use universally [6, 7]. Therefore this article demonstrates the making and use of a custom-made occlusal plane analyzer designed for semi-adjustable articulator (Dentatus, ARH type), which can be used with any semi-adjustable articulator with slight modifications.

2. Fabrication Method

The materials used for fabrication of custom made occlusal plane analyzer were Semi adjustable articulator (Dentatus articulator type ARH, Sweden), base plate wax (DPI, Mumbai, India), metal sleeve with slots, clear acrylic sheet (2mm thick, 4 × 4 inch), clear self cure acrylic resin (DPI, Mumbai, India), A4 Gum stick paper, paper holding pins and compass.

This is the simplest method for fabrication of highly useful custom made occlusal plane analyzer for any type of semi adjustable articulator. (Here basically described for Dentatus articulator, type ARH, Sweden)

Two wax indices were adapted on the upper jaw member of the Dentatus semi adjustable articulator, each on either side of attachment screw for upper mounting plate (Figure 1). A metal sleeve was adapted over the wax indices, with the impression of orientation holes present on the sleeve (0.5 cm diameter) onto the wax. The anterior bigger slot (1cm diameter) present in the metal sleeve was passed through the support rod for upper jaw member (Figure 2).

Figure 1: Wax Indices Adapted on Upper Jaw Member of Articulator

Figure 2: Metal Sleeve Adapted Over Wax-Indices
The wax indices were carefully removed from the upper jaw member of the Dentatus semi adjustable articulator and duplicated to form clear self cure acrylic resin attachment blocks (Figure 3). The adaptation of the clear acrylic indices were checked on upper jaw member of the articulator and the metal sleeve. With the acrylic indices attached on the upper jaw member of the articulator and metal sleeve adapted over it, a clear acrylic sheet of 4 x 4 inch was adhered with an adhesive at the centre of the metal sleeve taking reference of support rod for upper jaw member to align the sheet along the long axis of support rod (Figure 4).

After a few minutes when adhesion was completed, the flag was removed from the articulator and a gum stick paper of 4 x 4 inch was pasted over the clear acrylic sheet. The gum stick paper can be easily removed from the acrylic sheet and a new paper can be pasted over it when in use for other patients, thus helping in maintain a record of the patient. The flag was further supported to the upper jaw member of the Dentatus semi adjustable articulator with help of acrylic indices and paper holding pins (Figure 5).
3. Clinical Report

The technique of using custom made occlusal plane analyzer has been explained through a case report. A 62-year-old man seeking restoration of missing teeth in the maxillary and mandibular quadrants reported to the Department of Prosthodontics, Institute of Dental sciences. On clinical examination, it was found that maxillary right and left central incisor, maxillary right first premolar were present, while the mandibular arch had all the teeth except right and left central and lateral incisor and right second premolar. Mandibular posterior teeth were supra erupted both on right and left quadrants (Figure 6 A & B). Diagnostic casts were mounted in a semi-adjustable articulator (Dentatus articulator, type ARH, Sweden). Visual examination confirmed that the occlusal plane on the right and left side was deranged. After complete examination it was found that the patient requires full mouth rehabilitation which comprises Removable planned partial denture for missing maxillary teeth and fixed partial denture for rehabilitating mandibular arch.

Figure 5: Custom Made Occlusal Plane Analyzer

Figure 6 A: Mounted Diagnostic Casts of Patient’s Right Side
B: Mounted Diagnostic Casts of Patient’s Left Side
The occlusal plane of mandibular right and left canine teeth were assessed clinically and found to be satisfactory. The maxillary cast was removed from the articulator, and the custom made flag was attached on top of the upper member of articulator. The anterior survey point (ASP) was chosen on the midpoint of the disto-incisal edge of the mandibular right canine, from which a long arc of 4-inch radius was drawn on the flag with a compass (Figure 7 A & B).

Since the position of the distal mandibular right and left molar was judged to be unacceptable, the posterior survey point (PSP) was located on the anterior border of condylar element on articulator [8], and a short arc was drawn from the posterior survey point on the flag to intersect the long arc of anterior survey point (Figure 8 A & B). The needle of the compass was placed on the point of intersection of both the arc and a 4 inch radius line was drawn on the buccal surfaces of right mandibular teeth (Figure 9). Similar procedures were repeated for left mandibular teeth. Thorough evaluation of the occlusal plane revealed that on the right side of the mandibular arch, the first molar and third molar had supra eruption of about 6mm and 5mm respectively, while both second premolar and second molar had supra eruption of 2.5mm. On the left of Mandibular arch nearly all the posterior teeth had supra eruption of about 2.5mm. When it was determined that restoration of most of the posterior teeth was necessary, the Pankey-Mann-Schuyler technique was used for full mouth rehabilitation.
Figure 8 A: Posterior Survey Point (PSP) was Located on Anterior Border of Condylar Element of Articulator  
B: Short Arc of 4-Inch Radius was drawn From PSP on Flag to Intersect Long Arc

Figure 9: Extrusion of Mandibular Right Posterior Teeth

4. Discussion

In 1963, Dr Lawson Broadrick developed an instrument to provide a guide to the most suitable position and orientation of the posterior occlusal scheme where the natural Curve of Spee has been deranged. This instrument is commercially marketed as the ‘Broadrick Occlusal Plane Analyser’, often referred to as the ‘Broadrick flag’. This instrument includes a laminated piece of cardboard that is attached to the superior aspect of the upper member of an adjustable articulator. Its purpose is to permit reconstruction of the Curve of Spee in harmony with anterior and condylar guidance [9].

Esthetics and function place a considerable demand on the design of the occlusal plane. Compromise can be achieved by altering the length of the radius of the curve. In patients with a retrognathic mandible, a standard 4-inch curve would result in a flat posterior curve, causing posterior protrusive interferences. Such “low” mandibular posteriors would also lead to extrusion of
the opposing maxillary teeth. If the maxillary posterior teeth were to be restored to this low occlusal plane, the crown-to-root ratio would be less than ideal. Hence, a 3.75 inch curve is more appropriate when a class II skeletal relationship exists. Conversely, a 4-inch curve would create a steep posterior curve in patients with a class III skeletal relationship, leading to further posterior interferences. A 5-inch radius would be more suitable in this situation [10].

The Broadrick Occlusal Plane Analyser is an expensive instrument and adapted to only a few articulator systems, such as the DenarAnamark Fossae (Teledyne Waterpik, Ft Collins, Colo.) and all models of Hanau articulators (Teledyne Waterpik) [5, 6]. Since no such apparatus was available with Dentatus semi adjustable articulator, a custom made occlusal plane analyser was fabricated, which served the following purposes in the treatment plan of the case: (a) Preliminary determination of an acceptable plane of occlusion on the study models as an aid in treatment planning. (b) Preliminary determination of the amount of reduction that will be required when each tooth is prepared. (c) In the laboratory wax-up and final metal ceramic restoration, determination of the height of each cusp tip, which helped in establishing the curve of Spee and the curve of Wilson. Thus creating an ideal occlusal plane for masticatory system.

5. Conclusion

The custom made occlusal plane analyzer is a valuable tool in Prosthodontic and restorative dentistry, in that it locates the center of the curve of Spee. Extensive restorations designed with this tool permit mandibular excursions free from posterior interferences. Proper planning is required, but the predictability of a successful result can be enhanced by the use of a diagnostic wax-up, the transfer of information with an acrylic template, and the duplication of provisional restorations from the wax up. With use of custom made occlusal plane analyzer, the Prosthodontist can predictably produce high-quality restorations in harmony with the anterior and condylar guidance and avoid the introduction of possibly harmful sequelae to the patient.

References


