



A Modified Technique for Functionally Generated Occlusal Onlays for Complete Dentures

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ABSTRACT

Introduction: Occlusal harmony is vital for successful complete dentures. This article focuses on making functionally generated occlusal onlays for complete dentures.

Materials and Methods: Occlusal surfaces of posterior mandibular denture teeth were eliminated and a functionally generated path onlay was made on the articulator using resins and wax. The onlays were milled, pressed, or cast and bonded in the denture to result in a bilaterally balanced denture.

Conclusion: This technique creates an esthetic, durable, balanced occlusal surface that improves denture stability, masticatory function, and patient satisfaction.

KEYWORDS: Complete dentures, geriatrics, occlusion, removable prosthodontics, balance

I. INTRODUCTION:

Complete denture occlusion is complex. Occlusal schemes for dentures include monoplane, neurocentric, lingualized, and cross tooth-cross arch, each with their own list of benefits and disadvantages.¹ Not all occlusal schemes result in a balanced occlusion, but when they are balanced there are reports of improved patient comfort, less trauma to the soft tissue, and better retention and masticatory efficiency.² When an edentulous patient presents with a severely resorbed alveolar ridge or there is difficulty in obtaining an accurate and repeatable centric relation record, monoplane occlusion is often selected due to ease of fabrication. However, 67% of patients prefer a lingualized occlusal scheme when compared to a monoplane occlusion due to improved chewing efficiency.³

Wear of acrylic denture teeth is common and can result in loss of the vertical dimension of occlusion, loss of masticatory efficiency, defective tooth relationships, and masticatory muscle fatigue.⁴ Loss of occlusal vertical dimension can result in alteration of esthetics such as narrowing of the vermilion borders and over closed commissures. Reduced chewing efficiency, pain in the temporomandibular joint, and decreased muscle tone can also be the result of lost OVD.⁵ According to Harrison, denture occlusal tooth wear has been noted in 62% of patients after five years of use and is one of the causes for denture replacement.⁶ As wear progresses, the patient may need to use more force to masticate due to the obliterated occlusal surfaces. This excessive occlusal force may result in accelerated resorption of the residual ridge, further contributing to poor masticatory function, esthetic compromise, and lower quality of life for the denture wearer.⁷ The technique described in this article focuses on using functionally generated occlusal onlays fabricated on an articulator to generate a fully balanced occlusion, with the added benefit of reducing the amount of occlusal wear to the mandibular denture using gold, lithium disilicate, and zirconia. All patients who received care provided informed consent for treatment.

II. MATERIALS AND METHODS:

Three separate patients sought treatment at a prosthodontics practice for new complete dentures. Each patient wore complete dentures that were at least 10 years old, exhibiting moderate to severe wear of the acrylic denture teeth. The patients exhibited loss of occlusal vertical



dimension, loss of masticatory function, and loss of retention and stability of the denture. New complete dentures were fabricated for each patient after bolding molding, final, impressions, and wax try ins of the set denture teeth. Once the complete dentures were fabricated the following steps were completed to produce a functionally generated path onlay for the mandibular denture.

1. Reduce the occlusal surfaces of the mandibular posterior denture teeth and place a retention groove centered on the occlusal surface (Fig. 1).
2. Articulate the dentures in centric relation. Apply petroleum jelly to the prepared surfaces and opposing surfaces of the maxillary teeth. Apply GC America resin to the mandibular teeth and close the articulator so the maxillary teeth contact the resin. Open and close the articulator repeatedly to prevent the resin from sticking to the maxillary teeth. An impression of the maxillary occlusion will be made in the resin (Fig. 2).
3. After the resin has completely polymerized, reduce the resin to leave a fin that corresponds to the central groove and marginal ridges of the opposing teeth. This is the sulci ridge (Fig. 3).
4. Move the articulator through excursive and protrusive movements. Adjust the sulci ridges so that they maintain contact with all the opposing teeth through these movements. Adjustments to the maxillary denture teeth may need to be made to achieve smooth, simultaneous contact. Warm baseplate wax is applied to the resin on both sides of the sulci ridge and the articulator is used to mold the resin through excursive and protrusive movements. Wax can be added to non-functional areas and refined to improve the morphology. Marginate and polish (Fig. 4).
5. Once the functionally generated path is complete, invest the functionally generated path (FGP) pattern and then press with lithium disilicate or cast in metal (Figs. 5 and 6). The FGP pattern can also be scanned and milled in zirconia or lithium disilicate (Fig. 7).
6. Prepare the denture and bond the lithium disilicate, metal, or zirconia onlays into the prepared occlusal surfaces (Fig. 8). Perform a laboratory remount to ensure dentures are bilaterally balanced.
7. Deliver the complete dentures and check MIP, laterotrusive, and protrusive movements to confirm balance. If necessary, perform a clinical remount. (Figs. 9 and 10).

III. DISCUSSION:

The functionally generated pathway (FGP) is defined by the Glossary of Prosthodontic Terms as a registration of the paths of movement of the occlusal surfaces of teeth or occlusion rims of one dental arch in plastic, wax, or other medium attached to the teeth or occlusal rims of the opposing arch.⁸ The functional generated path is also called the chew-in record or functional chew-in record.⁸ The FGP technique can be used for complete oral rehabilitation, single unit restorations, tooth-supported and implant-supported prostheses, complete dentures, and digitally designed prostheses.⁹ Advantages of making a FGP include: fabricating accurate occlusal contours, it's a relatively simple procedure, can lead to minimal clinical time for delivery of the prosthesis due to less chairside adjustments, and it can capture the full dimensions of border movements.^{9,10} Disadvantages of a functionally generated path include: less than ideal esthetics of the anatomy of the occluding surface, clinician must have proper knowledge of occlusion and mandibular movements, might not be suitable for shorter clinical crowns, might not be a technique to use in patients with occlusal disharmony and/or TMJ dysfunction, and laboratory must be knowledgeable in the technique to achieve a great outcome.^{9,11}

Stansbury described the technique in 1951 using the functional chew in method for a maxillary complete denture opposing the natural dentition.¹² Meyer et al. in 1959 stated that the FGP technique could facilitate fabrication of a bilateral balanced occlusion by registering the occlusal pathways and capturing the dynamic movement of the opposing teeth.¹³ More recently in an article by Pravinkumar in 2009 the authors placed amalgam into mandibular denture teeth and had the patient perform eccentric movements to carve FGP into the setting amalgam.¹⁴ In 2012, Upadhyay et al. published an article in which they modified Stansbury's original method of the chew-in technique to make a FGP for a repaired maxillary complete denture.¹⁵ The authors completed the chew-in record intraorally and then used that to set denture teeth on the maxillary denture adjusting the denture teeth to fit the FGP.¹⁵ Agarwal and co-authors in 2019 used the chew-in technique to fabricate a FGP for a single maxillary complete dentition opposing natural dentition.¹⁶

Complete dentures can have significant wear of resin denture teeth. Wear of denture teeth is associated with the age of the denture and opposing dentition.¹⁷ Different techniques have been used to reduce wear of denture teeth to include placing



amalgam, gold, or base metal on the occlusal surfaces of the denture teeth.^{18,19} Due to the poor esthetics of the aforementioned materials, other materials such as zirconia have been looked at to provide a more esthetic solution to decrease wear of denture teeth.^{20,21} Highly polished zirconia has been shown to be less abrasive than other ceramics and similar to the wear of natural enamel.²² According to Jin et al. in 2019, gold alloys cause the least amount of wear opposing resin teeth, while feldspathic porcelain caused the most wear of resin teeth. The authors concluded that when esthetics was a concern zirconia should be the material of choice when opposing resin teeth.²³ In 2023 an article written by Alfaifi et al. was published in which the authors were able to use digital dentistry to fabricate a new maxillary denture with zirconia onlays (replacing an existing denture with gold onlays) on the posterior teeth to increase esthetics and decrease wear of the antagonist dentition.²⁴ However, no functionally generated path was used in the Alfaifi article, the occlusal scheme of the old complete denture was copied.

The functionally generated path has been used for many years to obtain the ideal occlusion for single restorations, fixed dental prostheses, and complete dentures. Many authors have modified the technique to achieve the same goal a functionally generated path that has ideal eccentric and centric occlusion. The technique described in this article modifies the FGP further and uses the articulator to fabricate the prostheses without the chew-in technique. By obtaining lateral and protrusive records to program a semi-adjustable articulator the clinician or lab technician can fabricate a FGP that can either be cast in gold, pressed in lithium disilicate, or scanned and milled in zirconia or lithium disilicate. The functionally generated path is made and then cemented onto a new denture and bilateral balance is obtained in the laboratory. The FGP onlay is fabricated using a material more resistant to wear than resin denture teeth. The complete denture is then delivered with minimal to no adjustments to the occlusion with a bilaterally balanced occlusal scheme.

IV. CONCLUSION:

The use of a functionally generated path technique to form the occlusal surfaces of complete dentures is a novel method to achieve bilaterally balanced occlusion. The FGP process has been modified over the years to increase efficiency and reliability of the technique. This article further modifies the technique to produce the FGP on a semi-adjustable articulator. By using this technique,

the occlusal onlays can be made out of a more wear resistant material such as gold or zirconia. This technique allows for a durable, balanced occlusal surface that has the benefits of denture stability, desired esthetics, and good patient satisfaction. Providing a balanced denture with functionally generated paths could help to reduce wear of denture teeth and preserve the tissue that remains.

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FIGURES

Figure 1. Retention groove down center of denture teeth.



Figure 2: Pattern resin on denture teeth after opening and closing.



Figure 5: FGP pattern is invested to press Emax lithium disilicate.



Figure 3: Resin reduced leaving the sulci ridge.



Figure 6: Finished FGP gold onlays.



Figure 4: Warm baseplate wax and apply to the pattern resin on either side of the sulci ridge and move the articulator through excursive and protrusive movements.



Figure 7: Milled and sintered zirconia onlays.



Figure 8: Final gold onlay denture.



Figure 9: Final Emax press onlay denture.



Figure 10: Final zirconia onlay denture.

