



FUNCTIONALLY GENERATED PATH TECHNIQUE- A PROSTHODONTIC REVIEW

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ABSTRACT:

Functionally generated path technique utilizes a different approach to achieve occlusal harmony between restoration and the other teeth in the oral cavity. Rather than using an articulator to simulate the movement of the mandible, this technique uses a tracing made directly in the mouth to capture the pathways travelled by the opposing cusps during mandibular function. This article discusses about functionally generated path technique in detail.

Keywords – Functionally generated path technique, modified recording base, PFM restoration, occlusal harmony...

INTRODUCTION:

Harmonious occlusion is a critical requirement for successful oral rehabilitation. Conventional techniques of construction have been unsuccessful in producing a prosthesis that can be inserted without intra-oral occlusal adjustment.

Functionally generated path technique utilizes a different approach to achieve occlusal harmony between restoration and other teeth in the mouth. Rather than employing an articulator to simulate the movement of the mandible, this technique uses a tracing made in the mouth to capture the pathways travelled by the opposing cusps during mandibular function. This method was first described by MEYER, who first described the technique, said that "no adjustment of the occlusion in the mouth should be necessary if the technique is carried out correctly. He said FGP is "three dimensional static expression of dynamic tooth movement". The technique was adapted for use in complete occlusal rehabilitation by Mann and Pankey Frederick

Frederick Meyer (1959) in his article stated that the principles and procedures

involved in FGP technique are in harmony with anatomic, physiologic and neurologic factors involved in occlusion. He concluded that-

Occlusal paths and cuspal paths generated in the mouth provide records which are in complete harmony with condylar paths and neuromuscular system, when compared to mechanical articulators.

Frederick Meyer (1959) in his concluding article on generated path technique cited that the generated path technique serves equally well for fixed partial dentures as for complete dentures.

NM Kafandaris (1981) described a technique to simplify those of Pankey and Mann

and Dawson for constructing a stable recording base capable of capturing all possible movements of the mandible during function. He utilized the metal framework of the fixed partial denture as the recording base. The occlusal table of the framework was extended using autopolymerizing acrylic resin to form a functionally generated path recording table.

Ihab A. Hamed and Hassan Nourall(1996) devised a technique to record a

Functionally generated path directly on the pattern to be invested and casted. Using a Vacu-press machine, a plastic coping of clear acetate sheet was made directly on the die of the prepared tooth. Functional wax was added to the occlusal surface and the patient asked to perform movements with the opposing arches in contact to create a functionally generated path on the wax pattern. The pattern is then placed on the die and axial contours and anatomy adjusted without hampering the occlusal surface.

John W. Guinn III and Loren C. Christensen (1998) devised a method to stabilize the record base, They embedded a long shank No. 556 straight handpiece bur in both recording tables with the shank of the bur crossing the midline perpendicularly. This helped in a bilateral stabilization of the recording tables in the mouth while the registration was carried out.

When understood and appreciated, use of the FGP technique is a straightforward and practical method to achieve harmonious occlusal anatomy of restorations with the anterior determinant/anterior guidance, the posterior determinant/condylar guidance, existing occlusal and cuspal anatomy, and the neuromuscular system. This record is then used to fabricate the posterior tooth restorations. The FGP technique has been used in the fabrication of complete dentures, oral rehabilitation cases, tooth supported fixed dental prostheses, implant-supported FDPs, single-unit indirect restorations and computer-aided design/computer-aided manufacturing (CAD/CAM) restorations.

FUNCTIONALLY GENERATED PATH TECHNIQUE

After the preparation of the abutment teeth, care must be taken to ensure occlusal harmony. The anterior teeth should provide a stable, functional and esthetically acceptable anterior guidance and the mandibular posterior teeth should be adequately aligned with an acceptable occlusal plane. The patient presented with no signs or symptoms of temporomandibular disorder.

Armamentarium for functional tracing

Petrolatum, 2. Cotton-tipped applicator, 3. Cavity varnish, 4. Tacky wax, 5. PKT waxing instruments 6. Bunsen burner, 7. Die fabricant 8. Mountingstone 9. Spatula. 10. Plaster bowl, 11. Sable brush, 12. Functional index try 13. Laboratory knife with no 25 blade, 14. Custom impression tray, 15. Impression material (base and accelerator), 16. Mixing pad 17. Syringe, 18. Bite registration frame, 19. Bite registration paste, 20. Die stone, 21. Di-lok tray, 22. Twin stage occluder /verticulator.

PROCEDURE FOR FUNCTIONALLY GENERATED PATH TECHNIQUE,

1. The occlusal reduction for the preparation is completed.
2. Before any proximal reduction is done, the tooth is stabilized with softened stick compound and the same compound is formed into a broader occlusal table to receive the functional wax.
3. Using a flame, the functional wax is softened (**Bosworth's Synthetic Tacky Wax**) and stuck to the prepared occlusal table. The occlusal portion is lubricated with saliva.
4. The patient should close into centric relation and move through all possible excursions. The wax should be checked to make sure it is firmly anchored to the base and that the base itself is absolutely stable. Any excess functional wax should be removed, and the patient should close and move his jaw in all directions with the teeth together. The wax is chilled with ice water.
5. A creamy mix of Fast Setting Gray Rock or Whipmix Bite Stone is made and vibrated into the FGP indentations. The stone is extended onto at least one tooth on each side of the prepared tooth. There should be sufficient thickness to the stone so that it can be removed without leakage after it hardens. The adjacent teeth are covered only enough to form a good matrix. A wooden tongue blade works well to carry additional stone to the teeth and makes removal easy.
6. The hardened stone is removed and set aside, the preparation is completed. An impression of the prepared tooth is made, including all teeth that will be covered with the stone functional core. An opposing model is not necessary.

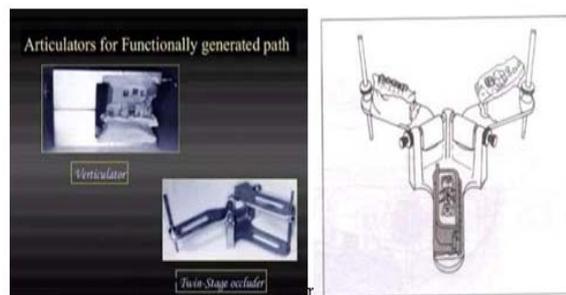
Laboratory procedure

1. The impression with removable dies for the prepared tooth and each adjacent tooth is poured.
2. The functional core is positioned against the die model. The unprepared teeth on the die model should fit perfectly into the stone index.
3. Any instrument that can repeatedly reposition the functional model against the die model with accuracy is acceptable for mounting the two models. They can be mounted in the joined position on a simple hinge articulator because the only requirement of the instrument is to permit the models to be separated and then returned to the same closed position. The arc of opening and closing has no importance, and of course no lateral movement is permitted. All pathways are represented on the functional model itself when it is closed. Instruments that have been especially designed for relating the functional model to the die model include the following.

a. The verticulator is a device that permits only an up or down movement. It is precision made with a sturdy metal stop that permits the functional model to be struck forcefully against the die model without danger of model breakage. This facilitates very accurate marking of interferences on the restorations with silk marking ribbon. The verticulator is spring loaded so that with each closure it springs open to give access to the die or pattern.

b. The twin stage occluder is a simple hinge articulator that will articulate both a functional core and an anatomic model interchangeably against the same die model.

1. When using FGP for a single tooth, one generally waxes the pattern directly against the functional core. The pattern should contact the functional model but should not interfere with its closure. If the restoration is to be in group function, the lingual inclines of the upper buccal cusps should be in continuous contact with the functional model. If the inclines are to be discluded, they must be reduced so that there is no contact, but centric relation contacts must not be lost. In all cases, the balancing inclines should be relieved from any contact with the functional core. White liquid shoe polish applied to the functional core is a good marking medium for locating interferences on the wax pattern. Thin marking ribbon may be used when the casting is in place. If group function of the restored working inclines is desired, the contact of the waxed incline against the functional core can be checked with the white shoe polish. The entire incline surface would be marked by the white polish when the models are closed. Anatomy is incorporated into the pattern by carving in grooves and sluiceways and making certain that blades remain but do not interfere. Working excursion contact is maintained by preserving enough of the white coated incline to ensure good group function.



Use of acrylic and other hard materials for fabricating the base.

Any material that can maintain accuracy through all the procedures is acceptable as a base. It must be stable and retentive. Furthermore, the base must fit the master die model as accurately as it fits the mouth, and it should not damage the dies when it is seated on and taken off the master model. I have not found acrylic bases to be consistently acceptable because of the distortion of the acrylic resin during or after setting and the damaging effect of the acrylic resin on the dies. Nevertheless, we have the flexibility to use any material or devise any technique for making the base as long as it fulfills the requirements of accuracy.

TECHNIQUE FOR CAST PARTIAL DENTURE.

Before recording the Functionally Generated Path, it was confirmed that the metal framework along with the denture base was firm, stable, and retentive intraorally. Occlusion rim was created on the base plate using hard inlay wax and visible gap was left between opposing teeth and the rim initially a. Softened inlay wax was added to the rim, and the framework was placed intraorally. Patient was asked to close in centric occlusion to indent the soft wax, instructed to glide the mandible through all possible excursive movements to ensure capturing all border movements. It was observed that the inlay wax was smoothly carved and shaped by the stylus action of the opposing maxillary cusps. Mounting of the casts.

The Functionally Generated Path record obtained was used to fabricate the stone occluding template. To accomplish this, the record was resealed and secured onto the master cast and boxing was done with the modeling clay and the modeling wax. Only wax registration and areas for vertical stops were left exposed, and it was filled with the dental stone to form occluding template. Recording the FGP eliminates the need to reproduce mandibular movements on the articulator, and hence the mounting was done on a simple three-point (mean value) articulator. Waxing and carving were done after teeth arrangement and try-in was carried out in a conventional manner.

FGP FOR QUADRANT DENTISTRY

The real value of functional path procedures is more practically realized when it is used bilaterally because of the stabilizing effect on the teeth and the FGP base when it is attached to both sides of the arch.

In a unilateral quadrant, it is often necessary to make a cast base in order to get enough stabilization. All other procedures for completing the FGP are the same as already outlined. When preparing a single quadrant, special care should be taken to make sure the opposite side is perfectly equilibrated so that there are no deviating interferences to influence the functional paths. After preparation of one side, it is good to recheck the occlusion on the other side and to verify the correctness of the anterior guidance before proceeding with the FGP.

FGP FOR LOWER TEETH

Functional path procedures are not generally used on lower teeth. If either the working or balancing inclines of the opposing upper teeth are too steep, the important lower buccal cusp will be wiped away in the functional wax. The restoration made from such an FGP would not contact in centric relation. For FGP to work on the lower teeth, the upper inclines would have to be perfected first. This can be done by equilibration before the lower tooth is prepared. It is a more logical approach to shape the upper tooth grossly in to alignment with its adjacent teeth when such shaping is needed and then to restore the lower tooth into good centric relation contact. FGP can be used on lower teeth, but only if the upper occlusal contours have been perfected first.

FGP FOR CROSS BITES

Posterior cross bites can be restored by use of FGP if lower cusp tip placement and cusp fossae contours have been perfected in advance. It is a practical approach when used on the upper teeth, particularly on bilateral restorations. If lower fossae contours are opened out as explained there will be no danger of losing the upper buccal cusps. The lower lingual cusp will serve as the functioning cusp and it will create lingual incline; for the upper buccal cusp that are just as functional as if they were made by the lower buccal cusps. We have the option of keeping them, in group function or discluding them. In all cases, the balancing inclines must be addition ally reduced when FGP is used.

DOUBLE CASTING METHOD:

Functionally generated path technique with double casting to fabricate fixed partial denture. Before generating the occlusal morphology we ensured that the base casting had adequate occlusal clearance and proper fit on the prepared teeth. The occlusal morphology was generated using pattern resin (GC Corporation, Tokyo, Japan) following the technique described by Dawson. Pattern resin was mixed applied on the occlusal surface of the metal coping with retentive beads.

The patient was instructed to close the mouth in Maximum inter cupal Position and then perform right lateral, left lateral, and protrusive movements in succession, ending in the MIP. The excess pattern resin was trimmed off using an acrylic trimmer. The occlusal surface was examined for any exposure of the metal and if this was present the metal in the area was trimmed, pattern resin was added in that area, and the movements were performed once again.

Once the occlusal morphology was perfected, the MIP contacts were marked using 50-im blue articulating papers. Zinc oxide powder was sprinkled and brushed onto the occlusal surface to form a thin, uniform coat, and the patient was instructed to perform the eccentric movements as before. All eccentric contacts became visible with the wiping away of the zinc oxide powder. Care was taken not to grind the MIP contacts that were registered in blue. The wiped out areas were trimmed using an acrylic trimmer to eliminate all eccentric interferences and the FGP patterns were completed. The pattern, along with the base casting, was invested and double casted.

The present technique has certain advantages over the conventional functional path technique; these are as follows:

1. A cast fixed partial denture with retentive beads was used as a stable base in the present case report. Hence a functional path tray was not required and the problems associated with the tray, including inaccurate seating and distortions, were avoided.
2. To overcome the drawbacks of using inlay wax for generating FGP, pattern resin was used in the present case; this has better dimensional stability compared to the waxes.
3. The occlusal morphology was developed and corrected directly in the patient's mouth. The discrepancies which can result due to differences between the teeth in the mouth and that in the master dies could thus be avoided.
4. A functional core used routinely for the conventional FGP technique was not utilized in the present technique. Hence, the discrepancies which may result from the functional core becoming slightly degraded during waxing and metal adjustment were avoided.



ADVANTAGES OF FGP:

Fgp is a precise method of fabricating accurate occlusal contours.

Simple and inexpensive instrumentation.

It demands minimum chair time, especially during try-in and cementation phase.

The technique has a distinct advantage that it is able to record all dimensions of such border movements at the correct vertical dimension as they are directly influenced by both condylar and incisal guidance.

DISADVANTAGES OF FGP:

However in clinical practice, this goal is seldom achieved due to one or more following problems –

1. Improper selection of the type of recording base or the careless recording of border movements on the functional wax table.

2. Movement at the interface between the recording medium and the abutment teeth where the base does not provide adequate stabilization.
3. The optimistic expectation that the recording wax will capture in a few minutes all the variety of the functional movements, voluntary and involuntary, that the mandible can perform under the influence of varying degrees of muscle activity with its corresponding vertical displacement of the condyles.
4. This technique cannot be used in cases with short clinical crowns and unfavorable occlusal morphology of the opposing teeth. (attrited teeth)
5. In patients having disharmony in occlusion (malocclusions like deep bite and crossbite) and temporomandibular joint dysfunction, the FGP technique is destined to fail.

DISCUSSION:

Even for carefully fabricated fixed partial dentures, a comparatively long time is needed for clinical adjustment. Experience has shown that occlusal adjustment is a tedious job and in the attempt to correct the interferences most of the occlusal morphology may be lost. If functionally generated path technique properly followed, the time taken for occlusal adjustment was very less. This is due to the occlusal morphology being generated directly in the patient's mouth.

The FGP is a static representation of the opposing cusps' dynamic movement from a centric position to eccentric positions to achieve optimal articulation and occlusal harmony. When understood and appreciated, use of FGP technique is straight forward and practical method to achieve harmonious occlusal anatomy of restorations with the anterior determinant (anterior guidance), posterior determinant (condylar guidance), existing occlusal and cuspal anatomy, and the neuro-muscular system.

Dawson describes the FGP technique as an extremely sophisticated and practical method of capturing the precise border pathways that the lower posterior teeth follow. The technique has a distinct advantage in that it is able to record all dimensions of such border movements at the correct vertical as they are directly influenced by both condylar guidance and incisal guidance.

The procedure can provide accuracy with fairly simple instrumentation and can be used in combination with almost any laboratory method for waxing posterior restorations. It can be used either in the actual fabrication of the restorations or as a three-dimensional check-bite technique.

CONCLUSION:

When simplified instrumentation is used (straight line or semi-adjustable articulators), excessive adjustment is often necessary at time of delivery. Fully adjustable articulators can be used, but these are time consuming and errors can be incorporated if they are not used regularly. FGP is a simple concept capable of producing very accurate results, but demands care and meticulous attention to detail. This technique reduces adjustment time during delivery of the final restoration. Recently FGP has also been used for the fabrication of implant retained fixed partial dentures. The FGP technique is simple and can produce excellent results.

Because of its simplicity it is sometimes derided by those dentists who do not use it. Simplicity should not be confused with inaccuracy; the technique is capable of producing very accurate results, but it demands great care and meticulous attention to detail. Because of its simplicity it is often overlooked by clinicians and not used more often.

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