

**Decreased mean chair side time and occlusal interferences post-insertion of removable or fixed prosthesis fabricated using functionally generated path technique - A Scoping review**

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**Type of Publication:** Review Article

**Conflicts of Interest:** Nil

**Abstract**

**Background:** In the year 1959, Meyer had given the functional generated path (FGP) concept which includes “recording of occlusal path of the teeth during functional movement directly in the patient’s mouth”. Correctly employed technique of recording functionally generated path requires only minimal corrections of any occlusal interferences during insertion of denture and for fixed prosthesis. This contributes as a major advantage over the insertion of prosthesis fabricated using conventional technique.

**Objectives:** This review was undertaken to assess the available literature and evidences to analyse if the functionally generated path technique produces decreased mean chair side time and occlusal interferences after insertion of fixed or removable prosthesis fabricated utilising functionally generated path technique.

**Sources of Evidence:** The articles were selected from electronic databases namely PUBMED, SCOPUS and Google scholar.

**Charting Methods:** After searching from databases, hand searching of any further required studies was done. Prospective studies, retrospective studies, Clinical trials, case series, case reports were included. Letters to editors and studies which were not fulfilling the context of study were excluded. The Search was not limited for publication year, so all the available scientific evidences until June 2021 were included.

**Results:** The electronic search yielded a total of 95 articles of which only 7 articles were included.

**Conclusion:** This review concludes that the functionally generated path technique effectively minimizes the occlusal interferences and reduces mean chair side time.

**Keywords:** Chew-in technique, fixed prosthodontics, functionally generated path technique, impression technique, occlusion, removable prosthodontics.

## **Introduction**

**Rationale:** The most precise articulator is the patient him/herself.<sup>1</sup> In the year 1959, Meyer proposed the functionally generated path (FGP) technique to fabricate a prosthesis that reflects the dynamic movement of opposing cusps without using a fully adjustable articulator.<sup>2</sup> The functionally generated path (FGP) is a static representation of the opposing cusps' dynamic eccentric movements from a centric position to achieve optimal articulation and occlusal harmony. By this method one is able to record such eccentric movements at the accurate vertical dimension of occlusion, as the excursive movements are mainly influenced by the anterior guidance as well as the condylar guidance.<sup>3</sup>

Meyer have stated that no correction or adjustment of the occlusion intraorally would be necessary when the technique is accurately employed.<sup>4</sup> Several authors have refined FGP methods. Mann and Pankey used this technique later in complete occlusal rehabilitation. The functionally generated path technique can be used during

actual fabrication of the restorations or as a checkbite technique to correct the finished restorations.

The FGP technique has been used to fabricate complete dentures, for full mouth rehabilitation cases, tooth supported and implant supported fixed dental prostheses (FDPs), single-unit indirect restorations, and CAD/CAM (computer-aided design/computer-aided manufacturing) restorations.<sup>3</sup> It has shown that vigilantly recorded FGP technique required merely minute occlusal adjustments during prosthesis insertion, which contributes as a major advantage over the conventional technique.<sup>3</sup>

This technique has been advantageous when used in patients who exhibit an acceptable centric occlusion and particularly those who have group function occlusal scheme. For providing group function occlusion, it uses the present non-involved teeth in the mouth in developing an occlusion. If the existing occlusal scheme has to be modified or if group function occlusion is not preferred, then alternative methods should be used.<sup>5</sup>

## **Focused Question**

Does functionally generated path technique reduce the mean chair side time and eliminate occlusal interferences in fixed and removable prosthesis fabrication?

## **PCC:**

**P** (population) – Patients with fixed or removable prosthesis

**C** (concept) – Use of Functionally generated path technique

**C** (context)– the reduced mean chair side time and reduction in occlusal interferences post insertion of prosthesis.

## **Eligibility Criteria**

### **Inclusion criteria**

1. All Randomized Control Trial studies based on functionally generated path technique assessing decreased occlusal interferences and chair side time.

2. All the case studies, case reports conducted till June 2021.
3. Articles in English language.

**Exclusion criteria**

1. All narrative reviews.
2. All letters to editor
3. All articles published in other languages.

**Information Source**

The Literature search was done using keywords as Functionally generated path technique, chew-in technique, occlusion, fixed prosthodontics, removable prosthodontics, impression technique. Data searching was done from databased of PubMed, SCOPUS and Google scholar till June 30<sup>th</sup> 2021. Additional articles from Cross references were checked. When the full text of the articles was not available, hand searching was carried out through electronic databases.

**Search**

All the articles in databases till June 30<sup>th</sup> 2021 were searched. Only Full text articles were chosen. Filters for

full text and study designs were not applied. Only articles in English language were selected.

Following Five search strategies using keywords were applied for literature search:

1. Functionally generated path technique OR chew-in technique OR generated path technique
2. Functionally generated path technique AND occlusion
3. Functionally generated path technique AND fixed prosthodontics
4. Functionally generated path technique AND removable prosthodontics
5. Functionally generated path technique AND impression technique

Search Strategy	Articles in hits	Articles selected	Reasons for exclusion
Functionally generated path technique OR chew-in technique OR generated path technique	PubMed: 20 Scopus: 31 (N= 51)	N=6+0=6	duplicate /not relevant to this study /other language
Functionally generated path technique AND occlusion	PubMed: 14 Scopus: 19 (N= 33)	N= 0	not relevant to this study /duplicate/ other language
Functionally generated path technique AND fixed prosthodontics	PubMed: 0 Scopus: 2 (N= 2)	N= 0	duplicate
Functionally generated path technique AND removable prosthodontics	PubMed: 2 Scopus: 2 (N= 4)	N= 0	duplicate

Functionally generated path technique AND impression technique	PubMed: 2 Scopus: 2 (N=4)	N= 0	duplicate
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Table 1

On Google scholar search, after excluding the duplicates and irrelevant studies, only 1 relevant study was selected.

**Selection of sources of evidence**

Pub Med

SCOPUS

Google Scholar

Institutional Library

**Data Charting Process**

A standard data extraction Excel sheet was made. The main interest was to obtain whether study shows reduction in mean chair side time and occlusal interferences in prosthesis (removable or fixed) fabricated after using FGP.

The extraction of data was done by one author independently by screening the titles and abstracts using search strategy according to the inclusion criteria. Full texts articles of included studies were acquired. Any kind of the problem was discussed with other authors and resolved. The total 7 studies of yielded search to be included in scoping review and Final data extraction sheet was prepared (Table 2). The reasons for excluded studies were mentioned in (Table 1). Blinding of authors was not carried out.

**Data Items**

Data items included for the data extraction were: -

1. **Study ID:** Number given to the study for identification.
2. **Type of Study:** Type of study design
3. **Author’s name:** Name of the author/s
4. **Year of publication:** Year in which the study was published.

5. **Location:** Place where the study was done.
6. **Concept:** Use of functionally generated path technique
7. **Results:** Decreased mean chair side time and occlusal interferences
8. **Remarks:** Results of the individual study.

**Critical Appraisal**

No quality assessment was performed, in accordance with the PRISMA guidelines for scoping reviews.

Study ID	Name of Author	Year of study	Study location	Study design	Population	Concept	Type of prosthesis assessed	Outcomes assessed	Results
1	Chandler et al	1975	USA	research article	1 patient	functionally generated path technique	fixed dental prosthesis single unit crown	chair side time occlusal interferences	reduced
2	Upadhyay et al	2012	India	short communication	1 patient	functionally generated path technique	maxillary single complete denture	chair side time occlusal interferences	reduced
3	DeVall et al	2012	USA	case report	1 patient	functionally generated path technique	fixed dental prosthesis- Two molar crowns	chair side time occlusal interferences	reduced
4	Prashanti et al	2014	India	case report	1 patient	functionally generated path technique	fixed dental prosthesis single unit crown	chair side time occlusal interferences	reduced
5	Liu FF et al	2017	China	A Randomized Clinical Trial	10 patients	functionally generated path technique	implant supported fixed prosthesis	chair side time occlusal interferences	reduced
6	Park et al	2019	Korea	case report	1 patients	functionally generated path technique	implant supported fixed prosthesis	chair side time occlusal interferences	reduced
7	Aggarwal et al	2019	India	case report	1 patients	functionally generated path technique	maxillary single complete denture	chair side time occlusal interferences	reduced

Table 2

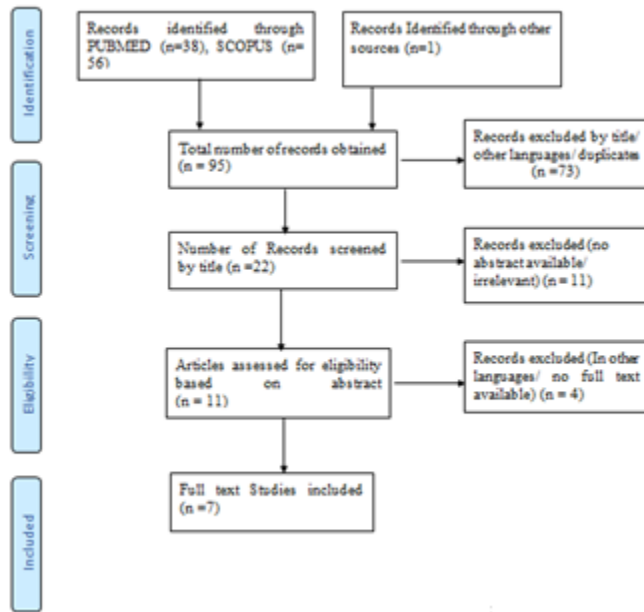
**Results**

Fig (A) represents the study selection according to PRISMA guidelines.

Through PubMed data search, total 38 results were obtained, SCOPUS data search yielded 56 articles while through Google Scholar 1 article was selected based on titles. Total number of articles obtained to be 95. Second step was done as screening through the titles, after which 73 articles were excluded by title as they were irrelevant or duplicates. Out of 22 Studies, 11 were excluded by abstract as few had no abstract available, some articles revealed study done with modifications, few mentioned techniques which were not evaluating the desired outcome and some mentioned only procedure. Remaining 11 articles were reviewed for full texts of which only 7 full text articles were selected excluding articles in other languages.

Conclusively, 7 studies included for the further qualitative synthesis.

### Prisma 2009 Flow Diagram



### Discussion

**Summary of evidence:** The functionally generated path (FGP) technique given by Meyer also called as ‘chew-in technique’ or ‘generated path technique’ has been used for fabrication various types prosthesis. It records patients own functional jaw movements without requiring a fully adjustable articulator. Thus, when technique is properly employed showed decreased the occlusal interferences in centric and eccentric contacts and reduced valuable mean chair side time.

**Chandler et al (1975)<sup>5</sup>** described a process of using the FGP technique to fabricate full occlusal PFM (porcelain fused to metal) fixed dental prosthesis. In this technique metal framework with softened recording wax was seated on prepared teeth receiving porcelain fixed bridge and patient was asked to close to the mouth till adjacent teeth contact for centric occlusion and also lateral and excursive movements were made. Stone occlusion template was made using the generated path and mounted on verticulator. Porcelain applied on the

occlusal surface of prepared teeth and adjusted according to the occlusion with anatomic cast. Balancing side interferences relieved at this time. It was concluded that correct use of this technique in vigilantly selected patients eliminates the need for occlusal corrections followed by further polishing before the insertion of prosthesis.

**Upadhyay et al (2012)<sup>8</sup>** presented a case of repeated fractures of maxillary complete denture opposing dentate mandibular arch. The patient was rehabilitated to obtain harmonious occlusion between the maxillary and mandibular arch by fabricating a maxillary complete denture using modified FGP technique opposed by natural mandibular teeth. Author modified the technique given by Stransbury where he repaired existing broken denture of patient which was stable enough and was used for recoding vertical dimension and functionally generated path. Later addition of carding wax on the occlusal surface of denture teeth was done and mandibular teeth indentation were recorded in centric relation. These indentations acted as centric stops and same was repeated to obtain right and left excursions. Stone core was obtained using wax path generated by functional movements of patient and joined to the mean value articulator against the waxed-up denture. Occlusion was examined and all interferences in centric and eccentric movements were carefully grounded. After processing. Finished and polished denture was inserted in patient’s mouth and it was observed that, Smooth eccentric movements with absence of interfering occlusal contacts were achieved. After denture processing only minimal grinding of the teeth was needed to correct errors and saved chairside time and extra laboratory step.

**DuVall, N. B. et al (2012)<sup>3</sup>** has given and applied FGP technique for the fabrication of posterior restorations in mandibular arch in the patient having bilateral group function occlusion. A stone crib which is a platform made for providing stability for the slurry stone bulk was fabricated on mandibular diagnostic cast using the custom tray material and relined intraorally. putty matrix was used to fabricate recording table intraorally and was retained on the prepared teeth. The stone crib was then positioned on the mandibular arch and checked for absence of interference with the recording table. The FGP record was made using FGP wax by instructing the patient to close into MIP and performing eccentric movements. Stone crib with retained functionally generated path wax record was placed intraorally followed by stone core fabrication using a slurry dental stone. Once that set, the stone core with stone crib was removed as a single unit and the core was then mounted against mandibular master cast to the upper member of the whip mix articulator, later full-gold crown was fabricated. It was observed that the FGP technique described produced restorations which required minimal chairside time for occlusal adjustment.

**Prashanti et al (2014)<sup>6</sup>** reported that conventional techniques of producing a prosthesis have been unsuccessful to be inserted without any occlusal adjustment in the mouth. He presented the use of FGP technique with double casting to make fixed dental prosthesis. Wax pattern having retentive beads that aided in its the retention was made with enough occlusal clearance during registering the occlusal morphology. Final castings obtained and checked for accurate fit on the model and intraorally as well. On the metal coping with retentive beads, pattern resin application was done on its occlusal surface. FGP pattern was recorded by instructing the patient to close mouth in MIP and then

perform right and left lateral, and protrusive movements ending in the maximum intercuspal position. All eccentric interferences identified as wiped-out areas with zinc oxide powder were eliminated and the FGP patterns were completed which were double casted. On intraoral examination, there was total absence of occlusal error in the maximum intercuspal position. Any present minor eccentric interferences were checked and the casting was selectively grounded. The total time required for reduction was dramatically reduced. The patient presented with complete comfort on insertion of the prosthesis.

**Lin PT et al (2017)<sup>1</sup>** conducted a study to compare Occlusion time (OT) and disocclusion time (DT) changes of the crown designed using Functionally Generated Path technique and conventional technique of crown fabrication. For this, single crowns were designed in 3 different ways using Functionally generated path technique (FGP), Average-value FGP technique (AVR) and conventional fabrication (CON) and evaluated for OT and DT. Sample size was 10. Three crowns of each participant were packed separately were tried by them in an orderly manner. Occlusion time (OT) and disocclusion time (DT) were recorded in advance before try-in of any crowns as the baseline. After try in, OT and DT were recorded again before any occlusal adjustments. Participants' response was recorded on the basis of Likert's 3-point scale for their opinion regarding any interferences of crowns and the best fitting crown selected by the participant was finally cemented. T-scan system was used to determine Occlusion time and disocclusion time. The mean Occlusion time, disocclusion time, Changes in both were calculated and statistical analysis showed FGP and AVR significantly saved time in occlusal adjustment, improving patients' satisfaction when compared to CON. However, he



conjointly said that FGP crowns were technique sensitive and needs to have further simplification of procedure.

**Park, S et al (2019)<sup>2</sup>** introduced the method of applying the FGP technique in implant supported fixed dental prosthesis fabricated by CAD-CAM technology. Usually the implant-supported fixed prosthesis is fabricated in centric occlusion, and interferences identified by articulating paper and corrected at the time of delivery. However, this is time consuming and may impair the ideal occlusal form. Author fabricated the functional occlusal path table of PMMA (Polymethyl methacrylate) over plastic impression copings such that both are bonded together and were fixed. Then FGP wax was placed on between functional occlusal path table and opposing teeth and patient was asked to perform centric and eccentric movements and wax path was generated. This was repeated to ensure accurate recording and then removed from mouth and wax path with FGP table was scanned and prosthesis was designed and milled using CAD CAM technology. It was stated that this method replicated patient's existing occlusal scheme thus minimal interferences and reduced mean chair side time at the evaluation appointment.

**Agarwal et al (2019)<sup>7</sup>** presented a case report using functionally generated path technique for a patient who was treated with a single maxillary complete denture opposing natural mandibular teeth, and a harmonious occlusion was achieved between the two. Desired vertical dimension of occlusion established using Modelling wax occlusal rim which was adjusted according to lip support. To another impression compound occlusal rim, carding wax was added to its full length and width. It was inserted in the patient's mouth and the patient was guided to close firstly in centric occlusion. Indentations of the opposing

mandibular teeth were recorded in wax and served as the future centric stops. The patient was then instructed to open the mouth and move to left side or right side and then sliding back the jaw into the centric position. This was repeated multiple times until it can be accepted as the final record. Final Insertion of processed denture in the mouth was achieved without any deflective occlusal contacts and smooth protrusive and lateral excursions were achieved. Thus, it was stated that If the FGP technique is properly recorded, only minor occlusal corrections are required during denture insertion, which is beneficial than the conventional procedure.

### **Limitations**

Total number of full text articles included are limited i.e., only 7 articles and only English language articles are screened in this scoping review. Very few numbers of studies available based on this technique. Also, one of the articles suggested although the proper use of functionally generated path technique gives accurate prosthesis and reduces need for occlusal adjustment, it is slight tedious and needs further simplification

### **Conclusion**

It was observed that functionally generated path technique used successfully in variety of clinical situations as in complete denture, full mouth rehabilitation, fixed dental prosthesis, implant supported prosthesis and showed beneficial clinical results in terms of reduced chair side time and minimal occlusal interferences during prosthesis insertion. In carefully selected patients with proper use of this technique or some modifications based on clinical conditions if FGP technique properly recorded gives accurate results. Additionally, there is scope for more evidences and research regarding the use or modifications of this procedure along with the advanced digital dentistry to

achieve the improved clinicians' work and reduced chair side time with optimal patient comfort.

### **Future Implications**

More number of studies with additional researches for simplification of procedure with the combination of advanced technologies like CAD-CAM etc. can be carried out.

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