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Clinical Considerations on Biofunctional Prosthetic System- A review on New Era of Complete Denture Fabrication

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***Abstract*: Traditional complete denture prosthesis imparts several problems such as poor retention, insufficient stability, denture sores, with severe pain, and discomfort, resulting in mastication, speech, nutritional and functional defects over a period of time. In order to overcome this difficulty, Biofunctional prosthetic system (BPS) is designed to enhance satisfaction, comfort, function and aesthetic to the patient. Furthermore, BPS also required fewer visits for the patientsas it follows a simple, standardized system for fabricating complete dentures thus minimizing the appointment time, with better aesthetic outcome. Literature studies, clinical trials and case reports focusing on advantagesof biofunctional prosthetic system in comparison to conventional complete dentures were published frequently. In accordance with this, the present review was carried out to briefly elaborate various aspects of BPS in prosthetic set-up based on the available literature with special emphasis on clinical consideration associated with its rehabilitation practice. Based on several observations, we conclude BPS as a superior technique in complete denture fabrication owing to its enhanced esthetics, form, function and comfort from a patient's perspective than the conventional one and increased patients Oral Health Quality of Life. (OHQoL). Nonetheless, further extensive research, clinical trials and long-term follow up studies on treatment outcomes are required to establish the superiority of BPS technique in prosthetic full mouth rehabilitation.**

***Keywords*: Balanced articulation, bifunctional movement, biofunctional prosthetic system, complete denture, injection moulding technique, patient satisfaction, OHQoL.**

1. Introduction

Rehabilitation of completely edentulous patients is a challenging task in clinical situations demanding restoration of normal form and function, preservation of residual alveolar bone, tooth and bone contour, along with patient's satisfaction, comfort, and pleasing esthetics [1]. Prolonged use of conventional complete denture prosthesis imparts several problems such as poor retention, insufficient stability, and denture sores, with severe pain, and discomfort, resulting in mastication, speech, nutritional and functional defects [2, 3]. Apart from physiological and nutritional concerns, psychological factors associated with speech difficulties, poor facial aesthetics, and patients low confidence on denture practice contribute largely to the successful outcome of complete denture treatment [4]. Over the years with increase in demand, numerous efforts have been put forward to construct high quality complete dentures and incorporate advance techniques in complete denture fabrication including Computer-aided design and computer-aided manufacturing (CAD/CAM) application. A major shortcoming of these several modified methods are the time constraints and appointment schedules required for construction of complete denture and also the fact that they can only be applied after some basic preclinical and clinical training, which will allow the dentist to decide whether the outcome of proposed step is satisfactorily done or not [5, 6].

In order to overcome this difficulty, Biofunctional prosthetic system (BPS) an advanced rehabilitation framework system designed to work in a biologically harmonious way with effective and efficient function, comfort, improved esthetics along with patient satisfaction have been introduced with clinical potential [6, 7]. It is also called as biogenic system because of its ability to fabricate dentures resembling natural oral environment both functionally and anatomically based on bilateral balanced articulation/bifunctional movements of the oral cavity in which the denture adapts well towards the tissue and thus improving the psychological and esthetic demands [8, 9].Furthermore, BPS also required fewer visits for the patientsas it follows a simple, standardized system for fabricating complete dentures thus minimizing the appointment time, with better aesthetic outcome [10, 11].

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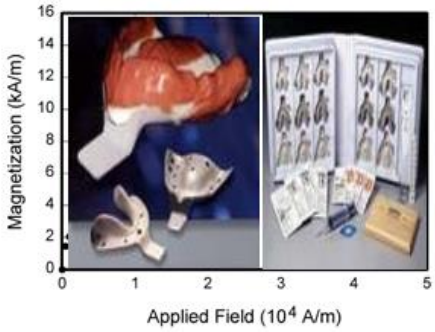

Fig. 1. Maxillary trays

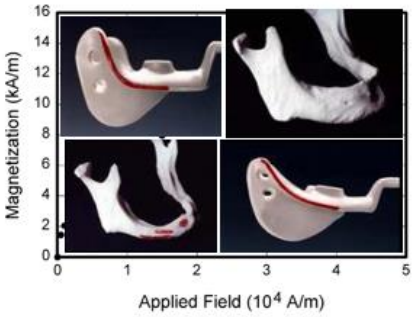

Fig. 2. Mandibular trays

Very few literature studies, clinical trials and several case reports were published every now and then focusing on advantagesof biofunctional prosthetic system in comparison to conventional complete dentures. The protocol or the guidelines to follow in making of the BPS denture is quite easier and simple to understand. In accordance with this, the present review was carried out to briefly elaborate various aspects of BPS in prosthetic set-up based on the available literature with special emphasis on clinical consideration associated with its rehabilitation practice.

2. Methodology

A structured literature search for articles written in the English language in PubMed/MEDLINE, EBSCOhost, Google Scholar, Scopus, and Web of Science databases was retrieved by using MeSH terms “Biofunctional prosthetic system” OR “Complete denture prosthesis” AND “Dental”, “Full mouth rehabilitation” AND “BPS” "Case Report, Case Series, Clinical Study, Clinical Trial, " OR “Esthetics”, “BPS denture”, OR "All Metadata" “Biofunctional prosthetic system”.

3. Discussion

Traditional complete dentures have been regarded as useful and cost efficient treatment option for significant number of edentulous patients. However, success of complete denture treatment outcome remains unpredictable due to post-insertion pain, discomfort, denture sores and loss of retention and stability of the prosthesis [1-4]. Recent advances of CAD/CAM complete dentures have improved the quality of prosthesis such as improved retention, reduction in porosity and polymerization shrinkage. Although many efforts undertaken in the field of rehabilitation and prosthetic care had a substantial impact, with increase in consumer demand for reasonable yet aesthetically pleasing dentures for edentulous patients with new and improved prosthetics is one of the biggest challenges facing dentists and dental lab technicians [12]. With these challenges, currently the Bio functional prosthetic system highlights the principle of bilateral balanced occlusion with enhanced form, function and esthetics in a shorter treatment duration compared with conventional one.

1) BPS Procedure

BPS denture fabrication involves the four clinical procedures whereas the conventional denture fabrication involves six clinical visits [14]. The four clinical procedures for BPS denture fabrication involves as follows.

2) First clinical visit

It involves Primary Impression and tentative Jaw relation. Totally 15 trays of various sizes (Accu- trays) are available for recording the primary impression, out of that 5 different sized trays are used for maxillary impression, the trays are selected according to the patient’s arch size and shape and 10 different sized mandibular trays are used for mandibular impression in regards with the patient needs. (Fig. 1, 2). The Primary Impression is made using Alginate (Vival NF Intro Kit IVOCLAR VIVADENT). Two types of alginate are used for taking impression they are namely Tray alginate and the second one is Syringe alginate .The irreversible hydrocolloid of different densities are used for taking impression. Low viscous alginate material, the syringe material (Syringe Acc gel, Accudent XD) was injected into the vestibular area using syringe and the high viscosity hydrocolloid is loaded to the occlusal centric tray and inserted into patient’s mouth to get the record. The syringe alginate material as an advantage of producing the accurate records of the anatomical landmarks because of its flow nature, they are also effective in bringing out the impressions free of air bubbles and voids and it also has faster setting time of 3 mins and 30 secs hence they are first mixed and loaded then the tray loaded with alginate is placed. (Fig. 3).

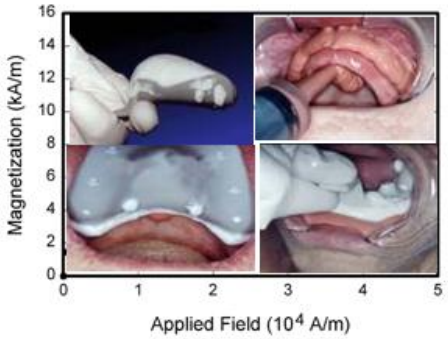

Fig. 3. Primary Impression

A Centric tray is used to record the jaw relation. The material used is either Alginate or Silicone putty. The jaw relation is recorded at the patients VDO (Vertical Dimension of Occlusion). Laboratory procedure involves the pouring of maxillary and mandibular cast and they are mounted and used for fabrication of special tray and attachment of Gnathometer.

3) Second Clinical Visit

It involves Secondary Impression and Final Jaw Relation and

Gothic tracing. Heavy body, Light body and Extra light body are used for recording the functional secondary impressions [15]. After impression was made with zinc oxide eugenol impression paste, white plastic spacer's are removed, the upper and lower plates with the screw are fixed into position. The vertical dimension can be adjusted, by turning the screw in the lower member. The upper plate is then coated with a colouring agent and an intra-oral Gothic arch tracing is recorded [16]. A plastic sleeve is inserted, and oriented to the centric point. Bite registration paste is injected, between the plates and the final centric position is recorded at the determined vertical dimension of occlusion. [13] (Fig. 4).

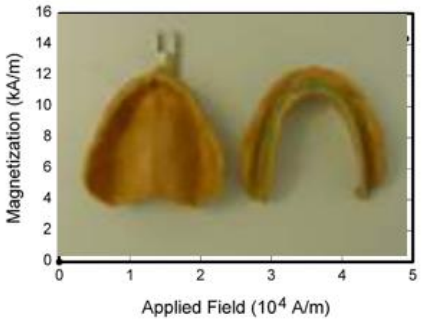

Fig. 4. Secondary Impression

4) Jaw Relation

After the final jaw relation selection of teeth and teeth are set up according to rules of M.A.P (Model Associated Positioning) (Fig. 5)

Fig. 5. Jaw relation

5) Third Clinical Visit

Wax try in is done to check the Occlusal relationships, esthetic, phonetics, retention, stability, posterior palatal seal and patient's comfort (Fig. 6).

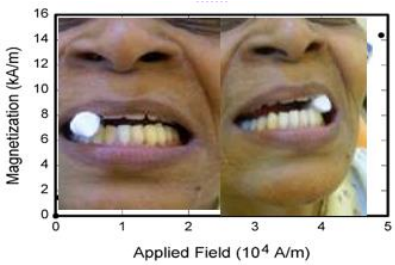

Fig. 6. Wax Try in

6) Injection Moulding Technique

The denture is then processed using SR Ivocap Injection moulding system. The system employs pressure/heat polymerization procedure which achieves an exceptionally high degree of polymerization. The pressure is maintained during the polymerization procedure completely to ensure the continuous pressure flow of additional material to compensate the material shrinkage. The vertical dimension and fit is achieved. The homogenous bubble free denture minimizes the risk of mucous membrane irritation. In addition, the homogeneous, bubble-free denture base surface minimizes the risk of irritating the mucous membrane [17, 18], (Fig.7).

Fig. 7. Injection moulding technique

B. Fourth Clinical Visit

1) Denture insertion is done for the patient (Fig. 8)

Fig. 8. BPS Denture Insertion

2) Denture Adjustments and its significance

Studies have shown significant difference in adjustment appointments as BPS complete dentures requires less corrective steps than conventional dentures. Denture adjustments can be required for several causes such as residual ridge resorption, the health of the soft tissues covering edentulous areas, the adaptability of patients to complete dentures, the skill of the clinicians and dental laboratory technicians involved in the fabrication, the jaw relationship, denture occlusion, and other local and systemic factors [2, 20]. It is evident that BPS system uses a controlled heat/pressure polymerization procedure during which exact amount of material flows into the flask at a rapid phase to compensate for shrinkage. Injection moulding and polymerization are performed by the injector in an automated process.

The chemical shrinkage of the material is fully compensated during the polymerization process due to the patented thermal management of the flask and the heating system. This allows the fabrication of high-precision denture bases offering unparalleled accuracy of fit. This pressure also optimizes the physical properties of the denture as well as post-insertion correction [1-4, 19, 20]. Matsuda KI et al [2] in a crossover trial and Xhajanka et al [8] in a Post-insertion BPS case evaluation and six-year follow-up case control study showed enhanced responses with BPS in terms of clinical parameters such as resorption status of residual ridge, passive stability, functional stability, functional interferences and health of the underlying

mucosa.

3) BPS Denture and Functional Esthetics

Edentulous patients have low self-esteem, this can be improved by making esthetically pleasing dentures which will be close to the original esthetic smile according to patient's age [19, 21, 22]. BPS System uses denture teeth that mimic natural teeth and have been designed to match the age and characteristics of the individual patient (Example: Premium SR Phonares II ®, Ivoclear®, Ivoclar Vivadent ® and SR Vivodent SPE ®). The tooth moulds are available in various forms distinguished by a high-quality surface texture with a true-to-nature strength. Proximal surfaces are designed to assist easy fit, establish contact angles and points, and well balanced opalescence/translucency characterized by high toughness, resistance to wear, tolerance and durability [1, 2, 6]. Lugo et al in a clinical case study observed superior functional properties with better comfort, esthetics and patient's satisfaction with BPS dentures [23].

Baskaran conducted a comparative study on patients satisfaction based on questionnaire survey of various aspects ranging from retention and aesthetics to thickness and smoothness of the denture revealed very satisfactory to satisfactory response level with regards to retention, aesthetics, and phonetics using BPS denture [19]. Matsuda KI et al in a crossover trial to evaluate clinical acceptability of BPS over conventional complete dentures showed high quality complete dentures in terms of occlusal feel, comfort, esthetics, and retention with satisfactory results. The Oral Health Impact Profile for edentulous subjects, Japanese version (OHIP-EDENT-J) also revealed complete absence of pain, psychological discomfort, functional difficulties including speech and mastication [2, 24].

Fenlon MR stated that quality of the mandibular residual alveolar ridges, retention and stability of the mandibular dentures, the accuracy of reproduction of retruded jaw relationship and patient adaptability were influential components of patients' satisfaction with complete dentures [25]. BPS Denture provide excellent retention as a result of surrounding muscular forces are in balance and lingual flanges are contoured in such a way that they provide adequate space for normal actions of the tongue. Cunha et al. reported that BPS method for complete denture fabrication is able to restore the masticatory function to a level comparable to that of a conventional protocol, both physiologically and according to the patient's perceptions [26].

4) BPS and other prosthetic applications

Apart from complete denture prosthesis, BPS system is also used for tooth supported over-denture, implant-supported over-denture in maxillary and mandibular reconstruction procedures [12, 27-29]. This could be attributed to combination of standardized techniques for impression making thus allowing the final impression in the closed position to reproduce the functional model more accurately than conventional impression methods. Similarly multiple recording of the maxillomandibular relationship ensures greater accuracy in recording and duplicating the jaw relation. In contrast, Khazi SS et al in a systematic review on BPS in prosthodontics concluded that the volume of literature available regarding the comparison of BPS to the conventional denture is insufficient to prove that it has a significant advantage over the conventional system [1]. The study also recommended a definite need for larger number of clinical trials, and further research to establish the competitive superiority of BPS technique.

4. Conclusion

It can be put forward that Biofunctional prosthetic system, a novel technique is superior to the conventional complete denture in esthetics, form, function and comfort from a patient's perspective and also increased patients Oral Health Quality of Life (OHQoL). It is also noted that dental practitioners with a small amount of clinical training can quickly produce complete dentures and satisfactory results with this method. Nonetheless, further extensive research, clinical trials and long-term follow up studies on treatment outcomes are required to establish the superiority of BPS technique in prosthetic full mouth rehabilitation.

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