CASE REPORT

Smile Design with Customized Non-rigid Connector as Stress Breaker!! - A Case Report

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ABSTRACT

Prosthetic rehabilitation of multiple edentulous spaces with fixed partial dentures varies based on the clinical situation. Treatment of pier abutments poses a great challenge to the prosthodontist due to the biomechanics involved with the rigid connection. Use of conventional rigid connectors is not an ideal treatment plan in pier abutment cases due to physiologic tooth movement, arch position of the abutment and a disparity in the retentive capacity of the retainers. For restoration of arches with pier abutments, if a rigid connector is used and occlusal load is applied at one end of fixed partial denture, it results in the pier abutment acting as a fulcrum. It will cause stress on the terminal abutments ultimately leading to the failure of the prosthesis and trauma to the periodontium. In such cases non-rigid connector acts as a stress breaker instead of usual rigid connector. Hence, the present case report presents an innovative and cost-effective way of fabricating a customized non-rigid connector.

Key words: Non-rigid connector, pier abutment, stress breaker

INTRODUCTION

Fixed partial denture has always been the most accepted treatment modality for replacement of one or two missing teeth. The success depends on a number of factors but, the failure could be attributed to the occlusal forces applied to prosthesis during the function. Variables that may influence the longevity of prosthesis and its abutment include occlusion, span length, bone loss, and quality of periodontium. The excessive flexing of the long- span fixed partial denture, which varies with the cube of the length of span, can lead to failure of prosthesis. Biomechanical factors such as overload, leverage, torque, and flexing induce abnormal stress concentration in prosthesis. Stress concentration is found in the connectors of the prosthesis and in the cervical dentin area near the edentulous ridge.[1] These forces are transmitted to the abutments all through the pontic, connectors, and retainers leading to abnormal stress concentration in fixed partial denture (FPD). Stress concentration is maximum at the region of the connector of prosthesis and in abutment near to edentulous ridge.[2] The situation become more challenging when abutment has edentulous spaces on either side.

Connectors that unite the retainers and pontics, may be rigid (solder joints or cast connector) or non-rigid (precision attachment or stress breaker) (NRCs). Rigid connectors are easy to fabricate but their use is not indicated in all situations.[3] Especially in case of pier abutment where a non-rigid connector is advocated acting as a stress breaking mechanical union to circumvent alignment problems in abutment preparations and to separate occlusal stresses. This "Broken-stress" principle can be achieved by means of an attachment either a precision or semi-precision attachment (Markley, 1951).

Rigid connector could be made by casting, soldering, and welding. The cast connectors are to be properly shaped in wax patterns. The soldered connectors are made by fusion of intermediate metal alloy to the previously made castings. The connector that permits limited movement between the

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otherwise, independent members of the FPDs is the NRC. The NRC could be made by an incorporation of prefabricated inserts, by use of a custom milling machine or by use of the prefabricated plastic patterns. Customization of these non-rigid attachments can reduce the cost for the patient.[1]

The present case report describes a simple technique to break stress around pier abutment by customizing semi precision attachment within a convention 9-unit FPD.

CASE REPORT

A 32-year-old female patient reported to the Department of Prosthodontics in Kamineni Institute of Dental Sciences, Narketpally, Telangana, with a chief complaint of loose teeth as well as missing teeth in the upper and lower anterior region [Figure 1]. Dental history revealed that patient had undergone extractions 2 months ago. On intraoral examination patient was completely dentate except 11, 12, 21, 22, 24, 31, 41, 42 [Figure 2]. In the maxillary arch, right canine and left second premolar act as terminal abutments and left canine act as a pier abutment.

Investigations

Orthopantamograph of the patient revealed that the pier abutment had adequate bone support which could be used as abutment [Figure 3]. After discussing all the treatment options, it was decided to rehabilitate the case with nine-unit FPD using non-rigid connectors on the distal aspect of the pier abutment. A written, informed consent was obtained from the patient.

Clinical Procedure

The following are the clinical steps carried out during the procedure:

- Maxillary and mandibular diagnostic impressions were made with irreversible hydrocolloid. The maxillary cast was mounted on a semi-adjustable articulator using transfer bow, a wax interocclusal record of centric relation position was made. The mandibular cast was related to the mounted maxillary cast using centric relation record.
- Mock preparation and diagnostic wax up was planned to decide the next phase of treatment. This was used as visual treatment objective for patient education [Figure 4]. Gingival scoring was done in the pontic sites to improve the emergence profile.
- Tooth preparations were done for porcelain fused to metal prosthesis irt 13, 14, 23, 25 with subgingival margins and shoulder finish line was established to enhance the aesthetics. Mandibular right and left canines and left lateral incisor were also prepared for crowns which was followed by provisionalization using indirect technique. The gingival retraction was

Figure 1: Clinical picture showing frontal view of the dentition depicting missing teeth

Figure 2: Intra oral view and occlusal view of maxillary and mandibular dentition showing missing teeth

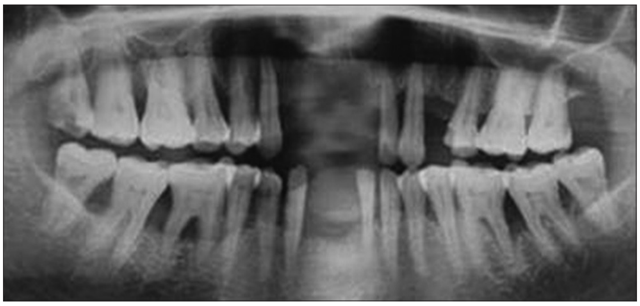

Figure 3: Pre-operative orthopantamograph showing the missing teeth in maxilla and mandible

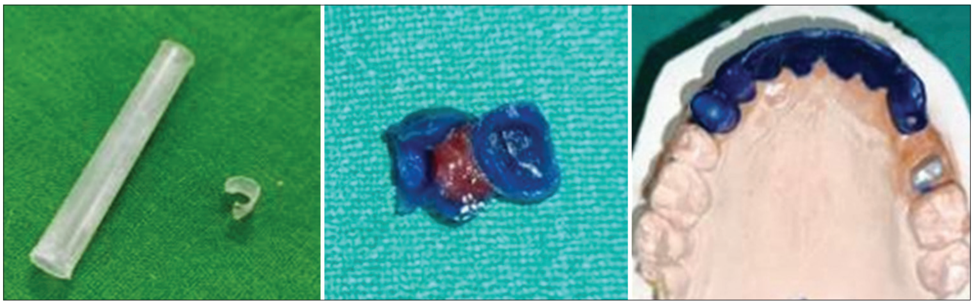

Figure 4: Diagnostic mock up

carried out and final impressions were made using elastomeric impression material with two step putty wash technique.

- An interocclusal record was made using bite registration wax (Alu wax). The impression was poured in type IV dental stone. Master cast was retrieved, and die was prepared. Master casts were mounted on the Hanau articulator using face bow transfer and interocclusal record.
- Wax pattern was fabricated for 14, 13, 12, 11, 21, 22, 23, 24, and 25. Female component was patterned to the distal part of the pier abutment i.e. canine, matching the height of the canine using a cut refill in the shape of semi-circle creating a recess and adding wax over it and then male part was patterned within the left first premolar pontic, as an extension which would slide fit into the recess created on canine [Figure 5]. Lower wax pattern was fabricated from the left canine to right canine and casting was done subsequently.
- There are humungous designs available to dissipate the stress between the distal abutment and the residual alveolar ridge. Each design is unique in its function, but however every stress breaker divides and controls the biomechanical stresses generated by the retainers. The customization of stress breakers enables the operator to minimize the cost, at the same time reaching the same function. This case report describes a novel technique-where a non-rigid connector was designed using a pen refill. The cut section of the pen refill functioned as matrix system to which patrix system was patterned. The non-rigid connection dissipates the stresses along the long axis of the pier abutment as well as provides a continuous physiological gingival stimulation to the surrounding soft tissues.
- Male wax pattern was seated in the casted female portion and verified intraorally. Male component was casted. Metal try-in was performed, the male and female components were checked for the rocking or misfit intraorally. Bisque trial was performed after ceramic layering. Anterior segment with female portion and posterior segment with male portion were assembled. During cementation, anterior seven-unit segment with keyway was cemented first followed by cementation of posterior two-unit segment with key using glass ionomer cement [Figure 6]. The patient was instructed to maintain proper oral hygiene. Use of dental floss and interdental brush was recommended. The patient was evaluated after 1 week to assess the oral hygiene status.

Figure 5: Cut refill used for customization of non-rigid connector

DISCUSSION

Connectors are the part of a FPD that unites the retainers and pontics. Connectors may be rigid (solder joints or cast connector) or non-rigid (precision attachment or stress breaker). Rigid connectors between retainers and pontics are the preferred way of fabricating most FPD. They are not indicated in all situations like an edentulous space on either side of pier abutment.[4] The selection of right type of connector during treatment planning

Figure 6: Bisque trial, final glazed porcelain fused to metal crowns along with cementation

is an essential step for success and failure of the prosthesis.

Teeth in different segments of the arch move in different directions. The facio-lingual movement of an anterior tooth occurs at a considerable angle to the facio-lingual movement of a molar, because of the curvature of the arch.[5] These movements of measurable magnitude in divergent directions can create stresses in a long span prosthesis that will be transferred to retainers and their respective abutments teeth. Those forces are transmitted to the terminal retainers as a result of the middle abutment acting as a fulcrum, causing failure of weaker retainer. Because of these dislodging forces rigid type of FPD with pier abutment have higher debonding rate than short span prosthesis, resulting in marginal leakage and caries.

When rigid connectors are used in presence of a pier abutment, an occlusal load applied on the abutment tooth at one end of an FDP with a pier abutment, the pier act as a fulcrum.[6] Tensile forces will then be released between retainer and the abutment at the other end of the restoration. Extrusive force will be experienced by the anterior as well as posterior abutments and the resultant tensile force at the retainer to abutment interface leads to loss of retention of these restorations resulting in marginal leakage, caries of the abutment and thus FDP failure.

The non-rigid connector acts as stress breaker between retainer and pontic instead of usual rigid connector. The movement in a non-rigid connector is enough to prevent the transfer of stress from segment being loaded to the rest of the FPD. The most commonly used non rigid connector consists of a T-shaped key that is attached to the pontic and a dovetail keyway placed within the retainer. Hence non-rigid connectors are recommended in such clinical situations.[7]

Shilling burg proposed the connector to be placed at the distal aspect of pier abutment.[8] Posterior teeth long axis tends to tilt mesially, occlusal forces applied vertically produce further movement in this direction. This would eliminate the fulcrum effect and the patrix/male of the attachment will be seated firmly in place when pressure being applied distally to the pier. The technique used in this case report was a customized matrix and a patrix system which is economical as well as served the same function of that of any semirigid connectors available in the market. The use of cut part of the pen refill acted as the matrix system to which the wax pattern was designed to fabricate the patrix system of the semi-rigid connection.

Indications for non-rigid connector are the existence of pier abutment which promotes a fulcrum-like situation that can cause the weakest of the terminal abutments to fail and may cause the intrusion of a pier abutment.[9] The existence of the malaligned abutment, where parallel preparation might result in devitalization. Such situation can be solved by the use of intracoronal attachment as connectors.[10] Long span, FPD which can be distort due to shrinkage and pull of porcelain on thin sections of framework and thus, affect the fitting of the prosthesis on the teeth in the mandibular arch, FPD consisting of anterior and posterior segments, a non-rigid connector is indicated as the mandible flexes mediolaterally during opening and closing strokes and there is disparity in retentive capacity of the abutment.[11]

CONCLUSION

A comprehensive evaluation, multi-disciplinary approach and a sequential treatment plan, worked out in harmony with the patient's aesthetic demand and perceptions are important for a long-term successful outcome. The prognosis of a fixed partial denture will depend on occlusion, span length, bone loss and quality of periodontium. The use of precision attachments which act as non-rigid or stress breakers play an important role in increasing the longevity, stability and success of long span fixed partial dentures. They serve as safety valves against the extreme leverage forces created by the rigid connectors which were promptly put-forth by Miles Markley in the Broken-stress principle. Thus, the use of a non-rigid connector tremendously increases the success of pier abutment situations. The design suggested in this case report is novel, which any operator can customize in his/her clinic so as to make the treatment affordable at a very reasonable price serving with its function as effectively as the prefabricated semirigid connector.

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