IOSR Journal of Dental and Medical Sciences (IOSR-JDMS)
e-ISSN: 2279-0853, p-ISSN: 2279-0861.Volume 14, Issue 6 Ver. III (Jun. 2015), PP 68-71
www.iosrjournals.org

Two Part FPD: Breaking Stress around Pier Abutment

Pragya Pandey[1], Sneha S. Mantri [2], Suryakant Deogade[3], Pushkar Gupta[4], Ankit Galav[5]

[1] *(Post Graduate Student Department Of Prosthodontics, Hitkarini dental college and hospital. Jabalpur (M.P), INDIA)*
[2] *(HOD & Professor Department Of Prosthodontics, Hitkarini dental college and hospital, Jabalpur (M.P), INDIA)*
[3] *(Professor Department Of Prosthodontics, Hitkarini dental college and hospital, Jabalpur (M.P), INDIA)*
[4] *(Reader Department Of Prosthodontics, Hitkarini dental college and hospital, Jabalpur (M.P), INDIA)*
[5] *(Post Graduate Student Department Of Prosthodontics, Hitkarini dental college and hospital, Jabalpur (M.P), INDIA)*

Abstract: *Fixed partial denture with all rigid connectors is less than ideal treatment plan for a 5 unit fixed partial denture involving pier abutment. Tooth movements in divergent directions create stresses, that are transferred to the abutments & cause failure of the weaker retainer as the pier abutment act as a fulcrum. Thus the use of non rigid connector in case of pier abutment is recommended. It transfers shear stresses to supporting bone & permits abutments to move independently. This case report presents a simple method to rehabilitate pier abutment cases using customized semi precision attachments.*

I. Introduction

In some patients, the pattern of missing teeth may require the use of an FPD with a pier abutment. Pier abutment also known as an intermediate abutment is defined as a natural tooth located between terminal abutments that serve to support a fixed or removable dental prosthesis.[1] The most common clinical scenario in maxillary and mandibular arch is missing first premolar and first molar with canine and 2nd molar as terminal abutments and second premolar as pier abutment. It has been postulated in literature that with the use of rigid connectors there are forces acting on terminal abutments with pier abutment acting as fulcrum.[2] Thus, tensile forces may then be generated between the retainer and abutment at the other end of the restoration leading to debonding of prosthesis.

According to Savion et al, the probable reason for debonding is development of extrusive reactive forces at the canine retainer as the first molar is loaded due to flexural forces developed within the FPD.[2] Thus, these restorations may result in marginal leakage and caries.

The desire to establish balance between functional stability and cosmetic appeal in partial dentures gave rise to the development of Precision Attachments also called as nonrigid connector. The nonrigid connector is a broken-stress mechanical union of retainer and pontic, instead of the usual rigid connector. The most commonly used nonrigid design consists of a T-shaped key that is attached to the pontic, and a dovetail keyway placed within a retainer.[3] The magnification of force created by a long span is too destructive to the abutment tooth under the soldered retainer. A nonrigid fixed partial denture transfers shear stress to supporting bone rather than concentrating it in the connectors. It appears to minimize mesiodistal torquing of the abutments while permitting them to move independently.[4]

The location of the stress breaking device in the five unit pier-abutment restoration is important. It usually is placed on the middle abutment, since placement of it on either of the terminal abutments could result in the pontic acting as a lever arm. The keyway of the connector should be placed within the normal distal contours of the pier abutment, and the key should be placed on the mesial side of the distal pontic.[5,6]

Gill (1952) recommended placing non rigid connector at one side or both sides of pier abutment. Adams (1956) stated placing one non rigid connector on distal of pier & one more at distal of anterior retainer. Schillinburg et al (1973) suggested that patrix of non rigid connector should be placed distal to pier retainer & matrix should be in distal pontic.[7]

The present case report describes a simple technique to break stress around pier abutment by customizing precision attachment, using plastic sleeve of a dowel pin.

II. Case- Report

A female patient aged 28 years reported to the department with chief complaint of difficulty in mastication. The intraoral examination showed missing maxillary left first premolar and first molar with canine and second molar acting as terminal abutments and second premolar as pier abutment (Fig. 1). Periapical radiograph showed good bone support for all the teeth to be used as abutment.

Considering patient's age, clinical and radiological examination, a two part, 5 - unit Porcelain fused to metal FPD with a non-rigid connector, interposed between pier abutment and distal pontic, was planned. Tooth preparation of 23, 25, and 27 was completed following the biomechanical principles (Fig. 2). Provisional restoration was made with autopolymerizing acrylic resin as five unit bridge (Fig. 3). Final impression was made by silicon elastomer with two step putty wash technique. Master cast was poured with Type IV stone and die pins were attached. Die cutting was done (Fig. 4). Articulation was done on mean value articulator using interocclusal bite record.

Wax pattern were fabricated for 23, 24, 25. Semi precision attachment was made with sleeve of dowel pin. The sleeve was opened from one side with a B.P blade to make a keyway (Fig. 5). Keyway was attached to the distal aspect of 25 wax pattern (Fig. 6). Casting was carried out (Fig. 7). Metal try-in was done. Then wax pattern was fabricated of 26 and 27 with key made with inlay wax and casted (Fig. 8). After ceramization, FPD was finished and glazed (Fig. 9).

Anterior 3 unit fixed partial denture was cemented followed immediately by posterior 2 unit fixed partial denture using glass ionomer luting cement (Fig. 10).


Fig. 1: Preoperative view **Fig. 2: Crown preparation**

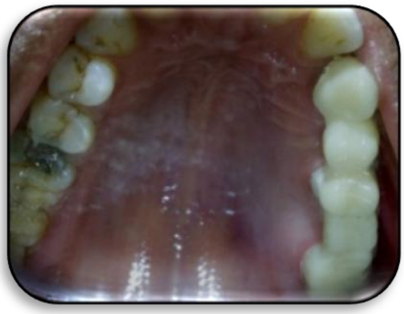
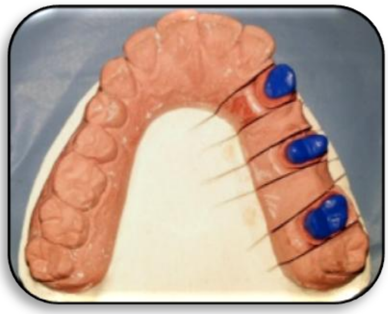

Fig. 3: Provisionalization **Fig. 4: Master cast**

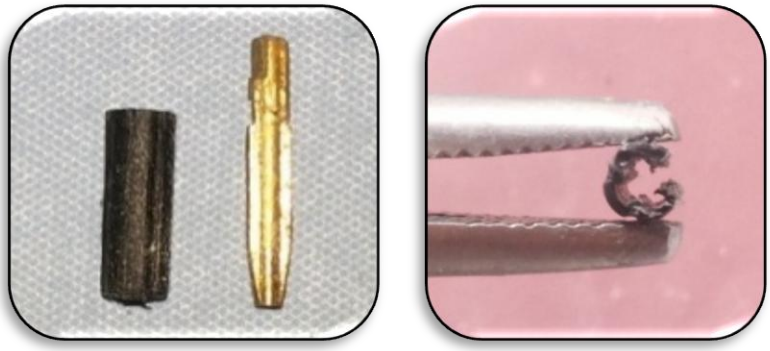

Fig. 5: Custom made attachment from sleeve of Dowel pin

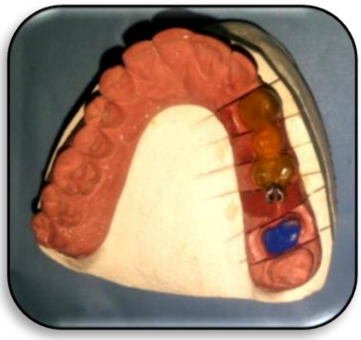


Fig. 6: Keyway attached to wax pattern Fig. 7: Casted mesial half of FPD

Fig. 8: Wax pattern of distal half of FPD

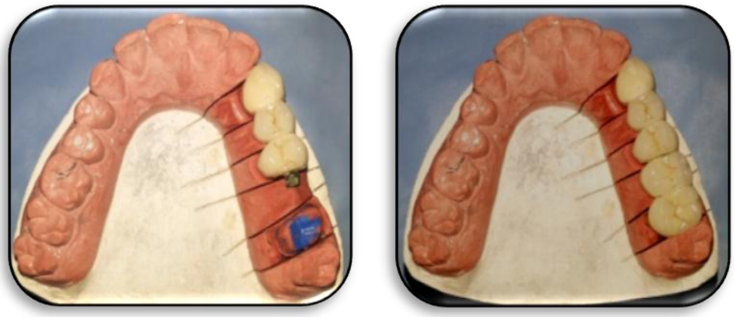

Fig. 9: Ceramized FPD

Fig. 10: Cementation of FPD

III. Discussion

The size, shape and type of connector play an important role in the success of a FPD.[8] Biomechanical features such as overload, leverage, torque and flexing bring about abnormal stress concentration in FPD. A comparison of stress distributions for different design types revealed that high stress values were located at the connectors and cervical regions of abutment teeth, especially at the pier abutment. Root surfaces and apical aspects were other stress concentration areas. This factor plays a significant role in the potential for failure in long span FPD.[9]

When a rigidly designed FPD with a pier abutment acts as a lever, high stress concentrations may occur at pier abutments, and excessive displacements may be observed at terminal abutments, resulting in damage to the abutment teeth. Thus, nonrigid connectors can be used to eliminate the fulcrum action of a pier abutment.[10]

Non rigid connector transfers shear stresses to supporting bone rather than concentrating them in connectors. It minimises mesiodistal torquing of abutments & permits them to move independently.[11] Segmenting the design of complex fixed partial dentures into shorter components makes them easier to replace /repair individually.

Moulding et al[12] performed a photoelastic stress analysis of supporting alveolar bone as modified by nonrigid connectors. The authors reported that the stress fields change depending on the location of nonrigid connectors. When a nonrigid connector is integrated at distal region of the pier abutment, the area of stress concentration in pier abutment is reduced. With this design type, there were no stress concentrations at the anterior abutment with posterior loading, and vice versa.[12]

Botelho and Dyson evaluated the longevity of long-span resin-bonded FPDs with 4 or more units with a modified nonrigid connector and increased extension of the retainer framework around the abutment. The authors found that long-span resin-bonded FPDs incorporating nonrigid connectors allow independent movement between the retainers, and, combined with increased framework extension, they appear successful in the short term.[10] However, excessive stress concentrations occur at the anterior terminal abutment due to placement of a nonrigid connector at the mesial region of the pier abutment or distal region of the anterior pontic. Since the molar tooth has a larger periodontal membrane area than the canine tooth, as reported previously, this may be an advantage for the molar tooth. Thus, it is less desirable to have stress on the anterior abutment than the posterior abutment. In an another study Bothelo and Dyson reported that rigid FPDs with pier abutment are linked with higher debonding rates than short span prosthesis.[10] Thus; these restorations may result in marginal leakage and caries.

Nonrigid connectors are suggested as an explanation to these problems. Russell D et al considered the stress transfer patterns with variable implant support and simulated natural teeth through rigid and nonrigid connection under simulated functional loads. They accomplished that rigid connector in particular circumstances caused only slightly higher stresses in the supporting structure and demonstrated more widespread stress transfer.[13] Recommendations for selection of connector design should be planned on basis of sound clinical periodontal health of a tooth and the support provided by implants.

Designs of the nonrigid connectors are key & keyway (Tenon- Mortise), cross – pin & wing, loop and split connectors. The most common design of all used is mortise (female component) placed within the contours of the retainers and a Tenon (male component) attached to the pontic.[14] Accurate position of the dovetail or cylindrically shaped mortise is critical, it must parallel the path of withdrawal of a distal retainer.[15]

Thus the use of nonrigid connector and its selection is very important in the longevity of the long standing bridges with pier abutment.

IV. Conclusion

Broken-stress measures serve as “safety valves” against the tremendous leverage forces created by the rigid attachment to two or more teeth. The employment of nonrigid connector increases the life of the restoration as it minimizes the stresses on the abutments. The stress distributions and values of an FPD and a pier abutment are affected by the presence and location of a nonrigid connector. The selection of appropriate design for connector is a significant step in treatment planning of pier abutment. Apart from the advantages of NRCs, the increased laboratory time and expense should be ignored on considering the augmented life of the restoration.

References

[1]. Glossary of Prosthodontic Terms. 8th edition. J Prosthet Dent 2005; 94: 11-95.
[2]. Savion I, Saucier C, Rues S, Sadan A, Blatz M. The pier abutment: Review of literature and a suggested mathematical model. Quintessance Int 2006; 37:345-52.
[3]. Parikh et al. Precisive means to manage pier abutments. EJDTR, 2013:3:160-166.
[4]. Rosenstiel SF, Land MF, Fujimoto J (2006) Contemporary fixed prosthodontics 4th edition.Pg 673-93.
[5]. Shillingburg HT Jr, Fisher DW (1973) Nonrigid connectors for fixed partial dentures. J Am Dent Assoc 87: 1195-99.
[6]. Prince Kumar, Vishal Singh1, Roshni Goel, Harkanwal P Singh. Non rigid connector in fixed partial dentures with pier abutment: An enigma simplified. Int J Health & Allied Sci 2012; 1:190-3.
[7]. Herbert T Shillingburg, Sumiyo Hobo. Fundaments of fixed prosthodontics – 3rd edition;
[8]. Tylman’s Theory of Fixed Prosthodontics. 8th edition.
[9]. Oruc S, Eraslan O, Tukay HA, Atay A. Stress analysis of effects of nonrigid connectors on fixed partial dentures with pier abutments. J Prosthet Dent 2008; 99:185-92.
[10]. Botelho MG, Dyson JE. Long-span, fixed-movable, resin-bonded fixed partial dentures: a retrospective, preliminary clinical investigation. Int J Prosthodont 2005;18:371-6.
[11]. Sutherland JK, Holland GA, Sluder TB, Whie JT. A Photoelastic stress analysis of stress distribution in bone supporting fixed partial dentures of rigid & nonrigid designs. J Prosthet Dent 1980; 44 : 616-23.
[12]. Moulding MB, Holland GA, Sulik WD. Photoelastic stress analysis of supporting alveolar bone as modified by nonrigid connectors. J Prosthet Dent 1988;59:263-74.
[13]. Russell D Nishimura, et al. Photoelastic stress analysis of load transfer to implants and natural teeth comparing rigid and semirigid connectors. J Prosthet Dent 1999; 81 : 696-703.
[14]. Jerkins G. Precision attachments, a link to successful restorative treatment. Quintessence: London; 1999. p. 127-31.
[15]. Badwaik PV, Pakhan AJ. Non-rigid connectors in fixed prosthodontics: current concepts with a case report. J Ind Prostho Soc 2005; 5:99-102.