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Case Report

Failure of An All Ceramic Posterior Fixed Partial Denture As A Consequence Of Poor Clinical Application Of Diagnostic Data

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ABSTRACT:
A fixed partial denture (FPD) provides a partially edentulous patient with alternative good choice of natural teeth since they are supported and retained by natural teeth. FPD prosthodontics is a clinical specialty that is learned with daily practice. Eleven different types of classification of FPD failures are comprehended in the scientific literature. Most of them revolve around diagnostic failures and improper embrasure forms. A female patient reported with chief complaint of discomfort in the left maxillary all ceramic posterior four unit FPD and loss of mandibular long span FPD. Clinical examination revealed that the gingiva under the FPD showed signs of inflammation which were more severe posteriorly. The all ceramic FPD was fabricated 5 months back and had failed to maintain gingival health due to improper diagnostic evaluation and improper embrasure forms both linked to the acceptable connector thickness recommended for FPD. The treatment plan offered to the patient was the replacement with conventional metal ceramic FPD for maxillary arch while the mandibular arch is in the process of receiving treatment using a cast partial denture with surveyed crowns on supporting abutments.
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INTRODUCTION

In recent advances in dental sciences, one of the material that has seen enormous attention in research is the dental porcelain. The focus has been to find a composition in porcelain, along with a technique that can be used as a posterior all ceramic crown and/or a fixed partial denture. Many materials and techniques have been tried in various compositions, but the answer to a perfect all ceramic restoration in the posterior replacement of natural teeth is still unanswered. The goal of posterior all ceramic systems is to achieve the strength that is closer to the already used base metal alloys. A restoration that was made entirely of porcelain was first tried but could not fulfil the criteria, which led to the focus being shifted to development of strong core materials that would hold the conventional feldspathic porcelain above. Historically, the substructure for all ceramic restoration has been either a cast metal or a snagged metal foil. [1] Other materials that has been in use as a substructure or a core are glass, ceramics, crystallized porcelains, sintered glass, ceramics, copy milled porcelains and computer aided diagnosis and computer aided machining (CADCAM) ceramics. The earliest technique of strengthening ceramic has stood the test of centuries in relation to time and the same method of strengthening ceramic through heat still exists in most forms of new dental porcelains. [2] The first ceramic denture tooth/teeth were made in 1774 (Alexis Dachateau) while the first all ceramic crown using a platinum foil matrix was patented in 1887 (C.H. land). [3], [4] The present day all ceramic crown as a restoration was developed in early 1900. Cheaper and user friendly material like acrylic resin took the limelight, until recently a renewed interest in ceramics was generated due to advances in robotic engineering. The platinum foil technique used in fabrication of early all ceramic restorations was extremely difficult to master which is one of the main reasons for it not gaining popularity and commercial interest. [3] Use of metal under ceramic became a treatment norm and most of the changes

in the metal substructure were related to the type of alloy to be used (noble or base metal alloys). The immediate drawback of using a metal as a substructure that leads to looking for new solutions was the mismatching in thermal expansions and contraction between the two materials (metal and porcelain). The first alternative to metal was developed in 1962 (Weinstein) with the introduction of Leucite containing feldspathic porcelain. [5] Research on ceramics since then has given rise to a plethora of porcelain types which can be gauged by the fact that dental ceramics can be classified according to 8 different types (firing temperature, uses, types, processing method, substructure material, fabrication methods, firing methods and applications). Currently, the market is flooded by 7 different types of porcelain compositions (feldspathic, leucite reinforced, aluminous, alumina core, glass infiltrated alumina and magnesium spinnel and finally glass ceramics). The processing has seen two advancements in casting (heat pressing) and machining (CADCAM, copy milling) from basic sintering. All ceramic can be machined, slip cast, heat pressed and sintered with basic constituents differing in each. [6] The disadvantages of olden days' ceramics though remain the same which are highly brittle, shrink on firing and cause occlusal natural tooth wear. [6] While the disadvantage of brittleness has been overcome to a large extent by different strengthening methods, one still needs to rely on the design of tooth preparation to achieve long term success in such restorations. Any feature that causes high tensile stress and stress concentration need to be avoided for all types of all ceramic restorations. A restoration is exposed to high tensile stresses when used as a posterior restoration. Among many substructures zirconia reinforced substructures have been found to be strongest tooth coloured substructure material. The problem of shrinkage still exists and all machined restorations have to be oversized so that they can compensate the large shrinkage (20 -25%) associated with it. [7] The other high strength all ceramic substructure is the alumina reinforced ceramic. Among various available all ceramic systems at present, only zirconia has been advised to be used a posterior FPD which also needs to be limited to short span and with extreme caution. [6], [7] These extreme cautions are purely clinical in nature and one needs to apply his basic knowledge and understanding of all ceramic material properties to ensure their clinical success.

This article in the form of case report highlights the significance of interpreting diagnostic data with extreme caution since the improper application can result in clinical failure as observed in this case.

CASE REPORT

An adult female patient reported to the undergraduate FPD clinics with a chief complaint of pain in relation to the left sided FPD in both arches since last 3 weeks. The mandibular FPD was lost as it had debonded from the prepared abutments after which she had misplaced it. Since the removal of the mandibular FPD had brought relief to her discomfort, she did not seek its correction by replacement. In the maxillary arch the patient had experienced dull pain that exaggerated upon chewing or when touched with the tongue. Patients personal, medical and drug history did not reveal any significant impact on past or existing dental treatment. The patient was socially active on virtual platforms like Instagram, WhatsApp and Facebook. Patients dental history revealed that she had undergone previous FPD treatment in the mandibular arch which was lost prior to getting it replaced again. When she had sought the replacement of mandibular lost FPD with a new one, she also got opposing missing two maxillary premolars on same side replaced with a fixed partial denture. The entire treatment was accomplished in the same institute by undergraduate students. Patient records revealed that 5 months back she underwent treatment for both missing maxillary and mandibular Kennedy class 3 partial edentulous situation with an all ceramic FPD. Extra oral examination revealed that she had a mild to moderate graded gummy smile and would expose the cervical margins of anterior teeth upon smiling.

Figure 1: (A) Intra oral examination showing a left sided four unit all ceramic FPD with cervical portion not conforming to underneath gingival contours and very high value shade (B) Left lateral view showing the maxillary failed all ceramic FPD and the lost mandibular FPD (note the mandibular tooth preparation with over tapered proximal surfaces) (C) Gingival dehiscence in relation to maxillary first molar and generalized marginal gingivitis due to lack of embrasure forms.

Patients oral hygiene was questionable when looking at her current dental status in term of decayed, missing and filled natural teeth.

Intra oral clinical examination revealed that in the maxillary arch there was a four unit all ceramic FPD (zirconia core with feldspathic porcelain) and in the mandibular arch there was partial edentulous space between first premolar and last molar on the left side of both arches (Fig 1). When viewed from the front, the maxillary canine was clearly visible and gave an artificial look since other adjacent teeth had multiple shades distributed in intensity of hue and chroma from cervical to incisal areas (Fig 1A). The neck of the retainer on the left canine was prominent and did not match the prominence on the other side. The incisal edge of the retainer on the canine was also not in symmetry with the contralateral canine. The gingiva under the FPD was oedematous and presented multiple inflammatory isolated lesions that were prominently distributed along the interproximal embrasures of the FPD (Fig 1B). The gingiva on the mesial aspect of the first molar retainer was more reddish and looked compressed and inflamed (Fig 1B, C). The maxillary FPD presented connectors that extended from the gingival margin to occlusal third. In the mandibular arch the prepared teeth were first premolar and last molar. The crown height of both preparations was less with over tapering of proximal surfaces (Fig 1B).

The patient was presented with multiple treatment options that were decided by the choice of conservation. These included the removal of the existing FPD in the maxillary arch followed by a temporary restoration till gingival inflammation would subside. The definitive treatment was the choice between restoring maxillary missing teeth with a conventional four-unit metal (Remanium CSe, Dentaurum J.P. Winkelstroeter KG, Ispringen, Germany) ceramic FPD or placing two single crowns on prepared abutments followed by implant supported restoration in relation to remaining missing teeth. For mandibular arch the choice of FPD was not an option since the span was too long. Therefore, treatment plan included restoration of a prepared abutment with individual single metal ceramic surveyed crown followed by the fabrication of a cast partial denture to replace missing mandibular teeth. The patient opted for conventional FPD in case of maxillary arch and a cast partial with surveyed crowns for mandibular arch. Designing of the cast partial denture framework was prepared and accordingly surveyed crowns were designed for the mandibular prepared abutments. For maxillary arch, routine clinical and laboratory procedures for fabricating a metal ceramic FPD were done. The patient is still in the process of treatment after completion of the maxillary FPD.

DISCUSSION

A case of a failed all ceramic four unit FPD has been presented with a brief overview of the types of all ceramics available. The cause of the failure is directly linked to the diagnostic evaluation of the abutments planned to be used for the FPD and the length of the span associated with it. One of the primary abutments was maxillary left canine and the distal abutment was maxillary left first molar. The cause of repeated failure in the mandibular FPD was planning a long span using short abutments, over tapering of preparations for the first FPD and failure to recognize the same for the second FPD. An all ceramic FPD was given in the mandibular arch during second treatment. This was probably decided that resin cement would be able to sustain dislodging forces. The first issue that needs to be discussed in such cases is the choice of all ceramic in the first instance. The patient was a female who was socially active, which could be one of the primary reasons for her to choose all ceramic since the general concept among the students is that all ceramic restorations are more esthetic than metal ceramic. The influence of metal over the overlying ceramic is limited to the effect on translucence and is overly compensated by the extra amount of tooth reduction that is desired for metal ceramic restorations. Technically and clinically, there should be no clinically visible difference between an all ceramic and metal ceramic restoration since the effect of metal on overlying ceramic is compensated by the use of an opaquer on metal and the extra thickness of porcelain. However, it is also true that certain patients insist on getting all ceramic restorations since they go by the marketing claims of companies that claim superior aesthetics at the expense of demeaning other options. Differences in aesthetic concepts between dentist and patients in this case has ultimately led to dissatisfaction of the patient with the treatment as reported in the literature. [8] For a student who wants to be an efficient clinician, it is important to refine basic knowledge by revising basic material science time and again during the course of their training. Such clinicians have also been stated to make the difference between the choice of treatment selected by the patient. [9]

Another major failure observed in the all ceramic retainer on the canine tooth is an over contoured cervical portion of retainer which is due to under preparation of the canine on the buccal surface. Extra preparation by few micrometres can enhance the aesthetic results and prevent the technician from making an over contoured restoration. [10] FPD failures have been classified by various authors and according to various types of FPD like failures according to FPD type (resin bonded FPD). [12], [13] With a total of eleven classifications, most of the failures in FPD have been attributed to diagnosis and embrasure forms. This article reiterates the

significance of both. In the maxillary FPD, the connector size fabricated during the machining of the coping was programmed which resulted in the connector paving way for embrasures especially gingival. Whenever planning an all ceramic bridge is done, it is mandatory to note down the clinical height of the abutment tooth and then analyze the height in relation to the permitted connector surface area that is different for different types of restorations. Because the flexural strength of base metal alloys is very high, therefore connector thickness can be kept minimum. [14] All ceramic on the other hand have less flexural strength, therefore the connector size has to be more (9 square millimetre to 16 square millimetres). [15] The permitted connector thickness of 9 mm square is for a three unit FPD while in this case a four-unit maxillary all ceramic FPD was fabricated. Since processing is programmed therefore adjustment of thickness is automatically increased or decreased in the machining systems. For every increase of the missing tooth, the connector thickness will be increased at the expense of the embrasures. [16] This explains the reason behind the extra vertical and horizontal thickness of the all ceramic FPD in the present case. All ceramic FPD has been limited to be used more in the anterior region than in the posterior region because it has a less flexural strength which needs to be compensated with extra connector thickness. While evaluating the pontic space in conventional FPD it is also important to determine the amount of horizontal space in both dimensions (mesio distal and bucco lingual). Pontic space available influences the choice of the connector as well as the pontic. [17] Selecting a FPD design that includes different type of material is complex. Besides local factors related to abutment and available pontic space, there are many other factors that determine the long term success of FPD. [18] Among the many described in literature, the case presented in this article highlights the patients desire and clinician's skill which led to the undesirable results ultimately resulting in FPD failure.

CONCLUSION

Prosthodontic treatment with any dental prosthesis requires strict patient adherence to enhance treatment compliance. It is important at times when dealing with over demanding patients, the prosthodontist must not succumb to patients' desires and be firm and authoritative in executing his treatment plan. All FPDs are specialized practices and anyone who wants to learn the skill must give due and deserved importance to the diagnostic data collection followed by its analysis and application for that particular patient.

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CONFLICT OF INTEREST

None

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