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Case Report

Contribution of Ceramic Restorations to Create an Optimal Interproximal Area

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1. Abstract

Amalgam has been a longtime, a very common procedure to restore decayed teeth. However the demand for esthetic look of natural teeth pushes our patients to seek replacement of these restorations. In the present paper, we report the case of a 28-year-old patient who was complaining about continuous food impaction between teeth number 46 and 45 because of the presence of aII class restoration not respecting interdental area. The patient expressed also his desire to replace these old restorations by esthetic ones. Lithium disilicate inlay /onlay was placed in tooth number 46 next to a zirconia based ceramic crown on tooth number 45 in order to achieve esthetics and the creation of optimal interproximal area.

2. Keywords

Amalgam; Composite resin; CAD /CAM; Periodontium; Gingival diseases; Dental inlay; Dental porcelain

3. Introduction

Dental caries is a significant oral health problem worldwide and nowadays, it is largely admitted that its treatment should focus on management of the carious process with a minimally invasive approach[1, 2].Over 100 years ago, Dr G.V Black proposed a classification system to categorize carious lesions based on the type of the tooth affected and the location of the lesion. Cavities on proximal surfaces of premolars and molars were defined as Class IIcavities [3].

This type of cavities is characterized principally by the damage that it brings to the interdental area that consists of: the contact surface, the interdental papilla and four pyramidal embrasures: cervical, occlusal, buccal and lingual [4].The shape and the health of interdental papilla are important in esthetics and in functions, including the prevention of food impaction.

The loss of the proximal walls leads to the loss of contact surface and open gingival embrasures which contributes to retention of food debris and can negatively affect the health of gingival papilla. It has been proved that inappropriate restoration of proximal contact leads to retention of food debris resulting in tooth decay or periodontal disease and possible pathological movement[4, 5].

So, the appropriate restoration of proximal contact with reconstruction of correct anatomic contour as well as the provision of appropriate proximal tightening is essential for periodontal health allowing self-cleaning process and also to maintain dentition stability and occlusal harmony.

Whether to restore directly with filling materials or to realize an indirect restoration with composite or ceramic inlay-onlay is still a challenging question for the practitioner.

It is largely admitted today that dental amalgam restorations have little place owing to their unesthetic appearance notwithstanding the issues around the Minamata convention on mercury). In fact, in 2013, the United Nations Environment Programme (UNEP) reached a binding agreement to decrease dental amalgam use regarding its environmental impact.

Resin-based composite materials meet patient's esthetic demand. However, there is some evidence[6] contra-indicating the use of resin composite materials via adhesive direct techniques in large size cavities or to recreate contact area and proximal adjacent walls. This because ofmany disadvantagesdescribed including considerable polymerization shrinkage [7] depending on depth and location, in addition to high occlusal wear. It has also been proved that proximal contact of composite restorations may deteriorate overtime.

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Bottenberg et al (2007) concluded on their study that quality of surface, margin and contact point decreased significantly over 5 years.

Restorations generated with CAD /CAM technology ensure ideal occlusal morphology and ideal proximal contouring to restore decayed posterior teeth and to overcome some of the disadvantages of direct resin composite.A wide collection of composite and ceramic materials are actually available for CAD /CAM technology. Ceramics are widely used as an indirect posterior restoration material because of their proved physical and mechanical properties. Current classifications divide ceramics into three types according to their composition: CAD /CAM glass ceramics, CAD /CAM polycrystalline ceramics and CAD /CAM resin matrix ceramics[8].

Lithium disilicate CAD /CAM ceramic (like IPS E Max®, IvoclarVivadent) was introduced in 2006. It possesses high fracture toughness which is higher than that of composite materials.

In this article, we will present a clinical situation in which a direct amalgam restoration was replaced by an indirect Lithium disilicate inlay, next to a non-vital tooth that was covered by a zirconia crown to ensure optimal recreation of interdental area.

4. Case Report

A healthy 28-year-old man was referred to the department of fixed dental prosthesis, the dental clinic of Monastir, Tunisia. He was complaining of repetitive food impaction between the teeth 45 and 46 because of a restoration of the contact area causing him pain and discomfort. The patient reported also an esthetic concern about the greyish aspect of amalgam restoration on the tooth 46.

Clinical examination revealed a medium oral hygiene, a class II amalgam restoration on the tooth 46. This tooth responded normally to cold thermal testing of pulpal vitality. The tooth 45 presented also an extended class II resin-composite restoration. It responded negatively to cold thermal testing (**Figure 1**).

The pre-operative radiograph showed an adequate endodontic treatment on the tooth 45 with absence of any radiographic changes. Clinical and radiographic examination revealed secondary caries nearing pulp on 46. At inter-proximal probing, bleeding was observed (**Figure 2**).

The Patient was interested in esthetical durable restoration. So, after comprehensive evaluation of and collection of data regarding the patient's complaint, a treatment plan including the replacement of the amalgam filling in 46 with a lithium disilicate inlay and the application of a layered zirconia crown on 45, was developed. It had begun by an initial therapy consisting of oral hygiene instruction and scaling which improved the gingival condition.

The removal of amalgam was realized under dental dam and followed by the excavation of recurrent caries subjacent to the restoration.

Then the tooth 46 was prepared respecting the guidelines of inlays' preparation. The unsupported and weak enamel was removed. The cavity walls were made divergent with rounded internal line angles. As the axial wall was nearer to the pulp chamber, a protective base of glass ionomer cement (FUJI I GC®, GC CORPOSATION TOKYO JAPAN) was applied on the axial wall.

At the same time, the tooth 45 was prepared to receive a zirconia-based all ceramic crown using round diamond bur (#6856-014). It required a bevel shoulder preparations for labial, lingual, mesial and distal margins. All the line angles and point angles should be rounded off. The taper should be 5 to 15 degree. The preparation was finished using multilayered carbide burs and finishing and polishing discs (**Figure 3**).

After final tooth preparation, the tooth 45 was cleansed and dried. A simultaneous double-mixed impression was made with a polyvinylsiloxane material (Virtual, IVOCLAR VIVADENT, Schaan, Liechtenstein) after a double gingival cord retraction (**Figure 4**). Shade selection was done using A-D shade guide®, IVOCLAR VIVADENT (**Figure 5**).

In a clinical session, one week later, the zirconia coping (AMMAN GIRRBACH®, Zirconia Disc, IVOCLAR VIVADENT) was tried in and internal fit and marginal adaptation were assessed in the prepared tooth (**Figure 6** and **7**).

A second impression was made with the framework placed on the preparation (**Figure 9**).

Figure1: Initial Situation

a- An occlusal view

b- A buccal view demonstration the absence of interdental papilla between the teeth 45 and 46.

Figure 2: Teeth preparation

Figure 3: Shade selection

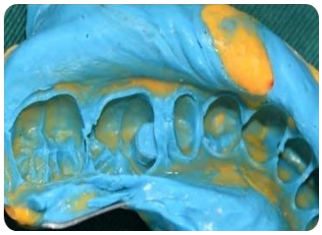

Figure 4: Simultaneous double-mixed impression

Figure 5: The zirconia coping is ready for clinical try

Figure 6: Clinical try-in of the zirconia framework

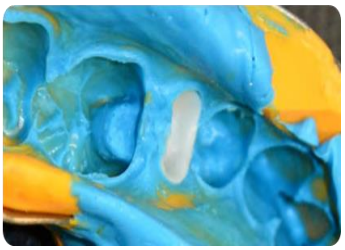

Figure 7: Second impression

Figure 8: Final restorations

Figure 9: Final result

This impression was used to perform the ceramic inlay and to veneer the zirconia coping with porcelain layer (AMMAN GIRRBACH® E MAX CERAM A1, IVOCLAR VIVADENT). These steps are realized at the same time to ensure a perfect reproduction of the contact area. A distance of 5mm between bone and contact point must be respected to have a papillary regeneration.

After the reception of the final restorations, the marginal adaptation, interproximal contact, shape, shade and esthetic harmony were evaluated together. The occlusal contacts were adjusted at maximal intercuspidation.

The zirconia-based crown was cemented using glass ionomer cement (FUJI I GC®, GC CORPOSATION TOKYO JAPAN) since it has a polycrystalline structure with no glass phase.

Posteriorly, the internal surface of the inlay (IPS E Max® CAD, IVOCLAR VIVADENT) was etched with 4, 5% hydrofluoric acid (ACID HYDROFLUORIC CERAMIC ETCHING GEL®, IVOCLAR VIVADENT) for 90s, and then washed under running water and air dried. A silane coupling agent (was applied for 3 min, as per the manufacturer's instructions. For the dental substrate treatment, 37% phosphoric acid (N ETCH ®, IVOCLAR VIVADENT) was applied for 15s followed by washing and air drying; two consecutive coats of the adhesive system (N BOND UNIVERSEL®, IVOCLAR VIVADENT) were then applied with rubbing for 20 s then gently air-dried and light-cured for 10s.

A thin layer of adhesive was applied on the inside of the restoration and not cured. The inlay /onlay was luted using a dual

polymerizing luting agent (MULTILINK®, IVOCLAR VIVADENT). The restoration margin was light cured for 3s on each side, excess material was removed and all restoration faces were light-cured for 60s.

Occlusal contacts at the maximum intercuspidation and mandibular movements were finally adjusted.

The final appearance was evaluated immediately after cementation. The patient was satisfied with the result (**Figure 9** and **10**).

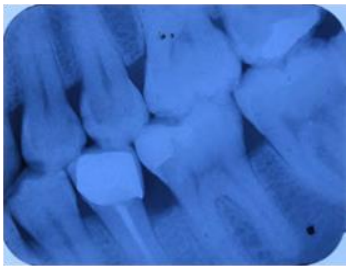

Figure 10: Post-operative bite-wing radiograph after 6 months

5. Discussion

Direct restorations are the most accomplished procedures in daily practice [9].

Dental amalgam has been commonly used as a filling material. It has the advantages of being cost-effective, sustainable and resistant to chewing forces in addition to its easy manipulation[10].

However the use of amalgam in dentistry has been controversial since the 19th century. In one hand, the European commission affirmed the lack of scientific evidence of the negative effects of dental amalgam on general health [11].

On the other hand, several studies have demonstrated correlations between the numbers of amalgam restorations and the mercury level found in patient's blood, urine and even amniotic fluid which might lead to degenerative illnesses like Parkinson's disease[12, 13].

Many countries like Norway have banned the use of dental amalgam, and all over the world, the rate of replacement of amalgam restorations has grown[14]. In addition to its controversial adverse effects on general health, its unesthetic aspect annoys the patients of nowadays.

There is also several other reasons why practitioners replace amalgam restorations like, essentially: secondary caries, attrition the loss of the restoration or of a part of it, and color change[9,15]. The criteria used by the practitioner to decide whether to repair or to replace the current restoration are very important because the replacement of every restoration engenders an additional loss of healthy substance and may bring additional damage to pulp. Thus, less invasive treatment for deficient amalgam like marginal seal or repair are more recommended. However, when we need a reproduction of the contact area in presence of an adjacent restoration, the replacement of amalgam restoration would be of extreme emergency.In fact, in the words of Keogh[16], even when properly performed amalgam restorations result in a straight line "Tofflemire contour" and not an anatomically correct contact as it can be evidenced by radiograph. As a matter of fact, thepresence of not precisedirect restorations is a very common cause of the loss of interdental papilla due to continuous food impaction. The loss of gingival papilla height can result in open gingival embrasures, phonetic problems, food impaction, and esthetic concerns several factors influence papilla form and may cause its loss. Therefore, it is really important for the clinician to prevent papilla loss and to better understand the challenges of regenerating lost gingival papilla [17].

In fact, lost dental papilla is difficult to regenerate and till now there is no studies demonstrating a predictable technique for papilla reconstruction[18].

The most crucial factor of regeneration of dental papilla is a distance between contact point and crest <5mm according to[19, 20] demonstrated in their study that both interproximal distance between roots and distance between contact point and alveolar crest are independent factors of papilla regeneration.

To sum up, the reproduction of tight contact area at a distance >5mm from alveolar crest, with correct proximal contours is a condition of success of class II restorations.

With the increasing popularity of resin composite as a direct posterior restorative material, issues with the reconstruction of proximal contact have emerged[21].Found in their study that resin composite showed looser proximal contacts than amalgam and that the use of high viscosity composites does not improve tightness compared to medium viscosity composites. Also, the elasticity of resin composite prohibits its condensation into the cavity and, in combination with thickness of matrix bond, makes the creation of tight contact surface an elusive goal. In addition to many important problems associated with direct resin composite resin restorations like loss of marginal seal due to polymerization shrinkage and post-operative sensitivity [22].These defaults weren't improved by the use of sandwich technique or by the use of increments technique[23].

Lately the development of resin-based adhesives and restorative materials has stimulated the use of indirect inlay /onlays. The indirect restorations manufactured with CAD /CAM techniques had better potential for generating anatomic forms[24]. The conception using appropriate software leads to optimal contouring and precise location of the contact area.

Currently, several resin and ceramic materials are available for fabricating indirect partial restorations. Ceramic materials

showed a high rate of success ranging from 75% to 95% in 15 years[25, 26].According to[27], tooth vitality was an important factor for restoration survival. Indeed, they found in their study that failure rates were 80% lower than for endodontically treated teeth.

Lithium disilicate is a high strength glass ceramic that thanks to the bonding[28], helps strengthen the structure of the decayed tooth. In fact, resin based adhesive systems tends to deform under stress.

[29]In 2008 found in their three-dimensional finite element analysis that ceramic inlays demonstrated better marginal integrity than the composite resin inlays. Actually, the increase of the rigidity of restoration material considerably lowers the stress at the adhesive joint.

Indirect restorations have a better survival rate than direct ones. In fact, 50% of direct restorations need to be replaced at 9 years, while 75% of inlay /onlays are still functional after 10 years[30, 31].

6. Conclusion

The development of adhesive dentistry, dental materials and CAD /CAM technology has generated growing interest for posterior indirect restorations among practitioners. This category of restorations enables conservation of the remaining dental structure and reinforcement of the decayed tooth. Another important advantage is the creation of correct contact surface and proximal contouring which contributes to the preservation of interdental papilla. Nevertheless, the respect of the indications, the choice of the luting agent, the form of preparation and the mastery of the adhesive protocol determine their success rate and durability.

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