Deficiencies in Silicone Impression for Crowns and Bridges

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There are many steps in fabrication of dental crowns and bridges at which an error can occur, and a technician can only fabricate a quality restoration if the impression itself is of adequate quality. All dental practitioners should have the ability to evaluate the quality of dental impression before sending to the laboratory. Elastomeric silicones (polysiloxane) are the most utilised impression materials in dental practice. The present study deal with the deficiencies of silicones dental impressions sent to commercial dental laboratories for fabrication of single crowns and bridges.

Keywords: polysiloxane, dental impression materials, crowns and bridges

A correct dental impression is essential to the fabrication of well-fitting laboratory crowns and bridges. Obtaining a good quality dental impression is one of the most challenging procedures in fixed prosthodontics [1, 2]. Despite continuous progress made by dental materials, the quality of impressions sent to dental laboratories is still deficient [3-5].

Impression materials are biocompatible polymers [6]. Elastic impression materials (elastomers) are used for dental impression in fixed prosthodontics. An elastomer is a polymer with viscoelasticity (having both viscosity and elasticity) and very weak inter-molecular forces, generally having low Young's modulus and high failure strain compared with other materials [7]. Elastomers used in fixed prosthodontics are classified in polysulfides, silicones and polyethers. The use of silicones far exceeds the use of all other impression materials in general dental practice [8] because they are highly elastic and possess superior compatibility with human tissue and body fluids and are biologically inert [9]. In fixed prosthodontics, the important properties are: adequate setting time, excellent details reproductions, pleasant odour and minimal distortion on removal.

Silicones are polysiloxane, organosilicon polymers, with general formula $(R_2SiO)_n$ (fig. 1), where R can be any one of a variety of organic groups, usually vinyl, methyl, or phenyl. They are easily transformed into a three-dimensional network by way of a cross link reaction, which allows the formation of chemical bond between adjacent chains [10]. Silicone elastomers are cross-linked according following one of these reactions: cross-linked with radicals, cross-linked by condensation, cross-linked by addition.

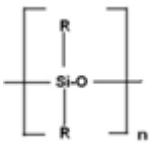

Fig. 1. Chemical formula of polysiloxane

In dentistry, condensation-cured silicones and addition-cured silicones are used, available in the following range of viscosities: light, medium, heavy and putty. C-type silicones (condensation-cured) are dimethylpolysiloxane, usually catalysed using organotin salts. They show significant shrinkage problems (due to evaporation of ethyl alcohol as a by-product of curing reaction [11], if impression is not poured immediately), but price-wise, are convenient.

The A-type silicones (addition-cured) are vinyl polysiloxanes, catalysed using platinum. They have very high dimensional stability over time and temperature, because there are no by-product of curing reaction, but nevertheless, expensive.

As there are many steps in fabrication of crowns and bridges at which an error can occur, the technician can only be expected to make a quality restoration if the impression itself is of adequate quality. Since the quality of dental impression decides the long-term success or failure of future restoration, all dental practitioners should have the ability to evaluate the quality of dental impression before sending to the laboratory [12].

An acceptable impression must be an exact record of all aspects of the prepared tooth and it must include sufficient unprepared tooth structure immediately adjacent to the margins for the dentist and laboratory technician to identify the contour of the tooth and all prepared surfaces [13, 14].

The aim of this study is to assess the deficiencies of silicones dental impressions sent to commercial dental laboratories for fabrication of single crowns and bridges.

Experimental part

Three dental laboratories are visited over one month period. A number of 247 silicones impressions for dental crowns and bridges were examined. From the study, impressions for veneers, resin bonded bridges and implant-supported restorations were excluded.

All impressions were evaluated under ambient room light without any additional room light and with 2.5 magnification loupes. All impressions were evaluated after disinfection and before being poured with stone. In cases with abutments impressed, a defect on any abutment was scored as a defect for the entire impression.

According to *Rosenstiel et al 2016* [14] the following points of evaluation of a silicone impression must be considered:

-the material should be properly mixed with homogenous colour, impressions that contain visible streaks of base or catalyst material should be rejected;

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-custom tray should not show through impression material, it is acceptable a thin spot which is not near the prepared teeth;

-any voids, folds or creases are not acceptable, except small defects in a noncritical area (away from the margin of a prepared tooth);

-presence of an even, uninterrupted extension of impression material beyond the margins of the prepared teeth;

-the impression material must not be separated from the tray.

As well, certain deficiencies were considered: lack of fluid material from the cervical margin of preparation and presence of foreign materials like blood or haemostatic substances [4, 12].

Results and discussions

The result of evaluation is presented and table 1 and illustrated in figures 2-7.

An accurate impression must be free of air bubbles, tears, thin spots, and other imperfections that might produce inaccuracies especially in area of the finishing line and occlusal surface of the other teeth. If bubbles or voids appear in the finishing line, the impression must be discarded.

Care must be taken in handling impression materials: sulphur inhibits vinylpolysiloxane setting time and impression presents uneven colour or lack of details. Latex gloves [15, 16] and haemostatic substances like epinephrine or ferric sulphate may inhibit setting time [17] due to contact with gingival tissue, tooth or impression material.

Disinfectants like glutaraldehyde may affect long-term surface details reproduction of polysiloxane impression materials [18].

Visible streaks of base or catalyst material was present in a small number of impressions (2.43%) (fig. 2). One explanation could be the decreasing use of hand-mixed material in favour of hand dispenser system or automatic mixing system, which ensure correct mixing ratio between catalyst and base paste.

Also, tray shows through impression material is encountered in 4.45% of impressions evaluated (fig. 3), which means correct choice of tray. A separation of impression material from the tray was more often was encountered (6.48%) (fig. 4), due to absence of tray adhesive.

The most frequent deficiencies in this study are related with cervical finishing line. Voids, folds or creases, an uneven / discontinuous extension of impression material beyond the margins of the prepared teeth, lack of fluid material from the cervical margin of preparation, presence of foreign materials, all are connected with a poor registration of with cervical finishing line (figs. 5-7). Fluids like blood or saliva around preparation alters as well accurate registration of details [19] similar with the existence of residues from temporary crown or provisional cements present in gingival sulcus.

In order to obtain an exact reproduction of this area, the knowledge of the anatomy of cervical area and selection

Deficiency	Number/Percentage
1. visible streaks of base or catalyst material	6 of 247 (2.43%)
2. tray shows through impression material	11 of 247 (4.45%)
3. voids, folds or creases	32 of 247 (12.96%)
4. presence of an uneven, discontinuous extension of impression material beyond the margins of the prepared teeth	108 of 247 (43.72%)
5. impression material separated from the tray	16 of 247 (6.48%)
6. lack of fluid material from the cervical margin of preparation	39 of 247 (15.79%)
7. presence of foreign materials	14 of 247 (5.67%)

Table 1
FREQUENCY OF OBSERVED ERRORS

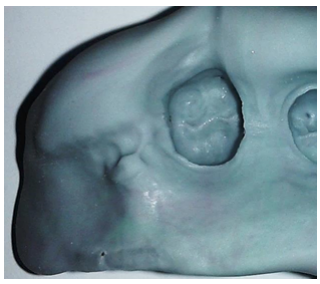

Fig. 2. Inadequate mix between catalyst and base paste. Visible reddish lines (catalyst)

Fig. 3. Tray shows through impression material

Fig.4. Impression material separated from the tray

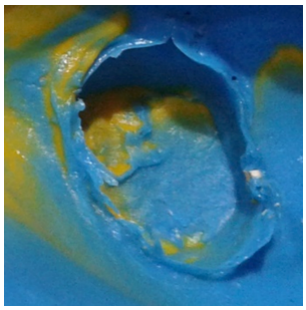

Fig.5. Presence of an uneven, in discontinuous extension of impression at gingival margin and foreign body

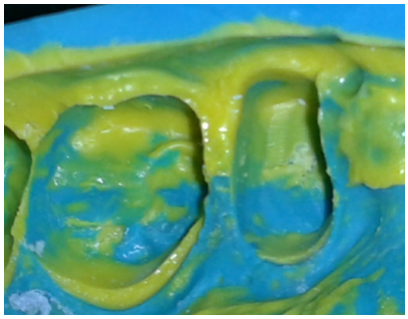

Fig.6. Void and lack of fluid material from the cervical margin of preparation

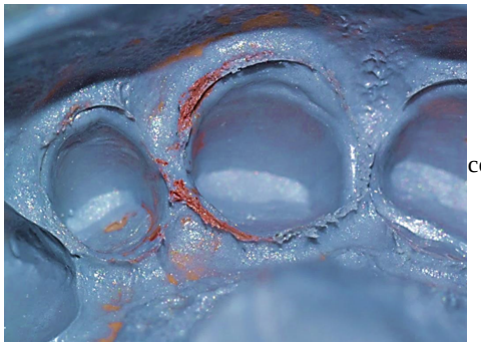

Fig. 7. Presence of haemostatic agent in contact with impression material

of adequate method of enlargement of gingival sulcus are mandatory [20, 21]. An inadequate enlargement of gingival sulcus and the presence of liquids at this level lead to errors in impressioning of this area. An enlargement of gingival sulcus less than 0.2 mm creates voids at gingival margin and has a high probability of distortions [22]. A gingival sulcus of 0.2 mm may be registered by any type of elastomeric impression material and technique, but a narrow sulcus less than 0.2 mm wide requires double-mix technique with two viscosity materials (light body wash and heavy body) [23].

Conclusions

Achieving excellent results with crowns and bridges depends on obtaining an accurate representation of dental preparation and surrounding soft tissue. Within the limitation of this study, a more critical evaluation of impressions by dentists is recommended.

Detecting of deficiencies requires thorough examination of dental impression. The possible causes of imperfections should be identified and solved before taking impression.

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