COMPARISON OF SEVERAL PROXIMAL CONFORMATION SYSTEMS' CLINICAL EFFICIENCY IN RESTORATIVE DENTISTRY

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Abstract: *A correct proximal restoration needs a protocol which implies an adequate choice of the restorative technique and of the instruments according to the features of the clinical case. The aim of this study is to evaluate the clinical efficiency of three proximal conformation systems by the clinical and radiological assessment of the restored proximal surfaces.*

INTRODUCTION

Performing correct proximal restorations has always been up to several difficulties related to the possibilities of restoring the original configuration of the proximal surface with good gingival margin seal.

A very important part in the protocol of restoring proximal caries is played by the proximal conformation system whose choice depends primarily on the features of the clinical case. Even if there are a lot of specific morphological features, some general data regarding the morphology of the proximal surfaces and contact areas of the permanent posterior teeth is important to be reminded.

The embrasures are gingival, occlusal, buccal and lingual. The more the teeth are in a posterior location, the wider the occlusal and buccal embrasures get.

General data say that the highest convexity of the mesial surfaces of the posterior teeth is occlusally oriented while the distal surfaces have the highest convexity oriented cervically. The contact areas are situated at the intersection of the medium and occlusal thirds in a vertical plan and they are also located at the intersection of the buccal and medium thirds in a transversal plan.

The embrasures have symmetry with a few characteristics:

1. The proximal slopes of two adjacent marginal ridges have the same inclination;
2. The proximal slopes of two adjacent marginal ridges have the same bucco-lingual (bucco-palatal) symmetry;
3. The marginal ridges of two neighbouring teeth have the same height;
4. The angular symmetry of the buccal and oral embrasures is present till the transition lines;
5. The cervical lines of a cervical embrasure are at the same level vertically;
6. The transition lines of two adjacent units of all the embrasures have symmetry (especially vertical).(1)

Both proximal surfaces of the first upper premolar have developmental concavities in the cervical third, while the distal contact area is situated more buccally than the location of the mesial contact area. The mesial marginal ridge has a peculiar developmental groove.

The second upper premolar has proximal surfaces without any concavities, the mesial contact area being situated lower than the other one.

The first maxillary molar has a longer mesial ridge than the distal one. The mesial contact is located close to the marginal ridge with buccal orientation. The distal contact area is vertically at the same level and it is located half way between the buccal and palatal surfaces.

The second upper molar has contact areas situated towards the center of the proximal surfaces, while the third molar is variable in shape.

The first lower premolar has the distal marginal ridge situated above the mesial one, while the two contact areas are located at about the same height.

The second mandibular premolar has a mesial marginal ridge located above the distal one. This premolar has also the mesial contact above the level of location of the distal contact area.

The first lower molar has a flat or concave mesial surface in the cervical region and it is convex in the other two thirds. The distal surface is narrower than the mesial one. The mesial contact area is just below the marginal ridge with bucco-lingual orientation.

The second and third mandibular lower molars have proximal surfaces with convexity and contact areas with cervical orientation.

Some general information about the features of the proximal configuration systems for posterior teeth is also welcomed. The proximal configuration systems together with dental wedges play a very important part in the morphological and functional restoration of the destroyed proximal walls and embrasures. A system always has a plastic or metallic matrix and a device that holds the matrix on the tooth.(2,3,4,5,6,7)

The matrix may be flat or slightly contoured and the retainer may have various designs and sizes. These devices may be made of plastic or steel and they may be manipulated by hand or by auxiliary instruments. The systems may have the retainer and matrix applied separately on the tooth or the two components form a single device that is adjusted to the outlines of the tooth.

The wedges are also very important and play different parts in the working protocol. They may be used sometimes to separate the teeth before excavation, they protect the gingival papilla and they essentially adjust the matrix to the rest of the proximal wall.(2,3,4)

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Nowadays, the wooden or plastic wedges come in different designs and sizes. Some wedges used for the initial separation of the teeth have incorporated metallic bands for protecting the adjacent proximal wall during excavation. These bands may be then replaced with metallic matrix. There are also modern proximal configuration systems which have incorporated wedges.(2,4)

PURPOSE

The aim of this study is to evaluate the efficiency of three proximal conformation systems used to restore caries which destroyed both proximal surfaces of the tooth.

The clinical and radiological analysis of the quality of the restorations intended to determine the configuration of the restored proximal wall, the characteristics of the new contact area and the quality of the gingival margin seal and buccal and oral margins of the restorations.

MATERIALS AND METHODS

150 maxillary and mandibular teeth diagnosed with both a mesial and distal carious lesions were involved in this study. The caries were primary or secondary to incorrect fillings.

The 300 cavitary caries had various extensions, the marginal ridges having different rates of destruction.

The moisture control method used Optidam (Kerr) and a gingival retraction cord for additional gingival humidity control. The caries were then excavated with burs and abrasive rotary instruments, the dentinal surfaces were disinfected and the pulp was protected with different layers according to the depth of the excavated cavity. According to the clinical situation, the pulp was actively protected using self-curing calcium hydroxide (Calcidor, Dorident) and passively protected with light cured glass ionomer cements modified with resins (Ionosit, DMG).

The teeth were finally restored using a radio-opaque nano-hybrid composite with a 5th generation adhesive system (Charisma Diamond, Haereus Kultzer). The material was chosen thanks to its good aestethics, proven durability and ease of handling.

The protocol of the application carefully followed the instructions for use of all the producers in all the clinical situations. Every clinical case had the proximal conformation system applied after the demineralization and before the primer/adhesive were applied.

The restorative composite material was applied using an anatomical layering technique and a contact forming instrument was used in every clinical situation.

Three proximal conformation systems were used during this stage, their efficiency being evaluated after the clinical and radiological analysis of the restored proximal walls.

Plastic straight and curved wedges were used according to the clinical needs, metallic bands for the protection of the adjacent proximal walls during excavation being used whenever it was necessary.

The following three proximal conformation systems were used to restore the missing proximal walls:

- individual plastic matrix with incorporated retainer (TDV). These systems are disposable, the matrix is pre-contoured, the incorporated retainer allowing the adjustment and fastening of the matrix to the anatomical outlines of the tooth. They may be used in any quadrant of the mouth and they have molar and premolar sizes.
- incorporated retainer and matrix Omni-Matrix (Ultradent). These disposable systems allow the adjustment of the matrix by twisting the conical handle. They have articulated head swivels which make them proper for use in any quadrant of the mouth. This study involved the red handled Omni-Matrix which have transparent matrix.
- retainer and matrix Adapt® SuperCap® Matrix (Kerr). The transparent matrices used in this study were pre-contoured, with premolar and molar sizes, the blue and green cylindrical retainers being manipulated using the SuperLock® tensioning instrument.

Every 50 clinical cases involved the use of one of the proximal conformation systems included in the study, the final evaluation of the quality of the restorations being made using clinical and radiological methods.

The clinical and radiological assessments were completed by three practitioners (observers) with different levels of medical training, the accuracy of the working protocol being constantly supervised.

The clinical cases were radiographed using no 2, speed E/F films and a standardized radiological technique (Toshiba B082D long cone device - 60 kV, 1.5 mA and 0.5 seconds). All the films were automatically processed by a single technician in order to avoid subjective variations.

The radiographs were scanned using a commercial flatbed scanner with transparency adaptor (Genius HR-7 1200/2400dpi) connected to a personal computer, at a scanning resolution of 400 dpi. The scanner had been previously calibrated in order to get the optimum resolution for digitizing intraoral radiographs. The radiological images were finally examined by the three observers who were provided with oral and written instructions about the use of Adobe Photoshop CS2 software as an image editor. All the digital images were assessed after being displayed on the same monitor. The observers were allowed to optimize the scanned image using the digital commands of the image editor. The aim of the radiological assessment was to identify the quality of the restored proximal walls and contact areas and to identify the incorrect restorations which needed replacement.

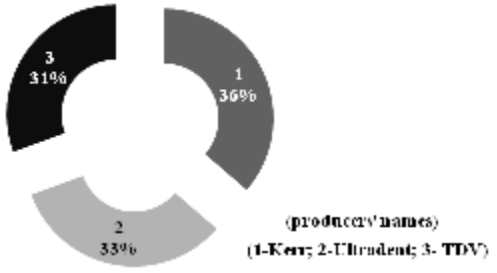
Finally, a statistical connection was made between the correct restorations and the proximal configuration system used to provide them. A statistical link was also done between the incorrect restorations in need for replacement and the proximal configuration systems used in these clinical cases. In the end, several statistical charts were completed in order to establish the efficiency of the three proximal conformation systems.

RESULTS

80% of the assessed clinical cases were identified by all observers as being correct restorations. The rest of them needed replacement or corrections using a similar or another conformation system.

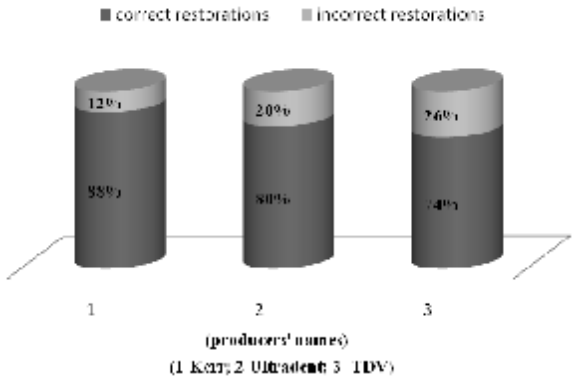
Kerr's proximal conformation systems was involved in the accomplishment of most of the correct restorations, the other two (Ultradent, TDV) coming in succession behind (figure no. 1).

Figure no. 1. The overall efficiency of the proximal conformation systems



The ratio of success for each proximal conformation system is the first step in the identification of the deficiencies of every one of them (figure no. 2).

Figure no. 2. The efficiency of each proximal configuration system



The evaluation of both mesial and distal restored walls was achieved by the observers using a group of criteria for morphological and functional proximal restorations.

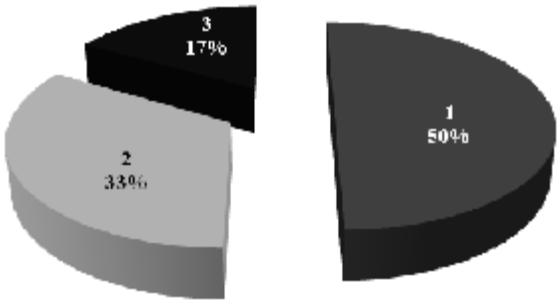
The criteria used by all the observers involved:

- correct convexity of the restored proximal walls (A);
- correct location of the newly restored area of inter-dental contact (B);
- correct seal of the gingival proximal margins (C);
- undetectable (buccal and lingual) restorative margins of the recently restored proximal walls (D).

A bunch of unfulfilled criteria for each system emerged after the clinical and radiological examination of the incorrect restorations.

The most frequent deficiencies identified to the restorations performed with Kerr's proximal conformation system involved incorrect convexity of the recently restored proximal walls (figure no. 3).

Figure no. 3. Unfulfilled criteria of Kerr's system



1- A; 2-B; 3- C

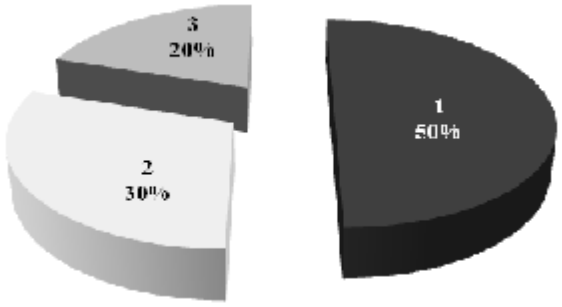
All of these improper restorations have been replaced using a similar proximal configuration system with the same retainers associated with metallic matrix instead.

The incorrect restorations that used Ultradent's system revealed a high percent of associated unachived criteria for the same restorations such as incorrect convexity of the proximal walls and wrong location of the contact area (figure no. 4).

Both Ultradent's and TDV's systems provided improper, detectable restorative margins (buccal and lingual) of the recently restored proximal walls, the latter also being the source of the highest rate of failed gingival margin seal (figure no. 5).

20% of the incorrect restorations obtained with Ultradent's system were replaced using an Omni-Matrix with metallic matrix while 80% of them were retreated using another proximal configuration system.

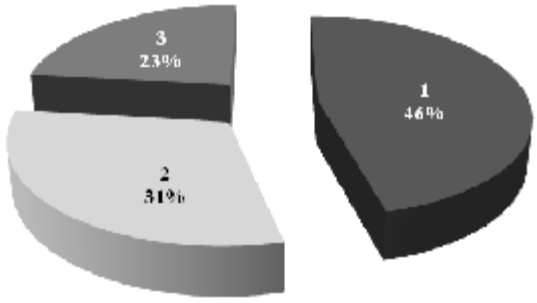
Figure no. 4. Unfulfilled criteria of Ultradent's system



1 A+B; 2 C; 3 D

85% of TDV's incorrect restorations were performed using another proximal conformation system, the rest of them being replaced using a TDV system with metallic matrix instead.

Figure no. 5. Unfulfilled criteria of TDV's system



1- A B; 2-C; 3- D

DISCUSSIONS

The reasons for which incorrect restorations appeared are various and they do not involve the proximal configuration systems only. The deficiencies of the bad restorations may be due to several improper working protocol steps such as:

- improper acquaintance with the particularities of the clinical case;
- improper preparation of the cavity;
- improper gingival moisture control;
- improper following of the instructions of use of all products;
- improper layering technique of the composite;
- improper use of the additional instrument for completing functional area of contact;
- improper choice of the proximal configuration system according to the features of the clinical case;
- improper use of the proximal configuration system;
- improper pre-wedging technique;
- improper choice of the wedge according to the features of the clinical case;
- improper use of the wedge.

The plot of this study is however focused on the features of several proximal configuration systems and on the way they may influence the quality of the final restorations.

The largest number of proper restorations was accomplished by using retainers and matrix Adapt® SuperCap® Matrix (Kerr).

The reasons why these systems performed well may have been the small size of the retainers which are very well stabilized on the tooth using the SuperLock® tensioning instrument.

All the incorrect restorations that had involved Kerr's system were related to caries with very large destruction level of the marginal ridge, the buccal and lingual margins of both mesial and distal regions being placed far from the initial contact area.

The identified deficiencies of these restorations were (in order of frequency): incorrect convexity of the proximal wall, improper location of the new contact area and inaccurate seal of the gingival margin.

These restorations were replaced using the same system with metallic matrix instead. The extended loss of dental tissue seemed to be in need for a more rigid matrix which proved to be a better choice in these situations.

The second most effective proximal configuration system that provided morphological and functional restorations was Ultradent's Omni-Matrix with red handle. The reason for these achievements may have been the lightness of the retainer (despite its big size) and the articulated head swivels which allowed it to be held tight to the outlines of the teeth.

The identified defects of the incorrect restorations were (in order of frequency): incorrect convexity of the proximal wall with improper location of the new contact area, inaccurate seal of the gingival margin and improper detectable (buccal and lingual) restorative margins of the recently restored proximal walls.

The clinical cases that have not been completed using Ultradent's system involved big loss of dental tissue or belonged to the second or third upper molars.

The first kind of clinical situations have been successfully overcome using a type of Omni-Matrix with metallic matrix, the other cases being solved using another category of proximal configuration system.

Considering a proper choice and use of a wedge, the matrix is sometimes not adjusted properly on the tooth because of a certain instability of the retainer which strains downwards the band.

This light movement is due to the weight and dimension of the retainer which proves itself, in some situations, not light enough, the surroundings interfering constantly with its spatial position.

The shortcoming of Ultradent's system still lies in the big size of the plastic retainer, despite the seeming lightness of this device.

The deficiencies of the restorations built using TDV's system were (in order of frequency): incorrect convexity of the proximal wall with improper location of the new contact area, inaccurate seal of the gingival margin and improper detectable (buccal and lingual) restorative margins of the recently restored proximal walls.

The clinical cases that have not been solved properly using TDV's system were various, some of them not having peculiarities.

Despite the use of performing wedges, the way the retainer works does not seem to offer, in some situations, a proper adjustment of the matrix on the tooth. Still, some of the situations were solved with a TDV system with metallic matrix instead.

In all the clinical cases that presented various degrees of subgingival extension, technical problems were encountered, the final restorations having frequently various deficiencies. No matter of the proximal configuration system involved in these cases, different technique tricks according to the practitioner's skills opened the way to success.

The posterior teeth with small coronal dimensions provided also difficult clinical situations for all the systems. We frequently solved these cases by using plastic matrix with stopper for anterior teeth.

CONCLUSIONS

Accomplishing correct proximal restorations depends essentially on the following of all the steps of the working protocol, the final result being a direct consequence of the practitioner's knowledge and skills.

All clinical situations have specific features which might interfere with the classic steps of a certain technique, these peculiarities driving, however, a bright practitioner on the right way of taking care of all the specific needs of every clinical case.

The proximal configuration systems play a very important part, its choice depending on the characteristics of the clinical situations and on the practitioner's experience.

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