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TOOLS AND PREPARATION GUIDES FOR ASSESSING TOOTH REDUCTION

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ABSTRACT

The science of fixed prosthodontics is highly demanding. Successfully treating a patient by means of fixed restoration is a combination of many aspects of dental treatment. Teeth requires preparation to receive restoration. Adequate tooth reduction is a prerequisite for the longevity of the restoration. Tooth preparation should follow fundamental principles to achieve success of the restoration. A good tooth preparation allows subsequent steps to be accomplished well. Hence tooth preparation should be measured to ensure uniform reduction of tooth and sufficient clearance for the restoration. The objective of this review article is to present various tooth reduction guides and methods from past to till date to enable the clinician clinically and in laboratory to achieve adequate tooth reduction.

KEYWORD:- Occlusal Clearance Guides, Tooth Preparation Guides.

INTRODUCTION

The key features and prime requisites of a prosthesis for rehabilitation of the stomatognathic system consists of restoring normal contour, function, esthetics, comfort, speech and maintaining the health of the surrounding tissues. The success of fixed prosthodontic treatment is a combination of various factors from patient education, sound diagnosis, operative skills, occlusal considerations.

Adequate tooth reduction is critical and crucial phase in fixed prosthodontics. If inadequate tooth reduction is done, resistance and retention features are not achieved and excessive tooth reduction leads to pulpal damage and weakening of the tooth structure resulting in failure of prosthesis.

Regardless of the method used for tooth preparation it is desirable to measure the amount of reduction before impression is made. For convenience and understanding the various methods have been categorized into conventional and recent techniques from past to present. various techniques recommended by different authors are as follows

Conventional techniques

- 1. Bite registration wax^[2]
- 2. Blotting paper & Articulating paper^[1]

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3. Putty index^[9]

Recent techniques

- 1. Silicon registration material with thermoplastic matrix^[4]
- 2. Clinical determination of angle convergence using mouth mirror^[5]
- 3. Hinged putty index^[7]
- 4. Fleximeter strips to determine clearance^[6]
- 5. Custom wax guide^[3]
- 6. A novel chairside technique to assess the interocclusal clearance and abutment axial walls during tooth preparation.^[11]
- 7. Customized occlusal reduction guide made from a thermoplastic sheet.^[8]
- 8. Digital preparation-evaluation tool.^[10]

1) Bite registration wax

This is the most commonly used technique. A piece of baseplate wax is cut into rectangular shape, softened uniformly and placed over the prepared tooth and adjacent tooth on either side of the tooth prepared and asked the patient to bite into maximum intercuspation. After the wax has cooled, removed and checked for the thickness of the wax against light for adequacy of tooth reduction.

Materials used - Bite registration wax, putty, bite registration resin.

Advantages

- a) Simple method
- b) Material easily available

Furthermore, the wax may stick to the teeth and

distorts the impression when removing the wax,

making the procedure even unsuitable for an

Disadvantages

- a) This method does not result in reliable measurements.
- b) It is only an estimate of the occlusal clearance, not a direct measurement.
- 2) More comprehensive method is the use of blotting paper as a thickness gauge



c)

estimate.

Fig. 1

METHOD

In this method articulating paper is held on one side of the articulating paper holder and blotting paper is held on other side that serves as a thickness gauge. Thickness gauge is placed over each cusp of tooth, patient is instructed to close in centric relation for each cusp. If gauge slips through, enough reduction is made. If gauge does not slip through, additional reduction is indicated. To find where the reduction has to be done, articulating paper section of the gauge is used. It is placed on the occlusal surface of the prepared tooth and ask patient to bite on it. The high spots are marked, then tooth is

3) Putty index



Fig. 2

Method

Putty is mixed with accelerator and kneeded in the palm of hand until uniform colour is obtained. Putty is then adapted to the unprepared tooth surface that has to be prepared and also adjacent tooth on the diagnostic cast or in the patients mouth such that it covers the occlusal, buccal, lingual surfaces of the teeth and allowed to polymerize that takes about 2 minutes. The putty index so obtained is sectioned at the central groove dividing it into buccal and lingual halves. This is then placed and checked against the prepared tooth to visualize tooth reduction.

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reduced on the marked areas. The process is repeated as often as necessary until the gauge pulls through.

Advantage

a) Readily available materials

Disadvantage

- a) Result interpreted incorrectly if the patient does not occlude completely.
- b) Provides limited information about actual amount of reduction





Advantage

- a) Simple and quick.
- b) Tooth reduction visualized in two planes (Occlusal and Axial tooth reduction).

Disadvantage

- a) Only a small number of sections can be obtained, and
- b) Sectioning is irreversible

4) Tooth reduction guide using vaccum formed thermoplastic matrix with silicon registration material





Method

The technique suggests fabrication of color contrasting positive guide using the silicone occlusal registration material in conjunction with adaptation of a vacuum formed clear thermoplastic matrix on to the master cast. The thermoplastic matrix is helpful in planning the tooth reduction, to know the tooth angulation and after reduction one can evaluate tooth reduction. Once tooth preparation is completed it can be verified by injecting a color contrasting silicone occlusal registration material on to the tooth prepared over which the thermoplastic matrix can be held to support it. After the material has polymerized it is removed and the amount of tooth reduction can be measured by measuring the thickness of this silicone using wax guage.





Advantage

- a) Easy to use
- b) Translucent which allows visual evaluation as well as measurement of the clearance underneath the matrix through holes or slots made in the matrix.
- c) Accurate duplication of the axial/Occlusal contours.
- d) Interim restorations can be fabricated using same guide.
- e) Can be used in all regions of the dentition.
- f) Applicable for fixed and removable prosthodontic procedures.

Disadvantage

a) Evaluation of tooth reduction may not be accurate because the procedure is performed intraorally, also its clear and translucent sheet blends with the tooth color.

5) Clinical determination of angle convergance using mouth mirror



Fig. 6

Method

This technique utilizes stainless steel disks, with openings in the back to fit onto a dental mirror. Mirror should be placed lingual to the tooth preparation, aligning the vertical diameter line with the axis of the path of placement and secant line with the bases of the two axial walls. The mirror should be moved aligning one of the lines with one of the axial walls. Procedure repeated, increasing the convergence angle progressively using the other disks, until the smallest difference between the lower limits of the convergence angle have been found.

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Advantages

- a) Autoclavable
- b) Easily built and applied on dental mirror
- c) Provides fast viewing of the angulation.

Disadvantage

- a) Not feasible when mouth opening is small
- b) Also difficult to visualize in second molar region and beyond.

6) Hinged putty index



Fig. 7

Method

First a 19 gauge stainless steel wire of proper length extending one tooth on either side of the tooth of interest is stabilized on the buccal and lingual surfaces of the premolars and molars below the gingival margin using resin. A putty index was fabricated in conventional manner, incision marks are made on the central grooves of premolars and molars followed by sectioning of the index with one incision on center of the index running mesio distally, then cuts are made interdentally that run buccolingual. Finally we get a single piece of putty index which was hinged around wire embeded in it as shown in

7) Fleximeter strips





Method

Color coded fleximeter strips are placed on the Occlusal surface of the prepared tooth. These color coded indicates the thickness of the strips. Pink strip (1mm x 1mm), green strip (1mm x 1.5mm), blue strip (1mm x 2mm). The strips are painted with arti-spot and placed on the Occlusal surface of the prepared tooth. After evaporation of the solvent, leaves a thin film of color. Every contact of the opposing teeth on the dry color will partially remove the pigment, making the basic material shine through the interference can be easily detected. The color strips indicate the amount of clearance to be given and the coated arti-spot indicate the interference to be reduced to give proper clearance.

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Fig. 8

the fig A and B. After tooth preparation is completed an impression is made and cast is poured on to which the hinged putty index can be placed and tooth reduction can be evaluated in all the planes occlusal, proximal, axial and lingual tooth reduction can be verified.

Advantages

a) Evaluates tooth reduction in different planes.

Disadvantage

a) In vivo studies have to be conducted to check its reliability and accuracy when used intraorally.



Fig. 10

Advantages

- a) Arti spot film is resistant to saliva.
- b) Area of interferance easily identified and easily be removed.

8) Custom made wax guide





Method

3 sheets of modelling wax with thickness of 0.5mm per piece. Leave the first sheet intact. Cut off a quarter of the second sheet. Then cut the third sheet in half. Stack the pieces on top of each other in a stepped manner so that each has a thickness of 0.5mm, a total of 2mm. Fold a new piece of Occlusal indicating wax twice to obtain a final thickness of 2mm. Place over the prepared tooth and instruct the patient to occlude onto the wax. Hold the wax shade guide and the occluded wax under light to compare thickness and measure the amount of reduction.

Advantages

a) Simple method.

b) Easily determines specific areas of tooth reduction.

Disadvantages

- a) It does not reveal amount of tooth structure to be removed.
- b) Measurement of wax thickness is difficult and time consuming.

9) A novel chairside technique to assess the interocclusal clearance and abutment axial walls during tooth preparation

In this technique, a modified Heister mouth gag forceps is used, where two opposing threaded screws of 3 mm width and 5 mm height are attached at the end of forceps arms which are precisely calibrated (up to 0.5 mm) on a curved scale, and a slidable metal stopper block which engages a Vshaped groove in one of the forceps arms near its furcation junction. The metal stopper provides a standardized opening of 13 mm at the forceps end. This modified instrument acts as a minihinged articulator and enables quick mounting of the bite record.

- 1. Screw the forceps knob up to three turns to slightly open up the forceps arms before the clinical appointment
- 2. After a tentative occlusal reduction during tooth preparation, record the bite using an addition silicone bite registration material only in the region of prepared abutment. Carefully cut the excess silicone index material adjacent to the abutment margin using a surgical blade number 22/23.

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- 3. Heat a Type 1 medium inlay wax stick over burner flame, and coat three to four layers on the abutment and opposing occlusal surface of silicone bite index.
- 4. Heat the threaded screws over the flame, orient the silicone index coated with inlay wax between them, and, immediately clamp the forceps arms until it contacts the metal stopper. This enables the inlay wax to flow inside screw threads and mechanically retain on the forceps.
- 5. After allowing the wax to cool down on its own, screw in the forceps knob to separate the silicone index from the inlay wax and clamp the forceps again until the arm rests on the stopper completely. This is the 0 mm position on the graduated curved scale.
- 6. Slide the metal stopper sideways along the groove, from the forceps arm and clamp both the forceps arms together until the opposing cusps meet. The reading on the scale now obtained, depicts the minimum occlusal clearance achieved in the tooth preparation.
- 7. Modify the abutment intraorally, in accordance with the measurements obtained on the scale
- 8. Evaluate the axial morphology of the abutment, after opening the arms of the forceps. Modify the axial walls in accordance with the undercuts, if present.

Advantages

- a) Readily available
- b) Cost effective.
- c) Less time
- d) As no carving or shape manipulation of wax, the pattern is done at the formative stage, no force is exerted, and minimal residual stresses are incorporated into the wax used.
 Clinician can visually assess the positive replica of the prepared abutment tooth three dimensionally,
- e) Along with accurately measuring its interocclusal clearance, thereby allowing the rectification of abutment morphology chairside.

10) Customized occlusal reduction guide made from a thermoplastic sheet

Procedure

- 1. Duplicate diagnostic casts and vacuum form a clear 2-mm plastic sheet over the cast in the conventional manner.
- 2. Mark the lines on the area of the opposing arch in the mounted casts according to the width of the prepared tooth. Cut the thermoplastic sheet along the lines and transfer that to the cast.
- 3. Analyze the occlusion and mark the functional and nonfunctional cusps. Adjust by grinding until the required reduction is attained.
- 4. Insert the COR guide in the opposing arch. Then prepare the tooth. Continue the occlusal reduction until the contralateral side occludes with a thin articulating paper. During tooth preparation, articulating paper can be used to identify inadequate reduction areas. The occlusal reduction is complete when the reduced surfaces fit the COR guide exactly.
- 5. Make a definitive impression and fabricate a definitive cast. The accuracy of reduction can be verify with the COR guide insertion. Then fabricate the definitive restoration.

11) Digital preparation-evaluation tool

Recently, the scanned data files needed to be exported from the intraoral scanner software program and imported into the metrology software program as the 2 programs were not compatible. A digital approach, which provides visual insights and evaluation of differences and enables an accurate measurement of the amount and quality of a tooth preparation with an intraoral scanner and its built-in superimposition and a metrology software program is described. The evaluation of a rest preparation is shown as a representative example of an intracoronal preparation, and the assessment of a complete crown preparation is shown as an example of an extracoronal preparation.

- 1. Scan the teeth before and after tooth preparation by using an intraoral scanner (TRIOS 3; 3Shape A/S2.
- 2. Apply the TRIOS Patient Monitoring tool to verify the accuracy of tooth segmentation and approve the segmented outcomes if accurate.
- 3. Apply the "tooth comparison" function and adjust the range of the scale bar.

The amount of preparation can be measured by placing the mouse cursor on the area of interest. Additionally, draw a line around the prepared tooth to obtain a crosssectional view. The amount of preparation can be measured by selecting 2 points on the cross-sectional view.

Advantages

- a) The method saves time
- b) Can be easily done at the chairside as it uses internal software tools and eliminates the need to extract the scanned data files.

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CONCLUSION

Tooth preparation is very critical for the success and longevity of fixed prosthesis. All the methods mentioned have their merits and demerits but it depends on the clinicians choice and their individual ability and experience in assessing tooth preparation in all the aspects. To ensure adequate tooth reduction one may use any of the methods mentioned that are helpful in guiding the new clinician to provide restoration that has long term success rate. Regardless of the method of tooth preparation it is desirable to measure this reduction before impression is made.

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