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A Comparative Evaluation of the Quantitative Gingival Displacement with Cordless and Conventional Cord Gingival Retraction Techniques in Thin and Thick Gingival Biotype

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Abstract **Original Research Article**

Background: Gingival retraction is an inevitable step in fabrication of fixed partial denture. With the evolution in the cordless retraction materials like Magic foam and Expasyl, the selection of among these materials has still been a dilemma as there are no specific criteria on selection among this material in literature. The purpose of this study was to compare and evaluate the quantitative gingival displacement among cordless and conventional cord gingival retraction techniques in thin and thick gingival biotype. ***Methods:*** A total of 20 heathy participants with 10 participants each in thin and thick gingival biotype category on the right central incisor were selected. Under standard protocol and manufactures instruction gingival retraction followed by impression were carried out using 5% aluminium chloride impregnated retraction cord, Magic foam and Expasyl. Through the cast obtained a 3mm samples were prepared and observed under digital binocular compound microscope at 40x magnification which was affixed to a computer with the Image Analyser Multimedia software-Motic Image Plus 2.0ML which would detect the edges and generate the results of quantitative displacement in vertical, horizontal and area of displacement. ***Results:*** In relation to the thin gingival biotype the maximum vertical displacement was observed in magic foam followed by Retraction Cord and Expasyl, whereas the maximum lateral displacement was observed by Retraction cord followed by Magic Foam and Expasyl. In thick gingival biotype the maximum vertical displacement was observed in Retraction Cord followed by Magic Foam and Expasyl, whereas the maximum lateral displacement was observed by Retraction cord followed by Expasyl and Magic Foam. The overall total area of displacement for both the thin and thick gingival biotype was observed by Retraction Cord followed by Magic Foam and Expasyl. ***Conclusion:*** The conventional retraction cord still stands to deliver the overall maximum amount of displacement in general for both the gingival biotype. Whereas among the cordless gingival retraction technique Magic Foam has proven to be more productive in thin gingival biotype than thick compared to Expasyl and vice versa in thick gingival biotype Expasyl has been more productive than Magic Foam. The study can be conclusive to state that the choice on cordless retraction material is also biotype dependent.
Keywords: Gingival retraction, fabrication, Magic Foam and Expasyl, gingival biotype.

INTRODUCTION

A healthy and harmonious co-existence of the surrounding periodontium with the adjacent hard and soft tissue along with the prosthesis is the ultimate aim in the treatment with Fixed Partial Denture. The key to achieve such a relationship or harmony is an accurate impression procedure [1].

Impression along the margin of tooth preparation or finish lines is critical for the marginal fit and emergence profile of the prosthesis. Margins of the tooth preparation which are supragingival are comparatively easier to record than those which are equigingival and subgingival, due to its close proximity to the gingival tissues. To make accurate impressions, displacement of the gingival tissue is essential particularly when the finish line is at or just below the crest of the gingival sulcus [2].

Gingival retraction with sufficient lateral and vertical space between the margins of the tooth preparation and the gingival tissue is essential in order to allow the injection of adequate bulk of impression material into the expanded crevice. The critical gingival sulcus width required for this is approximately 0.2 mm at the level of the finish line [3].

One of the most commonly used gingival retraction techniques is nonsurgical retraction techniques [3]. Nonsurgical techniques are Mechanical or Chemicomechanical retraction procedures. This can be achieved by conventional cord retraction techniques and the recent cordless techniques using materials such as Magic foam and Expasy[1].

The selection of the gingival retraction technique or material is mostly depending on the operator's preference. The selection among the conventional cord retraction techniques depends on the gingival biotype. If the gingival biotype is thin, it is advised to use single cord retraction technique whereas, if it's a thick biotype, double cord retraction technique is advised [4]. Double cord retraction technique in comparison to single cord retraction technique might take more time and incur additional expenses, but gives more accuracy in locating the margin of the preparation for fabrication of the prosthesis [5].

Studies have been carried out to compare the efficiency among commonly used conventional retraction cord techniques [6-12], but there is paucity in literature to justify on the selection of material based on gingiva biotype, among the conventional cord retraction techniques to the recent cordless techniques using Magic foam and Expasyl. Hence, this study was carried out to evaluate and compare the quantitative gingival displacement on the thin and thick gingiva biotype obtained using impregnated retraction cord, Magic foam and Expasyl.

METHODOLOGY

Selection of participants

The ethical approval for the study was obtained along with consent from all the 20 participants. The participants belonging to age group 20 -25 years, with healthy gingival index of 0 or 1, Probing depth <3mm, and with no relevant medical history was selected. The biotype of the gingiva was determined using probe transparency method with the Probex UNC-15 CC Periodontal probe. (fig.1) and 10 participants each categorised in thin and thick gingival biotype group. The participants were excluded in the presence of any inadequate oral hygiene, bleeding on probing, smoking habit, history of trauma to anterior teeth or surgery, major orthodontic correction. The impression of the maxillary dentulous arch was made with elastomeric impression material of the non-retracted gingiva which was considered as control group, the 5 % impregnated aluminium chloride gingival retraction cord, magic foam and expasyl with an interval of 7 days to allow the gingiva displace back to its normal zenith.

Fig-1: Determination of gingival biotype by probe transparency method

Selection of Tooth and determination of tooth height for the study

The tooth selected for the study was maxillary right central incisor due to the anatomy of tooth as it has an incisal edge which can be used as a demarcation for midpoint of teeth in sample preparation. The assessment of the gingiva zenith height from the incisal edge was also carried out by measuring distance between the gingival zenith and the incisal midpoint of the maxillary right central incisor using the Probex UNC-15 CC Periodontal probe.

Impression of the Maxillary dentulous arch with elastomeric impression material for non-retracted gingiva

Maxillary perforated plastic trays of anterior segment were selected as per the maxillary arch anatomy with the complete coverage of the Maxillary central incisor tooth and coated with tray adhesive and left to dry for 5 minutes as per manufactures instruction. All the armamentarium required for making an impression (fig.2.a) using Soft Putty with Light body impression material was arranged. Using manufactures instructions and protocols for impression making the impression of the non-retracted gingiva was made by double step double mix technique (fig.2.b). The cast model was made of type IV die stone from the impression.

Fig-2.a: Armamentarium for impression procedure

Fig-2.b: Impression procedure

Retraction procedure for Impregnated retraction cord

The armamentarium required for gingival retraction procedure using retraction cord was arranged (fig. 3.a). Retraction cord to a required length was impregnated in 5% aluminium chloride viscostat agent for 15seconds and retraction was carried out on the labial aspect of the tooth with proper protocol and manufactures instruction. (fig.3.b). Following same impression procedure and protocol cast model were obtained.

Retraction procedure for Magic Foam Cord

The armamentarium required for gingival retraction procedure using Magic Foam cord was arranged (fig. 4.a). Gingival retraction on the labial aspect of the central incisor was carried out with magic foam using proper protocols and manufactures instruction. The Magic Foam Cord was slowly injected into the sulcus and then comprecap anatomic was placed and secured by bite force. (fig.4.b). Following same impression procedure and protocol cast model were obtained.

Retraction procedure for Expasyl

The armamentarium required for gingival retraction procedure using Expasyl was arranged (fig. 5.a). The retraction paste was slowly injected into the sulcus (2 mm/s) with the tip parallel to the long axis of the teeth. The point of the cannula created a closed space between the tooth and the marginal edge of the gingiva as per proper protocols and manufactures instruction (fig. 5.b). Following same impression procedure and protocol cast model were obtained.

Fig-3.a: Armamentarium for gingival retraction with 5% procedure with 5% impregnated aluminium chloride chloride gingival retraction cord

Fig-3.b: Gingival retraction procedure impregnated aluminium gingival retraction cord

Fig-4.a: Armamentarium for gingival retraction Procedure with Magic foam with Magic foam

Fig-4.b: Gingival retraction

Fig-5.a: Armamentarium for gingival retraction procedure with Expasyl

Fig-5.b: Gingival retraction with Expasyl

Source of data/Preparation of the sample

The Die stone models thus obtained was sectioned and only the selected sample tooth was be obtained i.e. the right maxillary right central incisor. The mesiodistal width of the tooth was measured using a digital vernier calliper. (fig. 6) and the uniform cross section width of 3mm was obtained which was finalized with a digital vernier calliper. (fig. 7).

Fig-6: Measuring the mesiodistal width of the tooth using a digital vernier caliper

Fig-7: Verifying the sample thickness

Evaluation of each sample was done by examining the 3mm section of the sample under digital binocular compound microscope at 40x magnification took a clear image of the cross section of the sample and detected the edges of the retracted gingival and tooth surface on the sample. (fig. 8). The measurements were formulated using edge detector and image analysis software by the Image Analyser Multimedia software-Motic Image Plus 2.0ML which was computed with the microscope.

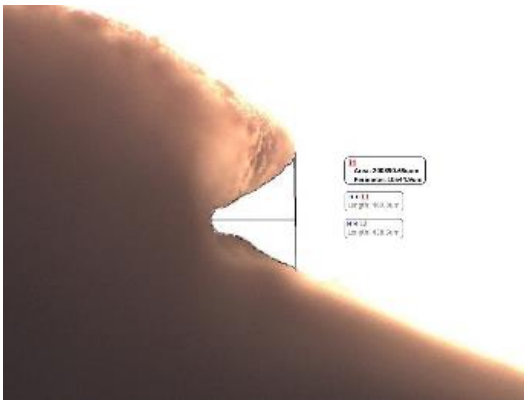

Fig-8: Microscopic view

RESULTS

The observation on the efficiency of the material was observed via the amount of displacement caused. Vertical displacement: In the thick gingival biotype category, the maximum vertical displacement was observed using retraction cord followed by magic foam and expasyl. Whereas, in that of thin gingival biotype category the maximum vertical displacement was observed by the use of Magic Foam followed by the impregnated retraction cord and expasyl. Table 1

shows the amount of the gingival displacement in micrometre for each group. Graph 9 states the inter-comparison between the vertical displacement using the retraction material in thick and thin biotype.

Table-1: Amount of mean vertical displacement in thin and thick gingival biotype (Superscript with same alphabet denotes no significance difference)

vertical displacement length in thick biotype (micrometer)	Control group Group A	Impregnated retraction cord Group B	Magic foam Group C	Expasyl Group D
mean	80.9[a]	314.4[b]	281.1333333[c]	231.7333333[d]
SD	2.62298	70.15261934	59.28425873	35.84024739
vertical displacement length in thin biotype (micrometer)	Control group Group A	Impregnated retraction cord Group B	Magic foam Group C	Expasyl Group D
mean	90.067[a]	358.3666667[b]	380.9[e]	289.7333333[c]
SD	15.41309	99.37264882	100.0598321	43.37122702

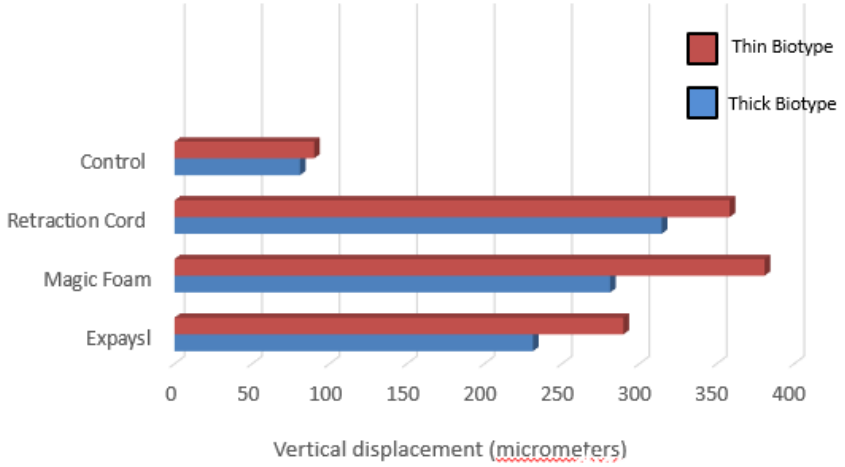

Fig-9

Lateral displacement: In the thick gingival biotype category, the maximum lateral displacement was observed using retraction cord followed by expasyl and magic foam. Whereas, in thin gingival biotype using the maximum lateral displacement was observed in retraction cord followed by magic foam and expasyl. Table 2 shows the amount of the gingival displacement in micrometre for each group. Fig 10 states the inter-comparison between the lateral displacement using the retraction material in thick and thin biotype.

Table-2: Amount of mean lateral displacement in thin and thick gingival biotype (Superscript with same alphabet denotes no significance difference)

lateral displacement length in thick biotype (micrometer)	Control group Group A	Impregnated retraction cord Group B	Magic foam Group C	Expasyl Group D
mean	95.5[a]	452.9666667[b]	290.4666667[c]	345[d]
SD	11.9508	44.40994633	93.1866049	24.1024895
lateral displacement length in thin biotype (micrometer)	Control group Group A	Impregnated retraction cord Group B	Magic foam Group C	Expasyl Group D
mean	137.433[a]	503.4666667[f]	424.6[b]	353.2[d]
SD	38.2147	26.56507733	22.05153056	24.9501503

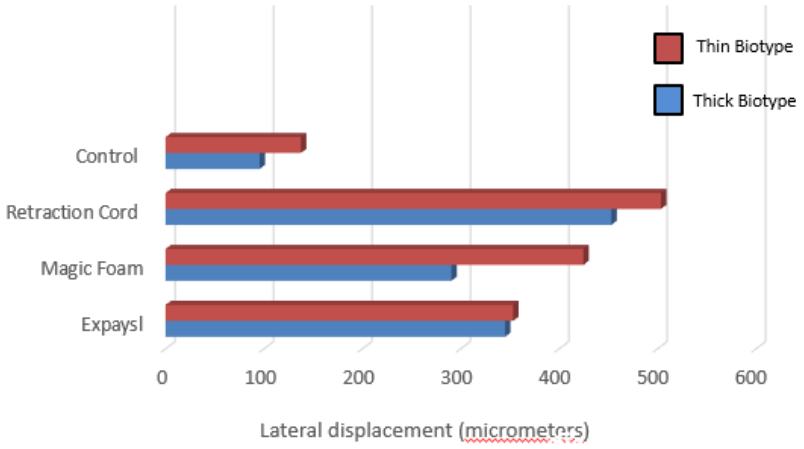

Fig-10

Area of displacement: In the thick as well as thin gingival biotype category, the maximum area of displacement was observed using retraction cord followed by magic foam and expasyl. Table 3 shows the amount of the gingival displacement in micrometre for each group. Fig 11 states the inter-comparison between the area of displacement using the retraction material in thick and thin biotype.

Table-3: Amount of mean total area of displacement in thin and thick gingival biotype (Superscript with same alphabet denotes no significance difference)

Area of displacement length in thick biotype (sq. micrometer)	Control group Group A	Impregnated retraction cord Group B	Magic foam Group C	Expasyl Group D
mean	20564.7 [a]	72103.8 [b]	57628.03333 [b]	39915.3 [c]
SD	11048.85541	26719.2483	18236.71867	13047.70117
Area of displacement length in thin biotype (sq. micrometer)	Control group Group A	Impregnated retraction cord Group B	Magic foam Group C	Expasyl Group D
mean	35611.93333[d]	131949.7667[e]	97686.6[e]	62363.63333[f]
SD	19382.5523	71130.60314	32061.37865	16686.12427

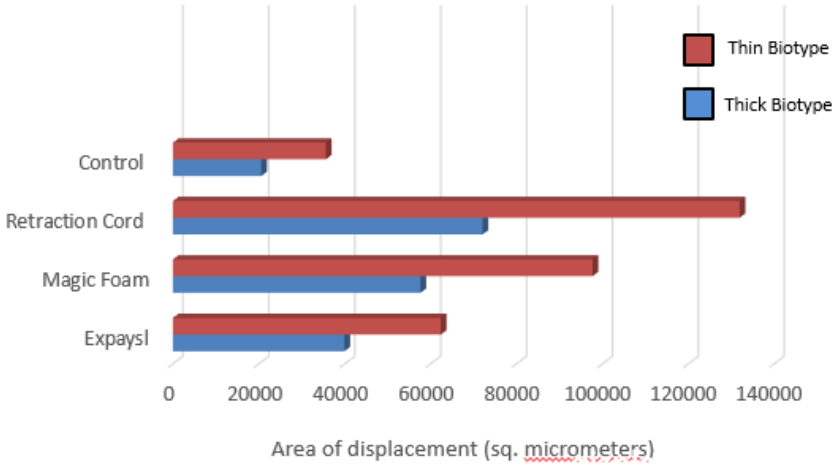

Fig-11

DISCUSSION

Full coverage tooth preparations often require subgingival margins because of extensive damage of tooth structure due to caries, aesthetic demands and need for additional retention. Impression techniques used in the procedure of fabricating a fixed partial denture, requires the gingival retraction to displace the gingiva away from the margins of tooth preparation for an accurate marginal fit. The selection of among these gingival retraction materials has been a dilemma in dental clinical practice and mostly operator preference.

Various studies have been carried out among conventional retraction procedure and criteria on their section of technique [5-12]. But there seems to be paucity in literature on selection, or effect of gingival displacement based on gingival biotype in cordless gingival retraction technique using magic foam and expasyl. Even whether the retraction carried out using cordless technique is same to that of conventional technique is questionable.

Conventional gingival retraction cords impregnated with astringents, vasoconstrictors and hemostatic liquids and gels are the most commonly used to obtain gingival retraction.[13] the use of cord impregnated with aluminum chloride (5 to 10%) is referred to be the safest and most effective method of gingival retraction[14-16]. Hence, in the present study 5% Aluminum chloride solution (Viscostat-Ultrapak) was used as the medicament for impregnating the cord. This hemostatic agent also acts as an astringent and has the ability to precipitate protein, constrict blood vessels and extract fluid from tissues [17]. It is highly soluble in water, freely soluble in alcohol and soluble in glycerine [18]. Ultrapak cord's retraction cord #1 interlocking loops also carry approximately 2.5 times more hemostatic solution than conventional cords which facilitates in a greater hemostatic action were used in the study [19].

Among the cordless retraction techniques, Magic Foam and Expasyl retraction materials were used in the present study. Magic Foam is a non-hemostatic "mechanical" gingival retraction system consisting of expanding type vinyl polysiloxane material. The Comprecap used in the present study was modifies to cover the maximum amount of the tooth structure and maintain a pressure on the retraction material by bite force.

Expasyl is a formulated hemostatic retraction paste which exerts moderate pressure on the gingiva. The material is dispensed around the tooth with the syringe apparatus containing a narrow needle-like tip containing aluminum chloride which is a hemostatic as well as an astringent along with kaolin and excipients like oil of lemon, water and colorant. Expasyl has no chemical or setting reaction. It creates and maintains space in the gingival crevice due to the viscosity characteristic mainly caused by kaolin. Hemostasis is caused by aluminum chloride and it requires minimum time of 1-2 minutes for blanching of the gingival tissue indicating displacement of the gingiva.

The selection of gingival retraction material has been a dilemma in dental clinical practice depending on the easy of application, patient's comfort, time duration and efficiency of the material to achieve gingival displacement

In the present study, the vertical, lateral and area of displacement of the gingiva from tooth surface has been reported with significant statistical difference between the control group (no gingival retraction) and 3 different retraction materials (impregnated gingival retraction cord with 5% aluminium chloride, Magic Foam and Expasyl) in both the gingival biotype.

In relation to the vertical displacement among these 3 different gingival retraction materials, the maximum vertical displacement in thin gingival biotype was reported by magic foam followed impregnated retraction cord with 5% aluminium chloride and expasyl but in thick gingival biotype it was by retraction cord followed by magic foam and expasyl.

In relation to the lateral and total area of displacement with relation to thin gingival biotype the maximum lateral displacement was observed with impregnated retraction cord followed by magic foam and expasyl whereas in thick gingival biotype among cordless retraction technique expasyl demonstrated more vertical displacement compared to magic foam as well as it was similar to the lateral displacement seen in thin gingival biotype.

The reason for maximum displacement in thick gingival biotype by the conventional gingival retraction cord techniques could be attributed due to mechanical pressure generated during placement of the gingival retraction cord using a cord packer, the prolong period of placement of the retraction cord in the gingival sulcus which causes displacement of the epithelial attachment, specific diameter along with impregnated agents which contributed to the hemostasis of the gingival tissue (astringent action) to shrink the gingival tissues. The maximum vertical displacement in thin gingival biotype using Magic Foam can be attributed by the continues pressure applied by the comprecap during expansion of the material, whereas, gingival displacement caused using conventional gingival retraction cord technique or cordless technique using Expasyl is not subjected to any mechanical pressure once placed in the gingiva sulcus.

The results in the present study are similar to studies carried out by Gupta A *et al*. [20] and Sachdev

et al.[21], but not in agreement to the study carried out by Rao D. B *et al.* [22] which states that maximum displacement of the gingiva is obtained by Expasyl. The conflict in results may be due limitations of the study carried out by Rao D. B et al, wherein standardised tooth (right central incisor), location of sectioning of the tooth (exactly the centre of the tooth) and selection of gingival retraction cord based on gingival biotype were not considered, as was in the present study.

The limitation of the present study was:

- The retraction procedures are carried out on a healthy unprepared tooth for standardization of the tooth surface for analyses along with the gingival biotype. Thus, one may contend to have alternate result in a prepared tooth.
- For the application of the comprecap along with the Magic Foam on a healthy unprepared tooth, the internal surface of the comprecap was modified respectively for coverage of maximum tooth structure.

CONCLUSION

Within the limitations of this study, it is concluded that, Even though, Conventional gingival retraction cord techniques have proven to be more effective than cordless techniques have their own cons such as a need of accuracy and control in placement of the retraction cord with mechanical pressure using cord packer, traumatic effect on the periodontium which requires minimum of 6-8 days to heal, prolong time period in placement of cord effectuating patient's comfort. Whereas, the use of cordless techniques for gingival retraction using Magic Foam and Expasyl are easy to apply, need less time for displacement of the gingiva endorsing patient comfort. But due to lack of hemostatic agent in Magic Foam in contrast to impregnated retraction cord with 5% aluminium chloride and Expasyl, care must be taken prior to selection of the retraction material depending on the health of periodontium and even based on the gingival biotype.

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