Research Article

Three Dimensional Model Analysis of the Gingival Sulcus Width with Different Retraction Cord and Different Retraction Time

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ABSTRACT

Introduction: The length of retraction time is important for the adequate expansion of the gingival sulcus. Thus, it is crucial to determine the appropriate retraction time which gives adequate expansion of the sulcus without any damage to the surrounding periodontal tissues.

Objective: To compare and evaluate the effect of different retraction time, with two chemically different retraction cords (ASCT and Ultrapak) on the width of gingival sulcus, using 3D model analysis.

Materials and Method: Forty mandibular right and left first premolar of 20 volunteers were included in the study. Aluminum sulphate and epinephrine impregnated cords were used. The cords were left in the buccal sulcus for 5, 10 and 15 min respectively in three consecutive visit. Impressions and stone models were made before and after the gingival retraction. 3D data were acquired using 3D laser scanner and were superimposed. The sulcus width with different retraction time, at mid buccal and transitional line angle area, with different retraction cords were measured and compared.

Result: The expansion of gingival sulcus between 5 and 10 min were significantly different at MB and TLA with both the cords. The sulcus width between retraction of 10 and 15 min were also statistically different both at TLA and MB but is less significant when compared with 5 and 10 min with both the cords. Sulcus width at MB were significantly greater than at TLA for 5, 10 and 15 min with both types of cords. The expansion of sulcus width between two types of cords is not statistically different.

Conclusion: The optimal time for retraction of gingival tissue for single cord technique is 10min. There is no significant difference in the expansion of gingival sulcus with ASCT and Ultrapak, so both types of cord can be used equally considering the systemic effect of medicaments.

Keywords: Gingival retraction; gingival sulcus width; three-dimensional; tissue hemostasis.

INTRODUCTION

The retraction of the gingival tissue is defined as the process of deflection of the marginal gingiva away from a tooth.[1] The main objective of gingival retraction is to create sufficient lateral and vertical space between the margins of the tooth preparation and the gingival tissue in order to allow the injection of adequate bulk of impression material into the expanded crevice.

The gingiva must be displaced to make a complete impression and sometimes even to permit completion of the preparation and cementation of the restoration without damaging the periodontal tissue.[2] The displacement of the gingiva is also required during the preparation of the tooth cervically and even while placing and finishing the restoration located cervically. This is done to avoid trauma to the periodontal tissue.[3]

As there are few reports in the dental literature that address the length of time, the medicated retraction cord is kept in the gingival sulcus to obtained the desired expansion, it is, therefore, difficult to estimate the length of time, the retraction cord impregnated with various medicaments be kept in the sulcus to obtain the desired effect on the gingival structures while avoiding noxious side effects.[4] Actual exposure time is bound to vary markedly in vivo, for example between 2 and 30 min. Anneroth and Goranson (1965) demonstrated a strong association between tissue damage, the length of time that cords were in place, and the use of various chemical agents.[5] Other studies suggest that some amount of tissue damage was caused by 5-10 min exposure to cords impregnated with racemic epinephrine, cords containing alum and aluminum chloride, but the damaged tissue returns to its normal healthy state approximately in 10 days.[6,7] Fisher (1987) observed that packing of knitted cord impregnated with 13.5% ferric sulfate solution for 1 min provides the amount of retraction needed.[8] But when used for 10-20 min, the resulting tissue displacement is maintained for at least 30 min, so that repacking is seldom necessary for multiple impression.[9] Barahav et al (1997) concluded from his study that the cord should remain in place for 4 min prior to impression.[10] However Zhang et al (2011) concluded from his experiment that before making the impression, gingival retraction time of single-cord mechanical technique should be at least 10 min. But for different gingival areas, the enlargement of gingival sulcus from gingival retraction and optimal retraction time were different.[11]

The purpose of our experiment was to determine how long the cord be left in the gingival sulcus to obtain the desired expansion so that the finish line of the preparation can be captured without any error and the impression can be withdrawn from the mouth without tearing and distortion of the material and also to compare the efficacy of Epinephrine and Aluminum Sulphate.

There are various methods to measure the sulcus width in clinical research, but every method has its own merits and demerits. Baharav et al (1997) utilizes miniature video camera to capture the closing crevice after the cord removal at different time interval, but this method seems to be difficult to apply in clinical situation.[10] Kazemi et al and Bowles et al cut the models in buccolingual direction to measure the sulcus width but cutting the models and then measuring the sulcus width may affect the research study.[12,13] Zhang et al utilized the digitalized model to compare the sulcus width.[11] 3D analysis of the scanned models to compare the sulcus width is the superior method than those traditional one because this method can measure the sulcus width many times without destroying the models. Also the superposition of the model helps to measure the sulcus width at different areas at the same point without any error. Also this method is time saving, reliable, and more model information can be obtained. So in our experiment we utilize 3D analysis of the scanned model to study the effect of retraction time on gingival sulcus width.

MATERIALS AND METHODS

The study was carried out in the department of Prosthodontics, Union Hospital, Tongji medical college. Forty mandibular premolars from 20 volunteers between the ages 20-30 years were included. The volunteers were dental students, general dentist, nurses and lab technician from the same hospital. All the volunteers were explained and made aware about the experiment and informed consent were taken. All the volunteers were clinically free of gingival inflammation

and exhibited Gingival indices of 0 (Loe and Silness,1963a). The mandibular right and left first premolar were included in the study and two different chemically impregnated retraction cords Ultrapak #00 and ASCT#00 were used.

In each volunteer, the gingival retraction cords were placed three times, and the retraction time was 5, 10 and 15 min respectively. The least interval between the two retraction procedures was 2 weeks so that the tissue comes to its normal healthy state in this 2-week period.

Impression materials used in our study is Polyvinylsiloxane (Silagum) putty and light body. The impression technique used is double impression technique. The impression for control group (C) is taken first without inserting the cord. Then, for the test group, firstly the impression is taken only with the Putty. After withdrawing the impression with putty from the mouth, retraction cord of 1.5 cm is taken from the dispenser one containing Epinephrine and the other with Aluminum sulphate. The Ultrapak cord was kept on the right first premolar and ASCT cord on the left premolar in the buccal sulcus with the help of cord packer, so that the comparison can be made between these two types of cord. On the first day the cord is left in the sulcus for 5 min, then after 2 weeks the cord is kept for 10 min and finally on the last visit after 2 weeks the cord is left in the sulcus for 15 min. The time starts only after both the cords were impressed in the sulcus. Then after the respective time measurement, the cord is removed from the sulcus and light body is dispensed both on the impression tray and in the expanded sulcus and thus the impression is taken. Cast were then made with the super hard dental stone

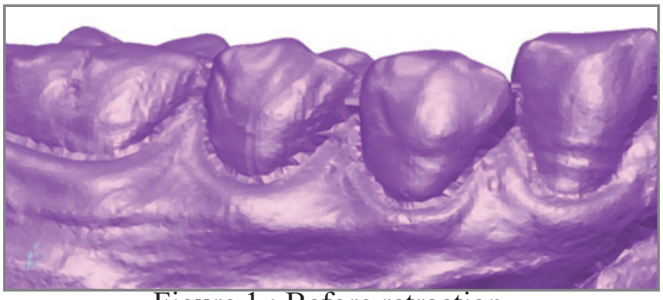

Figure 1 : Before retraction.

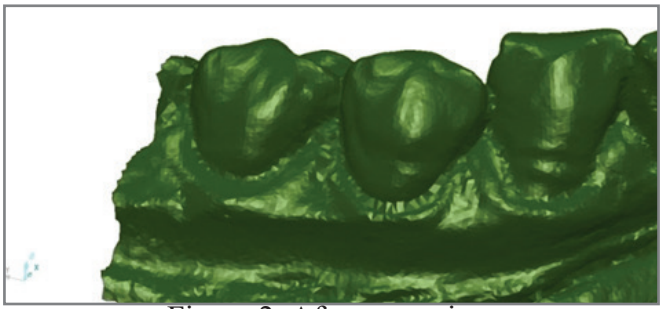

Figure 2: After retraction.

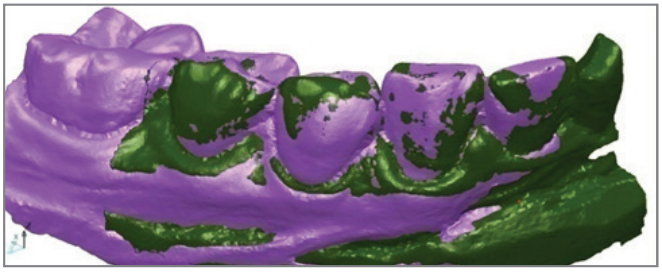

Figure 3: Superposition of model.

In this manner, finally each tooth has 4 models i.e. Control (C), 5, 10, and 15 min. All these models were scanned with Dental wings 3D scanner-5 series. The stone casts were marked at the MB (Mid-buccal), MTLA (Mesial transitional line angle) and DTLA (Distal transitional line angle) with the divider at the same point in all the four casts for each tooth. The superposition of the model is done so that the measurements of the sulcus width at different areas are at the same point. Also this method can measure the sulcus width many times without destroying the models. So, this method has more advantages comparing to past methods to measure the sulcus width.

Firstly, the model position and angle of inclination is regulated until the distinct image of the buccal sulcus is obtained. Then, the overlapping of the cast with three different retraction time is done

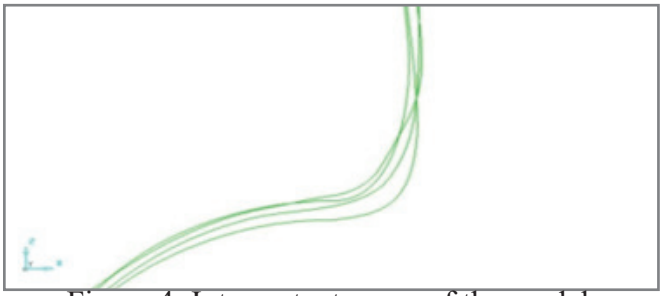

Figure 4: Intersectant curve of the model.

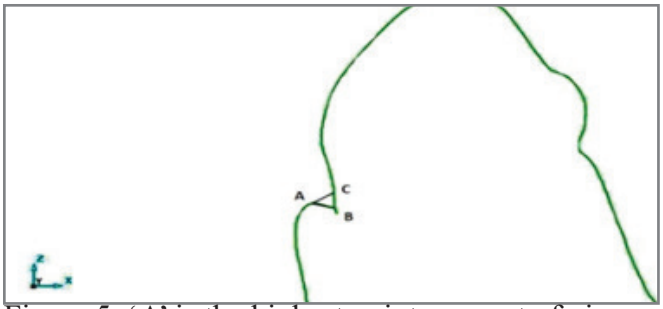

Figure 5: 'A' is the highest point on crest of gingiva, 'B' is the lowest point on base of sulcus & 'C' is drawn such that AB=Ac; AC gives the width of sulcus.

with the control cast by making references of the mark on the models at MB, DTLA and MTLA areas. The superposition of the models were done by using DelcamCopycad Pro software, saving in STL format. The highest point on the crest of the gingival sulcus is marked as 'A'; the lowest point on the base of the sulcus is marked as 'B'.

A point is marked on the tooth cervix as 'C' such that line AB=BC. The distance between point 'A' and 'C' i.e.AC is measured as gingival sulcus width.

SPSS 20.0 is applied for the statistical analysis. Comparison of sulcus width between 5, 10 and 15 min at MB and TLA were done by using paired sample t-test for both the epinephrine and aluminum sulfate retraction cords. Comparisons of sulcus width between Ultrapak and ASCT retraction cords at MB and TLA areas were also done by using paired sample t-test.

RESULTS

Table 1: Comparison of sulcus width between MB and TLA at 5, 10 and 15 min for Ultrapak retraction cord (Mean ± S.D. mm).

Time (min)	Gingival areas		*t*	*p*
	MB	TLA		
5	0.2910 ± 0.0331	0.2245 ±0.0267	6.686	< 0.001
10	0.4005 ± 0.0365	0.3132± 0.0427	10.805	< 0.001
15	0.4178 ± 0.0385	0.3259 ± 0.0440	10.246	< 0.001

Table 2: Comparison of sulcus width between 5 and 10 min and 10 and 15 min at MB and TLA areas for Ultrapak retraction cord.

Gingival area with different time	Mean ± S.D.	t-value	P value
MB 5 min	0.29105 ± 0.033161	10.894	< 0.001
MB 10 min	0.40055 ± 0.036558		
MB 10 min	0.40055 ± 0.036558	5.692	< 0.001
MB 15 min	0.41780 ± 0.038555		
TLA 5 min	0.22450 ± 0.026749	11.939	< 0.001
TLA 10 min	0.31320 ± 0.042758		
TLA 10 min	0.31320 ± 0.042758	6.814	< 0.001
TLA 15 min	0.32590 ± 0.044002		

Table 3: Comparison of sulcus width between TLA and MB at 5, 10 and 15 min for ASCT retraction cord (Mean ± S.D. mm).

Time (min)	Gingival areas		*t*	*p*
	MB	TLA		
5	0.29308 ± 0.033620	0.22597 ± .024554	6.724	< 0.001
10	0.40406 ±0.039524	0.31528 ± .042638	10.348	< 0.001
15	0.40851 ± .037264	0.32814 ± 0.044891	8.896	< 0.001

Table 4: Comparison of sulcus width between 5 and 10 min and 10 and 15 min at MB and TLA areas for ASCT retraction cord.

Gingival area with different time	Mean ± S.D.	t-value	P value
MB 5 min	0.29308 ± 0.033620	10.621	< 0.001
MB 10 min	0.40406 ± 0.039524		
MB 10 min	0.40406 ± 0.039524	1.524	< 0.001
MB 15 min	0.40852 ± 0.037264		
TLA 5 min	0.22597 ± 0.024554	11.429	< 0.001
TLA 10 min	0.31528 ± 0.042638		
TLA 10 min	0.31528 ± 0.042638	6.735	< 0.001
TLA 15 min	0.32814 ± 0.044891		

Table 5: Comparison between Ultrapak and ASCT retraction cords for 5, 10 and 15 min at TLA.

Time (min)	Types of cords		*t-value*	*p*
	Ultrapak	ASCT		
5	0.2260 ± 0.02460	0.2245 ± 0.02675	0.426	0.675
10	0.3153 ± 0.04257	0.3132 ± 0.04276	0.409	0.687
15	0.3282 ± 0.3282	0.3259 ± 0.04400	0.431	0.671

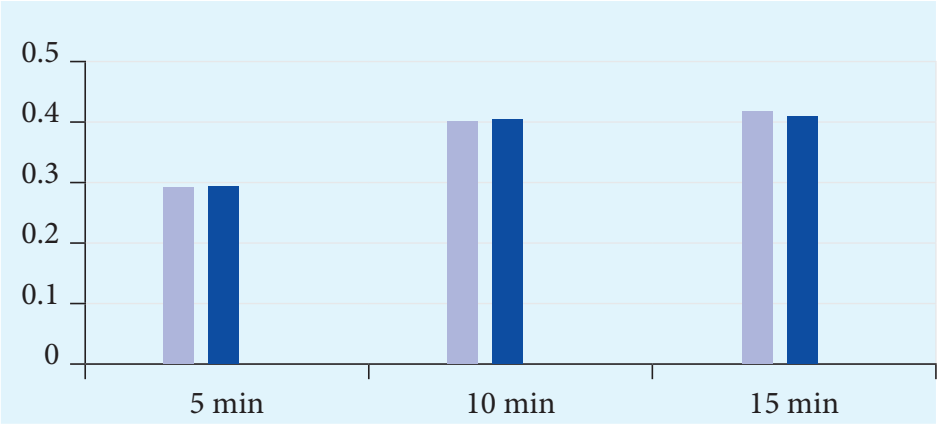

Figure 6: Comparison between Ultrapak and ASCT retraction cords for 5, 10 and 15 min at MB.

DISCUSSION

Adequate expansion of the gingival sulcus prior to impression making is crucial for the success of the fixed partial denture when the finish line is just at or below the gingiva. So, in order to obtain the adequate expansion of the gingival sulcus, there should be enough retraction time. Till date, there are only few researches regarding the relationship between the retraction time and the amount of expansion of the gingival sulcus.

In our study, the expansion of gingival sulcus width between three different retraction times i.e. 5 min, 10 min and 15 min were compared by using three dimensional model analyses for Epinephrine and Aluminum sulfate impregnated retraction cord. The expansion for gingival sulcus is observed at two different gingival areas i.e. MB and TLA areas. It was found that the expansion at MB and TLA area though statistically different for 5, 10 and 15 min for both Epinephrine and Aluminum sulfate impregnated cord, the t-value shows that the difference in expansion between MB and TLA for 5 min is less compared to 10 and 15 min. But 10 and 15 min retraction time shows the similar results which may be due to the fact that the 5

min is not the enough retraction time for gingival retraction and also it was found that the gingival sulcus width significantly increases at both the areas as 5 min increasing to 10 min, but there is no much difference in the sulcus width as 10 min increasing to 15 min, which indicate that 10min is suitable time for retraction rather than increasing the retraction time to 15 min. Similar results were observed in the experiment conducted by Zhang et al (2011).

In our study it was observed that, the expansion at MB area is greater than TLA area for all three retraction time for both Ultrapak and ASCT cord. This may be due to the difference in anatomic and histologic micro structure at TLA and MB gingiva. This difference may be responsible for the closure pattern of these two different areas. The higher density of collagen fibers and thicker gingiva and also the thicker cortical bone which gives rise to thicker alveogingival fibers may be responsible for the fast closure of the gingival sulcus at TLA than in the MB area. So the width of the gingival sulcus at TLA is narrower than at MB area.[14]

There are so many researches in Epinephrine and aluminum sulfate impregnated retraction cord regarding their effect in cardiovascular system, hemorrhage control, level of plasma catecholamine, cytotoxic effect on human gingival fibroblast, gingival blood flow and crevicular fluid, etc., but the comparison between these two most commonly used medicaments in regard to expansion of gingival sulcus has not been done yet. In the current study, it was observed that there is no significant difference in these two types of cords for the expansion of gingival sulcus. Expansion of sulcus width at MB and TLA area for both types of medicated retraction cord are not statistically different with p-value >0.05.

The use of epinephrine in retraction cords has still been an issue of controversy. Some studies have reported mild systemic effect from epinephrine retraction cord,[15,16] but some animal studies have shown that the epinephrine impregnated retraction cord cause some cardiovascular changes or may lead to elevated level of epinephrine in blood.[17] Many author concluded that elevated blood pressure and increased heart rate was due to the result of endogenous epinephrine production caused by patients increased level of stress.[18,19] However some author still recommend that the patients with risk factors such as cardio-vascular disease, hyperthyroidism, etc should be cautiously treated and epinephrine impregnated cord should be avoided as far as possible. However, Aluminum sulfate, a mild astringent, impregnated cord is considered as safe and suitable medicaments for gingival retraction. Hatch et al (1984) compared retraction cords with aluminum sulfate and 8% epinephrine. The epinephrine cords caused elevated circulation of catecholamine after 60 min but the cords with aluminum sulfate did not. Neither of these two medicaments influenced heart rate or blood pressure.[16] Some clinical studies have shown similar effect using these two medicament.[20,21] Since Aluminum sulfate can cause minimal soft-tissue irritation, but there are no known systemic side effects, many researchers recommend it as a safe and suitable method for gingival retraction.

Since these two medicated cords does not show significant difference in the expansion of sulcus width, both the cords can be used equally used weighing the systemic effect of the medicaments and patient health conditions.

CONCLUSION

It was concluded from our study that, the optimal time for retraction of gingival tissue for single cord technique is 10 min. No significant difference was found between Ultrapak and ASCT cord in regard to expansion of sulcus, so both of these cords can be used equally for gingival retraction weighing the systemic effect of medicaments.

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