J. Int Oral Health **2011**

P- ISSN
0976 – 7428

E- ISSN
0976 – 1799

Journal of International Oral Health

Prosthodontics

Original Research

Received: Nov, 2010
Accepted: Jan, 2011

Bibliographic listing:
EBSCO Publishing
Database, Index
Copernicus, Genamics
Journalseek Database,
Proquest, Open J Gate.

Evaluation of kinetic absorbency of 3 different medicaments by 5 different type of cords

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Abstract:
Objective:-The amount of liquid up take by gingival retraction cord is most important factor for successful gingival displacement procedure. The aim of this investigation was to determine the optimal soaking time for 5 different types (000, 00, 1, 2, 3) of retraction cords to ensure adequate amount of the 3 haemostatic solutions (Epinephrine, aluminum chloride and ferric sulfate). Methods: - The capability of the cords to absorb liquids was measured by a gravimetric method. Each type of cord was cut into identical lengths of 35 mm and soaked in medicament at 5 different time intervals (2 seconds; 1, 5, and 60 minutes; and 24 hours). The liquid up take can be calculated by, the weight of cord after immersion subtract the weight of cord before immersion, divided by weight of cord before immersion.
F test analysis, and $P<.05$ was regarded as significant. Results: - The rate of liquid uptake calculated from the saturation equations exhibited significant correlation with the cord thickness ($P<.05$). The saturation levels of the solutions did not show correlation with the cord thickness ($P>.30$). Conclusion: - The results of this study indicated that 20 minutes is optimum soaking time to get the maximum saturation of medicament, before use for gingival retraction.

Keywords: Gingival retraction cord, Gingival retraction medicament, optimum soaking time

Introduction:

The success of fixed prosthodontic restoration is largely dependent upon the long term health and stability of the surrounding periodontal structures[1]. Marginal integrity is one of the basic criteria of principals of tooth preparation. Margins are one of the most important and weakest links in the success of restorations, and also referred as 'gingival finish line'[2]. There are three types of gingival finish lines according to location of the marginal placement: Supra-gingival, Equi-gingival, Sub-gingival[3]. Supra-gingival and equi-gingival margin exert less impact on the health of abutment teeth as compared to sub-gingival margin, because of difficulty in recording the finish line during impression procedure, to finish the restoration and to maintain the health of abutment teeth. But in many situation such as; caries, existing restoration, esthetic demands, the need for additional retention, the placement of sub-gingival margin on the abutment teeth is necessary. So the gingival tissue must be dilated vertically and horizontally to allow sufficient impression material to be injected in to the dilated gingival tissue to record the sub-gingival margin accurately.

Various techniques and methods have been used to manage the gingival tissues. They include: (1) Mechanical methods (2) Mechanico-chemical methods (3) Rotary gingival curettage (Gingitage) (4) Electrosurgery [4]. The mechanico-chemical method is most frequently used method and causes the least amount of tissue injury. For this method; the retraction cord is either immersed in or pre-impregnated with hemostatic solutions. The retraction cord mechanically displaces the gingival tissue and absorbs moisture contamination in the gingival sulcus, while the chemical agent controls hemorrhage and shrinkage of the gingival tissue.

The mechanical effects of the cord itself will be considered equal for all materials, so that difference discussed will be solely a result of the medicaments used. So that the medicaments should satisfy the following criteria[5]:

1. It must be effective as a haemostatic agent.
2. Use of the material should not cause significant irreversible tissue damage.
3. Use of the material should not produce potentially harmful systemic effect.

Many different medicaments have been used or suggested for gingival retraction procedures. These include epinephrine, aluminum chloride ($AlCl_3$), aluminum sulfate, zinc chloride, alum (aluminum potassium sulfate), ferric sulfate, ferric sub sulfate, and Negatan. When the effectiveness and lack of the local injury are considered, the materials appear to be acceptable as gingival retraction agents: alum, aluminum sulfate, ferric sulfate, aluminum chloride (buffered), and racemic epinephrine 8%[6,7].

Epinephrine has direct effect on blood pressure and heart rate so its use is contraindication for patient having blood pressure and heart rate[8]. When the epinephrine is used during the gingival retraction procedure, it produces gingival tissue inflammation. But healing is completed within the 7 days[9]. Aluminum chloride exerts much more effect on the gingival tissue as compare to epinephrine. The gingival tissue comes in normal state within 7 to 10 days[10]. The ferric sulfate damages the gingival tissue in much greater amount and takes about 21 days to heal the gingival tissue completely. So, ferric sulfate is generally not indicated for gingival retraction procedure[11]. The expose dentine has no effect by any type of retraction medicament. Before taking impression care should be take no trace should be remain on expose dentine[12]. The newer retraction material Magic Form has no effect on quality of impression.[13] Latex glove contamination is preventing the polymerization of PVS impression material[14]. The margin fit of crown have no any correlation between, which technique uses for gingival retraction[15].

It is evident that the amount of medicament solution absorbed by cords during soaking is of importance to achieve a proper haemostatic action. In addition to the length, thickness, structure, and moistening properties of the cord, the amount of

medicament absorbed also depends on the length of soaking time. With a given cord size, the strengths of the responses in gingival microcirculation are expected to depend on the amount of medicament crossing the sulcus epithelium; therefore standardization of the conditions during the soaking procedure is critical.
The purpose of this study was to evaluate the time course of absorption of haemostatic solutions by retraction cords of various thicknesses. Determining the optimal soaking time of retraction cords could help practicing dentists to perform successful retraction procedures.

Material and method:
Five different types of retraction cords (No. 000, 00, 1, 2, and 3; Gingi-plain, Gingi-pak, Camarillo, USA) were used in this study. Each type of cord was cut in to 100 pieces with identical length of 35 mm. These 100 pieces of each type were then divided in to 4 groups according to the 4 different solution tested as retraction medicament. They are as follow:-

i. 8 % Epinephrine (Orostat, Gingi-pak, Camarillo, USA).
ii. 21 % Ferric sulfate (Statis, Gingi-pak, Camarillo, USA).
iii. 25 % Aluminum chloride (Gingi-Aid, Gingi-pak, Camarillo, USA).
iv. Physiological saline (control)

So, each group contains 25 pieces of cord. These 25 pieces of retraction cord were divided in to five groups according to different soaking time in medicament i.e. 2 seconds, 1 minute, 5 minutes, 1 hour, and 24 hours.

Each piece of retraction cord was weighed by gravimetric method before starting the procedure. Immediately before immersion, air included in the cord, which might interfere with inner moistening of the cord, was manually pressed out by pulling it against a clean filter paper held between the thumb and index finger. Omission of this step resulted in a large spread of measured value.
After soaking the piece of cord in the medicament for a specified time interval, the excess solution accumulates on the surface of the cord was removed by the filter paper saturated in to that corresponding solution.

The piece of cord was weighed again by gravimetric method. The amount of fluid absorbed was calculated by subtracting the weight of the piece of cord before the immersion from that measured at the termination of the immersion. This value was expressed in gram of fluid absorbed / gram unit of cord.

Value of this fluid uptake by cords of various thickness and incubation period in different test solution were plotted in liner coordinate system as a function of time, and the best fit line was constructed ($y = k + k' \cdot \log x$).

Results:
SPSS software package - 6.1 releases (SPSS Inc.) was used for the present study. In this study, the optimum soaking time of hemostatic agents by retraction cords. The optimum soaking time was calculated by gravimetric method.

Table 1: Liquid uptake of retraction cord type No. 000 from solution of various medicaments as a function of incubation time by equations of best-fit lines and regression coefficients analysis.

Agent	Absorbed fluid(g/g cord)	Time
Physiologic saline	0.46	2 seconds
Physiologic saline	0.74	1 minute
Physiologic saline	0.993	5 minutes
Physiologic saline	1.453	60 minutes
Physiologic saline	1.831	24 hours
Epinephrine	1.254	2 seconds
Epinephrine	1.406	1 minute
Epinephrine	1.926	5 minutes
Epinephrine	2.407	60 minutes
Epinephrine	2.653	24 hours
Aluminum chloride	0.54	2 seconds
Aluminum chloride	0.566	1 minute
Aluminum chloride	0.733	5 minutes

Aluminum chloride	1.818	60 minutes
Aluminum chloride	2.113	24 hours
Ferric sulfate	0.94	2 seconds
Ferric sulfate	1.02	1 minute
Ferric sulfate	1.206	5 minutes
Ferric sulfate	1.297	60 minutes
Ferric sulfate	1.572	24 hours
Ferric sulfate	0.592	2 seconds
Ferric sulfate	0.833	1 minute
Ferric sulfate	1.142	5 minutes
Ferric sulfate	1.388	60 minutes
Ferric sulfate	1.692	24 hours

Table 2: Liquid uptake of retraction cord type No. 00 from solution of various medicaments as a function incubation time by equations of best-fit lines and regression coefficients analysis.

Agent	Absorbed Fluid(g/g cord)	Time
Physiologic saline	0.684	2 seconds
Physiologic saline	1.265	1 minute
Physiologic saline	1.468	5 minutes
Physiologic saline	1.58	60 minutes
Physiologic saline	1.935	24 hours
Epinephrine	2.47	2 seconds
Epinephrine	2.61	1 minute
Epinephrine	2.96	5 minutes
Epinephrine	3.279	60 minutes
Epinephrine	3.714	24 hours
Aluminum chloride	0.429	2 seconds
Aluminum chloride	0.728	1 minute
Aluminum chloride	0.908	5 minutes
Aluminum chloride	1.559	60 minutes
Aluminum chloride	1.892	24 hours

Table 3: Liquid uptake of retraction cord type No. 1 from solution of various medicaments as a function incubation time by equations of best-fit lines and regression coefficients analysis.

Agent	Absorbed fluid(g/g cor	Time
Physiologic saline	0.954	2 seconds
Physiologic saline	1.225	1 minute
Physiologic saline	1.343	5 minutes
Physiologic saline	1.861	60minutes
Physiologic saline	2.098	24 hours
Epinephrine	2.323	2 seconds
Epinephrine	2.683	1 minute
Epinephrine	2.692	5 minutes
Epinephrine	2.709	60 minutes
Epinephrine	2.94	24 hours
Aluminum chloride	1.003	2 seconds
Aluminum chloride	1.754	1 minute
Aluminum chloride	2.12	5 minutes
Aluminum chloride	2.46	60 minutes
Aluminum chloride	2.581	24 hours

Ferric sulfate	1.41	2 seconds
Ferric sulfate	2.001	1 minute
Ferric sulfate	2.642	5 minutes
Ferric sulfate	2.813	60minutes
Ferric sulfate	2.988	24 hours

Ferric sulfate	0.472	2 seconds
Ferric sulfate	0.526	1 minute
Ferric sulfate	0.605	5 minutes
Ferric sulfate	0.89	60 minutes
Ferric sulfate	1.102	24 hours

Table 4: Liquid uptake of retraction cord type No. 2 from solution of various medicaments as a function of incubation time by equations of best-fit lines and regression coefficient analysis.

Agent	Absorbed fluid(g/g cord)	Time
Physiologic saline	0.652	2 seconds
Physiologic saline	0.71	1 minute
Physiologic saline	0.757	5 minutes
Physiologic saline	0.854	60 minutes
Physiologic saline	1.025	24 hours
Epinephrine	0.94	2 seconds
Epinephrine	1.18	1 minute
Epinephrine	2.24	5 minutes
Epinephrine	2.349	60 minutes
Epinephrine	2.44	24 hours
Aluminum chloride	0.291	2 seconds
Aluminum chloride	0.427	1 minute
Aluminum chloride	0.68	5 minutes
Aluminum chloride	1.072	60 minutes
Aluminum chloride	1.396	24 hours

Table 5: Liquid uptake of retraction cord type No. 3 from solution of various medicaments as a function incubation time by equations of best-fit lines and regression coefficients analysis.

Agent	Absorbed fluid(g/g cord)	Time
Physiologic saline	0.334	2 seconds
Physiologic saline	0.504	1 minute
Physiologic saline	0.718	5 minutes
Physiologic saline	1.028	60 minutes
Physiologic saline	1.388	24 hours
Epinephrine	0.795	2 seconds
Epinephrine	1.32	1 minute
Epinephrine	2.165	5 minutes
Epinephrine	2.204	60 minutes
Epinephrine	2.585	24 hours
Aluminum chloride	0.282	2 seconds
Aluminum chloride	0.448	1 minute
Aluminum chloride	0.646	5 minutes
Aluminum chloride	1.413	60 minutes
Aluminum chloride	1.628	24 hours

Ferric sulfate	0.428	2 seconds
Ferric sulfate	0.466	1 minute
Ferric sulfate	0.638	5 minutes
Ferric sulfate	1.24	60 minutes
Ferric sulfate	1.523	24 hours

The data were analyzed by F test analysis, and $p < 0.05$ was regarded as significant.

Discussion:

The amount of medicament solution absorbed by cords during soaking is of importance to achieve a proper haemostatic action. So, the soaking time is required for liquid uptake by retraction cord is a crucial factor in the successful gingival retraction procedure.

This study was designed to evaluate the optimum soaking time for liquid uptake (medicaments) by retraction cords to achieve successful gingival retraction procedure. The conditions for this step were standardized for reproduction in everyday practice. The proposed protocol allows reproducible estimation of the saturation times of cords with a given thickness immersed in medicament solutions.

The result from Table 1 to 5 showed that the best fit-line is at 20 minutes. If increase the time soaking time, that cannot exert any effect on liquid up take by cord. So the optimum soaking time for all five types of cords (No. 000, 00, 1, 2, and 3) are about 20 minutes. The thickness of cords could not exert any effect on optimum soaking time. So, it is recommended that cords cut to proper size, be incubated in the medicaments solution for 20 minutes before placement of cord in gingival sulcus for retraction. A shorten incubation time generally doesn't ensure even impregnation of the cords, whereas long-term storage yields only an insignificant increase in the amount of fluid absorbed.

On the basis of data, it is suggested that an inverse relationship between fluid absorption rate and cord thickness exists. Thus cords with smaller diameter exhibit faster absorption rates then thicker cords. Nevertheless, these values do not lead to conclusions regarding saturation time, as this parameter also depends on the maximum of fluid absorption capacity, but does not have a relationship to cord thickness. This can possibly be explained by the difference among in cord pore structure, moistening of inner surface and swelling of threads.

The results of this study shows that, during clinical practice the gingival retraction cord should be soaked in gingival retraction medicament for 20 minutes. This leads to maximum saturation of retraction cord with retraction medicament. That provides successful gingival sulcus displacement and allows sufficient space for the impression material to enter in the gingival sulcus to accurately record the gingival finish line, and also give sufficient thickness to impression material, which can be withdraw from the sulcus without tearing.

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Source of Support: Nil

Conflict of Interest: No Financial Conflict