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Evaluation of Lateral and Vertical Gingival Displacement Produced by Three Different Gingival Retraction Systems using Impression Scanning: An in-Vivo Original Study

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Abstract:- Isolation of the prepared margin along with control of gingival fluid and haemorrhage is an important factor to register finish lines, which can be achieved by displacing the gingiva away from the abutment which helps in better visualization of the prepared tooth surface. This study utilized digital scanning of rubber based impression material to compare the amount of gingival displacement produced by 3M ESPE capsule, plain retraction cord and impregnated retraction cord.

- ***Aims:***
  The aim of the study was to compare lateral and vertical gingival displacement produced by the three materials

- ***Settings and Design:***
  Case-Control

- ***Methods and Material:***
  Twenty participants requiring a full coverage restoration were selected. Gingiva around each tooth requiring a crown was retracted using the three materials and a rubber based impression was made. The impression was scanned using EXOCAD software to obtain readings for gingival displacement for control group, non-impregnated cord, impregnated cord and retraction paste.

- ***Statistical analysis used:***
  The scores were analysed in SPSS software using one way ANNOVA and post hoc analysis

- ***Results:***
  Significant difference was seen among all trial groups when compared to control. Highest mean vertical displacement was seen in clinical trial II (non-impregnated cord) followed by trial III (retraction paste).

- ***Conclusions:***
  Impregnated cord and retraction paste both produced adequate retraction for the margings to be registered. Use of paste was less time consuming and less traumatic for the patient and therefore can be substituted for retraction cords.

Keywords:- *Gingival Retraction, Displacement, Fixed Partial Denture, Retraction Paste, Finish Line*.

I. INTRODUCTION

Isolation of the prepared margin along with control of gingival fluid and haemorrhage is an important factor to register finish lines and the prepared abutment accurately to obtain a good marginal fit of the prosthesis.[1] This can be achieved by displacing the gingiva away from the abutment which helps in better visualization of the prepared tooth surface.

Lateral retraction enables the impression material to interface with the prepared tooth while vertical displacement exposes the finish line.[2] Displacement techniques of gingiva can be classified into Mechanical, Chemico-mechanical, Electrosurgical, and rotary curettage or combination.[3] Retraction cords are considered as the most commonly used mechanical method for displacement of gingival tissue.

Recently cordless gingival retraction techniques have been popularized. Cordless retraction materials are available as pastes, foam or gel. Cordless techniques have the advantage of being non-traumatic to the gingival tissue during placement, leaving no residue, being easy to use and time saving. Out of various cordless methods available for gingival retraction or displacement, the 3M astringent retraction paste capsule is a fairly new entrant and as per manufacturer, it provides significant retraction with minimum trauma and minimal bleeding with excellent control of haemorrhage. [4,5]

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Furthermore, previous studies on gingival retraction materials and their efficacy have been done using materials which are no longer available. measurements taken from the cast have chances of errors that are incorporated during impression making, handling as well as cast pouring. Impression scanning would lessen the chances of errors incorporated if impressions are poured and the cast is scanned. Therefore, this study utilized digital scanning of rubber based impression material to compare the amount of vertical and lateral gingival displacement produced by 3M ESPE capsule, plain retraction cord and impregnated retraction cord.

The study aimed to evaluate the amount of lateral and vertical gingival displacement using digital scanning of rubber based impression for each material.

II. MATERIALS AND METHODOLOGY

Patients reporting to the Department of Prosthodontics and crown & bridge, Hitkarini Dental college and hospital, Jabalpur were evaluated for a conventional fixed dental prosthesis. Patients within the age bracket of 18-50 years, requiring a full coverage restoration, with normal size and contour of teeth and clinically healthy gingiva were included in the study. Whereas, patients with grossly decayed teeth, poor oral hygiene, poor periodontal health and mal-aligned teeth were excluded.

Considering the inclusion criteria, the patients were explained the format of the study and a consent was obtained. The tooth was prepared with equi-gingival finish line, two indentations, each on mesio-buccal and disto-buccal line angle was made just above the finish line. (Figure 1) These indentations helped to standardize the points for retraction readings. A sectional impression using putty was made (control group) using two step putty wash technique. (Figure 2) The impression served as control group reading.

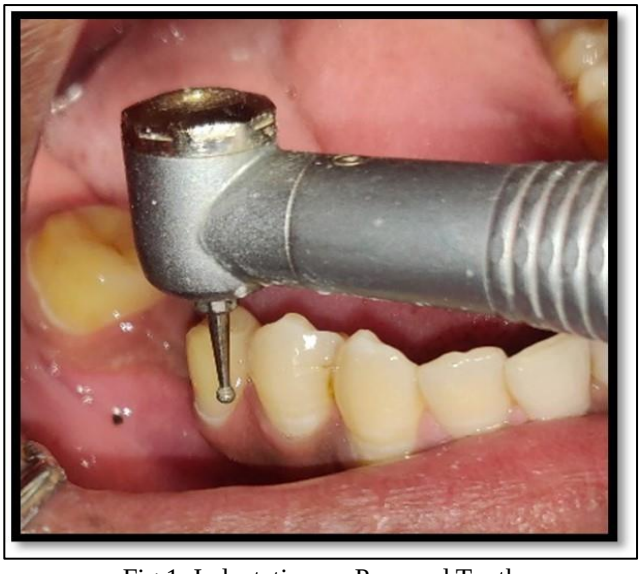

Fig 1: Indentation on Prepared Tooth

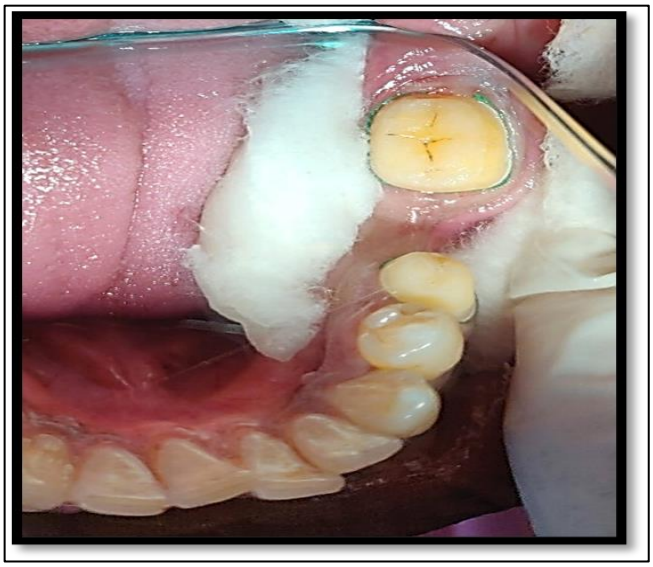

Fig 2: Retraction Using Non-Impregnated Cord

Readings for trial group I(sure-endo sure-cord non-impregnated retraction cord), trial II (sure-endo sure-cord impregnated retraction cord) and trial III (3M astringent retraction paste) was recorded in subsequent sittings , each after a gap of 7 days.

Selection of retraction cord was done according to sulcus depth and gingival biotype. Cord was placed in the gingival sulcus for 6 mins after which it was removed and a putty impression was made. This procedure was repeated for both non-impregnated and impregnated retraction cords.(Figure 2 & 3) In the final sitting, astringent retraction paste was used according to manufacturers instructions, kept in the sulcus for 2 mins, rinsed and the tooth was dried followed by a putty impression. (Figure 4)

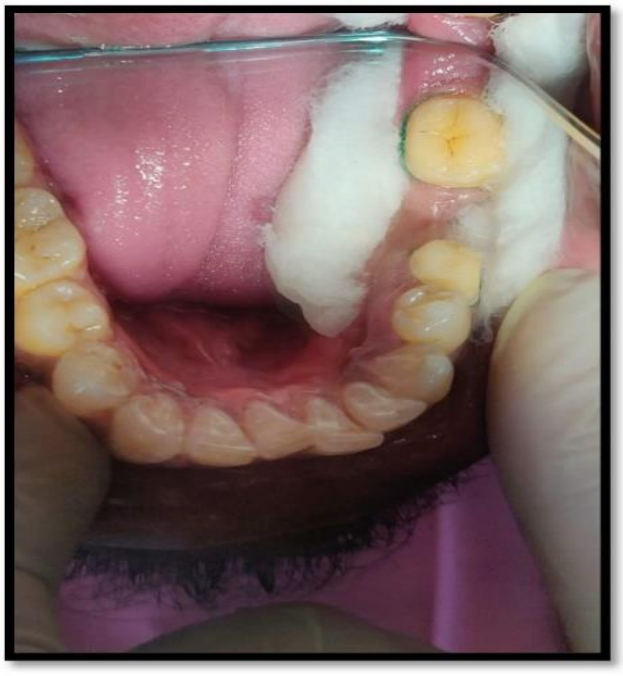

Fig 3: Retraction Using Impregnated Cord

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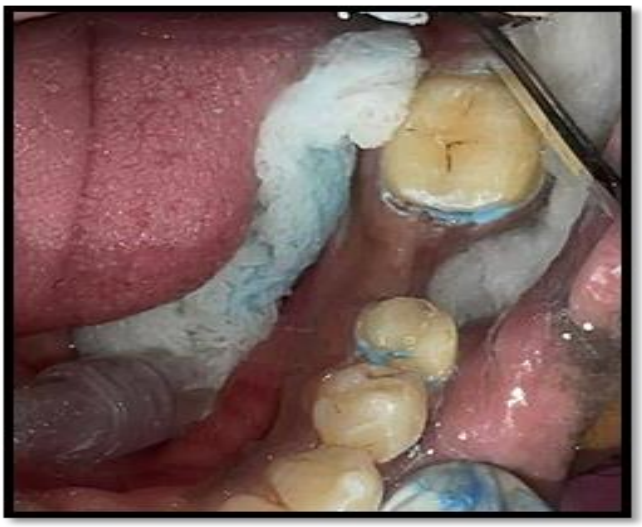

Fig 4: Retraction Using Astringent Paste

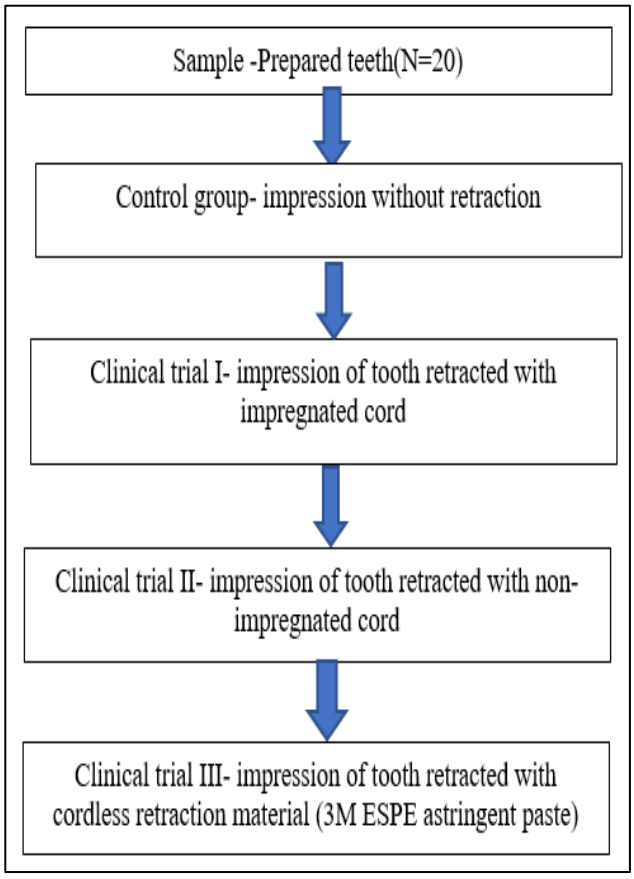

Fig 5: Flowchart

III. EVALUATION OF GINGIVAL RETRACTION

The impression collected for each group was evaluated using impression scanning. The measurements were recorded using EXOCAD software. Distance tool was used for calculating the retraction produced. The green dot of the distance tool marked the reference point on the tooth (indentation) , the red marked the sulcus depth and width on the gingiva. This process was repeated for each sample four times, for depth and width on the mesial side and for depth and width on the distal side and an average reading for each depth and width was obtained. (Figure 5 & 6)

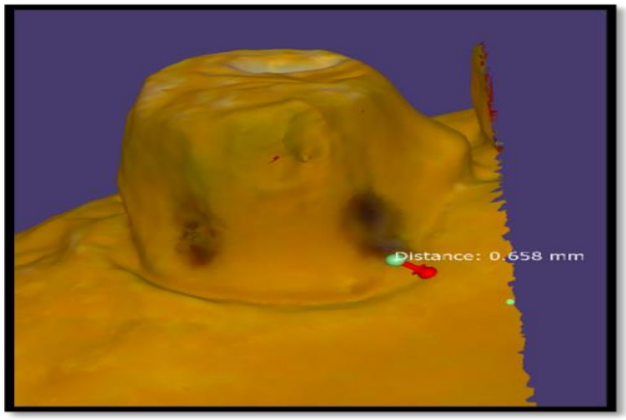

Fig 6: Horizontal Gingival Displacement Measurement

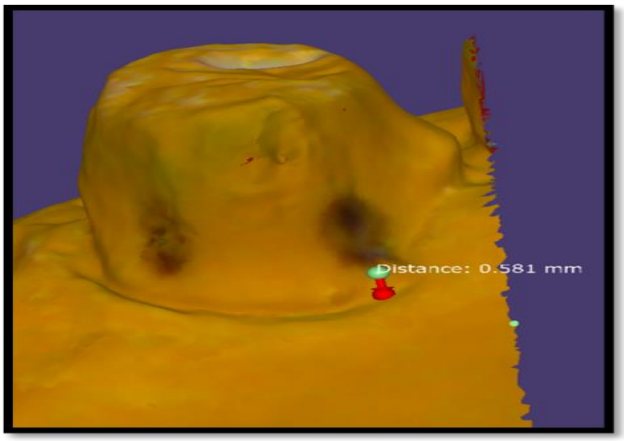

Fig 7: Measurement of Vertical Gingival Displacement

Intragroup and intergroup comparisons of the average produced was obtained via statistical analysis.

IV. DATA ANALYSIS

Data analysis of the 20 samples was done based on the objectives of the study. The data was entered into a spreadsheet computer program (Microsoft Excel 2007) and was analysed using SPSS statistical software version 19.0.(SPSS Inc., Chicago, Illinois, USA). The descriptive statistics included mean, standard deviation. The level of significance of the present study was fixed at 5% (0.05).

V. RESULTS

Table 1 show the lateral displacement of gingiva and mean values of all four groups. The table depicts that the mean lateral displacement values were highest for Clinical Trial II i.e. Impregnated retraction cord (0.740mm±0.148mm), followed by Clinical Trial III i.e. 3M ESPE retraction capsule (0.674mm±0.138mm), Clinical Trial I i.e. Non Impregnated retraction cord (0.614mm±0.151mm) and least in Control Group (0.553mm±0.141mm).

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When the Kruskal Wallis test was done to compare lateral displacement between all four groups, the difference between the groups was found to be statistically significant ($p<0.05$) (Table 2).

When the post hoc analysis using the Mann Whitney U test was done, intergroup comparison of lateral displacement was evaluated. Table 3 depicts that the difference between Control vs Clinical trial II, Control vs Clinical trial III, Clinical Trial I vs Clinical trial II to be significant ($p<0.05$). The same was used to plot the Graph 2 that shows intergroup comparison between all four groups for lateral displacement.

Table 3 depicts that the mean vertical displacement values were highest for Clinical Trial II (0.628mm±0.169mm), followed by Clinical Trial III (0.564mm±0.103mm), Clinical Trial I (0.528mm±0.111mm) and least in Control Group (0.468mm±0.109mm).

When the Kruskal Wallis test was done, the difference between the groups was statistically significant.

Table 4 shows comparison made between different groups using the post hoc analysis using the Mann Whitney U test . it was observed that the difference between Control vs Clinical trial II, Control vs Clinical trial III, Clinical Trial I vs Clinical trial II was found to be statistically significant.

VI. DISCUSSION

Gingival retraction as a procedure is especially important when sub-gingival finish lines are given, wherein displacement of the gingiva in both vertical and lateral direction is needed. Different techniques, such as mechanical, surgical, chemo-mechanical, electro-surgery and combinations of the above have been used. Of the above mentioned, chemo-mechanical (impregnated gingival retraction cord) is the most common. A survey conducted by Sumitha N. et al in the year 2015 concluded that 92% of the dental practitioners preferred using gingival retraction cords.[6]

Although retraction cords have merits, they are technique sensitive and may cause injury to the gingiva if not done meticulously. Placement time, removal technique of cord, etc may lead to injury and irreversible damage to gingival sulcus. These disadvantages lead to development of cordless retraction materials. Previous studies made use of merocel strip, expasyl and magic foam and compared the retraction using stereomicroscope, cast scanning, flexible strip and vernier callipers.

The present study evaluated vertical and horizontal retraction produced by three materials non-impregnated cord (Sure-endo Sure-cord), impregnated retraction cord (Sure-endo Sure-cord plus) and a cordless retraction material i.e. 3M ESPE astringent paste.

The mean lateral displacement in the present study, for the control group was found to be 0.553mm, non-impregnated cord was found to be 0.614mm, impregnated cord was 0.740mm and for 3M ESPE astringent retraction paste was 0.674mm (Table 1). The highest being in impregnated cord followed by astringent retraction paste and the least in non-impregnated retraction cord. All of which were more than control group. This is supported by a study by Shrivastava K.J et al in the year 2015,[4] that compared the efficacy of magic foam cord, expasyl and aluminium chloride impregnated retraction cord on central incisors and concluded that aluminium chloride impregnated cord produced maximum amount of retraction followed by expasyl and the least was seen by magic foam cord. The probable reason being that a chemically treated cord causes transient ischaemia, shrinking the gingival tissue and that it acts both by mechanical pressure and chemically by decreasing the gingival fluid in the sulcus.[5]

In table 2 when Post Hoc analysis was done to obtain significance between groups, difference between control group and Clinical trial I was not significant in lateral displacement. Similar result was concluded in a study conducted by Acar O et al in the year 2013,[7] where he compared non-impregnated cord, impregnated cord (soaked in aluminium chloride), and traxodent retraction paste and evaluated by using polyether impression material. He concluded that the non-impregnated was least effective in producing dilatation when compared to the other groups. Gingival margin quality recorded in the cast was noted to be the worst in non-impregnated cord cases. Significantly higher bleeding instances were seen on removal and placement of non-impregnated cord.[3]

In the present study, clinical trial II and III had significant difference when compared to control group (Table 4). A similar result was found in a study conducted by Mahajan A et al in the year 2019, that compared non-impregnated knitted retraction cord, aluminium chloride impregnated retraction cord and braided chitosan cord and concluded that impregnated retraction cords were better in gingival retraction when compared to non-impregnated cord. The probable reason of ineffectiveness of non-impregnated cord can be attributed to its non-impregnation with any kind of hemostatic agent.[8]

Table 4 shows comparison of control vs Clinical trial II(impregnated cord) to be highly significant (0.001). Whereas a statistically non-significant result was found between Clinical trial II and Clinical trial III suggesting that retraction produced by the two materials i.e. impregnated retraction cord and 3M ESPE astringent paste didn't show much difference to be statistically significant. A study by Qureshi S. M. et al in the year 2020 [9] contradicts the results of the present study where a statistically significant result was obtained when retraction cord, astringent retraction paste and expasyl were compared. He concluded that retraction paste showed highest retraction followed by Stayput retraction cord and the least in expasyl. The probable reason of which could be the type of cord used in the present study being knitted and the cord used by study conducted by Qureshi being braided. This contradictory result is supported in a study conducted by Raja Z and Nair C et al in the year 2003, [10] that compared potential of gingival retraction of knitted cord, braided cord and retraction paste. He concluded that knitted retraction cord

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provided maximum retraction followed by expasyl and the least by braided retraction cord.[11]

On intergroup comparison, Impregnated retraction cord(Clinical trial II) and astringent retraction paste (Clinical trial III) had a statistically significant vertical retraction when compared to control group ($p \leq 0.05$). A comparison between non-impregnated and impregnated cord showed statistically significant results whereas, it was found that the results between clinical trial I vs Clinical trial III and Clinical trial II vs Clinical trial III were non-significant. These results were in accordance with the study done by Kohli P.K. and Hegde et al in the year 2017, [12] where Ultrapak retraction cord was compared with Traxodent retraction paste and the study concluded that the mean retraction obtained by Ultrapak was significantly greater when compared to Traxodent retraction paste. The results obtained can be attributed to the fact that retraction cord being a mechanical method of gingival retraction has to be physically compressed into the gingival sulcus and has to be left for 5-10 minutes, therefore provides maximum retraction. Whereas 3M ESPE astringent paste in the present study being a chemical mode of retraction no pressure is applied while placement and the placement time for paste is also less compared to retraction cord.[13]

- *Limitations of The Study:*

Smaller sample size, inclusion of only posterior teeth, gingival biotype was not considered, single retraction technique used while cord placement.

- *Future Scope of the Study*

There still is scope of research in the present study on patients and clinicians comfort, time required for placement of the three materials in order to obtain appropriate retraction and displacement produced in different biotypes.

VII. CONCLUSION

The study concluded that impregnated cord and 3M astringent paste produced adequate retraction when compared to control group. Vertical and horizontal displacement was least with non-impregnated cord. Use of astringent paste was found to be easier and less time consuming. However, a longitudinal study with a much bigger sample size can provide better knowledge as to whether astringent paste is a viable option to conventional cord.

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TABLES

Table 1: Intergroup Comparison Of Lateral Dispalcement Between The Four Study Groups

Parameters	**Groups**	**N**	**Mean (in mm)**	**Std. Deviation (in mm)**	**Std. Error**	**95% Confidence Interval for Mean**		**Minimum (in mm)**	**Maximum (in mm)**
						Lower Bound (in mm)	**Upper Bound (in mm)**		
Lateral Displacement	Control	20	0.553	0.141	0.031	0.487	0.620	0.40	0.93
	Clinical trial I	20	0.614	0.151	0.033	0.543	0.684	0.43	0.95
	Clinical trial II	20	0.740	0.148	0.033	0.670	0.809	0.55	1.13
	Clinical trial III	20	0.674	0.138	0.031	0.609	0.739	0.54	0.98

Table 2: Post HOC Analysis

Dependent Variable	Groups	Mean Difference	Std. Error	Significance value	Significance
Lateral_ Displacement	Control vs Clinical trial I	0.060	0.045	0.193	Non-Significant
	Control vs Clinical trial II	0.186	0.045	0.001	**Significant**
	Control vs Clinical trial III	0.120	0.045	0.010	**Significant**
	Clinical Trial I vs Clinical trial II	0.125	0.045	0.008	**Significant**
	Clinical Trial I vs Clinical trial III	0.060	0.045	0.192	Non-Significant
	Clinical Trial II vs Clinical trial III	0.065	0.045	0.157	Non-Significant

Table 3: Vertical Dispalcement in the Four Study Groups

Parameters	**Groups**	**N**	**Mean (in mm)**	**Std. Deviation (in mm)**	**Std. Error**	**95% Confidence Interval for Mean (in mm)**		**Minimum**	**Maximum**
						Lower Bound	**Upper Bound**		
Vertical Displacement	Control	20	0.468	0.109	0.024	0.417	0.519	0.32	0.85
	Clinical trial I	20	0.528	0.111	0.024	0.476	0.580	0.40	0.90
	Clinical trial II	20	0.628	0.169	0.037	0.549	0.707	0.48	1.27
	Clinical trial III	20	0.564	0.103	0.023	0.516	0.613	0.44	0.90

Table 4: Post HOC Analysis

Dependent Variable	**Groups**	**Mean Difference**	**Std. Error**	**Significance Value**	**Significance**
Vertical Displacement	Control vs Clinical trial I	-.060	.03998	0.138	Non-Significant
	Control vs Clinical trial II	-.160*	.03998	0.001	**Significant**
	Control vs Clinical trial III	-.096*	.03998	0.019	**Significant**
	Clinical Trial I vs Clinical trial II	-.100*	.03998	0.014	**Significant**
	Clinical Trial I vs Clinical trial III	-.036	.03998	0.368	Non-Significant
	Clinical Trial II vs Clinical trial III	.063	.03998	0.114	Non-Significant