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# Effect of Pattern Materials on Marginal Gap of Cast Copings Fabricated on Titanium Implant Abutment: An In-Vitro Study.

[1*]Rajat R khajuria..[2]Mukesh kumar,[3]Dr. Romil Safaya, [4]Dr. Nauseen Hajira.
*[1]Ex-RegistrarDeptt of prosthodontics,Indira Gandhi govt dental college, Jammu.*
*[2]Professor,Department of conservative dentistry and endodontics,Patna dental college and hospital,Patna.*
*[34]Dental surgeonJammu Department of Prosthodontics including Crown and Bridge, Alnarjis Alwardi Clinic, Najran, Kingdom of Saudi Arabia.*
**Corresponding author: Rajat R khajuria*

***Abstract***
***Introduction:*** *Margin placement is an essential requirement in any fixed restoration as it limits the boundary of the restoration and seals the implant abutment junction for entry of any debris or saliva, thus failing the restoration.[2] The marginal fit of the cast restorations is essential for proper functioning, esthetics and success in oral cavity. The aim of the study is to compare the effect of pattern materials on marginal gap of cast copings fabricated on titanium implant abutment. Null hypothesis state no difference in pattern materials when tested for marginal fit over implant abutment.*
***Materials& method:*** *Two pattern materials: Inlay wax and Margin wax were used in the present study. And patterns were prepared on titanium Implant model with implants placed at premolar region and at molar position. Two grooves one at $90^0$ and other at $180^0$ were made and 20 samples of inlay wax patterns and 20 samples of margin wax patterns were made which were further divided into two subgroups of 10 each of premolar region and molar region respectively Two stage burnout was carried out and casting was done using nickel chromium alloy.. Two points marked at $90^0$ and $180^0$ were checked at margin level with the help of stereomicroscope and the vertical marginal gap was evaluated. The marginal gap was calculated at 2 points i.e. $90^0$ and $180^0$. The distance of the line from groove to the outermost margin was calculated at master die and on all the samples and their differences were recorded.*
***Results:*** *The data collected from all the samples was analyzed using ANOVA and post hoc tests. In intergroup comparison between both the groups, Group 1 recorded more marginal gap (25.40 ± 0.52 μm) than group 2 (19.99 ± 0.39 μm). In intra group comparisons between the subgroups, group B (24.13 ± 0.17 μm) recorded more marginal gaps than group A (21.26 ± 0.41 μm). The f value for all the subgroups was calculated as 87.2899 which was significant at $p<0.05$.*
***Conclusion:*** *Among the materials tested, patterns made of Margin wax proved to have more marginal fit than Patterns made of inlay wax.*
***Keywords:*** *Inlay, Margin, Post, Stereoscope, Distortion.*

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## I. Introduction

Prosthodontics deals with replacement of natural teeth by artificial substitutes along with maintenance of form, function and occlusal equilibrium. Prosthodontics consists of removable, fixed and implants restorations as sub divisions.[1] The success of fixed prosthodontics depends on the quality of abutment teeth, Type of restoration, type of margin and occlusal load on the restoration rendered. Margin placement is an essential requirement in any fixed restoration as it limits the boundary of the restoration and seals the implant abutment junction for entry of any debris or saliva, thus failing the restoration.[2] The marginal fit of the cast restorations is essential for proper functioning, esthetics and success in oral cavity. A well fitted, proper marginated cast restoration forms a ferrule type effect and distributes forces equally around margins.[3] Proper margin fit in implant restoration is more essential as the leakage of microorganisms in implant abutment junction leads to peri-implantitis.[2,4] It has been reported5 that misfit of the abutment prosthesis on the implant body leads to occlusal imprecision, screw fracture, screw loosening and increasing the possibility of abutment and/or implant fracture. [2,6,7] It has also been documentedthat marginal misfit transmits high stresses to the alveolar bone and dental implant components. [3,4,8]

Traditionally, the crowns over the implants are constructed by lost wax technique or CAD/CAM. CAD/CAM is more accurate but higher costs force us to use lost wax technique in general practice. The success of cast restoration achieved by lost wax technique depends on type of pattern wax used, type of investment, burn

out and finally the casting used. The inlay wax forms back bone for pattern fabrication. It has 0.001% residual on ignition4 and hard on setting makes it used for pattern fabrication purpose. One of the biggest disadvantages of inlay wax is wax distortion.4 The property of wax to return to its original shape and inclusion of internal stresses leads to distortion of waxes leading to misfit of restorations. Newer materials like margin wax, pattern resins, light cured resins are there in market boasting of their enhanced properties, eliminating the chances of distortion. The aim of the study is to compare the effect of pattern materials on marginal gap of cast copings fabricated on titanium implant abutment. Null hypothesis state no difference in pattern materials when tested for marginal fit over implant abutment.

## II. Materials And Method

The present study was carried out with two pattern materials: Inlay wax and Margin wax. A titanium Implant model was used in the present study with implants placed at premolar region and at molar position and abutments placed parallel to each other. Two grooves one at $90^0$ and other at $180^0$ were made with the help of frenum bur. 20 samples of inlay wax patterns and 20 samples of margin wax patterns were made which were further divided into two subgroups of 10 each of premolar region and molar region respectively. Mock Wax of 1.5 mm thickness of coping was carried out for both the premolar and molar sites and putty index was made using addition silicone as putty index. Both the waxes were dipped in their respective wax baths heated at $65^0$C. The abutments were dipped in wax bath repeatedly and standardized using putty index fabricated. All the samples fabricated were inspected for any irregularity or imperfections and were omitted. All the samples prepared were attached with the sprues and invested in phosphate bonded investment for an hour. All the samples prepared were invested in a single casting ring for standardization. Two stage burnout was carried out and casting was done using nickel chromium alloy. Castings were allowed to cool for an hour and were disinvested. Sprues were removed and sandblasting was done for the samples. Each sample was placed over the master die and a 10N load was placed over the coping to properly seat the coping over die. Two points marked at $90^0$ and $180^0$ were checked at margin level with the help of stereomicroscope and the vertical marginal gap was evaluated. The marginal gap was calculated at 2 points i.e. $90^0$ and $180^0$. The distance of the line from groove to the outermost margin was calculated at master die and on all the samples and their differences were recorded.

## III. Results

The data collected from all the samples was analyzed using ANOVA and post hoc tests. In intergroup comparison between both the groups, Group 1 recorded more marginal gap (25.40 ± 0.52 μm) than group 2 (19.99 ± 0.39 μm). In intra group comparisons between the subgroups, group B (24.13 ± 0.17 μm) recorded more marginal gaps than group A (21.26 ± 0.41 μm). The f value for all the subgroups was calculated as 87.2899 which was significant at $p<0.05$.

## IV. Discussion

Casting is an art of molding an object in metal. Casting involves various steps ranging from Impression making to pattern fabrication which is replicated in metal by melting the pattern which was invested in solid mold.. All waxes used for pattern fabrication should be uniform, have contrast color with the die, should not flake on softening of wax, dimensionally stable, good flow and rigid. The pattern is fabricated conventionally by Inlay wax. The Inlay wax is composed of paraffin wax, ceresin, gum Dammar, carnauba Wax and candeilla wax. . All conventional pattern materials have two major qualities which cause problem in usage- thermal change in dimension and tendency to distort. The aim of the present study is to compare inlay wax with newly introduced material margin wax on the basis of marginal gap of cast copings fabricated on titanium implant abutments.The entire study was carried out on 2 implant abutments i.e. premolar and molar. An addition silicone putty index was prepared of Mock Wax of 1.5 mm thickness of coping for both the premolar and molar sites to standardize the thickness of wax used. All the samples prepared were attached with the sprues, invested in a single casting ring for standardization using phosphate bonded investment. Casting was done using nickel chromium alloy as is economical and widelu used for ceramco metal alloys. Each sample was placed over the master die and a 10N load was placed over the coping to properly seat the coping over die. The marginal gap was calculated at 2 points i.e. $90^0$ and $180^0$ with the help of stereomicroscope and the vertical marginal gap was evaluated. The distance of the line from groove to the outermost margin was calculated at master die and data was analyzed using analysis of variance and post hoc test. In intergroup comparison between both the groups, Inlay wax Group recorded more marginal gap (25.40 ± 0.52 μm) than margin wax group (19.99 ± 0.39 μm). This shows that Inlay wax has more wax distortion than Margin wax. In intra group comparisons between the molar subgroup (24.13 ± 0.17 μm) recorded more marginal gaps than premolar subgroup (21.26 ± 0.41 μm). This may be due to increased amount of wax used leading to more distortion. In intergroup comparison between all the subgroups, Inlay wax with molar recorded maximum marginal gap followed by inlay wax on premolar,

Margin wax with molar and least with Margin wax with premolar. This may be attributed to enhanced wax distortion in inlay wax than margin wax and in molar abutment coping, the amount of wax used is more, thus raising the distortion level and finally the marginal gap. Various authors[9,10]have documented various acceptable crown margin discrepancy. Christenson[9] described 34-119 μm as acceptable value for supra gingival crown margin discrepancy where as 02-15 μm for subgingival crown margin discrepancy. In a study of 1000 crowns by Mclean and van Frahouner[10], 120 μm was considered as the upper limit for discrepancy. The present study recorded values of 25, 19, 21, 24 μm which can be considered fine for supra gingival but critical for sub gingival preparations. Also, the referencing studies are for natural teeth and we have carried out study on titanium implant abutments where the risk of peri implantatis is more, thus necessitating a material with minimum distortions. Allen Ignesium[11] also conducted a similar study to compare MOD patterns and full crowns patterns on the basis of marginal fit and found maximum polymerization shrinkage for inlay wax and minimum for auto polymerized resins, thus opening new doors for polymerizing resin for fabrication of patterns. Raja gopal et al[12] also stated that light cured samples are most stable, followed by pattern resins and least by waxes when tested for dimensional stability. Rollenback and Holllen,[13] Sushma et al[14] stated that patterns made of inlay wax shows less distortion if they are manipulated correctly. A low-storage temperature and incremental add up is therefore recommended to minimize distortion and moreover, to obtain an ideal result, the patterns should be invested instantly after being removed from the preparation. Further research is directed to carrying out the study with addition of light cured waxes and other alternatives. .

## V. Conclusion

Among the materials tested, patterns made of Margin wax proved to have more marginal fit than Patterns made of inlay wax.he patterns made on premolar shaped titanium implant abutment showed less distortion than on molar shaped titanium implant abutments due to less thickness of waxes used. .

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| Sno. | Group | Name of group | No. of samples |
|---|---|---|---|
| 1 | 1A | Inlay wax pattern on implant at Premolar region. | 10 |
| 2 | 1B | Inlay wax pattern on implant at Molar region. | 10 |
| 3 | 2A | Margin wax pattern on implant at Premolar region. | 10 |
| 4 | 2B | Margin wax pattern on implant at Molar region. | 10 |

**Table 1**:

| Sample no. | 1A | 1B | 2A | 2B |
|---|---|---|---|---|
| 1. | 20.11 | 26.32 | 18.25 | 21.36 |

| | | | | |
|---|---|---|---|---|
| 2. | 21.24 | 27.66 | 19.53 | 20.19 |
| 3. | 22.72 | 28.47 | 19.26 | 19.93 |
| 4. | 22.15 | 28.23 | 17.98 | 21.54 |
| 5. | 26.38 | 26.42 | 18.88 | 21.49 |
| 6. | 26.15 | 28.15 | 19.03 | 21.26 |
| 7. | 23.21 | 25.97 | 19.31 | 20.18 |
| 8. | 24.32 | 27.14 | 19.27 | 22.13 |
| 9. | 25.32 | 26.83 | 19.18 | 21.55 |
| 10. | 23.96 | 27.34 | 18.95 | 20.49 |

Distribution set up

**Table 2:** Readings recorded for all the samples.

| | Group 1A | Group 1B | Group 2A | Group 2B | Total |
|---|---|---|---|---|---|
| N | 10 | 10 | 10 | 10 | 40 |
| $\sum X$ | 235.56 | 272.53 | 189.64 | 210.12 | 907.85 |
| Mean | 23.556 | 27.253 | 18.964 | 21.012 | 22.6963 |
| $\sum X^2$ | 5587.448 | 7434.0757 | 3598.4906 | 4420.0818 | 21040.0961 |
| Std. Dev | 2.0709 | 0.8702 | 0.4896 | 0.7484 | 3.3409 |

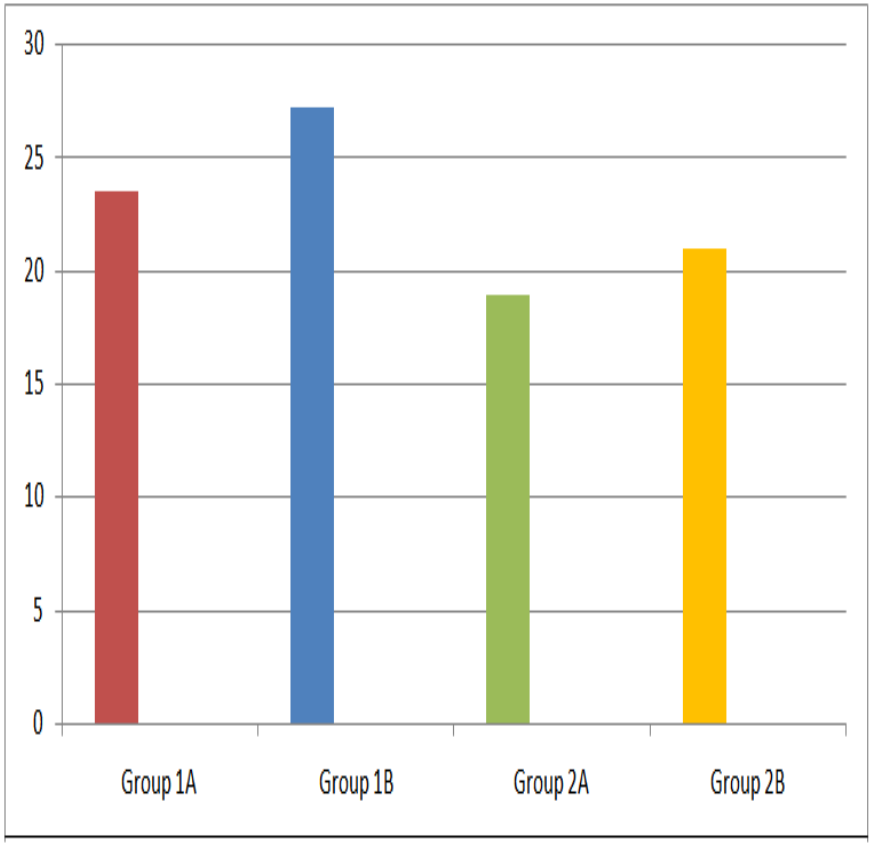
**Table 3:** Results

| Source | SS | Df | MS | F |
|---|---|---|---|---|
| Between treatments | 382.6953 | 3 | 127.5651 | |
| Within treatments | 52.6103 | 36 | 1.4614 | 87.2899 |
| Total | 435.3055 | 39 | | |

The value of f is calculated as 87.2899 which is significant at $p<0.05$.

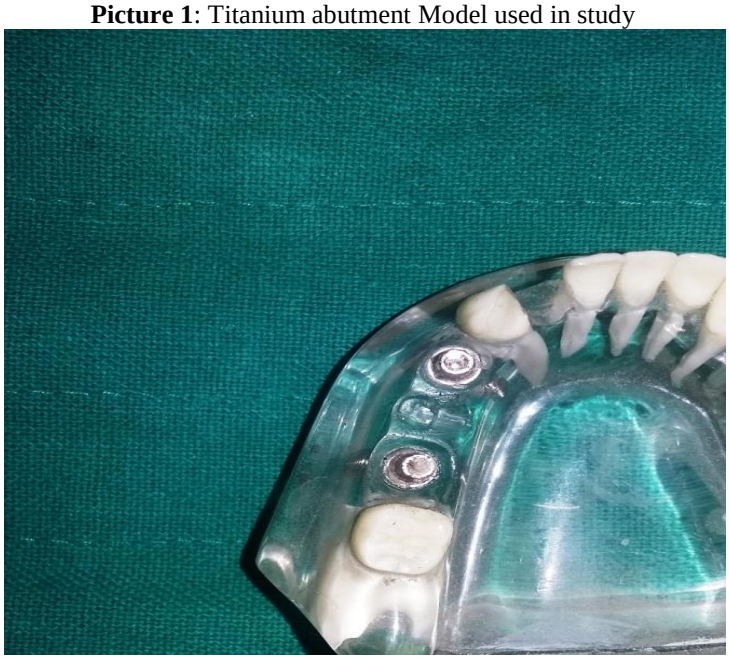
**Table 4**: Distribution set up

| Group | Type | Manuacturer | Batch number |
|---|---|---|---|
| 1. | Inlay wax | GC India, Mumbai. | B11264 |
| 2. | Margin wax | Delta waxes, Chennai | 013574 |




**Graph 1**: Marginal gap in all four subgroups.

**Picture 1**: Titanium abutment Model used in study



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