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Comparative Evaluation of Antimicrobial Activity Associated with Transmucosal Components of Implants

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KEYWORDS
Antimicrobial activity, transmucosal components, prosthetic abutment

ABSTRACT:

Background: Recently, there has been a growing interest in mucointegration as the formation of an early and long-standing soft tissue barrier seems essential for both the initial healing and long-term implant survival. The mucointegration is of major importance to ensure good prognosis of implant and to prevent bacterial progression from the oral cavity on the implant surface. Another important parameter is the design and material composition of the trans-mucosal components because it can create a stabilizing ring of connective tissue to protect underlying structures. Transmucosal components include healing abutment and prosthetic abutment. Prosthetic abutments must have properties including biocompatibility, polishability, antimicrobial properties, etc. Few of various prosthetic abutments which are commonly available were studied for antimicrobial activity in this paper.

Aim: To evaluate and compare antimicrobial activity on prosthetic abutment of implant

Material & Methods: Various implant prosthetic abutment materials which are available today include titanium, cobalt chromium, zirconia polished and zirconia glazed, peek etc. Out of these titanium, cobalt chromium, zirconia polished and glazed zirconia were studied for antimicrobial activity. The saliva samples were collected and depending upon prosthetic abutments selected, it was divided into various groups. The selected prosthetic abutments were immersed in saliva samples and cultured. After specific period of time microbial flora from the prosthetic abutments was scrapped and identified under a microscope for its type and quantity then the groups were compared.

Results: Results showed titanium abutment material showed less microbial activity as compared to other groups, while cobalt chromium abutment material showed high microbial activity. Glazed and polished zirconia material did not show any significant difference with each other and titanium abutment group.

Conclusion: Less the microbes present on the prosthetic abutment material, more was antimicrobial activity of the material and vice versa. Better the antimicrobial activity, better the soft tissue health and mucointegration and thus leading to long term success of implants.

INTRODUCTION:

Treatment with dental implants is a commonly recognized prosthodontic procedure. The need for long-term stability and efficient functional rehabilitation is growing along with the aging of society.[1] Osseointegration has been regarded as a crucial and essential component of implant success.[2] Furthermore, one of the key elements affecting the long-term results of dental implant therapy is the stability of the soft tissue

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surrounding the implant.[3] Gaining knowledge of the relationship between load distribution at the bone–implant contact and the intricate design of the implant and abutment is crucial.[4] The mechanical stability of implant abutments can be impacted by the vastly varied features of the various materials and designs.[5]

Mucointegration has drawn more attention lately since it appears that the establishment of an early and durable soft tissues barrier is crucial for both the initial healing process and the long-term survival of implants.[6] The mucointegration is of major importance to ensure good prognosis of implant and to prevent bacterial progression from the oral cavity on the implant surface. Another important parameter is the design and material components of the transmucosal components because it can create a stabilizing ring of connective tissue to protect underlying structures.

The surrounding soft tissues play a critical role in the long-term viability of dental implants by acting as a barrier against bacterial colonization and preventing peri-implant disease.[7]A perfect transmucosal implant component should reduce plaque buildup and bacterial colonization while simultaneously promoting epithelial and connective tissue attachment and its maintenance over time.[8]

Research has indicated that the surface characteristics of dental implants significantly influence the initial bacterial adherence.[8]It is vitally critical for implant materials exposed to the oral cavity to impede early colonization because early colonizers, like as streptococci, establish an environment that also supports the accumulation of later colonists. Factors include the transmucosal parts of implants and the chemical makeup and surface roughness of abutments have a significant impact on plaque formation.[8]

Transmucosal components include healing abutment and prosthetic abutment. Prosthetic abutments must have properties including biocompatibility, polishability, antimicrobial properties, etc. Various kinds of implant abutment materials such as titanium, cast gold alloy, zirconia, cobalt chromium, PEEK, are used.

Few of the prosthetic abutments which are commonly available will be studied for antimicrobial activity in this study.

METHODOLOGY:

SAMPLES:

Group A: Type and quantity of microbial flora on 3 titanium abutment.

Group B: Type and quantity of microbial flora on 3 cobalt chromium abutment

Group C: Type and quantity of microbial flora on 3 zirconia polised abutment

Group D: Type and quantity of microbial flora on 3 zirconia glazed abutment

The sample size came out to be 12.

PROCEDURE OF THE STUDY:

This study is an In-vitro study and is held in Department of Prosthodontic and Crown & Bridge. The saliva samples was collected post lunch and depending upon transmucosal components selected, it was divided into four A,B,C and D groups. The selected transmucosal components were immersed in saliva samples and was incubated for 72 hours in an incubator. After that, transmucosal components was cultured in three different culture mediums i.e Mac Conkey's agar medium, Blood agar medium, Nutrient agar medium for 24 hours. Then, colonies were scrapped from culture media with the help of nicrome wire loop.

Plates displaying growth of colonies were subjected to gram staining protocol.Then colonies were observed under microscope for quantity. Bacterial count was determined in Colony Forming Units. These were identified under a microscope for its quantity then the groups will be compared with each other.

STATISTICAL TESTS:

- Statistical analysis was performed using Statistical Product and Service Solution (SPSS) version 16 for windows (SPSS Inc., Chicago, IL).
- Descriptive quantitative data was expressed in mean and standard deviation respectively.
- Overall comparison between four groups will be done using Anova f test followed by Tukey post hoc test to find pair wise difference.

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- Confidence interval is set at 95% and probability of alpha error set at 5%. Power of study set at 80%.

RESULTS:

Overall intergroup comparison was done of mean antimicrobial activity associated with transmucosal components of four different implant materials respectively using One way Anova F test. The results of Blood agar, Mac Conkey agar and Nutrient agar respectively showed 2.55,3.9,1.8 * 10^3 cfu for Group A, 81.9,93.8,65.4 * 10^3 cfu for Group B, 6.6,8.2,5.3 * 10^3 cfu for Group C and 5.4,5.2,3.1 * 10^3 cfu for Group D. Thus One way Anova F test showed values of Blood agar as 37.8 and that of Mac Conkey agar 24.9 and Nutrient agar 20.1.

Pairwise intergroup comparison was done of mean antimicrobial activity associated with transmucosal components of four different implant materials respectively using Tukey's post hoc test. The comparison between Blood agar, Mac Conkey agar and Nutrient agar respectively showed Group A vs Group B p <0.001 for all mediums, Group A vs Group C p = 0.143,0.084,0.065, Group A vs Group D p = 0.195,0.472, 0,245 , Group B vs Group C p <0.001 for all mediums , Group B vs Group D p <0.001 for all mediums , Group C vs Group D p=0.872,0.751,0.617 (Table 1, 2)(Graph 1)

Table 1: Overall intergroup comparison of mean antimicrobial activity associated with transmucosal components of four different implant materials respectively using One way Anova F test

(x 10^3 CFU)	Blood Agar Mean (SD)	Mac Conkey Agar Mean (SD)	Nutrient Agar Mean (SD)
Group A (Titanium abutment)	**2.55 (1.3)**	**3.9 (1.7)**	**1.8 (0.6)**
Group B (Cobalt Chromium)	**81.9 (43.1)**	**93.8 (51.2)**	**65.4 (23.8)**
Group C (Zirconia polished)	**6.6 (2.6)**	**8.2 (3.7)**	**5.3 (1.7)**
Group D (Zirconia glazed)	**5.4 (2.1)**	**5.2 (1.8)**	**3.1 (2.4)**
One way Anova F test	**F = 37.8**	**F = 24.9**	**F = 20.1**
P value, Significance	**p < 0.001****	**p < 0.001****	**p =< 0.001****

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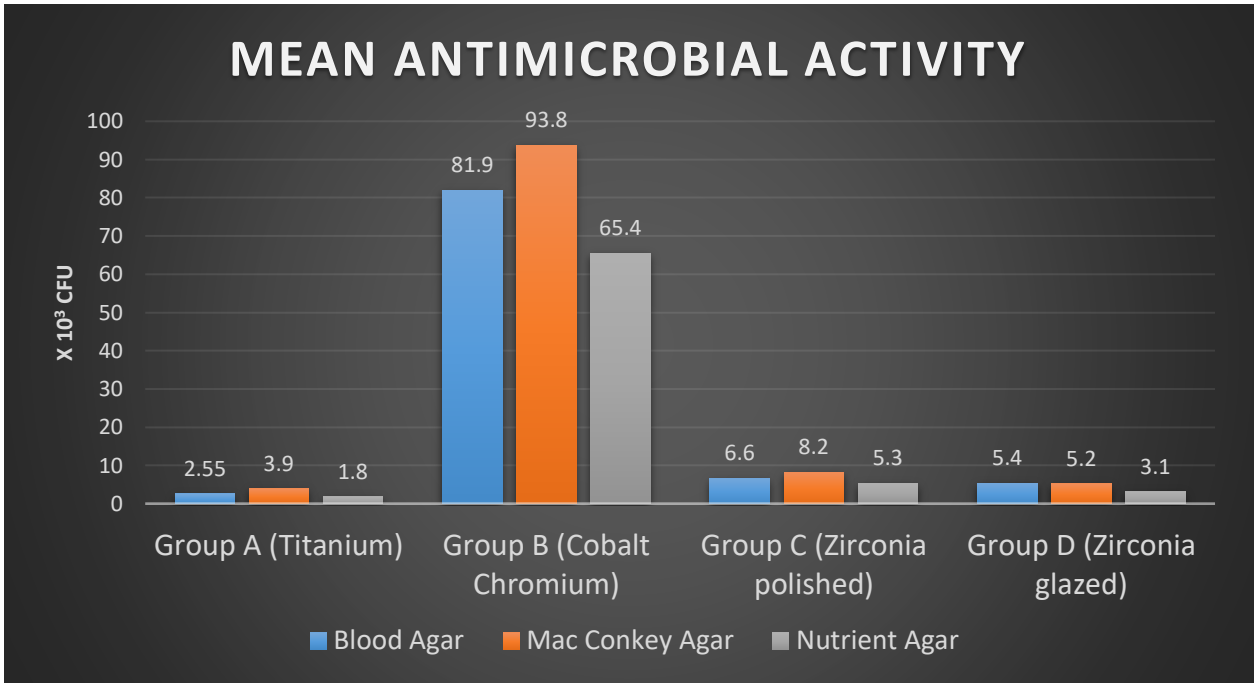

Graph 1: Overall intergroup comparison of mean antimicrobial activity associated with transmucosal components of four different implant materials respectively

Table 2: Pairwise intergroup comparison of mean antimicrobial activity associated with transmucosal components of four different implant materials respectively using Tukey's post hoc test

	Blood Agar Mean (SD)	Mac Conkey Agar Mean (SD)	Nutrient Agar Mean (SD)
Group A (Titanium abutment) vs Group B (Cobalt Chromium)	p < 0.001**	p<0.001**	p<0.001**
Group A (Titanium abutment) vs Group C (Zirconia polished)	p = 0.143	p =0.084	p =0.065
Group A (Titanium abutment) vs Group D (Zirconia glazed)	p = 0.195	p = 0.472	p =0.245
Group B (Cobalt Chromium) vs Group C (Zirconia polished)	p<0.001**	p<0.001**	p<0.001**

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Group B (Cobalt Chromium) vs Group D (Zirconia glazed)	**p<0.001****	**p<0.001****	**p<0.001****
Group C (Zirconia polished) vs Group D (Zirconia glazed)	**p =0.872**	**p = 0.751**	**p =0.617**

DISCUSSION:

Recently, there has been a growing interest in mucointegration as the formation of an early and long standing soft tissues barrier seems essential for both the initial healing and long term implant survival. The mucointegration is of major importance to ensure good prognosis of implant and to prevent bacterial progression from the oral cavity on the implant surface.

The results showed least antimicromial activity with respect to titanium abutment, while Cobalt chromium showed high microbial activity. Glazed and polished zirconia did not show any significant difference as compared to titanium.

The risks for the development of peri-implant inflammation have been widely studied in the past. Once peri-implantitis is established, it does not respond predictably to treatment. Therefore, it appears that the best management of plaque-induced peri-implant inflammatory diseases is prevention. To avoid the development of peri-implantitis not only solid osseointegration of the implants but also a robust soft-tissue integration at the transmucosal region is mandatory, since it is the first barrier against a bacterial invasion.

As the colonisation of the oral microflora is of particular clinical significance, our in-vitro study is of importance as they show that the titanium abutments had little inhibitory effect on the microflora as compared to the other groups.

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Image 1 : Saliva Sample

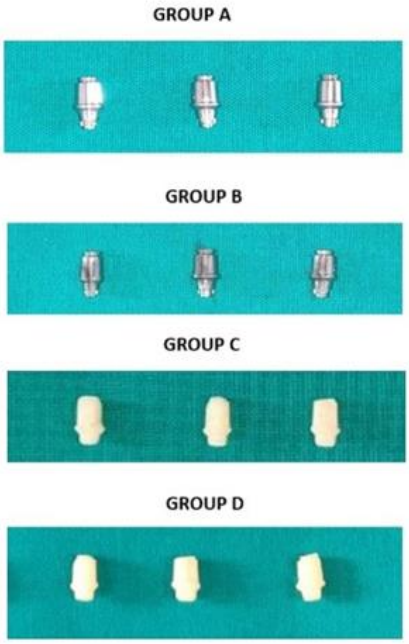

Image 2: Prosthetic Abutments

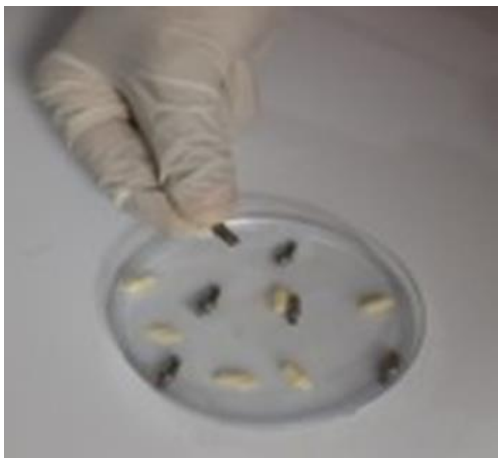

Image 3: Prosthetic Abutments immersed in saliva sample

Image 4: Incubation of samples in saliva

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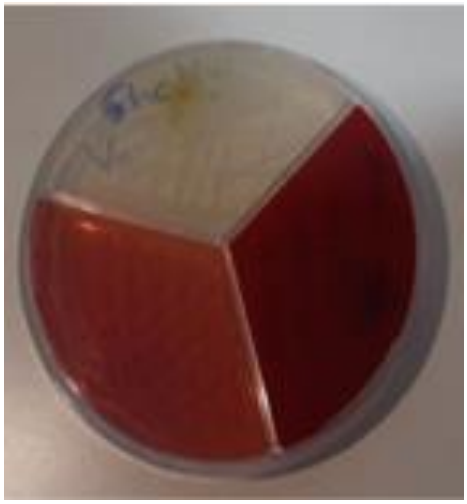
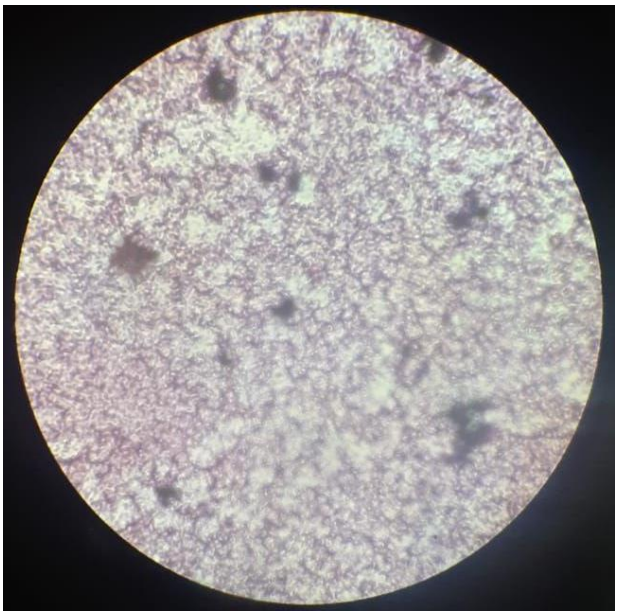


Image 5: Colonies formed after 72 hours of incubation



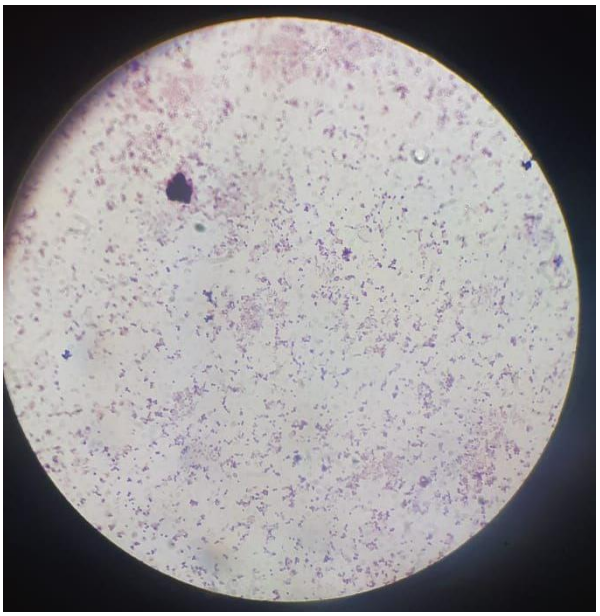


Image 6 : Microscopic view showing high mibrobes in cobalt chromium group and least in titanium group