



Microbial Adherence on 2 Different Suture Materials in Patients Undergoing Periodontal Flap Surgery - A Pilot Study

Authors

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Abstract

Background: *One of the most common complication after any surgical procedure is surgical site infection which can be due to plaque accumulation on suture material. Therefore, antibacterial suture can be used to inhibit plaque accumulation. Thus, the aim of the present study was to assess and compare the microbial colonization on two different suture materials in patients undergoing periodontal flap surgery.*

Material and Methods: *10 patients undergoing flap surgery were divided into 2 groups based on type of suture material used in flap approximation: Group 1 (test group, n=5): consisted of patients where flap approximation was carried out by polyglactin 910 suture coated with chlorhexidine and Group 2 (control group, n=5) where suturing was done with non-coated polyglactin 910 suture. On the 7th day after flap surgery, sutures were removed and sent to laboratory for culturing.*

Results: *Higher aerobic bacterial load was observed on sutures retrieved from Group 1 while higher anaerobic bacterial load was observed on sutures retrieved from Group 2. However, the differences between the groups were insignificant.*

Conclusion: *Chlorhexidine coated polyglactin 910 suture has potential in preventing colonization of microorganisms as compared to polyglactin 910 (non-coated) suture, thereby reducing the risk of bacteremia.*

Keywords: *Microbial adherence, Chlorhexidine coated polyglactin 910 suture, periodontal flap surgery.*

Introduction

A surgical suture is one which approximate the adjacent cut surfaces and compresses blood vessels to initiate hemostasis resulting in primary wound healing.¹ Although suture provides tensile strength for wound healing, suture materials serve as a passage for bacteria to gain entry into the surgical wound and increases the susceptibility of host tissue to establish infection by 10,000-fold.^{2,3} The role of suture material as a nidus for wound infection and contamination has been the subject

of speculation for more than 30 years and the findings of various studies have shown that surgical sutures exhibit an affinity for microbial adherence and colonization similar to that of other synthetic, implantable medical devices.⁴ Various factors influences the adherence of microbes on suture material, out of which, type of suture material is one of the crucial factor and it has been reported in various studies that bacterial adherence with severe inflammatory reaction is seen more in case of braided or multifilament

sutures than non – braided or monofilament sutures.⁵ So, the aim of the study was to assess and to compare the microbial colonization on two different suture materials in patients undergoing periodontal flap surgery.

Material and Methods

This comparative study was conducted on both male & female subjects meeting the inclusion and exclusion criteria, reporting to the Department of Periodontics, V.S. Dental College & Hospital, Bengaluru. A total of 10 patients undergoing periodontal flap surgery in the department were selected for the study based on the following inclusion criteria : Systemically healthy patients within the age range of 35-55 years requiring periodontal flap surgery where chlorhexidine coated polyglactin 910 sutures and non coated polyglactin 910 sutures were used. Exclusion criteria of the study were as follows : smoking, pregnant women or lactating mothers, under any systemic antibiotic therapy within last 3 months prior to study, periodontal treatment undertaken 6 months prior to the study, requiring antimicrobial therapy & use of chlorohexidine post-operatively. It was made clear to all the subjects that the participation is voluntary and verbal and written informed consent was obtained from those who agreed to participate. The subjects were randomized into 2 groups by toss of a coin: (1) Test Group (n=5): consists of patients undergoing flap surgery where suturing was done with chlorhexidine coated polyglactin 910 suture (Figure.1 &2), (2) Control Group (n=5): consists of patients undergoing flap surgery in the department where suturing was done with non-coated polyglactin 910 suture (Figure.3).

Treatment Procedure

In both the groups, periodontal dressing was not placed at the surgical site. On the 7th day, the sutures were removed and were placed in sterile container containing transport medium and was sent to the Department of Molecular Biology and Immunology, Maratha Mandal's NGH Institute of

Dental Sciences & Research Centre, Belgaum for aerobic and anaerobic culture.

Microbial analysis:

Sample received in the transport medium was first vortexed, then inoculated in the culture medium according to the requirement in enriched and selective medium.

Chocolate Agar medium and Mac Conkey Agar medium incubated for 24hrs at 37°C was used for the growth of aerobic organisms.

Mitis Salivarius agar (MSA) medium incubated at 37°C for 48-72 hrs in 5-10% CO₂ jar was used for the selective isolation of Streptococci species.

For *P. gingivalis* and *P. intermedia*, blood agar was used as an enriched medium. Brucella agar with hemin, vitamin K and blood agar was incubated at 37° C for 3–4 days in anaerobic jar. The blood agar medium was mixed with kanamycin which makes the medium selective for *P. gingivalis* and *P. intermedia*.

A selective medium, CVE (Crystal Violet Erythocin) Agar was used for the isolation of *Fusobacterium nucleatum* and it was incubated anaerobically at 37°C for 48-72hrs.

For isolation of *A. actinomycetemcomitans*, Dentaid Agar medium was used as a selective medium, incubated at 37°C in 5-10% CO₂ jar for 48-72hrs.

SDA- Saboroaud's Dextrose Agar medium was used for the cultivation of fungi which was incubated aerobically at 37°C for 24hrs.

After completion of incubation, the plates were removed and bacterial growth was expressed as CFU/ml. For, the final number of CFU/mL, the mean number of colonies counted was multiplied by the corresponding dilution factor (Figure.4).

Statistical Analysis

Descriptive analysis of all study parameters was done using Mean, SD & Median. Wilcoxon sum ranks Test was used to compare the mean in CFUs /ml between aerobic and anaerobic organisms within each study groups. The level of significance [P-Value] was set at P<0.05.

Statistical Software Package SPSS version 22 (IBM SPSS Statistics for Windows, Version 22.0, IBM Corp., released in 2013) was used to perform statistical analysis.

Results

No post-operative infection, swelling or allergic reaction was seen in any of the groups. Comparison of mean bacterial load in CFUs /ml [$\times 10^3$] of aerobic and anaerobic organisms between control and test group is shown in Table.1. The study results revealed that the aerobic bacteria load was higher in Group 1 (test group) with mean CFU of 85.0 ± 48.5 as compared to Group 2 (control group) with mean CFU of 55.2 ± 57.7 . However, there was no statistically significant difference between both the groups for the aerobic bacterial load ($p=0.29$). In contrast, the anaerobic bacterial load was more in Group 2 with a mean CFU of 51.6 ± 46.2 as compared to Group 1 with mean CFU of 46.0 ± 67

and there was no statistical significant difference between both the groups for anaerobic bacterial load ($p=0.34$) (Graph.1)

From aerobic bacterial strains isolated from both the groups, in Group 1, out of 5 patients, 2 patients showed growth of Staphylococcus species (40%) and rest of the patients showed growth of Proteus, E.fecalis and Staphylococcus species (20%) (Table.2, Graph.2). In Group 2, out of 5 patients, 3 patients showed growth of Streptococcus species (60%), 1 patient showed growth of Klebsiella (20%) and no growth was reported in 1 patient (Table.2, Graph.3).

From anaerobic bacterial strains isolated from both the groups, in Group 1, out of 5 patients only 2 patients showed growth of Streptococcus (40%) while no growth was reported in other 3 samples. In Group 2, out of 5 patients, 3 patients showed growth of Streptococcus (60%), one patient showed growth of Actinomyces and no growth was reported in 1 patient.

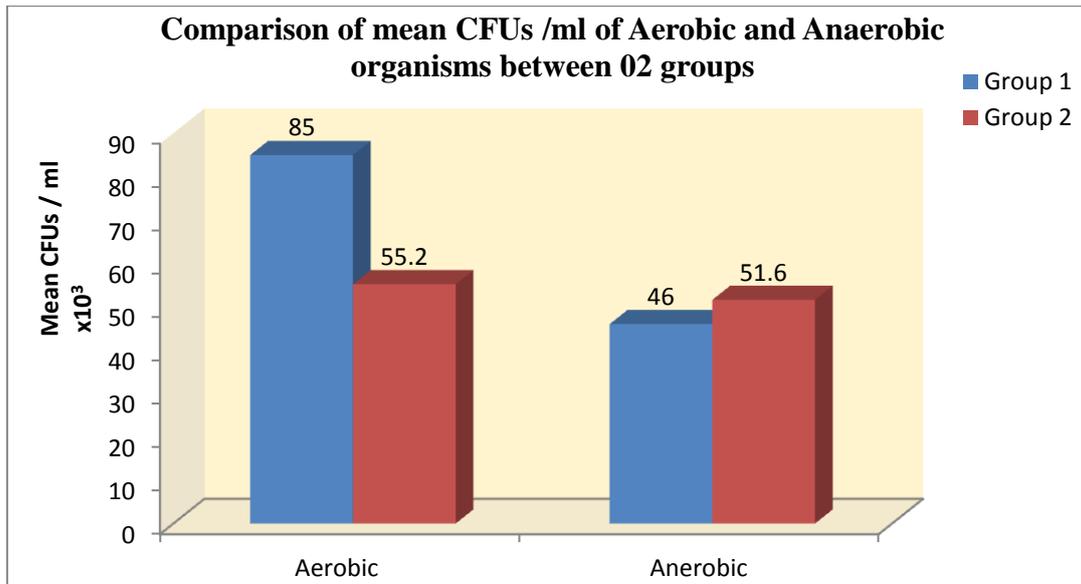
Table 1: Comparison of mean bacterial load in CFUs /ml [$\times 10^3$] of aerobic and anaerobic organisms between two study groups using Mann Whitney U Test :

Bacteria	Group	N	Mean	SD	Median	Mean Rank	Z	P-Value
Aerobic	Group 1	5	85.0	48.5	80.0	6.5	-1.051	0.29
	Group 2	5	55.2	57.7	0.0	4.5		
Anaerobic	Group 1	5	46.0	67.7	50.0	4.6	-0.955	0.34
	Group 2	5	51.6	46.2	40.0	6.4		

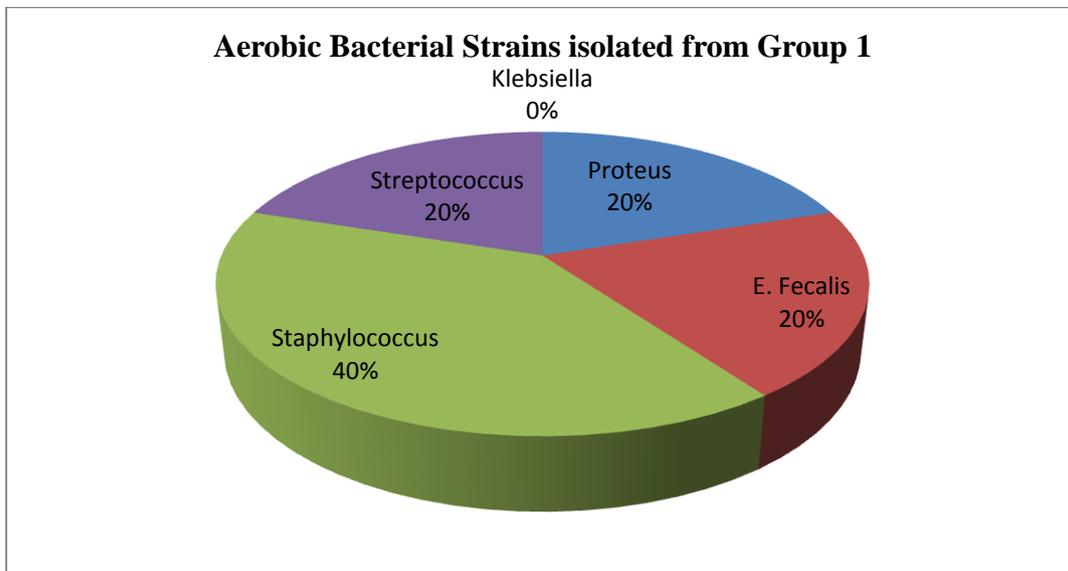
Table 2: Aerobic & Anaerobic Bacterial strains isolated from Group 1 & Group 2 sutures in 5 patients :

Bacteria	Strains isolated from sutures			
	Group 1		Group 2	
	n	%	n	%
Aerobic				
Proteus	1	20%	..	..
E. Fecalis	1	20%	..	..
Staphylococcus	2	40%	..	..
Streptococcus	1	20%	3	60%
Klebsiella	..	..	1	20%
Anaerobic				
Streptococcus	2	40%	3	60%
Actinomyces	..	..	1	20%

Graph.1:



Graph.2:



Graph.3:

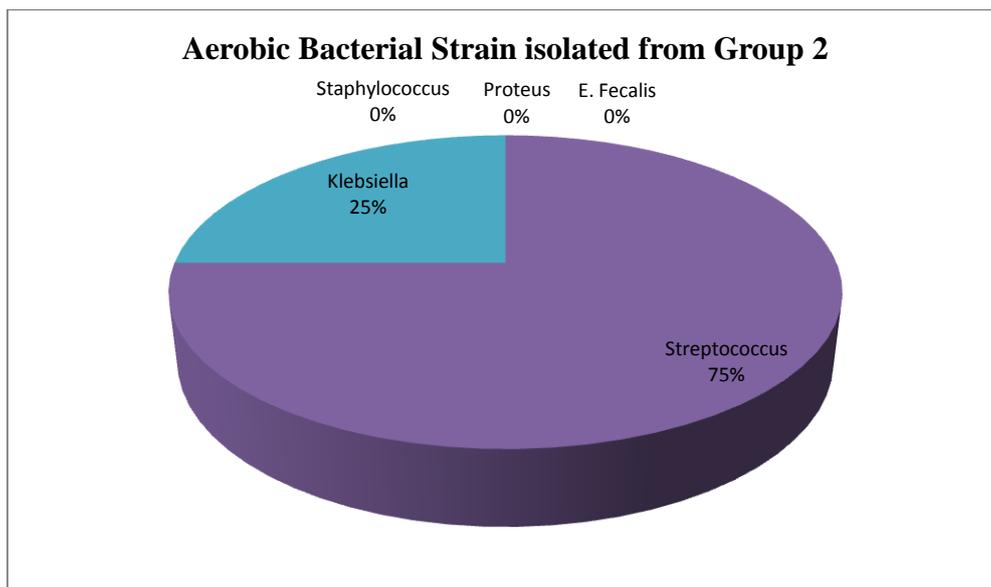




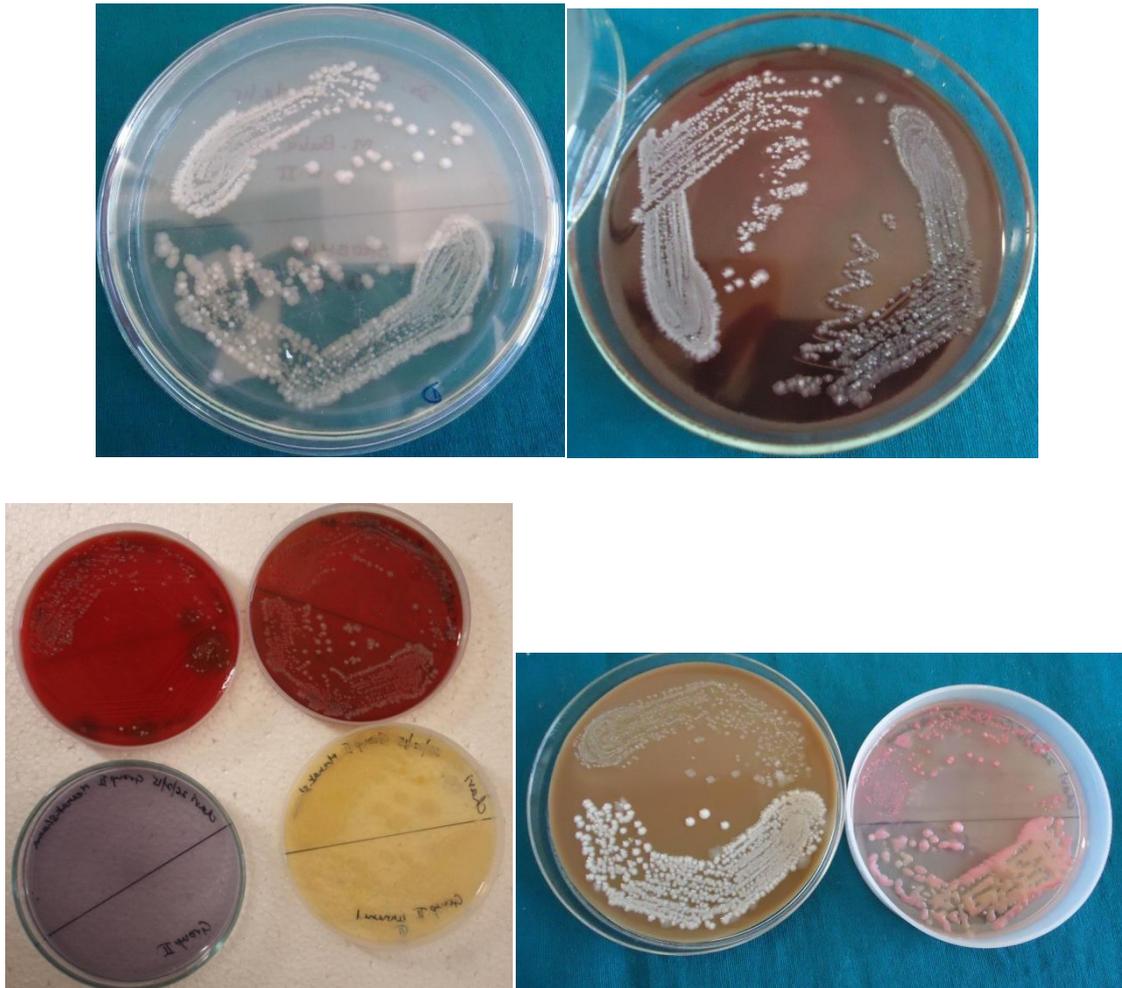
Figure.1 : Chlorhexidine coated Polyglactin 910 suture material



Figure.2 : Placement of Chlorhexidine coated Polyglactin 910 suture after periodontal flap surgery



Figure.3 : Placement of non coated Polyglactin 910 suture after periodontal flap surgery

Figure.4 : Bacterial growth seen on different culture media plates

Discussion

Variety of suture materials are available for both dental and medical surgical procedures; however, thorough knowledge of mechanical, physical and chemical properties of suture materials is essential for the clinicians in choosing the best suture material.^{3,6} No ideal suture material has been manufactured as yet.⁶

The physical properties and chemical composition of the suture materials play an important role in the interaction between suture and bacteria. A study done by Gristina and colleagues reported that approximation of skin edges with percutaneous suture were often colonized from the body surface into the wound track by strains of *S epidermidis* capable of producing an amorphous extracellular matrix (biofilm), protecting the microbial populations from host defense factors.⁷ The results of the in vitro study done by Katz et

al. have shown that adherence assays revealed remarkable variations in the affinity of bacteria to the various sutures : the large amount of bacteria adhered to braided (Dexon) suture and least amount of bacteria adhered to monofilament (nylon) suture. After subcutaneous implantation of bacteria associated suture into the mice to induce infection, it was seen that the degree of infection correlated well with the adherence properties of different types of suture materials.⁸

Because of presence of saliva, specific microorganisms and quality of tissue involved, sutures which are placed in the oral cavity behave differently as compared to placed outside the oral cavity.³ It has been well established that the presence of suture increases the likelihood of developing surgical infection. Black braided silk suture is the most commonly used suture material as it is reliable, easy to use and stable.⁶ However,

owing to its wicking phenomenon bacteria adhering to suture can enter into wounds by capillary action. An intense and slower healing process by black braided silk suture has prompted the use of other suture materials.⁷ Polyglactin 910 suture is a synthetic absorbable braided suture which has excellent tensile strength and placement of the suture results in least inflammatory response.⁹

In order to eliminate the possibility of suture material to become a route of infection, it can be coated with antibacterial agent. Development of an antibacterial surgical suture started as early as in 1980s. An in vivo study conducted by Storch and colleagues, demonstrated that coated polyglactin 910 suture with triclosan inhibits bacterial colonization of suture after direct in vivo challenge with *S. aureus* in a guinea pig model.¹⁰

A study done on pediatric patients by Ford and associates observed that there is decreased incidence of postoperative pain and diminished edema with triclosan coated sutures as compared to standard polyglactin 910 (noncoated) suture.¹¹

In medicine since 1953, a cationic bisbiguanide, Chlorhexidine has been widely used as an antimicrobial agent because of its broad spectrum antibacterial action. Loe, was the first person who reported the use of chlorhexidine as a mouthrinse for the treatment of plaque-induced gingivitis in humans.¹² Loe and Schiott demonstrated the efficiency of a 0.2% Chlorhexidine gluconate mouthrinse to prevent plaque formation and the development of experimental gingivitis and concluded that long-term use of 0.2% Chlorhexidine had been shown to be beneficial in reducing the number of anaerobes and streptococci from saliva.¹³ Thus, in the present study chlorhexidine coated polyglactin 910 suture was used in test group.

In the present study, there was no statistically significant difference between both the groups for the aerobic bacterial load. This was in contrast to earlier studies done by various authors.^{14,15,16} A study done by Kruthi N et al reported growth of aerobic bacteria on plain vicryl suture in 7 out of

20 samples (35%) while in group 2 (antibacterial coated suture), aerobes were seen adherent in only 2 out of 20 samples (10%).¹⁴ Similarly, lesser growth of aerobes was seen on antibacterial coated monocryl suture than on silk suture in a study done by Perez et al.¹⁵ Also, in a study, done by Plez et al, the number of aerobic species found on Vicryl plus suture was lower than that of on Vicryl suture but number of pathogenic aerobic species was higher than that of Vicryl suture.¹⁶

In the present study, adherence of anaerobes was less in chlorhexidine coated suture although difference between the groups was not statistically significant. Our observations are similar to observations of Kruthi N et al who reported decreased adherence of anaerobic bacteria to antibacterial coated vicryl suture.¹⁴ Similarly, lesser growth of anaerobes was seen on antibacterial coated monocryl suture than on silk suture in a study done by Perez et al.¹⁵ But the result of our study are in contrast to a study done by Plez et al where the number of pathogenic anaerobic bacteria were higher on Vicryl Plus ($n=81$) than on Vicryl ($n=79$).¹⁶

Bacteria found adherent to suture materials were same as those reported in odontogenic infections. To understand the implications of CFU, it is necessary to characterize the organisms to species level. With physical properties of both materials being same, the use of antibacterial coated sutures may be of use in high risk patients.

Conclusion

From the results of the present study, it is evident that although insignificant, chlorhexidine coated polyglactin 910 suture results in less adherence of anaerobic bacteria as compared to polyglactin 910 (non-coated) suture. This may be attributed to the combined antiseptic and antibacterial property of chlorhexidine. However the sample size is small to draw definitive conclusion.

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