

**Evaluation of antimicrobial efficacy of absorbable suture material against staphylococcus aureus, enterococcus faecalis and escherichia coli - An in vitro study**

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**Abstract**

**Background** The primary objective of suturing in oral tissues is to position and secure surgical site in order to promote optimal healing. The triclosan and Gentamicin coated suture materials were used in order to overcome bacterial adherence to the surgical site, and hence to prevent surgical infections. The objective of the study was to evaluate the bacterial zone of inhibition of triclosan and Gentamicin coated sutures in comparison with regular sutures materials.

**Method:** Four different suture materials Vicryl, Vicryl plus Gentamicin coated Vicryl were isolated from their sterile packages, cut into 6 mm long strands and placed into BHI broth culture media inoculated with Gram positive staphylococcus aureus, Gram negative Enterococcus faecalis and Escherichia coli. All types of suture materials in agar diffusion plates were incubated for 24 hrs. The zone of inhibition of microbes were evaluated with vernier callipers.

**Results:** Gentamicin and Triclosan coated suture showed greater zone of inhibition to Enterococcus faecalis and

Escherichia coli species and staphylococcus species in comparison with regular suture materials

**Conclusion:** Antibacterial suture coated using Gentamicin and Triclosan coated sutures showed good antimicrobial activity than non-coated sutures and hence triclosan coated and Gentamicin coated sutures may help in reducing bacterial surgical site infection (SSI) rate.

**Keywords:** Suture material, Culture media, Gentamicin Vernier calipers.

### Introduction

Oral wound healing varies compared to general wound healing in two broad ways. Primarily, wound in the oral cavity cannot be immobilized due to the functional movements of oral tissues. Secondly, oral cavity is colonized by variant bacteria which causes infection.[1]

The term “suture” describes any strand of material utilized to ligate blood vessels or approximate tissues. The main objective of dental suturing is to position and secure surgical site in order to promote proper healing by primary intention deliver support for tissue margin until they heal, without dead space and decrease postoperative pain. Inappropriate suturing may result in tissue skipping, necrosis, pain and delayed wound healing.[2]

Triclosan (CAS 3380-34-5) with the chemical name 5-chloro-2-(2,4-dichlorophenoxy) phenol or 2,4,4'-trichloro-2'-hydroxy-diphenyl ether. Triclosan is bacteriostatic at low concentrations, but at higher levels is bactericidal. At sublethal concentrations, it acts by inhibiting the activity of the bacterial enoyl-acyl carrier protein reductase (FabI), a significant enzyme in bacterial fatty acid biosynthesis.[3]

Gentamicin also an antibiotic and a member of the aminoglycoside group, which also includes streptomycin, neomycin, kanamycin, amikacin, tobramycin, and netilmicin. Gentamicin is found naturally in three chemical forms collectively referred to as gentamicin C.

Gentamicin is actively transferred across the bacteria cell membrane, where it irreversibly binds to one or more specific receptor proteins on the 30s subunit portions of the ribosomes. Thus, the presence of bound gentamicin prevents any complexing of messenger RNA to the ribosomal 30s subunits, resulting in a misreading of the DNA code and the formation of aberrant proteins; no new protein is synthesized and cell death results.[4]

Surgical site infections (SSIs) signify a common complication throughout all surgical procedures. SSIs may arise when bacteria colonise the suture material, creating a biofilm as prime site. This biofilm creates an immunity from both antimicrobial treatment and the host immune system. Triclosan has been used to successfully coat the following sutures and gained US food and drug administration approval in 2002.[3]

Vicryl Plus is an absorbable synthetic multi-filament suture where the features of the material are combined with a potential antibacterial activity due to surface coating with triclosan.

Vicryl coated Gentamicin is an absorbable synthetic suture material in which gentamicin is impregnated to suture by coating method and used in the study.

The need for the study is to evaluate the efficacy of two antibacterial .Triclosan coated and Gentamicin coated absorbable suture material against common oral microorganisms.

### Materials And Methodology

**Materials:** Three different suture materials Vicryl (**polyglactin 910**), Monocryl (poliglecaprone 25) and Vicryl plus (Antibacterial (polyglactin 910) and Gentamicin soaked Vicryl isolated from their sterile packages, cut into 6 mm long strands, Gram positive - staphylococcus aureus, Gram negative -Enterococcus faecalis, Gram negative- Escherichia coli, Mc Farlands 0.5

standard Agar, diffusion plate, Incubator and Vernier callipers

## Methodology

### Phase -1

#### Coating of suture material with Gentamicin

Sterile Vicryl suture material was soaked into Gentamicin 80 mg per 2ml and allowed to diffuse into the suture material after complete diffusion the suture material was allowed to dry for 24 hrs by air drying and vacuum drying for 6 hrs.[5]

### Phase -2

#### Preparation of microbial culture

To the fresh Agar media prepared with Mc Farlands 0.5 adjusted culture , 25 to 30 microliters of culture media that is BHI broth is added. The BHI broth is poured into the diffusion plate. About 0.25 ml of the prepared culture from 25 ml culture media is transferred into BHI agar broth. The culture medium of Staphylococcus, Escherichia coli and Enterococcus faecalis is inoculated uniformly in to the BHI agar broth and allowed to spread.

#### Evaluation of antibacterial effectiveness

Four different suture materials Vicryl, Vicryl plus, Gentamicin coated Vicryl and Monocryl were isolated from their sterile packages. BHI broth culture media was prepared according to Mc Farlands standard and inoculated with Gram positive staphylococcus aureus, Gram negative Enterococcus faecalis and Escherichia coli.

The suture materials are cut into 6 mm long strands and were placed into the diffusion Plates containing microbial cultures. The agar diffusion plates were transferred to an incubator for 24 hrs. After 24 hrs the diffusion plates were removed from the incubator and evaluated for zone inhibition. The zone of inhibition of microbes was measured using vernier callipers.

## Results & Discussion

Gentamicin coated suture showed greatest zone of inhibition of 8mm. Triclosan coated suture showed greater zone of inhibition of 6mm mean against both gram positive and gram negative microorganisms.

## Discussion

Surgical site infection (SSI) is the most common cause of nosocomial infections, and the most important.[6] Two-thirds of all cases of SSI appear at the zone of the incision. This probability is even greater in the presence of suture material.[7] It has been estimated that with conventional sutures (such as the natural black silk), barely 100 cfu would be needed to induce SSI.[8] Methods have been studied to decrease the incidence of surgical site infection, although some are uncontrollable others can be controlled. One of these methods is the use of sutures coated with antibacterial agents. In 2002, the United States Food and Drug Administration (FDA) authorized the use of polyglactin 910 coated with triclosan (Vicryl Plus, Antibacterial suture).

The oral cavity, is considered as "the window to general health", contains some of the most varied and enormous flora in the human body and is the main entrance for systems vital to human function and physiology, the gastrointestinal and respiratory systems.

The species of staphylococcus present in normal oral cavity are S epidermidis, S aureus. Infective endocarditis is a systemic infection correlated to oral carriage staphylococcus microorganisms as a systemic infection. Escherichia coli and Enterococcus faecalis are the common gram negative microorganisms detected in oral tissues.

The anticipated mechanisms of these oral-systemic communication include the spread of infection from the oral cavity in the form of bacteraemia or circulating bacterial toxins, generating increased circulating pro-

inflammatory cytokines and a debilitated immune system, as well as cross-reactivity between bacterial and self-antigens.[9]

In this current study the efficacy of triclosan and Gentamicin coated sutures along with controls were exposed to common oral microorganisms and the zone of inhibition was evaluated for a period of 24 hrs incubation against both gram- positive and gram- negative microorganisms which showed zone of inhibition of 2mm and 8mm against *Staphylococcus*, 2mm and 6 mm against *Escherichia coli* species and 6mm and 10mm for *Enterococcus faecalis*.

In a study conducted by Rothenburger S et al (2002) Coated Polyglactin 910 suture with triclosan subdued growth of test organisms consistently over a range of suture diameters and treatment conditions. Similarly the present study triclosan and Gentamicin coated Vicryl showed zone of inhibition in which Gentamicin had better efficacy.[10]

Smilarly Ravishankar PL et al conducted a study where equal segments of ciprofloxacin and aloe vera coated 3-0 silk sutures were incubated in *E.coli* culture media (blood agar) at 37°C for 24 hours in aerobic atmosphere. Plain uncoated suture served as control. Evaluated using Total Colony Forming Units and biofilm inhibition potential of sutures. The zone of inhibition around ciprofloxacin coated suture is nearly two-fold than that of with Aloe vera indicating that antibacterial efficacy of ciprofloxacin is more comparatively.[11]

Gentamicin is a bactericidal antibiotic active against *Escherichia coli*, *Proteus* species, *Pseudomonas aeruginosa*, species of the *Klebsiella-Enterobacter-Serratia* group, *Citrobacter* species, and *Staphylococcus* species (including penicillin- and methicillin-resistant strains). Species usually resistant to gentamycin and the other aminoglycosides are most species of streptococci,

particularly group D or viridans, and anaerobic organisms such as *Bacteroides* and *Clostridium*. Bacterial endocarditis is caused by enterococci (for example, *Streptococcus faecalis*), non-enterococcal streptococci (usually *S. viridans*), staphylococci (usually *Staph. aureus*), and gram-negative bacilli, with the non-enterococcal streptococci the cause of most cases of infective endocarditis.[12]

A study conducted by Sethi KS et al where equal segments of chlorhexidine and triclosan coated polyglactin sutures (3-0) were incubated at 37°C in saliva collected from 10 chronic periodontitis patients for 7 days. Plain uncoated suture served as control. The antibacterial efficacy of the sutures was tested against specific periodontal pathogens (*S.mutans*, *F.nucleatum*, *A.actinomycetomcomitans*, *P.intermedia*, *P.gingivalis*) using agar diffusion method. Confocal Laser Scanning Microscopy and SEM showed substantial biofilm inhibition around chlorhexidine-coated sutures followed by triclosan-coated.[13] In our study the efficacy of triclosan and Gentamicin are evaluated.

Marzo G et al conducted an in vitro study where antimicrobial efficacy, of an absorbable suture coated with triclosan (Vicryl Plus) against two bacteria, potential responsible for the development of oral diseases: *Pseudomonas aeruginosa* and *Streptococcus mutans*. A increased bacterial growth on Vicryl 3-0 for both bacteria (*P. aeruginosa* and *S. mutans*).[14] This study showed efficacy of triclosan against both gram positive and gram negative organisms as the current study.





Figure 1: Bhi Agar Medium

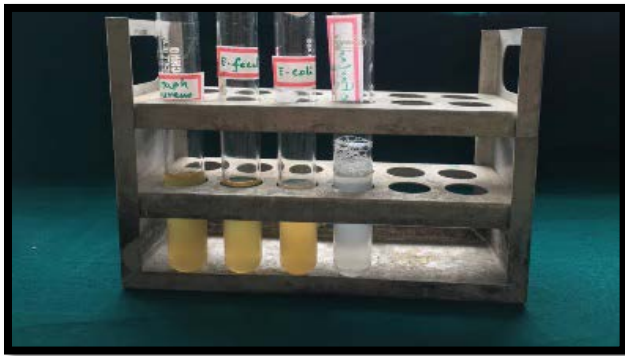


Figure 2: Culture Of Microorganisms



Figure 3: Armamentarium



Figure 4 :Gentamicin



Figure 5: Suture Materials



Figure 6 : Vernier Calipers



Figure 7: Preparation of Microbial Culture



Figure 8 : Suture strands of 6mm

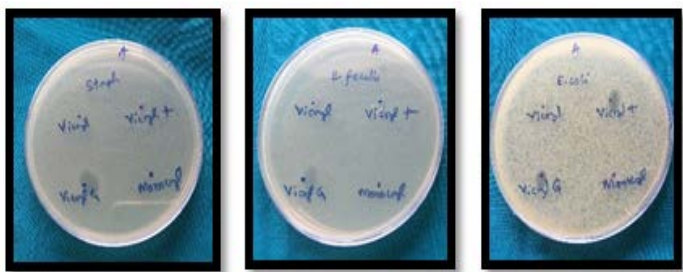


Figure 9 : Zone Of Inhibition Exhibited By The Sututre Materials

Table 1: Zone Of Inhibition Around Antibacterial Coated And Uncoated Suture Materials

	Vicryl I	Vicryl I Plus	Vicryl I Coated Gentamicin	Monocryl I
Staphalococcus	1mm	2mm	8mm	1mm
Enterococcus Fecalis	1mm	2mm	6mm	1mm
Eschericia Coli	1mm	6mm	10mm	1mm

**Conclusion**

Antibacterial suture coated with Gentamicin and Triclosan showed good antimicrobial activity against both Gram-positive and Gram-negative microorganisms than non-coated sutures and hence antibacterial coated sutures aids in reducing bacterial surgical site infection (SSI) rate.

**References**

1. M. Dragovic, M. Pejovic, J. Stepic, S. Colic, B. Dozic, S. Dragovic, et al., “Comparison of four different suture materials in respect to oral wound healing, microbial colonization, tissue reaction and clinical features-randomized clinical study,” Clin. Oral Investig., vol. 24, no.4, 2020, p. 1527-1541.
2. Hassan H K. Dental Suturing Materials and Techniques. Glob J Oto Vol12, no 2: 2017,555833.
3. Ahmed I, Boulton AJ, Rizvi S, et al. The use of triclosan-coated sutures to prevent surgical site infections: a systematic review and meta-analysis of the literature. BMJ Open Vol.9 2019: e029727.
4. Wynn RL. Gentamycin for prophylaxis of bacterial endocarditis: a review for the dentist. Oral surgery, oral medicine, oral pathology. Vol.60,no.2,1985 Aug, p.159-65.
5. Arora A, Aggarwal G, Chander J, Maman P, Nagpal M. Drug eluting sutures: A recent update. Journal of Applied Pharmaceutical Science. Vol.9, no.07, 2019 Jul:111-23.
6. Emori TG, Gaynes RP. An overview of nosocomial infections, including the role of the microbiology laboratory. Clin Microbiol Rev. vol.6,1993 p.428-42.
7. National Nosocomial Infections Surveillance (NNIS) report, data summary from October 1986-April 1996, issued May 1996. A report from the National Nosocomial Infections Surveillance (NNIS) System. Am J Infect Control. Vol.24,1996, p.380-8
8. Elek SD, Conen PE. The virulence of Staphylococcus pyogenes for man; a study of the problems of wound infection. Br J Exp Pathol. vol.38, 1957 p.573-86.
9. Seymour GJ, Ford PJ, Cullinan MP, et al. Relationship between periodontal infections and systemic disease. Clin Microbiol Infect.; vol.13, no. 4,2007 p.3–10
10. Rothenburger S, Spangler D, Bhende S, Burkley D. In vitro antimicrobial evaluation of Coated VICRYL\* Plus Antibacterial Suture (coated polyglactin 910 with

- triclosan) using zone of inhibition assays. *Surgical Infections*. Vol.3, no.1,2002 Dec 1p79-87.
11. Ravishankar PL, Vijayan V, Rao SK, Vadivelu SA, Narayanaswamy D, Teja S. In vitro antibacterial efficacy of sutures coated with Aloe vera and ciprofloxacin: A comparative evaluation. *J Pharm Bioall Sci* vol.11no.1,2019,p64-8.
  12. Sande MA, Scheld M: Combination antibiotic therapy of bacterial endocarditis. *Ann Intern Med* 92: 390-395, 1980. Hunter TH: Use of streptomycin in the treatment of bacterial endocarditis. *Am J Med* 2.1947, 436-442, 1947
  13. Sethi KS, Karde PA, Joshi CP. Comparative evaluation of sutures coated with triclosan and chlorhexidine for oral biofilm inhibition potential and antimicrobial activity against periodontal pathogens: An in vitro study. *Indian J Dent Res* vol.27,2016, p.535-9.
  14. Marzo G, Loffredi R, Marchetti E, Di Martino S, Di Pietro C, Marinelli G. In vitro antibacterial efficacy of Vicryl Plus suture (coated Polyglactin 910 with triclosan) using zone of inhibition assays. *ORAL & implantology*.vol.1,no.1,2008 Apr,p.43.