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A Comparative Evaluation of Antibacterial Properties of Neem Oil Coated and Ciprofloxacin Coated Sutures: An In Vitro Study

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ABSTRACT

Background- Sutures used for wound approximation can act as a reservoir of microbes at the surgical site leading to increased chances of surgical site infection (SSI). Sutures used in oral cavity are continuously bathed in saliva which results in wicking.

Aim - To assess and compare the antibacterial properties of Neem oil coated and Ciprofloxacin coated 3-0 silk sutures against Escherichiacoli.

Materials and methods - In this invitro study total 30 equal segments of suture samples were divided into 3 groups, 10 suture samples in each group. Equal segments of 5% ciprofloxacin and 100% Neem oil coated 3-0 silk sutures are to be incubated in E.coli culture media (blood agar) at 37°C for 24 hours in aerobic atmosphere. Plain uncoated suture served as control. Assessment was done using biofilm inhibition potential of sutures.

Results - The zone of inhibition around ciprofloxacin coated suture was nearly double than that of with Neem oil indicating better antibacterial efficacy of ciprofloxacin as compared to Neem oil. No inhibition zone around uncoated plain 3-0 braided silk was seen thus showing no antibacterial activity.

Conclusion - Both the ciprofloxacin and neem oil coated sutures have the antibacterial property against gram negative E.coli ciprofloxacin showed more than double zone of inhibition and can have a promising role in prevention of surgical site infection.

Keyword- ciprofloxacin, neem oil, zone of inhibition, Escherichia coli

I. INTRODUCTION

Periodontal diseases are bacterial infections associated with a complex microbiota of the dental biofilm, composed mainly by anaerobic gram negative species. These microorganisms induce a local and systemic inflammatory response that will lead to periodontal tissue destruction, which can be often treated with surgical management.[1] According to the World Health Organization, chronic periodontitis is one of the common dental diseases affecting human population with a prevalence rate of 10%–15%.[2] All surgical procedures in the oral cavity are at risk of postoperative infection which could jeopardize and delay normal healing. Sutures are considered to be a foreign body and a major factor in the incidence of postoperative infectionsdue to its susceptibility for microbial adherence.[3]Sutures used in oral cavity are constantly bathed in saliva containing 7.5×10^8 microorganisms per milliliter. This results in continuous wicking of microorganisms along the suture at the surgical site, which results in a prolonged inflammatory response and SSI.[4]

According to the National Nosocomial Infections Surveillance System, Staphylococcus aureus, coagulase negative staphylococci and enterococci spp., and Escherichia coli are among the most frequently isolated pathogens at surgical sites.[5]

Ciprofloxacin was shown to have activity against a broad range of bacteria and was particularly effective against the Enterobacteriaceae and various oral pathogens.[6] Ciprofloxacin had an extremely wide range of antibacterial activity, inhibiting aerobic and anaerobic cocci and bacilli at low concentrations.[7]

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In addition to antibiotics, natural antibacterial agents have a great potential to be used as prophylactic agents against wound infections, mainly because antibiotic resistance may be circumvented.[8]

Neem oil is extracted from the seeds of A. indica and has versatile medicinal and biological properties, including antibacterial, antifungal,immunostimulant, antipyretic, and acaricidal activities. These applications are a result of the active phyochemicals present in neem: azadirachtin, gedunin, isomargolonone, margolone, margolonone, nimbidin, nimbin, nimbolide, salannin, etc.[9]

This study was carried out to evaluate the antibacterial efficacy and oral biofilm inhibition of 3-0 silk sutures coated with ciprofloxacin and Neem oil in comparison to uncoated sutures against E. coli

II. MATERIALS AND METHODS

The study used an in vitro experimental design and was conducted in the Department of Periodontology and Department of Microbiology at Late Shri Yashwantrao Chavan Medical and Rural Development Foundation's Dental College and Hospital, Ahmednagar.

Study groups

Group I: sutures coated with 5%ciprofloxacin
Group II: sutures coated with 100% Neem oil
Group III: uncoated sutures (Control)

LABORATORY PROCEDURES

Pretreatment of sutures

The 3-0 silk sutures were scoured to remove any traces of impurities on their surface. The silk suture was scoured in 1% NaOH solution for 1 minute at room temperature and washed with distilled water.

Preparation of sutures coated with 5% ciprofloxacin

The scoured sutures were cut into small 3-4 mm pieces and autoclaved at 121°C for 15 minutes to ensure a sterilized suture for the study. The sutures were coated using dip coating method, to ensure a uniform coating, by dipping in 5% ciprofloxacin solution and left to stand overnight. Later, the sutures were dried in a desiccator to remove the solvent adsorbed on to surface. The dried sutures were evaluated for its antibacterial activity.

Figure 1: preparation of sutures coated with ciprofloxacin

Preparation of sutures coated with 100% Neem oil

Previously scoured sutures were dipped in the 100% neem oil for 24 hours and dried in desiccator similar to that of the ciprofloxacin-coated suture and evaluated for its antibacterial activity.

Figure 2: Preparation of sutures coated with neem oil

Preparation of Uncoated Sutures

Another set of sutures was dipped and dried in the same way but without drug; these sutures were referred to as control sutures

Zone of inhibition assay

The zone of inhibition assay is a crucial parameter used to evaluate the antimicrobial efficacy of the coated sutures. For this intent, E. coli bacteria (ATCC 25922) was selected for the study and cultured on liquid nutrient medium for 24 hours to form bacterial medium. The cultured bacterial suspension at a concentration of 1×10^8 colony-forming unit per milliliter was inoculated on to Muller Hinton agar medium in a Petri plate to form even bacterial overlay. Then, the sutures coated with Neem oil and ciprofloxacin, and uncoated sutures were placed on the bacterial overlay and gently pressed in. Bacterial inhibition zones of all the three

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sutures were calculated and photographed after incubating for 24 hours at 37°C.

Figure 3: Escherichia coli (ATCC 25922)

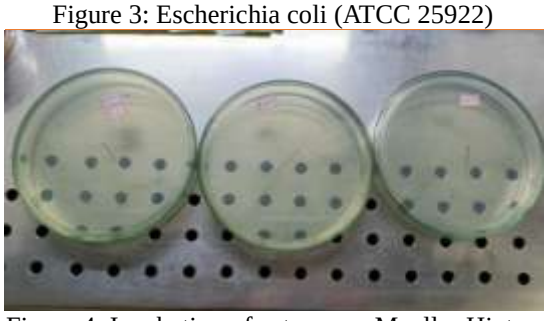


Figure 4: Incubation of sutures on Mueller Hinton Agar Medium

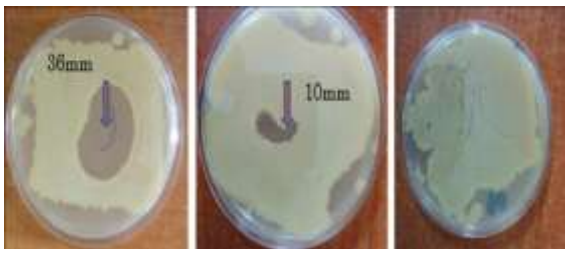


Figure 5: Zone of Inhibition

III. RESULTS

The zone of inhibition around ciprofloxacin-coated suture is nearly double than that around A. vera-coated suture, which indicted comparatively higher antibacterial efficacy of ciprofloxacin. The absence of any zone of inhibition around uncoated plain 3-0 braided silk shows that it has no significant antibacterial activity.

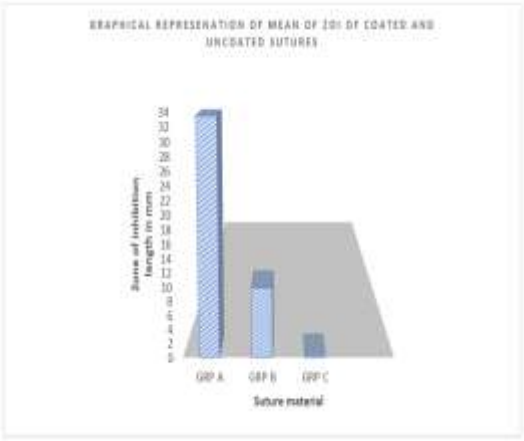
Table 1. The zone of inhibition measurements around the sutures (in mm)

	1	2	3	4	5	6	7	8	9	10
Group A	36mm	35mm	30mm	35mm	32mm	33mm	35mm	36mm	30mm	32mm
Group B	10mm	11mm	12mm	10mm	10mm	9mm	11mm	8mm	10mm	8mm
Group C	0mm	0mm	0mm	0mm	0mm	0mm	0mm	0mm	0mm	0mm

Group A(Ciprofloxacin-coated sutures) showed the largest inhibition zones, with measurements ranging from 30mm to 36mm, indicating a strong antibacterial activity.

Group B (Neem oil coated sutures) demonstrated much smaller inhibition zones, ranging from 8mm to 12mm, suggesting some antibacterial effect, but significantly weaker than that of ciprofloxacin.

Group C (Uncoated plain 3-0 braided silk sutures) showed no zone of inhibition (0mm), indicating the absence of antibacterial activity.
Thusthe data indicated that ciprofloxacin-coated sutures have the highest antibacterial efficacy, followed by neem oil coated sutures, while uncoated silk sutures exhibit no antibacterial properties.



Graph 1: Graphical Representation of mean of zone of inhibition of coated and uncoated sutures

IV. DISCUSSION

In a study conducted by Katz et al[10] using radiolabeled bacteria, authors stated that bacterial adherence to suture materials can play a significant role in the induction of SSI. According to Brown et al[11] intraoral suture removal can lead to bacteremia, which is a potential risk factor for developing bacterial endocarditis in high-risk patients.

Surgical site infection (SSI) is the third most common cause of infections in surgical patients and are more frequently encountered postoperative complication in oral and maxillofacial surgery.[12,13] Two-thirds of all cases of SSI appear in the zone of the incision.[14,15]This probability is even greater in the presence of sutures.[16,17,18]

The use of silk-braided sutures in the current study is justified by the fact that among all the natural suture materials, many surgeons regard silk as the gold standard due to its excellent pliability and widespread usage[19]

Study by Murugesh et al[20]has been done to assess the combination of certain natural oils such as neem to natural silk fibroin protein extracted from raw silk. This product exhibited very good antimicrobial property and excellent holding capacity which is a necessity for use as a medical product.Hence, in our study, we have coated the silk suture material with neem oil with the aim to reduce the risk of bacterial contamination after surgical procedures and improve the overall health outcomes for patients while also lowering the treatment cost.

According to Zeiler and Grohe[21]ciprofloxacin showed rapid bactericidal action against organisms in both the logarithmic and stationary growth phases. It also had a wider spectrum of activity against gram-negative organisms. Accordingly in our study, ciprofloxacin showed a significant zone of inhibition around suture against E. coli.

The neem oil-coated sutures effectively create a significant zone of inhibition (ZOI), demonstrating potential in preventing surgical site infections (SSI) by inhibiting bacterial growth, with measurable improvements in length, breadth, and overall area of antimicrobial activity. Additionally, these sutures are highlighted as a cost-effective alternative to traditional monofilament sutures, potentially offering a dual benefit of infection control and economic advantage, making them a promising option for surgical applications.[22]

Our study similarly found that neem oil exhibited antibacterial activity, though less potent than ciprofloxacin, as evidenced by smaller zones of inhibition against E. coli. The ciprofloxacin-coated sutures demonstrated a significantly larger zone of inhibition compared to neem oil-coated and plain uncoated sutures, indicating that while neem oil offers some antimicrobial benefits, ciprofloxacin remains more effective in inhibiting bacterial growth, suggesting its superior efficacy in preventing infections.

From the results of the current study, it is evident that both the antibacterial sutures are effective against periodontal pathogens. But ciprofloxacin-coated sutures showed comparatively high antibacterial effect against E. coli.

V. CONCLUSION

The study suggests that antibacterial-coated sutures, specifically those coated with ciprofloxacin and neem oil, demonstrate promising antibacterial properties against gram-negative E. coli and may play a role in preventing surgical site infections (SSI). However, these findings are preliminary and based on in vitro data, highlighting the need for further in vivo research to validate their efficacy and safety in clinical settings.

REFERENCES

[1]. Chen C, Hemme C, Beleno J, Shi ZJ, Ning D, Qin Y, et al. Oral microbiota of periodontal health and disease and their changes after nonsurgical periodontal therapy. ISME J 2018;12:1210-24.

[2]. Jacob S. Global prevalence of periodontitis. A literature review. Int Arab J Dent 2012;3:25-30.

[3]. Faibis F, Laporte C, Fiacre A, Delisse C, Lina G, Demachy MC, et al. An outbreak of methicillin-resistant Staphylococcus aureus surgical-site infections initiated by a healthcare worker with chronic sinusitis. Infect Control Hosp Epidemiol2005;26:213-5

[4]. Mangram AJ, Horan TC, Pearson ML, Silver LC, Jarvis WR. Guideline for prevention of surgical site infection, 1999. Centers for disease control and prevention (CDC) hospital infection control practices advisory committee. Am J Infect Control 1999;27:97–132; quiz 133–4;

[5]. Sunitha S, Adinarayana K, Pankaj T, Sravanthi Reddy P, Sonia G, Nagarjun R, et al. Fabrication of surgical sutures coated with Curcumin loaded gold nanoparticles. Pharm Anal Acta 2017;8:529

[6]. Chalkley LJ, Koornhof HJ. Antimicrobial activity of ciprofloxacin against Pseudomonas aeruginosa, Escherichia coli, and Staphylococcus aureus determined by the killing curve method: Antibiotic

comparisons and synergistic interactions. Antimicrob Agents Chemother1985;28:331-42.

[7]. Chin NX, Neu HC. Ciprofloxacin,a quinolone carboxylic acid compound active against aerobic and anaerobic bacterial. Antimicrob Agents Chemother1984;25:319-26.

[8]. Reinbold J, Uhde AK, Müller I, Weindl T, Geis-Gerstorfer J, Schlensak C, et al. Preventing surgical site infections using a natural, biodegradable, antibacterial Coating on surgical sutures. Molecules 2017;22:pii: E1570.

[9]. Ghosh V, Sugumar S, Mukherjee A, Chandrasekaran N. Neem (Azadirachta indica) oils. InEssential Oils in Food Preservation, Flavor and Safety 2016 Jan 1 (pp. 593-599). Academic Press.

[10]. Katz S, Izhar M, Mirelman D. Bacterial adherence to surgical sutures. A possible factor in suture induced infection. Ann Surg1981;194:35-41.

[11]. Brown AR, Papasian CJ, Shultz P, Theisen FC, Shultz RE. Bacteremia and intraoral suture removal: Can an antimicrobial rinse help? J Am Dent Assoc 1998;129:1455-61.

[12]. Sh ME, Rahgozar S, Tajmiri G, et al. Microbiological evaluation of the antibacterial Vicryl suture in the mandibular third molar surgery. J Oro-fac Sci 2022;14:120–127. DOI: 10.4103/jofs.jofs_131_22.

[13]. Hoshino S, Yoshida Y, Tanimura S, et al. A study of the efficacy of antibacterial sutures for surgical site infection: a retrospective controlled trial. Int Surg 2013;98(2):129–132.
DOI: 10.9738/CC179.

[14]. Sewlikar SA, Pillai RS, Mahajan NS, et al. Triclosan coated sutures: an overview of safety and efficacy in reducing risk of surgical site infection. Int Surg J 2016;2(1):1–7. DOI: 10.5455/2349-2902.isj20150201.

[15]. Tabrizi R, Mohajerani H, Bozorgmehr F. Polyglactin 910 suture compared with polyglactin 910 coated with triclosan in dental implant surgery: randomized clinical trial. Int J Oral MaxillofacSurg 2019;48(10):1367–1371. DOI: 10.1016/j.ijom.2019.01.011.

[16]. Guo J, Pan LH, Li YX, et al. Efficacy of triclosan-coated sutures for reducing risk of surgical site infection in adults: a meta-analysis of randomized clinical trials. J Surg Res 2016;201(1):105–117. DOI: 10.1016/j.jss.2015.10.015.

[17]. Chu CC, Williams DF. Effects of physical configuration and chemical structure of suture materials on bacterial adhesion: a possible link to wound infection. Amer J Surg 1994;147(2):197–204. DOI: 10.1016/0002- 9610(84)90088-6.

[18]. Wright KJ, Barbosa SV, Araki K, et al. In vitro antimicrobial and cytotoxic effects of Kri 1 paste and zinc oxide-eugenol used in primary tooth pulpectomies. Pediatric dentistry. 1994;16(2):102–106. PMID: 8015949.

[19]. Ford HR, Jones P, Gaines B, et al. Intraoperative handling and wound healing: controlled clinical trial comparing coated VICRYL® Plus antibacterial suture (coated polyglactin 910 suture with triclosan) with Coated VICRYL® suture (coated polyglactin 910 suture). Surgical infections. 2005;6(3):313–321. DOI: 10.1089/sur.2005.6.313.

[20]. Murugesh Babu K, Sahana N, Anitha DV, Kavya BS. Silk fibroin coated antimicrobial textile medical products. J Text Inst 2021;112:1199-207

[21]. Zeiler HJ, Grohe K. The in vitro and in vivo activity of ciprofloxacin. Eur J Clin Microbiol1984;3:339-43.

[22]. Kaur B, Sekhar V, Sharma P, Malhotra S, Jain A. A comparative assessment of antibacterial properties of neem oil coated sutures: An in vitro study. Journal of Indian Society of Periodontology. 2023 Sep 1;27(5):487-91.