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# Comparison of the number of bacterial colonies among four types of suture threads using simple loop method following periodontal surgery in patients with periodontitis: A single-blind randomized clinical trial

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## ABSTRACT

**Background:** This study investigated the number of bacterial colonies in four types of suture threads, including silk, nylon, monocryl, and monocryl plus after periodontal surgery in patients with moderate-to-severe periodontitis.

**Materials and Methods:** In this single-blind randomized clinical trial, a total of 12 patients with periodontitis who required periodontal flap surgery in all quadrants were included. One type of suture, either silk, nylon, monocryl, or monocryl plus (coated with triclosan), was used following each surgery in each quadrant. Sutures (3 mm) were removed from the mid, posterior, and anterior regions of the flap 7 days postoperatively, and placed in a tube-containing buffer medium to transfer to the culture medium in a laboratory. Then, the bacterial colonies on each culture medium were counted manually. Finally, the mean number of grown colonies (anaerobic and aerobic) was computed and compared in each group of sutures. Data were analyzed by SPSS (Version 20) using the repeated measures ANOVA and least significant difference follow-up tests ($\alpha = 0.05$).

**Results:** The findings of this study indicated a significantly higher mean number of aerobic, anaerobic, and aerobic-anaerobic colonies in silk suture than in the other three types of sutures ($P < 0.05$). However, no significant difference was observed among other types of sutures ($P > 0.05$).

**Conclusion:** The results of this study showed that silk suture had a higher bacterial adhesion (aerobic, anaerobic, and aerobic-anaerobic) than monofilament sutures, including nylon, monocryl, and monocryl plus. Moreover, no significant difference was found among the monofilament sutures in the number of colonies grown on them.

**Key Words:** Colony forming unit, periodontal diseases, suture

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## INTRODUCTION

Appropriate closure and maintenance of the surgical area are the most important factors involved in proper tissue repair and surgical success. Knowledge of a good suture or suture materials used in tissue repair following surgery is a basic principle in surgery.[1]

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The main problem, however, in the oral cavity is the prolonged immersion of suture in the saliva-containing microorganisms.[2,3] The type of suture significantly affects the repair process, and the surgeon should select a suture with optimal properties according to the conditions and type of tissue.[4]

Many clinicians prefer to use multifilament sutures, especially silk suture. Because working with monofilament sutures is more difficult, they have lower knot tie-down and their sharp end impairs the oral tissue.[5] Multifilament sutures and those requiring more knots have more tendency than monofilament ones to absorb the oral liquids and consequently microorganisms into the connective tissue.[3] However, the knot tie-down and strength of silk suture are higher than other available sutures, but its impregnation with wax or silicon reduces the knot tie-down.[6]

Nonabsorbable monofilament sutures possess advantages such as tensile strength, resistance against contamination, biocompatibility with the live tissues, and control owing to their rigidity, especially along the suture, and harder knot.[7] Monocryl is an absorbable monofilament suture derived from caprolactone and glycolide segmented copolymer. This complex polymeric system contains soft segments of caprolactone and glycolide random polymers that provide better control properties as well as hard segments of polyglicolide that make it highly strong. Among all available monofilament sutures, monocryl suture has the highest direct tensile strength and optimal properties with respect to control during procedures.[8,9]

Monocryl plus suture is, in fact, a polyglecaprone 25 that is coated with triclosan. Triclosan is an antibacterial agent derived from phenol that has *in vitro* activity against Gram-positive and Gram-negative bacteria. It has also potential anti-inflammatory activities by inhibiting the synthesis of interleukin-induced prostaglandin.[10,11] Biocompatibility studies carried out on polyglactin 910 suture coated with triclosan have shown the safety of this suture for clinical use.[12] Some current studies have reported the inefficacy of triclosan in decreasing the oral bacterial adhesion.[13-15] However, some other studies have shown the antibacterial effect of triclosan on bacterial adhesion.[16-23] Etemadi *et al*. in a comparison of triclosan-coated and silk sutures after dental implant surgery found no significant differences in the number of colony-forming unit (CFUs) and growth rates of microorganisms isolated from triclosan-coated and silk sutures 7 days postoperatively.[13]

On the other hand, Rothenburger *et al*. in an *in vitro* study about coated vicryl plus antibacterial suture concluded that coated polyglactin 910 suture with triclosan provides antimicrobial effect sufficient to prevent *in vitro* colonization by *Staphylococcus aureus* and *Staphylococcus epidermidis*.[20] de Castro Costa Neto *et al*. compared the adhesion of oral bacteria to silk, vicryl, vicryl plus, and nylon sutures and observed the lowest bacterial adhesion in nylon as a monofilament suture. However, vicryl plus showed a similar performance to that of nylon in reducing some bacteria such as *Fusobacterium nucleatum*.[22]

Considering the conflicting results reported by the previous studies and the advantages of use of monofilament sutures and triclosan as an antibacterial agent and that the former studies have mostly been conducted on multifilament sutures such as vicryl, the present study was aimed to investigate the microbial colonies formed on four types of sutures, including silk, nylon, monocryl, and monocryl plus in patients with periodontitis after periodontal flap surgery. If triclosan in monocryl plus suture can reduce the number of bacterial colonies, it can be used in surgeries like Guided Bone Regeneration and implant in patients who consider bacterial presence important.

## MATERIALS AND METHODS

This study was a randomized clinical trial performed in the single-blind manner. A total of 12 patients with periodontitis who met the inclusion criteria were recruited from among the patients referring to Ghaedi specialized dental clinic. The patients with moderate-to-severe periodontitis requiring periodontal flap surgery in four quadrants were included in the study by a convenience sampling method. The exclusion criteria included use of anti-inflammatory drugs or any other drugs affecting tissue inflammation and suffering from systemic diseases (diabetes, cardiovascular diseases, etc.).

The study sample was calculated to be 12 patients using statistical counseling. They were included in the study after taking written informed consent. This investigation was conducted in line with the guidelines provided by Isfahan University of Medical Sciences ethical committee about clinical trials and approved by

this committee (code of ethics: IR.MUI.RESEARCH.REC.1398.742 and IRCT20220101053584N1). The sample size calculation was done to evaluate the difference in the CFUs between groups by fixing an α error of 0.05 and statistical power at 80%. According to this, the minimum sample size required in each group was calculated as 12.

Four quadrants underwent surgery in each patient, and one type of suture was randomly selected for each quadrant using randomizing software. The frequency of using each suture in maxilla and the priority of surgery were equal in all sutures. The sutures used in this study included monocryl (polyglecaprone 25), (Ethicon Somerville, New Jersey, USA) monocryl plus (poliglecaprone 25 suture with triclosan), (Ethicon, Somerville, New Jersey, USA) silk (Supa, Iran) and nylon sutures (Ethicon, Somerville, New Jersey, USA). All sutures (4.0–19) were reverse cut. After performing conventional periodontal flap surgery, simple loop suture was applied interdentally without Coe-Pak dressing. The suture length after the knot was 3–4 mm in all loops. Postoperative instructions were given and Amoxicillin (500 mg t.i.d. for 7 days) and analgesics (ibuprofen 400 mg) were prescribed, but no mouthwash was used after surgery. Rinsing with normal saline instead of mouthwash was instructed twice daily.

The patients referred for extraction of suture 1 week after surgery. The sutures (3 mm) were removed from the outer part after the knot from the mid, posterior, and anterior regions of the flap and transferred to the laboratory in a 15-mg screw cap tube containing 2 cc buffer medium. The tube was transferred to a laboratory in 10 min and cultured after 20 min. In the microbiology laboratory, the tubes containing the buffer medium were put in a shaker for 5 min to isolate the bacteria attached to the suture and to obtain a homogenous solution. Ten λ of the homogenized solution was added to the blood agar to culture the Gram-negative and Gram-positive cultures and 10 λ of it was added to the Columbia culture (containing the same solution plus Vitamin K for anaerobic culture), which was then incubated at 37°C for 24 h (anaerobic culture media were placed in anaerobic jars). The anaerobic media were cultured for 5–7 days since they needed longer time for culture. Then, the bacterial colonies on each culture medium were counted manually. Since the colonies grown on the culture medium might not be countable, 0.5 ml of the above buffer solution was removed, from which 0.1 to 0.01 concentrations were prepared and cultured afterward. Finally, the mean number of grown colonies in each type of suture was calculated and compared (the number of aerobic and anaerobic bacteria was calculated separately). Data were analyzed by SPSS (Version 20, IBM-SPSS Inc., Chicago, IL, USA) software using the repeated-measures ANOVA and least significant difference (LSD) tests ($\alpha = 0.05$).

## RESULTS

In this study, 12 patients requiring full mouth periodontal flap surgery referred to Ghaedi specialized dental clinic were selected by convenience sampling method. Of the patients, 1 (8.3%) was male and 11 (91.7%) were female, with the age range of 20–40. No signs of allergy to sutures were observed in any of the patients. The results of repeated-measures ANOVA showed a significant difference among the four types of sutures in the mean number of aerobic ($P < 0.001$), anaerobic ($P = 0.003$), and aerobic-anaerobic ($P < 0.001$) colonies [Table 1].

The results of LSD test showed a significantly higher number of aerobic, anaerobic, and aerobic-anaerobic colonies in the silk suture than in other three types of sutures ($P < 0.05$), but no significant difference was found among other sutures ($P > 0.05$) [Table 2].

## DISCUSSION

This study performed a comparison of bacterial adhesion to four types of sutures, including silk,

**Table 1: Mean number of aerobic, anaerobic, and aerobic-anaerobic colonies (×10$^5$) in different sutures**

| Colony | Suture | Mean | SD | Minimum | Maximum | *P* |
|---|---|---|---|---|---|---|
| Aerobic | Silk | 6.54 | 2.54 | 1.63 | 9.45 | <0.001 |
| | Nylon | 3.93 | 1.74 | 1.63 | 7.2 | |
| | Monocryl | 2.85 | 1.53 | 1.24 | 6 | |
| | Monocryl plus | 3.08 | 1.89 | 1.24 | 6.35 | |
| Anaerobic | Silk | 3.35 | 2.06 | 0.81 | 7.65 | 0.003 |
| | Nylon | 1.98 | 1 | 0.81 | 4.5 | |
| | Monocryl | 1.45 | 0.9 | 0.62 | 4 | |
| | Monocryl plus | 1.54 | 0.97 | 0.55 | 3.06 | |
| Aerobic-anaerobic | Silk | 9.9 | 4.38 | 2.44 | 17.1 | <0.001 |
| | Nylon | 5.91 | 2.65 | 2.44 | 11.7 | |
| | Monocryl | 4.3 | 2.36 | 1.86 | 10 | |
| | Monocryl plus | 4.62 | 2.8 | 1.86 | 8.46 | |

SD: Standard deviation

**Table 2: Results of paired comparison of sutures based on the number of aerobic, anaerobic, and aerobic-anaerobic colonies by least significant difference test**

| Sutures | *P* | | |
|---|---|---|---|
| | Aerobic colonies | Anaerobic colonies | Aerobic-anaerobic colonies |
| Silk-nylon | 0.002 | 0.01 | 0.003 |
| Silk-monocryl | <0.001 | <0.001 | <0.001 |
| Silk-monocryl plus | <0.001 | 0.002 | <0.001 |
| Nylon-monocryl | 0.18 | 0.33 | 0.22 |
| Nylon-monocryl plus | 0.3 | 0.42 | 0.32 |
| Monocryl-monocryl plus | 0.77 | 0.86 | 0.8 |

nylon, monocryl, and monocryl plus following periodontal flap surgery. The aerobic and anaerobic microbial culture of sutures was done by counting the colonies using colony-forming unit in order to investigate the efficacy of triclosan in reducing the number of bacterial colonies by comparing monocryl plus with other sutures. Numerous studies have been carried out on the use of sutures in different fields of surgery such as medicine and dentistry. However, there has been growing concerns regarding the type of suture, histological reaction, and plaque accumulation. Bacterial colonization on sutures is also a significant risk factor for wound infection, bacteremia, and endocarditis after dentoalveolar surgeries.[3]

Bacteremia induced by the removal of sutures is a possible risk for endocarditis so that the involved bacteria mostly include intraoral bacteria, especially *Streptococcus sanguis*, *Streptococcus oralis*, and *Streptococcus salivarius*.[24] Formation of biofilm on sutures can act as the center of infection and be a potential risk factor for wound healing after oral surgery. Good sutures need special physical properties to limit or prevent the bacterial colonization of areas exposed to saliva. Different types of artificial sutures have been used in oral surgeries, monofilament versus multifilament and absorbable versus nonabsorbable ones. Generally, the monofilament and absorbable sutures show less biofilm formation than multifilament and nonabsorbable sutures.[25-27] In this study, the number of bacterial colonies isolated from the silk suture was higher than those of the other sutures, indicating that multifilament sutures have a higher tendency than monofilament sutures to absorb oral liquids and consequently microorganisms into the connective tissue.

Triclosan is an antimicrobial agent proven to act against microorganisms in the oral cavity, which is usually used in oral health products.[28] Triclosan is well-absorbed after oral administration in humans. The elimination half-life is 11–20 h indicating a more rapid elimination of triclosan.[29] However, when triclosan is mixed with suture, it probably increases the time of action against microorganisms.[16] Triclosan is an antiseptic agent with bactericidal properties that limits the growth of many receptor-free Gram-negative and Gram-positive bacteria.[30]

In a study comparing the efficacy of vicryl and vicryl plus sutures in reducing infection during head and neck cancer surgery, the suture coated with triclosan could not decrease the postsurgery neck wounds.[31] Further, an *in vitro* study on vicryl and vicryl plus sutures showed the use of sutures coated with triclosan did not control the oral biofilms. Moreover, the use of sutures coated with triclosan seems to be incompatible with cationic anti-plaque agents such as chlorhexidine and cetyl pyridinium, which are commonly used in oral surgeries.[15]

Pelz *et al*. compared the bacterial adhesion of vicryl and vicryl plus sutures in wisdom teeth surgery. Their results showed no preference for use of vicryl plus in oral surgeries because it not only did not reduce the Gram-negative pathogens but also decreased the normal flora bacteria. Due to high costs, possible allergy, and resistance, the use of sutures coated with triclosan was not suggested in this study.[14] de Castro Costa Neto *et al*. compared the nylon, silk, vicryl, and vicryl plus sutures in an *in vitro* study, all of which were multifilament except nylon. They found vicryl plus coated with triclosan had similar efficacy to that of nylon in reducing bacterial adhesion to suture compared to other multifilament sutures. Vicryl plus has acceptable characteristics for surgeries compared to nylon because of advantages like tensile strength, knot safety, and easy use.[22] However, the present study showed no significant difference between monofilament sutures and monocryl suture coated with triclosan and other monofilament sutures, nylon and monocryl, in decreasing the isolated colonies.

In healthy conditions, normal oral flora includes both aerobic and anaerobic bacteria. Anaerobic bacteria are dominant at the presence of inflammation and infection. Most studies conducted so far have been limited to cutaneous bacteria such as *S. aureus*, *S. epidermidis*, methicillin-resistant *S. aureus*, methicillin-resistant *S. epidermidis*, and *Escherichia coli*.[16,32] Further, studies on oral cavity have been

done in normal oral conditions, and few similar studies have been carried out with respect to the efficacy of triclosan or other antibacterial agents in decreasing bacterial adhesion in complex periodontal conditions.

In the present study, only multifilament silk suture, with the highest number of colonies, showed a significant difference with the other three sutures, confirming the wicking effect. Three types of monofilament sutures used in this study were of absorbable (monocryl and monocryl plus) and nonabsorbable (nylon) types, which showed no significant difference in the mean number of colonies. This indicates the inefficacy of triclosan, an antibacterial agent used in monocryl plus suture, in reducing the bacteria in oral surgeries.

Given the widespread nonmedical use of triclosan in household appliances, cosmetics[33] as well as the first reports on bacterial resistance against triclosan and warnings about the choice of potential pathogens,[34,35] further studies are required to compare the effectiveness of the suture coated with other materials such as chlorhexidine. Moreover, future studies are suggested to recruit larger study samples and use of specific culture media for periodontal pathogenic bacteria for microbial culture in order not to compare the sutures merely based on the number of bacteria isolated from the suture and to compare pathogenic bacteria separately.

A limitation in this study was difficulty in making equal conditions in patients during consecutive surgeries of four quadrants over about 2 months because patients gradually adapt to the postsurgery conditions and follow the orders better, which in turn affects plaque control and patient's health and can be considered a confounding factor in the number of colonies attached to the suture. In addition, patient cooperation for a timely referral after 7 days for the extraction of sutures was poor due to the frequency of surgeries and sampling.

## CONCLUSION

The findings of this study showed that silk sutures had a higher bacterial adhesion (aerobic, anaerobic, and aerobic-anaerobic) than other monofilament sutures, including nylon, monocryl, and monocryl plus. Further, no significant difference was found among the monofilament sutures used in this study.

### Ethical statement

This study was approved by the ethics committee of Isfahan University of Medical Science.

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### Conflicts of interest

The authors of this manuscript declare that they have no conflicts of interest, real or perceived, financial or non-financial in this article.

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