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Original Research

Effectiveness of antimicrobial coated and non - coated resorbable sutures versus traditional non – resorbable silk sutures in periodontal flap surgical procedures: A clinical microbiological study

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ABSTRACT

Background:Sutures used in periodontal flap surgery act as foreign bodies and may facilitate bacterial colonization, increasing the risk of surgical site infections (SSIs). The incorporation of antimicrobial agents such as triclosan into suture materials has been proposed to reduce microbial load and improve healing outcomes. **Aim**:To evaluate and compare the clinical and microbiological effectiveness of triclosan-coated resorbable sutures with non-coated resorbable sutures and conventional non-resorbable silk sutures in periodontal flap surgical procedures. **Materials and Methods**:A prospective, double-blind randomized controlled clinical trial was conducted on 45 patients aged 30–50 years with generalized chronic periodontitis requiring flap surgery. Participants were randomly allocated into three groups: Group A (triclosan-coated resorbable sutures), Group B (non-coated resorbable sutures), and Group C (non-resorbable silk sutures) (n = 15 each). Clinical parameters including Gingival Index (GI), Plaque Index (PI), Wound Healing Index (WHI), and Postoperative Pain Index (PPI) were recorded at baseline, 7, 15, and 30 days. Microbial colony counts (CFUs) were assessed on day 7 after suture removal. Statistical analysis was performed using ANOVA and Tukey's post-hoc test. **Results**:Triclosan-coated resorbable sutures demonstrated significantly lower gingival inflammation and plaque accumulation at all postoperative intervals compared to the other groups ($p < 0.001$). Microbiological analysis revealed the lowest bacterial colony counts in the triclosan group ($2.32 \pm 0.15 \times 10^{12}$) compared to non-coated resorbable ($5.56 \pm 0.16 \times 10^{12}$) and silk sutures ($5.75 \pm 0.19 \times 10^{12}$), indicating superior antimicrobial efficacy ($p < 0.001$). No statistically significant differences were observed among the groups for wound healing and postoperative pain scores. **Conclusion:**Triclosan-coated resorbable sutures exhibit superior clinical and microbiological performance by significantly reducing plaque accumulation, gingival inflammation, and bacterial colonization compared to non-coated resorbable and conventional silk sutures. These findings support their use in periodontal flap surgery to minimize infection risk and enhance postoperative outcomes.

Introduction

Sutures play a crucial role in periodontal surgery by ensuring tissue approximation, flap stability, and optimal wound healing. The evolution of suture materials has significantly influenced surgical outcomes; however, sutures also act as foreign bodies and may contribute to surgical site infections (SSIs).[1–3] Bacterial adherence to suture materials is a key factor in infection development, particularly in the oral cavity where a diverse microbial flora promotes rapid biofilm formation.[4]

Multifilament sutures, such as silk, are widely used due to their handling properties but are associated with increased bacterial colonization and plaque accumulation. Although synthetic resorbable sutures reduce tissue reaction, they remain susceptible to microbial adherence.[5]

To overcome these limitations, antimicrobial-coated sutures, particularly triclosan-coated sutures, have been introduced. Triclosan inhibits bacterial fatty acid synthesis and reduces microbial colonization on suture

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surfaces.[5] Experimental and clinical studies have demonstrated that these sutures significantly decrease bacterial load and improve postoperative outcomes.[6,7]

Recent studies and randomized clinical trials in oral and periodontal surgery have further supported the effectiveness of antimicrobial-coated sutures in reducing microbial colonization and enhancing healing.8 Additionally, alternative coatings such as chlorhexidine, tetracycline, and herbal agents have shown promising antimicrobial potential.[9]

Systematic reviews and meta-analyses have consistently reported a reduction in SSIs with antimicrobial-coated sutures, highlighting their clinical relevance.[10,11.12] Despite this evidence, limited data exist comparing triclosan-coated resorbable sutures with non-coated resorbable and conventional silk sutures in periodontal flap surgery.

Therefore, the present study aims to evaluate and compare the clinical and microbiological effectiveness of triclosan-coated resorbable sutures, non-coated resorbable sutures, and non-resorbable silk sutures in periodontal flap surgery.

Materials and Methods

The present study was designed as a prospective, double-blind, randomized controlled clinical trial conducted on 45 systemically healthy patients aged between 30 and 50 years, diagnosed with generalized chronic periodontitis and requiring periodontal flap surgery. Patients were selected from the outpatient department after obtaining informed consent, and the study protocol was approved by the institutional ethical committee.

Patients presenting with probing pocket depth ⩾5 mm were included in the study, while those with systemic diseases, smokers, pregnant or lactating women, individuals who had received antibiotic therapy within the previous three months, and those with poor oral hygiene compliance were excluded.

The selected patients were randomly allocated into three groups (n = 15 each) using a computer-generated randomization method: Group A received triclosan-coated resorbable sutures, Group B received non-coated resorbable sutures, and Group C received non-resorbable silk sutures. Both the patients and the examiner were blinded to the type of suture material used. All patients underwent phase I therapy prior to surgery. Periodontal flap surgery was performed under local anesthesia using a standardized surgical protocol. Following debridement and root planing, the flaps were repositioned and secured using the assigned suture material. Postoperative instructions were provided to all patients, and no systemic antibiotics were prescribed.

Clinical parameters, including Gingival Index (GI), Plaque Index (PI), Wound Healing Index (WHI), and Postoperative Pain Index (PPI), were recorded at baseline, 7 days, 15 days, and 30 days by a calibrated examiner. For microbiological analysis, sutures were removed on the 7th postoperative day under aseptic conditions, and the samples were transferred to a sterile transport medium. The collected samples were cultured, and bacterial colony-forming units (CFUs) were quantified.

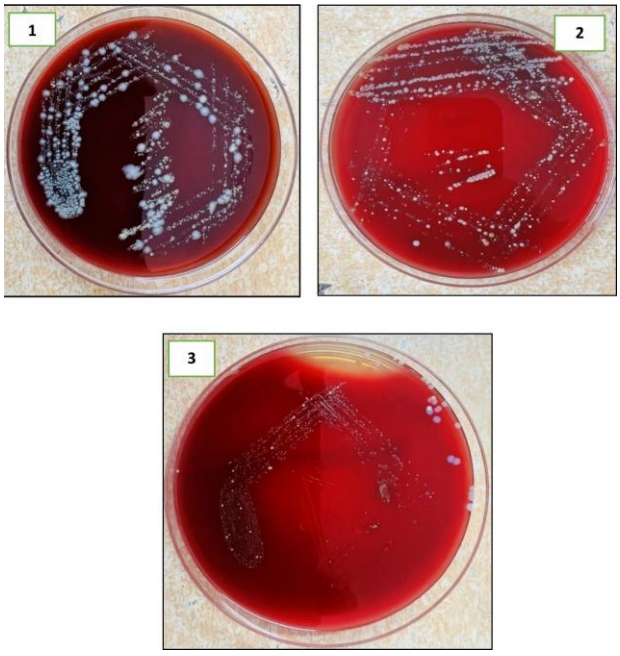
The obtained data were statistically analyzed using appropriate software. Intergroup comparisons were performed using one-way analysis of variance (ANOVA) followed by Tukey's post-hoc test. A p-value of less than 0.05 was considered statistically significant.

Results

The Gingival Index (GI) was evaluated to assess the effectiveness of antimicrobial-coated, non-coated

Figure 1- Different types of sutures

Figure 2 - showing microbial colony of different sutures after 24hrs



resorbable, and silk sutures following periodontal flap surgery. At baseline, GI scores were comparable among TCR (5.24 ± 0.52), NCR (5.34 ± 0.39), and silk (5.38 ± 0.31) groups (p = 0.640). At 7 days, the TCR group showed a significant reduction in GI (1.64 ± 0.16) compared to NCR (3.77 ± 0.33) and silk (4.60 ± 0.11) (p < 0.001). This trend persisted at 15 days (TCR: 1.85 ± 0.11; NCR: 4.13 ± 0.30; silk: 4.81 ± 0.16) and 30 days (TCR: 2.66 ± 0.37; NCR: 4.61 ± 0.22; silk: 5.16 ± 0.27), with statistically significant differences (p < 0.001). Overall, antimicrobial-coated resorbable sutures demonstrated the greatest reduction in gingival inflammation, followed by non-coated resorbable sutures, while silk sutures showed the least improvement. (Table 1, Graph 1)

Plaque Index (PI) scores at base line were comparable among TCR (4.37 ± 0.55), NCR (4.53 ± 0.44), and silk (4.51 ± 0.46) groups (p = 0.601), indicating similar preoperative plaque levels.

At 7 days postoperatively, the TCR group showed a marked reduction in PI (1.49 ± 0.10), which was significantly lower than NCR (4.72 ± 0.21) and silk (4.77 ± 0.30) (p < 0.001), demonstrating a strong early plaque-inhibitory effect. At 15 days, the TCR group maintained significantly lower PI scores (1.79 ± 0.36) compared to NCR (4.71 ± 0.32) and silk (4.85 ± 0.32) (p < 0.001), indicating sustained antimicrobial activity.

By 30 days, although a slight increase in PI was observed in the TCR group (2.61 ± 0.42), the values remained significantly lower than NCR (4.89 ± 0.32) and silk (5.15 ± 0.38) (p < 0.001), reflecting better long-term plaque control. Overall, antimicrobial-coated resorbable sutures demonstrated superior and sustained reduction in plaque accumulation compared to non-coated resorbable and silk sutures, highlighting their effectiveness in minimizing biofilm formation and improving postoperative periodontal healing. (Table 2, Graph 2)

The intergroup comparison of Wound Healing Index (WHI) scores at 7, 15, and 30 days showed no statistically significant differences among TCR, NCR,

Table 1(a). Intergroup comparison of Gingival Index (GI) scores Among Study Groups at different time intervals (n=45)

Time	Group	n	Mean ± SD	95% CI (Lower–Upper)	Min	Max	F	p
Baseline	TCR	15	5.24 ± 0.52	4.95 – 5.53	4.30	6.00	0.451	0.640 (NS)
	NCR	15	5.34 ± 0.39	5.13 – 5.56	4.25	5.80		
	Silk	15	5.38 ± 0.31	5.21 – 5.55	4.80	5.80		
7 days	TCR	15	1.64 ± 0.16	1.56 – 1.73	1.34	1.90	707.16	**<0.001(S)**
	NCR	15	3.77 ± 0.33	3.59 – 3.96	3.20	4.50		
	Silk	15	4.60 ± 0.11	4.54 – 4.66	4.40	4.80		
15 days	TCR	15	1.85 ± 0.11	1.79 – 1.91	1.60	2.00	836.07	**<0.001(S)**
	NCR	15	4.13 ± 0.30	3.97 – 4.30	3.70	4.70		
	Silk	15	4.81 ± 0.16	4.72 – 4.90	4.50	5.00		
30 days	TCR	15	2.66 ± 0.37	2.45 – 2.87	2.30	3.50	301.64	**<0.001(S)**
	NCR	15	4.61 ± 0.22	4.49 – 4.73	4.30	5.00		
	Silk	15	5.16 ± 0.27	5.01 – 5.31	4.50	5.60		

TCR (Triclosan-coated resorbable), NCR (Non-coated resorbable), Silk (Non-resorbable) NS = non-significant (p > 0.05)

and silk groups (p > 0.05). At 7 days, WHI scores were comparable, indicating similar early healing responses. This trend continued at 15 days, with identical scores across groups, and at 30 days, where slight variations remained non-significant.

Overall, the results indicate that suture material did not significantly influence wound healing outcomes, with comparable healing observed across all groups despite differences in plaque accumulation and gingival inflammation. (Table 3, Graph 3)

Graph 1. Intergroup comparison of Gingival Index (GI) scores Among Study Groups at different time intervals (n=45)

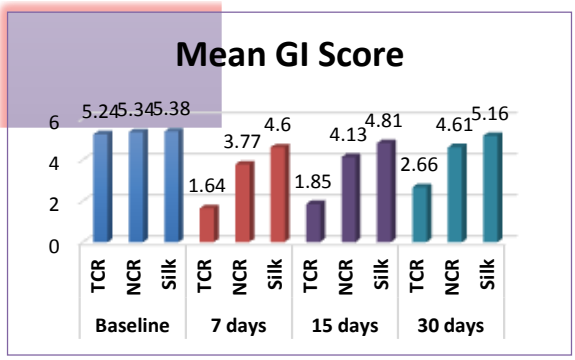


Table 2. Intergroup comparison of Plaque Index (PI) scores Among Study Groups at different time intervals (n=45)

Time	Group	n	Mean ± SD	95% CI (Lower–Upper)	Min	Max	F	p
Baseline	TCR	15	4.37 ± 0.55	4.06 – 4.67	3.50	5.00	0.516	0.601(NS)
	NCR	15	4.53 ± 0.44	4.29 – 4.78	4.00	5.00		
	Silk	15	4.51 ± 0.46	4.25 – 4.77	4.00	5.00		
7 days	TCR	15	1.49 ± 0.10	1.43 – 1.54	1.30	1.70	1109.47	**<0.001(S)**
	NCR	15	4.72 ± 0.21	4.61 – 4.84	4.30	5.20		
	Silk	15	4.77 ± 0.30	4.61 – 4.94	4.30	5.40		
15 days	TCR	15	1.79 ± 0.36	1.60 – 1.99	1.30	2.30	397.93	**<0.001(S)**
	NCR	15	4.71 ± 0.32	4.53 – 4.89	4.20	5.30		
	Silk	15	4.85 ± 0.32	4.68 – 5.03	4.50	5.70		
30 days	TCR	15	2.61 ± 0.42	2.37 – 2.84	2.00	3.40	207.71	**<0.001(S)**

NCR	15	4.89 ± 0.32	4.72 – 5.07	4.60	5.70
Silk	15	5.15 ± 0.38	4.94 – 5.37	4.60	6.00

TCR (Triclosan-coated resorbable), NCR (Non-coated resorbable), Silk (Non-resorbable) NS = non-significant ($p > 0.05$); S = Significant ($p \leq 0.05$)

Graph 2. Intergroup comparison of Plaque Index (PI) scores Among Study Groups at different time intervals (n=45)

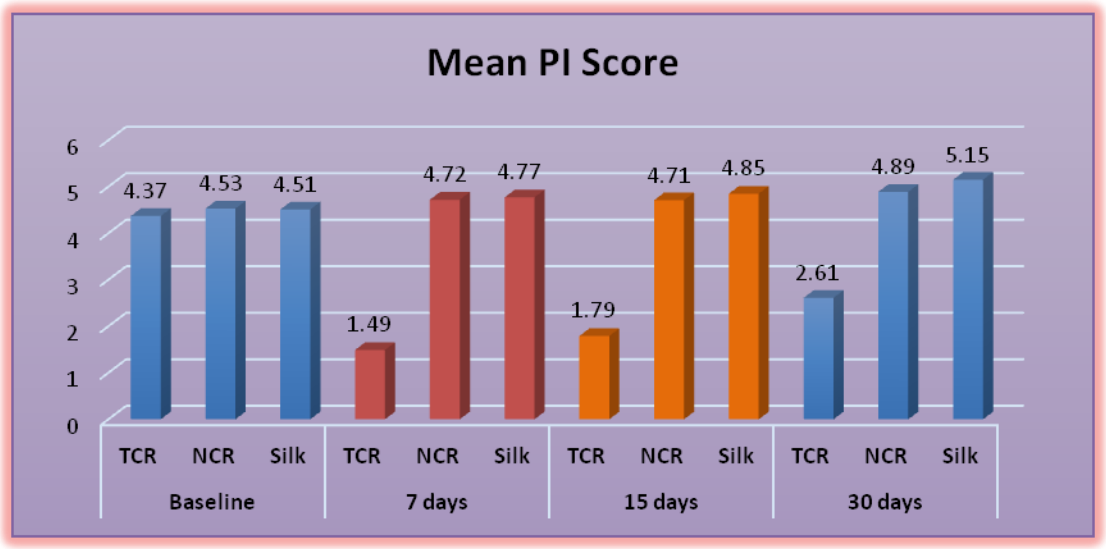


Table 3. Intergroup comparison of Wound Healing Index (WHI) scores Among Study Groups at different time intervals (n=45)

Time	Group	n	Mean ± SD	95% CI (Lower–Upper)	Min	Max	F	p
7 days	TCR	15	3.13 ± 0.64	2.78 – 3.49	2	4	0.064	0.938 (NS)
	NCR	15	3.20 ± 0.56	2.89 – 3.51	2	4		
	Silk	15	3.20 ± 0.56	2.89 – 3.51	2	4		
15 days	TCR	15	3.27 ± 0.46	3.01 – 3.52	3	4	0.000	1.000(NS)
	NCR	15	3.27 ± 0.59	2.94 – 3.60	2	4		

	Silk	15	3.27 ± 0.59	2.94 – 3.60	2	4		
30 days	TCR	15	3.40 ± 0.51	3.12 – 3.68	3	4	0.341	0.713(NS)
	NCR	15	3.40 ± 0.51	3.12 – 3.68	3	4		
	Silk	15	3.53 ± 0.52	3.25 – 3.82	3	4		

Graph 3. Intergroup comparison of Wound Healing Index (WHI) scores Among Study Groups at different time intervals (n=45)

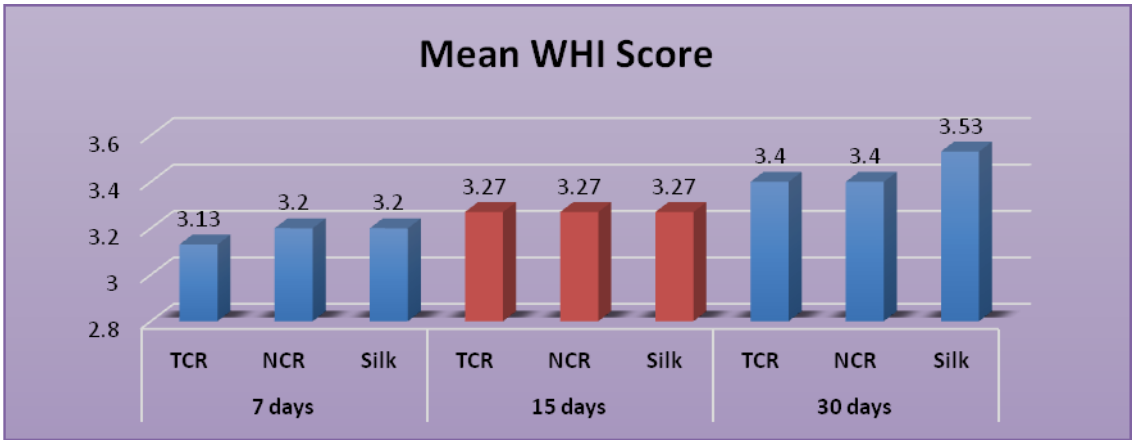


Table 4. Intergroup Comparison of Postoperative Pain Index (PPI) Scores Among Study Groups at Different Time Intervals

Time	Group	Mean ± SD	95% CI (Lower–Upper)	Min	Max	F	p
7 days	TCR	4.27 ± 0.59	3.94 – 4.60	3	5	0.176	0.839 (NS)
	NCR	4.33 ± 0.62	3.99 – 4.68	3	5		
	Silk	4.40 ± 0.63	4.05 – 4.75	3	5		
15 days	TCR	3.53 ± 0.64	3.18 – 3.89	3	5	1.575	0.219(NS)
	NCR	3.73 ± 0.70	3.34 – 4.12	3	5		
	Silk	3.33 ± 0.49	3.06 – 3.60	3	4		

30 days	TCR	2.53 ± 0.52	2.25 – 2.82	2	3	1.633	0.207(NS)
	NCR	2.67 ± 0.62	2.32 – 3.01	2	4		
	Silk	2.27 ± 0.70	1.88 – 2.66	1	3		

NS = non-significant (p > 0.05); S = Significant (p ≤ 0.05)

Graph 4. Intergroup Comparison of Postoperative Pain Index (PPI) Scores Among Study Groups at Different Time Intervals

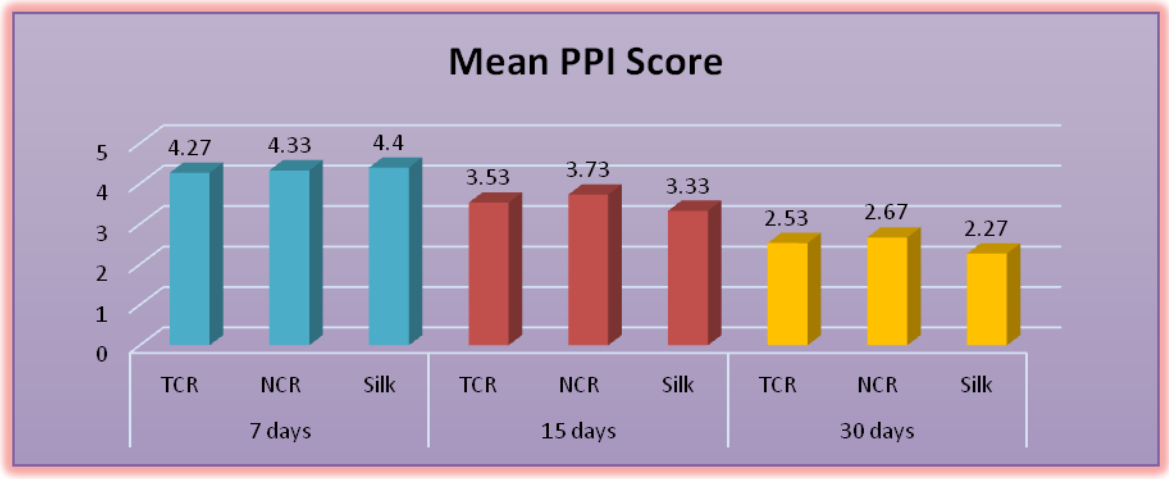
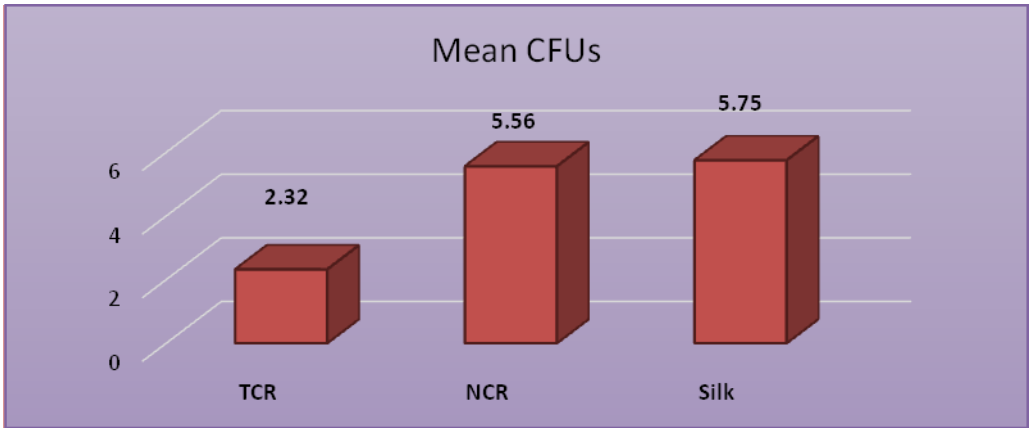


Table 5. Intergroup comparison of Microbial Colony Counts (CFUs ×10^{12}) at Day 7 After Suture Removal (n=45)

Group	Mean ± SD	95% CI (Lower–Upper)	Min	Max	F value	p value
TCR	2.32 ± 0.15	2.24 – 2.40	2.0	2.6		
NCR	5.56 ± 0.16	5.47 – 5.65	5.2	5.8	**1990.85**	**<0.001 (S)**
Silk	5.75 ± 0.19	5.65 – 5.86	5.4	6.1		

NS = non-significant (p > 0.05); S = Significant (p ≤ 0.05)

Graph 5. Intergroup comparison of Microbial Colony Counts (CFUs ×10^{12}) at Day 7 After Suture Removal (n=45)



The intergroup comparison of Postoperative Pain Index (PPI) scores at 7, 15, and 30 days showed no statistically significant differences among TCR, NCR, and silk groups ($p > 0.05$).

At 7 days, pain levels were comparable across groups (TCR: 4.27 ± 0.59; NCR: 4.33 ± 0.62; Silk: 4.40 ± 0.63). A gradual reduction in pain was observed at 15 days (TCR: 3.53 ± 0.64; NCR: 3.73 ± 0.70; Silk: 3.33 ± 0.49) and further at 30 days (TCR: 2.53 ± 0.52; NCR: 2.67 ± 0.62; Silk: 2.27 ± 0.70), with no significant intergroup differences at any interval.

Overall, postoperative pain decreased progressively in all groups, indicating normal healing; however, suture material did not significantly influence pain perception.(Table 4, Graph 4)

The intergroup comparison of Microbial Colony Counts (CFUs ×10^{12}) at Day 7 after suture removal showed a highly statistically significant difference among the three groups ($p < 0.001$). The TCR group demonstrated the lowest microbial load (2.32 ± 0.15), indicating minimal bacterial colonization. In contrast, the NCR group showed higher counts (5.56 ± 0.16), while the silk group exhibited the highest microbial load (5.75 ± 0.19).

The markedly lower CFU levels in the TCR group highlight the superior antimicrobial efficacy of coated sutures in inhibiting bacterial adhesion and biofilm formation. Conversely, the higher microbial counts observed in NCR and silk groups suggest increased susceptibility to plaque accumulation and bacterial retention, particularly in silk due to its braided structure.

Overall, antimicrobial-coated resorbable sutures demonstrated significantly better control of microbial colonization, thereby potentially reducing the risk of postoperative infection and improving clinical outcomes.(Table 5 , Graph 5)

Summary of Findings

Antimicrobial-coated resorbable sutures (TCR) showed significantly lower gingival inflammation, plaque accumulation, and microbial load compared to NCR and silk sutures. Baseline parameters were similar across groups. Wound healing and postoperative pain were comparable in all groups. Overall, TCR sutures demonstrated superior clinical and microbiological

outcomes, while silk sutures performed the least effectively.

Discussion

The present clinical–microbiological study evaluated the effectiveness of antimicrobial-coated resorbable sutures compared with non-coated resorbable and conventional silk sutures in periodontal flap surgery. The findings demonstrate that antimicrobial-coated sutures provide superior control of gingival inflammation, plaque accumulation, and microbial colonization, while wound healing and postoperative pain remain comparable among all groups.[13,14,15]

At baseline, all groups showed comparable Gingival Index (GI) and Plaque Index (PI) scores, confirming homogeneity of the study population. Postoperatively, the antimicrobial-coated resorbable suture (TCR) group exhibited a significant reduction in gingival inflammation at all time intervals, with the greatest improvement at 7 days. This early reduction may be attributed to the antibacterial action of triclosan, which inhibits bacterial colonization and subsequent inflammatory response. [16,17]

Similarly, plaque accumulation was significantly lower in the TCR group compared to NCR and silk groups. The antimicrobial coating likely interferes with biofilm formation on suture surfaces, thereby reducing plaque retention. In contrast, silk sutures demonstrated the highest plaque accumulation, which can be explained by their braided structure that promotes bacterial adherence and wicking of oral fluids.[12,17]

Microbiological analysis further supported these findings, as the TCR group showed significantly lower microbial colony counts compared to the NCR and silk groups. These results are consistent with previous studies demonstrating reduced bacterial adherence and antimicrobial activity of triclosan-coated sutures [18,19,20] .The significantly higher microbial load observed in silk sutures further highlights their susceptibility to bacterial colonization and potential risk for surgical site infection.[19,21]

Within-group comparisons revealed a marked and sustained reduction in GI and PI scores in the TCR group, indicating both immediate and prolonged antimicrobial effects. In contrast, the NCR group showed moderate improvement, while the silk group exhibited minimal improvement with a tendency toward increased plaque accumulation over time. These findings are in agreement with clinical studies reporting improved periodontal outcomes with antimicrobial-coated sutures compared to conventional materials.[22,23,24]

Interestingly, no statistically significant differences were observed among the groups in terms of Wound Healing Index (WHI). This suggests that although antimicrobial-coated sutures reduce bacterial load and inflammation, the overall wound healing process is not significantly influenced by suture type and is likely governed by host response and surgical factors[25,26] .

Similarly, postoperative pain scores decreased progressively in all groups without significant intergroup differences. This indicates that pain perception following periodontal surgery is independent of suture material and is more closely related to surgical trauma and individual patient factors.[27,28]

Overall, the findings of this study establish a clear hierarchy among suture materials. Antimicrobial-coated resorbable sutures demonstrated the most favorable outcomes, followed by non-coated resorbable sutures, while silk sutures exhibited the least favorable results due to higher plaque retention and microbial colonization[29,30].

Conclusion

Within the limitations of the present study, antimicrobial-coated resorbable sutures demonstrated superior clinical and microbiological performance compared to non-coated resorbable and conventional silk sutures in periodontal flap surgery. These sutures were significantly more effective in reducing gingival inflammation, plaque accumulation, and microbial colonization, likely due to their sustained antibacterial effect.

Non-coated resorbable sutures showed moderate improvement in clinical parameters, whereas silk sutures exhibited the least favorable outcomes, with higher plaque retention and bacterial adherence. Despite these differences, wound healing and postoperative pain were comparable among all groups, indicating that suture material does not significantly influence these parameters.

Overall, antimicrobial-coated resorbable sutures can be considered a superior and clinically advantageous alternative for periodontal surgical procedures, particularly in reducing the risk of postoperative infection and improving periodontal health.

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