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A Comparative Study Of Nylon And Vicryl Sutures In Oral Wound Healing

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ABSTRACT

Introduction: Wound closure in oral surgeries often presents unique challenges, such as bacterial colonization and biofilm formation, which can complicate healing. This study investigates the effects of Nylon and Vicryl sutures on bacterial colonization and wound healing quality following third molar extraction, aiming to provide insights for optimal suture selection in oral surgery.

Materials & Methods: In this single-blind clinical trial, 29 patients undergoing third molar surgery were randomly assigned to receive either Nylon or Vicryl sutures. Surgery for both teeth was performed in a single session. For each patient, after the procedure, Nylon sutures were randomly assigned to one side of the surgical site, while Vicryl sutures were used on the contralateral side. Inflammation, tissue consistency, bleeding, and bacterial colonization were assessed on the seventh postoperative day. Bacterial samples from the sutures were collected and analyzed, with colony counts and bacterial types documented.

Results: Vicryl sutures were associated with higher levels of bacterial colonization compared to Nylon sutures. Significant differences were observed in gum redness, with 41.4% of patients in the Vicryl group showing red and movable gums, compared to 20.7% in the Nylon group (p=0.009). In the Nylon group, diphtheroid bacteria were detected in 27.6% of cases, compared to 4.3% in the Vicryl group (p=0.025).

Conclusion: Nylon and Vicryl sutures were associated with different patterns of bacterial colonization and wound healing; however, these findings do not support a definitive recommendation of one suture material over the other.

Keywords: Bacterial Load; Wound Healing; Surgery, Oral; Nylons; Polyglactin 910; Sutures

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Introduction

Wound repair and closure after oral surgeries is one of the vital steps to accelerate the healing process and prevent infection [1]. Unlike wounds in other areas of the body, the oral environment presents unique challenges such as bacterial colonization, biofilm formation,

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and constant exposure to food and saliva, which can complicate wound healing process [2, 3]. For this reason, it is essential to select the appropriate suture to facilitate healing and reduce the risk of infection [4, 5].

Third molar surgery (wisdom tooth extraction) is one of the most common and technically demanding oral surgeries, largely due to the high incidence of impaction [6]. While most of these procedures are completed without complications, risks such as bleeding, infection, and wound healing issues have been reported in approximately 30.9% of cases [7-9]. Sutures play a crucial role in wound closure for these surgeries, and the choice of suture material can directly impact clinical outcomes [10].

Suture threads are classified based on different criteria. One common classification distinguishes between monofilament and polyfilament sutures, while another categorizes them as absorbable or non-absorbable, depending on their chemical composition [11]. Evidence suggests that the risk of infection is influenced by bacterial adhesion and the physical and chemical properties of the sutures. Polyfilament sutures, due to their capillary effect and greater porosity, have a higher tendency to absorb bacteria compared to monofilament sutures.

Polyglactin 910 (Vicryl) is a synthetic, absorbable polyfilament suture that retains its tensile strength in tissues for approximately two to three weeks before being fully dissolved by hydrolysis over eight to ten weeks [12, 13]. In contrast, Nylon suture threads are synthetic, monofilament sutures that are flexible and well-suited to resist repeated bending while maintaining optimal knot integrity. These sutures remain securely in place until removed by the physician. Nylon sutures are commonly used in general, skin, and plastic surgeries [14].

Sutures are considered foreign objects in the body and can serve as focal points for bacterial adhesion [15, 16]. Any bacterial accumulation or prolonged inflammatory response may lead to clinical complications and disrupt the wound healing process [17]. Additionally, suture removal can sometimes cause bacteremia [18]. Common bacteria associated with post-surgical infections include *Fusobacterium*, *Peptostreptococcus*, *Prevotella intermedia*, *Actinomyces*, *Capnocytophaga*, *Enterococcus*, *Streptococcus*, and *Staphylococcus aureus* [14, 19, 20].

Bacteria such as *Pseudomonas aeruginosa*, *Escherichia coli*, and *Streptococcus viridans* have been detected on Vicryl sutures [21]. In vivo studies have shown that non-absorbable sutures tend to adsorb more pathogens than absorbable sutures. Laboratory research further indicates that while the colonization rate of *Streptococcus intermedius* is similar between suture types, *Prevotella intermedia* exhibits greater growth on polyamide threads compared to Monocryl sutures [19].

Due to the widespread use of sutures in various medical fields, particularly in oral and dental surgeries, there are limited studies examining the effects of different suture types on bacterial colonization and wound healing in oral, maxillofacial, and dental surgeries. Given the availability and common use of these two types of sutures in most intraoral procedures, this study aims to investigate the clinical differences between them regarding inflammation and wound healing. The findings from this study may help in selecting the most appropriate suture material for sensitive intraoral surgeries, such as orthognathic procedures and

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extensive reconstructions. Additionally, this study compares bacterial colonization and healing outcomes between Nylon and Vicryl sutures in patients who have undergone third molar extraction surgery.

Materials & Methods

Study Design

This single-blind clinical trial was conducted on 29 patients from the Department of Oral and Maxillofacial Surgery at Babol University of Medical Sciences who required surgery for impacted wisdom teeth in 2023. Participants were candidates for the surgical extraction of mandibular third molars and required suturing. The study was approved by the Oral Health Research Center of the Faculty of Dentistry, Babol University of Medical Sciences, under ethics code IR.MUBABOL.HRI.REC.1400.115, and was registered in the Iranian Clinical Trials Registry IRCT20220705055371N1.

The minimum sample size was calculated using the following formula, with a type I error (study accuracy) of $\alpha = 0.05$ and a type II error (study power) of $\beta = 0.2$. Based on the results of a study by Nadafpour et al. [14] on the bacterial colonization rate using Nylon and Vicryl sutures, the required sample size was determined to be 29 participants.

$$n \geq \frac{\left(Z_{1-\frac{\alpha}{2}} + Z_{1-\beta}\right)^2 \left({\delta_1}^2 + {\delta_2}^2\right)}{d^2} = \frac{(1.96 + 0.84)^2 (2^2 + 3.22^2)}{4} = 28.16 \cong 29$$

The flow of participants through each stage of the study is shown in a CONSORT diagram, following the Consolidated Standards of Reporting Trials (CONSORT) guidelines to ensure transparency and standardized reporting of this randomized clinical trial (Figure 1).

The sampling method was both random and purposive. After obtaining faculty approval, 29 patients referred to the Department of Oral and Maxillofacial Surgery at Babol University of Medical Sciences were selected for the study. These patients required suturing after impacted wisdom tooth surgery. Inclusion criteria were good general health, absence of specific systemic or oral diseases, and non-smoking status. Exclusion criteria were age over 35 years, history of systemic diseases, poor health, smoking, or alcohol consumption.

A dental file was created for each participant upon registration at the oral and maxillofacial surgery department. Patients were recruited using a random sampling method to ensure unbiased selection of eligible individuals. After comprehensive clinical and radiographic examinations, detailed demographic and medical histories were recorded, including age, gender, smoking habits, alcohol consumption, systemic disease history, current medications, and periodontal status. Only patients scheduled for unilateral third molar extraction (upper or lower jaw) were enrolled in the study. Before any intervention, all participants received detailed explanations about the characteristics of the suture materials being studied, and written informed consent was obtained from each individual.

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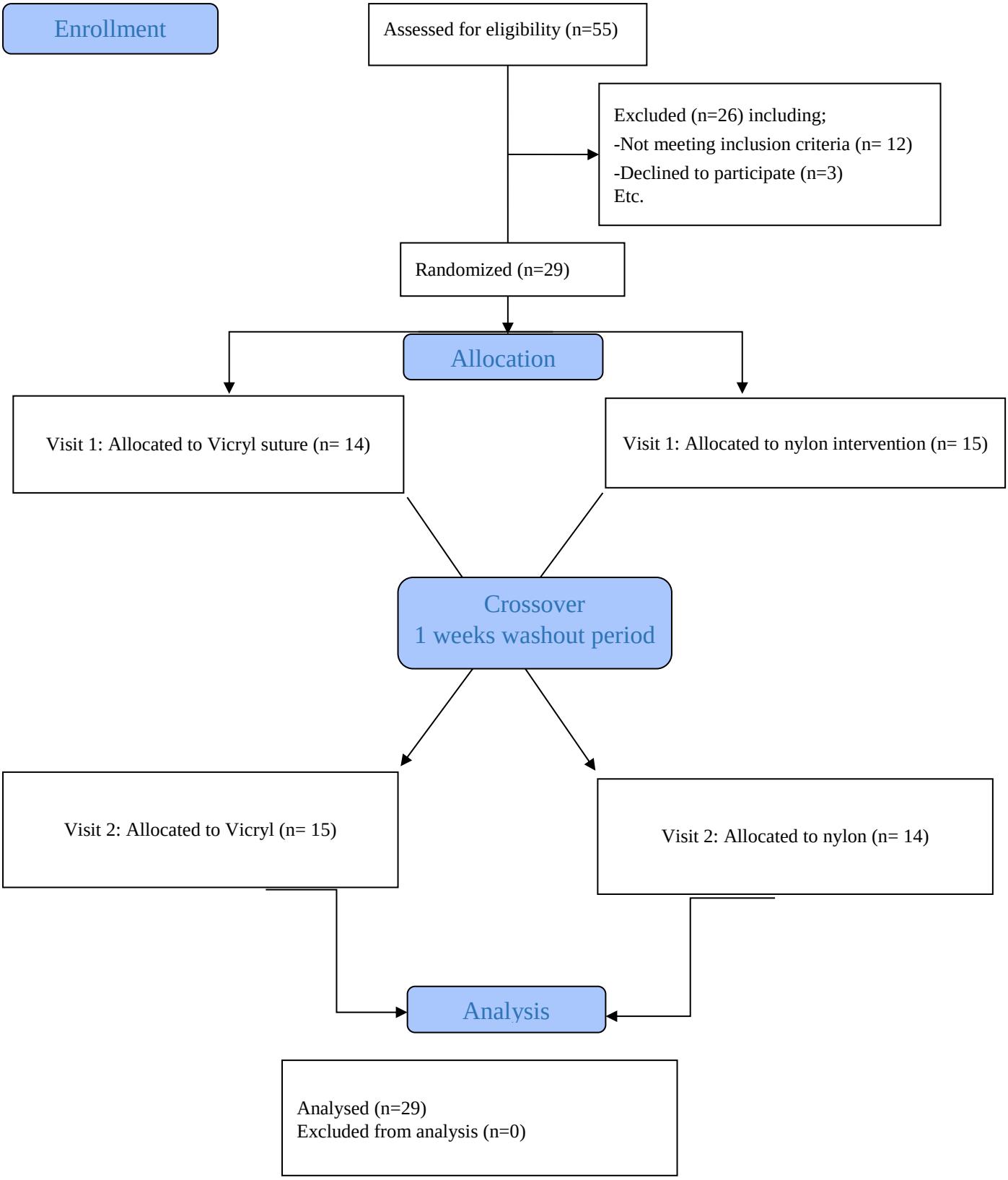


Figure 1. CONSORT 2010 flow diagram

For the study, Vicryl sutures used were 4-0 gauge with a length of 19 mm, while Nylon sutures were 0-gauge, also 19 mm in length [22]. In the lower jaw, the pocket design for the

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mucoperiosteal flap began with a sulcular incision starting from the first molar, involving the second molar, and extending buccally along the oblique ridge. Surgery for both teeth was performed in a single session. In each patient, after the procedure was completed, Nylon sutures were randomly assigned to one side of the surgical site, while Vicryl sutures were used on the opposite side. Postoperative care instructions were consistent for all patients and included an antibiotic regimen (Amoxicillin 500 mg or Clindamycin 300 mg every 8 hours), NSAID analgesics every 6 hours, and a 0.2% chlorhexidine solution rinse three times daily for 7 days. Patients were also advised to use an intermittent cold compress immediately after surgery until bedtime.

Oral hygiene practices were standardized for all patients during the period when sutures were present. On the 7th day after surgery, patients returned for evaluation, and wound healing parameters were measured. The maturity and quality of the regenerating tissue were assessed using the Modified Healing Index [23, 24]. This index evaluates wound healing based on four indicators: tissue color, consistency of healing tissue, pus secretion, and bleeding. Each parameter was scored from 1 to 3, with a score of 1 indicating excellent healing and a score of 3 indicating poor healing [25]. The total score of the Modified Healing Index, calculated by summing all four indicators, ranged from 4 to 12. The specific grading criteria for each parameter are presented in Table 1.

Methodology

In this study, suture threads were removed according to the clinical protocol. Although the scheduled follow-up was set for the seventh postoperative day, the final decision regarding extraction depended on the clinician's assessment of tissue maturity. If wound healing was deemed insufficient or inflammation prevented safe removal, the procedure was postponed until the tenth or fourteenth day. For the physical dimensions of the samples, the entire length of each extracted suture thread was processed, with lengths typically ranging from 2.5 to 4.0 cm depending on the surgical site. All retrieved segments were immediately placed in sterile microtubes containing 1 mL of Brain Heart Infusion (BHI) broth (Merck Co., Germany) and sent to the microbiology laboratory at the Faculty of Medicine, Babol University of Medical Sciences, for colony counting, identification, and confirmation. Upon arrival, microtubes were placed on a shaker for 5 minutes to detach bacteria from the thread, producing a homogeneous solution. A 10-µL sample of this solution was cultured on blood agar and incubated at 37°C for 24 hours. Bacterial colonies were then enumerated using the spread plate technique and manually counted.

If colonies on the culture medium were too numerous to count, 0.5 mL of the solution was diluted to concentrations of 0.1 or 0.01 and cultured. After collecting a 10-µL sample for colony counting, the remaining broth was incubated at 37°C for an additional 24 hours. Following bacterial growth, a streak culture from the bacteria in the microtubes was performed on blood agar and incubated at 37°C for 24 hours.

Bacterial colonies were then prepared for smear staining. Identification of Gram-positive cocci involved catalase, slide coagulase, tube coagulase, mannitol salt agar, DNase, novobiocin sensitivity, hemolysis pattern, bacitracin disk sensitivity, optochin disk

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sensitivity, and salt tolerance tests. The oxidase test was used for Gram-negative cocci. For Gram-positive bacilli, Albert staining and culture in Tinsdale medium were conducted, while Gram-negative bacilli were identified via carbohydrate fermentation, H_2S and gas production in TSI medium, motility, indole and gas production in SIM medium, MR-VP, and citrate tests.

Data were reported as means and percentages. The maturity and quality of the healing tissue were assessed using the Modified Healing Index. In this index, wound healing was evaluated based on four criteria: tissue color, consistency of the healing tissue, pus discharge, and bleeding. Each criterion was assigned a score from 1 to 3, with a score of 1 indicating excellent healing and a score of 3 indicating very poor healing. The scores for all four criteria were summed to obtain the final Modified Healing Index score, which ranged from 4 to 12. Table 1 presents the scores for each component separately.

Table 1. Scoring criteria for the four categories of the Modified Healing Index

Index	Score 1	Score 2	Score 3
Tissue Color	All gingival tissue is pink	< 50% of gingiva is red and mobile	> 50% of gingiva is red and mobile
Tissue Color and Consistency	Granular, pink	Soft, red	Friable, green or gray
Pus Secretion	No pus	No pus, with plaque on socket walls	Pus formation
Bleeding	No bleeding	Bleeding upon touch	Spontaneous bleeding
Modified Healing Index	Good (4)	Moderate (5–8)	Poor (9–12)

Statistical Analysis

Chi-square, Monte Carlo chi-square, Fisher's exact test, and Mann-Whitney U test were used to assess relationships between variables. Statistical analysis was performed using SPSS software (IBM Corporation, New York, USA), version 26. A significance level of 0.05 was applied to all statistical tests.

Results

Of 29 participants, 15 (51.7%) were men and 14 (48.3%) were women, with a mean age of 22.45 ± 2.78 years.

In the Nylon suture group, 6 cases (20.7%) had red and movable gums, compared to 12 cases (41.4%) in the Vicryl group, a statistically significant difference (p=0.009). However, there was no statistically significant difference between the two suture types in tissue color and consistency, pus discharge, or bleeding rates (Table 2).

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Table 2. Comparison of mucosal color, healing tissue color and consistency, pus discharge, and bleeding levels by suture type**.**

		Group				
		Nylon suture		Vicryl suture		P-value
		Count	Percent	Count	Percent	
Mucosal Color	100% of gingiva pink	23	79.3%	17	58.6%	**0.009**†
	<50% of gingiva red, movable	0	0.0%	8	27.6%	
	>50% of gingiva red, movable	6	20.7%	4	13.8%	
Healing Tissue Color and Consistency	close grained, pink	8	27.6%	14	48.3%	0.088‡
	soft, red	18	62.1%	15	51.7%	
	fragil, greenish or grayish	3	10.3%	0	0.0%	
Pus Discharge	absent	20	69.0%	13	44.8%	0.063‡
	absent but pronouced amount of plaque around socket walls	9	31.0%	16	55.2%	
Bleeding Levels	absent	15	51.7%	10	34.5%	0.185‡
	induced by palpation	14	48.3%	19	65.5%	

† Monte Carlo Chi-Square test was used.
‡ Chi-Square test was used.
Significant values are shown in bold.

The tissue repair index in the Nylon suture group was 6.03 ± 1.55, while in the Vicryl group it was 6.28 ± 1.07. This difference was not statistically significant (Table3).

As shown in Table 3, a statistically significant difference was found between the two groups only in the presence of *diphtheroi*d bacteria. In the Nylon suture group, 8 cases (27.6%) showed *diphtheroid* bacteria, compared to 1 case (4.3%) in the Vicryl group (P = 0.025). The frequency of other bacteria studied did not differ significantly between the two groups.

As shown in Table 4, gram-positive bacteria were identified in 27 cases (93.1%) in both groups, with no statistically significant difference between them. For gram-negative bacteria, their presence was observed in 16 cases (55.2%) in the Nylon suture group and 20 cases (69%) in the Vicryl group, though this difference was also not statistically significant.

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Table 3. Comparison of bacterial culture results by suture type.

		Group				P-value
		Nylon Suture		Vicryl Suture		
		Count	Percent	Count	Percent	
Beta-Hemolytic Streptococcus (Non-A, B, C)	Negative	21	72.4%	17	58.6%	0.269†
	Positive	8	27.6%	12	41.4%	
Neisseria	Negative	16	55.2%	14	48.3%	0.599†
	Positive	13	44.8%	15	51.7%	
Enterococcus	Negative	22	75.9%	19	65.5%	0.387†
	Positive	7	24.1%	10	34.5%	
Staphylococcus aureus	Negative	24	82.8%	23	79.3%	0.738†
	Positive	5	17.2%	6	20.7%	
Streptococcus Viridans	Negative	18	62.1%	21	72.4%	0.401†
	Positive	11	37.9%	8	27.6%	
Staphylococcus epidermidis	Negative	23	79.3%	23	79.3%	1.000†
	Positive	6	20.7%	6	20.7%	
Diphtheroids	Negative	21	72.4%	28	96.6%	**0.025**‡
	Positive	8	27.6%	1	3.4%	
Klebsiella	Negative	26	89.7%	28	96.6%	0.611‡
	Positive	3	10.3%	1	3.4%	
Gamma-Hemolytic Streptococcus	Negative	28	96.6%	28	96.6%	1.000‡
	Positive	1	3.4%	1	3.4%	
Enterobacter	Negative	27	93.1%	27	93.1%	1.000‡
	Positive	2	6.9%	2	6.9%	
Escherichia coli	Negative	26	89.7%	21	72.4%	0.094‡
	Positive	3	10.3%	8	27.6%	
Micrococcus	Negative	29	100.0%	26	89.7%	0.237‡
	Positive	0	0.0%	3	10.3%	

† Chi-Square test was used.
‡ Fisher Exact Test was used.
Significant values are shown in bold.

Table 4. Comparison of positive and negative gram bacterial presence by suture type

		Group				P-value
		Nylon Suture		Vicryl suture		
		Count	Percent	Count	Percent	
Positive	No	2	6.9%	2	6.9%	1.000†
	Yes	27	93.1%	27	93.1%	
Negative	No	13	44.8%	9	31.0%	0.279‡
	Yes	16	55.2%	20	69.0%	

† Fisher Exact Test was used.
‡ Chi-Square test was used.

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Discussion

In this study, significant differences in gingival redness were observed between the groups using Nylon and Vicryl sutures. Vicryl sutures were associated with greater inflammation, as a higher percentage of patients in the Vicryl group experienced gum redness (41.4% vs. 20.7% in the Nylon group), a statistically significant difference (P=0.009). Previous studies also suggest that the multifilament structure of Vicryl can increase tissue irritation and bacterial accumulation, contributing to inflammation. In contrast, Nylon sutures, with their monofilament and smooth structure, tend to cause less tissue irritation and reduced inflammation [28]. While inflammation is a typical surgical response, excessive or prolonged inflammation can hinder wound healing and increase the risk of complications, such as infection [29].

This increased inflammatory response correlates with the specific patterns of bacterial colonization observed in our study. Vicryl sutures demonstrated a higher susceptibility to bacterial colonization overall, as their multistranded structure provides greater surface area for biofilm formation. However, we also noted a higher prevalence of diphtheroids on Nylon sutures (p=0.032). Although beta-streptococci were more common in the Vicryl group (p=0.037), the key finding remains that the structural properties of Vicryl facilitate greater bacterial adherence, thereby exacerbating the local inflammatory response compared to the smoother Nylon surface [28]. Additionally, gram-positive bacteria exhibited a significantly higher colonization rate on both types of sutures, reflecting the composition of the oral microbiome.

Despite observed differences in bacterial colonization and inflammation, the results showed no statistically significant difference in overall wound healing indices between the two suture groups. Both suture types produced similar outcomes for tissue repair, pus secretion, and bleeding on the seventh day after surgery. These findings suggest that, despite differences in initial tissue responses, both suture types have comparable effects on the overall wound healing process. This allows surgeons to consider other factors, such as mechanical properties, patient characteristics, or cost, when selecting sutures for oral and dental surgeries. These results are consistent with previous studies showing that, while single- and multi-stranded sutures can differ in their early impact on wound healing, these differences tend to diminish over time [13, 14].

These findings highlight the importance of suture selection in infection prevention, as certain suture materials may be more appropriate depending on individual infection risk. This is especially relevant for patients with weakened immune systems, where a more careful choice of suture thread may help reduce infection risks. The preference for Nylon in minimizing early inflammation supports its use in situations where rapid soft tissue recovery is a priority.

Suture-related infections and their impact on delayed wound healing remain critical concerns in surgical practice [26]. Various factors, including suture type, patient characteristics, surgical conditions, and the specific microorganisms present in the wound, influence bacterial colonization rates and the healing process [15, 26]. Understanding these factors and examining local microbial patterns at each treatment center are essential steps

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toward minimizing surgical infections [27]. Given the importance of this issue, the present study aimed to compare Nylon and Vicryl sutures regarding their effects on bacterial colonization and wound healing quality following third molar surgeries. Additionally, identifying the local microbial profile at Babol University of Medical Sciences supports the tailored prescription of antibiotics based on the suture type used.

Our findings regarding the higher bacterial accumulation on Vicryl sutures align with those of Mahesh et al. [15], who demonstrated that multifilament sutures, due to their unique structure, tend to absorb more fluids and biological materials, creating an environment conducive to bacterial growth. Similarly, Singh et al. reported that Nylon sutures, with their monofilament structure, resulted in reduced inflammation and bacterial colonization. Additionally, as in our study, they found no significant difference in the wound healing index between the two suture types [30].

A study by Nadafpour et al. confirmed that Vicryl sutures had a higher rate of bacterial accumulation, particularly with *Enterococcus faecalis* and *Staphylococcus aureus*, compared to Nylon sutures. They reported that Vicryl was over 4.2 times more likely to attract bacterial adhesion than Nylon [14]. Additionally, Scribante et al. examined the effects of antibacterial coatings, such as triclosan, on Vicryl sutures and showed that these coatings can significantly reduce bacterial accumulation. These findings suggest that applying antibacterial coatings to Vicryl or similar multifilament sutures could be an effective strategy to lower infection risk [31].

While the present study showed that Vicryl (multifilament) sutures were more prone to bacterial accumulation, some previous studies, such as those by Banche et al., found that multifilament polyester and silk sutures had lower bacterial adherence compared to monofilament sutures like Nylon. These contrasting findings may be due to the varying physical and chemical properties of the different suture materials used [20].

These results align with most previous studies, reinforcing that Nylon sutures are a preferable choice due to their reduced bacterial accumulation and inflammation, especially in oral surgeries where infection risk is elevated. Vicryl sutures, with their absorbable properties, can still be beneficial in cases requiring absorbable sutures. However, due to their susceptibility to gram-positive bacterial colonization, Vicryl sutures should be used with caution in surgeries with a high risk of infection, unless antibacterial-coated variants such as Vicryl Plus are used. As previous research has confirmed, suture type and structure are only some of the factors influencing bacterial growth; other factors, including environmental conditions, patient immune status, and surgical technique, also play important roles.

Limitations and Future Research Suggestions

The relatively small sample size of this study and its focus on a single research center may limit the generalizability of the findings. Future research with larger sample sizes across multiple centers could provide a more comprehensive understanding of the long-term effects of different suture types on wound healing and infection rates. Additionally, investigating bacterial colonization and wound healing quality across various suture brands and environmental conditions (both aerobic and anaerobic) would offer valuable insights into the

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effects of these variables. Given the role of biofilms in chronic wound infections, future studies should also examine biofilm formation on different suture materials to better understand how they influence biofilm persistence and infection risk.

Conclusion

Nylon and Vicryl sutures were associated with different patterns of bacterial colonization and wound healing; however, these findings do not support a definitive recommendation of one suture material over the other.

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Conflict of interest

The authors declare that they have no competing interests.

Author's Contribution

MR, AJ and FB designed the study. MK contributed to data collection. SS Contributed to statistical analysis and interpretation of data. AJ supervised the work and was a major contributor in writing the manuscript. All authors read and approved the final manuscript.

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