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Evaluation of the Effect of 0.2% Chlorhexidine and Listerine Mouthwashes on the Tensile Strength of Selected Absorbable Sutures: An In-Vitro Study

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Abstract

Background: Absorbable sutures are vital in oral surgery, but their tensile strength may be affected by oral environments, including saliva and antimicrobial mouthwashes. Understanding these effects is essential for optimizing surgical outcomes.

Aims/Objectives: This study aims to evaluate the impact of 0.2% chlorhexidine gluconate and Listerine mouthwash on the tensile strength of Vicryl (polyglactin 910), Monocryl (poliglecaprone 25), and Chromic Catgut sutures over 14 days.

Methods: In an in-vitro study, 150 suture samples were immersed in artificial saliva, 0.2% chlorhexidine, or Listerine for 1, 7, and 14 days. Tensile strength was measured using a universal testing machine, with data analyzed via ANOVA and Tukey post hoc tests.

Results: Monocryl 4-0 exhibited the highest tensile strength, ranging from 39.30 ± 2.65 N (pre-immersion) to

28.50 ± 1.50 N (Day 14, chlorhexidine). Chromic Catgut showed significant degradation, dropping to 5.20 ± 0.80 N in chlorhexidine by Day 14. Vicryl had intermediate strength with variable solution effects. **Conclusion**: Monocryl 4-0's superior tensile strength suggests its suitability for oral surgeries involving antimicrobial mouthwashes, potentially enhancing surgical outcomes.

Keywords: Sutures, Tensile Strength, Chlorhexidine, Mouthwashes, Oral Surgery, In Vitro

Introduction

Sutures are critical for wound closure in surgical practice, particularly in oral and maxillofacial surgery, where the oral cavity's unique conditions—moisture, pH fluctuations, microbial activity, and mechanical stresses from mastication—challenge suture performance[1,2]. Absorbable sutures, which degrade naturally, are preferred in oral procedures as they eliminate the need for removal, reducing patient discomfort and infection risks[3].

Tensile strength, the maximum force a suture can withstand before breaking, is a key factor in maintaining wound integrity during healing[4]. Commonly used absorbable sutures include Vicryl (polyglactin 910), a synthetic braided suture; Monocryl (poliglecaprone 25), a synthetic monofilament suture; and Chromic Catgut, a natural suture treated to delay absorption[5,6].

The oral environment, including saliva and antimicrobial mouthwashes like 0.2% chlorhexidine gluconate and Listerine, can influence suture degradation[7,8]. These mouthwashes are prescribed to reduce bacterial load post-surgery, but their chemical components may interact with suture materials, potentially compromising tensile strength (9, 10).

While prior studies have explored suture performance in various solutions, data on the specific effects of chlorhexidine and Listerine on absorbable sutures in oral surgery are limited[11,12]. This in-vitro study evaluates the tensile strength of Vicryl, Monocryl, and Chromic Catgut sutures exposed to artificial saliva, 0.2% chlorhexidine, and Listerine over 14 days, aiming to provide evidence-based guidance for suture selection in oral surgery.

Materials and Methods

Study Design

This non-randomized in-vitro experimental study was conducted at the Department of Oral and Maxillofacial Surgery, Chhattisgarh Dental College & Research Institute, Rajnandgaon, in collaboration with the Central Institute of Petrochemicals Engineering and Technology (CIPET), Raipur, Chhattisgarh. The methodology was adapted from established in-vitro protocols[13,14].

Suture Materials

Three 4-0 absorbable sutures were selected based on their common use in oral surgery:

- Vicryl (polyglactin 910): Synthetic braided suture.
- Monocryl (poliglecaprone 25): Synthetic monofilament suture.
- Chromic Catgut: Natural suture treated with chromium salts (15, 16).

Immersion Solutions

Sutures were immersed in:

- Artificial Saliva: pH 7.0, mimicking oral conditions.
- 0.2% Chlorhexidine Gluconate: Antimicrobial mouthwash.
- Listerine Zero Alcohol Mouthwash: Essential oils-based mouthwash[17,18].

Sample Preparation

A total of 150 suture samples (50 per suture type) were tied in a 3:1:1 knot configuration around a 4 mm diameter rubber rod to standardize tension, following established protocols[19,20].

Immersion Protocol

Samples were immersed in their respective solutions at 37°C for 0 (pre-immersion), 1, 7, and 14 days. Post-immersion, samples were blotted dry to remove excess solution.

Tensile Strength Testing

Tensile strength was measured using a universal Instron testing machine. Samples were clamped, and a load was applied at 10 mm/min until breakage, with the maximum load recorded in Newtons (N)[13,14].

Statistical Analysis

Data were analyzed using SPSS version 22 (IBM Corp., Armonk, NY, USA). One-way ANOVA compared tensile strength across suture types and solutions, with Tukey post hoc tests for pairwise comparisons ($p \leq 0.05$)[13,14].

Results

The study tested 150 suture samples, with tensile strength varying significantly across suture types and solutions (Table 1).

Table 1: Mean Tensile Strength (N) ± Standard Deviation Across Solutions and Time Points.

Suture Type	Solution	Pre-immersion	Day 1	Day 7	Day 14
Monocryl	Artificial Saliva	39.30 ± 2.65	35.50 ± 2.00	32.80 ± 1.90	30.10 ± 1.80
	Chlorhexidine	39.30 ± 2.65	34.20 ± 1.80	30.50 ± 1.60	28.50 ± 1.50
	Listerine	39.30 ± 2.65	36.00 ± 2.10	33.20 ± 1.85	31.00 ± 1.70
Vicryl	Artificial Saliva	10.25 ± 3.64	9.80 ± 2.50	8.50 ± 2.00	7.20 ± 1.80
	Chlorhexidine	10.25 ± 3.64	9.50 ± 2.30	7.80 ± 1.90	6.50 ± 1.60
	Listerine	10.25 ± 3.64	12.50 ± 2.00	10.00 ± 2.10	8.00 ± 1.90
Chromic Catgut	Artificial Saliva	17.06 ± 2.26	15.50 ± 1.80	12.80 ± 1.50	10.50 ± 1.20
	Chlorhexidine	17.06 ± 2.26	12.00 ± 1.60	8.50 ± 1.20	5.20 ± 0.80
	Listerine	17.06 ± 2.26	14.80 ± 1.70	11.50 ± 1.40	9.00 ± 1.10

Pre-immersion: Monocryl showed the highest tensile strength (39.30 ± 2.65 N), followed by Chromic Catgut (17.06 ± 2.26 N) and Vicryl (10.25 ± 3.64 N) ($p = 0.001$).

Artificial Saliva: All sutures exhibited gradual strength decline, with Monocryl maintaining the highest strength (30.10 ± 1.80 N, Day 14) and Chromic Catgut the lowest (10.50 ± 1.20 N, Day 14).

Chlorhexidine: This solution significantly reduced tensile strength, especially for Chromic Catgut (5.20 ± 0.80 N, Day 14). Monocryl remained stable (28.50 ± 1.50 N, Day 14).

Listerine: Vicryl showed an initial strength increase (12.50 ± 2.00 N, Day 1) before declining, while Monocryl and Chromic Catgut followed patterns similar to artificial saliva.

Statistical analysis confirmed significant differences across suture types and solutions at most time points ($p < 0.05$), except for Chromic Catgut on Day 1 ($p = 0.471$). These findings align with studies indicating synthetic monofilament sutures outperform natural or braided sutures in oral environments[17,18].

Discussion

This study demonstrates that Monocryl 4-0 maintains superior tensile strength compared to Vicryl and Chromic Catgut when exposed to artificial saliva, 0.2% chlorhexidine, and Listerine. Monocryl's synthetic monofilament structure likely contributes to its resistance to hydrolysis, consistent with prior research[4,9]. Chromic Catgut's significant degradation, particularly in chlorhexidine, may result from enzymatic breakdown accelerated by the solution's chemical properties[19,20].

Vicryl's variable performance, including an initial strength increase in Listerine, may reflect interactions between its braided structure and the mouthwash's essential oils, warranting further investigation[1,5]. These findings have significant implications for oral surgery, where suture integrity is critical to prevent wound dehiscence. Monocryl's stability suggests its suitability for procedures requiring prolonged tensile strength, particularly with antimicrobial mouthwash use.

Comparative studies, such as those by Alsarhan et al. 4 and Aktı et al. 3, report similar degradation patterns, though some suggest mouthwashes may temporarily enhance suture strength due to chemical interactions. The in-vitro setting limits direct clinical applicability, as oral conditions involve dynamic factors like saliva flow and microbial activity[7,8]. Future clinical studies are needed to validate these findings and assess patient outcomes.

From a public health perspective, optimizing suture selection can reduce post-operative complications, lowering healthcare costs and improving patient quality of life[11,12]. This study underscores the need for tailored surgical protocols considering post-operative Care Regimens.

Conclusion

Monocryl 4-0 exhibited the highest tensile strength retention when exposed to artificial saliva, 0.2% chlorhexidine, and Listerine over 14 days, making it a preferable choice for oral surgeries involving antimicrobial mouthwash use. These findings highlight the importance of selecting sutures based on their stability in oral environments to enhance surgical outcomes and reduce complications.

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