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Original Research Article

To study the effect of Cetylpyridinium Chloride (0.07%) and Chlorhexidine Gluconate (0.2%) mouthwashes on the tensile strength of selected absorbable sutures: An in vitro study

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Abstract

Introduction: Proper wound closure is vital for optimal healing in periodontal surgeries, and suture materials must maintain mechanical integrity when exposed to oral environments, including mouthwashes.

Aim & Objective: This in vitro study evaluated the effect of two commonly used antiseptic mouthwashes—Cetylpyridinium Chloride (0.07%) and Chlorhexidine Gluconate (0.2%)—on the tensile strength and elongation of absorbable sutures.

Materials and Methods: Forty suture specimens (Vicryl and Monocryl, 5-0) were tied around rubber rods and immersed in either CPC or CHX mouthwashes. Samples were incubated at 37°C and tested for tensile strength and elongation on Days 1, 3, 7, and 10 using a Universal Testing Machine. Statistical analysis was conducted using repeated measures ANOVA ($p<0.05$).

Result: Both suture types showed a progressive reduction in tensile strength and increase in elongation over time. However, sutures immersed in CPC exhibited a significantly greater loss in tensile strength and increase in elongation compared to those in CHX ($p<0.05$). Braided sutures demonstrated more resistance than monofilament sutures in both solutions.

Conclusion: Cetylpyridinium Chloride (0.07%) has a more deleterious effect on the mechanical properties of absorbable sutures compared to Chlorhexidine Gluconate (0.2%). These findings suggest clinicians should exercise caution when prescribing CPC-containing mouthwashes post-surgically, especially when monofilament sutures are used.

Keywords: Sutures Material, Cetylpridinium chloride, Chlorhexidine gluconate, Mouthwashes, Tensile strength, Elongation, Monocryl, Vicryl.

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1. Introduction

In order for surgical wounds to heal, suturing is essential.[1] The most often used method of wound closure is suture application, which stabilises the wound edges to a high degree and effectively for the purpose of ensuring good wound closure for a predetermined amount of time without interfering with the physiological components of wound healing. The successful outcome of any surgical procedure is contingent upon the appropriate closure and stabilisation of the wound edges in their intended position.[2,3] Surgical dental procedures require a thorough understanding of suturing materials and techniques. These materials are constantly being subjected to mechanical pressures from chewing, speaking, making facial expressions, and changing pH, saliva, bacterial proteolytic enzymes, and vascularization.[4]

The main characteristics and attributes that affect how various sutures work are the filament structure, size, tensile strength, surface roughness, degrading property, stiffness, and flexibility of the materials. The size and tensile property of the suturing material directly correlates with the sutures' capacity to withstand stress caused by the tissues and their ability to heal themselves. Based on their degenerative and resorptive capacities, sutures are primarily classified as synthetic or natural, and absorbable or nonabsorbable.[1] Polyglactin 910 (Vicryl) is a multifilament absorbable synthetic coated suture made of a copolymer produced from 90% glycolide and 10% L-lactide, whereas Poliglecaprone 25

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(Monocryl_) is a monofilament synthetic absorbable surgical suture made from copolymer glycolide and epsilon-caprolactone.

Due to their many physical and biomechanical characteristics, such as their faster rate of degradation, ability to reduce adherent bacterial biofilm, and improved healing response, Monocryl and Vicryl sutures have been utilised extensively [6–8]. Their popularity and use in a variety of oral and periodontal surgical procedures are attributed to these distinctive properties. For a better healing process, the suture material's tensile strength should equal the tissue's tensile strength.[1] Tensile strength, which is determined by the weight (kg) required to sever the suture material, is known to vary with suture material size. The number of filaments—monofilament or multifilament—also affects the suture material's tensile strength. The ability of a suture to withstand tension during knotting and to protect the wound during the lengthy healing phase is largely dependent on its tensile strength.[5]

Numerous studies indicate that certain solutions or fluids eaten may have an impact on a suture's tensile strength. Vicryl suture materials gradually lose their tensile strength after being exposed to saliva, bovine milk, and soy milk for 35 days, according to an experimental investigation conducted by Ferguson et al.[9] Comparatively speaking to the other soaking solutions, saliva-soaked specimens exhibit a faster loss of tensile strength.[9] Vicryl exhibits superior breaking strength in comparison to natural sutures, according to another study. After immersing in physiological and acidic pH solutions, this becomes particularly clear.[6] Furthermore, a recent study indicates that the failure load of sutures used in knee surgery may be impacted by antiseptic solutions.[10] The study conducted by Alsarhan et al suggests that Listerine mouthwash can be prescribed safely after using either Vicryl 4-0 or 5-0 sutures or Monocryl 4-0 sutures. However, Monocryl 5-0 sutures performed better when 0.2% chlorhexidine gluconate mouthwash was used.[1]

However, to the best of our knowledge, no study has compared the strengths of Monocryl and Vicryl suture materials over time when exposed to cetylpyridinium chloride (0.07%)

Therefore, the current study aims to evaluate the tensile strength and elongation of Monocryl and Vicryl sutures in association with two different commercial types of mouthwashes (cetylpyridinium chloride (0.07%) and chlorhexidine gluconate (0.2%) mouthwashes), immersed for 14 days.

2. Materials and Methods

2.1. Suture specimens

Two types of absorbable sutures, multifilament coated polyglactin 910 (VICRYL *PLUS*- Ethicon) and monofilament poliglecaprone 25 (MONOCRYL *PLUS* - Ethicon), were used in this study. For each type of suture, one gauge (5-0) was selected. Atleast 20 suture packs of each material and gauge (Vicryl_ 5-0, Monocryl_ 5-0). Each suture pack was utilized to create 10 suture specimens tied around a single custom-made rubber rod of diameter 4cm. Four rubber rods, each containing 10 suture specimens of each material and gauge were placed in a plastic container labelled with the experimental condition name and sample number.

This resulted in 40 suture specimens. Each tested suture was tied using knots consisting of initial triple wrap (surgeon's knot) throw and followed by two square throws. Following samples were obtained: Group a: monofilament suture (5-0) immersed in chlorhexidine gluconate mouthwash. Group b: monofilament suture (5-0) immersed in cetylpyridinium chloride mouthwash. Group c: multifilament suture (5-0) immersed in chlorhexidine gluconate mouthwash. Group d: multifilament suture (5-0) immersed in cetylpyridinium chloride mouthwash.

2.2. Experimental conditions

Two mouthwashes were used to compare. For test group a cetylpyridinium chloride-based mouth with brand name Colgate Plax was used and for control group, gold standard chlorhexidine mouthwash with brand name Hexidine mouthwash was used. The sutures were immersed in the mouthwashes.

2.2. Statistical analysis

Repeated measures ANOVA was used to analyze changes in tensile strength and elongation of sutures across multiple time points (Day 1, 3, 7, and 10). A p-value of <0.05 was considered statistically significant. Where necessary, post-hoc comparisons were conducted to identify specific differences between groups.

3. Results

As shown in **Table 1**, **Table 2** the tensile strength of monofilament suture in CPC and CHX mouthwashes was checked at different time intervals. It was observed that a decrease in tensile strength was seen for monofilament suture under both the mouthwashes but the reduction of tensile strength for monofilament suture under CPC mouthwash was more significant than monofilament suture under CHX mouthwash ($p<0.05$).

As shown in **Table 3**, **Table 4** the tensile strength of braded suture in CPC and CHX mouthwashes was checked at different time intervals. It was observed that a decrease in tensile strength was seen for braded suture under both the mouthwashes but the reduction of tensile strength for braded suture under CPC mouthwash was more significant than braded suture under CHX mouthwash ($p<0.05$).

As shown in **Figure 1**, the effect of Cetylpyridinium chloride (0.07%) (CPC) and Chlorhexidine gluconate (0.2%)

(CHX) mouthwashes on the Tensile Strength of monofilament and braded suture was examined at 1st day, 3rd day, 7th day and at 10th day. It was observed that a reduction in tensile strength was seen but a greater significant reduction in tensile strength for braded suture under the effect of CPC mouthwash was seen compared to others.

As shown in **Table 5**, **Table 6** the Elongation (%) of monofilament suture in CPC and CHX mouthwashes was checked at different time intervals. It was observed that an increase in Elongation (%) was seen for monofilament suture under both the mouthwashes but the increase in Elongation (%) for monofilament suture under CPC mouthwash was more significant than monofilament suture under CHX mouthwash ($p<0.05$).

As shown in **Table 7**, **Table 8** the Elongation (%) of braded suture in CPC and CHX mouthwashes was checked at different time intervals. It was observed that an increase in Elongation (%) was seen for braded suture under both the mouthwashes but the increase in Elongation (%) for braded suture under CPC mouthwash was more significant than braded suture under CHX mouthwash ($p<0.05$).

As shown in **Figure 2**, the effect of Cetylpyridinium chloride (0.07%) (CPC) and Chlorhexidine gluconate (0.2%) (CHX) mouthwashes on the elongation (%) of monofilament and braded suture was examined at 1st day, 3rd day, 7th day and at 10th day. It was observed that an increase in elongation (%) was seen but a greater significant increase in elongation for monofilament suture under the effect of CPC and CHX mouthwash was seen compared to others.

Table 1: Tensile strength (N) of monofilament suture in CPC mouthwash at different time intervals

Suture	Mouthwash	At 1st day	At 3rd day	At 7th day	At 10th day	ANOVA (p Value)
Monofilament	CPC	21.8	20.17	18.36	15.84	0.04*

Table 2: Tensile strength (N) of monofilament suture in CHX mouthwash at different time intervals

Suture	Mouthwash	At 1st day	At 3rd day	At 7th day	At 10th day	ANOVA (p Value)
Monofilament	CHX	22.88	20.92	19.4	18.54	0.06^{NS}

Table 3: Tensile strength (N) of braded suture in CPC mouthwash at different time intervals

Suture	Mouthwash	At 1st day	At 3rd day	At 7th day	At 10th day	ANOVA (p Value)
Braded	CPC	23.9	22.50	20.14	18.56	0.04*

Table 4: Tensile strength (N) of braded suture in CHX mouthwash at different time intervals

Suture	Mouthwash	At 1st day	At 3rd day	At 7th day	At 10th day	ANOVA (p Value)
Braded	CHX	26.01	25.05	23.27	22.10	0.06^{NS}

Table 5: Elongation (%) of monofilament suture in CPC mouthwash at different time intervals

Suture	Mouthwash	At 1st day	At 3rd day	At 7th day	At 10th day	ANOVA (p Value)
Monofilament	CPC	14.85	16.10	19.42	20.98	0.04*

Table 6: Elongation (%) of monofilament suture in CHX mouthwash at different time intervals

Suture	Mouthwash	At 1st day	At 3rd day	At 7th day	At 10th day	ANOVA (p Value)
Monofilament	CHX	29.99	30.58	31.98	35.05	0.05^{NS}

Table 7: Elongation (%) of braded suture in CPC mouthwash at different time intervals

Suture	Mouthwash	At 1st day	At 3rd day	At 7th day	At 10th day	ANOVA (p Value)
Braded	CPC	10.78	11.67	12.56	14.53	0.04

Table 8: Elongation (%) of braded suture in CHX mouthwash at different time intervals

Suture	Mouthwash	At 1st day	At 3rd day	At 7th day	At 10th day	ANOVA (p Value)
Braded	CHX	10.56	11.40	11.92	13.01	0.06^{NS}

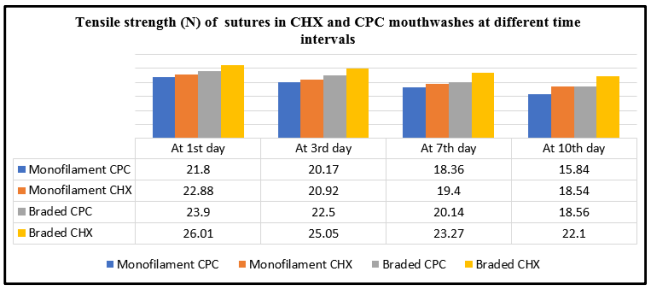

Figure 1: Tensile strength (N) of monofilament and braded suture in CHX and CPC mouthwashes at different time intervals

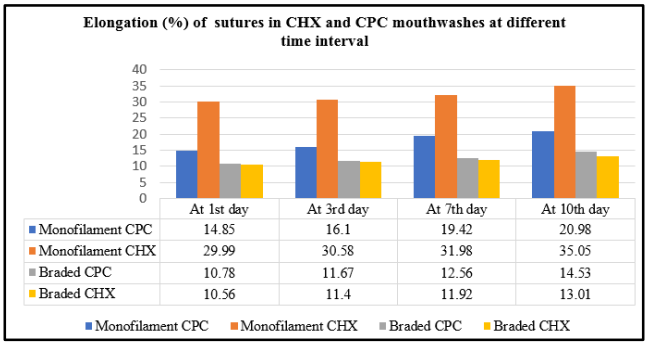

Figure 2: Elongation (%) of monofilament and braded suture in CHX and CPC mouthwashes at different time intervals

Figure 3: Universal Testing Machine (Computerized Software Based)

4. Discussion

The mechanical properties of suture materials are critical in ensuring proper wound closure and optimal healing, particularly in the oral cavity where sutures are routinely exposed to chemical agents such as mouthwashes. In this study, the effect of Cetylpyridinium chloride (CPC, 0.07%) and Chlorhexidine gluconate (CHX, 0.2%) on the tensile strength and elongation of monofilament and braided sutures over time was evaluated.

Results showed a progressive reduction in tensile strength of both monofilament and braided sutures in both mouthwash groups. However, the reduction was statistically significant ($p<0.05$) in sutures immersed in CPC, while it was not significant in the CHX group. These findings are in agreement with previous research indicating that certain antiseptics can degrade suture materials by altering their structural integrity over time.[11,12]

Specifically, monofilament sutures in CPC demonstrated a decrease in tensile strength from 21.8 N to 15.84 N, whereas in CHX, the decrease was from 22.88 N to 18.54 N. Similarly, braided sutures in CPC showed a significant reduction (23.9 N to 18.56 N), whereas those in CHX showed only a mild, statistically non-significant reduction (26.01 N to 22.10 N). The surfactant properties of CPC may facilitate deeper penetration into the polymer matrix of the suture material, weakening its fibers more aggressively than CHX.[13,14]

When examining elongation (%), all suture types showed a general increase over time, indicating material softening. Notably, this increase was significantly higher in CPC groups for both monofilament and braided sutures. For instance, monofilament sutures in CPC increased from 14.85% to 20.98% ($p=0.04$), whereas in CHX, the elongation rose more modestly (29.99% to 35.05%, $p=0.05$). A similar pattern was observed in braided sutures (CPC: 10.78% to 14.53% vs CHX: 10.56% to 13.01%).[15,16]

The results suggest that while both CHX and CPC affect the mechanical performance of sutures, CPC has a more detrimental impact, particularly on tensile strength and elasticity. These differences may be due to the cationic nature and molecular size of CPC, which may enhance fluid absorption and degradation of the suture material. In contrast, CHX has been shown in some studies to preserve or even slightly enhance tensile strength due to its protein-binding properties and mild effect on synthetic materials.[13,16]

Although periodontists frequently recommend antiseptic mouthwashes after surgeries, the impact of different antiseptic mouthwashes on sutures has not been well investigated. Previous clinical studies found no discernible difference in the strength loss of Vicryl and Vicryl Rapide sutures when exposed to chlorhexidine mouthwash, which contradicts the current study hypothesis that antiseptic commercial mouthwashes had an effect on the tensile strength of Vicryl and Monocryl suture materials.[17,18] This disparity might be explained by the short time the sutures

were exposed to chlorhexidine mouthwash in the clinical trials that were previously mentioned. Furthermore, that research examined lifetime rather than tensile strength.

Limitation of current study were as follows the study was conducted under laboratory conditions, which do not fully replicate the complex biological environment of the oral cavity (e.g., temperature fluctuations, saliva enzymes, food debris, and mechanical stress from mastication). Only two antiseptic mouthwashes (CPC 0.07% and CHX 0.2%) were evaluated. The findings may not apply to other concentrations, formulations, or brands. The effect of bacterial enzymes or microbial colonization on suture degradation was not evaluated, although this is a critical factor in vivo. Furthermore, invivo study research are needed.

5. Conclusion

This study concludes that both CPC and CHX mouthwashes influence the tensile strength and elongation properties of commonly used suture materials, with CPC having a more pronounced degrading effect, particularly on monofilament sutures. The structural weakening observed could compromise wound stability in clinical settings if not properly considered.

Based on the results, Chlorhexidine gluconate (CHX) may be a more suitable postoperative mouthwash in procedures requiring prolonged suture retention. Nonetheless, clinicians should exercise caution and select mouthwashes considering both antimicrobial efficacy and compatibility with suture materials. Further in vivo studies are needed to confirm these findings under real-world oral conditions, including dynamic forces and salivary interactions.

6. Conflict of Interest

The authors declare that they have no conflicts of interest

7. Source of Funding

None.

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