RESEARCH PAPER

THE EFFECT OF CHLORHEXIDINE AND HERBAL MOUTHWASH ON THE TENSILE STRENGTH OF SURGICAL SUTURES: AN IN VITRO STUDY

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Abstract

Background: Sutures are essential for maintaining wound-edge approximation during the early stages of oral and periodontal wound healing. Their mechanical performance may be influenced by material composition, filament architecture, knot configuration, and exposure to saliva or postoperative mouthrinses. Chlorhexidine is commonly used to support plaque control after oral surgery, while herbal rinses are increasingly available; however, their effects on suture mechanics may differ between formulations and materials.

Aim: To compare the reported tensile-strength values of 4-0 braided silk (Mersilk) and monofilament polypropylene (Prolene) following immersion in artificial saliva, 0.2% chlorhexidine, and a herbal mouthwash over 14 days.

Materials and methods: This in-vitro study record describes immersion of suture specimens in three media at 37°C, with testing at days 1, 3, 7, 10, and 14. The immersion medium was replenished every 48 hours. Tensile testing was described as being performed using a universal testing machine. Numerical results are retained from the supplied manuscript record; the exact sample allocation, test units, and some statistical entries require confirmation against the original laboratory records.

Results: Reported mean values declined over time for both materials in all media. At day 14, Mersilk values were 11.7 in artificial saliva, 10.0 in chlorhexidine, and 10.85 in herbal mouthwash. Corresponding Prolene values were 15.6, 14.8, and 15.45. Prolene showed higher reported mean values than Mersilk at all recorded time points. Between-medium comparisons were reported as significant on days 10 and 14, although the statistical output requires verification.

Conclusion: Within the limitations of the available dataset, tensile-strength values decreased over the observation period, and the lowest day-14 values were reported after chlorhexidine exposure. These laboratory observations cannot establish clinical suture failure or justify changing postoperative rinse recommendations. Before submission, the raw data, units, specimen allocation, and statistical output should be reconciled.

Keywords: surgical sutures; tensile strength; chlorhexidine; herbal mouthwash; silk; polypropylene; artificial saliva; in-vitro study

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Introduction

Suturing is a central component of oral and periodontal surgery. It brings wound margins into close apposition, supports flap stability, helps protect the underlying surgical site, and contributes to predictable early healing. The quality of closure is influenced not only by surgical technique but also by the properties of the selected suture, including tensile strength, elasticity, knot security, handling characteristics, tissue response, and susceptibility to microbial colonisation. A material that maintains adequate strength during the initial healing interval can help preserve wound approximation; nevertheless, mechanical strength alone does not determine clinical success.[1],[2]

Suture materials differ in their chemical composition, construction, surface characteristics, and degradation behaviour. Silk is a natural, braided, non-resorbable material widely valued for flexibility and handling. Its multifilament structure can facilitate knot tying but also creates interstices in which oral debris and microorganisms may accumulate. Polypropylene, marketed as Prolene, is a synthetic monofilament

material with a relatively smooth surface and limited capillarity. These differences may influence handling, bacterial retention, tissue response, and mechanical behaviour, but comparisons must account for gauge, diameter, knot type, and testing conditions.[1],[3],[4]

The oral cavity presents a challenging environment for wound closure materials. Saliva, changes in pH, food debris, mastication, tongue movement, temperature variation, and microbial biofilm expose sutures to repeated chemical and physical influences. Laboratory immersion models are useful for isolating selected factors, but they do not reproduce the full complexity of the postoperative mouth. Consequently, results from in-vitro experiments should be interpreted as material-performance observations rather than direct predictors of wound dehiscence, infection, or healing outcomes.[1],[5]

Chlorhexidine gluconate is commonly prescribed as an antimicrobial rinse in selected postoperative situations. Its antimicrobial activity makes it clinically useful, yet the chemical environment created by a mouthrinse may interact differently with different suture polymers. Previous in-vitro investigations have reported material-specific changes rather than a single uniform effect. Alsarhan and colleagues examined absorbable sutures exposed to chlorhexidine and an essential-oil rinse and reported that the response varied by material and exposure duration.[6] More recent work has also evaluated chlorhexidine exposure in silk and other suture types, with findings that depend on the material, experimental protocol, and measurement schedule.[7],[8]

Herbal rinses should not be treated as one standardised category. Products differ in active ingredients, concentrations, pH, solvents, and preparation methods. A study investigating myrrh and frankincense solutions, for example, reported that tensile responses differed by suture type and solution, and that myrrh produced the lowest values under that particular protocol.[9] These findings support the need to identify the exact formulation when interpreting results and avoid generalising the behaviour of one herbal product to all herbal mouthwashes.

Reviews of oral-surgery suture materials have highlighted variability in tensile properties, bacterial adherence, and tissue response.[1],[3] Recent reviews of suture colonisation also suggest that monofilament materials such as polypropylene may retain less bacterial plaque than braided silk in some clinical contexts.[10] However, reduced microbial adherence and tensile strength are separate outcomes: one should not be used as a substitute for the other.

Against this background, the present study compares reported tensile-strength values for 4-0 Mersilk and Prolene sutures immersed in artificial saliva, 0.2% chlorhexidine, or a herbal mouthwash for up to 14 days. The principal objective is to describe time-related changes and compare the reported values across media and materials. The interpretation is deliberately limited by the incomplete technical and statistical details available in the supplied study record.

Aim and objectives

Aim: To evaluate the effect of artificial saliva, 0.2% chlorhexidine, and a herbal mouthwash on the reported tensile strength of non-resorbable silk and polypropylene sutures over 14 days.

Objectives: (1) to describe the time-related pattern in each immersion medium; (2) to compare reported values between the two suture materials; and (3) to identify whether the supplied statistical summaries indicate differences between immersion media.

Materials and Methods

Study design

The supplied study record describes an in-vitro laboratory comparison of two non-resorbable suture materials across three immersion media and five assessment points (days 1, 3, 7, 10, and 14). This manuscript retains the design details documented in the source and does not infer missing allocation information.

Suture materials and immersion media

The materials were Mersilk 4-0, a braided natural silk suture, and Prolene 4-0, a monofilament polypropylene suture. Artificial saliva served as the control medium; the test media were 0.2% chlorhexidine mouthwash and a herbal mouthwash. The source record gives pH values of 8.6 for artificial saliva and 8.4 for chlorhexidine. The herbal product's complete ingredient list, concentration, and pH were not documented in the extracted methods and should be added from the product label or laboratory records.

Specimen preparation and immersion protocol

According to the supplied synopsis, suture specimens were prepared around custom-made rubber rods measuring 4 mm in diameter and secured using a surgeon's knot. Specimens were placed in labelled containers corresponding to the assigned material, medium, and observation period. The containers were maintained at 37°C to approximate oral temperature. Immersion solutions were replenished every 48 hours, and specimens were rinsed with distilled water before tensile testing. The original record mentions a total sample size of 30, but it does not unambiguously document the number of independent specimens in each material-by-medium-by-time-point group. The exact allocation must be verified before publication.

Tensile-strength testing

The source states that tensile testing was performed with a universal testing machine after the specimens were removed from the rods. For reproducibility, the final manuscript should specify the machine manufacturer and model, load-cell capacity, calibration status, gauge length, crosshead speed, gripping arrangement, knot configuration, endpoint definition, and measurement unit. These details are not available in the supplied synopsis and have therefore not been invented.

Outcome measures and statistical analysis

The primary outcome was the reported tensile-strength value at each time point. The source reports means and standard deviations, one-way analysis of variance (ANOVA) for comparisons among immersion media at

each time point, and unpaired t-tests for comparisons between Mersilk and Prolene within each medium. Statistical significance was set at $p < 0.05$. Because raw observations, confirmed group sizes, and full statistical output were not supplied, the analyses could not be independently reproduced. The original statistical entries should be checked by the study statistician, including apparent inconsistencies in the Mersilk day-7 ANOVA entry and the Prolene chlorhexidine day-7 standard deviation.

Study workflow

Selection of 4-0 Mersilk and 4-0 Prolene suture materials

↓

Preparation of specimens using 4-mm rubber rods and a surgeon's knot

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Allocation to artificial saliva, 0.2% chlorhexidine, or herbal mouthwash

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Storage at 37°C; replenishment of immersion media every 48 hours

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Assessment at days 1, 3, 7, 10, and 14

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Rinsing with distilled water and tensile testing using a universal testing machine

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Recording of reported values and statistical comparison (subject to verification)

Figure 1. Study workflow reconstructed from the supplied methods synopsis. Confirm the specimen allocation and testing parameters against the laboratory record before submission.

Results

The reported mean tensile-strength values decreased over the 14-day observation period for both suture materials in all three media. Prolene had higher mean values than Mersilk at every reported time point. Numerical values below are reproduced from the supplied study record; they have not been silently corrected or recalculated.

Table 1. Reported tensile-strength values for Mersilk in different media

Medium	Day 1 Mean (SD)	Day 3 Mean (SD)	Day 7 Mean (SD)	Day 10 Mean (SD)	Day 14 Mean (SD)
Artificial saliva	13.9 (0.14)	13.65 (0.07)	13.1 (0.1)	12.55 (0.07)	11.7 (0.14)
0.2% CHX	13.75 (0.07)	13.2 (0.14)	11.3 (0.14)	11.3 (0.14)	10.0 (0.14)
Herbal mouthwash	13.75 (0.21)	13.4 (0.14)	12.1 (0.0)	12.1 (0.0)	10.85 (0.35)
Reported p-value	0.586 (NS)	0.077 (NS)	0.190 (NS; F entry needs verification)	0.002*	0.013*

Table 2. Reported tensile-strength values for Prolene in different media

Medium	Day 1 Mean (SD)	Day 3 Mean (SD)	Day 7 Mean (SD)	Day 10 Mean (SD)	Day 14 Mean (SD)
Artificial saliva	17.3 (0.14)	17.3 (0.14)	16.65 (0.21)	16.2 (0.14)	15.6 (0.14)
0.2% CHX	17.25 (0.07)	16.8 (0.14)	16.25 (7.28; verify)	15.6 (0.14)	14.8 (0.0)
Herbal mouthwash	17.25 (0.21)	16.95 (0.21)	16.75 (0.07)	16.05 (0.21)	15.45 (0.07)
Reported p-value	0.933 (NS)	0.121 (NS)	0.128 (NS)	0.046*	0.006*

Table 3. Between-material comparison (reported values)

Medium	Time	Mersilk Mean (SD)	Prolene Mean (SD)	Reported p-value
Artificial saliva	Day 1	13.9 (0.14)	17.3 (0.14)	0.048*
Artificial saliva	Day 3	13.65 (0.07)	17.3 (0.14)	0.031*
Artificial saliva	Day 7	13.1 (0.1)	16.65 (0.21)	0.012*
Artificial saliva	Day 10	12.55 (0.07)	16.2 (0.14)	0.006*
Artificial saliva	Day 14	11.7 (0.14)	15.6 (0.14)	0.001*
0.2% CHX	Day 1	13.75 (0.07)	17.25 (0.07)	0.041*
0.2% CHX	Day 3	13.2 (0.14)	16.8 (0.14)	0.008*
0.2% CHX	Day 7	11.3 (0.14)	16.25 (7.28; verify)	0.002*
0.2% CHX	Day 10	11.3 (0.14)	15.6 (0.14)	0.005*
0.2% CHX	Day 14	10.0 (0.14)	14.8 (0.0)	0.008*

Herbal mouthwash	Day 1	13.75 (0.21)	17.25 (0.21)	0.005*
Herbal mouthwash	Day 3	13.4 (0.14)	16.95 (0.21)	0.009*
Herbal mouthwash	Day 7	12.1 (0.0)	16.75 (0.07)	0.021*
Herbal mouthwash	Day 10	12.1 (0.0)	16.05 (0.21)	0.015*
Herbal mouthwash	Day 14	10.85 (0.35)	15.45 (0.07)	0.01*

NS, not statistically significant; *reported $p < 0.05$. Units were not specified in the supplied record. All reported means, standard deviations, and p-values require confirmation against the original data and statistical output.

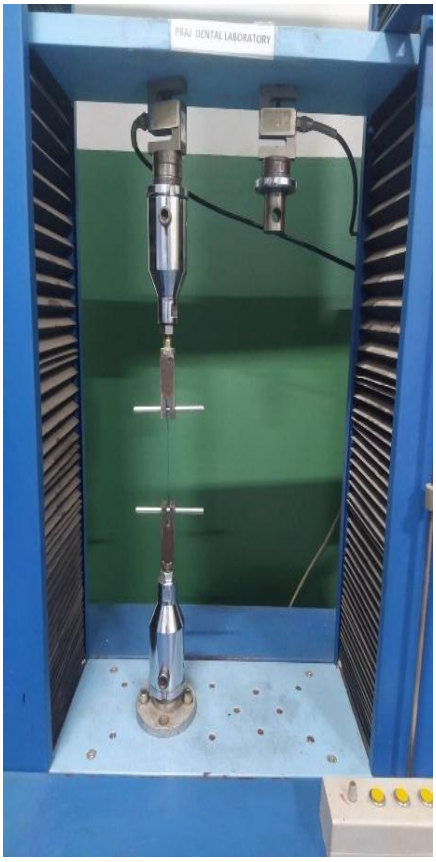
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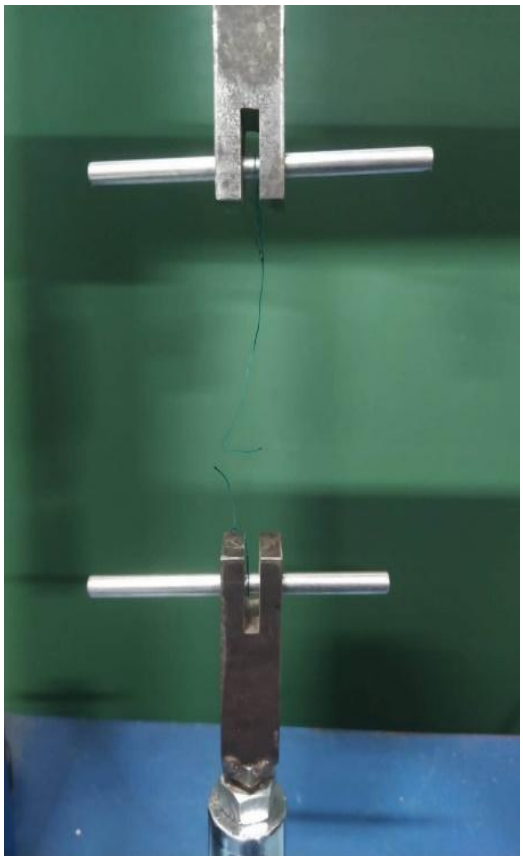
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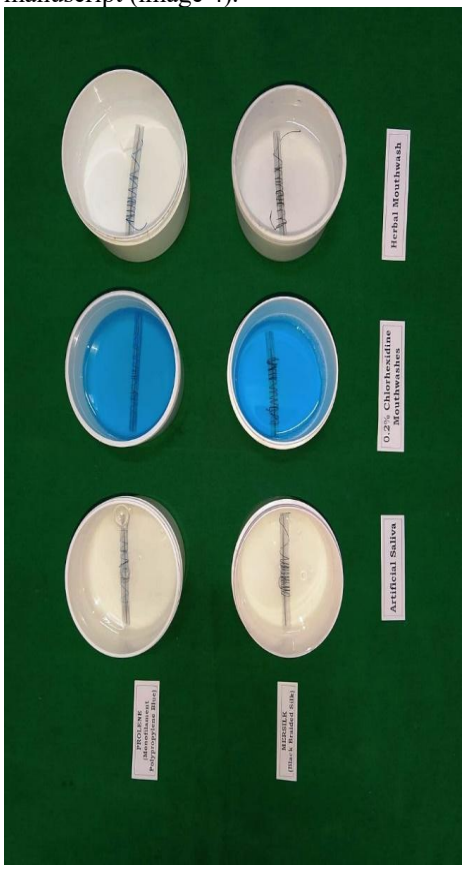
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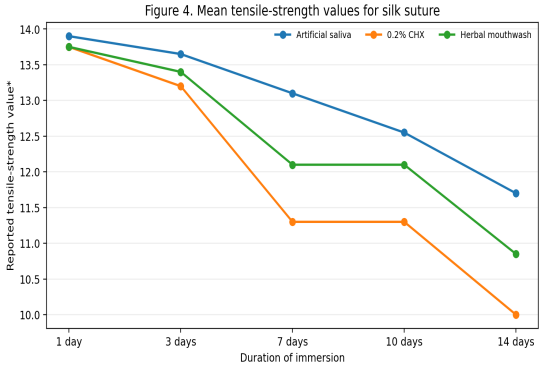
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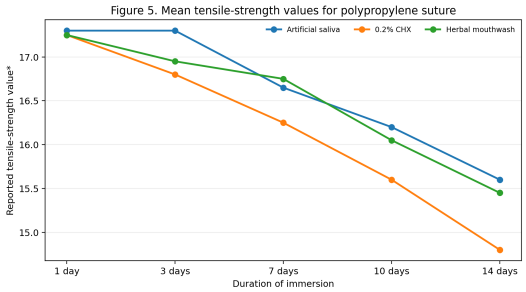
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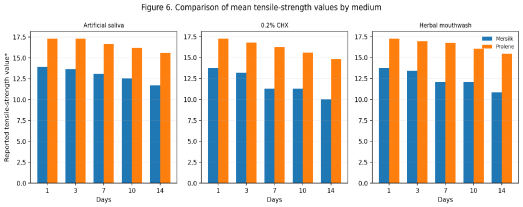
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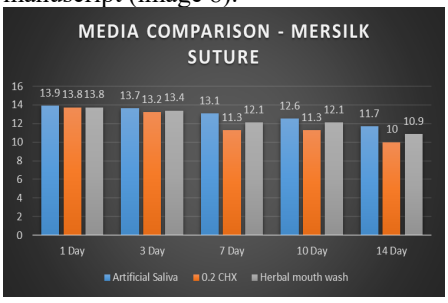
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Discussion

The principal pattern in the supplied dataset is a reduction in reported tensile-strength values over time in both suture materials and all three immersion media. At day 14, artificial saliva was associated with the highest reported value for both Mersilk (11.7) and Prolene (15.6), whereas chlorhexidine was associated with the lowest values (10.0 and 14.8, respectively). The herbal mouthwash values were intermediate. These observations describe the dataset; they do not, by

themselves, demonstrate that a particular rinse causes clinically important weakening.

The higher reported values for Prolene than Mersilk at every time point may reflect differences in polymer chemistry and filament architecture. Silk is braided and has favourable handling characteristics, while polypropylene is a synthetic monofilament. A systematic review of suture materials used in oral surgery reported differences across materials in physical properties, tissue response, and bacterial adherence, and noted that non-resorbable monofilament synthetic materials generally showed less tissue response and microbial accumulation than multifilament alternatives.[1,3,10] Nevertheless, the present numerical comparison should not be interpreted as a universal ranking of all silk and polypropylene products: diameter, knot tying, test speed, grip arrangement, and endpoint definition can materially affect measured loads.

The lower day-14 values in chlorhexidine are broadly compatible with some experimental reports of time- and material-dependent changes after mouthrinse exposure. Aktı and colleagues tested silk and absorbable multifilament PGLA in artificial saliva and chlorhexidine, with and without thermal cycling, and reported decreases over the observation period, particularly by day 14.[7] In a separate study, Alsarhan and colleagues found that responses to chlorhexidine and an essential-oil mouthwash differed by suture type and time point; some Vicryl groups showed increased strength while Monocryl 5-0 showed a significant decrease with the essential-oil rinse.[6] This variation is important: results from one polymer or formulation should not be extrapolated to another.

Other published results are not identical to the present pattern. Ching and colleagues evaluated several absorbable and non-absorbable sutures after immersion in 0.12% chlorhexidine and artificial saliva. Their results indicated that polypropylene maintained tensile strength relatively well, while silk showed a different time course; in that study, some silk and polyglactin results favoured the chlorhexidine condition over artificial saliva at selected time points.[8] Such differences from the present reported results may arise from the chlorhexidine concentration, suture manufacturer and structure, specimen count, knot technique, immersion protocol, machine settings, and statistical approach. The correct conclusion is not that chlorhexidine always weakens sutures, but that the effect may depend on the tested material and experimental conditions.

Evidence concerning herbal solutions is similarly formulation-specific. Alaqeely and colleagues evaluated artificial saliva, chlorhexidine, myrrh, and frankincense solutions with polypropylene and two absorbable suture types. Their study reported that the myrrh condition produced the lowest tensile-strength values under their protocol and that responses differed by material.[9] A commercial herbal mouthwash with a different composition cannot be assumed to behave like a home-prepared myrrh or frankincense solution. The present study's herbal product should therefore be identified by trade name, complete ingredient list, concentration where available, pH, and batch information.

Mechanical performance is only one aspect of intraoral suture selection. Sutures may support bacterial adherence and biofilm formation, and this may vary with the surface structure of the material. A systematic review of bacterial plaque on sutures used after third-molar surgery reported that silk often carried higher bacterial loads, whereas polypropylene and some antibacterial sutures showed lower colonisation.[10] These microbiological observations are clinically relevant but do not prove that one material is optimal for every periodontal procedure. Suture choice must also consider wound tension, required duration of support, tissue response, operator preference, patient factors, and whether removal is planned.

Several limitations restrict interpretation. First, this is an in-vitro immersion model and cannot reproduce salivary flow, enzymes, dynamic pH, temperature cycling, chewing forces, bacterial biofilm, tissue incorporation, or patient adherence to postoperative instructions. Second, the exact number of specimens in each experimental cell is unclear despite a total sample-size statement in the source. Third, the measurement unit and several machine parameters are missing, which limits reproducibility and makes it difficult to compare numerical values with published studies that report maximum load in newtons. Fourth, some standard deviations and statistical entries appear internally questionable and require verification. Fifth, no usable results for the stated breakage-mode outcome were supplied. These issues should be resolved before the work is submitted to a journal.

Future investigations should use a clearly reported factorial design with a justified sample size, a prespecified primary outcome, and sufficient independent specimens per material-medium-time combination. The full product details and pH of each solution should be recorded. Tensile testing should report the machine, load cell, crosshead speed, gauge length, knot type, units, calibration, and failure mode. Raw data should be retained and analysed using a model appropriate for the design, with correction for multiple comparisons where needed. Inclusion of clinically relevant cycling or biofilm conditions may improve translational relevance, although clinical studies would still be required to establish effects on wound healing.

Taken together, the current results provide a preliminary description of how the two tested suture materials behaved under the documented laboratory conditions. They support further standardised testing rather than a clinical recommendation to avoid or prefer a particular mouthrinse.

Limitations

The study is limited by its in-vitro design, unclear specimen allocation, absent raw data, unspecified measurement units, incomplete testing parameters, and statistical entries requiring verification. The herbal formulation is incompletely characterised, and the source does not provide results for breakage mode. These gaps

should be addressed from the laboratory record before submission.

Conclusion

Within the limitations of the supplied dataset, reported tensile-strength values decreased over 14 days for Mersilk and Prolene in artificial saliva, 0.2% chlorhexidine, and herbal mouthwash. Prolene had higher reported mean values than Mersilk at all time points. On day 14, the lowest reported means for both materials occurred in chlorhexidine. Because important methodological and statistical details remain unverified, these findings should be treated as preliminary laboratory observations and not as direct evidence of clinical wound failure or as a basis for changing postoperative care.

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