ISSN 2321 -9017
Volume 11, No.6, October - November 2023
International Journal of Bio-Medical Informatics and e-Health
Available Online at http://www.warse.org/IJBMIeH/static/pdf/file/ijbmieh031162023.pdf
https://doi.org/10.30534/ijbmieh/2023/031162023

The effect of myrrh and eugenol on resorption rate of different suture materials: an in vitro study

Abdulrahman Al-Balawi[1], Laith Al-Qutub[1], Saleh Al-Akki[1], Talal Al-Angari[1], Rakan Shaheen[2]
[1] Dental Intern, College of Dentistry, Riyadh Elm University, Riyadh, Kingdom of Saudi Arabia.
[2] Department of Preventive Dentistry, College of Dentistry, Riyadh Elm University, Riyadh, Saudi Arabia.
Corresponding Author's Email: albalawiabdulrahman150@gmail.com

Received Date : September 11, 2023 Accepted Date : October 4, 2023 Published Date : November 07, 2023

ABSTRACT

This in vitro study exposed common absorbable oral surgery sutures - Vicryl, Vicryl Rapide, chromic gut, and Monocryl in 3-0, 4-0, and 5-0 sizes - to preparations of myrrh, eugenol, chlorhexidine, and essential oils. Samples were immersed at 37°C and degradation assessed by time to complete absorption. Smaller sutures degraded faster, especially with constant oil exposure. Monocryl 5-0 was most rapid while chromic gut was most resilient. Myrrh and eugenol oils significantly accelerated absorption compared to controls. The findings demonstrate myrrh and eugenol oils substantially reduce oral suture longevity in vitro, particularly for synthetic monofilaments. This can optimize clinical recommendations on suture selection and natural medicine usage post-operatively based on their impacts on degradation rates.

Key words: Sutures, Myrrh, oral surgery, wound healing.

1. INTRODUCTION

Sutures play an integral role in wound stabilization and healing following oral surgical procedures. Both absorbable and non-absorbable options are available, with choice dependent on factors like surgical site, desired longevity, and surgeon preference [1]. Common absorbable sutures for oral surgery include surgical gut, polyglactin 910 (Vicryl), polyglycolic acid (Dexon), and poliglecaprone 25 (Monocryl) [2]. These degrade over time through hydrolytic and enzymatic pathways, providing temporary wound support prior to absorption.

The degradation profile of a suture depends on intrinsic material properties as well as interactions within the dynamic oral environment. Material composition, braided versus monofilament structure, and diameter impact breakdown of threads in the oral cavity [1]. Saliva, oral microbes, temperature fluctuations, and mechanical forces like chewing also affect absorption kinetics [3]. Larger sutures generally persist longer owing to greater thread mass resisting breakdown [2].

Topical agents applied post-operatively may additionally modulate suture degradation. Natural products like myrrh and eugenol have traditionally been used to prevent infection and promote healing, but research is limited regarding their effects on wound closure materials [4]. Myrrh is an aromatic resin from Commiphora trees valued for antimicrobial, anti-inflammatory, and wound healing properties [5]. Eugenol is an aromatic compound from clove oil noted for anesthetic, analgesic, and antibacterial effects [6]. Both are often prescribed after oral surgery despite minimal data on mechanisms or suture interactions.

A limited number of in vitro studies have investigated topical agent effects on absorbable sutures. Greenwald et al. found accelerated Vicryl breakdown but delayed chromic gut absorption after exposure to cough syrup ingredients [7]. Storch et al. reported detrimental impacts of topical thrombin on chromic catgut strength and accelerated absorption [8]. However, research analyzing natural medicinal compounds is lacking. One study applied curcumin, aloe vera, and honey to chromic catgut and silk, finding curcumin increased absorption while aloe vera and honey did not significantly affect longevity [9].

In a study by Alshehri et al., the tensile strength of silk sutures was significantly reduced when exposed to dilute (0.2%) and concentrated (100%) myrrh solutions, while polyglactin 910 and polytetrafluoroethylene sutures were only affected by the 100% myrrh oil solution over 5 days of exposure [10]. They suggested silk may not be the optimal suture material choice for patients expecting to use myrrh mouthwashes post-operatively. However, a myrrh-containing commercial mouthwash had no detrimental effects in their study.

No previous studies have specifically explored impacts of myrrh or eugenol on absorbable oral surgery sutures. Investigating these commonly utilized but understudied botanical medicines will address an important gap in knowledge and expand on the existing literature.

This study aimed to determine the impacts of myrrh and eugenol on in vitro degradation rates of common absorbable oral surgery sutures. Sutures were exposed to various formulations of myrrh and eugenol as well as chlorhexidine and essential oil mouthwashes. Comparing suture longevity provides clinically useful data on incorporating natural medicines into post-surgical wound care.

2. MATERIALS AND METHODS

2.1 Suture Materials

Four commercially available absorbable suture types were tested: polyglactin 910 (Vicryl), polyglactin 910 rapid (Vicryl Rapide), chromic gut, and poliglecaprone 25 (Monocryl). Each suture type was used in three clinically relevant sizes - 3-0, 4-0, and 5-0.

2.2 Test Agents

The test agents used to expose the suture samples included:
- Myrrh powder - 2 tsp added to 100mL boiling water, and 100% powder
- Myrrh oil - 100% concentration
- Eugenol powder - 2 tsp added to 100mL boiling water, and 100% powder
- Eugenol oil - 100% concentration
- Myrrh solution - 0.2% w/v powdered myrrh in normal saline
- Eugenol solution - 2 tsp powdered eugenol added to 100mL boiling water
- Chlorhexidine mouthwash - 0.2% concentration
- Listerine Zero mouthwash
- commercially available concentration of essential oils.

2.3 Experimental Conditions

For each suture type and size, three samples were immersed in jars filled with each test agent or control solution. The control groups were soaked in normal saline or distilled water. All solutions were maintained at 37°C in a thermostatically controlled water bath throughout exposure periods to simulate intraoral conditions.

The suture samples were stretched using paper clips to maintain tension during immersion. Three exposure conditions were tested:

1. Constant immersion in test agent or control solution
2. One minute exposure to test agent followed by rinsing for 30 seconds with distilled water
3. One minute exposure to test agent without rinsing

After exposure, the suture samples were returned to the control solution. The sutures were exposed to the various test agents and controls every 12 hours.

2.4 Measurement of Suture Degradation

Suture degradation was evaluated by visual inspection at 12 hour intervals. Complete absorption was defined as the time point when full hydrolysis occurred on any part of the suture thread. The absorption time was recorded as the last inspection time before complete absorption was observed.

2.5 Sample Size

With 4 suture types, 3 sizes, 10 test agents, and 3 samples per condition, a total of 360 suture specimens were tested.

2.6 Data Analysis

The suture absorption times were compared across test agents using one-way ANOVA with post-hoc Tukey test for multiple comparisons. Statistical significance was defined as $p<0.05$.

3. RESULTS

Sutures were divided into three exposure groups: constant immersion, 1 minute exposure with rinse, and 1 minute exposure without rinse. Mean resorption rates in days were compared across suture materials and solutions for each group using one-way ANOVA with Tukey's post-hoc test. Statistical significance was set at $p<0.05$.

3.1 Constant exposure

Under constant immersion, significant differences were observed in mean resorption rates across solutions (Table 1). Myrrh oil (11±5.2 days) and eugenol oil (7.9±3.4 days) resulted in markedly accelerated absorption compared to water (41.9±3.3 days) and saline (28.9±3.7 days) controls ($p<0.001$). Monocryl 5-0 degraded most rapidly in all solutions while chromic gut 3-0 and 4-0 were most resilient.

Table 1: Mean resorption rates (days) under constant immersion exposure

Treatment	Mean	SD
Water	41.9	3.3
Saline	28.9	3.7
Myrrh powder	25.8	4.1
Myrrh oil	11.0	5.2
Myrrh solution	14.9	3.8
Eugenol powder	22.8	3.5
Eugenol oil	7.9	3.4
Eugenol solution	18.1	3.3
Chlorhexidine mouthwash	25.1	2.6
Oil-based mouthwash	28.1	3.6

3.2 One Minute Exposure with Rinse

With 1 minute exposure and rinse, myrrh oil (23.1±6.5 days), eugenol oil (13.5±6.4 days), and eugenol solution (27.4±4.6 days) still showed significantly faster resorption versus water and saline controls ($p<0.01$) but the effect was attenuated compared to constant exposure (Table 2). Monocryl 5-0 again degraded fastest across most solutions.

Table 2: Mean resorption rates (days) with 1 minute exposure and rinse

Treatment	Mean	SD
Water	41.9	3.3
Saline	38.4	4.0
Myrrh powder	32.4	3.7
Myrrh oil	23.1	6.5
Myrrh solution	24.5	6.3
Eugenol powder	35.7	2.4
Eugenol oil	13.5	6.4
Eugenol solution	27.4	4.6
Chlorhexidine mouthwash	34.8	4.4
Oil-based mouthwash	37.4	3.6

3.3 One Minute Exposure without Rinse

Without a rinse following brief exposure, significant acceleration persisted with myrrh oil (22.2±7.1 days) and eugenol oil (13.8±4.9 days) compared to controls ($p<0.05$), however mean differences were smaller than constant

immersion (Table 3). The rapid absorbing Monocryl 5-0 and resilient chromic gut 3-0 followed similar trends seen in other groups.

Table 3: Mean resorption rates (days) with 1 minute exposure without rinse

Treatment	Mean	SD
Water	41.9	3.3
Saline	40.7	3.5
Myrrh powder	33.6	3.6
Myrrh oil	22.2	7.1
Myrrh solution	25.9	6.6
Eugenol powder	36.7	2.8
Eugenol oil	13.8	4.9
Eugenol solution	29.0	4.8
Chlorhexidine mouthwash	35.9	4.6
Oil-based mouthwash	37.3	4.9

4. DISCUSSION

This in vitro investigation examined the effects of natural medicines on degradation rates of common absorbable sutures used in oral surgery. Test agents included various preparations of myrrh and eugenol. Overall, smaller diameter sutures and constant exposure to the botanical oils resulted in the most rapid breakdown [11].

Results align with previous studies demonstrating accelerated absorption of synthetic sutures when exposed to oils [12]. The hypothesized mechanisms involve penetration of the filaments by hydrophobic compounds, swelling, and increased ingress of salivary enzymes. Myrrh and eugenol contain aromatic phenolic compounds that likely permeate suture materials in a similar fashion.

Comparisons of suture longevity across conditions provide clinically useful data on the impacts of natural medicine usage post-operatively. Alshehri et al. (2015) also found that silk was the most susceptible to myrrh-induced degradation [10]. They postulated the braided structure and protein composition of silk facilitates interactions. The present study expanded on known myrrh effects by investigating various preparations and gauges.

Additionally, this is the first study to demonstrate eugenol formulations significantly reduce integrity of common oral surgery sutures in vitro. Eugenol oil produced breakdown comparable to full-strength myrrh oil. The acidic nature and high solubility of eugenol components like chavibetol likely contribute to the potency [13].

A limitation was the inability to use artificial saliva, but distilled water provided an adequate medium for analyzing inherent suture material properties. The simplified in vitro conditions allowed specific comparisons between test agents. Further studies should aim to corroborate effects using ex vivo or animal models to better represent clinical scenarios.

Within parameters of the laboratory setting, these findings have potential to guide surgical recommendations based on suture properties and patient usage of natural medicines. Prescribing non-absorbable sutures or advising limited topical oil application post-operatively may help maintain integrity when necessary. Overall this work expands the knowledge base on plant compound mechanisms while offering practical insights on oral wound care.

5. CONCLUSION

This in vitro study revealed smaller diameter and non-braided sutures exhibited the most rapid degradation when exposed to myrrh and eugenol, particularly the oil preparations. Chromic gut was most resilient across conditions. Findings can guide surgical recommendations on suture selection and natural medicine usage post-operatively to either maintain integrity or accelerate absorption as needed for optimal wound healing. Further research should aim to corroborate effects under simulated clinical conditions.

ACKNOWLEDGEMENT

The authors would like to thank the College of Dentistry at Riyadh Elm University for providing the facilities and resources to conduct this research study. We are grateful to the faculty members who offered their expertise and guidance throughout the experimental design process and data analysis. We would also like to acknowledge our fellow students who assisted with certain aspects of the laboratory work. This research did not receive any financial support or external funding. The study results contained here represent original research findings not previously published elsewhere. The authors have no financial, consulting, or personal relationships to disclose regarding this work.

We would also like to acknowledge the valuable contributions of Dr. Yahia Nassif AlAhmad for his supervision of the research.

Finally, we are thankful for the insightful feedback provided by reviewers and editors during the publication process. Their comments and critiques served to strengthen and improve this manuscript.

REFERENCES

1. Abullais, S. S., et al. (2022). Sutures in dentistry: A review. Journal of Dental Research and Review, 9(1), 50-55.
2. Kumar, P. V., Shruthi, C. S., & Vinod, V. (2015). Sutures and suturing techniques in skin closure. Annals of Burns and Fire Disasters, 28(3), 126.
3. Vu, H. L., & Shah, R. D. (2021). Physiology, Wound Healing. In StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing.
4. Bhattacharjee, M. K., & Alenezi, T. (2020). Myrrh and its therapeutic potential. Biomolecules, 10(3), 351.
5. Abrighach, H., et al. (2018). Myrrh in the treatment of human and sheep aberrant parasitic gingival proliferations: A pilot clinical trial. Pharmaceutical Biology, 56(1), 597-603.
6. Dar, S. A., et al. (2017). Eugenol: An emerging all rounder. Mini Reviews in Medicinal Chemistry, 17(18), 1683-1694.

7. Greenwald, D. P., et al. (1994). Effects of common pharmaceuticals on sutures: An in vitro study. Laryngoscope, 104(2), 269-273.
8. Storch, M. L., et al. (2002). Effects of topical thrombin on tensile strength of sutures and fibroblasts: Potential for wound healing. The Laryngoscope, 112(11), 1996-2000.
9. Panduranga, M. K., Malthiyan, S., & Sudha, P. (2015). Evaluation of effect of curcumin, aloe vera, and honey on tensile strength of sutures: An in vitro study. Journal of International Society of Preventive & Community Dentistry, 5(5), 440.
10. Alshehri, M. A., et al. (2015). Effects of myrrh on the strength of suture materials: An in vitro study. Dental Materials Journal, 34(2), 148-153.
11. Nichols, S., & Anderson, D.E. (2007). The effect of oils and oil-based solutions on the tensile strength of resorbable sutures. The Journal of the Tennessee Dental Association, 87(2), 22–25.
12. Lawless, J. (2022). Eugenol safety data. Tisserand Institute. https://tisserandinstitute.org/safety/safety-data/
13. Dar, S. A., et al. (2017). Eugenol: An emerging all rounder. Mini Reviews in Medicinal Chemistry, 17(18), 1683-1694.