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MAIN ARTICLE

The effects of different suture materials in the nasal cavity

A DURMAZ[1], A KILIC[2], R GUMRAL[2], U YILDIZOGLU[1], B POLAT[1]

Departments of [1]Otolaryngology, and [2]Medical Microbiology, Gülhane Military Medical Academy, Ankara, Turkey

Abstract

Objective: To investigate the effects of different suture materials in the nasal cavity on encrustation and micro-organism colonisation.

Methods: Four different suture materials were used to suture the nasal septum. The effects of suture materials on intranasal encrustation were evaluated with anterior rhinoscopy. The sutures were removed and evaluated in terms of micro-organism colonisation on the 7th and 21st post-operative days.

Results: Monofilament sutures were found to cause less encrustation and micro-organism colonisation. There was increased late-stage encrustation if an absorbable monofilament suture remained in place for a long time. The removal of a non-absorbable monofilament suture in the early or late post-operative period made no difference in terms of micro-organism growth on the suture.

Conclusion: The material and physical characteristics of sutures placed inside the nose may indirectly affect the healing process. It may be more appropriate to use different materials depending on the length of time the suture is to remain in place.

Key words: Sutures; Nasal Cavity; Wound Healing

Introduction

Various types of tampons and sutures are used to ensure proper wound healing and prevent complications after endonasal procedures.[1] Intranasal sutures are used to close incisions, approximate mucosal flaps, and stabilise cartilage and bones.[2,3] The anatomical features of the nasal cavity make the manipulation of tools in this narrow space difficult. Various techniques have therefore been developed to apply sutures to the nasal septum.[2]

The suture materials used vary according to the technique. Absorbable or non-absorbable materials can be used. Absorbable monofilament and rapid absorbable multifilament synthetic sutures are typically preferred because of the ease of use inside the nose. These absorbable sutures are expected to be resorbed and fall out by themselves in the post-operative period, without being manually removed.[4] Non-absorbable materials are preferred where sutures must stay in the nasal cavity for a long time, especially in cases involving maxillofacial trauma and tumours. Non-absorbable sutures are removed after healing is completed, on the 7th to 10th post-operative day on average.[5]

Suture materials are divided into absorbable and non-absorbable according to the substance from which they are made. Additionally, these sutures may be monofilament or multifilament according to the way they are produced.[6] Multifilament braided sutures can easily adapt to the shape of tissue, but they have a structure that is open to the growth of micro-organisms. The risk of tissue reaction and infection is less with monofilament sutures. Suture materials differ in terms of their likelihood of inducing inflammation and the associated risk of infection.[7]

The physical and chemical characteristics of suture materials may indirectly affect the healing process.[8,9] The technique and material to be used in the nose is determined according to the experience and preference of the surgeon. There are no studies investigating different suture materials in the nasal cavity, and relevant data are mainly based on skin or intra-abdominal studies. In this study, we investigated the effects of different suture materials – including absorbable, non-absorbable, monofilament and multifilament materials – in the nasal cavity on encrustation and micro-organism colonisation as indirect indicators of the healing process and the risk of infection.

Materials and methods

The study began once the approval of the local ethics committee (Keçiören Training and Research Hospital,

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Ankara, Turkey) had been obtained. Only patients undergoing septoplasty were included in the study.

Upon completing functional septoplasty via a hemitransfixion incision, four interrupted sutures were applied, with a different suture material for each patient. Synthetic non-absorbable monofilament polypropylene sutures (Premilene®), synthetic absorbable monofilament Polyglytone™ 6211 sutures (Caprosyn®), synthetic absorbable braided multifilament polyglactin 910 sutures (Pegalak®) and synthetic rapid absorbable braided multifilament polyglactin 910 sutures (Pegalak Rapide) were used. A nasal tampon was then inserted.

To prevent bias, the nasal mucosa was evaluated daily by the same physician with anterior rhinoscopy, until the sutures were removed. Mucosal encrustation, mucosal redness and inflammation, microabscesses or other evidence of infection, and the presence of granuloma formation around the sutures were evaluated. The presence of encrustation with mucosal redness at the time the sutures were removed was considered as positive for significant encrustation.

The patients were randomly divided into two groups. Randomisation was conducted using online Research Randomizer software.[10] The sutures were removed in the early post-operative period (7th post-operative day) in the first group (group A) and in the late post-operative period (21st post-operative day) in the second group (group B), and the presence or absence of micro-organism growth was evaluated.

A 1 cm sample from each of the four different suture materials taken from the nasal cavity was examined using standard microbiological methods and the BD Phoenix Automated Microbiology System (Becton Dickinson Diagnostic Systems, Sparks, Maryland, USA). The results were recorded in terms of the number of micro-organisms reproducing (colony-forming units) per centimetre.

The results obtained for the two groups (A and B) were analysed in terms of the four different suture materials. Subgroup 1 represents non-absorbable monofilament suture material, subgroup 2 represents absorbable monofilament suture material, subgroup 3 represents absorbable multifilament suture material and subgroup 4 represents rapid absorbable multifilament suture material. Within- and between-group comparisons of the early post-operative period groups (groups A1, A2, A3 and A4) and late post-operative period groups (groups B1, B2, B3 and B4) were conducted to determine whether there were any statistically significant differences.

The data are presented as numbers, percentages, means and standard deviations. The number of colonies is presented using logarithmic transformation. The chi-square test (Fisher's exact test) was used to compare discrete variables. The Kruskal–Wallis test was used for a multiple group comparison of constant variables. The Mann–Whitney U test with Bonferroni correction was used for pairwise comparisons. A p value of less than 0.05 was considered statistically significant.

Results

A total of 40 patients (160 sutures), with a mean age of 25.5 ± 7.1 years (range, 18–44 years), were included in the study. The mean age of the 20 patients evaluated on the 7th post-operative day (group A) was 23.9 ± 5.9 years, and the mean age of the 20 patients evaluated on the 21st day (group B) was 27.1 ± 8.3 years. There was no statistical difference between these two groups in terms of age ($p = 0.08$).

All sutures remained in the nasal cavity on the 7th post-operative day (group A). On the 21st post-operative day (group B), all sutures remained in the nasal cavity except for three (15 per cent) of the rapid absorbable multifilament sutures. These patients were excluded from the study, and three new patients were added to this group in order to have an equal number of patients.

There were no major complications, such as bleeding, haematoma, infection or perforation, in any patient during the study.

Effects of suture materials on encrustation

There was a significant difference between the groups whose sutures were removed at an early post-operative period (groups A1, A2, A3 and A4) in terms of encrustation ($p = 0.001$) (Table I). A similar difference existed between the groups whose sutures were removed in the late post-operative period (groups B1, B2, B3 and B4) ($p < 0.001$) (Table II). Monofilament sutures were found to cause less encrustation than multifilament sutures.

Effects of early and late removal of suture materials on encrustation

There was no difference in the non-absorbable monofilament polypropylene suture groups (groups A1 and B1), absorbable multifilament polyglactin 910 suture groups (groups A3 and B3) or the rapid absorbable multifilament polyglactin 910 suture groups (groups A4 and B4) ($p = 1.000$, $p = 0.364$ and $p = 0.188$, respectively). However, a significant difference was found between the absorbable monofilament Polyglytone 6211 suture groups (groups A2 and B2) ($p = 0.012$). There was increased encrustation if an absorbable monofilament suture remained in the nose for a long time.

Effects of suture materials on micro-organism colonisation

There was no significant difference between sutures removed in the early post-operative period (groups A1, A2, A3 and A4) regarding the number of reproducing micro-organism colonies ($p = 0.740$) (Table I). However, there was a significant difference between sutures removed in the late post-operative period (groups B1, B2, B3 and B4) ($p = 0.003$) (Table II). Monofilament sutures were found to cause less

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TABLE I
ENCRUSTATION AND MICRO-ORGANISM COLONISATION ON SUTURE MATERIALS REMOVED IN EARLY POST-OPERATIVE PERIOD*

Suture material	Encrustation (*n* (%))	*p* (Kruskal–Wallis)	Micro-organism colonisation (mean ± SD (range); CFU/cm)	*p* (chi-square)
Polypropylene (group A1)	3 (15)	0.001†	0.9 ± 1.2 (0.0–3.8)	0.740
Polyglytone 6211 (group A2)	1 (5)		1.3 ± 1.6 (0.0–4.8)	
Polyglactin 910 (group A3)	11 (55)		1.6 ± 1.9 (0.0–5.6)	
Polyglactin 910 rapid (group A4)	10 (50)		1.5 ± 1.9 (0.0–6.0)	

*Total $n = 20$. †Groups A1 and A2 and groups A3 and A4 were similar on pairwise comparisons ($p = 1.000$ and $p = 1.000$, respectively); the difference stemmed from the comparison of group A1 with group A3 ($p = 0.048$) and group A2 with groups A3 and A4 ($p = 0.006$ and $p = 0.006$, respectively) using a Mann–Whitney U test with Bonferroni correction. Groups A1 and A4 were found to be similar ($p = 0.108$). SD = standard deviation; CFU = colony-forming units

micro-organism colonisation than multifilament sutures.

Effects of early and late removal of suture materials on micro-organism colonisation

Comparisons were made to investigate differences in micro-organism growth between the same suture material removed in the early or late post-operative period. There was no difference between the non-absorbable monofilament polypropylene suture groups (groups A1 and B1) ($p = 0.060$). However, there was a significant difference between the absorbable monofilament Polyglytone 6211 suture groups (groups A2 and B2), the absorbable multifilament polyglactin 910 suture groups (groups A3 and B3) and the rapid absorbable multifilament polyglactin 910 suture groups (groups A4 and B4) ($p = 0.004$, $p < 0.001$ and $p < 0.001$, respectively). Removal of non-absorbable monofilament suture material in the early or late post-operative period had no effect on micro-organism growth on the suture. However, there was increased micro-organism growth if the other sutures remained in the nose for a long time.

Discussion

Primary wound healing is dependent on patient-related factors, such as age, systemic disease and general health. However, it may also be affected by factors unrelated to the patient, such as the surgical technique and suture materials used. For good wound healing, the tissue should be handled without causing trauma, the wound surfaces should be approximated properly, there should be no dead space and good haemostasis should be achieved. Complications such as post-operative wound infection, exudate collection and haematoma can negatively affect the healing process.

Tampons and/or nasal septal sutures of various materials are placed using different techniques to ensure proper wound healing following endonasal procedures.[1–3] Current knowledge about the effects of suture materials on wound healing is mainly based on dermal and intra-abdominal study procedures. Gabrielli *et al.* compared monofilament, multifilament, absorbable and non-absorbable sutures in patients who underwent primary skin closure. They concluded that suture materials had no significant effect on infection risk and wound healing. Patient-related factors were found to have a significant effect on infection risk and wound healing.[7]

Inflammation occurs around all suture materials in the first week post-operatively and gradually decreases. It increases again with the beginning of absorption when absorbable sutures have been used. Less inflammation occurs with synthetic materials absorbed through hydrolysis than with organic sutures absorbed through the enzymatic route. Less inflammation also occurs with thinner sutures than with thick ones.[11]

TABLE II
ENCRUSTATION AND MICRO-ORGANISM COLONISATION ON SUTURE MATERIALS REMOVED IN LATE POST-OPERATIVE PERIOD*

Suture material	Encrustation (*n* (%))	*p* (Kruskal–Wallis)	Micro-organism colonisation (mean ± SD (range); CFU/cm)	*p* (chi-square)
Polypropylene (group B1)	4 (20)	<0.001†	2.8 ± 2.4 (0.0–6.7)	0.003‡
Polyglytone 6211 (group B2)	9 (45)		3.9 ± 2.6 (0.0–7.0)	
Polyglactin 910 (group B3)	16 (80)		5.0 ± 2.0 (0.0–7.7)	
Polyglactin 910 rapid (group B4)	16 (80)		5.3 ± 2.1 (0.0–7.9)	

*Total $n = 20$. †Groups B1 and B2 and groups B3 and B4 were similar on pairwise comparisons ($p = 0.546$ and $p = 1.000$, respectively); the difference stemmed from the comparison of group B1 with groups B3 and B4 ($p < 0.001$ and $p < 0.001$, respectively) using a Mann–Whitney U test with Bonferroni correction. Group B2 was similar to groups B3 and B4 ($p = 0.132$ and $p = 0.132$, respectively). ‡Groups B1 and B2, groups B3 and B4, groups B2 and B3, and groups B2 and B4 were similar on pairwise comparisons ($p = 0.612$, $p = 1.000$, $p = 1.000$ and $p = 0.600$, respectively); the difference stemmed from the comparison of group B1 with groups B3 and B4 ($p = 0.012$ and $p = 0.006$, respectively) using a Mann–Whitney U test with Bonferroni correction. SD = standard deviation; CFU = colony-forming units

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Absorbable materials are preferred in the nasal cavity because of their ease of use. When used in the skin, these sutures maintain their tension for about 2 weeks and are fully absorbed within 90 days.[6] When used inside the nasal cavity, they lose their tension within about 7 to 10 days and start to fall out, but they can remain for up to 3 weeks. These sutures may cause encrustation and infection when they remain in place for a long time, like any foreign body.

All the sutures used in our study were synthetic, and all were still inside the nasal cavity on the 7th post-operative day. Monofilament sutures were found to cause less encrustation than multifilament sutures in the early post-operative period (Table I). We found that 17 (85 per cent) of the rapid absorbable multifilament sutures, and all the other sutures, remained in the nasal cavity on the 21st post-operative day. Non-absorbable monofilament sutures were found to cause less encrustation than the other sutures in the late post-operative period (Table II). In contrast to other sutures, the encrustation with absorbable monofilament sutures lasted a long time while the suture remained in place. This was considered a result of the increase in inflammation in the late stage associated with the start of absorption of the absorbable sutures.

The difficulty of handling, poor knot security and mucosal irritation caused by the free edge of the monofilament sutures have led to the preference for multifilament sutures for mucosal surfaces. However, multifilament sutures can result in the entry of micro-organisms inside the tissue in regions with secretions, such as the oral and nasal cavities. Although the bacterial biofilm layer caused by a multifilament suture does not lead to an infection requiring antibiotic use, it can lead to leakage of secretions to the suture line and inflammation that may negatively affect tissue healing.[12,13] Banche *et al*. compared monofilament, multifilament, absorbable, and non-absorbable sutures with a silk suture in the oral cavity. There was no infection, but bacterial colonisation in various amounts was reported in suture samples taken on the 8th day. The authors concluded that the absorbable monofilament suture was the best of the five sutures compared.[8]

- **Suture materials used in the nasal cavity vary in terms of their effect on encrustation and micro-organism colonisation**
- **Late-stage encrustation may occur with absorbable sutures, especially when these sutures stay in place for a long time**
- **In terms of micro-organism growth, non-absorbable monofilament sutures appear to be more appropriate for long-term use in the nasal cavity**

Otten *et al*. reported that bacterial colonisation on sutures occurring after oral surgery constitutes a risk for bacteraemia and bacterial endocarditis associated with removal of the suture.[13] They recommended that sutures be removed as early as possible after oral surgery. There are many experimental bacterial contamination studies reporting that sutures with a multifilament structure cause more micro-organism entry inside the tissue than those with a monofilament structure.[11,14] On the contrary, the results of in situ studies of sutures taken from patients show that monofilament and multifilament sutures do not differ in terms of micro-organism colonisation and contamination.[7,9] However, more biofilm was formed and more micro-organisms were present on sutures placed in an infected site compared to sites with no infection.[9]

The abovementioned results indicate that the physical characteristics of suture materials can influence wound healing in regions susceptible to infection, such as the oral and nasal cavities. We found no difference between sutures removed at an early post-operative period in terms of the number of micro-organism colonies (Table I). However, non-absorbable monofilament sutures led to less micro-organism colonisation compared to absorbable multifilament sutures for sutures removed at the late post-operative period (Table II).

Conclusion

The healing process cannot be evaluated only by encrustation and other mucosal findings. Furthermore, infection risk is difficult to assess only by measuring the amount of micro-organisms adhering to the suture. Even if histological evaluation of inflammatory cell infiltration and the degree of epithelialisation are evaluating points, encrustation with mucosal findings and micro-organism colonisation may be informative as indirect indicators of the healing process and the infection risk.

Although there are many studies on the effects of different suture materials on infection risk and the healing process, ours is the first study in the English-language literature in which different suture materials used in the nasal cavity are compared. The results of this study have demonstrated that different degrees of encrustation and micro-organism colonisation are present on different suture materials in the nasal cavity, despite the lack of infection findings.

Absorbable sutures may be preferred because of their ease of use, but late-stage encrustation may occur with these sutures, especially if they stay in for a long time. Although it seems more appropriate to use non-absorbable monofilament suture materials in the nasal cavity for longer periods, a significant disadvantage of endonasal sutures is the feeling of discomfort and pain experienced in the course of their removal.

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Address for correspondence:
Dr Abdullah Durmaz,
Department of Otolaryngology,
Gülhane Military Medical Academy,
Etlik,
Ankara 06010, Turkey

Fax: +90 312 304 57 00
E-mail: adurmaz@gata.edu.tr

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