TYPES OF SUTURING MATERIALS IN ORAL SURGERY

Biljana Evrosimovska
University Dental Clinical Centre St. Pantelejmon

TYPES OF SUTURING MATERIALS IN ORAL SURGERY

Biljana Evrosimovska [1], Daniela Veleska-Stevkovska [1*], Vesna Jurikovska-Sotarovska [2], Cena Dimova [3], Visar Disha[4]

[1, 1*] University Dental Clinical Centre St. Pantelejmon", Clinic for Oral Surgery and Implantology, Faculty of Dentistry, Skopje, North Macedonia

bevrosimovska@stomfak.ukim.edu.mk

[2] University Dental Clinical Centre "St. Panteleimon", Clinic Prosthodontic, Faculty of Dentistry, Skopje, North Macedonia

[3] Faculty of Medical Sciences, Dental medicine, University "Goce Delcev" Stip, North Macedonia

[4] Faculty of Dentistry, Department of Prosthodontics,

University of Prishtina Hasan Prishtina

Abstract

Aim: In everyday surgical practice, different types of suturing materials are available. They play an important role in tissue healing, facilitate the process of hemostasis, enable the reconstruction and reunification of tissue whose integrity has been compromised during surgery or trauma. The aim of this study is to examine the reaction of the tissue to different suturing materials, as well as to determine the speed of wound healing and the incidence of complications after their use, in order to prove which of them is most suitable for oral surgery procedure.

Material and methods: These researches were done based on analyzes presented on "MEDLINE" and "PubMed" databases, from 1970 to 2018, using the following keywords: oral surgery, suture materials, flap, periodontium, polyglucapron, polytetrafluoroethylene, polyglycolic acid, polylactic acid, silk.

Results: Tissue reactions to suturing materials vary depending on the surface properties and the adhesion properties of the bacteria to the material. Silk is the most commonly used

suturing material in oral surgery. The application of silk sutures increases the risk of infections, because they react with the connective tissue, allowing the accumulation of dental plaque and bacterial adhesion around them. Studies about tissue response to suturing material confirm the presence of inflammation when using silk and cotton threads, and minimal reaction in others (nylon, polyester, polytetrafluoroethylene (ePTFE), polyglycolic acid (PGA).

Conclusion: In addition to the observance of surgical suturing techniques, and the proper maintenance of oral hygiene in the postoperative period, the choice of suturing material has a significant impact on tissue healing. This underscores the need for careful selection of suturing material during oral surgery.

Key words: oral-surgical interventions, suturing material, resorbable and non-resorbable sutures.

Introduction

In recent years the attention of surgeons has been increasingly focused on selection of "ideal suturing material". Suture is a stich or series of stiches made to secure apposition of the edges of a surgical or traumatic wound. Moreover, suture material is an artificial fiber used to keep wound together until they hold themselves by natural which is synthesized & oven into a stronger scar. [1]

The main cause with the suturing is to achieve: wound edge, apposition, provide adequate tension, maintain hemostasis, aid in wound healing, - avoid wound infection, produce aesthetically pleasing scar by approximating skin edges.

The healing process itself depends on the amount of suturing material used, the type of stitches, sewing technique and the density set suture. However, the healing of oral wounds is accompanied by certain peculiarities. First, the oral cavity is colonized by bacteria, which in combination with detritus from food form a biofilm and facilitate the possibility of wound infection. Secondly, oral wounds cannot be immobilized due to the continuous movements that occur in masticator apparatus. The surgical wound is in constant contact with various tissues

(enamel, cement) and materials (metal, ceramics) that do not have adequate active metabolic exchange, which compromises the healing process.

Nowadays, there is a wide range of choice of suturing materials. And according to several criteria, they are classified into three major groups. According to the physical structure of the material, there are monofilament and multifilament. While, according to biological characteristics their division is into resorbable and non-resorbable materials. And, in terms of origin are divided into natural and synthetic suturing materials. [2]

Monofilament suturing materials are in fact a homogeneous structure, consists of single strand of suture material. As representatives of this group and resorbable materials, include: Monocryl (poliglecaprone), Fast absorbing gut, Chromic gut, PDS II (polydioxanone) and others. Non-resorbable monofilament representatives, Nylon, Polyamide, Polypropylene and Polyester as examples. Unlike monofilament, multifilament suturing materials consists of several filaments twisted or braided together. As representatives of this group, but resorptive materials are: Polyglycolic Acid, Polyglactin, as well as Polyglactin - rapid. And the group of multifilament and non-resorptive materials include: Surgical silk, Surgical Lenin, Cotton, Polyamide braided and Polyester braided. [3]

The aim of our research was to examine the reaction of the tissue to different suturing materials, as well as to determine the speed of wound healing and the incidence of complications after their use, in order to prove which of them is most suitable for oral surgery procedure. We conducted the research based on already confirmed analyzes of individual authors and their collaborators, presented on "MEDLINE", "PubMed" and "CYBERLENINKA" databases, in the period from 2003 to 2018.

Materials and methods

All the 11 studies (table 1) included in present literature review were carries out at universities or at healthcare centers. Seven studies were clinical and four studies had an experimental researchable approach. The experimental studies were performed on humans, Wistar rats, Rhesus monkeys and Beagle dogs.

Table 1.

Authors/year	Examination material	Type of intervention	Suturing material	
Leknes KN et al./ 2005 [4]	Human	Periodontal surgery	**Silk** (multifilament) an **PTFE** (monofilament, non-resorbable)	A stronger inflammatory reaction of the tissue was observed in silk sutures compared to PTFE sutures.
Kakoei S et al./2010 [5]	Animal model	Oral mucosal surgery (buccal mucosa)	**Plain gut** (monofilament) and **silk**	In the first two postoperative days - the silk sutures showed a significantly greater inflammatory response to the surrounding tissue than the catgut sutures. However, in the next four days, a larger amount of fibrous tissue was observed around the catgut sutures compared to the silk sutures.
Дрыга А.В. et al./ 2005 [6]	Human	Oral surgery	**Silk**, **nylon** (monofilament, non-resorbable), **polyester** (monofilament, non-resorbable), Polyglecaprone 25	Cotton, linen, silk as multifilament sutures induce infection and subsequent inflammation much more often than monofilament sutures. Therefore, it is recommended to avoid their use in wounds that have the possibility of bacterial contamination. Silk has been shown to have a particularly inhibitory effect on macrophages, affecting mainly the adhesion of these cells.
Banche G. ***et al./2007*** [7]	Human	Dentoalveolar surgery	**Silk**, **nylon** (monofilament, resorbable), **polyester** () **Polyglecaprone 25** (sintetic, monofilament, resorbable)	Bigger number of adherent bacteria was observed around non-resorbable sutures than on resorptive ones. Resorbable silk and polyglucapron 25 showed the lowest number of adherent bacteria.
Yilmaz N et al./2010 [8]	Animal model	Oral mucosal surgery (buccal mucosa)	**Silk** (natural,multifilament, non-resorbable), **catgut** (natural, monofilament,	Reactions to silk and catgut are similar in animals with diabetes and in healthy individuals. More positive effects on tissue healing with polyglucapron 25 compared to others.

			resorbable) and **Polyglecaprone 25** (sintetic, monofilament, resorbable)	
Pons-Vicente O. et al./2011 [9]	Human	Implantology	**Silk**, **polyester suture**, **teflon**	The results showed that there is a larger accumulation of plaque on the silk threads. The intraoperative manipulation with the silk sutures was more uncomfortable, and the patient's comfort was worse compared to the polyester sutures coated with Teflon.
Sortino et al. /2008 [10]	Human	Oral-surgical intervention	Silk and polyglycolic acid - PGA (synthetic, resorbable)	Silk sutures showed greater reliability compared to PGA sutures.
Vastardis S and Yukna R/ 2003 [11]	Human	periodontal surgery	Polyglactin 910 (synthetic, resorbable)	The reaction of the periodontal tissue to the sutures is a possible cause of gingival abscesses.
Kim J-S et al. /2011 [3]	Animal (Dog-beagle)	Surgical intervention on oral mucosa (buccal mucosa and gingiva)	Nylon	On the buccal mucosa it was observed that the number of macrophages increased in the first days around the suture material, while in the connective tissue the infiltration was low. On the gingiva (keratinized tissue) showed that the number of polymorphonuclear leukocytes, lymphocytes and macrophages decrease from the surrounding tissue to the submucosal tissue.
Volodko V. A. / 2018 [12]	Human	Oral-surgical intervention extraction of retained lower third molars	Vicryl (as a traditional suture material) and Vicryl plus (synthetic, resorbable material with antibacterial coating)	In patients in whom suture material Vicryl was used, by applying cytological analyzes on 3 and 7 days in the smear, microorganisms Staphylococcus aureus and Staphylococcus epidemidis, macrophages and leukocytes were detected in large numbers. - While in patients who were administered Vicryl plus, on days 3 and 7 Staphylococcus aureus and Staphylococcus epidemidis were also observed,

				macrophages and leukocytes in significantly smaller numbers. -This is due to the minimal development of reactive inflammation in the wound area. Mild edem and hyperemia of the mucous membrane have also been reported in these patients. Patients with Vicryl on the third day showed larger edem and hyperemia of the mucous membrane.
Дрыга А.В. at al. / 2005 [6]	Animal (dog)	Surgical intervention on oral mucosa	Polyglycolides -Polysorb, Maxon, Vicryl (resorptive)	Polysorb sutures have the highest tear strength (14.7 kg), Maxon sutures have slightly lower tear strength (14.2 kg), while Vicryl sutures have the lowest tear strength (11.2 kg). As for the ability to stretch, Maxon sutures under constant load are stretched over time, which reduces the possibility of tissue incision in the event of edem. While this ability hasn't been observed in Polysorb and Vicryl sutures. The formation of a scar when suturing the tissue with Maxon sutures takes place in conditions of minimal inflammatory reaction, but the biodegeneration of the suture material is slowed down.

In seventh studies, involving periodontal surgical interventions, surgical procedures on the buccal mucosae, and dental implant surgery - tissue reactions were performed between silk and other suturing materials, including polytetrafluoroethylene (PTFE), nylon, poliglecaprone 25, polyglycolic acid, and catgut sutures.

Three studies, including the studies by Leknes et al. [4], Kakoei S et al. [5] presented that the silk as multifilament suturing material causes intense inflammatory tissue reaction, compared to monofilament polytetrafluoroethylene (PTFE) and Cat gut sutures. In addition, silk has a

particularly inhibitory effect on macrophages, mainly affecting their adhesion. It is therefore recommended to avoid its use in wounds that have the possibility of bacterial contamination.

Also, three studies (Banche G et al. [7], Yilmaz N et al. [8], Pons-Vicente O et al. [9]) and their collaborators, reported that poliglecaprone 25 has more positive effects on wound healing and exposes fewer adherent bacteria compared to silk.

Regarding the durability of suturing materials, as one of the important features they should possess, Sortino F et al. [10] in his research reported that – the silk sutures as natural and non-resorbable material have shown greater reliability, compared to PGA threads which are synthetic and resorptive.

In a study by Vastardis S and Yukna RA [11], cases were presented where the occurrence of stitch abscesses was associated with Polyglactin 910 sutures.

In an experimental study, Kim J-S et al. reported that nylon as a suturing material, on the buccal mucosa, increases the number of macrophages around the suturing material in the early days after applying. While the same material applied on gingiva – as keratinized tissue, the number of macrophages, polymorphonuclear leukocytes and lymphocytes was significantly reduced.

In the clinical study by Володько В. А. [12], using Vicryl and Vicryl plus as antibacterial impregnated surgical material, points us to the fact that on cytological analysis where was used Vicryl as suturing material were detected microorganisms as Staphylococcus aureus and Staphylococcus epidermidis, macrophages and leukocytes in higher numbers. While in the regions where Vicryl plus was used, their number was significantly lower.

Дрыга А.В. et al. [6] in their experimental study analyzed Polysorb, Maxon and Vicryl in terms of their ability to stretch, tear strength and scar formation conditions. They confirmed that according to the tear strength, on the first place - as the strongest material was Polysorb (14,7kg), on the second place was Maxon (14,2kg) and as the weakest material was Vicryl with a strength of 11.2 kg.

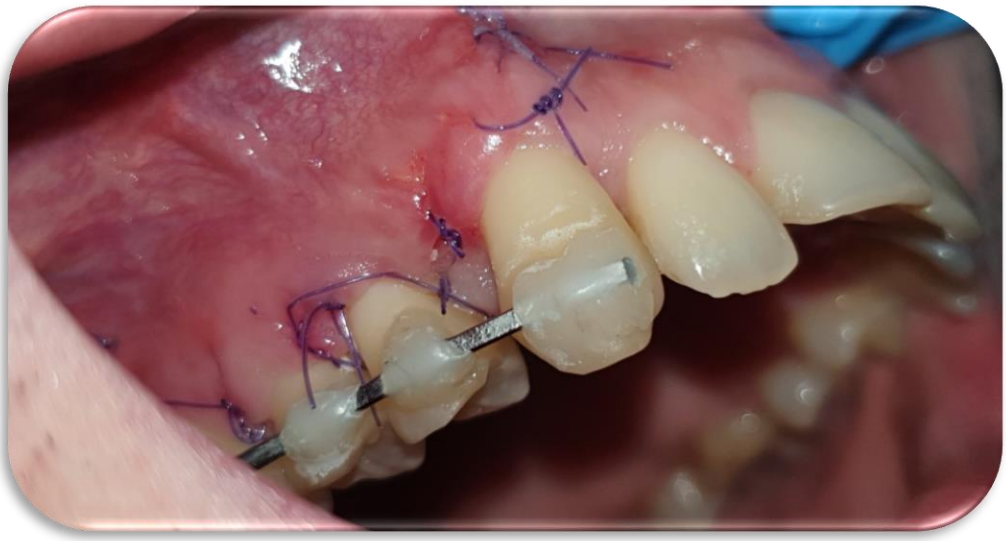
As for the ability to stretch, Maxon sutures under constant load are stretched over time, which reduces the likelihood of tissue rupture in the event of swelling**.** But, at the other sutures that ability was not noticed.

The scar formation, during suturing the tissue with Maxon - took place under conditions of minimal inflammatory reaction, but the biodegradation of the suture material was slowed down.

In addition of doing an analysis of world-renowned current papers on this topic, we have done two clinical cases using two different suturing materials. From what we have done, we can conclude the same as the studies we have developed.

Namely, in the both cases were made GBR (Guided Bone Regeneration). Why we selected these 2 cases? Because of the reason that the Guided bone regeneration needs a longer wound healing period, and the suturing material (thread) of the surgical wound remains for a longer period of time, so in the resorbable thread 3 weeks, and in the non-resorbable 10 days. So, in that period we can consider the possibility of dental plaque accumulation and bacterial adherence on the suturing material. Also, we can notice the tissue inflammation reactions that were clinically visible, or there was an absence of inflammation.

In the first case, bone augmentation was performed with PRF and PRF membrane, because there was a loss of bone tissue on the canine and premolar. We used resorbable suturing material.



While, in the second case, the radix was primarily extracted, and the further bone augmentation was also performed with PRF and PRF membrane. In order to make our comparison between resorbable and non-resorbable material the wound was sutured with silk.

We found out that our results really matched with the results of the studies we have developed. We came to the same conclusion that silk - as a traditional and commonly used suturing material, (although it is cheap and easy to handle), compared to other materials, it

should not be the "material of choice" in oral surgery, due to the fact that inflammatory tissue reactions are most violent when using this material.

We have clinically determined that there are signs of inflammation (color, rubor, dolor, tumor, function lease), the wound edges do not heal and there is no creation of new granulation tissue.

The performed analyzes confirmed that the bacterial adherence and the present dental plaque on the suturing material, lead to inflammation of the surgical wound. It is generally known that systemic disorders such as poorly controlled diabetes mellitus and cardiovascular disease can cause an oral inflammatory reaction. Therefore, an inflammatory tissue reaction that is primarily provoked by suturing materials may falsely suggest that it is caused by a systemic disease. (Yilmaz N, Inal S, Muğlali M, Güvenç T, Baş B. Effects of polyglecaprone 25, silk and catgut suture materials on oral mucosa wound healing in diabetic rats: an evaluation of nitric oxide dynamics. Med Oral Patol Oral Cir Bucal. 2010 May 1; 15(3):e526-30.; Banche G, Roana J, Mandras N, et al. Microbial adherence on various intraoral suture materials in patients undergoing dental surgery. Journal of Oral and Maxillofacial Surgery. 2007;65(8):1503–1507)

Other provoking factors that can contribute to the occurrence of oral inflammation are smoking and the use of other tobacco products. However, there is still a lack of clinical studies that could reliably support this hypothesis. (Javed F, Klingspor L, Sundin U, Altamash M, Klinge B, Engström PE. Periodontal conditions, oral Candida albicans and salivary proteins in type 2 diabetic subjects with emphasis on gender. BMC Oral Health. 2009;9(1, article 12).; Javed F, Chotai M, Mehmood A, Almas K. Oral mucosal disorders associated with habitual gutka usage: a review. Oral Surgery, Oral Medicine, Oral Pathology, Oral Radiology and Endodontology. 2010;109(6):857–864.)

However, it is evident that different suturing materials used in oral surgery cause a wide variety of tissue reaction, depending on several factors, including the surface characteristics of the material and the degree (amount) of bacterial adherence. This research emphasizes the need for careful selection of suturing material during oral surgery.

Nowadays there is no ideal suturing material, but it should have the following characteristics: high tensile strength to hold the wound margins appropriately till healing is complete, should not be allergic or cause any tissue inflammation, have least capillarity so that the material does not soak up much of the inflamed tissue fluid surrounding the wound and further exaggerate infection, should have good knotting properties, easy to sterilize, to be visible in the surgical field, have an affordable price.

Conflict of interests

The authors declare that they have no conflict of interests.

References

1. Javed F, Al-Askar M, Almas K, Romanos G E, Al-Hezaimi K, International Scholarly Research Network ISRN Dentistry 2012, ID 762095; 6.
2. Fawad J., Mansour A. A., Khalid A., Georgios E. R., and Khalid Al-H. Tissue Reactions to Various Suture Materials Used in Oral Surgical Interventions. 2012 DOI:10.5402/2012/762095.
3. Kim J-S, Shin S-I, Herr Y, Park J-B, Kwon Y-H, Chung J-H. Tissue reaction to suture materials in the oral mucosa of beagle's dogs. Journal of periodontal and implant science. 2011; 41: 185-191.
4. Leknes KN, Røynstrand IT, Selvig KA. Human gingival tissue reactions to silk and expanded polytetrafluoroethylene sutures. Journal of Periodontology. 2005;76(1):34–42.
5. Kakoei S, Baghae F, Dabiri S, Parirokh M, Kakooe S. A comparative in vivo study of tissue reactions to four suturing materials. IEJ. 2010; 5, (2).
6. Дрыга А.В., Привалов В.А., Понькин А.В., Голощапова Ж.А., Фефилова А.С. ИЗУЧЕНИЕ ФИЗИЧЕСКИХ И ИМПЛАНТАЦИОННЫХ СВОЙСТВ НЕКОТОРЫХ ВИДОВ СОВРЕМЕННОГО СИНТЕТИЧЕСКОГО ШОВНОГО МАТЕРИАЛА. 2005. Серия

«Образование, здравоохранение, физическая культура», выпуск *5*, том 1. Вестник ЮУрГУ, No 4.

7. Banche G, Roana J, Mandras N, et al. Microbial adherence on various intraoral suture materials in patients undergoing dental surgery. Journal of Oral and Maxillofacial Surgery. 2007;65(8):1503–1507.
8. Yilmaz N, Inal S, Muğlali M, Güvenç T, Baş B. Effects of polyglecaprone 25, silk and catgut suture materials on oral mucosa wound healing in diabetic rats: an evaluation of nitric oxide dynamics. Med Oral Patol Oral Cir Bucal. 2010 May 1; 15(3):e526-30.
9. Pons-Vicente O, López-Jiménez L, Sánchez-Garcés Mª A, Sala-Pérez S, Gay-Escoda C. A comparative study between two different suture materials in oral implantology. Clin. Oral Impl. Res. 22, 2011; 282–288. doi: 10.1111/j.1600-0501.2010.01993.
10. Sortino F, Lombardo C, Sciacca A. Silk and polyglycolic acid in oral surgery: a comparative study. Oral Surg Oral Med Oral Pathol Oral Radiol Endod. 2008 Mar; 105(3):e15-8.
11. Vastardis S, Yukna RA. Gingival/soft tissue abscess following subepithelial connective tissue graft for root coverage: report of three cases. Journal of Periodontology. 2003; 74(11):1676–1681.
12. Володько В. А. СРАВНИТЕЛЬНЫЙ АНАЛИЗ ПРИМЕНЕНИЯ ШОВНОГО МАТЕРИАЛА В АМБУЛАТОРНОЙ ЧЕЛЮСТНО-ЛИЦЕВОЙ ХИРУРГИИ. Материалы дистанционной научно-практической конференции молодых учёных. Фундаментальная наука в современной медицине – 2018; 376-378.