LUPINE PUBLISHERS

ISSN: 2637-4595

Latest Trends in Textile and Fashion Designing

DOI: 10.32474/LTTFD.2022.04.000191

Mini Review

Textile Sutures Used in Dental Surgery and their Associated Problems

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Received: January 10, 2022 **Published:** January 19, 2022

Abstract

A variety of suture materials are available for primary wound closure following oral surgical procedures. The tissue reactions to the various suture materials used in oral surgical interventions have been analyzed. Databases have been searched relating to cotton, nylon, polyglecaprone 25, polytetrafluoroethylene (ePTFE), Polyglactin 910, polyglycolic acid (PGA), polylactic acid, silk, surgery, suture, and tissue reaction. An interesting compilation has been done from various reliable sources. A number of investigations have been included. Few studies reported that polyglecaprone 25 had positive effects on wound-healing as compared to silk. More studies reported that silk elicits more intense tissue inflammatory response and delayed wound healing as compared to other suture materials (including ePTFE, polyglecaprone-25, PGA, and nylon). Polyglactin 910 sutures were associated with the development of stitch abscess in one clinical study. A number of studies reported that tissue reactions are minimal with nylon sutures. Tissue reactions to suture materials used for oral surgical interventions may vary depending on the surface properties and bacterial adherence properties of the material.

Keywords: Dental surgery; Sutures; Textile materials; Properties; Wound healing

Introduction

Most oral surgical interventions require primary wound closure using a previously raised flap. For this purpose, a variety of suture materials are available which may be classified upon their origin (organic and synthetic) or according to their durability in host tissues (absorbable and nonabsorbable) [1,2]. The essential features of suture material include

a) Knot safety,

b) Stretch capacity,

c) Tissue reactivity, and

d) Wound safety.

Besides the adopted surgical and suturing technique, the choice of suture material may also influence the healing of the incised soft tissues [1– 3]. In their study, Vastardis and Yukna [4] reported three case reports of complications after the use of a subepithelial connective tissue graft where an abscess occurred following the initial healing phase. This study [4] concluded that a stitch abscess or reaction to the suture material used for the submerged sutures could be a possible cause of the abscesses. Thus, the selection of the suture material should be brought under consideration during treatment planning for oral surgical interventions. Tissue reaction is reflected through an inflammatory response, which develops during the first two to seven days after suturing the tissue [1–3]. Several studies published over the past four decades have reported that synthetic materials exhibit a superior behavior to oral tissues in terms of tissue inflammatory reactions compared to nonsynthetic suture materials [3–19]. Suture materials that have been frequently investigated in terms of tissue reactions include cotton, braided silk, polyester, nylon, and cat gut; however, the study outcomes remain debatable. Polyester sutures have been reported to cause a mild inflammatory reaction whereas cotton threads have been associated with an intense tissue inflammatory response [15–17]. Other commercially available suture materials include polyglycolic acid (PGA) and polyglactin 910 (derived from copolymerization of glycosides and lactides) and have been labeled as "desirable suture materials" [1,15,20]; nevertheless, controversy persists over the efficacy of suture materials. Sortino et al. [8] reported the bacterial count over the braided silk and PGA sutures to be similar; conversely, other studies have reported that silk sutures are more susceptible to bacterial invasion and severe tissue inflammatory

reactions compared to other suturing products [14–17]. However, in terms of cost-effectiveness, silk continues to enjoy its status as an "inexpensive" suture material as compared to other nonabsorbable suture materials [2]. Since the choice of the suture material used in oral surgical interventions may play a role in optimal postsurgical wound healing, the present study aimed to review the tissue reactions to the various suture materials used in oral surgical interventions.

Characteristics of Included Studies

All the 17 studies [3–5,7–19] included in the present literature review were either carried out at universities or at healthcare centers. Six studies [4,8–10,12,15] were clinical and 11 studies [3,5,7,11,13,14,16,19] had an experimental research design. The experimental studies were performed on male Wistar rats, Rhesus monkeys and Beagle dogs [3,5,7,11,13,14,16–19]. In all clinical studies [4,8–10,12,15], the participants were systemically healthy, whereas in one experimental study [7], efficacies of various suture materials were investigated in diabetic male Wistar rats. The investigated suture materials were catgut, cotton, nylon, perlon, polyester, polyglecaprone 25, PGA, expanded polytetrafluoroethylene (ePTFE), braided silk, and steel. In eight studies [4,10,11,13–15,17], involving periodontal surgical interventions, tissue reactions were compared between braided silk and other suture materials including cotton, chromic, nylon, and polyglactin 910. In four studies [3,5,18,19], oral surgical procedures were performed on the buccal mucosae and tongues of beagle dogs and the sutures materials under investigation included silk, cotton, polyester, steel, and chromic. Two studies [7,9] reported that polyglecaprone 25 had positive effects on wound healing and exhibited lesser numbers of adherent bacteria as compared to braided silk. Six studies [9–11,13,15,16] (five clinical [9,10,13,15,16] and one experimental [11]) reported that braided silk elicits more intense tissue inflammatory response and delayed wound healing as compared to other suture materials (including ePTFE, polyglecaprone 25, PGA, and nylon). In a study by Vastardis and Yukna [4], three case reports were presented where the occurrence of stitch abscess was associated with Polyglactin 910 sutures. In their experimental study, Yilmaz et al. [7] reported that silk and chromic gut are well tolerated in diabetic rats whereas Selvig et al. [14] reported bacterial invasion to be common in these materials, particularly in braided silk sutures. Four studies [3,16,17] associated cotton sutures with intense tissue reactions. Eight studies [3,5,15–19] reported that nylon sutures provide the best biological results. These studies [15–17], also reported the least inflammatory response. Castelli et al. [17] compared the tissue inflammatory responses induced by silk, cotton and nylon, and the results showed that nylon sutures did not elicit any form of inflammatory response in oral tissues compared to silk and cotton.

Several suture materials are available for dental and medical surgical procedures; however, it is essential for surgeons to be aware of the nature of the suture material, the biologic processes of healing, and the interaction of the suture material with the surrounding tissues. This is a critical issue because the surgeon must ensure that a suture will retain its strength until the tissues of the previously raised surgical flaps recover sufficient strength to keep the wound edges together. To date, research data regarding the efficacies of various materials remains debatable and inconsistent. Thus, the present study attempted to review the tissue reactions to different suture materials used in oral surgical interventions. Traditionally, silk has been the mostly used suture material for dental and several other surgical procedures [21]. Even though silk is inexpensive and easy to handle as compared to other nonabsorbable suture materials [19,22]; the authors believe that it should not be considered as a "material of choice" for oral surgical interventions. Studies on oral tissue reactions to sutures have revealed constant inflammatory reactions, which are most prominent with silk and cotton and minimal with others including nylon, polyester, ePTFE, polyglecaprone 25 and PGA [3,5,7–19]. A histological study [15] compared the oral tissue reactions to various suture materials. The results showed the presence of a large number of neutrophilic polymorphonuclear leukocytes in the premises of silk sutures which were less intense in oral tissues farther from silk sutures [15]. Another finding was that fibroblasts and new capillaries formed at a slower pace in the oral tissues in the vicinity of silk sutures compared to tissues farther from the silk sutures. This may be a justification for the delayed healing and severe tissue reactions associated with silk sutures.

Another factor that may instigate tissue reactions is the capability of bacteria to adhere to various suture materials. In their in vitro study, Katz et al. [23] investigated the capability of bacteria to adhere to various types of sutures to cause tissue reactions. The results showed that bacterial adherence to braided silk sutures was five- to eight folds higher as compared to nylon to which the least numbers of bacteria adhered [23]. In another study [9], colonization on various intraoral suture materials from patients microbial having undergone dentoalveolar surgery was investigated. The results showed a larger numbers of bacteria on silk as compared to polyglecaprone 25 [9]. In an experimental study, Leknes et al. [10] investigated the inflammatory responses in oral tissues sutured with silk and ePTFE by recording the presence or absence of bacterial plaque along the suture track. The results showed that bacterial plaque was present in 10 out of the 11 silk and four out of the 11 ePTFE suture channels [10]. These studies may act as possible explanations to the minimum tissue reactions evoked in nylon and polyglecaprone 25 as compared to braided silk sutures. Thus, the different rates of bacterial adherence to various suture materials support the hypothesis that bacterial adherence to sutures plays a significant role in the induction of tissue reactions. Since sutures are immediately contaminated as soon as they contact the oral cavity, it is recommended that sutures should be opened just before being passed through the gingival tissues in order to minimize complications such as stitch abscesses [4]. It is well known that systemic conditions such as poorly controlled diabetes mellitus and cardiovascular disease are directly associated with oral inflammatory conditions [24–28].

Therefore, it may be hypothesized that the massive inflammatory response induced by such confounding factors may "mask" the tissue reactions provoked by the suture material. Data from the clinical studies [8–10,12,15], included in the present review, revealed that all participants were systemically healthy; therefore, the influence confounding parameters (such as those mentioned previously) may be overruled. In one experimental study [7], tissue reactions to silk, catgut, and Poliglecaprone 25 were investigated in diabetic rats. The results reported similar activities of silk and catgut in the diabetic and control groups [7]. Could this similarity in tissue reactions between the two suture materials be attributed to diabetes control or to the properties of the suture material, remains unclear. Other confounding parameters that may also contribute to oral mucosal inflammation include smoking and use of tobacco products. Nevertheless, due to the lack of data regarding tobacco habits in these studies, the role of tobacco habits as a confounding factor in suture-induced tissue reactions may be a topic to explore for future clinical studies.

Conclusion

It is still evident that various suture materials used in oral surgical interventions present varying degrees of tissue reactions depending on several factors including surface properties and bacterial adherence properties. The present study emphasizes on the need for careful suture selection of suturing materials for oral surgical interventions.

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DOI: 10.32474/LTTFD.2022.04.000191