



Review Article

ISSN: 2581-3218
IJDR 2025; 10(2): 54-56
Received: 06-05-2025
Accepted: 08-07-2025
Published: 31-08-2025
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www.dentistryscience.com
doi: 10.31254/dentistry.2025.10206

Suture Materials in Oral Surgery: A Review of Current Trends and Future Directions

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Abstract

Sutures are used to support the wound caused by surgery or trauma and enhance healing process by holding tissues together. Wide variety of suture material are available for medical purpose. Recently there have been increasing development in newer suture materials which are used in dentistry with wide variety of property. Sutures are now used to prevent chances of post-operative wound infection Variety of absorbable and biocompatible sutures are now available. A comprehensive literature search was conducted using Pubmed, Scopus and Web of sciences, and Google Scholar. In this review article we discuss about the emerging suture materials such as antimicrobial sutures, antimicrobial-coated sutures, silver nanoparticle treated sutures, drug-eluting sutures, smart sutures, Vicryl plus, fibres from ramie plant. These sutures not only approximate the tissue margins but also acts as a biologically altered component allowing delivery of drugs to the desired site with enormous application in therapeutics and diagnostics.

Keywords: Antimicrobial sutures, Antimicrobial agent coated sutures, Silver nanoparticles treated sutures, Drug-eluting sutures, Stem cell seeded sutures, Smart sutures.

INTRODUCTION

The suture, often known as a surgical suture, is a piece of medical equipment used to keep the borders of wounds and body tissues intact following surgery or trauma [1]. After an accident or surgery, sutures are primarily used to hold the opposing tissues intact in order to promote repair and minimize the creation of scars. Poly (lactic-co-glycolic acid) and polydioxanone are two examples of the synthetic biomaterials that have been employed as suture materials lately. But no suture material is suitable for every kind of surgical or medicinal use [2].

In the final stage of oral surgery, the tissues suture permits the approximation and stability of the wound lip's margins, promotes haemostasis, prevents the building up of alimentary residues on the incision line, and permits the initial intended healing. An effective suture prevents the destabilization of the surgical incision caused by the displacement pressures produced by the muscle insertions, functional motions, and outside forces [3].

However, sutures are still widely used in surgical procedures, wound closure after surgery or any trauma despite the advancements and developments in suture materials. The suture material that has been used for decades is routinely put into use. As the number of surgical procedures performed increases, the demand for suturing material also increases, despite the availability of suture substitutes in the market such as surgical strips, glue and staples. The number of tissue layers in the wound closure, oedema, expected time of suture removal, possess necessary strength and show some or no inflammatory reactions [2]. In this review article, we will be discussing about the various newer advancements in suturing material in dentistry.

MATERIALS AND METHODS

This review article aimed to summarize the current evidence on advances in suture materials for wound closure. A comprehensive literature search was conducted using Pubmed, Scopus and Web of sciences, and Google Scholar using the keywords Sutures, Antimicrobial sutures, antimicrobial agent coated sutures, silver nanoparticles treated sutures, Drug-eluting sutures, Stem cell seeded sutures, Smart sutures, Vicryl plus, fibres from ramie plant. This search was limited to articles published in English and till 2024. The search identified 50 articles of which 16 were included in the review after title and abstract screening. The full text of these articles was reviewed and data were extracted using standardized form. The data were synthesized using a narrative synthesis approach, with results presented in discussion form.

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ANTIMICROBIAL SUTURES

Following reconstructive surgeries and the placement of implanted biomedical appliances, infections caused by bacterial adhesion and growth on device or implant exteriors are a serious concern. The most frequent postoperative consequences are localized surgical site infections (SSIs) [1]. To encourage healing and avoid postoperative infection, antibacterial suture materials are either coated or infused with antimicrobial chemicals. It is necessary to ascertain how the agent affects both the usual microbes in the mouth and the bacterial species which are deemed harmful. Polymers or absorbable materials (such as polyglactin 910, polyglactone 25, or polydioxanone) coated with antibacterial agents (such as triclosan or chlorhexidine) are examples of antibacterial suture materials now on the market [5].

ANTIMICROBIAL AGENT COATED SUTURE

Numerous studies, preclinical and clinical research have demonstrated the antibacterial effectiveness of antimicrobial-coated sutures [3-5]. Because surgical sutures can host bacterial infections, antimicrobial-coated sutures provide a practical way to reduce the risk of surgical site infections (SSIs) following maxillofacial surgeries by increasing the creation of biofilm, growth, and the development of treatment-resistant microorganisms [5]. Comparing chlorhexidine-coated and triclosan-coated sutures to plain uncoated sutures, CLSM and SEM demonstrated significant biofilm suppression surrounding the former. When contrasted with plain, uncoated sutures, the antibacterial-coated sutures displayed a statistically noteworthy distinction in CFUs/ml and zone of inhibition. Chlorhexidine-coated sutures performed better than other coated sutures [5]. Chitosan coating on sutures may really decrease postoperative infections, speed up the healing process, and enhance the qualities of already available antimicrobial sutures [6]. Following implantation in animal models, polyglactone suture containing triclosan (Monocryl Plus, Ethicon) has demonstrated powerful antibacterial properties. The zone of inhibition for the chlorhexidine-coated suture and Vicryl Plus was shown to be statistically equal when tested against MRSA and *S. epidermis*, although it was statistically more significant when tested against *E. coli* [6].

SILVER-NANOPARTICLE TREATED SUTURES

Due to its broad variety of applications in numerous aspects of illness detection and therapy, nanotechnology saw enormous development and constituted an essential component of dental research [7,8]. By using silver nanoparticles, the amount of antibiotics and nanoparticles needed to have an effective antibacterial impact on different bacteria is reduced, which lowers the possibility of adverse effects [7]. Because of their small size and greater surface-to-volume ratio, which allow for greater contact with microbial membranes, nanoparticles—insoluble materials smaller than 100 nm—have a greater area on their surfaces of antimicrobial activity. Silver, silver ions, and silver compounds have been used as antibacterial agents in biomedical applications [8]. AgNPs have applications in oral and maxillofacial surgery, including guided tissue regrowth, tooth extractions mouth cancer, apical operations, wound and recovery of bones, and implant dentistry. Greater diffusion of the silver ions and an improved antibacterial action are associated with smaller nanoparticle sizes. The specialties of implant dentistry and oral and maxillofacial surgery mainly treat wounds that most commonly result from trauma, cutting, or extraction within the mouth cavity. The breakdown of the epithelial membrane, which may or may not necessitate harm to the connective tissue and its structures beneath, is the step-by-step regulated process that wound recovery involves. Wound closure is facilitated by the presence of growth factors, mediators, and cytokines. Over time, drug manufacturers have created silver-based wound dressings that are not specific to the dentistry sector but rather depend on the kind of injuries, the degree of infection, and the clinical signs [9].

DRUG-ELUTING SUTURE

Surgical treatments that necessitate the subsequent administration of medications at the site or generally to treat the infection might result in surgical site infections (SSIs). Antimicrobial-containing drug-eluting sutures represent a latent tactic that inhibits the delivery of a second dose of medication. Additionally, it provides the potential to deliver a wide range of therapeutic drugs to a specific wound location in order to provide analgesia, anti-inflammatory effects, or the release of proteins that aid in the healing process [10]. It might be clinically hard to remove sutures, especially in paediatric patients or in anatomical locations that are difficult to reach. For the patient's comfort and the effectiveness of the treatment in these situations, biodegradable sutures are recommended. Since drug-eluting sutures not only perform their mechanical duties during wound repair but also administer the medication to the wound, they are the next generation of surgical sutures. A localized medication delivery method that reduces systemic adverse effects linked to after surgical operations is created by incorporating active pharmaceutical ingredients (APIs) into the suture [11]. Most importantly, drug eluting sutures decrease the need for supplemental medications while also reducing surgical site infections, wound healing, and post-operative problems. The greatest accomplishment will be achieving the intended dosage and effect in these sutures without compromising their mechanical characteristics [12].

SHAPE MEMORY SUTURE

According to the cooperation of the form memory effect and disulfide bond, a two-step shape memory-assisted self-healing polyurethane system was suggested. In order to achieve the healing of the mechanical properties, the shape memory effect was used to first seal the crack. Then, the disulfide exchange reaction accelerated the chain interdiffusion and created links across the broken surfaces [12]. Shape memory polymers (SMPs) are stimuli-responsive "smart" materials that may change their shape in response to the right external stimulus, such as an electric field, magnetic field, temperatures or moisture. When the temperature rises over their transition temperature, thermally sensitive SMPs—which are typical models among SMPs—can transform from a temporary to a persistent shape [13].

VICRYL PLUS

Vicryl plus is an antibacterial surgical suture which is commonly used in dental surgical procedures. Vicryl Plus's characteristics, including its absorbability within the body, lack of tissue irritation, and antibacterial qualities, can help wounds recover to a certain extent. They don't need sutures to be removed, which could hurt or bother the patient, and they don't need a follow-up appointment at a convenient postoperative time. Among the elements that regulate the suture's performance during clinical use are its tensile characteristics, elasticity, and stiffness [16]. Compared to conventional sutures, Vicryl Plus offers benefits in reducing wound-related problems. Vicryl Plus sutures cost more than conventional sutures [14].

FIBRES FROM RAMIE PLANT

Plant-based fibers can be used to create suture biomaterials that are more affordable and biocompatible. The fiber from the ramie plant (*Boehmeria nivea*) has excellent qualities, making it a potential substitute source for surgical suture creation. Ramie has good tensile strength. A special intrinsic quality of ramie fiber is its high antimicrobial effectiveness. Ramie suture demonstrated excellent wound closure and healing efficiency, leaving the injured area scar-free. Ramie suture can be an excellent cost-effective suture biomaterial since the raw materials needed to make it are readily available and significantly less expensive than silk [15].

CONCLUSION

It is widely accepted that sutures are a vital and successful component of trauma care and surgery. Sutures are primarily used to hold tissues together to promote and speed the healing process after an injury or surgical operation, leaving little or no scarring. Significant pliability and flexibility are also necessary for sutures to have improved handling properties while suturing ^[16].

Conflicts of Interest

The author reports no conflicts of interest.

Funding

None declared.

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HOW TO CITE THIS ARTICLE-

Rilna P, Vishwanathan C, Sudhakaran A, Hidayath A, Asok A, Santhosh A. Suture Materials in Oral Surgery: A Review of Current Trends and Future Directions. *Int J Dent Res* 2025; 10(2):54-56. doi: 10.31254/dentistry.2025.10206

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