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Chlorhexidine Coated Polyglactin Sutures In Prevention Of Surgical Site Infection

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ABSTRACT

Surgical Site Infections (SSIs) are one of the most common complications of any intervention in the maxillofacial region. Most of the times sutures used for wound approximation act as a nidus of bacterial accumulation and subsequent infection due to the presence of scores of microbes in and around the oral cavity. This has been attributed to the wicking action associated with braided sutures. Various methods to prevent surgical site infections are reported in literature, the most recent being use of antibacterial coated sutures. Sutures are either coated with triclosan or chlorhexidine or a combination of antimicrobial agents and fatty acids. These sutures are known to have a significant role in the prevention of SSIs elsewhere in the body, but the role in oral cavity remains questionable. This study aims to establish the role of chlorhexidine coated sutures in the prevention of surgical site infections if any. Chlorhexidine-coated and uncoated suture materials were used in 17 patients undergoing third molar extractions. Seven days post-operatively the sutures were removed, and bacteria were isolated. Following which colony-forming units (CFU/ml) were counted. Concerning the total number of oral pathogens, that adhered to suture material, no reduction was demonstrated for Chlorhexidine coated sutures. The use of chlorhexidine-coated suture material offers no advantage in intraoral surgery.

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INTRODUCTION

Suture materials were originally derived from natural materials, such as animal tendons and cotton fibres which potentially lead to infections. Later synthetic suture materials and sterilization techniques led to a decrease in some postoperative infection. However, suture materials are still foreign bodies which tend to attract microbes like bacterial, fungi, viruses, etc. by wicking effect. Postoperative wound infections are one of the most common perioperative complications. Because of this, recent research has been focusing on avoiding bacterial colonization of sutures by using the various antibacterial coating. The antibacterial coating may prevent the adherence of bacteria on medical materials, but it is not possible to kill bacteria that adhere to suture materials, once a bio-film has formed (Donlan and Costerton, 2002).

Suture materials used during surgery carry a risk of postoperative wound infections and associated complications like bone infection, organ abscess, bacteraemia, endocarditis, sepsis (Giglio *et al.*, 1992; King *et al.*, 1988; Otten *et al.*, 2005).

Wound infections lead to more extended stays in hospital, requiring additional treatment, antibiotics, all of which cause a substantial increase in expenses (Zhan and Miller, 2003).

Oral flora is unique in each individual and changes the life of an individual. The commensal flora is always accompanied by opportunistic flora which is known to cause delayed wound healing (Otten *et al.*, 1987).

The presence of antibacterial coatings on sutures is thought to limit the ability of these opportunistic microbes to adhere, thereby preventing a delay in wound healing (G, 2014; Cruz *et al.*, 2013).

Chlorhexidine (CHX) is a biguanide antiseptic with an antibacterial activity that has been in widespread use since the late 1940s. CHX, being positively charged, reacts with the negatively charged microbial cell membrane destroying its integrity. Subsequently, it penetrates the cell causing leakage of intracellular components, thereby leading to cell death.

CHX has shown high anti-infective efficacy in several studies involving orthopaedic (Darouiche *et al.*, 1998; Kälicke *et al.*, 2006), obstetric (Vorherr *et al.*, 1980), surgical (Fardai and Turnbull, 1986) and dental applications (Suido *et al.*, 1998; Karpiński and Szkaradkiewicz, 2015).

CHX is minimally absorbed percutaneously and poorly absorbed across mucosal surfaces. CHX has been used in several pharmaceutical products due to its antiseptic properties and biocompatible nature (Karde *et al.*, 2016; Obermeier *et al.*, 2014; Harnet *et al.*, 2009).

In vitro studies have shown a zone of inhibition around the CHX coated suture materials as compared to be less as compared to triclosan coated sutures (Karde *et al.*, 2016).

The aim of the presented study was a comparative analysis of bacterial colonization on conventional absorbable suture material as compared to antibacterial coated absorbable suture material in routine dentoalveolar surgery(third molar extractions). Investigations were concentrated on the total number of viable bacteria on the suture materials used.

MATERIALS AND METHODS

The study examined two different suture materials-absorbable braided dyed polyglactin 910 (3-0) (VICRYL®, Ethicon) and absorbable braided dyed polyglactin 910 (3-0) coated with Chlorhexidine (Petcryl ®CS, Dolphin suture) as used in dentoalveolar surgery. Vicryl® is a synthetic sterile resorbable surgical suture material consisting of a copolymer of 90% glycolid and 10% l-lactide (polyglactin 910). Petcryl ® CS is a chlorhexidine coated polyglactin 910 suture material.

For three months, both suture materials were used for routine wound treatment in 17 patients (18–43 years old) who underwent third molar extractions. All 17 patients underwent extraction of two wisdom teeth on the same side at the same time. One operation site was closed by a Vicryl® suture and the other by a Petcryl ® CS suture. Post-operatively, all the sites were rinsed with saline only. The sutures were removed after seven days and transferred into sterile tubes containing transport medium.

Suture samples were agitated into test tubes containing 10 mL saline using a vortex mixer. Dilution of 10^{-2} was prepared, and 0.1 ml of this dilution was plated on the blood agar plate using streak method. The agar plates were incubated aerobically at 37°C for 48 hours. Colonies of bacteria were counted using classical bacterial counting technique, and they expressed as a number of CFU/ml.

RESULTS AND DISCUSSION

Total Number of Bacterial Colonies were expressed as colony-forming unit/ml or CFU/ml. The total number of bacteria was 37% higher on the Petcryl® CS sutures (7.3×10^8 colonies) than on those made of Vicryl® (5.3×10^8 colonies) (Table 1). Intraindividual variations in regards to bacterial colonies were found to be high (Table 2).

The treatment of SSI can be costly, and as prevention is better than cure, a preventive measure should be adopted to reduce the incidence of SSIs in post operated cases. Evidence of "loss of clot" as proposed by Nitzan in 1983 as pathogenesis of dry socket also postulates microbial adherence leading to fibrinolysis. Hence, bacterial adherence to sutures can be one of the reasons for dry socket.

Smart sutures are materials which respond to stimuli by altering one or more of their properties (Sivakumar and Naseem, 2016). They are covered with temperature sensors and micro-heaters which can detect infections, if coated with antibacterial drugs, they might be highly effective in the prevention of SSIs.

Despite controversial results amongst different clinical studies, the anti-microbial suture was more or less effective in decreasing the risk for postoperative SSIs in a broad population. Antibacterial sutures should possess better handling qualities, be non-carcinogenic, non-toxic, and free of allergens (Ind-

Table 1: Comparison of the total number of bacterial colonies on Vicryl® and Petcryl® CS sutures

S.no	Vicryl®(No of colonies *10^3)	Petcryl®CS (No of colonies *10^3)
1	8020	2176
2	1024	1908
3	18158	7194
4	9454	16886
5	23300	180200
6	30640	40860
7	2641	92620
8	21286	9769
9	105	15
10	6060	3618
11	75720	94420
12	16266	4000
13	140150	67470
14	40334	5935
15	1950	4000
16	97510	58320
17	40010	141910

Table 2: Mean and Standard deviation

	Vicryl®(No of colonies *10^3)	Petcryl ®CS (No of colonies *10^3)
Sum	532808	731301
Mean	31342	43018
SD	38846	55221

humathi and Kumar, 2019). Most anti-microbial sutures are coated with triclosan as it has proven to be effective in various extra-oral sites (Singh *et al.*, 2014; Leaper *et al.*, 2011, 2010).

However, there is innate resistance or high tolerability to triclosan in some bacterial strains through bacterial efflux pumps, but this may be of little clinical significance in regards to SSIs (Leaper *et al.*, 2017).

A review of published literature for the use of triclosan coated sutures in the maxillofacial region illustrates the need for conscious decision making in the selection of suture materials post-surgery (Janani and Kumar, 2018). Sethi et al (Karde *et al.*, 2016) used antibacterial coated suture to prevent the colonization of periodontal pathogens and inhibition of oral biofilm formation in vitro, a comparative evaluation of sutures coated with triclosan and CHX. Their analysis showed a maximum biofilm inhibition potential with CHX-coated suture followed by triclosan-coated suture. Large in vivo studies and clinical trials comparing different materials are necessary to validate the efficacy of CHX-coated sutures and their use in a clinical scenario.

CONCLUSIONS

The in vivo results for CHX coated sutures did not meet expectations for their use in the oral cavity. Because of the cost, the apparent disadvantage of no decrease in colony count, the use of CHX-coated sutures is not recommended by the authors. However, the study is limited to the fact that identification of an individual colony was not carried out. A larger randomized controlled trial may be carried out to evaluate the efficacy of CHX coated sutures.

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Conflict Of Interest

The authors declare that they have no conflict of interest

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