Journal of Pharmaceutical Research International

32(19): 8-17, 2020; Article no.JPRI.59804
ISSN: 2456-9119
(Past name: British Journal of Pharmaceutical Research, Past ISSN: 2231-2919, NLM ID: 101631759)

Assessment of Incidence of Presence of Bacteria in Sutures of Maxillofacial Trauma Patients

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Authors' contributions

This work was carried out in collaboration among all authors. Author YS designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Authors AW and PSM managed the analyses of the study. Author PSM managed the literature searches. All authors read and approved the final manuscript.

Article Information

DOI:10.9734/JPRI/2020/v32i1930704
Editor(s):
(1) Dr. Ilknur Dag, Eskisehir Osmangazi University, Turkey.
Reviewers:
(1) Eugenio García Cano, Hospital Betania, Mexico.
(2) Suneel Kumar Punjabi, Liaquat University of Medical and Health Sciences (LUHMS), Pakistan.
(3) Tahrir N. Aldelaimi, University of Anbar, Iraq.
Complete Peer review History: http://www.sdiarticle4.com/review-history/59804

Original Research Article

Received 02 June 2020
Accepted 07 August 2020
Published 26 August 2020

ABSTRACT

Background: Sutures under selective host or environmental factors can potentiate postoperative surgical site infection. The present study characterized microbial recovery and biofilm formation from explanted absorbable and non-absorbable sutures from infected and non-infected sites of maxillofacial trauma patients.

Aim: The aim of the study was to assess the incidence of microbiology of explanted suture segments from infected and non-infected maxillofacial trauma patients.

Methods and Materials: Non absorbable and absorbable suture segments were collected at Randomly from 80 patients with two groups one group with infected sutures second group with non-infected sutures. Explanted sutures were recovered from maxillofacial trauma surgeries. Suture segments were obtained upon patient return to the clinic after seven days for review. All suture segments were collected aseptically. Designation of non-infected versus infected was determined by clinical presentation and criteria defined by the National Healthcare Safety Network of the Centers for Disease Control and Prevention. All the suture specimens were sent to University Microbiology department for bacterial culture and the results were studied.

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Results: A significant difference in mean microbial recovery between non infected and infected sutures were noted. Age distribution showed, males 86.25% and females 13.75% [Fig. 1]. Fig. 5 shows the Association of infected and non-infected suture groups with presence or absence of bacteria infected suture shows presence bacteria 13.75%, and non-infected suture showed presence of bacteria 6.25%, absence of bacteria 80.0%. Table 1- Presence or absence of infection cross tabulation showed, presence of bacteria in infected suture 11, presence of bacteria in non-infected suture 5 and absence of bacteria 64.

Conclusion: Within the limitation of study, we found that bacterial presence on the suture has a statistically significant role in causing postoperative infection. Any suture may be considered as a port of entry for infection, which in turn may compromise healing of the surgical wound. It is advised to minimize the duration of the presence of sutures, and their removal should be carried out as early as possible, according to the specific healing conditions.

Keywords: Absorbable and non-absorbable sutures; bacteria; infection; trauma.

1. INTRODUCTION

Most surgical procedures are finalized with sutures, which enables flap approximation and hemostasis, allowing restoration of function and esthetics [1]. Choosing an appropriate Suture material may influence wound healing, particularly in the oral cavity due to the various functions of the oral cavity and the presence of saliva [2]. In clinical situations, suture selection relies mostly on personal preference of the surgeon. Factors which are taken into consideration by the surgeon in suture selection include the surgical site, duration until their removal, ease of handling, and tensile strength. Due to the importance of infection and inflammation in the Healing process following surgery, the biological response to the suture material, such as tissue reaction and bacterial adhesion, should be included while considering the use of a specific Suture [2].

A great variety of suture materials are commercially available. Classification of sutures is based on the chemical and physical properties of each suture, as well as the biological processes occurring in the environment and the adjacent tissues [3]. Sutures are usually classified according to their bio absorbable properties or mechanical properties or according to their macrostructure monofilament vs. multi filament. Most studies focused on the inflammatory response to the suture material. Selvig et al. showed that changes in the surrounding tissue occurs immediately after placement of the sutures which peak after 3 days [4]. The healing was categorized by areas according to the histological findings: close to the Entry of the stitch canal adjacent to inflammatory cell exudate, the stitch canal which is associated with tissue fragments and damaged cells, the connective tissue infiltrated with inflammatorycells. Acute inflammation occurs due to the adherence of bacteria and their penetration into the stitch canal, which is mostly evident when using poly filament threads [5]. Poly filament sutures also showed higher numbers of bacteria residing inside the tissue.

Intrinsically, microbial contamination of the wound bed results in delayed wound healing, since the presence of bacteria in the wound at closure alters the local environment of the wound, lowering the oxygen tension within the wound and depressing fibroblast proliferation [6]. A heavily contaminated wound may present acutely with incisional dehiscence. When the wound microbial burden is low the infection may present as a late onset or chronic process that is nonresponsive to traditional therapeutic strategies [7].

Sutures function as a foreign body within the surgical wound, sequestering microbial contamination and under selective host conditions serving as a potential nidus for infection [8]. In the present study, suture segments were recovered from an intraoral area of surgical patients; and also recovered from documented infected cases. Additional suture segments were harvested from noninfected patients but were culture positive with commensal bacterial populations, including Staphylococcus and coagulase negative staphylococci.

So the rationale of this study was to assess the incidence of any bacterial presence in the sutures of maxillofacial trauma patients which if proven can be a potential factor in the etiology of post-operative infections in those patients.

2. MATERIALS AND METHODS

2.1 Study Setting and Data Collection

This was a Prospective Randomized controlled clinical conducted in patients from June 2019-March 2020 who had reported to Saveetha Dental College for treatments of maxillofacial trauma. Patients reporting to the Department of Oral and Maxillofacial Surgery with the diagnosis of maxillofacial trauma were included in this study. A final sample, which contains 80 patients were enrolled for the study.

2.2 Sampling

The study population included patients who underwent treatment for maxillofacial trauma at Saveetha Dental College by means of Systematic Sampling.

- Inclusion Criteria- Patients of all age groups and gender with maxillofacial trauma and who underwent open reduction and internal fixation treatment were included.
- Exclusion Criteria- Patients with common dental problems or underwent any major surgeries other than trauma were excluded from the study.

All patients enrolled in this were maxillofacial trauma patients. All were called after a week for review. Non absorbable and absorbable suture segments were collected from 80 patients with two groups, one group with infected sutures and the second group with non-infected sutures using block Randomization. Explanted sutures were recovered from maxillofacial trauma surgeries. Suture segments were obtained upon patient return to the clinic for after seven days for review. All suture segments were collected aseptically. Designation of noninfected versus infected was determined by clinical presentation and criteria defined by the National Healthcare Safety Network of the Centers for Disease Control and Prevention. All the suture specimens were sent to University Microbiology department for bacterial culture and the results were studied.

Duplicate patient records and incomplete data were excluded. Datas were reviewed by an external reviewer. Totally, n= 80 patients were included. Demographic data such as the patient's age, gender were also recorded.

2.3 Data Analysis

The data obtained were tabulated in Microsoft Excel 2016 (Microsoft office 10) and later exported to SPSS (Statistical Package for Social Sciences) for Windows version 20.0, SPSS Inc, Chicago IU, USA) and subjected to statistical analysis. Chi-square test was employed with a level of significance set at $p<0.05$.

3. RESULTS

A significant difference in mean microbial recovery between non-infected and infected devices was noted. Age distribution shows males 86.25% and females 13.75% Fig. 1, Fig. 2 shows gender distribution associated with infected and non-infected sutures at infected sutures males 6.25% and females 7.50%, non-infected sutures males 80% females 6.25%, Fig. 3 shows age group distribution as 17-27 years, 28-38 years, 39-49 years, above 49 years, Fig. 4 shows association of age group with presence of bacteria in age group distribution, Fig. 5 Association of infected and non-infected suture groups with presence or absence of bacteria. The infected suture shows presence of bacteria of about 13.75%, and noninfected suture shows presence of bacteria in only 6.25% and absence of bacteria 80.0%. The commonest bacteria present in non-infected sutures were Streptococcus mutants and sanguis, oralis and lactobacillus which occupy 19.63% and fusobacterium and peptostreptococcus, staphylococcus which occupies 8.74%, where as in case of infected sutures, the bacteria present were lactobacillus and, streptococcus, mutans, viridans and oralis occupy 18.76% and staphylococusviridan,peptostreptoocus,actiniomyces,fusobacterium,Neisseria species occupy 56.31%. Table 1 shows the suture and presence or absence of bacteria cross tabulation shows presence bacteria in infected suture in all 11 patients, presence of bacteria in non-infected suture were found in 5 patients and absence of bacteria in 64 patients. Table 2 shows age group and gender cross tabulation 17- 27 years were 31 males and 3 females, and in the age group 28 - 38 years, there were 21males and 5 females and in the age group of 39-49 years, there were 11 males,3 females, and in above 49 years age group, there were 6 males. Table 3 shows Association of age group with presence of bacteria cross tabulation in that presence of bacteria in infected suture in 17- 27 years is in only 1patient, and in the age group of 28- 38 years they were 3 patients, and in the age group of 39- 49 years, there were 3 patients and in above 49 years, there were only 4 patients. And in Non-infected suture shows presence of bacteria were seen in one patient in each age group.

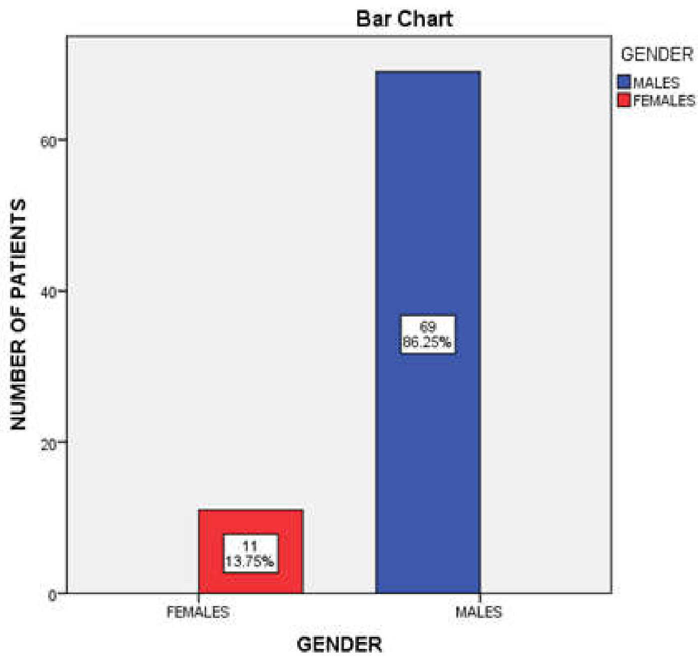

Fig. 1. Bar graph showing Gender distribution of study population. X axis represents gender group and Y axis represents number of patients. From the graph, it is observed that prevalence of male patients(86.25%) is more when compared to females(13.75%)

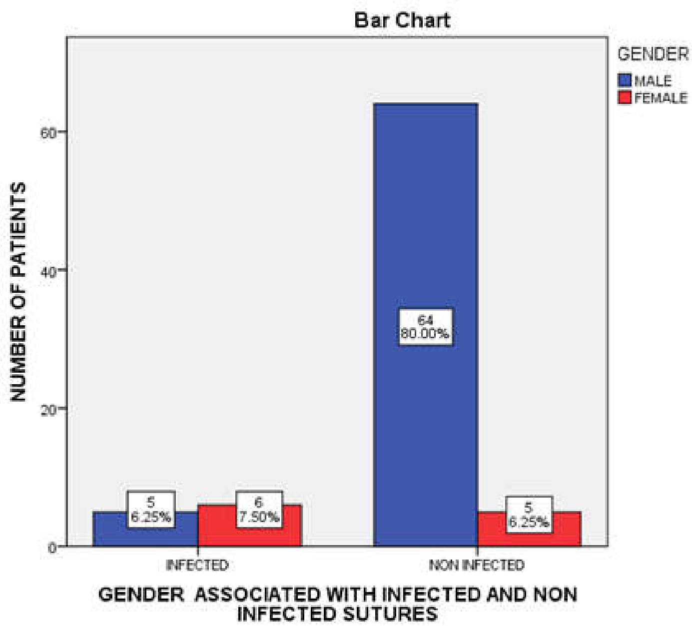

Fig. 2. Bar graph showing Gender distribution of study population of infected non infected suture patients. X axis represents gender group and Y axis represents number of patients. From the graph, it is observed that prevalence of male patients(86.25%) is more when compared to females(13.75%) in non-infected group and females prevalence is more in infected group

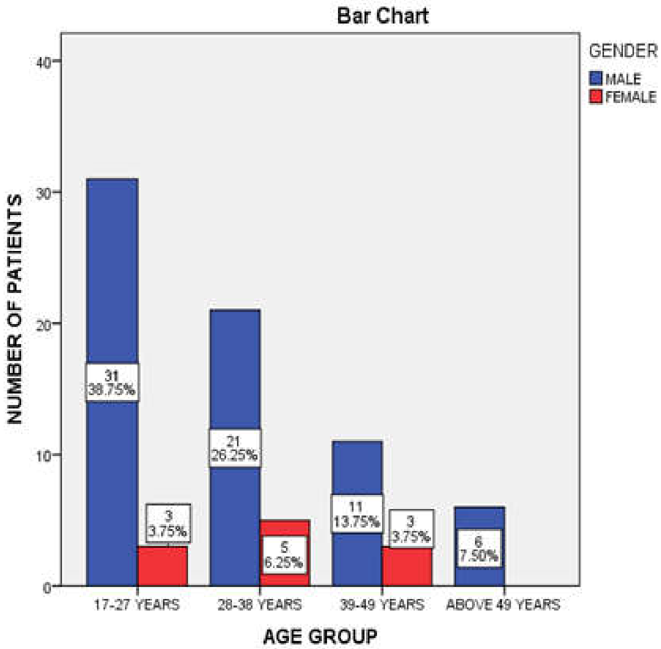

Fig. 3. Bar graph showing age group distribution of study population. X axis represents gender group and Y axis represents number of patients. From the graph, it is observed that prevalence of patients under 17-27 were more (38.75%) is more when compared to other age groups. Chi Square test done. Pearson's chi square value -3.007 df-3 and p value is 0.391 (p>0.05) hence statistically non-significant

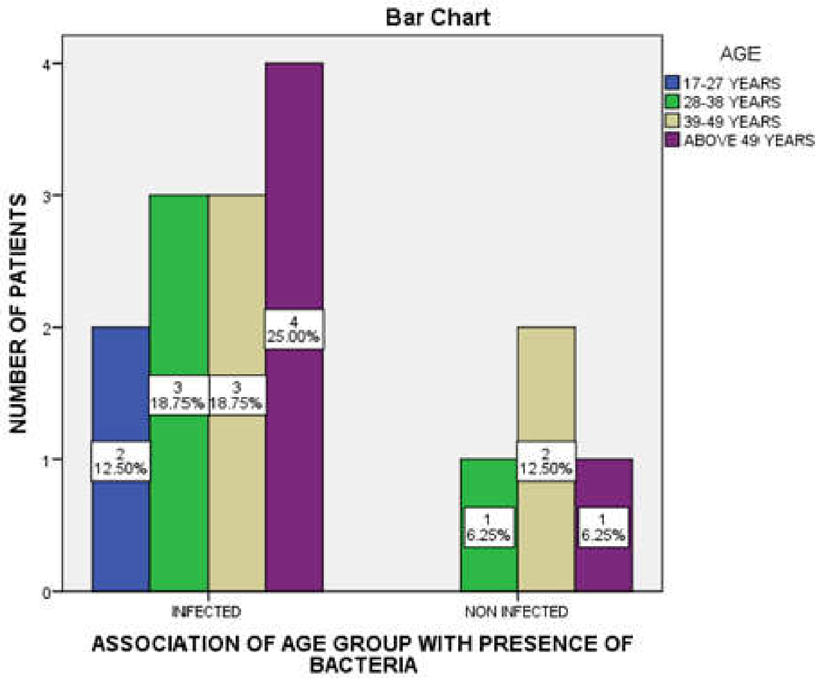

Fig. 4. Bar diagram showing the association of age groups with presence of bacteria. X axis represents the age group in infected and non-infected suture groups and Y axis represents number of patients with bacterial presence. From the graph, it is observed that bacteria were present mostly in the sutures of patients above 49 years when compared to other groups. Chi-square test done. Pearson's Chi square value1.333.df -3 .p value 0.721(p>0.05).hence statistically non-significant

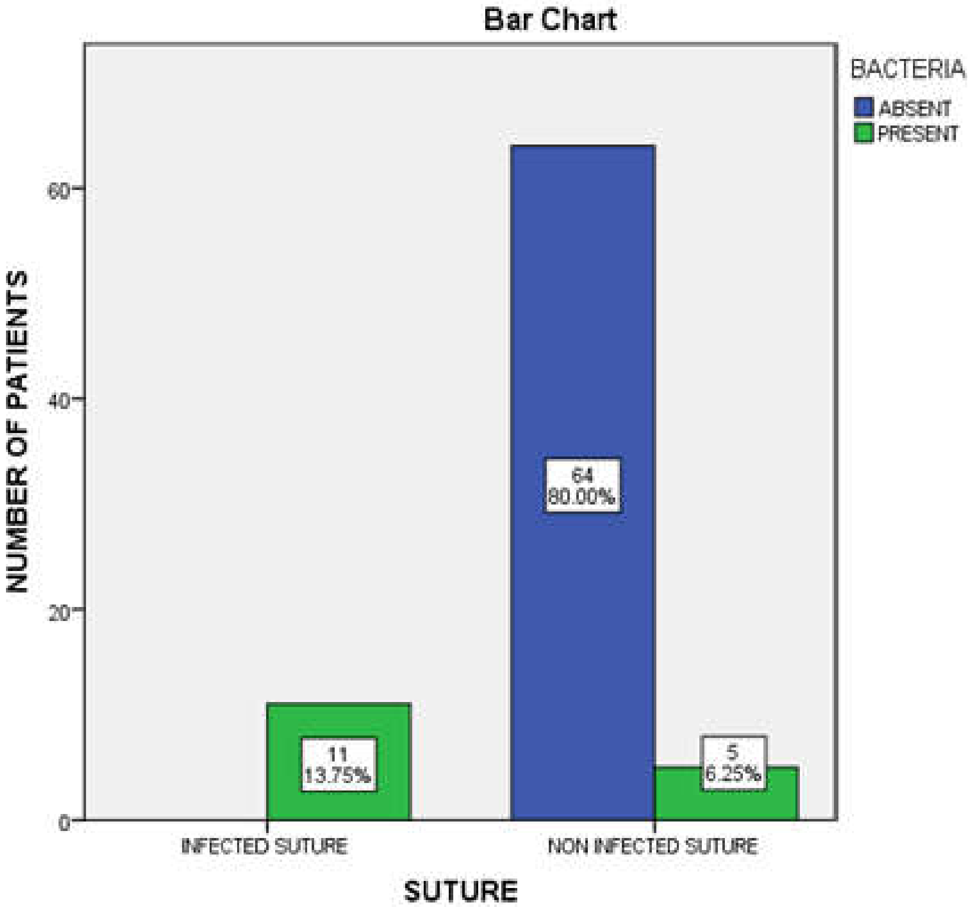

Fig. 5. Bar diagram showing the association of infected and non-infected suture group with presence or absence of bacteria. From the graph it is observed that the presence of bacteria is mostly common in all infected suture patients whereas the in non-infected suture patients, only 6.25%presence of bacteria. Chi square test, df-1 and p value 0.000(p<0.05) hence statistically significant

Table 1. Suture * Bacteria cross tabulation

Count

		Bacteria		Total
		Absent	**Present**	
Suture	Infected	0	11	11
	Non Infected	64	5	69
Total		64	16	80

Chi-square tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	51.014[a]	1	.000		
Continuity Correction[b]	45.382	1	.000		
Likelihood Ratio	44.189	1	.000		
Fisher's Exact Test				.000	.000
N of Valid Cases	80				

Table 2. Age group and gender crosstabulation

Count

		Gender		Total
		Males	**Females**	
Age group	17-27 years	31	3	34
	28-38 years	21	5	26
	39-49 years	11	3	14
	above 49 years	6	0	6
Total		69	11	80

Chi-square tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	3.007[a]	3	.391
Likelihood Ratio	3.765	3	.288
N of Valid Cases	80		

a. 4 cells (50.0%) have expected count less than 5. The minimum expected count is .83

Table 3. Association of age group with presence of Bacteria cross tabulation

Count

		Age group				Total
		17-27 years	**28-38 years**	**39-49 years**	**above 49 years**	
Presence of Bacteria	Infected suture	1	3	3	4	11
	Non-infected suture	1	1	2	1	5
Total		2	4	5	5	16

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	1.333[a]	3	.721
Likelihood Ratio	1.762	3	.623
N of Valid Cases	16		

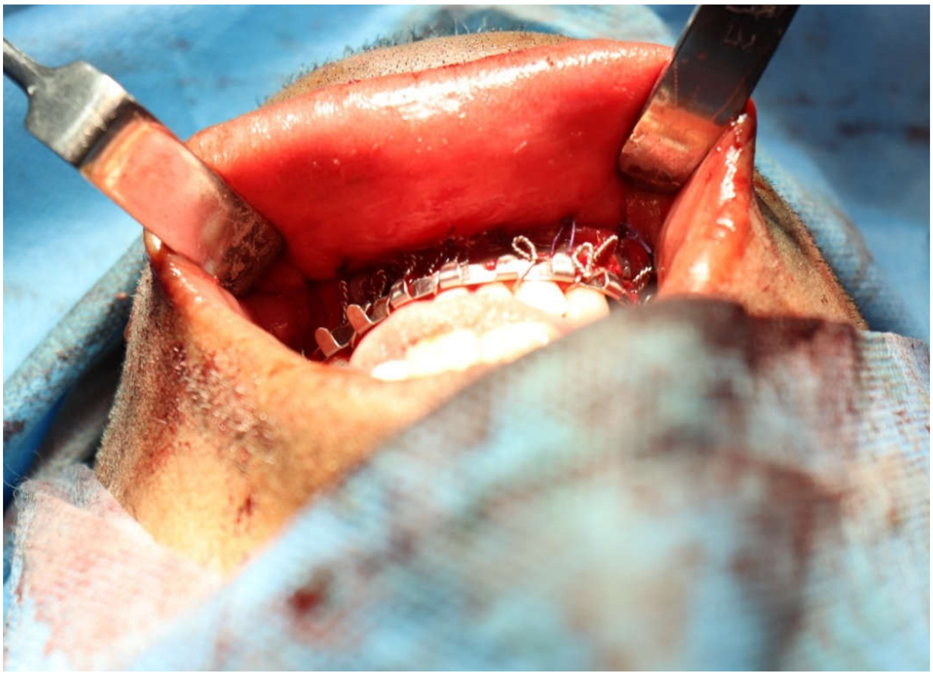

Fig. 6. Shows presence of suture in non-infective case

Fig. 7. Shows the presence of sutures in infected patient

4. DISCUSSION

Sutures function as a foreign body within the surgical wound, sequestering microbial contamination and under selective host conditions serving as a potential nidus for infection [8]. In the present study, suture segments were recovered from an intra-oral area of surgical patients; and also recovered from documented infected cases. Additional suture segments were harvested from noninfected patients but were culture positive with commensal bacterial populations, including Staphylococcus and coagulase negative staphylococci. A bacterial biofilm was observed on 100% of infected suturing devices, the majority of which were from device related infections, while only 2/3 of the non-infected culture positive sutures examined harbored a surface biofilm. These findings are complementary to previous in vitro studies which suggest that bacterial adherence to surgical sutures is associated with the formation of a luxurious bacterial biofilm [9,10]. A significant difference in biofilm formation in the randomly sampled suture segments was noted. The reason for this difference at first glance is less than intuitive, since previous work conducted in our laboratory has suggested that biofilm-forming staphylococcus commonly inhabits selective hospitalized patients [11]. The failure to detect a biofilm in 1/3 of the sampled suturing devices may be due in part to device processing or sentinel wound defense factors commonly operative in the normal host. It is well documented that the first 48 hrs following mucosa closure is a period of intense granulocytic cell activity within the wound bed. The presence of a suture actually intensifies this process, which can typically be documented by observing redness along the intact suture line. Ironically, the presence of a foreign body left within the wound can also exacerbate infection in the presence of wound contamination, since it lowers the inoculum burden required for infection in a clean surgical wound [12,13,14].

Using a mouse model with radio labeled bacteria, Katz et al. found similar results and reported lower adhesion of bacteria to nylon sutures in comparison to the other suture materials [5]. This notion is also in accordance with other studies, which showed that multifilament absorbable braided sutures have higher bacterial counts compared to monofilament non resorbable sutures [1]. Leknes et al. also showed that nylon and vicryl suture exhibited less adhesive properties compared to silk suture, both in the surrounding connective tissue infiltrate and in the presence of bacterial plaque inside the suture canal [3]. On the other hand, Banche et al. showed that an absorbable monofilament suture, Monocryl, exhibited significantly low microbial load [2].

The flow of bacteria along the suture canal from the oral environment and into the tissues causes an inflammatory response [15]. As a consequence, the medical and dental literature stresses the harmful effect of bacterial adhesion to suture materials and also states a clear advantage of monofilament non absorbable suture [16,17]. One very interesting conclusion was noted by Edlich et al. that the chemical structure of the suture appeared to be the most important factor in the development of surgical infection while the physical configuration of the suture played a relatively minor role [18,19-29].

5. CONCLUSION

Within the limitation of study we found that bacterial presence on the suture has a statistically significant role in causing postoperative infection in maxillofacial trauma patients. Any suture may be considered as a port of entry for infection, which in turn may compromise healing of the surgical wound. So to prevent post-operative infections in maxillofacial trauma patients, it is advised to minimize the duration of the presence of sutures, and their removal should be carried out as early as possible, according to the specific healing conditions even though absorbable sutures were placed.

6. LIMITATIONS OF THE STUDY AND FUTURE SCOPE

This study is of shorter duration with limited population. So to ascertain the findings of our study we have to do further studies in the future with large sample size and longer duration. This can be of helpful to find the role of antibiotics in patients undergoing therapeutic orthodontic extractions.

CONSENT

As per international standard or university standard, respondents' written consent has been collected and preserved by the author(s).

ETHICAL APPROVAL

Ethical committee approval for this study was obtained from the Institutional Ethics Committee with the following ethical approval number. SDC/SIHEC/2020/DIASDATA/0619-0320.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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Peer-review history:
The peer review history for this paper can be accessed here:
http://www.sdiarticle4.com/review-history/59804