

EVALUATION OF KNOTLESS BARBED SUTURE IN INTRAORAL SURGICAL PROCEDURES-SPLIT MOUTH STUDY

Dr. A Srujana Reddy¹, Dr. L Krishna Prasad MDS², Dr. Musunuri Manoj Kumar MDS,
FTMJF RCSEd^{3*}, Dr. S Anand Vijay⁴, Dr. P Raja Satish MDS⁵, Dr. B Vidya Sagar MDS⁶

² Professor & HOD, Department of Oral & Maxillofacial Surgery, SIBAR Institute of Dental Sciences, INDIA

^{4,5} Professor, Department of Oral & Maxillofacial Surgery, SIBAR Institute of Dental Sciences, INDIA

³ Associate Professor, Department of Oral & Maxillofacial Surgery, SIBAR Institute of Dental Sciences, INDIA

⁶ Senior Lecturer, Department of Oral & Maxillofacial Surgery, SIBAR Institute of Dental Sciences, INDIA

¹ Post Graduate, Department of Oral & Maxillofacial Surgery, SIBAR Institute of Dental Sciences, INDIA

ABSTRACT

Introduction: Effective wound closure is critical in oral and maxillofacial surgery to ensure hemostasis, reduce infection risk, and promote optimal healing. Traditional silk sutures, while widely used, rely on knots that may harbour bacteria and disrupt tension distribution. Knotless barbed sutures, designed with barbs along their length, offer potential advantages by eliminating knots and evenly distributing tension. This study compared barbed and silk sutures in intraoral surgeries, evaluating closure time, healing, and bacterial colonization.

Materials and Methods: A single-blind, split-mouth clinical trial was conducted on 15 patients undergoing bilateral intraoral surgical procedures. One side was closed with barbed sutures and the contralateral side with silk sutures. Closure time was recorded intraoperatively. On day seven, wound healing was assessed using the Landry index, and removed sutures were evaluated microbiologically for bacterial colonization (CFU/ml). Data were analyzed using SPSS v26 with t-tests and Mann-Whitney U tests; $p < 0.05$ was considered significant.

Results: Barbed sutures significantly reduced closure time (93.26 ± 115.53 s) compared to silk (231.80 ± 201.99 s; $p = 0.02$). Wound healing scores were significantly better with barbed sutures (mean rank 20.07 vs. 10.93; $p < 0.001$). Bacterial colonization was also markedly

lower on barbed sutures (59466.66 ± 10815.77 CFU/ml) than silk (102533.33 ± 211673.33 CFU/ml; $p < 0.001$).

Conclusion: Knotless barbed sutures offer a promising alternative to conventional silk sutures in oral surgeries, reducing operative time, improving healing, and lowering infection risks, thus enhancing both surgical efficiency and patient outcomes.

Keywords: Barbed sutures, silk sutures, oral surgery, wound healing, bacterial colonization, knotless sutures

Introduction:

Effective closure of wounds is essential for achieving favourable results in oral and maxillofacial surgical interventions. Suturing is regarded as the gold standard for approximating soft tissue flaps, ensuring hemostasis, reducing dead space, and promoting swift, predictable healing^[1]. Primary closure not only accelerates recovery but also alleviates postoperative pain and functional limitations when compared to secondary healing.^[2,3] Considering that nearly 11 million wounds are treated each year in emergency departments across the United States, with approximately 90 million skin suturing procedures conducted annually, the clinical and economic ramifications of wound management are significant.^[3] The selection of suture material, gauge, and technique is vital in reducing complications such as wound dehiscence, delayed healing, excessive scarring, and infection.^[1,4,5] Conventional suture materials like silk and Vicryl, although commonly utilized, depend on knotting to secure the edges of wounds. Nevertheless, knots can serve as sites for bacterial colonization, disrupt the even distribution of tension along the wound, and may loosen over time, thereby heightening the risk of local infections and delayed wound healing^[6,7]. Intraoral wounds are especially vulnerable due to the intricate micro-biome of the oral cavity, where pathogens such as Streptococcus species, Fusobacteria, and anaerobes like Prevotella and Porphyromonas can adhere to suture surfaces, resulting in local infections, impaired healing, or even systemic complications such as bacteraemia and endocarditis^[7,8]. To overcome these limitations, innovative suture technologies, such as knotless barbed sutures, have been introduced. These sutures are designed with barbs along their length that secure into tissue, allowing for even tension distribution and eliminating the necessity for knots.^[9] The lack of knots minimizes potential sites for bacterial entrapment, may reduce operative time, and could lessen postoperative irritation. Barbed sutures have shown

encouraging results across a range of surgical fields including plastic, laparoscopic, and cardiovascular surgeries by improving wound integrity and shortening closure times.^[10,11] However, their application in oral and maxillofacial surgery is still relatively under-researched. In light of these factors, this study intends to compare the clinical efficacy of knotless barbed sutures against traditional silk sutures in the context of oral and maxillofacial surgical wound closure. It specifically examines wound closure duration, healing quality (including inflammation and scarring), and bacterial colonization on the suture material. By methodically evaluating these factors, the study aims to identify which type of suture provides better outcomes in facilitating efficient wound healing, minimizing infection risk, and improving overall patient recovery. This evidence could assist clinicians in choosing the most effective suturing techniques, thereby enhancing surgical care in the field of oral and maxillofacial surgery.

Methodology:

The present study was designed as a single-blind, bilateral split-mouth clinical trial conducted in the Department of Oral and Maxillofacial Surgery at the SIBAR Institute of Dental Sciences, Takkellapadu. The study period extended from March 2023 to October 2024. Ethical clearance was obtained from the institutional ethics committee (IEC protocol no: Pr.182/IEC/SIBAR/CIR/2023) and approved by Dr. NTRUHS, Vijayawada (Reg. No: ECR/1362/Inst/AP/2020). All participants were informed about the nature and purpose of the study, and written informed consent was obtained prior to enrolment. The sample size was determined using G POWER software version 3.1.9.7, with an effect size of 0.8, α error probability of 0.05, and power of 0.90, resulting in a total sample size of 15. Patients reporting for intraoral surgical procedures who were classified as ASA I or II and willing to provide consent were included. Patients with active space infections, ongoing antibiotic therapy for systemic conditions, or uncontrolled diabetes were excluded from the study. Each patient underwent a split-mouth design procedure, where one side was randomly assigned to closure with a bidirectional reverse cutting 3-0 barbed suture and the contralateral side with a braided reverse cutting 3-0 silk suture. All procedures were performed by the same surgeon to minimize operator bias. The primary outcomes measured included the time required for wound closure, wound healing, and microbial colonization on the suture material. The duration of suturing was recorded intra-operatively using a stopwatch. Patients were recalled after seven days for suture removal. At this visit, wound healing was assessed using the Landry et al. wound healing index, which categorizes healing from very poor (score 1) to

excellent (score 5) based on clinical parameters such as tissue colour, bleeding on palpation, presence of granulation tissue, and epithelialization of wound margins. Sutures removed at this appointment were subjected to microbiological analysis using the grid manual method to quantify bacterial colonization. Any adverse effects, including the need for re-suturing, were documented. Blinding was maintained by ensuring that the statistical analysis was performed without revealing group allocation. Only after the completion of the statistical analysis were the data un-blinded for interpretation. Data were analysed using SPSS version 26. Means and standard deviations were calculated for continuous variables. The independent sample t-test was used to compare microbial counts between the two groups, while the Mann-Whitney U test was employed to compare wound healing index scores. A p-value of <0.05 was considered statistically significant.

Results:

Table 1 presents the gender distribution of the study participants, indicating that 53.3% were male and 46.7% were female. The distribution of participants based on the type of intraoral surgical procedure is detailed in Table 2. The majority of cases involved impaction surgeries (53.3%), followed by trauma-related procedures (26.7%) and Alveoloplasty (20%). A comparison of the time required for suturing at both surgical sites, analysed using an independent t-test, is shown in Table 3. The results demonstrated a statistically significant difference between the two groups (p = 0.02). Assessment of wound healing using the Landry Wound Healing Index revealed a highly significant difference (p < 0.001) between the sites sutured with barbed and conventional silk sutures, as summarized in Table 4. Additionally, Table 5 shows the comparative analysis of mean bacterial colony-forming units per millilitre

Gender	n	%
Male	8	53.3%
Female	7	46.7%

(CFU/ml) recovered from the suture materials, with the independent t-test indicating a statistically significant reduction in bacterial colonization at the sites closed with barbed sutures (p < 0.001).

Table 1 Distribution of study participants according to gender

Type of Surgery	n	%
Impaction	8	53.3%
Alveoloplasty	3	20%
Trauma	4	26.7%

Table 2 Distribution of study participants according to type of Intra Oral Surgery done

SITE	MEAN±SD	t Value	P Value
SITE 1	93.26±115.53	2.306	0.02*
SITE 2	231.80±201.99		

Table 3 Comparative Analysis of Time taken(sec) for suturing among both the sites using Independent t test

*p≤0.05 is considered as statistically significant

SITE	MEAN RANK	Z Value	P Value
SITE 1	20.07	3.322	0.00*
SITE 2	10.93		

Table 4 Comparative analysis of Wound Healing Scores according to Landry Healing Index among both the sites using Mann-Whitney U test

*p≤0.05 is considered as statistically significant

SITE	MEAN±SD	t Value	P Value
SITE 1	59466.66±10815.77	10.481	0.00*
SITE 2	102533.33±211673.33		

Table 5 Comparative analysis of Microbial count (CFU/ml) using independent t test

*p≤0.05 is considered as statistically significant

Discussion

The present study investigated the comparative efficacy of barbed sutures versus conventional silk sutures in oral surgical wound management, specifically assessing wound closure time, healing outcomes via the Landry index, and bacterial adherence at suture removal. The findings contribute to the evolving literature on optimizing suture materials and techniques in oral and maxillofacial surgery. Wound closure time was markedly shorter with barbed sutures (mean: 93.26 s) compared to silk sutures (231.80 s), indicating a statistically significant advantage. This aligns with Rubin et al.^[12] who reported considerable reductions in closure times when using barbed sutures, especially in procedures not requiring deep dermal suturing, saving an average of 10.3 minutes. Similarly, Mansour et al.^[13] demonstrated a 40% reduction in spinal wound closure time using barbed sutures, translating into a cost saving of approximately \$884.60 per procedure. Such time efficiency minimizes anaesthesia duration and overall operative risks, particularly relevant in oral procedures often performed under local or short-duration general anaesthesia. Wound healing quality, evaluated through the Landry Wound Healing Index, was superior in the barbed suture group (mean rank 20.09) compared to the silk suture group (10.93). This is consistent with Gazivoda et al.^[14], who found that advanced suture materials like polyglactin 910 yielded lower infection, edema, and hematoma rates than traditional materials. Our results extend these observations by demonstrating that knotless barbed sutures may provide even better outcomes in terms of wound stability and reduced complication rates. The multi-point fixation of barbed sutures distributes tension evenly, reducing localized ischemia that can compromise healing (Joshi et al.; Gogulanathan et al.).^[15,16] Bacterial adherence findings showed significantly lower counts on barbed sutures (59466.66 CFU) versus silk (102533.33 CFU). This mirrors Edmiston et al.^[17] who reported lower bacterial adherence on barbed monofilament sutures like Quill compared to traditional braided or even triclosan-coated sutures. The absence of knots which can serve as bacterial niduses coupled with the monofilament structure likely underpins this reduced colonization. These findings are important in the oral cavity where a complex, bacteria-rich environment elevates the risk of postoperative infections. Historically, suturing has undergone remarkable evolution, from linen used in ancient Egypt (Edwin Smith Papyrus, ~1600 BCE) and catgut popularized by Galen (~150 CE), to Sushruta's documentation of silk and gut techniques in India around 500 BCE (Sushruta Samhita). Joseph Lister's introduction of antisepsis in the late 19th century and Johnson & Johnson's sterilized catgut in 1887 dramatically reduced infections. These milestones paved the way for

modern absorbable and synthetic suture materials. Recent decades introduced synthetic polymers like polydioxanone (PDS), polyglactin 910 (Vicryl), and polyglycolic acid (Dexon), offering predictable absorption, improved tensile strength, and reduced tissue reactivity.^[18] Barbed sutures represent one of the most innovative leaps, first patented by John Alcamo in 1964, refined through McKenzie's bidirectional concept, and later advanced by Sulamanidze's APTOS threads for aesthetic lift procedures.^[19,20] Subsequent improvements by Wu and Isse integrated multi-barb geometries for superior tissue engagement in facial and reconstructive surgeries.^[20] The design has since found applications across disciplines, including general surgery, orthopaedics, urology, and now increasingly in oral and maxillofacial procedures. In dentistry, especially oral surgery, silk sutures have long been preferred for their flexibility and handling. However, their multifilament nature promotes capillarity, increasing bacterial wicking and inflammatory response. Over time, silk undergoes phagocytosis, losing tensile strength and becoming encapsulated or absorbed within 1-2 years (Rajih et al.; Greenberg and Clark).²¹ This makes them less ideal for situations requiring prolonged support. Barbed sutures overcome these limitations by eliminating knots, which reduces bulk and local ischemia, ensures uniform tension along the wound, and shortens operative times (Rubin et al.; Mansour et al.).^[22,23] They also mitigate risks such as knot slippage and extrusion. The barbs engage tissue along the entire length, providing secure closure even under dynamic forces typical in oral musculature. Additionally, their reduced bacterial adherence, as corroborated by studies on monofilament and antimicrobial-coated sutures, emphasizes their value in minimizing infection risks (Edmiston et al.).^[17] The purpose of this study is to evaluate the effectiveness of traditional silk sutures and knotless barbed sutures after Oral and Maxillofacial surgery. The study's direct comparison of these two suture types, which offers thorough insights into important aspects including wound closure duration, healing, and bacterial colonization, is one of its main benefits. The study's robustness is increased by the multifactorial assessment approach, which uses bacterial cultures and standardized clinical grading systems to objectively evaluate wound healing. Furthermore, by identifying the type of suture that performs better in terms of healing and infection rates, the study may have a direct impact on patient outcomes, making it clinically relevant. Additionally, the study establishes the groundwork for future investigations into suture materials in a variety of surgical specialties. There are certain limitations to consider in the present study one of the primary concern is the sample size, as small sample may lack statistical power to detect meaningful differences between the suture types. Variability among patients such as differences in age, immune status, and

comorbidities could introduce variability in the results, affecting the generalizability of the findings. Moreover, postoperative care variability could confound the results, as differences in wound care and antibiotic use might impact healing and bacterial colonization. Additionally, the study may be limited by the follow-up duration, as long-term complications such as scar formation or chronic infection might not be fully captured with short-term assessments. To overcome these limitations, increasing the sample size, standardizing surgical techniques and postoperative care, extending the follow-up period, and controlling for potential confounding variables would help to strengthen the study.

Clinical Significance

In oral surgery, alveolar osteitis is still frequently difficult to treat, which frequently causes patient discomfort and slows healing. This study demonstrates how Platelet-Rich Fibrin (PRF) is more effective than ozone gel at lowering pain, inflammation, and promoting soft tissue repair in cases of dry socket. Because PRF is an autologous, affordable, and simple-to-prepare biomaterial, it offers physicians a safe and biocompatible way to encourage quicker healing and raise patient satisfaction. The results lend credence to the use of PRF in standard postoperative treatment for patients with alveolar osteitis. Even though this study shows that Platelet-Rich Fibrin (PRF) is more effective than ozone gel for treating alveolar osteitis, more research is necessary to support these conclusions. To improve the generalizability of findings, future research should incorporate multicenter trials and bigger sample sizes. To assess the recurrence rate, bone healing quality, and general patient satisfaction, long-term follow-up is required. Furthermore, investigating the usage of PRF and ozone gel together may show possible synergistic advantages. Its clinical uses should be further expanded by looking into standardized PRF preparation procedures and assessing its function in various oral surgical circumstances. Additionally, incorporating patient-reported outcome measures (PROMs) and cost-effectiveness analysis will promote evidence-based practice and wider clinical adoption.

CONCLUSION

In conclusion Barbed sutures offer a significant advancement over traditional suturing techniques, particularly in challenging intraoral procedures. By eliminating the need for knot tying, they streamline wound closure, reduce operative time, and provide secure, tension-free

approximation. Their absorbable nature further enhances patient comfort by minimizing the need for suture removal. While considerations such as potential bacterial adherence and difficult removal exist, overall, barbed sutures improve surgical efficiency and patient outcomes, representing a valuable alternative to conventional sutures in modern surgical practice.

CONFLICT OF INTEREST

The authors declare that there are no conflicts of interest related to this study. No financial support, sponsorship, influenced the outcome or interpretation of the research presented.

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