

Original Research Article

TITLE

Effectiveness of Knotless Barbed Sutures for Closure of Intraoral Incisions after Impacted Mandibular Third Molar Surgery: A Split Mouth Randomized Clinical Trial

ABSTRACT

Objectives: The aim of the present clinical trial study is to compare the effectiveness of 3-0 knotless barbed suture (polydioxanone) with 4-0 polyglactin 910 (vicryl) in achieving wound closure after impacted mandibular third molar surgery.

Methods: This prospective study included 20 patients who had been referred to the Oral Surgery Clinic at Department of Oral and Maxillofacial Surgery for bilateral mandibular third molar impaction of similar difficulty index enrolled in the split mouth study. Samples were allocated on the basis of simple randomization. Wound closure was done using 3-0 knotless suture for the study group and 4-0 polyglactin 910 (vicryl) for the control group following extraction. The clinical outcome parameters that were measured were (1) time taken to achieve wound closure and haemostasis, (2) post-operative wound healing using “Landry’s wound healing index” on 1st, 3rd and 7th post-operative days, following surgical extraction in relation to impacted mandibular molars under local anaesthesia.

Results: In this study we observed, the mean time taken for wound approximation was 2.69 min and 4.27 min for the study and control groups respectively. Statistically significant difference in suturing time was noted between the study and control group (p-value <0.05). Wound healing was found to be better and statistically significant in the study group than the control group on all the postoperative review days (p-value<0.05).

Conclusion: Within the limitations of the present study, knotless barbed suture is a promising alternative to conventional sutures for intra-oral wound closure as it reduces suturing time and facilitates effective wound closure following surgical removal of impacted mandibular third molars.

Keywords: third molar; knotless sutures; barbed sutures; mandibular molar; intraoperative time; wound healing, polyglactin 910 suture

INTRODUCTION

Conventional suturing requires placement of knots to secure the suture material to the tissues and to maintain adequate tension at the approximated wound margin [1,2]. Surgical knots are simply a necessary evil needed to anchor smooth suture to allow it to function in its role in tissue re-approximation [3]. Suturing after maxillofacial surgery procedures presents with the following technical difficulties: restricted access, difficulty in instrumentation, difficulty in securing knot [4]. As surgical knots act as a nidus of accumulation of food debris, they can lead to numerous knot related complications such as infection and soft tissue irritation.

Intraoral suturing in maxillofacial surgery should be aimed at the following; re-adaptation and maintenance of the surgical flaps in normal anatomical position to facilitate wound healing, providing water-tight closure to avoid contamination of the surgical site by saliva and food debris, prevention of implant exposure [5–7] and providing adequate strength against the dynamic peri-oral muscles [7].

Surgical removal of impacted third molar is the most frequently performed procedure by a maxillofacial surgeon [8]. Wound closure following removal of impacted third molar is generally achieved by suturing. However, suturing after mandibular third molar surgery presents with the following technical difficulties: restricted access, difficulty in instrumentation, difficulty in securing knot [7]. In addition, numerous knot related complications have been documented in literature such as accumulation of food debris leading to infection and soft tissue irritation [7, 9] and the knots could cause ischemia due to additional pressure which predisposes the wound to infection. Improper suturing also leads to complications such as wound dehiscence, infection, and post-operative pain [10].

Knotless suturing is an innovative method of wound closure used in the fields of bariatric surgery [11], abdominoplasty [12], facial rejuvenation procedures [13], arthrotomy [14], laparoscopic myomectomy [15], partial nephrectomy [16], and in various minimally invasive procedures. The configuration allows the suture to be self-anchoring, allowing close approximation of tissue while resisting the migration that can occur with swelling.

Previously our team had a rich experience in working on various research projects across multiple disciplines [17–31]. Now the growing trend in this area motivated us to pursue this project. Based on this inspiration we aim to assess the effectiveness of knotless barbed

sutures for intra oral wound closure following surgical removal of impacted mandibular third molar surgery. This research study explores to assess the intraoperative wound closure time and postoperative wound healing following placement of knotless barbed sutures versus conventional vicryl sutures in minor oral surgery.

MATERIALS AND METHODS

Study Setup:

This randomized prospective controlled clinical study was conducted among patients reporting to the outpatient dental department of Oral Surgery Clinic during the period between June 2020- March 2021. The study population included 20 adult patients who were randomly selected and had been referred to the department of oral and maxillofacial surgery for surgical removal of bilateral impacted mandibular third molars. Patient with similar difficulty index were recruited for this clinical study based on preoperative assessment of orthopantomogram. The study was done using the 'split-mouth method', where one side was assigned for Knotless suture (study group) and the contra-lateral side for polyglactin 910 suture (control group). Removal of the impacted molars in the opposite arch was done one month after the first surgery.

In the Study group intraoperative wound closure was achieved with 3-0 knotless barbed suture. In the Control group intraoperative wound closure was achieved with polyglactin 910 suture.

Inclusion Criteria:

- Patients between 18 years-50 years of age
- Both genders
- Patients belonging to ASA 1 (American society of anaesthesiology) category
- Patients with clinical and radiographic records requiring surgical removal of bilaterally impacted mandibular third molars.
- Patients with impacted teeth of similar difficulty index and willing to undergo the surgical procedure

Exclusion Criteria:

- Patients with incomplete clinical and radiological records.
- Patients with severe systemic conditions like diabetes and hypertension.
- Patients with any history of medication with anticoagulants and those with known history of lignocaine allergy

Procedure:

Surgical removal of the impacted teeth was performed under local anaesthesia. The surgical procedure was standardized as follows; 2% lignocaine hydrochloride with 1:80,000 adrenaline bitartrate was administered as inferior alveolar and buccal nerve blocks. Conventional Ward's incision was placed to raise a mucoperiosteal flap [32]. Bone removal was done using a surgical drill under cold saline irrigation for surgical exposure and delivery of the tooth. Haemostasis was achieved and wound closure was performed with 4-0 polyglactin 910 suture (Ethicon Inc., Somerville, NJ, USA) (dyed) for the control group and 3-0 knotless suture (Covidien V-loc 90 knotless absorbable wound closure device) [Figure 1] for the study group respectively. The technique of suturing was two simple, interrupted sutures for the polyglactin 910 group. For the knotless group, suturing proceeded from the distal end of the wound (2nd molar) to the proximal end, by utilizing a continuous suturing technique. This engaged the barbs deeper into tissues and approximated the wound margins in a firm manner. The sutures were then cut closer, flush with the tissues with no exposure of suture material in the oral cavity [4].

Diagnostic Criteria:**1. Intraoperative wound closure time:**

The time taken to complete the suturing was measured in minutes, by using a stopwatch.

2. Post Operative Wound Healing:

Post operative wound healing was assessed using "Landry's wound healing index" on the 1st, 3rd and 7th post-operative days. The wounds were assessed based on characteristics such as tissue colour, response to palpation (bleeding), presence of granulation tissue, incision margin (epithelialization and exposure of connective tissue) and suppuration (present/ absent). The scores are ranged from 1 to 5; very poor (1) poor (2), good (3), very good (4) and excellent wound healing (5).

Study Parameters:

The following data were extracted for the purpose of the study:

- Age of the patient
- Gender of the patient
- Intraoperative wound closure time
- Post operative wound healing on 1st, 3rd and 7th day

The subjects were divided into four age groups- Group 1: 11-20 years, Group 2: 21-30 years, Group 3: 31-40 years, Group 4: 41-50 years.

Data Collection:

The data related to the study parameters were obtained from among patients who reported to the Outpatient Department from June 2020- March 2021. Approval for the study was obtained from the Institutional Ethical Committee. All assessments were done by a single examiner and the findings were reviewed and recorded by two investigators. Written informed consent was obtained from the patients.

Statistical Analysis:

The data was tabulated and analysed using IBM SPSS version 23.0 software. Descriptive statistics was expressed in mean, standard deviation and frequency, percentage based on the obtained data. As this was a split mouth study, the paired t-test was used to compare the mean intraoperative suturing time values between the control and experimental groups. Landry's wound healing indices between the two groups were compared using the Mann Whitney test. The significance level was set at $P < 0.05$ with a confidence interval of 95%.



Figure 1. 3-0 knotless suture (Covidien V-loc 90 knotless absorbable wound closure device)

RESULTS

A total of 20 patients participated in this study, with an overall 100% participation.

Age Distribution:

The youngest and oldest patients were aged 18 and 50 years, respectively. The distribution of study subjects based on age revealed that most patients belonged to 31-40 years of age group (67.50%).

Gender Distribution:

The distribution of study subjects based on gender, over a ten-month period, revealed that 15 patients (75%) women and 5 patients (25%) men participated in this study.

Intraoperative wound closure time:

The time taken for suturing was considerably lesser in the study group as compared to the control group. The study group demonstrated a mean suturing time of 2.69 minutes as compared to 4.27 minutes in the control group. The difference in suturing time was statistically significant between the study and control group (p-value <0.05), as assessed by the students t-test [independent sample t test] (Table 1).

Post Operative Wound Healing:

Wound healing was observed to be better in the study group on all review days and the results were statistically significant. Mann-Whitney U test was employed to compare healing between the study and control groups on 1st postoperative day (p-value < 0.05), 3rd postoperative day (p-value < 0.05) and 7th postoperative day (p-value < 0.05) (Table 2).

Table 1. Wound closure time between the two study groups.

Parameter	Study Group (Knotless Sutures) Mean (S.D)	Control Group (Polyglactin 910 Sutures) Mean (S.D)	P Value
Intraoperative wound closure time (mins)	2.69+_1.06	4.27+_0.61	0.021*

*Statistically significant; students t-test

Table 2. Wound healing time between the two study groups.

Postoperative wound healing (Landry's wound healing index)	Study Group (Knotless Sutures)	Control Group (Polyglactin 910 Sutures)	P Value
POD 1st day	2.65+_0.55	2	<0.05*
POD 3rd day	3.41+_0.50	2.60+_0.44	<0.05*
POD 7th day	4.05+_0.60	3.65+_0.49	0.0034*

***statistically significant; Mann-Whitney U test**

DISCUSSION

Intra oral suturing, especially in the retro molar region, is technically challenging because of constricted space available for instrumentation and placement of knots. Further wound healing following intra oral suturing may be compromised due to the tendency of the knots to attract food debris and colonization of microbial flora which are inherent to the oral cavity [4].

Conventional suturing depends on knots to secure the sutures to the tissues. Placement of knots is also important for providing the necessary strength to hold the wound margins in the approximated position [33] especially during the period of early wound healing [34].

However, the knots and the zone adjacent to the knot constitute the weakest portions in any suture. Knot slippage at time of approximation of tissues leads to inadequate wound closure and wound dehiscence. Knotting also causes reduction in the tensile strength of the classic suture by 35-95% due to structural deformation of the suture material [35].

Uneven distribution of tension across the wound margin has also been related to knots, which compromises the healing and remodelling potential of the wound. Over tightening of knots to prevent knot slippage impairs fibroblastic proliferation [35]. Palpability of the knots along with tissue irritation is also one of the frequent complaints of the patients [36].

The use of barbed sutures was first reported by McKenzie in human cadaveric models and animal studies. After FDA approval in 2004, [7, 37] barbed sutures have been extensively used in various surgical procedures. Vicini et al. and Babademez M A, et al. [38, 39] have published reports on pharyngoplasty performed with barbed sutures for obstructive sleep apnoea. Unidirectional Barbed sutures consist of a single swaged needle and barbs pointing along a single direction while bidirectional barbed sutures demonstrate needles on either end with the orientation of barbs getting reversed in the centre of the suture [35].

The scope for intraoral use of knotless suture is tremendous. The first use of knotless sutures for intraoral wound closure was reported by Ganesh SK [40] et al in ORIF of Le Fort fracture where knotless sutures simplified the suturing technique as well as negated the accumulation of debris at surgical suture site. According to a study performed by Ceyar et al, [4] knotless barbed sutures were used for intra oral wound closure following surgical removal of impacted mandibular third molar surgery. The study group (knotless suture) showed a statistically significant reduction in the duration for achieving wound closure in comparison to the control group (polyglactin 910 sutures) ($p < 0.0001$).

Katherine smith et al. [41] conducted an extended review comparing the wound closure time between barbed and conventional suture in hysterectomy procedures. They reported an average reduction of 15.6 minutes in wound closure time with barbed sutures compared to conventional sutures, for vaginal cuff closure. All of these results were in accordance with our study, which demonstrated a significant reduction in time taken for wound closure with knotless suture in comparison to vicryl suture as they averted the need for knot placement.

These sutures greatly improved the surgeon's comfort in tissue approximation. Though the wound closure time observed in both the groups was slightly higher than the normal which could be attributed to the minimal experience of the surgeon, the difference between the two groups was found to be statistically significant. According to a study performed by Crosetti et al [42], barbed sutures were used in oral cavity reconstruction and the average intraoperative time was 486 minutes for group A and 516.75 minutes for group B. However, there was no significant difference between groups.

The knotless sutures depend upon the barbs for their anchorage into the tissue. The equidistant placement of barbs along the long axis of the suture material helps them to

effectively engage the tissues at every 1mm [43]. The barbs facilitate even distribution of the forces over larger contact areas along the wound margin which is critical for wound healing [41]. Lesser incidence of inflammation and irritation to the localized tissue by the virtue of the knotless nature of barbed sutures provide good wound healing [7].

Bacterial adherence was seen to be the least with knotless barbed sutures by Fowler JR et al [44] who comparatively assessed the bacterial adherence in contaminated wound models between barbed monofilament sutures and conventional braided sutures. Rettenmaier et al. and Seidhoff et al. found lesser wound dehiscence with barbed sutures when compared to conventional sutures in laparoscopic hysterectomy procedures [45].

According to the study performed by Sharma et al [43], no incidence of wound dehiscence was observed in the knotless suture group and wound healing was found to be better and statistically significant in the knotless suture group than the polyglactin 910 suture group. Crosetti et al [42] also demonstrated that the use of unidirectional barbed stitches for suturing of a free flap to the recipient site reduces the complication rate principally in terms of dehiscence. All of these studies were in accordance with the results of our study.

Mild erythema on the first postoperative day was the only unusual clinical sign noted with knotless barbed sutures in a few patients. However, no other adverse effects were noted and the erythema was painless and subsided spontaneously and could be attributed to the micro-haematoma due to the barbs and tissue reaction to Polydioxanone suture material. Our institution is passionate about high quality evidence-based research and has excelled in various fields [21, 46–65].

Limitations of the study

Knotless barbed sutures cannot be used for simple interrupted suturing technique as they require multiple points of tissue anchorage for retention of sutures. Removal of the suture can be traumatic to the tissues because of its firm engagement into the tissues, if a surgical site needs to be revised.

Future scope

Although the literature provides a number of studies on the use of knotless sutures as an innovative method of wound closure used in the fields of surgery, there are limited studies related to its use in third molar surgery procedures. Therefore, further blinded clinical trials with a larger sample size and longer follow up need to be conducted to add more clinical data regarding delayed tissue reaction and widespread application of these sutures.

CONCLUSION

Within the limits of this study, it can be concluded that knotless barbed sutures reduce the intraoperative wound closure time which simplifies suturing technique and facilitates superior wound healing thereby proving to be effective as an intraoral wound closure agent in maxillofacial surgery procedures.

CONSENT

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

ETHICAL APPROVAL

Ethical approval was obtained from the institution's ethical committee.

COMPETING INTERESTS DISCLAIMER:

Authors have declared that no competing interests exist. The products used for this research are commonly and predominantly use products in our area of research and country. There is absolutely no conflict of interest between the authors and producers of the products because we do not intend to use these products as an avenue for any litigation but for the advancement of knowledge. Also, the research was not funded by the producing company rather it was funded by personal efforts of the authors.

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UNDER PEER REVIEW