



RESEARCH ARTICLE

EVALUATION OF EFFICACY OF BARBED SUTURES IN INTRAORAL WOUND CLOSURE

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Abstract

Background and Objective: Surgical knots though provides an anchoring function on suture line, but also present a potential source of infection. Knotless barbed sutures were designed to prevent knot-related complications. The aim of this study was to determine the safety, effectivity and longevity of unidirectional barbed sutures in intraoral wound closure.

Materials and method: A non-randomised study involving 13 patients who required intraoral incisions for open reduction and internal fixation of mandibular fractures and alveoloplasty. Following the surgical procedures, wound closure was done by unidirectional barbed sutures. Outcome parameters that were measured were type of healing, erythema, wound discharge, wound dehiscence, necrosis and pus on 3rd and 7th post-operative day and 2nd and 4th post-operative week.

Results: Statistically significant change in healing and erythema status was observed in the group (P value < 0.001) across the timeline. No statistical significance was found for other parameters. Dehiscence of sutured wound was observed on the same day of the procedure in one patient. Suture extrusion was also noticed in one patient after 1st postoperative week.

Conclusion: Knotless barbed sutures can be used without harm in wound approximation of intraoral incisions with no potentially harmful major or minor complications.

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Introduction:-

For several centuries wounds have been sutured by rudimentary though effective methods [1]. Proper wound closure is part of successful overall wound care after the assessment of patient and sustained wound, debridement and irrigation. The most commonly used method for closing laceration is suturing [2].

The conventional sutures require tying of knots to secure the closure which present with various complications such as breakage, slippage, extrusion, infection [1]. With the invent of barbed suture, it has been possible to eliminate the complications that are experienced with the conventional ones.

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The introduction of barbed sutures has resulted in a paradigm shift in how wounds can be closed eliminating knot tying speeding the placement of sutures and enhancing the equal distribution of tension and creating the possibility of improved scar cosmesis [1].

Barbed sutures may be unidirectional or bidirectional. A bidirectional barbed suture contains needle on each end with barbs changing direction at the suture midpoint. A unidirectional barbed suture has a needle on one end and an anchoring loop on the other with barbs running in perpendicular direction along the length of the suture [3].

Though this device has demonstrated good track record in extra-oral wound approximation, its description in intra-oral application has not been recorded much. The study demonstrates the safety and efficacy of intra-oral use of unidirectional knotless sutures for wound closure in maxillofacial procedures and to determine the incidence of complications after wound approximation.

Materials And Methods:-

A non-randomised prospective study of 13 consecutive patients was conducted in the Department of Oral Maxillofacial and Reconstructive Surgery, Bapuji Dental College and Hospital, Davangere, Karnataka, India with after being granted approval from the Institutional Review Board, Bapuji Dental College and Hospital, Davangere. Informed written consent was obtained from all the patients who participated in the study. Criteria for inclusion in the study were patients who presented with mandibular fractures and those who needed minor surgical procedure such as alveoloplasty. Patients with score of ASA 4 and those with extraoral surgical wounds were not included. Sample size estimation was done using openepi software version 2.3.1. At 95% confidence level, and 80% power of the study, sample size was calculated to be 13.

This study demonstrates the use of knotless suture (Covidien V-Loc 180) for closure of intra-oral incisions. Covidien V-Loc 180 suture is composed of a polymer of glycolic acid and trimethyl carbonate. It has 20 barbs per centimetre. On one end there is a needle and on the other end an anchoring loop to promote suture fastening with barbs running in direction along the length of the suture [5,6]. Its tensile strength in 7 days is 80%, in 14 days is 75% and in 21 days is 65%. Absorption profile is 180 days and is available in green colour or is transparent [6].

Crestal incisions during alveoloplasty and intra-oral vestibular incisions for open reduction and internal fixation of mandibular fractures were placed. After the completion of the surgeries, wound closure was done by placing unidirectional barbed sutures. All the patients were reviewed on postoperative day 3, 7, at 2 weeks and at 1 month as shown in **Fig 1a-f** and **Fig 2a-e**. The incisions were closed in standard fashion with a submucosal continuous pattern.

Detailed wound assessment which included parameters such as healing, erythema, wound discharge, dehiscence, necrosis and malodour was done on days 3, 7, 2 weeks and at 1 month.

The data obtained was tabulated by Contingency tables constructed for the six types of wound complications. Statistical analyses were done using SPSS software 11.0. Chi-square test with Fisher's exact P value was applied for the qualitative data with statistical significance defined as $p < 0.001$.

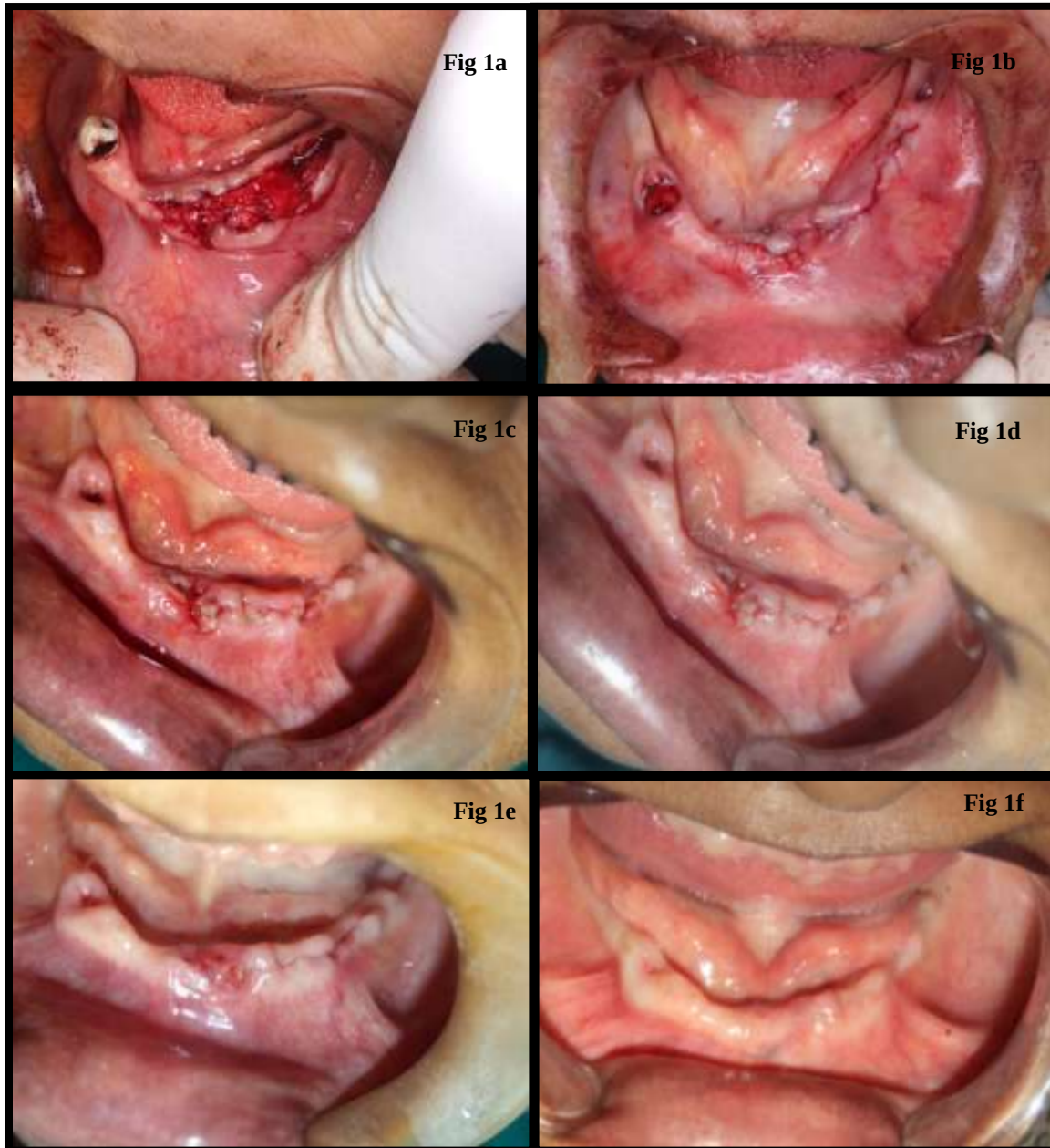


Figure 1 a: Figure showing crestal incision with raised mucoperiosteal flap in alveoloplasty.

Figure 1 b: Figure showing closure of the wound with barbed suture.

Figure 1 c: Figure showing of the wound healing on post-operative day 3

Figure 1 d: Figure showing of the wound healing on post-operative week 1

Figure 1 e: Figure showing of the wound healing on post-operative week 2

Figure 1 f: Figure showing of the wound healing on post-operative month 1



Figure 2 a: figure showing closure of the incision sutured with barbed sutures after open reduction and internal fixation of right parasymphysis fracture of mandible.

Figure 2 b: Figure showing healing of the wound on post-operative day 3

Figure 2 c: Figure showing healing of the wound on post-operative week 1

Figure 2 d: Figure showing healing of the wound on post-operative week 2

Figure 2 e: Figure showing healing of the wound on post-operative month 1

Results:-

Out of the 13 patients, barbed sutures were used for wound closure of 10 patients who underwent alveoloplasty and of 3 patients who underwent open reduction and internal fixation of mandibular fractures. 8 and 3 patients demonstrated mild and moderate erythema respectively, along the wound border on the 3rd post-operative day, shown in **Table 1, Fig. 3 a and Fig. 3 b**. From the 1st week onwards, most patients exhibited normal healing parameters. The healing and erythema in all the patients were statistically significant with a p value of 0.001 (**table 1**). Wound discharge at one point was evident only in 2 patients on post-operative day 3 as depicted in **Table 1, Fig. 3 c**. One patient demonstrated superficial wound dehiscence which was prevalent on postoperative day 3 and for 1 week only (**Table 1, Fig. 3 d and 4**). No patient displayed wounds with necrosis or pus/ malodor. Wound separation was also seen in one patient after suturing was complete on the same day of the surgery (**Fig. 5a**) and was sutured using 4-0 silk (**Fig 5b**). One patient showed suture extrusion at postoperative week 1 (**Fig. 6**).

Overall, the test showed that there was significant change in healing and erythema in the group across the timeline. There was significant change in healing status to normal over the timeline from 2nd week onward. There also was significant change in erythema to no erythema from 1 week onward.

Table 1:- Table depicting the wound assessment parameters – healing, erythema, wound dehiscence, wound discharge, necrosis and pus/malodour on 3rd, 7th postoperative days and 2nd, 4th postoperative weeks.

		Timeline				Chi-square value	P value
		Day 3	1 WEEK	2 WEEKS	1 MONTH		
Healing	normal healing	1	8	12	13	34.2	0.001
	some bruising	1	2	0	0		
	Considerable bruising	0	0	0	0		
	Mild erythema	8	2	1	0		
	moderate erythema	3	1	0	0		
	Severe erythema	0	0	0	0		
Erythema	normal healing without erythema	2	10	12	13	35.07	0.001
	at one point	0	1	0	0		
	Around sutures	1	1	0	0		
	along wound border	10	1	1	0		
	Extended around wound site	0	0	0	0		
	Severe inflammation	0	0	0	0		
Pus	Yes	0	0	0	0	*	*
	No	13	13	13	13		
Necrosis	Yes	0	0	0	0	*	*
	no	13	13	13	13		
Wound Discharge	Normal healing without wound discharge	11	13	13	13	6.2	0.10
	At one point	2	0	0	0		
	Along wound edges	0	0	0	0		
	Large volume	0	0	0	0		
	Prolonged at large volume	0	0	0	0		
Dehiscence	no	12	12	13	13	2.08	0.55
	superficial	1	1	0	0		
	Full	0	0	0	0		

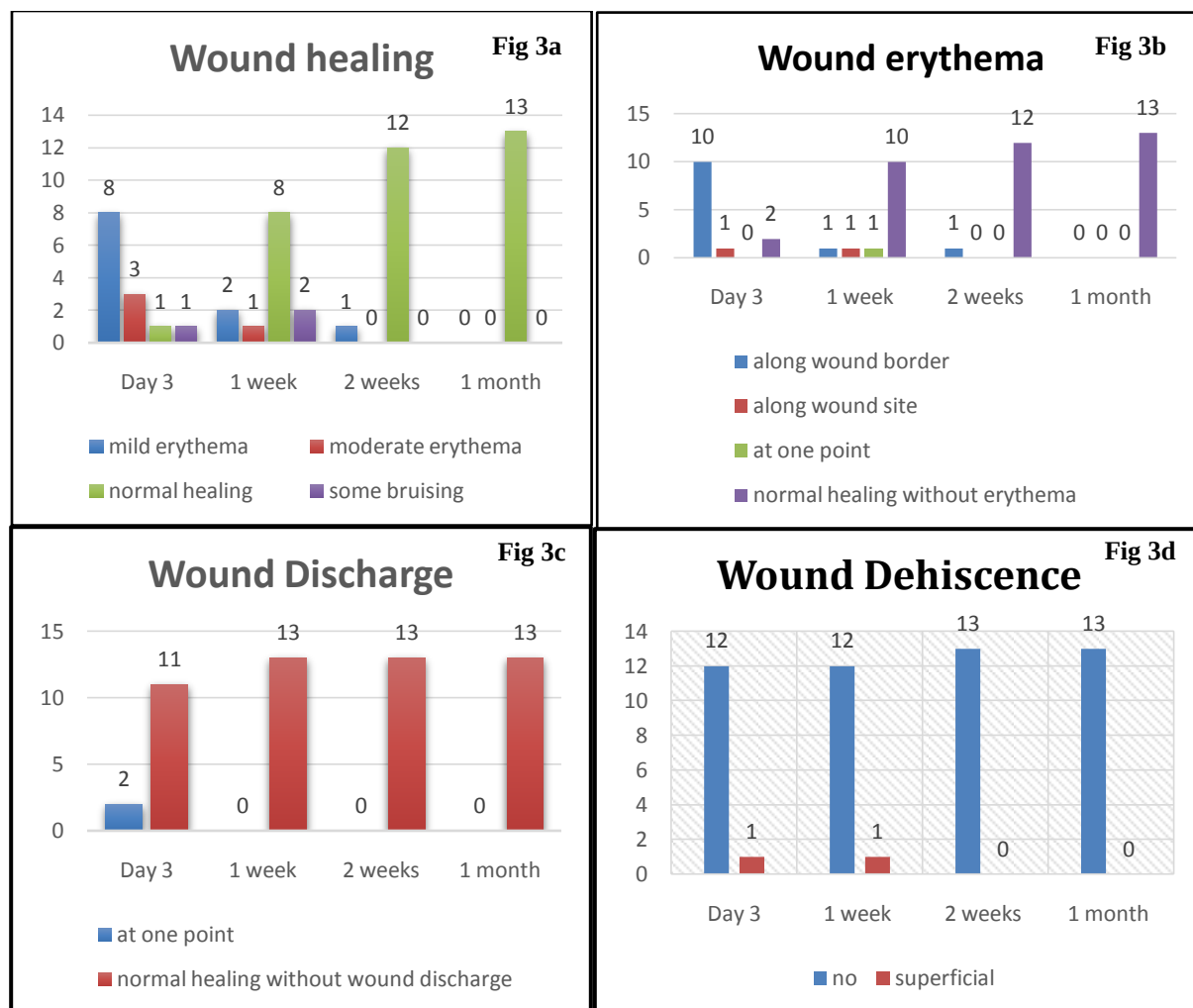


Figure 3 a: Bar graph showing changes in healing status over the timeline

Figure 3 b: Bar graph showing changes in erythema status over the timeline

Figure 3 c: Bar graph depicting number of patients who presented with wound discharge. Only two patients showed wound discharge on post-operative day 3.

Figure 3 d: Bar graph depicting number of patients with wound dehiscence. One patient demonstrated superficial wound dehiscence on postoperative day 3 and 1st week.



Figure 4:- Figure showing superficial wound dehiscence on post-operative day 3.

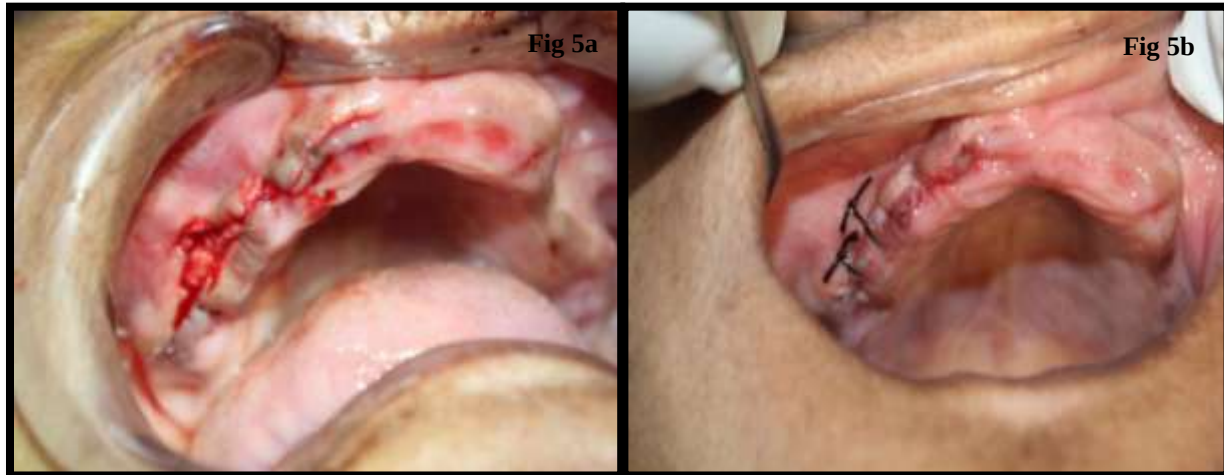


Figure 5 a: Figure depicting wound separation on the distal aspect of the incision on the same day of the minor surgical procedure, i.e., alveoloplasty.

Figure 5 b: The dehiscenced part of the wound sutured with 4-0 silk on the same day.

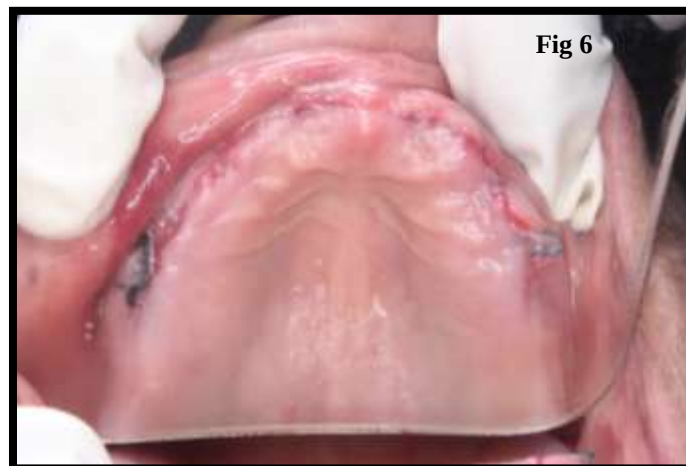


Figure 6:- Figure demonstrating barbed suture extrusion in one patient undergoing alveoloplasty after 1st post-operative week and suturing of the other end of the incision with 4-0 silk due to shortage of suture material.

Discussion:-

Suture material has undergone two major changes, one in 1907 with the introduction of a process for the sterilisation of catgut and the introduction of absorbable, synthetic materials in 1970s. but the smooth configuration of the suture material and the need for securing knots remained unchanged [7]. Surgical knots are a necessary evil which reduces the tensile strength of sutures as reported from 35% to 95% by thinning and stretching the material [8,9].

The advent of barbed sutures has given surgeons a new tool for soft tissue suturing. These sutures have been used with good clinical success in closure for donor leg wound in coronary artery bypass grafting [4], thoracotomy incisions [1], urologic applications [1,10], breast surgery [11]. In the maxillofacial region bidirectional barbed sutures have been used for aesthetic procedures such as brow-lifting [12], midface lifting [12], lower face and neck lifting [12] and scalp incisions [13]. However, the literature regarding intraoral use of this suture material for closure of intraoral wounds is limited. They have been used for wound closure following open reduction and internal fixation of maxillofacial fractures and in free flap suturing [14,15,16].

This study was conducted to evaluate the longevity, safety and efficacy of unidirectional barbed sutures in closure of incisions after oral surgical procedures.

Literature reveals a few advantages of extraoral knotless sutures such as greater wound strength [5], reduced wound closure time [14], elimination of tissue irritation and chances of wound contamination [4].

11 patients in this study developed erythema on the 3rd post-operative day which gradually subsided over the period of 1 month as depicted in **table 1, Fig. 3 b**. Similar tissue reaction with extraoral usage have been observed and attributed to the micro-hematoma due to barbs and tissue reaction to polydioxone [3]. In a study comparing Quill barbed sutures, V- Loc barbed sutures and non-barbed sutures, V- Loc devices have demonstrated the least amount of inflammation at days 3 and 10 [3].

Only one patient showed superficial mucosal separation from post-operative day 3 onwards (**Fig. 4**). Another patient who underwent closure of incision after alveoloplasty showed wound separation on the same day of the surgical procedure after the suturing was accomplished (Fig. 5a) which was followed by stitching of the dehiscence part with 4-0 silk (Fig. 5b). This can be attributed to a failure in deep layer closure.

Patients who underwent alveoloplasty were not prescribed any antibiotic before or after the procedure whereas those with mandibular fractures were under antibiotic coverage for five post-operative days. None of the patients developed infection.

The other alternatives that have been used as suture less wound closure are fibrin glue and cyanoacrylate but they are technique sensitive and cannot provide optimum strength to the approximated wound. Fibrin glue requires a preparatory phase and have a limited storage time. It is also associated with risks of hypersensitivity and transmission of blood borne diseases [17]. Cyanoacrylates cannot be used in infections and cause desquamation when applied on the mucosa [17]. Intraoral wounds are constantly subjected to muscular forces, conditions under which fibrin glue and cyanoacrylates cannot sustain wound strength [17].

The drawbacks of barbed device are related to the extrusion of suture and its slow absorption profile [16]. As the length of the suture was 15 cm, the entire length of the wound could not be sutured with the same suture and part of the incision was stitched with 4-0 silk in the same patient shown in **Fig. 6**. Barbed sutures are stiffer than the conventional ones hence it can be inconvenient for the patients. The small extruded part of the suture in the patient in this study was cut with a BP blade. Also it is impossible to remove the stitch once the barbs have engaged the mucosa and there is no procedure to correct the misplaced suture other than cutting it and starting all over again. The time taken for closure of the incisions was slightly long as the art of mastering the technique of suturing with this device is a little challenging. This contradicts conclusions by previous studies which reported lesser time consumption for wound closure with barbed sutures [14,15,16]. This study neither compares non-barbed sutures with barbed ones as was done in previous institutional researches [4,15,16] nor presents as a cohort study but supports the notion that these sutures are significant in reducing post-operative complications which are frequently observed with conventional sutures [4,7,15].

As a novel technology, barbed sutures are more expensive than traditional suture material which is one of the major limitations.

Despite the drawbacks, patients did not report with any major wound complications after a period of 1 week. The clinical advantages offered by these sutures may outweigh the cost issues. Due to the small sample size, statistical analyses for a few parameters are inconclusive and the data needs to be verified in large multi-institutional series. Otherwise, as proved, barbed sutures are effective and safe to be used for intraoral wounds after minor and major surgical procedures.

Conclusion:-

The introduction of barbed sutures and devices have revolutionised the ways in which wounds may be closed. Our study supports the performance of absorbable barbed sutures in safe approximation of intraoral wounds. Our results showed improved rates of healing and erythema from 1st week and 2nd week onward respectively with no signs of infection in any of the patients. Wound separation was observed in one patient till the 1st week after which it approximated with no other complications. Based on our experience, further development and incorporation of this suture material into clinical practice should be actively explored.

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