



Analysis of Clinical Outcomes in Connective Tissue Donor Site Healing With Two Different Suturing Protocols: A Prospective Case Control Study

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Abstract

Background: Connective tissue harvesting from the hard palate has been practiced since decades and remains the 'gold standard' for soft tissue grafts. Very little has been researched on healing patterns of the palatal donor site and the incidence of post-operative complications of donor site.

Aim: The aim of the study was to evaluate the influence of two different suturing methods on the healing outcomes of donor site after Connective Tissue Graft (CTG) harvesting.

Material and Methods: Thirty patients who had undergone CTG harvest for various procedures were analyzed for the assessment of clinical healing outcomes of palatal donor site. A similar technique for the harvest of CTG in both groups was used using Liu's class Ia incision. The

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method of closure of the donor site in these patients was divided into two groups; Group A - combination of criss-cross and horizontal mattress sutures and Group B - simple interrupted sutures. The parameters assessed preoperatively were palatal tissue thickness, intraoperative superficial palatal flap thickness and postoperatively the incidence of post-operative complications and donor site healing was assessed using Wachtel's index (2003) at 7 days, 14 days and 1 month postoperatively.

Results: The incidence of complications was more in Group B in comparison to Group A. The healing outcomes differed significantly between Group A and B at 7 days, 14 days and 1 month postoperatively; however, there was no statistically and clinically significant difference at 03 months post operatively.

Conclusion: The combination of criss-cross with horizontal mattress suture for closure of palatal donor site after harvesting with Liu's Class Ia incision was found to yield superior patient comfort and lesser post-operative complications during the early healing period.

Keywords

Connective Tissue Graft; Suturing; Healing

Key Messages

It is well known that superficial flap thickness at CTG donor site is one of the critical elements in donor site healing. The superficial flap should have sufficient thickness to avoid flap edge necrosis. In addition, the flap adaptation should be close to the palatine bone to enhance faster healing by vascularity thereby avoid dead space and prevent post-operative complications at the donor site.

Introduction

The horizon of periodontal plastic surgical practice has expanded vastly with the introduction of contemporary surgical approaches with current understanding of wound healing concepts. Till date, the role of connective tissue grafting in various periodontal plastic procedures remains unchallenged, because of the predictability of the results obtained with autogenous soft tissue grafts. There are numerous techniques to harvest Connective Tissue Graft (CTG) amongst which the minimally invasive approaches with maximal tissue preservation using a single incision technique is most preferable. The healing of the connective tissue donor site is equally important, especially, if the patient is in need for second time graft harvesting at the

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same site for any surgical treatment in future. Till date, there are various methods of closing the palatal donor site after CTG harvesting and securing the donor site to aid in primary intention healing is of utmost importance.

Material and Methods

The aim of the study was to assess the healing outcomes of CTG donor sites using two different suturing techniques. The objectives included comparison of incidence of post-operative complications and clinical healing parameters of palatal donor site. The subjects included those who underwent palatal CTG harvesting for various root coverage and soft tissue augmentation procedures. A written informed consent was taken before the surgery and the post-operative healing outcomes were assessed [Fig. 1]. All the patients were subjected to Liu's Class Ia type incision for the harvesting CTG [1]. The subjects were grouped into two different groups, based on the suturing protocol used for closure of the donor site.

After aseptic preparation and palatal infiltration with 2% lignocaine and 1:80,000 Adrenaline, the Liu's Class Ia type incision was given 2 mm apical from the palatal gingival margin. The length of incision was standardized to extend from mesial line angle of maxillary first premolar to distal line angle of maxillary first molar. A subepithelial sharp dissection was carried out with the aim of maintaining minimum 1mm thickness of the superficial flap and extended to a width of 8-10 mm from the incision line which was connected over its entire length. The depth of first incision was clinically kept equal to the length of the bevel (1 mm) of cutting portion of No.15c blade (Fig. 2). A blunt dissection was made sub-periosteally below the graft and sharp incisions in distal, apical and mesial borders to free the graft with intact superficial palatal flap, to ensure primary closure of the donor site (Fig. 3). The suturing technique used to close the donor site varied between the two groups. Digital pressure was applied for five minutes to establish hemostasis and dressing or stent was not used in both groups.

Group - I: A combined suturing protocol with two criss-cross sutures followed by two equally spaced horizontal mattress sutures using 3/0 braided black silk was used (Fig. 4).

Group - II: Three interrupted sutures were placed connecting the superficial palatal flap of donor area and the attached palatal marginal gingiva using 3/0 braided black silk (Fig. 5-7).

The preoperative parameters measured was the thickness of palatal mucosa at the donor site using a no.30 spreader with a stopper at 2nd premolar area, 5 mm apical to palatal gingival margin for ascertaining suitability for Liu's Class Ia incision. Intraoperatively, the thickness of the superficial palatal flap was measured after the graft was harvested using a precision gauge to confirm the thickness of the superficial flap. These pre-operative and intraoperative

measurements were done to ensure standardization of comparison. The sutures were removed at 7th post-operative day in both the groups. The post-operative parameters assessed were the incidence of post-operative complications, modified Wachtel's index (2003) on 7th, 14th and 21st day post-operatively [2].

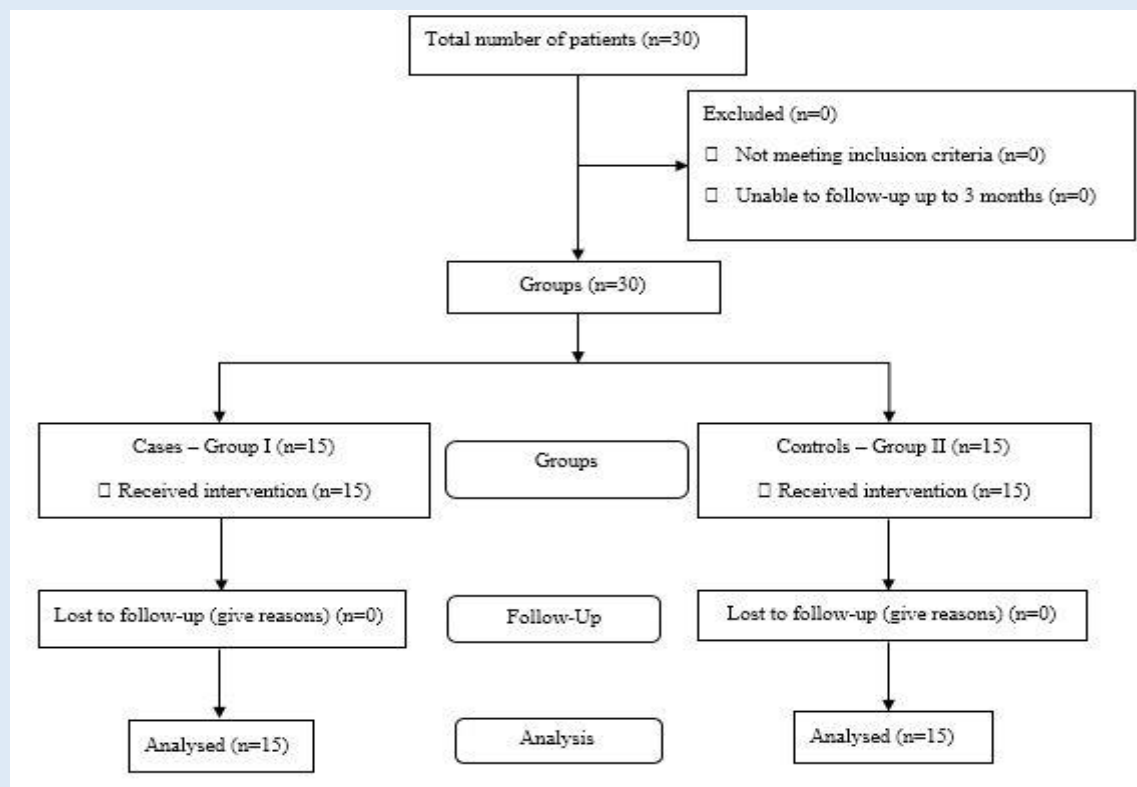


Figure 1: Flowchart of the procedure followed.

Results

Without the assumption that the values are normally distributed, the groups being compared were statistically analyzed using a non-parametric test with Mann-Whitney U test in SPSS (Version 27). There was no statistically significant difference in pre-operative palatal tissue thickness between Group I and Group II both pre-operatively ($U=106.000$; $p=0.802$) (Table 1-4). The inter-group comparison of intra-operative superficial palatal flap thickness post-harvesting of CTG, did not have statistically significant difference between the groups and the thickness averaged to 1 mm ($U=97.500$; $p=0.548$) (Table 1,4). The incidence of complications was high in Group II (No. of events, $n= 22$) whereas, it was extremely low in Group I (No. of events, $n=2$) (Table 2). The delay in donor site wound healing was the most common complication observed in 53% of patients in Group II (53%, $n=8/15$) in comparison to 6% in Group I (6%, $n=1/15$). Flap edge necrosis was found in 40% of patients in Group II (53%, $n=6/15$) in comparison to 6% in Group I (6%, $n=1/15$). The other complications observed

included post-operative swelling (33%, n=5/15), primary hemorrhage / secondary (6% each, n=1/15 each). Post-operative infection was absent in both groups (Table 2). There was statistically significant difference between the two groups at 7th day and at 14th day post-operative healing of the donor site (U=60.000; p=0.003) and (U=27.000; p=0.000) (Table 3,4) respectively. The healing scores were high in Group II, signified that the early wound healing is delayed for up to 14 days in comparison to complete healing within 7 days in Group I. However, there was no statistically significant difference between the two groups at 21st day post-operative period of the donor site between both the groups (U=82.5; p=0.222) (Table 3,4). This implies that the initial wound healing was fully completed at 14 days in 93.3% of sites (n=14/15) in Group I and only at 13.3% of sites (n=02/15) in Group II. The third week healing assessment revealed that 100% of sites were completely healed clinically in Group I (n=15/15) and in 73.3% of sites in Group II (n=11/15). It was observed that 26.6% of sites in Group II (n=4/15) did not clinically heal completely even after 3 weeks post-operatively.

S No.	Measurements of palatal mucosa			
	Group - I		Group - II	
	Baseline (in mm)	Superficial palatal flap thickness (in mm)	Baseline (in mm)	Superficial palatal flap thickness (in mm)
1	2.0	1.0	2.0	1.0
2	3.0	1.0	3.0	1.0
3	3.0	1.0	3.0	1.0
4	3.0	1.0	3.0	1.0
5	3.0	1.0	3.0	1.0
6	3.0	1.0	3.0	1.0
7	3.0	1.0	3.0	1.0
8	3.0	1.0	3.0	1.0
9	2.5	1.0	3.0	1.0
10	3.0	1.0	3.5	1.0
11	3.5	1.0	3.0	1.0
12	3.0	1.0	3.0	1.0
13	3.0	1.0	3.0	1.0
14	3.0	1.0	3.5	1.5
15	3.0	1.0	2.5	1.5

Table 1: Palatal tissue thickness. It shows no difference between both groups in baseline and intra-operative palatal mucosal thickness. p-value < 0.05 considered as statistically significant.

S No.	Post-operative complication	Group - I	Group - II
(i)	Primary hemorrhage	-	-
(ii)	Secondary hemorrhage	-	01
(iii)	Post-operative swelling	-	03
(iv)	Premature dislodgement of sutures	-	01
(v)	Flap edge necrosis	01	06
(vi)	Delayed wound healing beyond 7 days	01	08
(vii)	Donor site infection	-	-

Table 2: Incidence of donor site post-operative complications. It shows the incidence of number of cases with each post-operative complication as mentioned against both the groups. p-value < 0.05 considered as statistically significant.

S No.	Group -I (in degrees)			Group -II (in degrees)		
	Day 7	Day 14	Day 21	Day 7	Day 14	Day 21
(i)	1	1	1	2	1	1
(ii)	1	1	1	2	3	1
(iii)	1	1	1	1	3	1
(iv)	2	1	1	2	2	1
(v)	1	1	1	2	4	2
(vi)	1	1	1	1	2	1
(vii)	2	4	1	2	3	1
(viii)	1	1	1	2	3	1
(ix)	1	1	1	2	4	2
(x)	2	1	1	1	3	1
(xi)	1	1	1	2	4	2
(xii)	1	1	1	1	1	1
(xiii)	1	1	1	1	3	1
(xiv)	1	1	1	2	2	1
(xv)	1	1	1	2	4	2

Table 3: Early Healing Index (Modified from Wachtel, et al., 2003). It shows different grades of early wound healing index in both groups. p-value < 0.05 considered as statistically significant.

Test	Palatal tissue thickness		Early healing index		
	Baseline	Intraoperative	Day 7	Day 14	Day 21
Mann-Whitney U	106.000	97.500	60.000	27.000	82.5
Z-Score	-.248	-.601	-2.156	-3.525	-1.223
p - value	0.802	0.548	0.030	0.000	0.222

Table 4: Statistical analysis. It shows the statistical analysis (Mann - Whitney U Test, Z score - Standard Score) for comparison of palatal tissue thickness and Early Haeling Index. Two tailed hypothesis analyses with p-value (probability value) < 0.05 was considered as statistically significant.

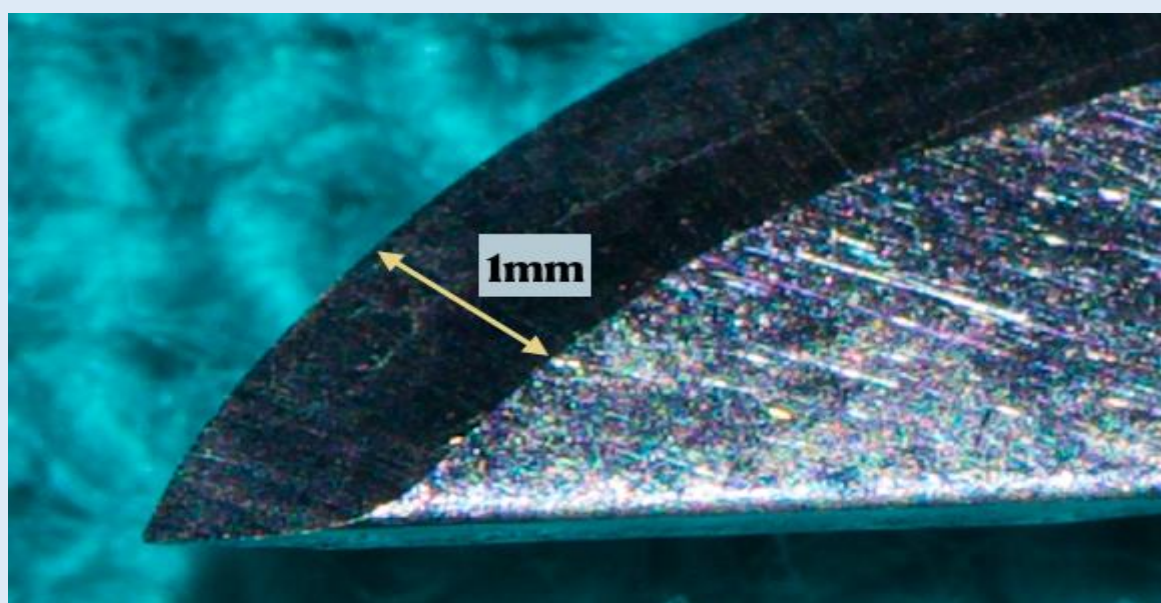


Figure 2: Length of bevel in No.15c Blade.

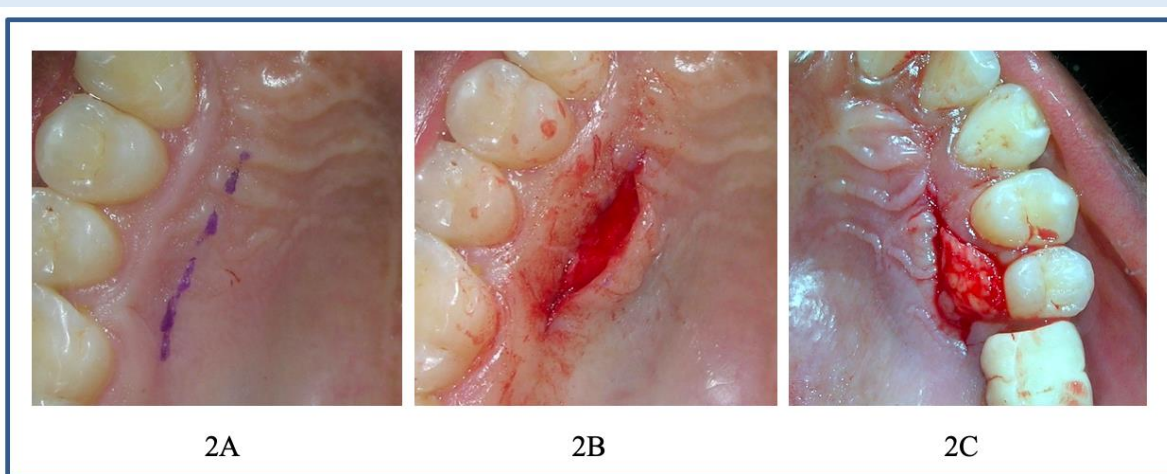


Figure 3: A: Incision Line; B: Split thickness flap raised; C: Harvesting CTG.



Figure 4: A: Combined suture in Group I; B: Healing at day 7 in Group I; C: Healing at day 14 in Group I.



Figure 5: A: Simple interrupted suture at donor site in Group II; B: Healing at day 7 in Group II; C: Healing at day 14 in Group II.



Figure 6: A: Degree 1 healing with complete flap closure with no fibrin line; B: Degree 2 healing with complete flap closure with fine fibrin line; C: Degree 3 healing with complete flap closure with fibrin clot; D: Degree 4 healing with incomplete flap closure with partial necrosis; E: Degree 5 healing with incomplete flap closure with complete necrosis.

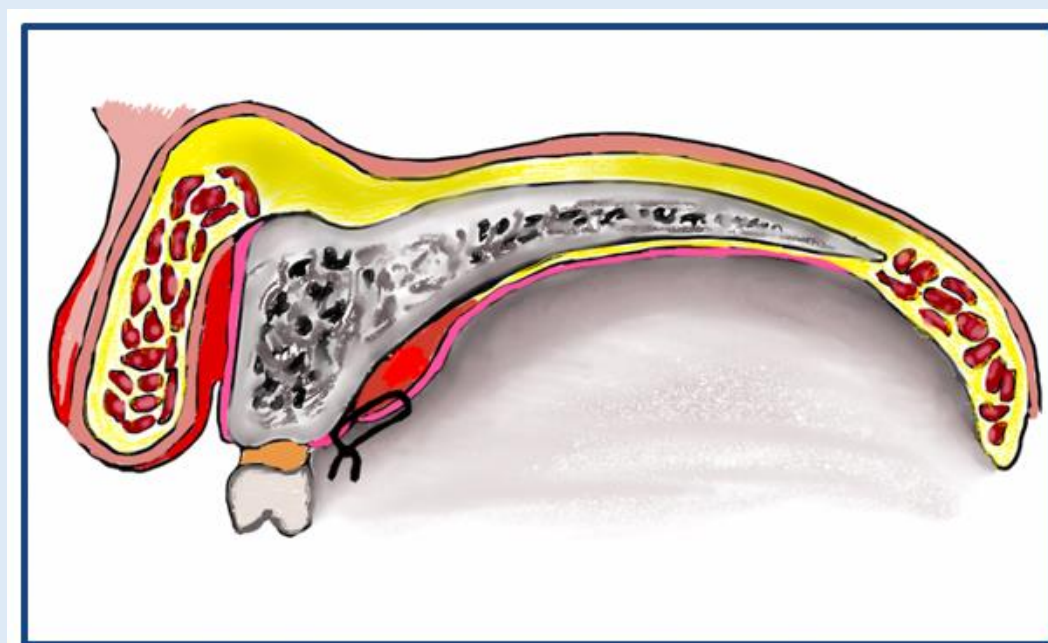


Figure 7: Schematic diagram of possible dead space with simple interrupted sutures.

Discussion

Periodontal plastic surgery is an art and the success of the surgical outcome is governed by various factors including proper case selection, appropriate technique selection, host factors and expertise of the surgeon. The methods of harvesting the CTG had evolved over the years and whenever feasible, principles of minimally invasive periodontal surgery needs be advocated. The single incision technique of harvesting CTG has higher possibility of primary intention healing [3]. The healing of the palatal donor site is equally important especially, if future graft harvesting may be required for the same patient [4].

The various suturing protocols available for palatal donor site closure are simple interrupted sutures, criss-cross suture, continuous suture, continuous interlocking suture, horizontal mattress suture, vertical mattress suture or combination of these. Theoretically, there is risk of potential dead space at the donor site after closure, which may lead to delay in healing or risk of post-operative infection. Ideally, after CTG harvesting, the wound margins are closed primarily so that the superficial palatal flap lies in close approximation to the underlying palatal bone without any tension to prevent flap dehiscence / necrosis. The primarily closed wound margins undergoes less soft tissue remodeling with minimal post-operative discomfort [5].

The epithelium lacks inherent vascularity and is dependent on the underlying connective tissue for trophism. It is emphasized that a 'critical thickness value' of the superficial flap at the donor site should be maintained at least 1 mm thickness in order to maintain the vascularity of the flap. This critical thickness of the superficial flap should be maintained evenly throughout especially at the edges of flap margins which are the risk sites for 'edge necrosis' [6]. It was shown that primary intention wound healing at the harvest site had significantly lowered patient discomfort [7]. It was proposed that, after the initial incision that the graft be harvested at least 2 mm inner to the primary flap incision in order to rest the flap margin on sound connective tissue bed [8].

The available palatal soft thickness was in agreement with Kim, et al., 2014 and was within a range of 2-3 mm [9]. The length and width of harvested CTG in the entire study was within a range of 8-10 mm and 5-6 mm respectively, which was well within the safety zones to prevent haemorrhage [10]. When single incision techniques are used for harvesting CTG, extreme care has to be taken so as to not compromise the graft thickness as well as simultaneously maintaining uniform superficial flap thickness [11]. Pandit N, et al., in 2006 compared the difference in healing patterns of the donor site using an envelope vs trap-door technique of harvesting CTG and found superior outcomes with envelope method being less invasive [12]. The method of closure using simple interrupted sutures approximates the free end of the flap margin with the palatal gingival margin. This method does not attempt to adapt the flap close

to bone, as it involves only soft tissue to soft tissue approximation which carries a risk of potential dead space at the healing donor site. This can be overcome by a suturing technique which can approximate the wound margins as well as adapt the flap close to the underlying bone, thereby eliminating the chances of potential dead space. The superficial flap was found to be closely adapted to the underlying bone by the application of combined criss-cross with horizontal mattress sutures in the palatal donor site, as this method of suturing slings around the adjacent teeth.

In the periodontal literature, the incidence of complications at donor site after harvesting CTG and its healing outcomes are less studied than the recipient site healing outcomes. The post-operative swelling and flap edge necrosis were the most commonly observed complications in Group II. It was found that, the analgesic consumption in CTG patients increased with the incidence of wound dehiscence and flap edge necrosis [13]. The clinical healing during first 3 weeks post-operatively was assessed using Early Healing Index modified from Wachtel et al 2003 as follows (Fig. 5).

Degree 1 - Complete flap closure with no fibrin line

Degree 2 - Complete flap closure with fine fibrin line

Degree 3 - Complete flap closure with fibrin clot

Degree 4 - Incomplete flap closure with partial necrosis

Degree 5 - Incomplete flap closure with complete necrosis

There was significant difference in healing outcomes of the palatal donor sites being superior in Group - I, which received combined suturing technique (criss-cross and horizontal mattress suture) in comparison to Group II with simple interrupted sutures. This was not in agreement with the previous study which compared the criss-cross sutures with continuous interlocking suture and concluded that, there was no significant association between the suturing technique and palatal donor site healing [14]. This study showed that, there can be a possible association between the suturing technique and early wound healing events, provided the superficial flap thickness is uniformly maintained at 1 mm. It is already proven that single incision technique aids in faster healing of donor site with significantly reduced post-operative pain [15].

The comparatively superior results obtained with Group I can be attributed to:

- a. Close adaptation of the soft tissue to the hard tissue (Primary flap to palatal bone)
- b. Elimination of dead space
- c. Closure to soft tissue by anchoring to the teeth [16]

The method of simple interrupted suturing as in Group - II may not completely eliminate the potential dead space leading to various complications like secondary hemorrhage, swelling, flap edge necrosis and significantly increased wound healing period (Fig. 7). The combined

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method of suturing the palatal donor site appears to have reduced incidence of complications and led to faster healing outcomes. It is not possible to assess the volume gain or quality of tissues at the healed donor site post-operatively due to ethical reasons. The available evidence showed that, second time harvesting from the same site is possible as early as 9 weeks post-operatively [17].

One of the main limitations of this prospective study was the use of braided black silk suture for closure in both groups. There is solid concrete evidence that this suture material is prone for 'wick effect', which in itself can be a potential source of infection of the donor site [18]. There is no available data in human studies to ascertain the incidence rate of post-operative infection due to wicking caused by multifilament sutures, as the same is difficult to assess in oral cavity with numerous microbial reservoirs and niches [19]. The other limitation was the graft harvesting procedure which was performed macroscopically. A single microincision technique which achieves butt joint wound coaptation yields superior healing outcomes in the donor site with significantly lesser post-operative complications [20]. The results obtained in this prospective analysis was similar to a previous study by Del Pizzo, et al., 2002 and needs larger sample of participants [21]. All the cases in both groups were operated by a single operator thereby avoiding operator bias.

Conclusion

This prospective study showed that there are less chances of post-operative complications when the flap is closely adapted to the palatine bone using a combined method of criss-cross and horizontal mattress sutures. The technique requires consistent practice and is found to be effective in palatal closure after harvesting CTG and showed superior and faster healing outcomes of the donor site. Further to this, more research is needed on the influence of method of suturing at the donor site after harvesting CTG in order to delineate the indications for each method of suturing. There is definitely a need for prospective randomized controlled clinical trials to assess the influence of different techniques of flap closure with and without microsurgical techniques.

Conflict of Interest

There are no conflicts of interest.

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