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Research Article

Comparison of Recession Coverage Using Periosteal Pedicle Graft Alone and in Combination with Low Level Laser Therapy - A Randomised Controlled Clinical Trial

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Abstract

Background and Objectives: For recession coverage, Subepithelial connective tissue autograft is the gold standard, but it has inherent disadvantages of complexity and requirement of second surgical site. Thus many techniques have been tried for the same. Utilizing the principle of connective tissue autograft, an ingenious technique known as periosteal pedicle graft has been tried in the recent times. Low level laser therapy (LLLT) to optimize healing is more popular of late. Thus the purpose of this randomised controlled clinical trial was to compare recession coverage using periosteal pedicle graft alone and in combination with low level laser therapy.

Materials and Method: 14 healthy patients with a mean age of 20-50 years with one or two teeth having Miller's Class I, II or combination of class I and II recession defects were selected. Out of the 14 sites 7 were randomly assigned to control group and the other 7 sites to the test group. The test group was treated with periosteal pedicle graft and laser irradiation whereas the control group was treated by periosteal pedicle graft alone. Clinical parameters were assessed at baseline, 3 weeks, 3 months and 6 months after surgery.

Results: Statistically significant differences were observed between test and control sites in the gingival recession width (GRW) and clinical attachment level (CAL) measurements after 6 months ($p \leq 0.05$). The exceptions were the gingival recession depth (GRD), width of keratinised tissue (WKT) and probing pocket depth (PD) which was not statistically significant ($p \geq 0.05$) between the test and control groups.

Conclusion: At the end of six months in the current clinical trial, post-surgical evaluation revealed that PPG can be an excellent alternative for root coverage procedures and the use of LLLT may stabilise the root coverage obtained by PPG.

Keywords: *Biostimulation; Gingival Recession; Low Level Laser Therapy; Periosteal Pedicle Graft; Wound Healing*

Abbreviations

GR: Gingival Recession; MRTD: Multiple Recession Type Defects; CEJ: Cemento Enamel Junction; CAF: Coronally Advanced Flap; SCTG: Subepithelial Connective Tissue Graft; CRC: Complete Root Coverage; GTR: Guided Tissue Regeneration; LLLT: Low Level Laser Therapy; GRD: Gingival Recession Depth; GRW: Gingival Recession Width; PD: Probing Depth; CAL: Clinical Attachment Level; KTW: Keratinized Tissue Width; PI: Probing Index; GI: Gingival Index; BI: Bleeding Index; RT: Recession Type; MGJ: Mucogingival Junction; PR: Palatal Recession; GF: Gingival Fibroblasts; PDGF: Platelet Derived Growth Factor

Introduction

The apical migration of the gingival margin beyond the cementoenamel junction or gingival recession has been and will continue to be a concern both for clinicians and patients worldwide [1]. It is often accompanied by unwanted sequeale such as hypersensitivity, root caries and poor aesthetics The most common predisposing factors for the same are thin gingival biotype, buccal prominence of teeth, lack of keratinized tissue, high frenal attachment, chronic gingival inflammation and last but not the least vigorous brushing by the patient [2].

To overcome the aforementioned unwanted sequeale, a gamut of surgical treatment modalities have been attempted with a varying degree of success. By far the SCTG + CAF has the best predictability, but owing to a second surgical site, complex nature and poor patient compliance at times this combination cannot be applied in all clinical scenarios.

Keeping this in mind few combinations such as CAF plus alloderm, CAF plus GTR, CAF plus Enamel Matrix Derivative (CAF+EMD), CAF plus Acellular Dermal Matrix (CAF+ADM), CAF plus porcine Collagen Matrix (CAF+CM), CAF plus Platelet Concentrate Graft (CAF+PCG), CAF plus Human Fibroblast-Derived Dermal Substitute (CAF+HF-DDS), CAF plus Bone Graft Substitute (CAF+BGS), CAF plus Platelet-Rich Fibrin Membrane (CAF+P-RFM) have been used in the recent times [3]. But it incurs additional cost, and unwanted foreign body reactions. Hence, there is a long felt need for a graft that has its own blood supply, which can be harvested without requiring any second surgical site and has the potential for promoting the regeneration of lost periodontal tissue [4].

Thus, the adult human periosteum with its high vascularity and its inherent cellular composition of fibroblasts, and their progenitor cells along with stem cells provides the ultimate solution for the recession dilemma. In all age groups, the cells of the periosteum retain the ability to differentiate into fibroblasts, osteoblasts, chondrocytes, adipocytes, and skeletal myocytes. The tissues produced by these cells include cementum with periodontal ligament fibres and bone.

Recently, Low Level Laser Therapy (LLLT) has found it's utility in several treatments. LLLT has been widely used for promoting wound healing due to its capacity for facilitation of collagen synthesis, fibroblast and keratinocyte cell motility, angiogenesis and growth factor release at microscopic level.

CAF along with periosteal pedicle grafting and LLLT have been combined to obtain a supradditive effect in periodontal wound healing which could contribute substantially for recession coverage. Therefore this study evaluated Recession Coverage Using Periosteal Pedicle Graft Alone and in Combination with Low Level Laser Therapy.

Materials and Methods

The present prospective, comparative, randomised controlled clinical trial was conducted at Department of Periodontology, Krishnadevaraya College of Dental Sciences and Hospital, Bangalore for a duration of 6 months. The study was conducted in full accordance with the declared ethical principles (World Medical Association Declaration of Helsinki, version VI, 2002) and approval for the same was obtained from the Institutional Ethical Committee affiliated to Rajiv Gandhi University of Health Sciences.

Inclusion criteria

- Patients with one or two teeth having Millers class I and II or combined class I and II recession defects in maxillary or mandibular arches
- Age group between 20 - 50 years.

- Patients with thick gingival biotypes (> 0.8 mm).
- Patients with healthy or treated periodontal conditions.
- Full mouth plaque score less than or equal to 10% (O'Leary 1972).
- Patients with esthetic concerns.
- Patients willing to participate in the study.

Exclusion criteria

- Pregnant or lactating females.
- Tobacco smoking.
- Uncontrolled systemic conditions.
- Use of systemic antibiotics in the past 3 months.
- Patients treated with any medication known to cause gingival hyperplasia.
- Drug and alcohol abuse.

Sampling technique

Each patient was treated with an initial phase of scaling and root planing, and oral hygiene instructions were emphasized. A coronally directed roll technique for brushing was prescribed for teeth with recession defects to minimize the tooth brushing trauma to the gingival margin. The patient was recalled after 1 month for the planned surgery.

Randomization

In the selected cases, randomization was done using toss of coin method. In control group defects were treated with periosteal pedicle flap, whereas the test group was treated with periosteal pedicle flap and low level laser therapy.

Surgical procedure

After administering local anaesthesia 2% Lignocaine with 1:80,000 adrenaline an intrasulcular incision was made with 15C Bard Parker surgical blade at the buccal aspect of the involved tooth. Two horizontal incisions were made perpendicular to the adjacent interdental papillae, at the level of the CEJ preserving the gingival margin of the neighbouring teeth and two oblique vertical incisions were extended beyond the mucogingival junction and a full thickness trapezoidal flap was raised 3–4 mm apical to the osseous crest.

The flap was then pulled buccally to create tension on the periosteum and an incision was made through the flap with the periosteum still attached to bone, and a partial thickness flap was created which extended to expose a sufficient amount of the periosteum which was then separated from the underlying bone using a Glickman periosteal elevator. The process of separating the periosteum was initiated at the apical extent which was then lifted slowly in a coronal direction and care was taken not to detach completely from the underlying bone, leaving it attached at its coronal most end. The periosteal pedicle graft (PPG) thus obtained was then pushed over the exposed root surface coronally and sutured with a synthetic 4-0 bioabsorbable suture (ETHICON, Division of Johnson and Johnson Ltd). After stabilizing

the periosteal graft, the flap was coronally positioned and sutured using sling sutures. The releasing incisions were adapted with interrupted sutures using 3-0 silk sutures (Figure 1).

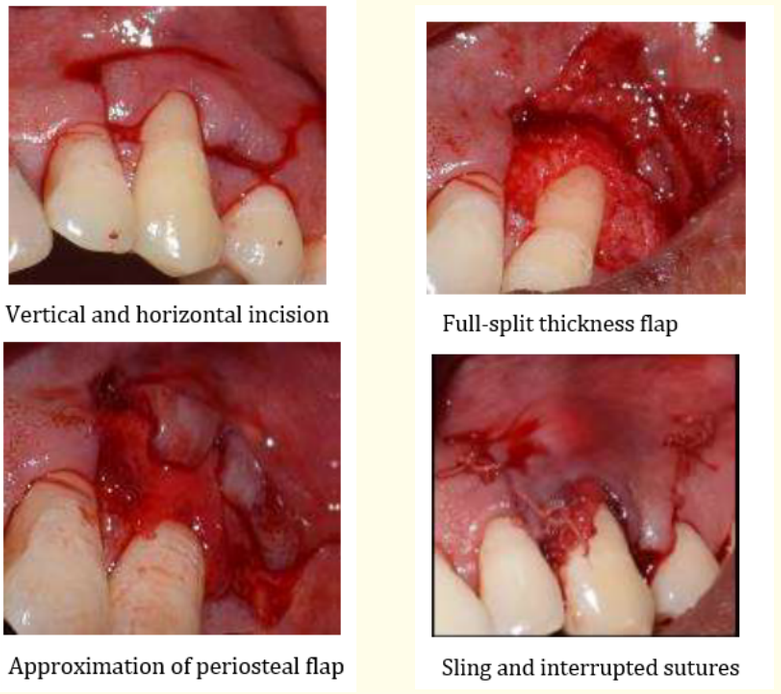


Figure 1: *Surgical procedure for control group.*

The test site received an application of diode low intensity laser with a wavelength of 810 nm and a power of 120 mW in a continuous mode for 5 minutes (Figure 2 and 3). During the irradiation, the tip of the laser probe was placed perpendicularly in contact mode. Before suturing irradiation was done on the exposed root surface, adjacent surgical area and inner surface of the mobilized flap. Then the flaps were repositioned coronally and stabilized with sutures on both test and control sites. LLLT irradiation was repeated immediately after flap closure for the test sites for 5 minutes. The sutures were considered as the margins of the wound area and laser was applied by slight contact with the tissue from the margins towards the centre of the wound in circular movements (Figure 2). Post operatively, LLLT was repeated on the test sites 5 minutes daily for 5 days.

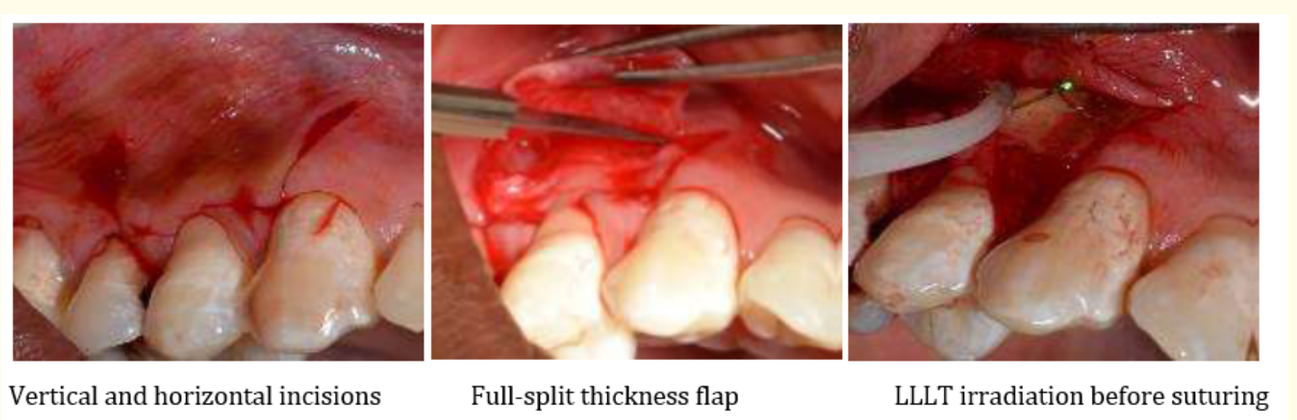


Figure 2: *Surgical procedure for test group.*

Sling and interrupted sutures

LLLT irradiation after suturing

Figure 3

For the control site laser application was simulated, without pushing the start button followed by placement of periodontal dressings. VAS scoring was done at the end of each day for 5 days.

Post operatively patients were prescribed Amoxicillin 500 mg (Novamox-500TM) T.I.D and analgesic Diclofenac Potassium and seratiopeptidase (Divon-STM) T.I.D for 5 days. 0.2% chlorhexidine mouth rinse was advised three times daily for 15 days from third postoperative day. Patients were advised not to chew rigorously and to avoid brushing and flossing in the treated area for a period of 2 weeks. Patients were instructed in mechanical cleaning of the treated teeth and use of a soft toothbrush and roll technique of brushing for one month. Clinical parameters were recorded at 3 weeks, 3 months and 6 months after surgical procedure except for probing depth which was recorded at the end of 3rd month and 6th month.

Data collection

Data collection included clinical measurements and photographs.

Clinical measurements

- Gingival Recession Depth (GRD), measured as the distance from the CEJ to the deepest point of gingival margin.
- Gingival Recession Width (GRW), measured as the distance between the mesial gingival margin and distal gingival margin (measurement will be recorded on a horizontal line tangential to the cementoenamel junction).
- Probing Depth (PD), measured as the distance from the gingival margin to the base of gingival sulcus.
- Clinical attachment level (CAL), measured as Gingival Recession Depth+ Probing Depth.
- Width of keratinized tissue (WKT) measured as the distance from the mucogingival junction to the gingival margin, with the mucogingival junction location determined using a visual method (Schiller's Potassium Iodide Solution).
- Plaque Index -Silness and Loe 1964.

- Gingival Index – Loe and Silness 1963.
- Gingival Bleeding Index –Ainamo and Bay 1975.
- Wound healing index (Lien-Hui Huang., *et al*. 2005).

Statistical analysis

Inter group and intra group comparisions were done with Mann Whitney U test. p value less than 0.05 was considered statistically significant.

Results

The present prospective, randomised controlled clinical trial was conducted to compare recession coverage using periosteal pedicle graft alone and in combination with low level laser therapy.

A total of 14 healthy patients with mean age of 39.8 years in test group (all males) and 34 years in control group (6 males and 1 female) were selected for the study who satisfied the inclusion and exclusion criteria were enrolled for the study. Surgeries and post-operative sequelae were uneventful and none of the patients developed any complications. Data of all the patients were analysed and subjected to statistical analyses. All the measurements were recorded at baseline. The clinical parameters were then assessed at three weeks, three months and six months post-surgically.

The various clinical measurements to quantify the recession were gingival recession depth (GRD), gingival recession width (GRW), width of keratinised tissue (WKT), clinical attachment level (CAL), and pocket depth (PD). Among these the GRD and GRW decreased significantly and more so in the test group. GRD decreased from 2.5 mm (base line) to 0.75 mm (6 months) in test site whereas 3.57 mm (base line) to 1.86 mm (6 months) in control site (Table 1, graph 1) (Figure 4). The GRW reduced from 2.75 mm (baseline) to 0.75 mm (6 months) in test group and in control group it was from 2.86 mm (base line) to 2 mm (6 months) (Table 1, graph 2) (Figure 5). The mean WKT increased marginally from 3 mm at baseline to 3.57 mm at 6 months for the control sites. Similarly it increased from 3.75 mm at baseline to 4.25 mm at 6 months for the test site. The intra and inter group comparison of gain of WKT was not significant statistically (Table 1, graph 3). The mean PD decreased from 1.29 mm at baseline to 1.14mm at 6 months in the control group. The reduction in the test group was from 1.38 mm at baseline to 1mm at 6 months. The PD reduction was not statistically significant (Table 1) (Figure 6). The mean CAL value in the control group was 4.86 mm at baseline and changed to 3mm at 6 months. For the test group it varied from 4.13 mm at baseline to 1.63 mm at 6 months. The CAL gain was statistically significant among the groups at all time intervals (Table 1, graph 4) (Figure 7). The mean scores of PI (Sillness T and Loe H, 1964) and GI (Loe and Silness, 1963) reduced over the study period of 6 months and remained stable. The GBI (Ainamo J and Bay I, 1975) was recorded for both the test and control groups (Table 1). The mean GBI score in the control became 0 at 6 months from 1 at baseline. It was the same for test group, score 1 at baseline to 0 at 6 months (Table 1). So there was no variations in scores at different time intervals for both the groups. Lien-Hui Huang Wound healing index was recorded for all the subjects. In the control group at baseline 61% of subjects showed score 2 which was reduced to 0 at 3 and 6 months. In the test group 28% of subjects showed score 2 at the baseline which reduced to 0 at both the time intervals. Thus the intragroup reduction of the score was statistically significant and so was the intergroup comparison (Table 2).

Figure 4: *Gingival recession depth (GRD).*

Figure 5: *Gingival recession width (GRW).*

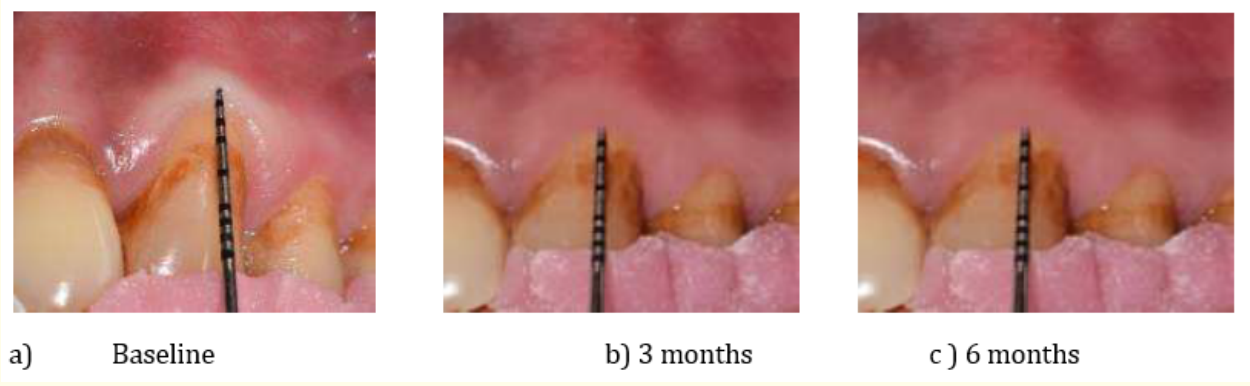
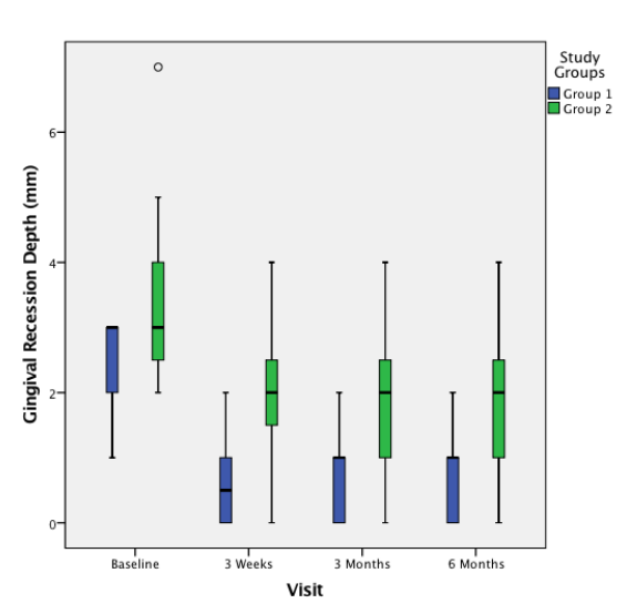
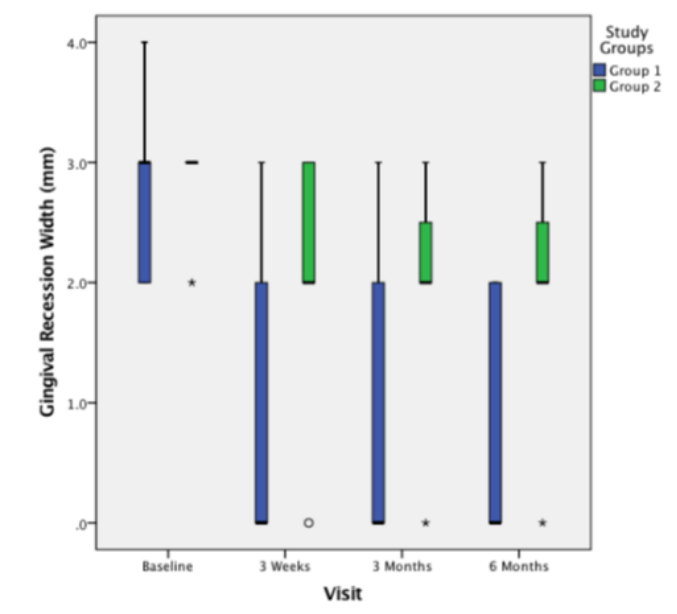


Figure 6: *Probing depth (PD).*

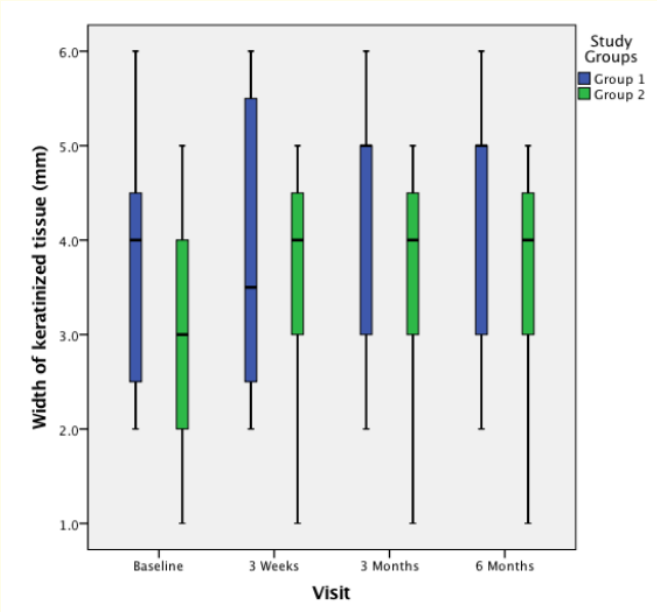
Figure 7: *Clinical attachment level (CAL).*



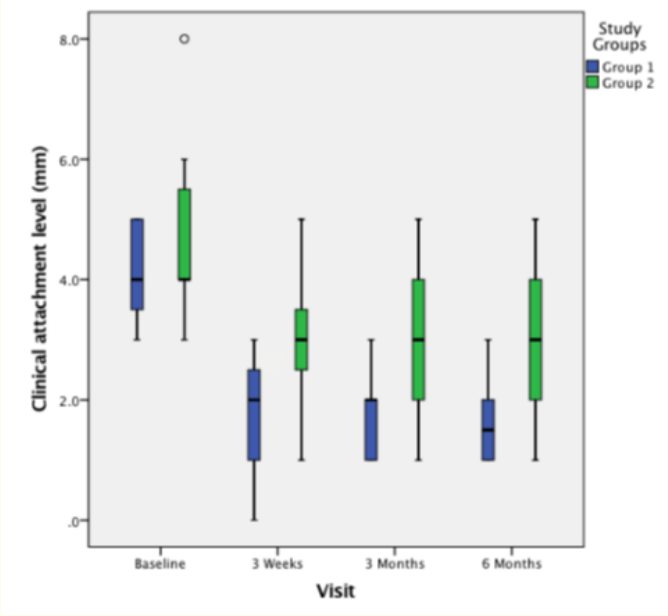
Graph 1: *Gingival recession width (mm).*
Group 1- Test, Group 2- Control.



Graph 2: *Gingival recession width (mm).*
Group 1- Test, Group 2- Control.



Graph 3: *Width of keratinized tissue (mm).*
Group 1- Test, Group 2- Control.



Graph 4: *Clinical attachment level (mm).*
Group 1- Test, Group 2- Control.

Clinical Parameters		Baseline		3 Weeks		3 Months		6 Months	
		Mean	p value	Mean	p value	Mean	p value	Mean	p value
Gingival recession depth	Test	2.50 ± 0.76	0.28	0.63 ± 0.74	0.03	0.75 ± 0.71	0.08	0.70 ± 0.71	0.08
	Control	3.57 ± 1.81	(NS)	2.0 ± 1.29	(S)	1.86 ± 1.35	(NS)	1.86 ± 1.35	(NS)
Gingival recession width	Test	2.75 ± 0.71	0.63	0.88 ± 1.25	0.07	0.88 ± 1.25	0.09	0.75 ± 1.04	0.04
	Control	2.86 ± 0.38	(NS)	2.14 ± 1.07	(NS)	2.0 ± 1.0	(NS)	2.0 ± 1.0	(S)
Width of keratinized tissue	Test	3.75 ± 1.39	0.35	3.88 ± 1.64	0.81	4.25 ± 1.39	0.33	4.25 ± 1.39	0.33
	Control	3.0 ± 1.53	(NS)	3.57 ± 1.40	(NS)	3.57 ± 1.40	(NS)	3.57 ± 1.40	(NS)
Probing depth	Test	1.38 ± 0.52	0.72	-		1.13 ± 0.35	0.92	1.0 ± 0.53	0.56
	Control	1.29 ± 0.49	(NS)			1.14 ± 0.38	(NS)	1.14 ± 0.38	(NS)
Clinical attachment loss	Test	4.13 ± 0.83	0.47	1.75 ± 1.04	0.06	1.75 ± 0.71	0.07	1.63 ± 0.74	0.04
	Control	4.86 ± 1.68	(NS)	3.0 ± 1.29	(NS)	3.0 ± 1.41	(NS)	3.0 ± 1.41	(S)
Gingival index	Test	1.0 ± 0	1.0	0.63 ± 0.52	0.20	0	1.0	0.02 ± 0.05	0.35
	Control	1.0 ± 0	(NS)	0.29 ± 0.49	(NS)	0	(NS)	0	(NS)
Gingival bleeding index	Test	1.0 ± 0	1.0	0.25 ± 0.46	0.17	0	1.0	0	1.0
	Control	1.0 ± 0	(NS)	0	(NS)	0	(NS)	0	(NS)
Plaque index	Test	0.85 ± 0.28	0.48	0.63 ± 0.52	0.20	0	1.0	0	1.0
	Control	0.74 ± 0.32	(NS)	0.29 ± 0.49	(NS)	0	(NS)	0	(NS)

Table 1: *Intergroup comparision of the study variables of study groups from baseline to six months.*

Groups	Wound Healing Index	Baseline	3rd Month	6th Month
Test group (n = 7)	Mean (SD)	1	0	0
Control group (n = 7)	Mean (SD)	2	0	0
Independent t test	P value	< 0.05	> 0.05	> 0.05

Table 2: *Comparison of wound healing index between test and control groups at baseline, 3rd month and 6th month.*

Discussion

Gingival recession is a fairly common condition with a wide distribution ranging from populations with a high degree of awareness in oral hygiene to those without the knowledge of even basic oral hygiene. Epidemiological studies show that gingival recession increases with age and the incidence varies from 8% in children to 100% after the age of 50 years [5]. Multiple surgical procedures have been attempted to obtain the elusive goal of cent percent root coverage. Amongst these, the most predictable has been subepithelial connective tissue autograft technique (SCTG) and can be considered as the 'Gold standard'. As with any mucogingival surgery the SCTG has its own drawback in the form of a second surgical site for donor tissue. It has always been a challenge to the periodontists, to develop a root coverage procedure which can be highly predictable as well as have a good patient compliance.

It was Alexander Gaggl [6] in the year 2005 who pioneered the use of periosteum for recession coverage, though Lekovic [7] can be credited with the use of periosteum as a barrier membrane prior to this. Due to its inherent properties periosteum has gained several synonyms namely "Sleeping Giant", "River of Regenerative Tissue", "Springboard of Nerve Regeneration" and "Umbilical Cord of Bone". The chief advantage of periosteum is its rich vascularity, which is vital for regeneration especially on an vascular root surface. It has its own set of advantages like close apposition of the periosteum to the recession defects sufficiently, prevention of necrosis, avoidance of twin surgical sites, reduced surgical trauma, minimal postoperative complications and a more favourable patient compliance.

LLLT since its introduction in 1971 [8] has gained popularity due to its accentuation of the wound healing process. It works basically in a biostimulatory mode and after its application on wounds, there is increased granulation tissue synthesis, enhanced neovascularisation, improved fibroblast proliferation, maturation, attachment and matrix synthesis. In addition the biological effects of LLLT may contribute to the higher tensile strengths of gingival flap margins. The stability of the granulation tissue and blood clot under the wound may subsequently prevent the collapse of the healing wound thus minimising soft tissue recession. Since recession coverage is extremely sensitive procedure both of the above techniques have been merged to obtain the best possible outcome. In the present study, the test group (PPPG + LLLT) had a definite edge in the terms of healing over the control group (PPG).

The key parameter to assess recession coverage after treatment are GRD and GRW. The GRD reduced by 1.75 mm at 6 months for the test group and 1.71 mm for the control group. The overall reduction in GRD was statistically significant in both the groups. But there was no difference on intergroup comparison. The mean coverage of the GRW was 2 mm in the test group and 0.75mm in the control group. Both intra and inter group comparison of values were statistically significant showing the accentuated effects of periosteal pedicle graft and LLLT respectively.

In a case series done by Mahajan., *et al.* in 2009 [9] where four patients with Miller Class I and II recessions with a mean GRD of 3.75 mm were treated by PPG and followed up for a period of 1 year. There was 100 % root coverage in all of the patients which was higher than the coverage obtained in the control group of the present study. This could be probably explained by the longer follow up period of 1 year and the consequent creeping attachment. A case series by the same author in 2010 where Miller's class I and II were treated by PPG and the mean GRD 3.75 mm at baseline was reduced to 0.3 mm at 6 months, these are comparable to the results of our study. In a study by Ozturan., *et al.* in 2011, [10] CAF procedure with and without laser biostimulation was carried out to assess the effect of LLLT on root coverage surgery. Here in the laser group, the mean gain of GRD was 2.57 ± 0.77 mm which can be comparable to the gain of 1.75 mm in the present study where PPG along with laser biostimulation was carried out. In the aforementioned study of 2011 by Mahajan., *et al.* the mean GRW reduced by 1.51 ± 1.15 mm in the test group and 1.48 ± 0.45 mm in the control group. When the current study was compared, the reduction of mean GRW was 2 mm in the test and 0.86 mm in the control group. The minor differences could probably explained by the fringe effect of periosteal pedicle graft. A case report in 2014 used periosteal pedicle grafting for recession coverage, the mean GRW of 3.6 mm was decreased to 0.9 mm at 6 months similar to the present study. The keratinised tissue width in the control group increased from 3 mm at baseline to 3.75 mm at 6 months and in the test group 3.75 mm at baseline to 4.25 mm at 6 months. These findings coincide with those of study by Mahajan., *et al.* in 2010 where WKT increased from 2.57 mm to 3.71 mm [11].

The study by Ozturan., *et al.* using LLLT, the WKT increased from 4.49 ± 0.31 mm at baseline to 4.71 ± 0.22 mm at 1 year and 4.51 ± 0.30 mm to 5.09 ± 0.38 mm at 1 year for the test group which was similar to the results of the present study [12]. The control group showed a CAL gain of 1.86 mm and the test group 2.50 mm at 6 months, which was statistically significant. A comparative clinical trial of periosteal pedicle graft and acellular dermal matrix allograft along with CAF was done on 14 patients in a split mouth design. The sites treated with PPG gained a mean CAL of 3.39 ± 0.63 mm at 12 months, which was greater than the results of the present study. The adjunctive Alloderm may have contributed to the better result. The study by Ozturan., *et al.* in 2011 where LLLT was used along with CAF there was a CAL gain of 2.83 ± 0.85 mm at the end of 1 year, which was similar to the CAL gain in the test group. The mean PD reduction at the end of 6 months

for the test and control groups was0.38 mm and 0.25 mm respectively [13]. This marginal change in the PD was also seen in a study by Mahajan., *et al.* in 2012 where PPG was compared with subepithelial connective tissue graft. The mean PD reduction for PPG was 0.30 ± 0.20 mm at 12 months. 61% of the subjects in the control group showed a score 2 and 28% of the subjects in the test group showed score 2 of Lien-Hui Huang wound healing index at baseline. This signifies the vast difference of healing response with the laser group showing the lesser percentage of subjects having oedema, erythema, patient's discomfort or flap dehiscence [14].

No other study in literature has perused the effects of laser biostimulation on the clinical outcome of PPG for root coverage and it is the first of it's kind. Routinely resorbable and non resorbable membranes have been used for treatment of recession and the predictability in most of the cases is 70%. Since periosteum is an autologous source in terms of regeneration we can ensure the best possible outcome. The periosteum is easily obtained in the adjacent area thereby the patient will not need to spend additionally on a membrane.

In the current study, routine surgical armamentarium were utilised to carry out the periosteal pedicle grafting. A more sophisticated armamentarium could have probably improved the results.

In the present study laser application was done on 5 consecutive days, starting from the day of surgery which could have been prolonged to 7 days to obtain superior outcomes. But even for 5 days LLLT application, patient compliance was a difficulty. When the end result amongst the groups was scrutinised it could be said that the amount of root coverage obtained was substantial overall. Periosteal pedicle graft with adjunctive LLLT did show a greater improvement in the recession parameters when compared to the periosteal pedicle graft group.

Conclusion

Within the confines of the current randomised controlled clinical trial it can be safely concluded that with the proper case selection and well honed surgical finesse PPG can almost yield complete root coverage. The adjunctive use of LLLT does contribute significantly to higher output values. As predictability and stability are always less than optimal in any of the treatments for denuded roots a concomitant procedure like laser biostimulation could give a higher predictability and stability. The exact mechanism and the underlying cellular changes could probably be explained by a more extensive clinical, histological and/or immunohistological studies of the same in the future years.

Bibliography

1. American Academy of Periodontology. Glossary of periodontal terms. American Academy of Periodontology (1992).

2. Tugnait A and V Clerehugh. "Gingival recession—its significance and management". *Journal of Dentistry* 29.6 (2001): 381-394.

3. Cairo Francesco Michele Nieri and Umberto Pagliaro. "Efficacy of periodontal plastic surgery procedures in the treatment of localized facial gingival recessions. A systematic review". *Journal of Clinical Periodontology* 41 (2014): S44-S62.

4. Sakata Yoshiro., *et al*. "Osteogenic potential of cultured human periosteum-derived cells–a pilot study of human cell transplantation into a rat calvarial defect model". *Journal of Cranio-Maxillofacial Surgery* 34.8 (2006): 461-465.

5. Newman Michael G., *et al*. "Carranza's clinical periodontology". Elsevier health sciences (2011).

6. Gaggl Alexander., *et al.* "A New Technique of Periosteoplasty for Covering Recessions: Preliminary Report and First Clinical Results". *Periodontal Practice Today* 2.1 (2005).

7. Lekovic Voja., *et al.* "The use of autogenous periosteal grafts as barriers for the treatment of Class II furcation involvements in lower molars". *Journal of Periodontology* 62.12 (1991): 775-780.

8. Mester E., *et al.* "The effect of laser irradiation on the regeneration of muscle fibers (preliminary report)". *Zeitschrift fur experimentelle Chirurgie* 8.4 (1975): 258-262.

9. Mahajan Ajay. "Periosteal pedicle graft for the treatment of gingival recession defects: A novel technique". *Australian Dental Journal* 54.3 (2009): 250-254.

10. Ozturan Seda., *et al.* "Coronally advanced flap adjunct with low intensity laser therapy: a randomized controlled clinical pilot study". *Journal of Clinical Periodontology* 38.11 (2011): 1055-1062.

11. Mahajan Ajay. "Mahajan's modification of Miller's classification for gingival recession". *Dental Hypotheses* 1.2 (2010): 45-50.

12. Ozturan Seda., *et al*. "Coronally advanced flap adjunct with low intensity laser therapy: a randomized controlled clinical pilot study". *Journal of Clinical Periodontology* 38.11 (2011): 1055-1062.

13. Ozturan Seda., *et al.* "Coronally advanced flap adjunct with low intensity laser therapy: a randomized controlled clinical pilot study". *Journal of Clinical Periodontology* 38.11 (2011): 1055-1062.

14. Mahajan A., *et al*. "Comparison of periosteal pedicle graft and subepithelial connective tissue graft for the treatment of gingival recession defects". *Australian Dental Journal* 57.1 (2012): 51-57.

Volume 20 Issue 10 October 2021