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RESEARCH ARTICLE

PINHOLE SURGICAL TECHNIQUE VERSUS VESTIBULAR INCISION SUBPERIOSTEAL TUNNEL ACCESS TECHNIQUE IN CONJUNCTION WITH COLLAGEN MEMBRANE IN THE TREATMENT OF CAIRO TYPE 1 ISOLATED GINGIVAL RECESSION DEFECTS

Abdelkarim Darwish[1], Ayman Elkashty[2] and Hesham El-Sharkawy[3]

1. Master Student of Periodontology and Oral Medicine, Department of Periodontology and Oral Medicine, Faculty of Dentistry, Mansoura University, Egypt.
2. Lecturer of Periodontology and Oral Medicine, Department of Periodontology and Oral Medicine, Faculty of Dentistry, Mansoura University, Egypt.
3. Professor of Periodontology and Oral Medicine, Head of the Department of Periodontology and Oral Medicine, Faculty of Dentistry, Mansoura University, Egypt.

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Abstract

Purpose: The objective of this research was to conduct a clinical comparison of the efficacy of the pinhole surgical technique (PST) versus the vestibular incision subperiosteal tunnel access (VISTA) technique. These procedures were assessed in the treatment of single, isolated gingival recession defects classified as Type 1 by Cairo et al., with both being performed in conjunction with a collagen membrane.

Methods: This study includes 20 patients. Cases were distributed into two main groups, group I was treated with vestibular incision subperiosteal tunnel access (VISTA) technique in conjunction with collagen membrane, while group II was treated by pinhole surgical technique in conjunction with collagen membrane. Clinical assessment was caried out at baseline including the following parameters: probing depth (PD), clinical attachment level (CAL), keratinized tissue width (KTW), gingival thickness (GT), recession depth (RD). Re-evaluation of theses parameters was carried out after three and six months, while evaluation of pain score using visual analogue scale (VAS) was carried out after 24 hours, 72 hours, first and second week of surgery.

Results: Both groups demonstrated statistically significant improvements from baseline in less recession depthand advance in clinical attachment levels. Nevertheless, no statistically significant change was found between VISTA and PST regarding PD, CAL, RD, KTW, GT, and VAS score.

Conclusions: VISTA and PST when combined with collagen membrane were both effective in treating Cairo's type 1 single isolated gingival recession defects.

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Corresponding Author:-Abdelkarim Darwish
Address:-Egypt, Mansoura, Elgomhoriast., Mansoura University, Faculty of Dentistry.

Introduction:-

Marginal tissue recession is the displacement of the soft tissue edge apical to the cementoenamel junction (CEJ) [(1)]. Gingival recession is a common condition that many individuals experience. Some patients express concern and seek corrective treatment, while others may be oblivious of its existence or identify it but not care. Patients with gingival recession typically present with three main problems: dentine hypersensitivity brought on by the exposed root surface, fear about potential tooth loss, and aesthetic dissatisfaction[(2)].
To aid in the diagnosis of gingival recessions, a number of classifications have been put out in the literature, including the Sullivan and Atkins (1968), Miller (1985), Smith index (1990), Mahajan classification (2010), Cairo et al. (2011) [(3)].

A more accurate classification system for gingival recession based on the degree and presence of interproximal clinical attachment loss was presented by Cairo et al. [(4)] in 2011. This approach distinguishes between three different types of recessions. Gingival recession without any discernible deterioration of interproximal attachment is an indicator of Recession Type 1 (RT1). In clinical practice, there is no discernible difference between the cementoenamel junction (CEJ) at the mesial and distal aspects. Gingival recess and interproximal attachment loss are characteristics of Recession Type 2 (RT2), where the extent of decrease is comparable to or less than that seen at the buccal aspect. Gingival recession and loss of interproximal attachment are the hallmarks of Recession Type 3 (RT3), with the interproximal decrease being greater than that of the buccal surface[(4)].

Numerous mucogingival techniques have aimed to successfully cover denuded roots for both functional and aesthetic reasons. Many modalities have been established to achieve predictable root coverage. These advancements aim to enhance predictability, patient discomfort reduction, minimize the amount of surgical sites, and satisfy the patient's cosmetic expectations, including the ultimate color and tissue blending of the grafted region[(5)].

Currently, the gold standard technique for root coverage correction is the pair of a subepithelial connective tissue graft (SCTG) and a coronally advanced flap (CAF). However, this approach involves creating a secondary surgical region, which increases patient suffering, and requires vertical releasing cuts, leading to scar formation that compromise aesthetics [(6)].
The vestibular incision subperiosteal tunnel access technique was developed by Zadeh HH[(7)] and combined with collagen membrane[(8)] to get around these limitations. In 2012, Chao presented a new minimally invasive procedure known as the pinhole surgical method (PST), which was based on a similar idea [(9)]. These methods have the benefit of maintaining the blood supply from the periosteal bed underneath as well as the flap above, without sacrificing vascularity because of the papillae dissection[(6)].

The main drawback of non-resorbable membranes is that they require another surgical procedure to be removed, which may impair wound healing and have a negative impact on overall clinical results[(10, 11)]. No statistically significant differences in clinical results have been found between non-resorbable and bioabsorbable barrier membranes in comparative studies assessing their effectiveness in controlling gingival recession[(12, 13)]. As a result, bioabsorbable membranes, especially collagen-based ones, are typically preferred since they can reduce the need for a second surgery while still offering similar clinical effectiveness.

Collagen membranes' capacity to expand tissue volume is one of the main advantages of utilizing them to treat gingival recession. The host's own tissue eventually replaces the membrane as it is absorbed, aiding in the keratinized gingiva's regeneration. In addition to improving aesthetic results, this regeneration process aids in functional repair. Collagen membranes also help to lessen typical side effects like wound infection or membrane exposure that are seen in other regenerative techniques. Collagen membranes are a more effective and non-intrusive option for root covering and gingival tissue regeneration because of these benefits[(14)].

The aim of this study was to compare clinically the efficacy of the pinhole surgical technique (PST) in combination with collagen membrane and the vestibular incision subperiosteal tunnel access technique (VISTA) in treating type 1 single isolated gingival recession defects according to Cairo et al [(4)]classification.

Subjects and Methods:-

Study population:

Twenty volunteers in all were gathered from the outpatient clinic of Mansoura University's Faculty of Dentistry's Department of Oral Medicine and Periodontology. Every participant had a thorough clinical assessment and was given extensive information about the suggested course of therapy, including the stages involved in the procedure, potential risks, and alternative treatment options. The purpose of this trial was to evaluate the effectiveness of the vestibular incision subperiosteal tunnel access approach in combination with collagen membrane and the pinhole surgical technique in treating type 1 single isolated gingival recession defect, as classified by Cairo et al. With permission number A09061222, the study protocol was accepted by the Mansoura University Faculty of Dentistry's ethics committee. Before beginning treatment, everyone provided written informed consent,the prospective advantages, related risks, probable consequences, and the necessary follow-up plan were all fully explained to the patients.

Selection Criteria:

Patients above 18 years old with type 1 gingival recession according to Cairo et al classification and with recession depth ≥ 3mm were included in the study.

Exclusion criteria included:

1-Patients with type 2 and type 3 gingival recession according to Cairo et al classification, 2-smokers and expectant or lactating mothers, 3-presence of antibiotic or periodontal therapy within the last 3 months, and 4-those with history of systemic diseases.

Clinical examination & preoperative preparation:

Every patient had a thorough medical and dental history obtained before any surgical procedures began. To facilitate efficient dental care at home, patients received encouragement and instruction on proper personal oral hygiene practices during the same visit. A comprehensive scaling and root planing (SRP) operation was given to each patient. Using a digital camera (Nikon D5300), preoperative baseline intraoral images were taken.

Clinical Parameters:

The parameters include: probing depth (PD) [15], clinical attachment loss (CAL) [15], keratinized tissue width (KTW) [16], gingival thickness (GT) [17], recession depth (RD) [18], and evaluation of pain score using visual analogue scale (VAS) [19]. These parameters were evaluated at baseline (T0), 3 months (T1) and 6 months (T2), while VAS score was recorded at 24h, 72h, one week and two weeks after surgery.

Surgical procedures:

Group I: VISTA group [7]:

A vestibular entrance incision is made to begin the VISTA procedure under local anesthetic. The location of this incision depends on the area that needs to be treated: the midline frenum was used for the maxillary anterior segment; the area between the canine and lateral incisor close to the frenum was used for the maxillary posterior segment; and the interproximal area between the canine and lateral incisor was used for the mandibular anterior and posterior segments.

The facial bony plate and any root dehiscence were made visible by extending the access incision through the periosteum to form a subperiosteal tunnel. EDTA gel (MD-ChelCream, METABIOMED, Pennsylvania, USA) was used for root surface biomodification to condition the exposed root region. A collagen membrane was then formed to fit the surgical site's size and placed so that it protruded 3–5 mm past the edges of the bone dehiscence that covered the root surfaces.

After that, each tooth was ready for suture attachment. Each tooth's facial enamel surface was gently acid etched for less than five seconds, followed by a thorough rinsing and air drying. Tosuccessfully avoid apical displacement of the gingival margin during the early healing period, a little amount of flowable composite resin was applied over the knot to secure monofilament polypropylene sutures (5-0) to the facial surface. Following the approximation and closure of the vestibular access incision, 5-0 polypropylene sutures were used to further attach the collagen membrane to the mobilized flap (GMS, Ghatwary Medical, Borg El Arab City, Alexandria, Egypt).

Group II: PST group [9]:
Following the administration of local anaesthetic, a 2–3 mm horizontal incision was made, and a transmucosal periosteal elevator tunnelling tool was inserted through the pinhole to conduct delicate tissue separation. After that, the tissue flap was moved laterally and coronally to allow for the elevation of two nearby papillae next to the exposed root surface. The mucogingival tissue complex was able to be repositioned at the recession site beyond the cementoenamel junction thanks to the flap's lateral and coronal extension.

EDTA gel (MD-ChelCream, METABIOMED, Pennsylvania, USA) was applied to the exposed root surface to bio-modify it. A collagen membrane was placed underneath the tunnel that was formed and injected through the pinhole for stability. The coronally advanced flap was secured in place with gentle digital pressure for five minutes. After attaching the collagen membrane to the mobilized flap, 5-0 polypropylene sutures were used to seal the access incision (GMS, Ghatwary Medical, Borg El Arab City, Alexandria, Egypt).

Postoperative measures:
For two weeks, patients were prescribed 400 mg of ibuprofen to be taken three times a day and mouthwash containing 0.12% chlorhexidine digluconate to be used twice a day. During this period, brushing was not permitted at the surgical site. Individuals were instructed to maintain appropriate oral hygiene practices, which included gently cleaning the treated region with a soft-bristled toothbrush and were scheduled for a follow-up appointment after 14 days to have the sutures removed.

Statistical Analysis
Version 22 of the Statistical Package for the Social Sciences (SPSS) was used to analyze the data. Frequencies and percentages were used to represent categorical (qualitative) variables. To determine whether continuous (quantitative) variables were normal, the Kolmogorov–Smirnov test was used. Results were displayed as means and standard deviations for data with a normal distribution. Depending on the distribution, the Student's t-test or the Mann-Whitney U test were used for continuous data, and the Chi-square test for categorical data, respectively, were used for statistical analysis.

Results:-
Twenty participants in all, ranging in age from 20 to 40, were enrolled in this study and complained of type 1 gingival recession (RT1) in Cairo. Ten patients were assigned to Group I, which involved the vestibular incision subperiosteal tunnel access (VISTA) technique in combination with collagen membrane, while ten patients were assigned to Group II, which involved the pinhole surgical technique (PST) in combination with collagen membrane.

The comparison of the VISTA and PST groups with respect to probing depth (PD) at baseline, three months, and six months is shown in Table 1. Between the two groups under study, an insignificant variance in PD values was found at baseline. Additionally, at three and six months, both groups' mean PD values showed a considerable decline. After three and six months, however, a statistically insignificant distinction in PD was observed between the VISTA and PST groups.
In terms of clinical attachment loss at baseline, three, and six months, Table 2 compares the VISTA and PST groups. At baseline, there was a statistically insignificant distinction between the two groups. Although there was a considerable drop in mean CAL for both groups at 3 and 6 months, there was no statistically noteworthy distinction between the two groups at those points.
The comparison of the recession depth at baseline, three, and six months between the VISTA and PST groups is shown in Table 3. At baseline, a difference that was not statistically significant between the study groups was found. At three and six months, the mean recession depth declined statistically significantly for both the VISTA and PST groups. However, at three and six months, a non-statistically significant distinction between the groups was found.
Table 4 compares the keratinized tissue width at baseline, three, and six months for the VISTA and PST groups. The difference between the two groups at those time points was not statistically significant. Additionally, at three and six months, the mean keratinized tissue value did not alter significantly in the VISTA and PST groups.

The gingival thickness comparison between the VISTA and PST groups at baseline, three, and six months is shown in Table 5. At baseline, three, and six months, there was a non-statistically significant distinction between the two groups. Furthermore, at three and six months, the mean gingival thickness increased non-significantly in the VISTA and PST groups.

Table 6 compares the VAS scores at 24 hours, 72 hours, 1 week, and 2 weeks for the VISTA and PST groups. In both the VISTA and PST groups, a statistically significant variance was found between 24 and 72 hours. Furthermore, after 24 hours, a statistically significant distinction between the two study groups was found. But after 72 hours, as well as after one and two weeks, a non-statistically significant alteration was noted.

Discussion:-

In addition to being a major aesthetic concern for many patients, gingival recession may also have functional consequences. For the treatment of single or multiple gingival recessions, a range of therapeutic alternatives are available. Numerous criteria, such as the patient's particular aesthetic expectations, the phenotype of gingival tissue, the health of the alveolar bone and interdental papillae, the width of keratinized gingiva, and the level of the marginal gingiva, influence the choice of the best treatment approach. By keeping these factors in mind, the surgeon can guarantee a customized course of treatment to attain the best possible functional and aesthetic results[20].

Significant progress has been achieved in surgical protocols for managing gingival recession over the past decades, with various adjunctive treatments frequently integrated into coverage procedures. The gold standard is generally considered to be the combined use of the connective tissue graft (CTG) and the coronally advanced flap (CAF), delivering root coverage rates of 65% to 98%. However, the technique is not without limitations. Challenges such as discomfort, pain, and delayed healing associated with a secondary surgical site, along with the necessity for highly skilled practitioners, present barriers to its broader application[21-23].
To improve clinical results, novel approaches to surgery have been suggested to lessen tissue damage and improve vascularization at the recipient location[24]. Tunnelling procedures would be one of these methods.

This study aimed to clinically assess the efficiency of two distinct tunnelling techniques—the vestibular incision subperiosteal tunnel access (VISTA) technique and the pinhole surgical technique (PST)—in the management of type 1 single isolated gingival recession defect as classified by Cairo et al.
Similar clinical efficacy has been documented in research comparing bioabsorbable and non-resorbable barrier membranes. However, a significant drawback of non-resorbable membranes is that their removal necessitates additional surgery, which may have an adverse effect on healing and overall clinical results. Because they may integrate into the host tissue without requiring extra steps, bioabsorbable membranes—like those composed of collagen—are therefore typically preferred[25].

Collagen membranes were utilized in our study to facilitate soft tissue recovery by offering suture integrity, immediate stability for the blood clot, and an environment conducive to the early settlement of soft tissue cells. These properties of collagen membranes are integral to enhance healing outcomes, gives some thickness for gingival tissues and ensuring the success of regenerative procedures [25].
To guarantee a clear comparison of the treatment outcomes during the follow-up periods, there was no statistically significant difference between the two groups in the current study at baseline in any of the clinical indicators (PD, CAL, RD, KTW, GT, and VAS).

There was no statistically significant disparity in the probing depth between the two groups when the follow-up durations were compared. However, between the baseline and follow-up periods, the mean probing depth decreased within each study group.

The mean probing depth in the VISTA and PST groups differed statistically significantly from baseline to 3 and 6 months. One reason for this is that the minimally invasive technique maintains the interdental papillae's vascular integrity, which is essential for encouraging tissue repair and regeneration. According to studies, preserving the papillae's vascularity promotes quick revascularization, which improves clinical results including increased root coverage and cosmetic integration. These conclusions are in line with data from other research that used VISTA and PST to show comparable decreases in PD and better periodontal outcomes, emphasizing the technology's capacity to produce superior clinical and aesthetic effects with little invasiveness[20, 26-30].
A comparison of the two methods revealed non-statistically significant variations between the two groups, but notable improvements in CAL and recession depth at 3 and 6 months of follow-up. However, an intragroup comparison revealed notable differences between baseline and 3 and 6 months.
The root coverage observed in the present study can likely bereasoned by the coronal advancement of the gingival margins beyond the cementoenamel junction (CEJ) and the stabilization of this position through coronal anchorage with sutures. This technique ensures the gingival margins remain in the desired position during the critical healing

period. The importance of coronal advancement in achieving successful root coverage has been previously highlighted in the study by Pini Prato et al. [31], that emphasized its role in optimizing surgical outcomes for gingival recession treatment.

In VISTA technique, there was a decline in median CAL and median recession depth between baseline and 3 months follow up period and after 6 months. This is agreeing with several studies which concluded that the VISTA technique resulted in stable results with no recurrence of gingival recession during the study time frame. And contributed these results to the minimal invasion characteristics that helps preserve the delicate interdental papillae which ensures better vascularization and reduces the risk of tissue ischemia, leading to more favorable healing conditions. In the studies, this preservation was associated with a reduced risk of complications like tissue necrosis and graft failure, resulting in high patient satisfaction and minimal recurrence of recession [26, 32, 33]

In the pinhole group, there was a shrink in both the median clinical attachment level (CAL) and median recession depth, with statistically significant differences observed between baseline and the 3- and 6-month follow-up periods. These findings are align with the results reported by Chao[9], who concluded that the Pinhole Surgical Technique (PST) can effectively enhance tissue quality and provide persistent outcomes, particularly when the initial tissue thicknesses ranging is at least 0.8–1 mm. This could be attributed to the fact that, in the Pinhole Surgical Technique (PST), flap elevation is avoided, thereby allowing the full native soft-tissue thickness at the recipient site to be preserved and effectively utilized during the procedure[34]. This observation is also consistent with findings from other investigators who have highlighted several advantages of the Pinhole Surgical Technique (PST), including biological, aesthetic, and procedural efficiency. Specifically, PST preserves the lateral vascular supply, minimizes the risk of scar formation, and reduces overall surgical time[28, 30, 35].

There was no statistically significant distinction in keratinized tissue width (KTW) between the two groups or within each group across the follow-up periods. This result can be attributed to the adoption of minimally invasive incision techniques, which minimize the likelihood of damaging gingival tissue. Furthermore, these approaches help maintain the integrity and blood supply of the delicate papillae, facilitating a more effective healing process, thus maintaining the KTW [36, 37].

The lack of keratinized tissue grafts in the treatment regimen is another reason why the study found no increase in the breadth of keratinized tissue. This outcome is in line with findings from earlier research, including Kuis et al.[38]that highlight the vital role keratinized tissue grafts—such as connective tissue grafts or free gingival grafts—play in enhancing the keratinized tissue zone.

The lack of KTW gain suggests that while techniques like VISTA and PST are efficient in achieving root coverage and boosting gingival thickness, they are not specifically designed to address the augmentation of keratinized tissue. These minimally invasive procedures focus on repositioning existing soft tissue to cover exposed roots, rather than introducing new keratinized tissue.

These findings underscore the importance of tailoring surgical approaches to the specific clinical objectives of each case. If elevating the width of keratinized tissue is a priority, incorporating grafting techniques may be necessary. Conversely, for cases focused on esthetic root coverage and soft tissue enhancement, minimally invasive procedures like VISTA and PST remain highly effective options.

This result runs counter to the findings of Reddy's study[29], which found that the width of keratinized tissue had increased. That study suggested that the periodontal ligament's role in granulation tissue production and the mucogingival junction's ultimate restoration to its genetically specified location could be responsible for this rise. The reported rise in KTW seems to be largely due to the MGJ relocation process. The precise amount of time needed for the MGJ to completely relocate to its original location and contribute to the rise in KTW, however, is still unknown and needs more research[39].

Regarding gingival thickness (GT), no significant difference was observed between the study groups. However, there was an increase in the mean gingival thickness from baseline to follow-up periods in both groups. This can be attributed to the use of collagen membranes, which are used in guided tissue regeneration (GTR) to act as a barrier, preventing epithelial downgrowth and allowing periodontal ligament and bone cells to regenerate. Nevertheless,

collagen membranes do not strongly induce fibroblast proliferation or angiogenesis in the same way that autogenous grafts do, and this limits the amount of new connective tissue formed in the overlying flap.[40]

Our findings highlight that collagen membranes alone may help with root coverage in Class I gingival recession, but they do not reliably increase gingival thickness. For true increase in gingival thickness, a combination therapy (e.g., CTG + membrane) is generally required.

This outcome is consistent with prior research showing that gingival thickness increased by 1 mm when a collagen matrix was used in conjunction with a coronally advanced flap. Given that both VISTA and PST are variants of coronally sophisticated approaches, this aligns with our research. Furthermore, the study that used a collagen matrix to treat gingival recession produced comparable outcomes, confirming the usefulness of collagen matrices in gingival recession treatment[41, 42].

When comparing the two groups' VAS scores, it was found that the mean scores for both groups had significantly decreased after 24 hours, but that there had been no statistically significant difference after 72 hours, 1 week, or 2 weeks. Postoperative effects, such as pain, edema, and bleeding, were modest and transient, and there was little discomfort during the procedure. Aesthetic results, like tissue merging and color matching, were also positive. These results can be ascribed to the procedures' low invasiveness, their sparing use of sutures, and the patients' quick, apparent aesthetic benefits. Additionally, by doing away with vertical releasing incisions, these methods avoid jeopardizing blood supply, stop scarring, and shorten the duration of surgery[35].

It was revealed that the VISTA technique has been associated with fewer postoperative complications, including swelling, pain, and bleeding. Because the procedure is minimally invasive and involves less manipulation of the gingival tissues, there is less disruption to the tissue and a reduced risk of infection or graft failure. The use of a single incision and subperiosteal tunnelling also minimizes the chances of flap dehiscence, a common complication in traditional techniques [26, 32].

Moreover, in accordance with our results regarding PST, A retrospective study demonstrated effectiveness of the Pinhole Surgical Technique (PST) in treating Miller's Class I and II gingival recession reported a comparable results where postoperative complications were minimal with cases experiencing mild pain, slight bleeding, and postoperative swelling, all of which subsided within the first two days. Additionally, the study highlighted significant patient satisfaction, particularly in terms of aesthetic outcomes, with 95% of patients expressing high levels of satisfaction [29].

Conclusion:-

We may infer that Cairo's type 1 single isolated gingival recession problems were successfully managed using VISTA and PST in conjunction with collagen membrane. Both groups showed statistically significant gains in clinical attachment levels and a reduction in the depth of the recession compared to baseline. Collagen membrane can also be employed as a graft material, which has the clinical benefits of bypassing a donor site and significantly reducing post-operative patient discomfort.

Limitations and Recommendations:-

Due to the relatively brief follow-up periods (3 and 6 months), isolated gingival recession problems were the focus of this investigation. Additionally, while case reports and case series make up most published data, there are notably few randomized controlled trials examining the efficacy of VISTA and PST procedures in conjunction with collagen membranes for the treatment of gingival recession. Further multicenter randomized clinical investigations that include both localized and numerous gingival recession lesions are therefore advised. To assess the therapeutic effectiveness and long-term results of VISTA and PST more thoroughly in treating gingival recession, these studies ought to include longer observation times and bigger participant cohorts.

Table 1:-Probing depth (PD; mean ±SD) between groups at different time intervals:

Probing depth (mm)	VISTA n=10	PST n=10	p value
Baseline	1.35±0.16	1.47±0.21	NS
3 months	1.16±0.14	1.25±0.18	NS
6 months	1.14±0.12	1.22±0.15	NS
Comparison	*p1<0.001*, p2<0.001* p3>0.05*	*p1<0.001*, p2<0.001* p3>0.05*	

Student t test and Paired t test were used for analysis.
p1: difference between baseline and after 3 months, p2: difference between baseline and after 6 months
p3: difference between 3 and 6 months, *Statistically significant, NS=non-significant (p>0.05).

Table 2:-Clinical attachment loss (CAL; mean ±SD) between groups at different time intervals:

Clinical attachment loss (mm)	VISTA n=10	PST n=10	p value
Baseline	4.25±0.45	3.82±0.34	NS
3 months	0.75±0.64	0.56±0.32	NS
6 months	0.90±0.83	0.85±0.63	NS
Comparison	p1<0.01*, p2<0.01* p3>0.05	p1<0.01*, p2<0.01* p3>0.05	

Mann Whitney U test and Wilcoxon signed rank test were used for analysis.
p1: difference between baseline and after 3 months, p2: difference between baseline and after 6 months,
p3: difference between 3 and 6 months, *Statistically significant, NS=non-significant (p>0.05).

Table 3:-Recession depth (RD; mean ±SD) between groups at different time intervals:

Recession Depth (mm)	VISTA n=10	PST n=10	p value
Baseline (T0)	2.75±0.27	2.53±0.32	NS
3 months (T1)	0.25±0.36	0.34±0.56	NS
6 months (T2)	0.32±0.49	0.27±0.35	NS
Comparison	p1<0.01*, p2<0.01* p3>0.05	p1<0.01*, p2<0.01* p3>0.05	

Mann Whitney U test and Wilcoxon signed rank test were used for analysis.
p1: difference between baseline and after 3 months, p2: difference between baseline and after 6 months
p3: difference between 3 and 6 months, *Statistically significant, NS=non-significant (p >0.05).

Table 4:-Keratinized tissue width (KTW; mean ±SD) between groups at different timepoints:

Keratinized tissue width (mm)	VISTA n=10	PST n=10	p value
Baseline (T0)	5.16±2.38	5.99±2.75	NS
3 months (T1)	5.16±2.36	5.99±2.54	NS
6 months (T2)	5.16±2.34	5.99±2.43	NS
Comparison	p1=NS, p2=NS p3=NS	p1=NS, p2=NS p3=NS	

Mann Whitney U test and Wilcoxon signed rank test were used for analysis.
p1: difference between baseline and after 3 months, p2: difference between baseline and after 6 months
p3: difference between 3 and 6 months, NS=non-significant (p >0.05).

Table 5:-Gingival thickness (GT; mean ±SD) between groups at different timepoints:

Gingival thickness (mm)	VISTA n=10	PST n=10	p value
Baseline (T0)	1.81±0.42	1.83±0.46	NS
3 months (T1)	1.90±0.65	1.95±0.55	NS
6 months (T2)	1.88±0.57	1.91±0.58	NS
Comparison	p1=NS, P2=NS	p1=NS, p2=NS	

	p3=NS	p3=NS	

Student t test and Paired t test were used for analysis.
p1: difference between baseline and after 3 months, p2: difference between baseline and after 6 months
p3: difference between 3 and 6 months, NS=non-significant (p >0.05).

Table 6:-Visual analogue scale score (VAS; mean ±SD) between groups at different timepoints:

VAS score	VISTA n=10	PST n=10	p value
24h	4.90±1.19	3.70±1.25	p<0.05*
72h	2.70±0.94	2.90±0.57	p=NS
1 week	0	0	
2 weeks	0	0	
	p<0.001*	p<0.05*	

Student t test and repeated measures ANOVA test were used in the analysis.
*Statistically significant.

Cases:

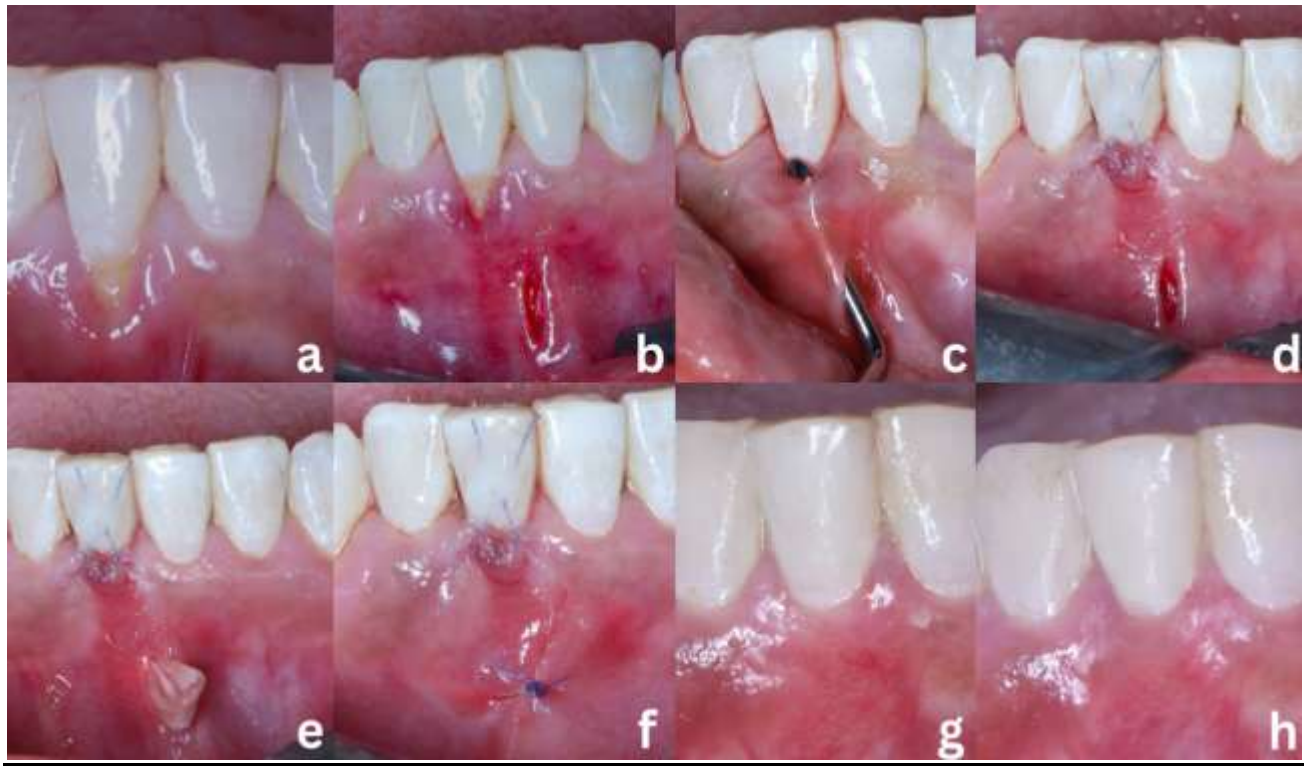

Fig.1:-VISTA case showing a) baseline, b) VISTA incision, c) tunnel preparation, d) gingival margin repositioning, e) membrane insertion, f) incision suturing g) 3-month follow-up, h) 6-month follow-up.

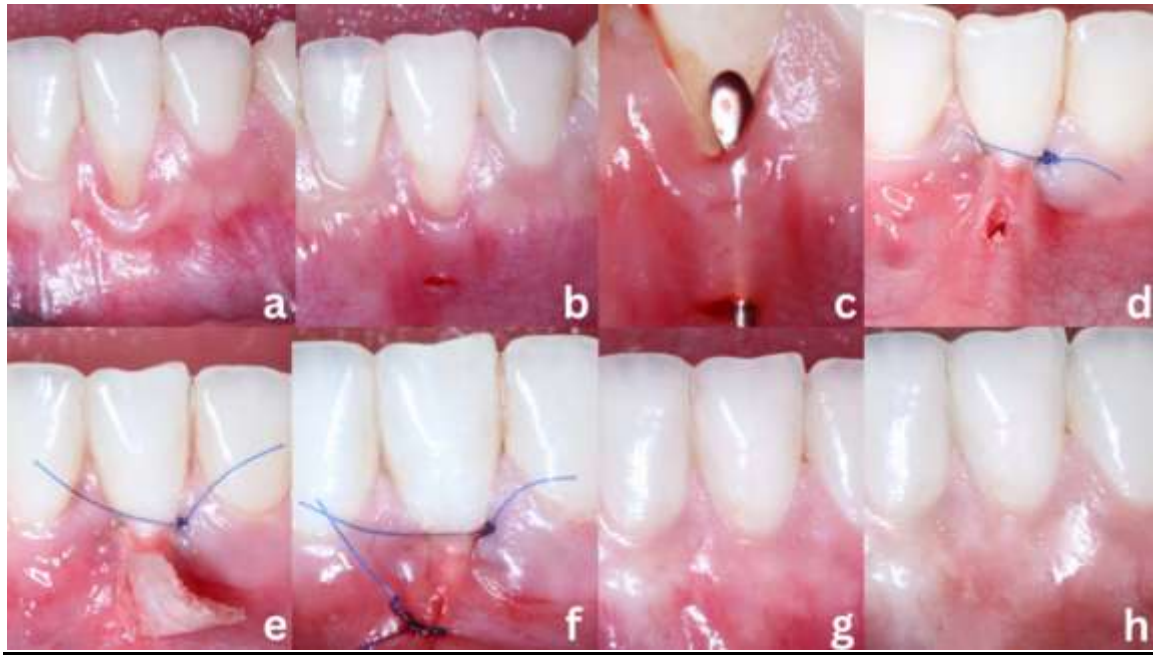

Fig.2:-PST case showing a) baseline, b) PST incision, c) tunnel preparation, d) gingival margin repositioning, e) membrane insertion, f) incision suturing g) 3-month follow-up, h) 6-month follow-up.

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