Pin Hole Surgical Technique: A Nominally Incursive Root Coverage Procedure: An Evidence Based Meta Analysis and Systematic Review

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Abstract

Introduction

The concept of Minimally Invasive Surgery (MIS) is embracing all aspects of surgical techniques aiming to produce minimal wounds, minimal flap reflection, and gentle handling of the soft and hard tissues. Chao's Pinhole Surgical Technique (PST) which is a minimally invasive option for treating multiple gum recession.

Unlike traditional grafting techniques, PST is incision and suture free. Current meta-analysis is being carried out to check the efficacy of PST based on the previously conducted researches in literature.

Methods:

An extensive literature search was performed in the Cochrane Library, PubMed and EMBASE. The search terms included 'Gingival Recession', 'Pin Hole Technique', 'periodontal treatment' combined with outcomes of interest, including 'plaque index', 'gingival index', 'probing pocket depth', 'clinical attachment level', 'Width of keratinized mucosa' and 'Recession depth'. Studies were thoroughly assessed and the similar studies were filtered out to carry out the meta-analysis. There were only 2 similar studies found in the literature where Probing pocket depth [PPD], Clinical Attachment Level [CAL], Width of keratinized tissue and Recession Depth [RD] were measured.

Results:

The mean values varied significantly from the baseline to follow up among all the parameters. Where, the PPD, CAL and RD were found to be decreased significantly at follow up and the width of keratinized tissue increased significantly at follow up compared to baseline.

Conclusion:

The main outcome of comparing the included clinical studies was that the PST achieves non-invasive treatment of the unlimited number of gingival recession defects with high predictable esthetic results in one appointment without donor sites or exposure of the graft, which make PST a promising modality that reaches the periodontist ambition.

Introduction:

One of the most prevalent periodontal disorders globally is gingival recession (GR). It can affect a patient's comfort, aesthetics, and functionality as well as raise the risk for root caries and hypersensitivity [1,2,3]. A detailed understanding of the disease and its treatment modalities is essential for managing it successfully and with predictable long-term outcomes given the great incidence of this ailment, the cosmetic and functional issues associated with it, and the obstacles it brings during therapy.

For the treatment of gingival recession problems, there are several periodontal plastic surgery techniques that have been reported in the literature [4]. For improved treatment outcomes, the aetiology and causative factors must be corrected. This includes correcting malocclusions, improving tooth brushing technique, and removing local causes (plaque and calculus) [5]. Root covering techniques primarily seek to enhance keratinized tissue, which stops the advancement and improves the tissue's aesthetic look. For the treatment of gingival recession, several periodontal plastic procedures, such as free gingival grafts, laterally repositioned flaps, and coronally advanced flaps (CAF) with their many variations, are recommended.

The goal of periodontal reconstructive surgery is reportedly the restoration of a stable periodontium in conjunction with optimal patient-centered result [6-8]. Because of the extensibility of the avascular root surface area and the rising desire for precision treatment, the challenge provided to the physician by many recession defects creates a high level of difficulty. The thin biotype of gingiva, reduced keratinized tissue width, root prominence, and root closeness are additional issues that restrict treatment possibilities. Currently, the gold standard and most reliable method for root coverage is the subepithelial connective tissue graft procedure. However, this method involves

creating a second surgical site, which increases the patient's morbidity, and includes vertical release incisions, which cause scarring and compromise the patient's aesthetics [9].

Therefore, a surgery that addresses all types of GR in a single visit, is quick, simple, operator-friendly, does not call for a second surgical site, and most importantly, addresses the patient's cosmetic issues, is an appealing prospect. Following a similar approach, Chao presented the PINHOLE SURGICAL Procedure (PST) [10], an unique minimally invasive technique, in 2012. Compared to other existing treatment techniques, this procedure offers a cautious approach to treating recession abnormalities.

For getting patient-based outcomes, PST is thought to be a more dependable, efficient, minimally invasive, time- and money-efficient alternative to FCTG procedures [11]. Compared to other existing treatment techniques, this procedure offers a cautious approach to treating recession abnormalities.

PST lowers the time and expense associated with performing suturing operations since it does not use sutures or suturing methods. Using envelope incisions and semilunar incisions, this approach also has the advantage of not necessitating vertical incisions, which makes the treatment less traumatic and ramps up recovery [9]. PST preserves the integrity of the tissue while leaving the periosteum intact and without changing the vascularity of the surrounding tissues. As a consequence, there is no impairment of the vascular supply, which accounts for the quicker healing time without any problems or scarring, which has additional biological and cosmetic benefits. Additionally, the patient may see the root covering right away following the treatment, which raises their degree of general satisfaction [12].

Briefly said, the pinhole procedure is a viable alternative for treating gingival recession. Because of its minimally invasive character, it is not only technically viable for the doctor but also helps patients comply. This treatment offers promising outcomes in terms of the aesthetic aspect as well as the management of the issues related to gingival recession.

The aim of this systematic review was to determine whether Pin hole surgery technique offers any additional benefits over current techniques alone as measured by the clinical parameters [PPD as the primary outcome] and biochemical markers of periodontal inflammation [secondary outcomes] based on the findings of randomized controlled trials [RCTs].

MATERIAL AND METHODS

This systematic review was carried out in accordance with the Cochrane Handbook for Systematic Review of Interventions and the Preferred Reporting Items for Systematic Reviews and Meta-Analysis [PRISMA] [13,14]. The study is registered at National institute for health research (PROSPERO 2021 CRD42021282174).

Search strategy

An extensive literature search was performed in the Cochrane Library,

PubMed and EMBASE. Any record relevant to treatment of gingival recession defects by Minimally invasive Pin Hole Surgical technique was included for further screening with no restrictions regarding the publication year or language. The reference lists of all selected full-text publications were scanned at the same time. No additional manual search of journals was performed. The search terms included 'Gingival Recession,' 'Pin Hole Technique', 'periodontal treatment' combined with outcomes of interest, including 'plaque index', 'gingival index', 'probing pocket depth', 'clinical attachment level', 'Width of keratinized mucosa' and 'Recession depth'. Study selection in the first stage, the titles and abstracts of all retrieved reports were screened for potentially eligible studies. The full text articles of the previously identified studies were then examined in detail according to predefined eligibility criteria for inclusion in the qualitative review. Finally, the references covered by the selected studies were searched manually to avoid the omission of any information related to the topic. Two reviewers performed the screening process independently. Whenever there was a disagreement between the two reviewers regarding study selection, discussions were carried out until a consensus was reached. The inter-reviewer reliability was assessed by Cohen's kappa test, assuming 0.6 as an acceptable threshold value.

Participants were patients diagnosed with gingival recession. There were no restrictions in the age, gender, ethnicity, or socioeconomic status of the participants. The participants were randomly allocated. Each participant underwent the treatment of the gingival recession of variant grades with pin hole surgical technique. The clinical parameters were noted at pre op and at follow up. The parameters included are Probing Depth, Clinical Attachment Level, Width of Keratinized Mucosa and Recession Depth.

Potential participants who had any systematic disease or who were under medication that was known to affect the inflammation progress and wound healing of periodontal tissue were excluded, as were any who had undergone periodontal treatment within the past 6 mo. Any other treatment protocol adapted other than pin hole technique is excluded.

Risk of Bias:

The Cochrane Tool for Risk of Bias Assessment was used to assess the risk of bias in the included studies [13]. Seven assessment domains make up this technique, including "random sequence generation," "allocation concealment," "blinding of participants," "blinding of key employees," and "selective reporting." Each study's overall methodological quality was rated as low risk if all four domains received the same assessment of "having a low risk of bias," moderate risk if at least one domain received the assessment of "having an unclear risk of bias," and high risk if one or more domains received the assessment of "having a high risk of bias" (Table 1).

Table 1: Assessment of Risk of Bias

Study	**Random sequence**	**Allocation concealment**	**Reporting bias**	**Blinding of participants**	***Mean risk of bias***

	generation (selection bias)	**bias (selection bias)**	**(selective reporting)**	**and personnel (performance bias)**	
Manvi Chandra et al, 2021	+++	+++	+	++	+++
Chao et al, 2012	+++	+++	+	++	+++

+ low risk, ++ moderate risk, +++ high risk

Statistical analysis:

REVMAN 5.4.1 was used to conduct the meta-analysis [13]. The stated standard deviation and sample size of each trial included in the meta-analysis were used to calculate the weight of each impact estimate [15]. For clinical indices and biochemical markers, the effect size was calculated and given as the mean difference (MD) or standardized mean difference (SMD) with the 95% confidence interval (CI). Using the I2 statistic and the chi-squared test with an alpha level of 0.10, heterogeneity was evaluated. If the I^2 value was more than 50%, moderate to significant heterogeneity was thought to exist. The two-tailed z test's statistical significance threshold was set at 0.05 for the hypothesis test.

Search and selection results:

The search on databases including PubMed, Lilacs, ScienceDirect, Web of Science, Google Scholar, Upstate Library, Scopus, and Embase turned up a total of 126 entries. A second search was done, and it turned up 2 entries from different websites. After removing the duplicate records, 128 records were left out of the total. 42 records left after 86 were eliminated from the 128 records due to their titles. 11 of those 42 records were eliminated after reviewing the abstract because they did not meet the inclusion criteria. Nine of the 11 full-text papers that were accessible were disregarded for various reasons, including the lack of identical factors being studied in the study, the method of the study's execution, the type of method employed, the follow-up duration, etc. There were just 2 records remaining for the meta-qualitative analysis's and quantitative synthesis.

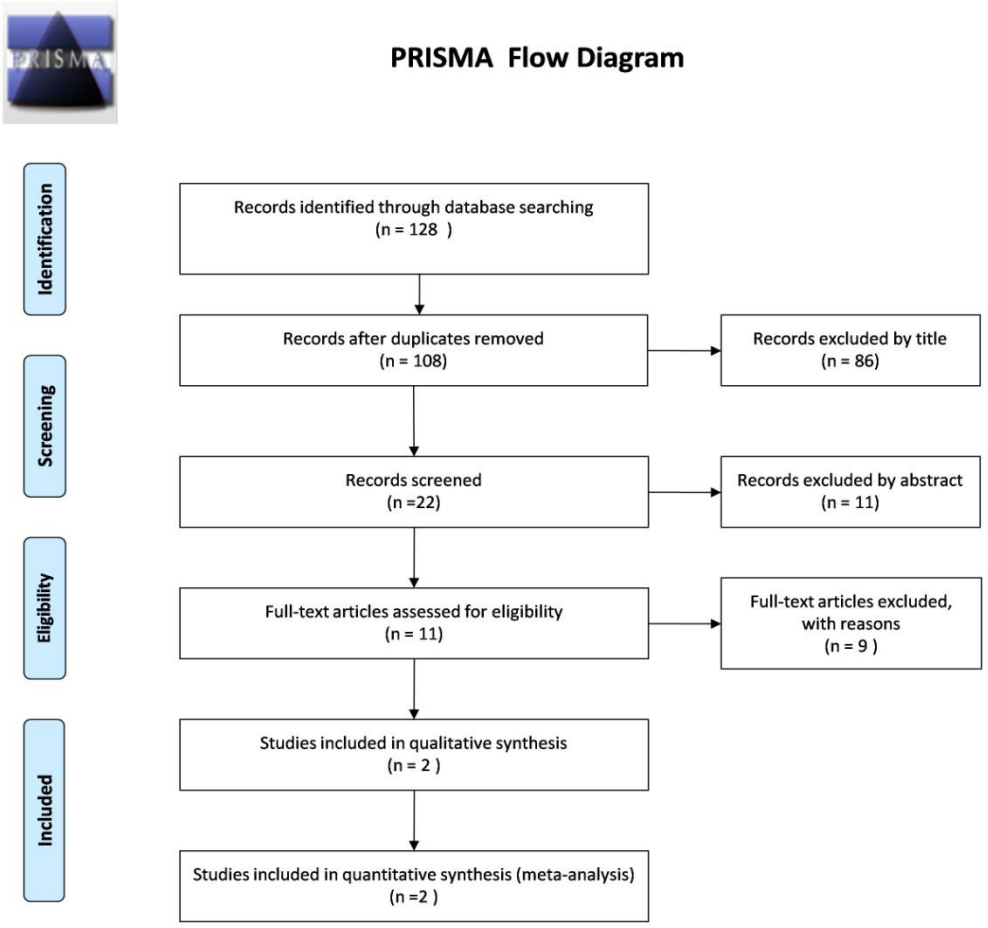

Figure 1: PRISMA flow chart showing the selection of the studies

Characteristics of the studies:

The characteristics of the included studies were summarized in Table 2. The characteristics summarized includes the sample size, location of the study carried out, parameters measured, study design, groups divided, Findings of the study.

Table 2: Characteristics of studies

Author	Sample size	Study location	Periodontal parameters included	Study design	Findings
Manvi Chandra et al [20]	20 sites	Uttar Pradesh, India	Probing depth, recession depth (RD), Recession width (RW), clinical	Prospective	This case series represents a 6 month follow up of a recently introduced pinhole surgical

			attachment Level (CAL), and width of keratinized Tissue (WKT)		technique were the percentage of root coverage was found to be statistically significant.
Chao et al [10]	85 sites	California	Recession depth (RD), Recession width (RW), Probing depth, Clinical attachment Level (CAL), and keratinized gingiva	Retrospective	Pinhole technique holds promise as a minimally invasive predictable, effective and time and cost-effective method for obtaining optimal patient-based outcomes

RESULTS

Forest plots were made to compare the efficacy of PST on periodontal status, using various parameters and to address the heterogeneity of the involved studies. Random effect model is used for the quantitative analysis and calculated at Confidence intervals of 95%.

Forest plot made for 2 studieswhich took PPD as a clinical parameter for determining the periodontal condition at baseline and follow up states that probing depth was reduced at the follow up with Z= 1.56 at p = 0.12 (Not significant). Forest plot was prepared for PPD of the studies selected is mentioned as **Figure 2** and funnel plot is illustrated as **Figure 3.**

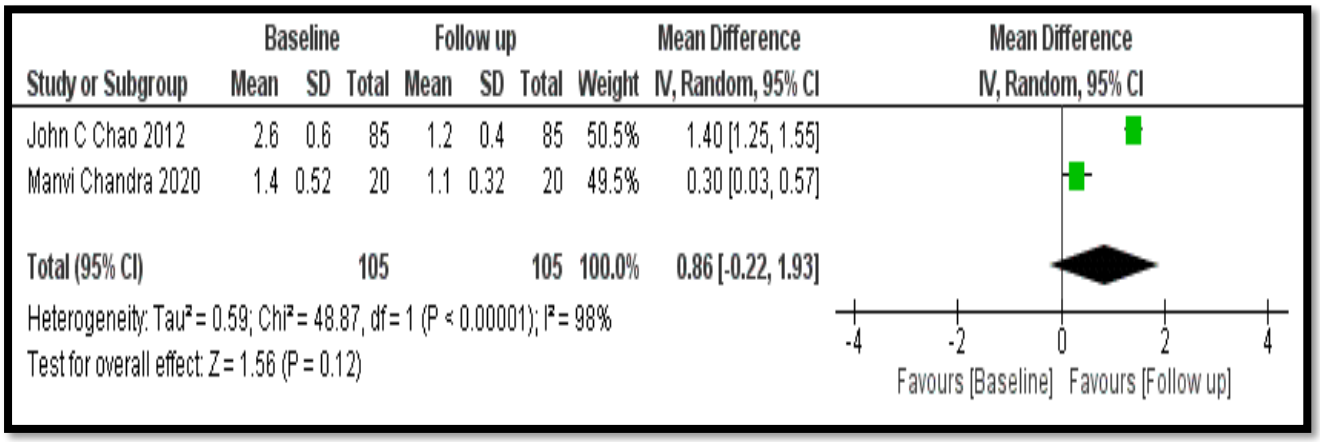

Figure 2: Forest plot of PPD

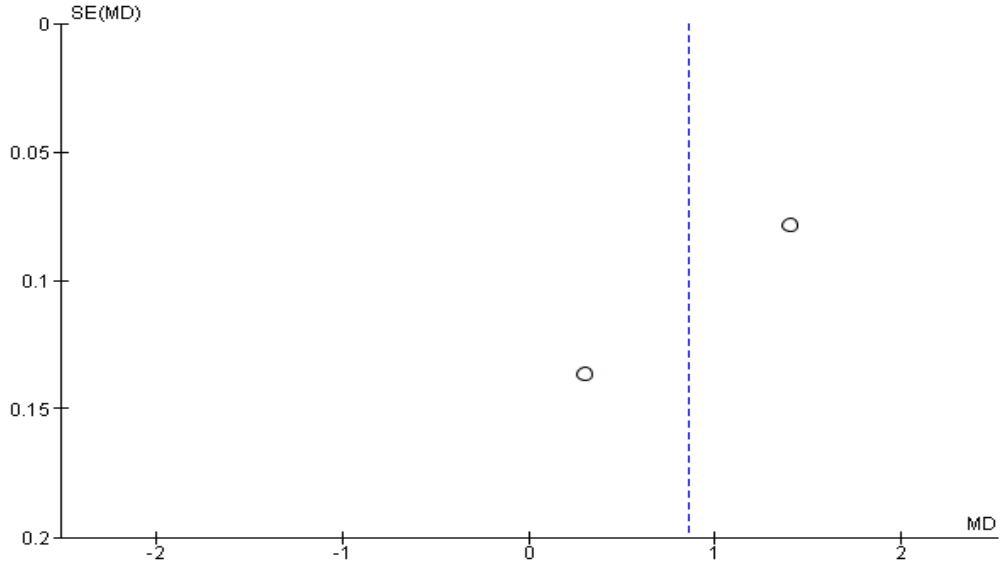

Figure 3: Funnel plot of PPD

Forest plot made for 2 studieswhich took CAL as a clinical parameter for determining the periodontal condition at baseline and follow up states that attachment loss was reduced at the follow up with Z = 3.75 at p = 0.0002 (significant). Forest plot, was prepared for CAL of the studies selected is mentioned as **Figure 4** and funnel plot is illustrated as **Figure 5.**

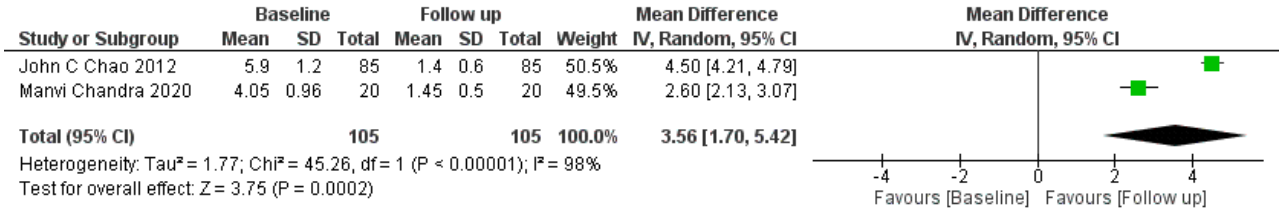

Figure 4: Forest plot of CAL

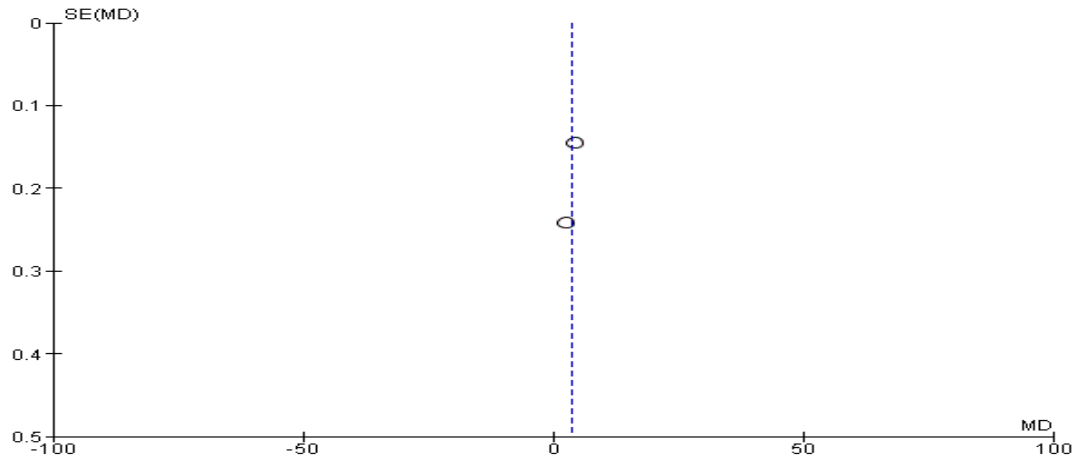

Figure 5: Funnel plot of CAL

Forest plot made for 2 studieswhich took width of keratinized gingiva as a clinical parameter for determining the periodontal condition at baseline and follow up states that width of keratinized gingiva was increased at the follow up with Z = 1.93 at p = 0.05 (significant). Forest plot, was prepared for WKT of the studies selected is mentioned as **Figure 6** and funnel plot is illustrated as **Figure 7.**

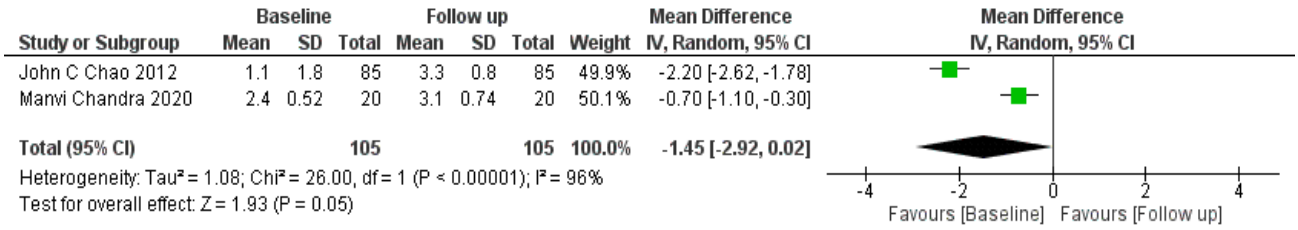

Figure 6: Forest plot of Keratinized tissue width

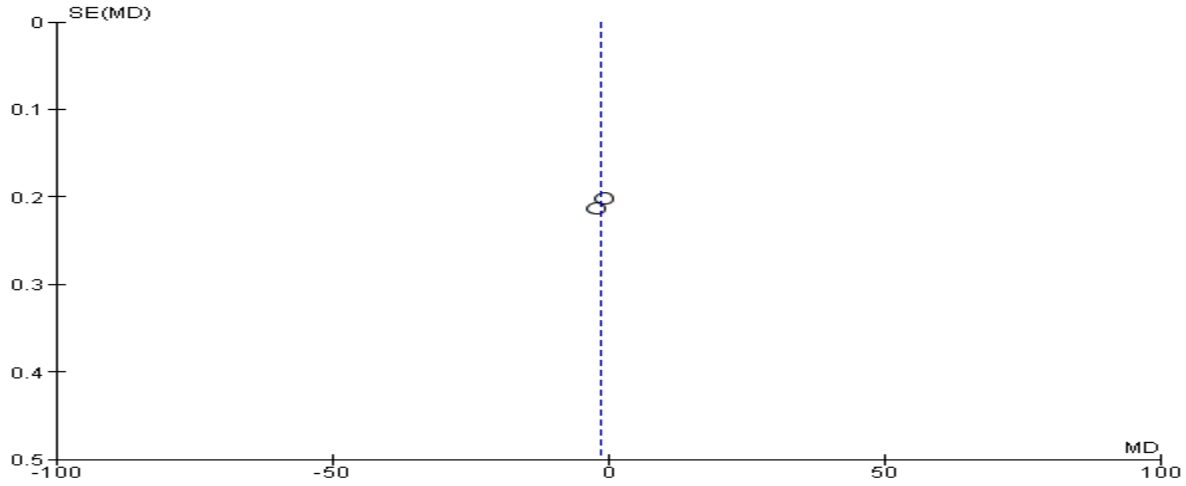

Figure 7: Funnel Plot of Keratinized tissue

Forest plot made for 2 studieswhich took Recession depth as a clinical parameter for determining the periodontal condition at baseline and follow up states that recession depth was decreased at the follow up with Z = 6.78 at p < 0.0001 (significant). Forest plot, was prepared for RD of the studies selected is mentioned as **Figure 8** and funnel plot is illustrated as **Figure 9.**

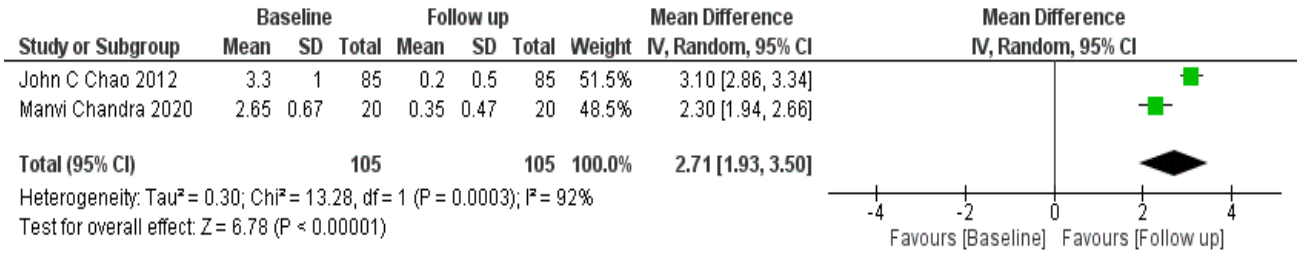

Figure 8: Forest plot of RD

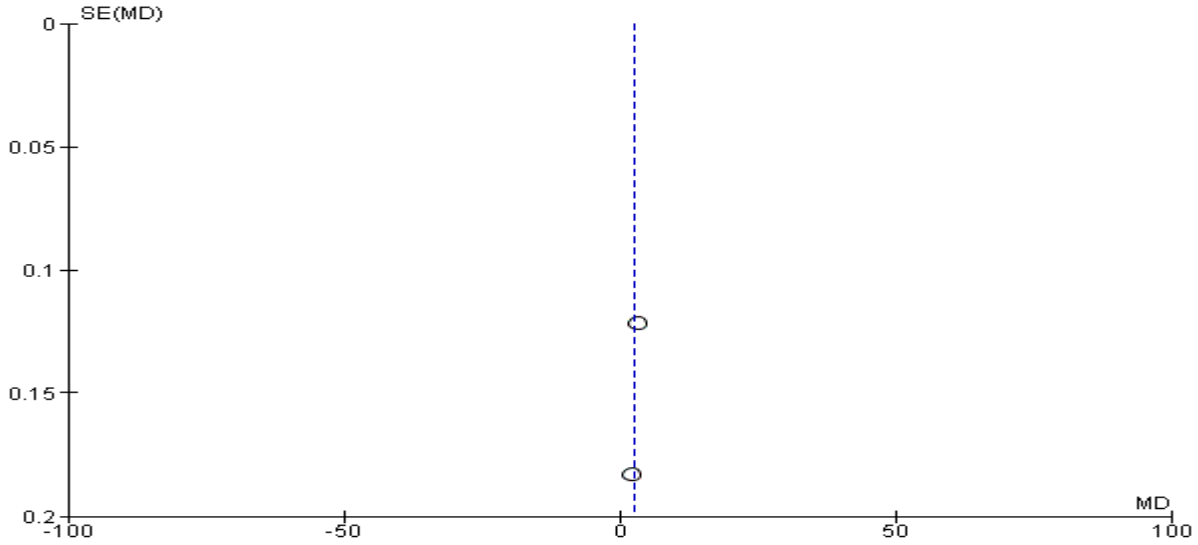

Figure 9: Funnel plot of RD

Discussion:

The general public is becoming more and more concerned about the cosmetic and functional implications of gingival recession on teeth. The extent of the avascular root surface area makes it difficult for clinicians to provide precise therapy for various recession problems. The choice of surgical therapy is also complicated by thin biotype, reduced Keratinized Tissue Width (KTW), root prominence, and root proximity [16]. Additionally, when a patient complains about the aesthetics of their teeth, full root coverage up to the cementoenamel junction is the ultimate aim to be accomplished. [17]

There are various recommended procedures for correcting recession, however many of them are better suitable for fixing single defects [18]. Despite being the current gold standard, the sub-epithelial connective tissue graft has several disadvantages, such as the need to harvest at a distant donor location, a limited supply of tissue, scarring at the recipient site, and a higher risk of post-harvest morbidity [19].

Furthermore, poor root coverage or a repeat of the recession are frequently brought on by muscle stress during the healing process. Furthermore, if the gingiva is too thick or the area is not integrated adequately, even if complete root coverage is surgically accomplished, the results may not be fully satisfactory. [17]

The requirement to get access through a narrow sulcular access point and the greater danger of upsetting and perforating the sulcular tissues, which might result in adverse healing results, make tunnel method for numerous recessions problematic in nature. The Vestibular Incision Subperiosteal Tunnel Access (VISTA) method was created to get over some of the possible drawbacks of intrasulcular tunnelling procedures, particularly for maxillary anteriors, because of these restrictions [18].

The pin hole approach, developed by John Chao and based on the principles of minimally invasive surgery, is an emerging technique that uses no sutures or scalpels to treat recessions. Simply said, the current gingival tissues are moved to the coronal position without the need for a secondary surgical site, a releasing incision, or the release of sutures. Patients should thus anticipate few postoperative side effects such pain, edoema, and bleeding [10]. However, there are relatively few studies that provide solid data to support the advantages of new PST in the management of gingival recession. Therefore, to clarify this study topic, a systematic review was done.

The proportion of the time that either full root coverage or nearly full (90%) root coverage was attained was used to calculate predictability. 85 of the 121 sites were Miller Classes I and II, and 36 were Miller Classes III, making a total of 14. Complete root coverage was attained in 69.4% of sites and 90% defect coverage was attained in 77.7% of sites when Class III sites' data was combined with that from Class I and II sites. Complete defect coverage was reached in 81.2% of sites and nearly full defect coverage was seen in 90.6% of sites when just the 85 Class I and II sites were calculated. The overall mean defect coverage and mean defect reduction were used to gauge efficacy. The overall mean baseline recession was 3.4±1.0 mm. The overall mean defect coverage and mean defect reduction for all 121 locations were, respectively, 88.4% and 3.0 ± 1.1 mm [10]. In the 10 cases, nine cases at the three-month mark constituted full root coverage (CRC), which was decreased to six cases at the six-month mark. The median VAS reading was 3.4 ± 0.84, which indicates higher patient satisfaction and lower morbidity [20].

According to the PPD, CAL, breadth of keratinized mucosa, and recession depth in both investigations, the present body of data suggests that PST has some short-term advantage. However, given the significant methodological flaws and significant heterogeneity across the included studies, the findings of this systematic review should be regarded with care.

Limitation of the Study:

The research features were viewed as being too heterogeneous due to the short number of publications and the variability of techniques, including different classifications of recession, follow-up times, and types of grafting. Additionally, the root length parameter should be taken into consideration while determining PST predictability, and no research on the management of class IV Millar's recessions have been conducted. Additionally, the clinical data is not yet supported by any histology research.

Conclusion:

In dental clinics, where invasive surgical manipulations are used to repair the lost tissues, less invasive periodontal interventions are a necessity. Therefore, the required strategy is to rebuild the periodontium and cover roots utilizing a conservative surgical technique with the less postoperative complications. The primary finding from analyzing the included clinical trials was that PST is a promising modality that may repair number of gingival recession abnormalities non-invasively and with good predictability of aesthetic results in only one session without donor sites or exposure of the graft.

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