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Original Article

Radiographic Evaluation of Partial versus Complete Removal of Granulation Tissue in Modified Minimally Invasive Surgical Technique (M-Mist)

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ABSTRACT

Aim: This study aims to assess radiographic outcomes after complete versus incomplete removal of granulation tissue (GT) during modified minimally invasive surgical technique (M-MIST) for management of periodontitis patients stage III with intra-bony defects. **Methodology:** Ten patients with a total of 13 deep pockets (≥5mm) associated with vertical intra-bony defects were recruited for this study. They were randomized into 2 groups; Intervention group with incomplete removal of Granulation tissue GT and the control group with complete removal of GT. Distance from cemento enamel junction to base of the defect (CEJ to BD) was taken at 0,6 and 9 months. **Results:** Both groups showed minimal bone resorption (CEJ to BD) in (0.037 ± 0.4 mm, p =0.936, 0.897 ± 0.6 mm, p = 0.184). No statistical significant difference between the 2 groups (p > 0.05). **Conclusions:** Intervention group showed results similar to control M-MIST only, with no signs of bone regeneration in both groups. Further studies with larger sample size are needed to confirm the results.

Keywords: Periodontitis, Scaling, Granulation tissue, Infrabony

I. INTRODUCTION

Periodontitis is a microbially-associated, host mediated inflammation that results in damage and the loss of the supporting structures of the periodontium (Tonetti et al. 2018) Periodontitis affects a

wide range of people across all age groups and genders. The disease leads to the breakdown of connective tissues and supporting bone causing the formation of pockets and gradual periodontal breakdown. Eventually, this results in loosening of the teeth, aesthetic problems, abscess formation and eventual tooth loss (Needleman et al. 2012)

Over the last few decades traditional periodontal surgical techniques, such as open flap debridement, have often been used to repair the damage sustained during active destruction (Harrel 1999; Trombelli and Farina 2008) The true purpose of periodontal surgery is to reconstruct the attachment apparatus with the preservation of the pre-surgical soft tissue's contour and height (Trombelli and Farina 2008), however the purpose was not met.

The development of minimally invasive surgical techniques and their modifications (M-MIST) by Cortellini (2009) led to an improvement in healing and regeneration of tissues following periodontal surgery for the treatment of isolated interdental intra-bony defects.

Complete removal of granulation tissue has been considered an important step in every surgical technique, old and new. It has been considered an essential step for surgical site preparation for periodontal regeneration. However studies have shown the presence of stem cells with osteogenic potential being extracted from these granulation tissue questioning the need for its complete removal which is a time consuming and delicate process(Cortellini and Tonetti 2009; Li et al. 2014) The aims of this study was to examine the regenerative outcomes after complete versus incomplete removal of granulation tissue.

Accordingly, the current study was designed to compare the radiographic outcomes after complete versus incomplete (partial) removal of GT using M-MIST for management of periodontitis patients with deep pockets associated with infra-bony defects.

II. SUBJECTS AND METHODS

Study participants

Patients for the current study were recruited from the postgraduate clinic of the department of Periodontology and Oral Medicine, Faculty of Dentistry – Cairo University. recruitment started from December 2018 and to April 2021. Healthy study subjects diagnosed with periodontitis with an age range of 25 – 55 years were enrolled in the study. (Mishra et al., 2013).

Preoperative preparation:

Non-surgical periodontal therapy was completed for all subjects, as an initial step. Supra and subgingival debridement was done using a combination of ultrasonic and hand instruments. All study subjects were put on a strict oral hygiene program; brushing regularly in addition to chlorhexidine mouthwash (0.12%, Hexitol, Adco, Egypt) twice daily for 2 weeks and the use of interdental cleaning aids (flossing or interdental brush). After 6 weeks, patients were re-evaluated to check for non-resolving deep pockets using a 15 mm periodontal probe.

Patients with periodontitis (stage III or IV) with any grade with residual pockets (≥ 6 mm) associated with vertical bone defect (≥ 3 mm), 8 weeks following non-surgical periodontal therapy were recruited. Patients with uncontrolled medical conditions, self-reported pregnancy, tobacco

smoking or grade 2 tooth mobility or higher were excluded from the study. These non-resolving residual pockets were randomized into either groups using computer generated program. Allocation concealment was done using opaque concealed envelopes.

A written informed consent was obtained from all study subjects before participation in the study, in accordance with the Good Clinical Practice (GCPs) guidelines (1996) and the Declaration of Helsinki of 1975, as revised in 2013.

Sample size calculation:

The study sample size was calculated based on a study by (Mishra et al., 2013). Using a power of 90% and 5% significance level, 6 sites in each group were found to be sufficient to detect the difference between the 2 groups in CEJ to BD. This number was increased to 7 in each group to account for losses during follow up (20% more than the calculated). The sample size was calculated based on data from a study on the effect of M-MIST alone on the CEJ to BD assuming a difference of 1.5 mm between the means and a standard deviation of the difference in means of 0.7 mm. Sample size calculation was done using PS: Power and Sample Size Calculation software Version 3.1.2 (Vanderbilt University, Nashville, Tennessee, USA (Mishra et al., 2013)

Surgical method

Profound anesthesia was achieved using 0.4% Articaine hydrochloride/adrenaline anesthesia by infiltration labially or buccally at the defect site. Bone sounding was performed to determine the anatomy of the bony defect. A modified or simplified papilla preservation incision was used interdentally, then a small labial or buccal sulcular incisions in the adjacent teeth were done for better accessibility. All loose interdental tissues underlying papilla at the crest of the alveolar bone was cut using micro-scissors. After that, muco-periosteal elevator was used to minimally elevate and reflect a full thickness flap buccally.

The root surface was debrided thoroughly by mini curettes. The infrabony defect was cleared from all of the GT in the control group. While in the test group, only unattached GT was removed, leaving well-formed GT in the defect site intact. Finally, the surgical site was irrigated using sterile saline for both groups.

The wound was sutured by using a single modified internal vicryl suture (Laurell loop) using 6 zeros or 7 zeros suture material.

All surgical procedures were performed by the principal investigator (A.A.I) using loupes (Eighteeth 3.5x, China) for magnification in order to have better vision and accessibility.

Postoperative care:

Ibuprofen 400 mg (Abbott, Egypt) tertiary daily supplement (t.d.s) was prescribed for pain control on a need basis for the first week postsurgical. Chlorhexidine mouthwash 0.12% (Hexitol, Adco, Egypt) was prescribed twice daily as a plaque control measure instead of brushing the surgical site for the first 4 weeks. After that, tooth brushing was resumed using a soft toothbrush in the surgical site.

Sutures were removed 10 days post-surgically. Then, each patient was given oral hygiene instructions and recalled at 1, 2, 4 weeks then at 3, 6, 9 months intervals. Adverse events, if arose, were recorded at every visit. Gentle scaling with no subgingival instrumentation was

performed at last 3 visits **Error! Reference source not found.**.

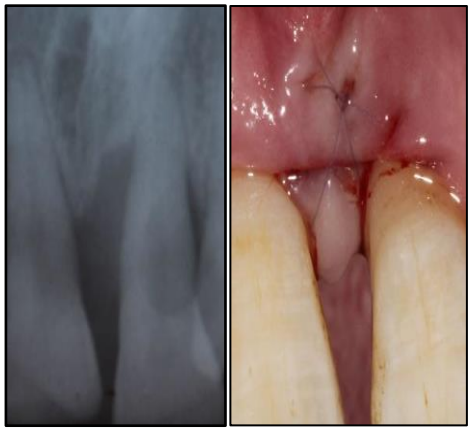

Figure (1): shows infrabony defect related to mesial surface of upper right central incisor (11) with RPD (8mm) and recession (3mm), radiographic images of the infrabony defect at surgical time.

Study outcomes

Radiographic Parameters:

Radiographic parameters were recorded using a size 2 Digora imaging plate in a film holder (Rinn XCP) for obtaining standardized digital paralleling periapical technique. All teeth were radiographed using "Mainray x-ray machine" (SOREDEX, Nahkelantie-Tuusula, Finland) with exposure parameters 70 kvp, 7 mA and exposure time of 0.08 seconds. After exposure, the DIGORA Optime laser scanner was used for scanning of the imaging plate and obtaining the digital image to be evaluated using DIGORA® for Windows 2.7 (U.S.A).

The distance from the CEJ to the base of the defect BD was measured at 0 ,6 and 9 months.

All radiographic outcomes were reported by a calibrated assessor (H.E.N) thus avoiding detection bias (Viera & Bangdiwala, 2007).

Postoperative pain were recorded using VAS scale. It was recorded by the patient 1 week postsurgical on the VAS scale and by reporting on the number of analgesic pills consumed during that period.

III. RESULTS

Study population

10 systemically healthy adult subjects with 14 eligible periodontal sites, 7 in each group, were included in the present study (**Error! Reference source not found.**). The study population consisted of 6 females and 4 males, with mean age at baseline of 38 years ± 4.19 in the control group and 37 years ± 3.95 in the test group (***Table (1***)

Table (1): Baseline characteristics: All data are expressed as mean and standard deviation. Test group (incomplete removal of GT), Control group (complete removal of GT), FMPS (full-mouth plaque score), FMBS (full-mouth bleeding score), CAL, rPD, REC, BOP (bleeding on probing), CEJ (cemento enamel junction), BD (base of the defect).

Demographic data	**Test group (n=7)**	**Control group (n=7)**	***P***
Age	37 years ± 3.95	38 years ± 4.19	0.596
Gender (F/M)	(4/3)	(3/4)	
FMPS (%)	13.21 ± 1.77	12.63 ± 2.19	0.859
FMBS (%)	14.52 ± 0.54	13.84 ± 1.22	0.719
CAL (mm)	8 ± 2.08	7.08 ± 1.02	0.059
RRPD (mm)	7 ± 2.2	6.25 ± 0.76	0.241
REC. (mm)	1.28 ± 1.38	0.833 ± 1.3	0.809
BOP	0.571 ± 0.202	0.5 ± 0.342	0.844
Defect characteristics			

Angle of the defect (degree)	47.9 ± 19.67	46.3 ± 14.18	0.21 7
Defect depth (mm)	2.767 ± 2.3	2.22 ± 1.17	0.29 1
Distance from CEJ to BD	6.66 ± 1.68	6.52 ± 2.1	0.45 6
No. of remaining walls (n)	3 (2), combined (5)	3 (3), combined (4)	

CEJ to Base of the defect (BD) distance

At baseline, CEJ to BD distance was in control group (6.52 ± 2.1mm) and in test group (6.66 ± 1.68mm). After 9 months, a reduction in CEJ to BD in control group (0.037±0.4mm, p =0.936) and in test group (0.897±0.6mm, p=0.184)

Table (2): shows the radiographic outcome means between the 2 groups at 3, 6 and 9 months

Outcomes	**Group (N)**	**6 months**	**9 months**
CEJ TO BD.	**Test**	**7.58 ± 1.75mm, p = 0.119**	**7.56 ± 1.57mm, p = 0.184**
	Control	**6.6 ± 2.1mm, p = 0.744**	**6.56 ± 2.2mm, p = 0.936**

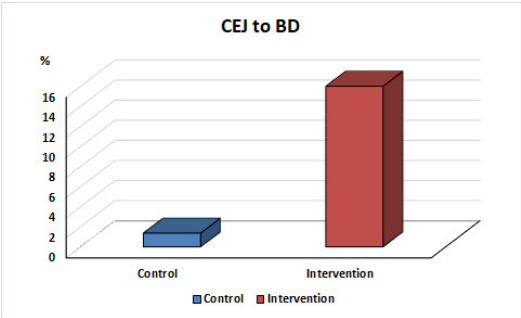

Figure (2): CEJ to |BD change over time between the 2 groups

(CEJ to BD) similar values in both control (6.52 ± 2.1mm) and intervention group (6.66 ± 1.68mm) at baseline, indicating nearly the same amount of bone and attachment loss.

After 6 months, CEJ to BD increased in both groups; less in control (0.085 ± 0.247mm, p =0.744) than in intervention (0.9 ± 0.5mm, p=0.119) .

While at 9 months, control group had CEJ to BD more reduction (0.037±0.4mm, p =0.936) compared lesser reduction in intervention group (0.897±0.6mm, p=0.184) without any statistical significance (p > 0.05).

IV. DISCUSSION

The treatment of periodontitis aims mainly to achieve a clean root surface allowing the recreation of a new attachment, replacing what was destroyed by periodontal disease. The treatment is composed mainly of thorough scaling and root debridement however, just scaling and root debridement alone was found to have a limited effect on treating cases with deep pockets (C M Cobb 1996, Drisko and Lewis 1996).

Surgical treatment allows for improved accessibility and visibility when compared to non-surgical modalities alone (J Lindhe et al. 1982, Eaton, Kieser, and Davies 1985) However surgical treatment alone did not address all aspects of periodontal disease and it was found that in order to obtain optimum clinical results in terms of clinical attachment gain and probing depth reduction, surgical intervention of deep pockets following phase I periodontal therapy was proposed.

It was found also that infected granulation tissue extracted during periodontal surgery aiming to treat intra-bony defects, contains cells with embryonic stem cell markers (Ronay et al. 2013). Although, formation of granulation tissue occurs in any wound healing, its removal from intra-bony defects is considered one of the key elements for optimum periodontal regeneration, no matter the treatment approach (Cortellini and Tonetti 2009, Susin et al. 2015). This complete removal of granulation tissue in intra-bony defects leaves raw bone surface allowing new tissue to form. This healing leads to regeneration of periodontium instead of repair by long junctional epithelium (Cortellini and Tonetti 2009).

Although, studies showed that inflamed granulation tissue obtained from intra-bony defects contained cells with osteogenic potential (McCULLOCH 1993, Hung, Lin, and Chan 2012), its incomplete removal seemed to have no effect on the gain in clinical parameters when measured (Jan Lindhe and Nyman 1985).

Apatzidou suggested leaving sufficient granulation tissue in-situ during periodontal surgery (Apatzidou 2018). Based on the fact that infected periodontal granulation tissues have beneficial MSCs with regenerative potential similar to healthy ones. Also, Zaganescu (2015) was questioning the necessity for the complete removal of inflamed granulation tissue from intrabony defects, as it is time consuming with no additive benefit. Moreover, and in the shadow of treating moderate to shallow intrabony defects by (fibre retention osseous resective surgery), it was concluded that leaving supracrestal fibers at the bottom of the defect is beneficial. As these fibers act as a barrier which prevents further bone loss, also it leads to more clinical and bone attachment stability (Carnevale 2008). These fibers acted as a barrier to prevent further bone loss and lead to more clinical and bone attachment stability (Cairo F, 2008). Our study aimed to find the difference between complete and incomplete removal of GT from contained infrabony defects in M-MIST.

Regarding radiographic outcomes, assessment of bone fill was done via linear fill assessment. At Baseline, CEJ to DD distance (which represents linear measurement of the bone fill in our study) had similar values in both control (6.52 ± 2.1 mm) and intervention (6.66 ± 1.68 mm). (Table 2)

At 6 months, Mishra et al., obtained statistically insignificant radiographic linear bone gain (1.85 ± 1.18mm). This was not the case in our study, where both control and intervention showed minimal bone loss (0.085 ± 0.247 mm) (0.9 ± 0.5 mm) respectively. After 9 months, a reduction in CEJ to BD in control group (0.037±0.4mm, p =0.936) and in test group (0.897±0.6mm, p=0.184) showing minimal changes in base of the defect in relation to the CEJ.

At 1 year, Cortellini et al reported bone fill about 77% ±19% in their trial with M-MIST alone. Whereas our control group had linear bone gain (0.68 ± 0.287 mm, p 0.064) compared to bone resorption in test group (-0.59 ± 0.5, p = 0.914) after 9 months (Cortellini & Tonetti, 2011). This difference can be explained as Cortellini (M-MIST alone) group started by deeper defects INFRA (5.2±1.1) at baseline. And it had much better linear gain compared to shallower DD (< 3mm) in our both groups (Cortellini, 2015).

V. CONCLUSION

This study showed no added benefit of complete removal of GT from infrabony defects compared to incomplete or partial removal of GT in M-MIST regarding radiographic outcomes.

Further studies with large sample sizes are needed to confirm these results.

Declaration

The authors declare no conflict of interest in the present study.

Ethics:

Ethical approval was obtained on 26.08.2018 by Research Ethics Committee from the faculty of Dentistry, Cairo University. After acquiring ethical approval from the Cairo University ethical approval committee (approval number # 22-9-18)

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Data Availability:

The data that support the findings of this study are available from the corresponding author

VI. REFERENCES

1. Adam, K., Günay, H., Vaske, B., Flohr, M., & Staufenbiel, I. (2022). The granulation tissue preservation technique in regenerative periodontal surgery—a randomized controlled clinical trial. Clinical and Experimental Dental Research, 8(1), 9–19. https://doi.org/10.1002/cre2.532
2. Apatzidou, D A. 2018. “Stem Cell- - like Populations and Immunoregulatory Molecules in Periodontal Granulation Tissue.” *Journal of Periodontal Research*, no. February: 1–12. https://doi.org/10.1111/jre.12551.
3. Björn H, Halling A, Thyberg H. Radiographic assessment of marginal bone loss. Odontol Revy. 1969;20(2):165-79. PMID: 5259016.
4. Cairo F, C. G. B. M. P. GP. (2008). Fiber retention and papilla preservation technique in the treatment of infrabony defects: a microsurgical approach. Int J Periodontics Restorative Dent.
5. Cairo, F., Carnevale, G., Buti, J., Nieri, M., Mervelt, J., Tonelli, P., Pagavino, G., & Tonetti, M. (2015). Soft-tissue re-growth following fibre retention osseous resective surgery or osseous resective surgery: a multilevel analysis. Journal of Clinical Periodontology, 42(4), 373–379. https://doi.org/10.1111/jcpe.12383
6. Clerehugh V, Worthington HV, Lennon MA, Chandler R. Site progression of loss of attachment over 5 years in 14- to 19-year-old adolescents. J Clin Periodontol. 1995 Jan;22(1):15-21. doi: 10.1111/j.1600-051x.1995.tb01766.x. PMID: 7706535.
7. Cortellini, P. (2007). Minimally invasive surgical technique and enamel matrix derivative in intra-bony defects . I : clinical outcomes and morbidity. Periodontol, Clin, 5, 1082–1088. https://doi.org/10.1111/j.1600-051X.2007.01144.x
8. Cortellini, P. (2012). Minimally Invasive Surgical Techniques in Periodontal Regeneration. The Journal of Evidence-Based Dental Practice, 12(3), 89–100. https://doi.org/10.1016/S1532-3382(12)70021-0
9. Cortellini, P., & Tonetti, M. S. (2009). Improved wound stability with a modified minimally invasive surgical technique in the regenerative treatment of isolated interdental intrabony defects. Periodontol, Clin, 2003, 157–163. https://doi.org/10.1111/j.1600-051X.2008.01352

10. Cortellini, P., & Tonetti, M. S. (2011). Clinical and radiographic outcomes of the modified minimally invasive surgical technique with and without regenerative materials : a randomized-controlled trial in intra-bony defects. Journal of Clinical Periodontology, January, 365–373. https://doi.org/10.1111/j.1600-051X.2011.01705.x
11. Cortellini P, Tonetti MS. Clinical concepts for regenerative therapy in intrabony defects. Periodontol 2000. 2015 Jun;68(1):282-307. doi: 10.1111/prd.12048. PMID: 25867990.
12. Drisko CH, Lewis LH. Ultrasonic instruments and antimicrobial agents in supportive periodontal treatment and retreatment of recurrent or refractory periodontitis. Periodontol 2000. 1996 Oct;12:90-115. doi: 10.1111/j.1600-0757.1996.tb00085.x. PMID: 9567998.
13. Harrel SK, Rees TD. Granulation tissue removal in routine and minimally invasive procedures. Compend Contin Educ Dent. 1995 Sep;16(9):960, 962, 964 passim. PMID: 8598026
14. Hung, T., Lin, H., & Chan, Y. (2012). Isolating stromal stem cells from periodontal granulation tissues. 1171–1180. https://doi.org/10.1007/s00784-011-0600-5
15. Li, C., Tan, J., & Wang, Q. (2014). The Immunomodulatory Properties of Periodontal Ligament Stem Cells Isolated from Inflamed Periodontal Granulation. https://doi.org/10.1159/000367986
16. Lindhe J, Nyman S. Scaling and granulation tissue removal in periodontal therapy. J Clin Periodontol. 1985 May;12(5):374-88. doi: 10.1111/j.1600-051x.1985.tb00928.x. PMID: 3891796.
17. McCULLOCH, C. A. G. (1993). Basic considerations in periodontal wound healing to achieve regeneration. Periodontology 2000, 1(1), 16–25. https://doi.org/10.1111/j.1600-0757.1993.tb00203.x
18. Melcher AH. On the repair potential of periodontal tissues. J Periodontol. 1976 May;47(5):256-60. doi: 10.1902/jop.1976.47.5.256. PMID: 775048.
19. Mishra A, Avula H, Pathakota KR, Avula J. Efficacy of modified minimally invasive surgical technique in the treatment of human intrabony defects with or without use of rhPDGF-BB gel: a randomized controlled trial. J Clin Periodontol. 2013 Feb;40(2):172-9. doi: 10.1111/jcpe.12030. Epub 2012 Nov 21. PMID: 23167912.
20. Needleman IG, Worthington HV, Giedrys-Leeper E, Tucker RJ. Guided tissue regeneration for periodontal infra-bony defects. Cochrane Database Syst Rev. 2006 Apr 19;(2):CD001724. doi: 10.1002/14651858.CD001724.pub2. 29;5:CD001724. PMID: 16625546.
21. Park JC, Kim JM, Jung IH, Kim JC, Choi SH, Cho KS, Kim CS. Isolation and characterization of human periodontal ligament (PDL) stem cells (PDLSCs) from the inflamed PDL tissue: in vitro and in vivo evaluations. J Clin Periodontol. 2011 Aug;38(8):721-31. doi: 10.1111/j.1600-051X.2011.01716.x. Epub 2011 Mar 30. PMID: 21449989.
22. Pihlstrom, B. L., Michalowicz, B. S., & Johnson, N. W. (2005). Periodontal diseases. Lancet (London, England), 366(9499), 1809–1820. https://doi.org/10.1016/S0140-6736(05)67728-8
23. Rodríguez, J. A. M., & Ruiz, A. J. O. (2022). Periodontal granulation tissue preservation in surgical periodontal disease treatment: A pilot prospective cohort study. Journal of Periodontal and Implant Science, 52. https://doi.org/10.5051/JPIS.2105780289
24. Ronay V, Belibasakis GN, Schmidlin PR, Bostanci N. Infected periodontal granulation tissue contains cells expressing embryonic stem cell markers. A pilot study. Schweiz Monatsschr Zahnmed. 2013;123(1):12-6. PMID: 23426569.
25. Steffensen, B., & Weber, H.-P. (1989). Relationship Between the Radiographic Periodontal Defect Angle and Healing After Treatment. Journal of Periodontology,

60(5), 248–254. https://doi.org/10.1902/jop.1989.60.5.248

26. Susin C, Fiorini T, Lee J, De Stefano JA, Dickinson DP, Wikesjö UM. Wound healing following surgical and regenerative periodontal therapy. Periodontol 2000. 2015 Jun;68(1):83-98. doi: 10.1111/prd.12057. PMID: 25867981.
27. Tan, N., Sabalic, M., Nguyen, L., & D'Aiuto, F. (2023). Regenerative Potential of Granulation Tissue in Periodontitis: A Systematic Review and Meta-analysis. Stem Cells International, 2023, 1–11. https://doi.org/10.1155/2023/8789852
28. Tonetti MS, Pini-Prato G, Cortellini P. Periodontal regeneration of human intrabony defects. IV. Determinants of healing response. J Periodontol. 1993 Oct;64(10):934-40. doi: 10.1902/jop.1993.64.10.934. PMID: 8277400.
29. Tonetti MS, Greenwell H, Kornman KS. Staging and grading of periodontitis: Framework and proposal of a new classification and case definition. J Periodontol. 2018 Jun;89 Suppl 1:S159-S172. doi: 10.1002/JPER.18-0006. Erratum in: J Periodontol. 2018 Dec;89(12):1475. PMID: 29926952.
30. Tonetti, M. S., Jepsen, S., Jin, L., & Otomo-Corgel, J. (2017). Impact of the global burden of periodontal diseases on health, nutrition and wellbeing of mankind: A call for global action. Journal of Clinical Periodontology, 44(5), 456–462. https://doi.org/10.1111/jcpe.12732
31. Trombelli, L., & Farina, R. (2008). Clinical outcomes with bioactive agents alone or in combination with grafting or guided tissue regeneration. Journal of Clinical Periodontology, 35, 117–135. https://doi.org/10.1111/j.1600-051X.2008.01265.x
32. Viera AJ, Bangdiwala SI. Eliminating bias in randomized controlled trials: importance of allocation concealment and masking. Fam Med. 2007 Feb;39(2):132-7. PMID: 17273956.