COMPARISON OF CONNECTIVE TISSUE GRAFT AND XENOGENIC COLLAGEN MATRIX IN THE TREATMENT OF RT1 GINGIVAL RECESSIONS – A SYSTEMATIC REVIEW AND META ANALYSIS

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ABSTRACT

The aim of this systematic review was to compare the clinical efficacy using xenogenic collagen matrices vs autogenous connective tissue graft in the treatment of RT1 gingival recession (All) and multiple gingival recessions as reported from the systematic reviews. Methods: A literature search using pre-determined keywords and inclusion /exclusion criteria was carried out for published systematic reviews in the following electronic databases: PubMed, Google Scholar and Cochrane Database of Systematic Reviews (CDSR). Complete root coverage, mean root coverage, recession depth, keratinized tissue width, clinical attachment level gain and probing pocket depth reduction were measured. Pooled data were analyzed using fixed effect models and forest plots were constructed. Results: For gingival recessions (All) CTG showed superior results in achieving complete root coverage while XCM showed statistically significant (p < 0.0001) results only in achieving better keratinized tissue gain. Whereas no significant differences could be observed between the two in terms of mean root coverage, recession reduction, probing depth and clinical attachment gain. For multiple gingival recessions CTG showed statistically more significant results in obtaining complete root coverage, mean root coverage, recession depth reduction and keratinized tissue gain. On the opposite insignificant results were seen in achieving clinical attachment level gain and pocket depth reduction when both the grafts were compared. Conclusion: The CTG is highly recommended for patients with high demand for complete root coverage to resolve aesthetic problems and treat root hypersensitivity. However, XCM could be a viable alternative to CTG in achieving mean root coverage, reduction in recession depth, clinical attachment gain and reduction in probing depth in the treatment of gingival recessions (All). There is also a need for conducting more clinical trials with a larger sample size using XCM and comparing it to autogenous grafts in maxilla and mandible treating all types of recession defects with a longer period of follow up.

Key Words: *"gingival recession" OR "root exposure" AND "xenogenic collagen matrix" OR "mucograft" OR "CTG" OR "CTG" OR "coronally advanced flap" OR "tunnel technique" AND "complete root coverage" OR "increased keratinized tissue".*

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INTRODUCTION

Nowadays, gingival recession has a high rate of prevalence among dental problems, and it has been estimated that over 60% of the humans have gingival recession defects.[1] Gingival recession usually indicates the need for augmentation of soft tissue volume, creates an aesthetic concern for the patients especially in anterior teeth, followed by other complications including hypersensitivity, root caries and cervical wear and erosion and an increase in the dental plaque accumulation.[2] These complains lead the patient to seek for the appropriate treatment. Gingival recessions can either be single or multiple. Various surgical interventions have been suggested for the treatment of isolated gin-

gival recessions providing certain degree of success in terms of complete root coverage[3] while treatment of multiple gingival recessions is more challenging as more anatomical variations may be present along with larger surgical field. In this review, treatment of gingival recessions (All) and multiple gingival recessions (RT1) will be discussed.

Several non-surgical and surgical treatment options are available for gingival recessions. In the cases of minimal gingival recession with no complain of hypersensitivity and not affecting aesthetics, presence of adequate amount of keratinized tissue and appropriate plaque control, no treatment modality is required. However, deeper gingival defects are approached by various surgical procedures that have been suggested as treatment modalities for gingival recessions with numerous outcomes in achieving complete or maximum root coverage.

Rationale

Gingival thickness is of great importance as it has an influence on the presence of gingival recessions and outcomes of mucogingival procedures. When compared with thick gingival flaps, gingival thickness less than 1 mm had reduced root coverage.[4] Also, gingival thickness and volume minimizes the risk of recurrence and contributes to the stability of marginal gingiva.[5]

The use of connective tissue graft (CTG) in combination with coronally advanced flap for root coverage procedures was demonstrated in many clinical studies resulting in increased probability of complete root coverage when compared to coronally advanced flap alone.[6,7] Therefore , use of CTG in combination with coronally advanced flap has been demonstrated as a golden standard in treating multiple gingival recessions.[8] In a long-term split mouth study of five years of follow up, Pini Prato et al compared the efficacy of coronally advanced flap with or without CTG in 93 Miller class I, II or III recession defects. Sites treated with coronally advanced flap and CTG showed complete root coverage of 52% while coronally advanced flap alone showed a complete root coverage of 35%.[9] In terms of outcomes, coronally advanced flap carried out in conjunction with CTG provided better complete root coverage when compared to coronally advanced flap alone. The limitations of this study may be associated to its non-randomized design.

However, at the same time, use of CTG has few short comings including increased patient morbidity, limited quantity of the tissue from the donor site, increased surgical time and possible post-operative complications from surgical site of the donor area such as bleeding, pain and discomfort.[10]

Consequently, different alternatives to overcome the drawbacks of autogenous soft tissue grafts have been proposed to use in combination with root coverage procedures for an increase in keratinized tissue. Currently several biomaterials are being used including xenogenic collagen matrix (XCM), enamel matrix derivate (EMD), acellular dermal matrix (ADM) and barrier membrane.[11,12] Pietruska et al carried out randomized clinical study for the treatment of 91 gingival recessions in mandible with modified coronally advanced tunnel technique (MCAT).[13] This surgical intervention was carried out using either CTG or XCM. The mean root coverage achieved after the use of XCM and CTG were 53.20% and 83.10% respectively. Both the grafting materials resulted in the reduction of gingival recessions, but the use of CTG contributed to better aesthetics and appeared to more effective in root coverage. However due to the limited number of participants with twelve months of follow up, the results of this study should be confirmed with a larger group of participants for a longer period.[13]

Given that the gap of knowledge in the literature is whether the use of CTG or XCM has superior outcomes in treating type RT1 gingival recessions (single + multiple = All) and multiple gingival recession defects alone in maxilla or mandible. This research has the intention to guide the clinicians for the treatment of RT1 gingival recessions with the use of appropriate grafting materials according to patient's needs and requirements aiming for a complete or maximum root coverage with aesthetical outcomes in maxilla or mandible.

This review aims systematically assessing the literature to compare the clinical performance of CTG with XCM in the Treatment of RT1 Gingival Recessions.

METHODOLOGY

PICO framework was used by author to answer the above-mentioned research question:

PICO

- **Population:** Treatment of gingival recessions (single+multiple= All) and only multiple gingival recessions (Type RT1) in maxilla or mandible

- **Intervention:** Use of xenogenic collagen matrices (XCMs)

- **Comparison:** Use of autologous connective tissue grafts (CTG)

- **Primary outcomes:** Complete root coverage (CRC%), mean root coverage (MRC%), keratinized tissue gain (KT)(mm), Recession Reduction (RecRed mm)

- **Secondary outcomes:** Clinical attachment level gain (CALgain)(mm), probing depth reduction (PPDRed) (mm).

The inclusion and exclusion criteria to be followed for the selection of the systematic reviews is listed below:

Inclusion criteria

Systematic reviews from 2010 till date (because XCM was released in 2009) including RCTs conducted on humans above 18 years of age. Systematic reviews reporting use of CTG in treating RT1 gingival recessions (All) and multiple gingival recessions or XCM in treating RT1 gingival recessions (All) and multiple gingival recessions. Clinical outcomes considered must have been reported.

Exclusion Criteria

All primary studies, control trials, cases series, case reports and in vitro studies were excluded. Other systematic reviews were also not considered for this study which were carried out on animals.

Types of outcomes measures selected

Primary Outcomes

- Complete root coverage (CRC)
- Mean root coverage (MRC)
- Gain in keratinized tissue (KT) width(mm)
- Recession reduction (RecRed)(mm)

Secondary Outcomes

- Clinical attachment level (CAL) gain (mm)
- Probing pocket depth reduction (PPDRed)(mm)

Study design

It is a Systematic Review dealing with the treatment of gingival recessions (All) and multiple gingival recessions with RT1 defects comparing the use of CTG and XCM in achieving complete root coverage (%), mean root coverage (%), keratinized tissue gain(mm), reduction in the recession(mm), probing pocket depth reduction(mm) and clinical attachment level gain (mm).

Literature search

Following keywords were combined with Boolean operators in Pubmed Advanced search to limit the search and yield desired studies focusing on the research question: "gingival recession" OR "root exposure" AND "xenogenic collagen matrix" OR "mucograft" OR "CTG" OR "CTG" OR "coronally advanced flap" OR "tunnel technique" AND "complete root coverage" OR "increased keratinized tissue".

The search strategy was focused on including systematic reviews and search was limited to articles published in English and studies conducted on humans (Figure 1 shows the search strategy). To retrieve maximum number of systematic reviews a literature search was carried out using the following electronic databases: PubMed, Google Scholar and Cochrane Database of Systematic Reviews (CDSR). A manual search was also be carried out on some selected journals of field of Periodontology. (Journal of Periodontology, Journal of Clinical Periodontology and International Journal of Periodontics and Restorative Dentistry). The duplication of the articles was checked and discarded later if present.

Risk Assessment of Included Studies

The full texts of the publications that met the desired inclusion and exclusion criteria were critically appraised using three different tools: Critical Appraisal Skill Programme (CASP) tool (CASP, 2017), AMSTAR-2 (A MeaSurement Tool to Assess systematic Reviews), Risk of Bias in Systematic Reviews (ROBIS).

Statistical Analysis

Data from the included systematic reviews were analyzed using Review Manager version 5.3, The Nordic Cochrane Centre, The Cochrane Collaboration, Copenhagen, 2014) and was used to perform meta – analysis. Risk Ratio (RR) was used to analyze data for complete root coverage (%) while mean difference (MD) with 95% confidence interval (CI) was used for the analysis data for all the remaining five outcome variables. The heterogeneity was assessed using chi-squared tests and possible impact on the meta – analysis was quantified via I^2 statistic which if greater than 50% was used to indicate variability and increase levels of heterogeneity among the studies. Fixed effect model was used to acquire the combined estimate of all the outcomes measured in the review. The results of all the studies included in the meta – analysis with the MD and 95% CI were illustrated in the forest plots. Statistical significance level and its precision was determined by p – value < 0.05 and 95% CI respectively.

Data Extraction

The titles and abstracts of all the included articles were reviewed and analyzed by the two main authors (SM and SH). Each title was read individually, and a third reviewer (UA) was involved where there was disagreement amongst the authors. After the screening process, the studies were extracted based on the following data: author name, journal name, study design, complete root coverage, mean root coverage, gain in keratinized tissue, recession reduction, clinical attachment gain and pocket depth reduction.

RESULTS

Outcome of literature search

The initial electronic search yielded 109 published articles. From the initial number of articles 85 were excluded after the screening of the title such as recession

TABLE 1: SUMMARY OF THE SELECTED SYSTEMATIC REVIEWS

Authors	Years of the study	Control group	Test group	No of included RCTs	No of patients included	Recession type (RT1)	Location	Ant or Post teeth	Follow up (months)
Al-Sahran et al	2019	Use of CTG	Use of XCM	Four	257	multiple	Maxilla and mandible	Ant, premolar and molar	3 – 12
Moraschini et al	2019	Use of CTG	Use of XCM	Four	482	combined (all)	Maxilla and mandible	Ant, premolar and molar	6-12
Huang et al	2018	Use of CTG	Use of XCM	Five	396	Single, multiple and combined (all)	Maxilla and mandible	Ant, premolar and molar	6 – 12
Atieh et al	2016	Use of CTG	Use of XCM	Three	172	combined (all)	Maxilla and mandible	Ant, premolar and molar	6 – 12

Abbreviations: Ant, anterior; CTG, CTG; No, number; Post, posterior; RCT, randomized controlled trial; XCM, xenogenic collagen matrix;

TABLE 2: SUMMARY OF THE RESULTS IN THE TREATMENT OF GINGIVAL RECESSIONS (ALL)

Authors/year	CRC (%) (RR) (95 % CI)	MRC (%) (MD) (95 % CI)	KT width (MD) (95 % CI)	RecRed (MD) (95 % CI)	CAL gain (MD) (95 % CI)	PPD Red (MD) (95 % CI)
Moraschini et al/2019	-	-	0.07 (95% CI [-0.14,0.27]	-	-0.04 (95% CI [-0.13,0.06]	0.02 (95% CI [-0.07,0.11]
Huang et al/2018	0.64 95% CI [0.48,0.85]	-10.19 (95% CI [-19.27, -1.10]	-0.46 (95% CI [-0.60, -0.32]	-0.21 (95% CI [-0.42, 0.00]	0.37 (95% CI [0.06,0.68]	0.10 (95% CI [-0.03, 0.24]
Atieh et al/2016	1.85 (95% CI [1.10,3.11])	0.24 (95% CI [- 0.03, 0.51]	0.24 95% CI [- 0.03, 0.51]	0.30 95% CI [0.14,0.47]	0.44 (95% CI [0.23,0.65])	-0.02 95% CI [-0.13,0.08]

Abbreviations: CAL, clinical attachment gain; CI, confidence interval; CRC, complete root coverage; KT, keratinized tissue; MD, mean difference; MRC mean root coverage; RecRed, recession reduction; RR, risk ratio; PPD Red, probing pocket depth reduction.

TABLE 3: SUMMARY OF THE RESULTS IN THE TREATMENT OF MULTIPLE GINGIVAL RECESSIONS.

Authors/year	CRC (%) (RR) (95 % CI)	MRC (%) (MD) (95 % CI)	KT width (mm) (MD) (95 % CI)	RecRed (mm) (MD) (95 % CI)	CAL gain (mm) (MD) (95 % CI)	PPD Red (mm) (MD) (95 % CI)
Al Sahran et al/ 2019	0.743 95% CI [0.472,1.170]	-0.760 95% CI [-1.186, -0.334]	-0.665 95% CI [-1.335, 0.004]	-0.442 95% CI [-0.804, -0.0809]	-0.452 (95% CI [-0.924,0.019]	-0.143 95% CI [-0.327, -0.0403]
Huang et al/2016	0.47 95% CI [0.24 0.92]	-11.35 95% CI [-26.05 ,3.34]	-0.50 (95% CI [-0.65, -0.35]	-0.23 (95% CI [-0.47, -0.01]	0.21 (95% CI [-0.18, 0.61]	0.09 (95% CI [-0.10, 0.29]

Abbreviations: CAL, clinical attachment gain; CI, confidence interval; CRC, complete root coverage; KT, keratinized tissue; MD, mean difference; MRC mean root coverage; RecRed, recession reduction; RR, risk ratio; PPD Red, probing pocket depth reduction.

TABLE 4: META - ANALYSIS OF THE CLINICAL OUTCOMES

| Outcomes	Subgroup Type of defects:	RR/MD	Upper (95% CI)	Lower (95% CI)	P – value	I² (%)	P value (Heterogenity)
CRC	All	0.69	0.54	0.85	p < 0.00001	90%	P = 0.002
	Multiple recession	0.58	0.41	0.76	p < 0.00001	56%	P = 0.13
MRC	All	0.23	-0.04	0.50	p = 0.09	80%	P = 0.02
	Multiple recessions	-0.77	-1.19	0.34	p = 0.0004	50%	P = 0.16
KT gain (mm)	All	-0.21	-0.32	-0.11	P < 0.0001	93%	P < 0.00001
	Multiple recessions	-0.51	-0.65	-0.36	P < 0.00001	0%	P = 0.64
RecRed (mm)	All	0.11	-0.01	0.24	P = 0.08	93%	P = 0.0002
	Multiple recessions	-0.29	-0.49	-0.09	P = 0.004	0%	P = 0.34
CAL gain (mm)	All	0.06	-0.02	0.14	P = 0.16	91%	P < 0.0001
	Multiple recessions	-0.06	-0.36	0.24	P = 0.70	78%	P = 0.03
PPD Red(mm)	All	0.03	-0.04	0.09	P = 0.42	0%	P = 0.38
	Multiple recessions	-0.03	-0.16	0.10	P= 0.65	66%	P = 0.08
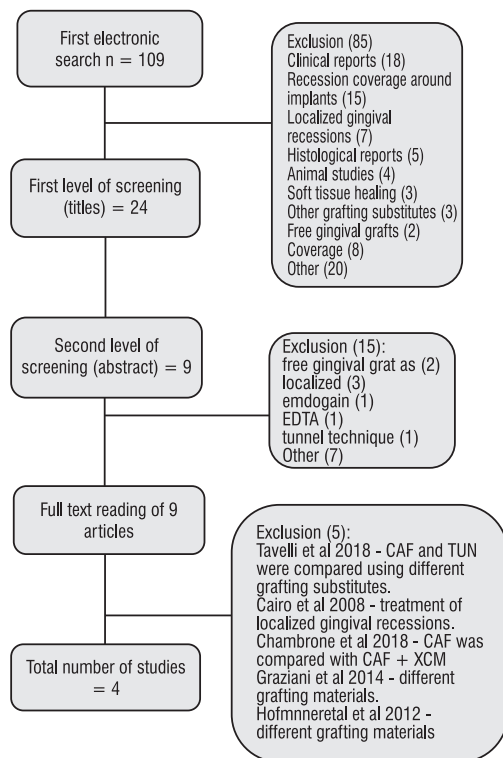
Fig 1: Search strategy; different literature screening stages

Abbreviation: CAF, coronally advanced flap; TUN, tunnel technique; XCM, xenogenic collagen matrix.

coverage around implants (15), clinical reports (18), histological reports (5), localized gingival recession (7), animal studies (4), soft tissue healing (3), other graft substitutes (3), not relevant to dentistry (10), free gingival graft (2). The examination of the abstracts of the remaining 24 articles narrowed down the number of articles to 9. The main reason of the exclusions was due to use of free gingival graft as substitute (2), localized (3), emdogain (1), Ethylenediamine tetra acetic acid (EDTA) (1), tunnel technique (1). After the third screening (full texts) four systematic reviews were included while the remaining five articles were excluded because of various reason mentioned in the Figure 1 below:

Presentation of the Results

The four included systematic reviews are carried out using various RCTs comparing clinical efficacy of XCM and autogenous CTG in the treatment of RT1 multiple or pooled anterior or posterior gingival recessions in maxilla or mandible. Out of these four, one systematic review of Al Sahran et al[14] included four RCTs treating RT1 multiple gingival recessions, two systematic reviews compared pooled gingival recessions (All);Moraschini et al[15]; Atieh et al[16] and study of Huang et al[17] compared the treatment of multiple gingival recessions and gingival recessions in general. Various surgical techniques were used for the treatment of recessions including coronally advanced flap, the tunnel
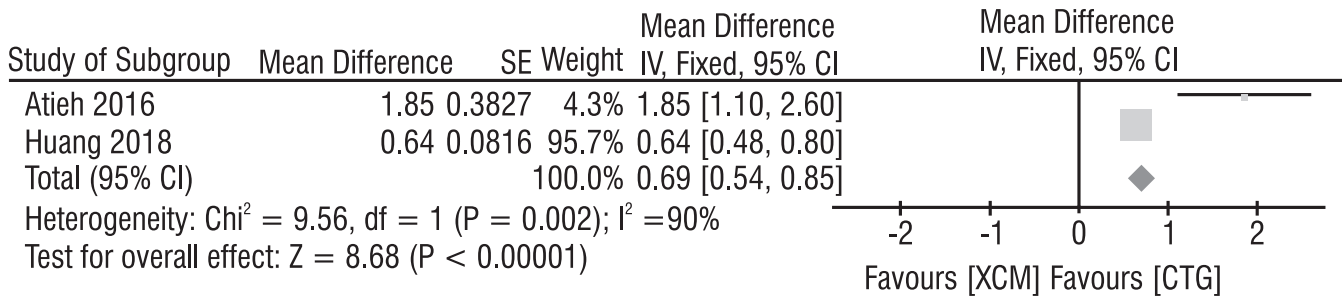
Study of Subgroup	Mean Difference	SE	Weight	Mean Difference IV, Fixed, 95% CI
Atieh 2016	1.85	0.3827	4.3%	1.85 [1.10, 2.60]
Huang 2018	0.64	0.0816	95.7%	0.64 [0.48, 0.80]
Total (95% CI)			100.0%	0.69 [0.54, 0.85]

Heterogeneity: Chi^2 = 9.56, df = 1 (P = 0.002); I^2 =90%
Test for overall effect: Z = 8.68 (P < 0.00001)

Favours [XCM] Favours [CTG]

Fig 2: Forest plot for CRC in the treatment of gingival recessions (All)

Abbreviations: CI, confidence interval; CTG, connective tissue graft; XCM, xenogenic collagen matrix.

Study of Subgroup	Mean Difference	SE	Weight	Mean Difference IV, Fixed, 95% CI
Al Sahran 2019	0.743	0.1383	41.8%	0.74 [0.47, 1.01]
Huang 2018	0.47	0.1173	58.2%	0.47 [0.24, 0.76]
Total (95% CI)			100.0%	0.58 [0.41, 0.76]

Heterogeneity: Chi^2 = 2.27, df = 1 (P = 0.13); I^2 =56%
Test for overall effect: Z = 6.53 (P < 0.00001)

Favours [XCM] Favours [XCM]

Fig 3: Forest plot for CRC in the treatment of multiple gingival recessions.

Abbreviations: CI, confidence interval; CTG, connective tissue graft; XCM, xenogenic collagen matrix.

Study of Subgroup	Mean Difference	SE	Weight	Mean Difference IV, Fixed, 95% CI
Atieh 2016	0.24	0.1378	99.9%	0.24 [-0.03, 0.51]
Huang 2018	-10.19	4.6327	0.1%	-10.19 [-19.27, -1.11]
Total (95% CI)			100.0%	0.23 [-0.04, 0.50]

Heterogeneity: Chi^2 = 5.06, df = 1 (P = 0.02); I^2 =80%
Test for overall effect: Z = 1.68 (P = 0.09)

Favours [XCM] Favours [XCM]

Fig 4: Forest plot for MRC in the treatment of gingival recessions (All)

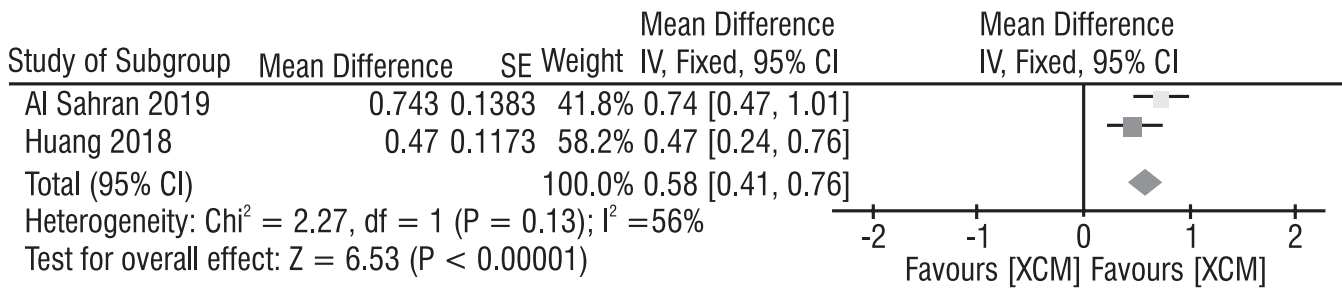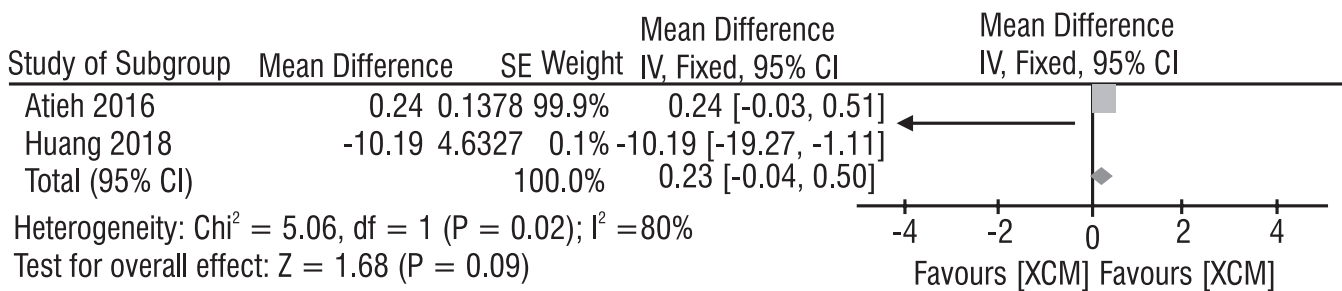Abbreviations: CI, confidence interval; CTG, connective tissue graft; XCM, xenogenic collagen matrix.

Study of Subgroup	Mean Difference	SE	Weight	Mean Difference IV, Fixed, 95% CI
Al Sahran 2019	-0.76	0.2174	99.9%	-0.76 [-1.19, -0.33]
Huang 2018	-11.35	7.5001	0.1%	-11.35 [-26.05, 3.35]
Total (95% CI)			100.0%	-0.077 [-1.19, -0.34]

Heterogeneity: Chi^2 = 1.99, df = 1 (P = 0.16); I^2 = 50%
Test for overall effect: Z = 3.54 (P = 0.0004)
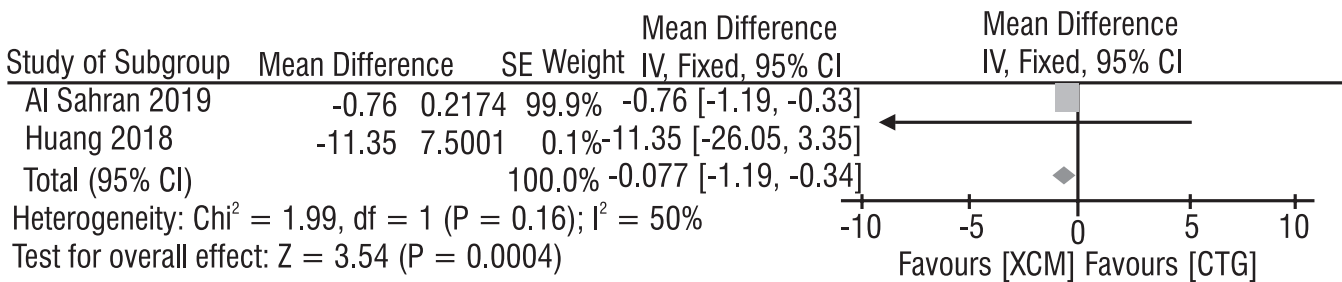
Favours [XCM] Favours [CTG]

Fig 5: Forest plot for MRC in the treatment of multiple gingival recessions.

Abbreviations: CI, confidence interval; CTG, connective tissue graft; XCM, xenogenic collagen matrix.

Study of Subgroup	Mean Difference	SE	Weight	Mean Difference IV, Fixed, 95% CI
Atieh 2016	0.24	0.1378	15.7%	0.24 [-0.03, 0.51]
Huang 2018	-0.46	0.0714	58.4%	-0.46 [0-.60, -0.32]
Moraschini 2019	0.07	0.1071	25.9%	0.07 [-0.14, 0.28]
Total (95% CI)			100.0%	-0.21 [-0.32, -0.11]

Heterogeneity: Chi^2 = 29.76, df = 2 (P = 0.00001); I^2 = 93%
Test for overall effect: Z = 3.90 (P = 0.0004)

Mean Difference IV, Fixed, 95% CI
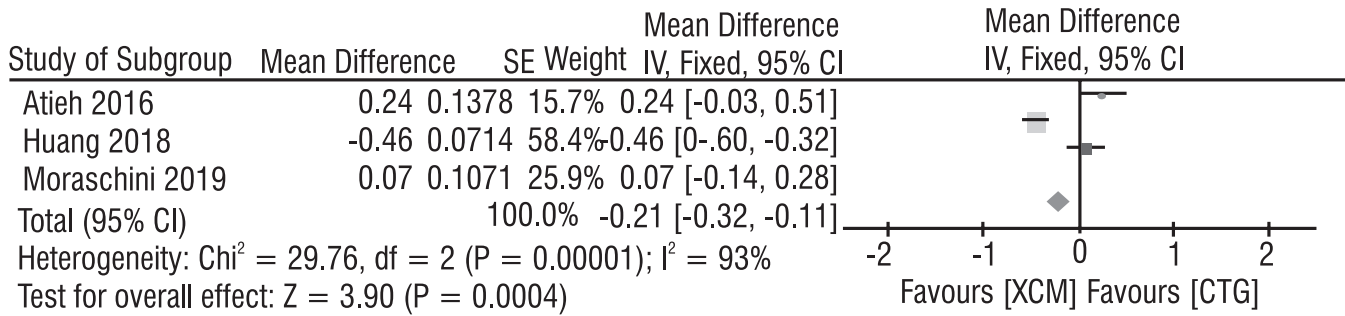
-2 -1 0 1 2
Favours [XCM] Favours [CTG]

Fig 6: Forest plot for KT gain in the treatment of gingival recessions (All).

Abbreviations: CI, confidence interval; connective tissue graft, CTG; XCM, xenogenic collagen matrix.

Study of Subgroup	Mean Difference	SE	Weight	Mean Difference IV, Fixed, 95% CI
Al Sahran 2019	-.665	0.3418	4.8%	-0.67 [-1.33, 0.00]
Huang 2018	-0.5	0.0765	95.2%	-0.50 [-0.65, -0.35]
Total (95% CI)			100.0%	-0.51 [-0.65, -0.36]

Heterogeneity: Chi^2 = 0.22, df = 1 (P = 0.64); I^2 = 0%
Test for overall effect: Z = 6.80 (P = 0.00001)

Mean Difference IV, Fixed, 95% CI

-1 -0.5 0 0.5 1
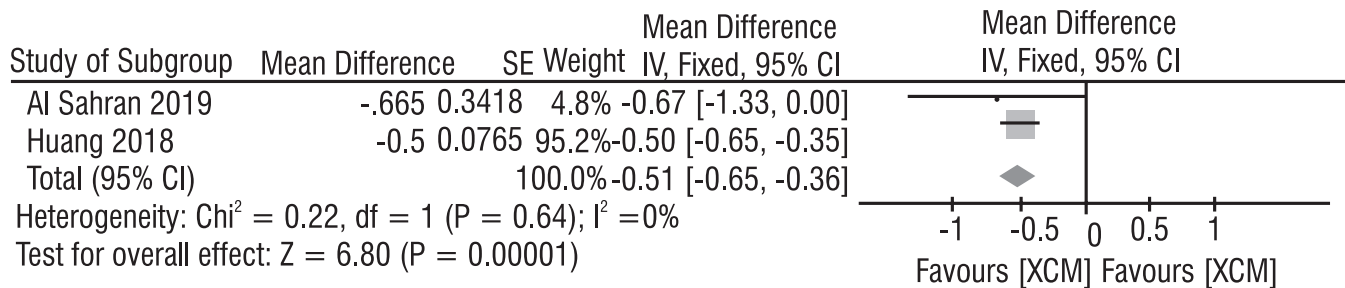Favours [XCM] Favours [XCM]

Fig 7: Forest plot for KT gain in the treatment of multiple gingival recessions.

Abbreviations: CI, confidence interval; CTG, connective tissue graft; XCM, xenogenic collagen matrix.

Study of Subgroup	Mean Difference	SE	Weight	Mean Difference IV, Fixed, 95% CI
Al Sahran 2019	0.3	0.0816	63.3%	0.30 [0.14, 0.46]
Huang 2018	-0.21	0.1071	36.7%	-0.21 [-0.42, -0.00]
Total (95% CI)			100.0%	0.11 [-0.01, 0.24]

Heterogeneity: Chi^2 = 14.35, df = 1 (P = 0.00002); I^2 = 93%
Test for overall effect: Z = 1.74 (P = 0.08)

Mean Difference IV, Fixed, 95% CI

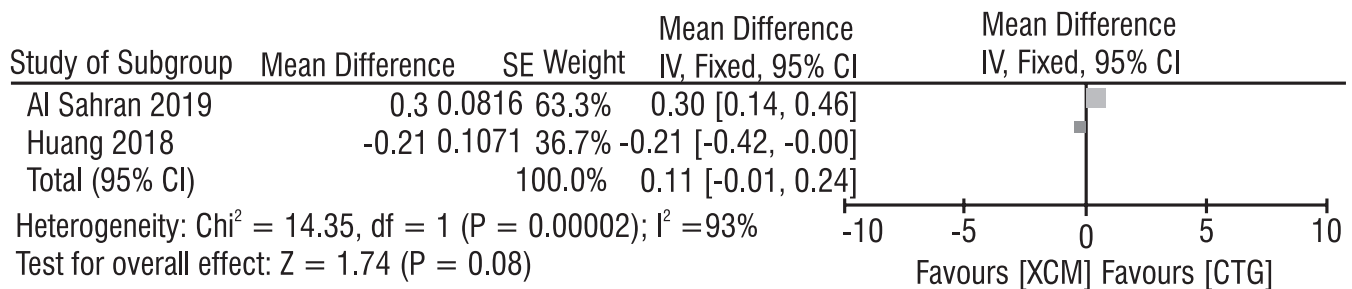-10 -5 0 5 10
Favours [XCM] Favours [CTG]

Fig 8: Forest plot for RecRed in the treatment of gingival recessions (All).

Abbreviations: CI, confidence interval; CTG, connective tissue graft; XCM, xenogenic collagen matrix.

Study of Subgroup	Mean Difference	SE	Weight	Mean Difference IV, Fixed, 95% CI
Al Sahran 2019	0.442	0.1847	30.5%	0.44 [-0.80, -0.08]
Huang 2018	-0.23	0.1225	69.5%	-0.23 [-0.47, 0.01]
Total (95% CI)			100.0%	-0.29 [-0.49, -0.09]

Heterogeneity: Chi^2 = 0.91, df = 1 (P = 0.34); I^2 = 0%
Test for overall effect: Z = 2.89 (P < 0.004)

Mean Difference IV, Fixed, 95% CI

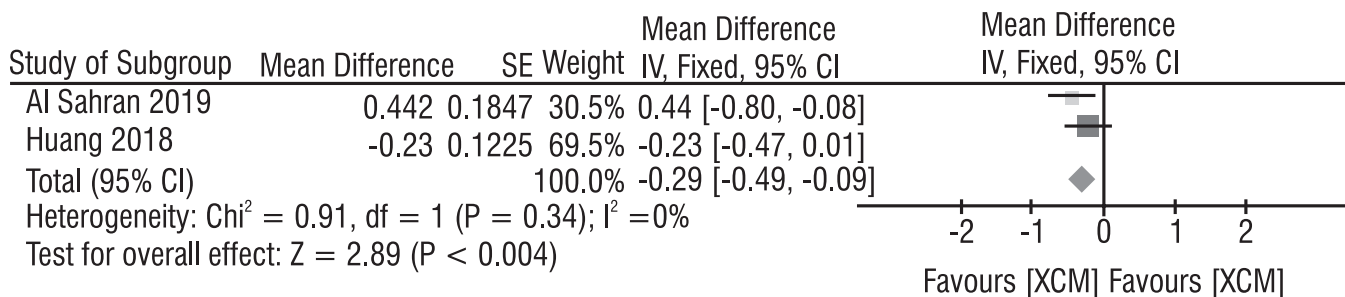-2 -1 0 1 2
Favours [XCM] Favours [XCM]

Fig 9: Forest plot for RecRed in the treatment of multiple gingival recessions.

Abbreviations: CI, confidence interval; CTG, connective tissue graft; XCM, xenogenic collagen matrix.
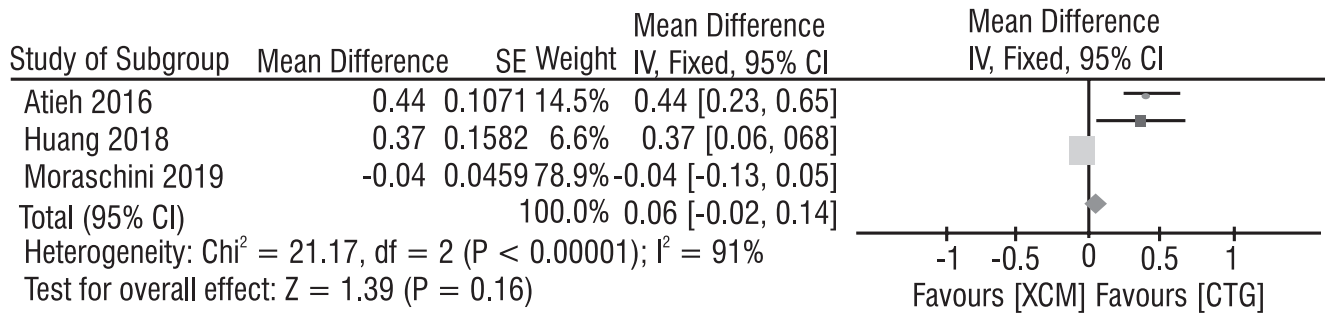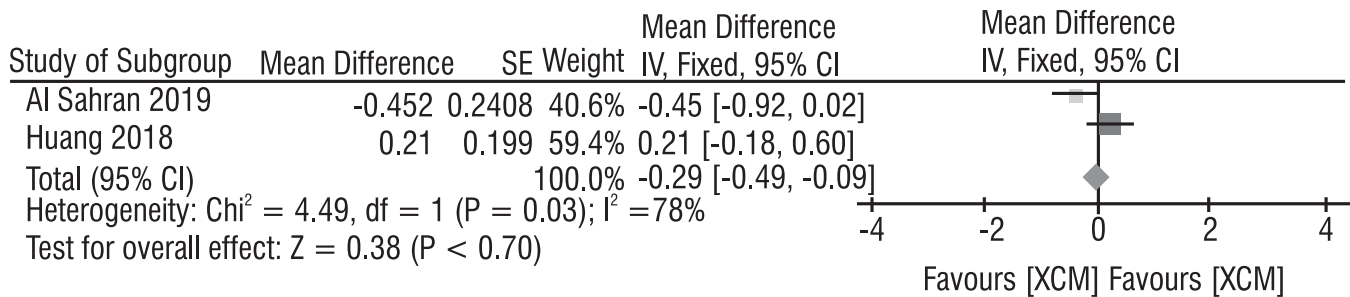
Study of Subgroup	Mean Difference	SE	Weight	Mean Difference IV, Fixed, 95% CI
Atieh 2016	0.44	0.1071	14.5%	0.44 [0.23, 0.65]
Huang 2018	0.37	0.1582	6.6%	0.37 [0.06, 068]
Moraschini 2019	-0.04	0.0459	78.9%	-0.04 [-0.13, 0.05]
Total (95% CI)			100.0%	0.06 [-0.02, 0.14]

Heterogeneity: Chi^2 = 21.17, df = 2 (P < 0.00001); I^2 = 91%
Test for overall effect: Z = 1.39 (P = 0.16)

Fig 10: Forest plot for CAL gain in the treatment of gingival recessions (All).

Abbreviations: CI, confidence interval; CTG, connective tissue graft; XCM, xenogenic collagen matrix.

Study of Subgroup	Mean Difference	SE	Weight	Mean Difference IV, Fixed, 95% CI
Al Sahran 2019	-0.452	0.2408	40.6%	-0.45 [-0.92, 0.02]
Huang 2018	0.21	0.199	59.4%	0.21 [-0.18, 0.60]
Total (95% CI)			100.0%	-0.29 [-0.49, -0.09]

Heterogeneity: Chi^2 = 4.49, df = 1 (P = 0.03); I^2 = 78%
Test for overall effect: Z = 0.38 (P < 0.70)

Fig 11: Forest plot for CAL gain in the treatment of multiple gingival recessions.

Abbreviations: CI, confidence interval; CTG, connective tissue graft; XCM, xenogenic collagen matrix.

Study of Subgroup	Mean Difference	SE	Weight	Mean Difference IV, Fixed, 95% CI
Atieh 2016	-0.02	0.0561	31.2%	-0.02 [-0.13, 0.09]
Huang 2018	0.1	0.0663	22.3%	0.10 [-0.03, 0.023]
Moraschini 2019	0.02	0.0459	46.5%	0.02 [-0.07, 0.11]
Total (95% CI)			100.0%	0.03 [-0.04, 0.09]

Heterogeneity: Chi^2 = 1.93, df = 2 (P = 0.38); I^2 = 0%
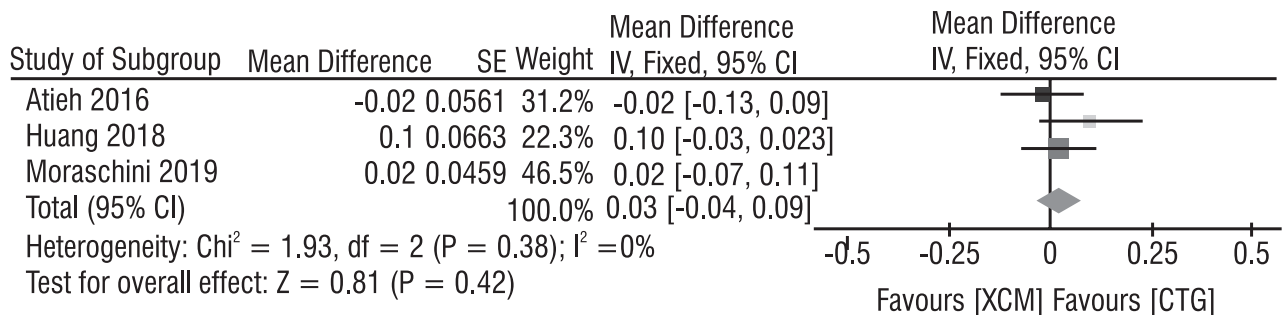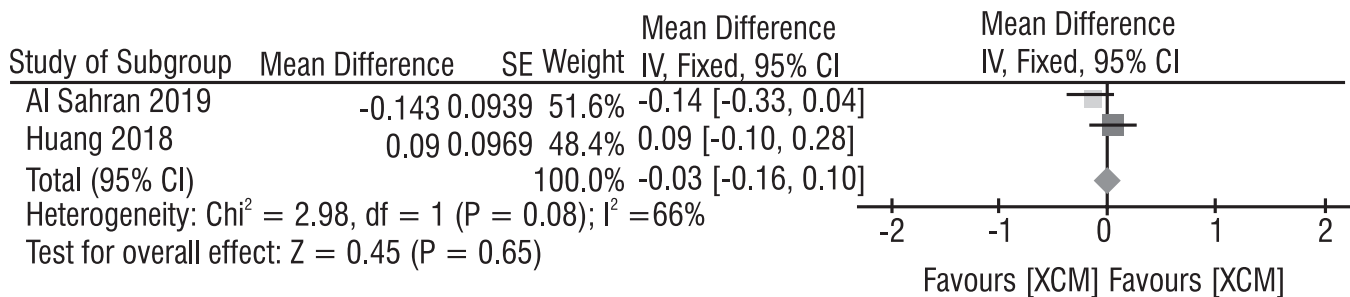Test for overall effect: Z = 0.81 (P = 0.42)

Fig 12: Forest plot for PPD Red in the treatment of gingival recessions (All).

Abbreviations: CI, confidence interval; CTG, connective tissue graft; XCM, xenogenic collagen matrix.

Study of Subgroup	Mean Difference	SE	Weight	Mean Difference IV, Fixed, 95% CI
Al Sahran 2019	-0.143	0.0939	51.6%	-0.14 [-0.33, 0.04]
Huang 2018	0.09	0.0969	48.4%	0.09 [-0.10, 0.28]
Total (95% CI)			100.0%	-0.03 [-0.16, 0.10]

Heterogeneity: Chi^2 = 2.98, df = 1 (P = 0.08); I^2 = 66%
Test for overall effect: Z = 0.45 (P = 0.65)

Fig 13: Forest plot for PPD Red in the treatment of multiple gingival recessions.

Abbreviations: CI, confidence interval; CTG, connective tissue graft; XCM, xenogenic collagen matrix.

technique,[18] the Modified Coronally Advanced Tunnel technique[19] either with the use of XCM or CTG.

Primary outcomes measured

a) Complete root coverage (CRC)

The use of CTG in gingival recessions (All) significantly higher values of 0.69 MD with 95% CI [0.54, 0.85] when compared to XCM thus favoring using CTG.

The use of CTG in treating multiple gingival recessions showed statistically significant values (p < 0.00001) of MD of 0.58 with 95% CI [0.41,0.76] when compared to XCM.

b) Mean Root Coverage (MRC)

The I^2 value (80%) was high which implies heterogeneity across the two studies included in the meta-analysis. As a result, MD of pooled gingival recessions could be used to infer that XCM has not achieved statistically significant MRC when compared to CTG (p = 0.09, MD = 0.23 95% CI [-0.04,0.50].

MD -0.77 [-1.19, -0.34] of multiple gingival recessions could be used to infer that CTG achieved statistically significant mean root coverage in the treatment of multiple gingival recessions when compared to XCM (p=0.0004, I^2 = 50%, chi^2 = 1.99).

c) Keratinized Tissue (KT) gain

MD of -0.21 95% CI [-0.32, -0.11] was used to infer that XCM achieved statistically significant KT width when compared to CTG.

The MD of -0.51 [-0.65, -0.36] was used to infer that CTG achieved statistically significant KT width when compared to XCM in the treatment of multiple gingival recessions.

d)Recession depth reduction(mm) (RecRed)

The I^2 value (93%) and P=0.0002 were high which implies high heterogeneity across the two studies. As a result, overall effect (Z=1.74) and MD of value 0.1195% [-0.01, 0.24] were used to infer that reduction in the recession depth was achieved with the CTG when compared to XCM but findings were not statistically significant (p = 0.08) in the treatment of gingival recessions.

Across the two eligible studies in the meta-analysis, the I^2 value was 0% showing no heterogeneity across them.MD value of -0.29(95%CI [-0.49, -0.09]) was used to infer that CTG has achieved statistically significant recession reduction when compared to XCM in the treatment of multiple gingival recessions.

Secondary Outcomes measured

a) Clinical attachment level (CAL)

MD value of 0.06 (95%CI [-0.02,0.14]) was used to infer CTG shows no statistically significant difference in achieving CAL gain when compared to CTG (p = 0.16).

Chi^2 value of 4.49 and moderately high value of I^2 (78%) demonstrated heterogeneity among the two studies. In the treatment of multiple gingival recessions CTG did not achieve statistically significant (p=0.70) CAL gain when compared to XCM in the treatment of multiple gingival recessions with a MD of -0.06 (95%CI [-0.36, 0.24].

b) Probing Pocket Depth (PPD) Reduction (Red) (mm)

MD of 0.03 (95%CI [-0.04, 0.09]) was used to infer that XCM has not achieved statistically significant PPD Red when compared with CTG.

Chi^2 value of 2.98 and I^2 value of 66% demonstrated moderately high heterogeneity among the two included studies.[14,17] MD of -0.03 (95%CI[-0.16,0.10]) was used to infer that XCM has not achieved statistically significant PPD Red when compared with CTG(p=0.65).

DISCUSSION

Nowadays in the presence of several defects' novel options for the treatment of gingival recessions in the periodontal space is of great priority and importance. A mutual effort to reduce the patient morbidity, operating time, reduced number of surgical interventions along with meeting patient's aesthetic demands is an area of intensive research in dentistry. To meet this criteria, collagen matrix of porcine origin has been developed and it is a safe alternative to autogenous CTG providing gingival tissue regeneration and promoting wound healing.[20]

Comparison between XCM and CTG in the treatment of Gingival recessions (All)

Moraschini et al assessed as being at low risk of bias included four RCTs comparing XCM with various substitutes and techniques including CTG.[15] The meta-analysis of this study revealed no statistical significant difference between the use of XCM and CTG in achieving clinical attachment level gain (p = 0.19), keratinized tissue width (p = 0.51) and probing pocket depth reduction (p = 0.66).The results of this study therefore encouraged the use of collagen matrix in the treating RT1 gingival recessions where use of autogenous graft is not viable. However, one of the major shortcomings of this study was that it did not measure complete root coverage, mean root coverage and recession reduction contributing to a decrease in the strength of the evidence.

The RCTs which were included in Huang et al, evaluated complete root coverage at either site level on all patients in single gingival recessions or at patient/area level in multiple recessions contributing to a substantial heterogeneity while merging the data of complete root coverage in the treatment of single and multiple recessions (All). The meta-analysis of this study has proposed the efficacy of CTG to be superior to the XCM in achieving complete root coverage. However, there are many factors which need to be considered for successful clinical outcomes after mucogingival surgery which have not been discussed in the included systematic reviews, but they need some clinical reflection and are as follows:

- The best possible blood supply from the recipient bed and the covering flap should be provided for graft survival: incision- and flap-design.[21]

- Thickness of the flap (> 0.8 mm) [22] and tension of the flap (≤ 0.4g).[9]

- Suturing protocol (bite size, location and position of the knot tied, material used and its mechanical properties and needle's characteristics). [23] Early suture removal (< 10 days) after the root coverage procedure might negatively affect the achievable complete root coverage in the treatment of single tooth recession type.[12]

- Complete graft coverage.[24]

- An atraumatic surgical proceeding.[25]

- Furthermore, it should be kept in mind that the risk of graft necrosis might increase with graft thickness.[26]

- Care should be taken that the blood clot between wound bed and transplanted tissue is post-operatively as thin as possible to minimize diffusion distance and capillary proliferation length, and that the graft is embedded stable and immobile in the recipient site by tension-free flaps and appropriate suturing techniques.[9]

A systematic review by Atieh et al included three RCTs with patients having gingival recession defects treating with coronally advanced flap with either CTG or XCM. After 12 months of follows up in these RCTs it was concluded that CTG has greater efficacy in terms of complete root coverage, mean root coverage and recession reduction but XCM might be a viable option in reducing postoperative patient morbidity and operating time.

Comparison between XCM and CTG in the treatment of multiple gingival recessions

Complete root coverage and mean root coverage were significantly lower with XCM when compared to CTG (p = 0.001, p = 0.001 respectively). [14]Further no significant results were achieved with either of the grafting materials in achieving clinical attachment level gain (p = 0.60) and keratinized tissue gain (p=0.052).

In a single-blinded, split mouth RCT, fifteen patients (82 gingival recessions) were randomly assigned to control group (CTG) and test group (XCM) for the treatment of RT1 multiple gingival recessions in maxilla.[27] After 12 months of follow up, the achieved root coverage was 82.14% and 77.7% respectively with the use of CTG and XCM. Therefore, within the limitations of the study which included lack of double blinding and a small number of participants with treatment limited only to maxillary recessions, it was concluded that XCM might be a feasible alternative to CTG in the treatment of gingival recessions. Similarly in a systematic review by Huang et al, no significant difference was found in mean root coverage and recession reduction between the use of either of the grafts, but higher percentage was detected in achieving complete root coverage with the use CTGs in the treatment of multiple gingival recessions.[17]

Compared to the current and available clinical evidence, the CTG showed statistically more significant results in obtaining complete root coverage, mean root coverage, recession depth reduction and keratinized tissue gain in the treatment of multiple gingival recessions. A possible hypothesis for achieving less keratinized tissue width with XCM may be due to the lack of vital cells in the matrix and have limited potential achieve creeping attachment.[28]

Limitations of the study

Despite the quality assessment of the included systematic reviews was low, one of the major drawbacks was the lack of information regarding the location of the gingival recession defects. Also, very few RCTs were included in the systematic reviews which did not provide separate results of single and multiple gingival recession defects individually and they were merged in the meta-analysis thus decreasing the strength of the evidence.[15,16] Moreover, the included systematic reviews had RCTs which had a short observation time post operatively (≤ 12 months) due to which the long-term stability of XCM in root coverage procedures could not be estimated and is unknown.

CONCLUSION

After performing a systematic search and evaluating four systematic reviews related to this topic and carrying out meta-analysis, the following conclusions can be withdrawn within the limitations of this study:

- The autogenous CTG is highly recommended for patients with high demand for complete root cov-

erage to resolve aesthetic problems and treat root hypersensitivity.

- XCM could be a viable alternative to autogenous graft in achieving mean root coverage, reduction in recession depth, clinical attachment gain and reduction in probing depth in the treatment of gingival recessions (All).

- However, the CTG showed superiority in achieving mean root coverage, gain in keratinized tissue and recession reduction in the treatment of multiple gingival recessions.

- Also, according to the patient's requirements and the need to achieve clinical outcomes it is necessary for the clinician to opt for an appropriate graft in mucogingival surgery.

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