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Original Article

Effect of magnification on root coverage surgery: a systematic review

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Root coverage surgery can be performed in patients with gingival recession to cover the exposed root aiming to control hypersensitivity and promotes better aesthetic. Optical magnification has been proposed as a refinement in this surgical technique to increase root coverage. This approach may lead to enhanced soft tissue stability, less post-operative discomfort, better predictability and esthetic appearance. **Aim:** This systematic review aimed to evaluate the effectiveness of magnification on root coverage surgery when compared to procedures performed without magnification. **Methods:** Randomized controlled trials with a follow-up of at least 6 months that compared surgeries for root coverage performed under optic magnification versus conventional (macro) root coverage surgery were screened. The primary outcome was mean root coverage (mm) (MRC) and secondary outcomes were percentage of root coverage (PRC) and complete root coverage (CRC). **Results:** Of 569 papers relevant to this review, seven were included. Meta-analysis showed that the use of magnification may favor greater PRC (7.38%, 95% CI 3.66-11.09). **Conclusion:** Magnification can increase PRC in root coverage surgeries. More randomized trials with the use of magnification may be necessary to verify if this benefit is clinically relevant, in order to justify the use of this device.

Keywords: Gingival recession. Microsurgery. Periodontitis. Review.

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Introduction

Gingival recession (GR) is the apical displacement of the gingival margin, which results in the exposure of the root surface[1,2]. It is a frequent condition, which affects a significant percentage of subjects and teeth[3]. It has been associated with older age, male gender[4], smoking exposure[5,6], higher education[3,5,7,8], poor self-reported oral hygiene[5,6,9,10], higher percentage of sites with gingivitis[6], regular dental visits, history of periodontal treatment and presence of calculus[3,5,7,8].

Exposed root surfaces present an increased risk for caries, abrasion and erosion[1,11,12]. Furthermore, GR is related with hypersensitivity and poor esthetics, which has an impact on oral health-related quality of life[13]. Root coverage surgery can be performed in these patients, aiming to cover the exposed root[14,15]. The main objective of root coverage surgery is to achieve clinically relevant root coverage (RC). Several techniques have been proposed as root coverage procedures[11,16,17], which result in correction of gingival deformities, position and/ or amount of keratinized tissue[14,15].

Currently, optical magnification has been proposed as a refinement in mucogingival surgical techniques, aiming to increase RC. Magnification of the operative field can be obtained by the use of loupes or microscope during the surgical procedure to amplify visual acuity and enhance illumination. As a consequence, magnification may minimize surgical invasiveness, enables more precise incisions and suture co-adaptation of wound edges[18]. This approach may lead to enhanced soft tissue stability, less post-operative discomfort, better predictability and esthetic appearance[2,19].

Some clinical trials have observed that the use of optical magnification in root coverage procedures may enhance clinical outcomes and patient related outcomes, as aesthetic condition, when compared to conventional surgical procedures[20-22], however, there is still lack of evidence in this field. A comprehensive evaluation, combining similar studies may contribute to understanding the impact of magnification on root coverage surgery. Therefore, the present systematic review and meta-analyses aims to evaluate whether the use of magnification provides better clinical and aesthetic results when compared to conventional treatment in root coverage surgery. The following focused question was addressed: "In systemically healthy patients with Miller class I and/or II gingival recession, does magnification favor better clinical outcomes when compared to procedures without magnification?"

Materials and methods

The protocol of this systematic review (SR) was registered at the National Institute for Health Research PROSPERO, International Prospective Register of Systematic Reviews (http://www.crd.york.ac.uk/PROSPERO, registration number CRD42017064682). The review text was structured according to PRISMA's guidelines (Preferred Reporting Items for Systematic Reviews and Meta-Analyses)[23], *Cochrane Handbook of Systematic Reviews of* Interventions[24] and Check Review checklist[25].

Eligibility Criteria

Inclusion Criteria

Randomized controlled trials, with follow-up of at least 6 months, that compared surgeries for root coverage performed under optic magnification versus conventional (macro) surgery in patients with Miller class I and/ or II gingival recessions were selected. Only studies that mentioned the use of microscope or loupe in the surgical procedure were included.

Exclusion Criteria

Trials that included patients with systemic disease (e.g., diabetes). Non-randomized trials, studies that did not have a control group without magnification, animal studies, in vitro studies, reviews and letters.

Primary Outcome

Mean root coverage (MRC), expressed in millimeters.

Secondary Outcomes

Percentage of root coverage (PRC), complete root coverage (CRC), keratinized tissue width (KTW) change, keratinized tissue thickness (KTT) change, clinical attachment level (CAL) change, probing pocket depth (PPD) change, aesthetic condition change, surgical operation time (min) and adverse effects.

Information source and search strategy

MEDLINE via PubMed, EMBASE and LILACS databases were used to search publications up to May 2019. MeSH terms and keywords were combined with Boolean operators (OR; AND) and used to search the databases. There was no restriction regarding language or publication year. Search strategies were: 1# root coverage OR gingival recession (MeSH terms) OR coronal advanced flap OR connective tissue graft OR periodontal plastic surgery OR mucogingival surgery AND; 2# microsurgery (MeSH terms) OR microscope OR microsurgical OR magnification OR loupe. In addition, reference lists of the selected studies were hand-searched, and unpublished studies were searched at Open Grey.

Study Selection

Study selection was completed in two phases, as follows: 1) titles and abstracts; 2) full text screening. In the first phase, two reviewers (M.G.M. and M.L.S.S.) independently screened titles and abstracts. In the second phase, the same reviewers independently read the full text of the selected articles. In both phases, any disagreement was resolved by a third reviewer (C.M.P.). Data extraction and validity assessment were performed for publications that met the inclusion criteria and reasons for excluding publications were recorded.

Data collection

Two reviewers (M.G.M. and M.L.S.S.) collected data from the selected articles using extraction forms. Any disagreements in the data extraction were discussed with a

third reviewer (C.M.P.). Also, if needed, the authors of the included studies were contacted to elucidate questions or provide missing data.

The following data were recorded from the eligible studies: 1) citation, 2) country of the study, 3) characteristics of trial participants (age, gender and other trial´s eligibility criteria), 4) Miller's classification of the recession defect[26], 5) length of follow-up, 6) intervention's characteristics (type of surgery, type of microscope/ loupe, magnification and microsurgical instruments), 7) sample size, 8) outcome measures, 9) conclusions, and 10) financial support and conflict of interest.

Risk of bias of the included studies

Risk of bias was ascertained according to the Cochrane Collaboration's Tool for Assessing Risk of Bias. Two reviewers (M.G.M. and M.L.S.S.) independently evaluated quality of randomization and allocation concealment (selection bias); completeness of follow-up period/ incomplete outcome data (attrition bias); selective reporting (reporting bias); blinding of examiners (detection bias) and other forms of bias. Performance bias was not evaluated since it is not possible to mask patients and operators in studies that use microscopes or loupes. Each domain was classified as adequate (+), inadequate (-) or unclear (?). Overall risk of bias was categorized as: 1) low risk of bias if all criteria were met; 2) unclear risk of bias if one or more criteria were partly met; or 3) high risk of bias if one or more criteria were not met. Any disagreement was solved by a third investigator (C.M.P.).

Quality of evidence (GRADE)

GRADE (Grades of Recommendation, Assessment, Development, and Evaluation) guidelines were used to assess the strength of evidence across RCTs for each outcome. The quality of evidence was classified into four categories: high quality, moderate quality, low quality, and very low quality, based on risk of bias, consistency, directness and precision[27].

Summary measures and Synthesis of results

Summary measures were calculated as difference in means for MRC and PRC, gain of KTW and CAL change, and as risk ratio for CRC, using random-effects models. All meta-analyses were conducted with a software package (Review Manager Software, version 5.3, The Nordic Cochrane Centre, The Cochrane Collaboration, Copenhagen, Denmark). Moreover, heterogeneity among the included studies was assessed with Cochran Q statistic and I^2 [28].

RESULTS

A total of 569 potentially relevant papers were identified. After screening of titles and abstracts, 558 were excluded, leaving 11 articles. After complete reading of full text, 4 papers were considered not eligible for inclusion. At the end of the process, 7 papers were included in the review, as shown in the Flowchart (Figure 1).

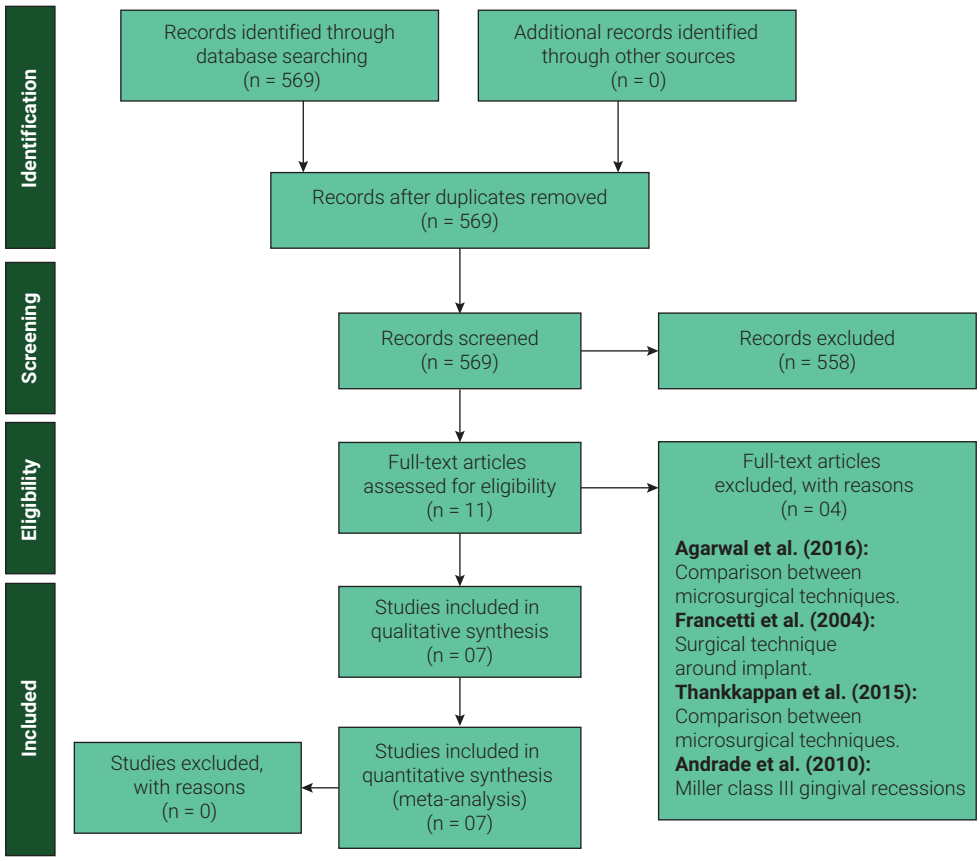


Figure 1. Flowchart.

Included studies

Initially, 135 subjects with gingival recession were enrolled, and 128 (94.8%) completed the follow up period. The main characteristics of the included studies are shown in Table 1. The age of the included patients ranged from 18 to 67 years old, and most of them were female. When Miller's classification of the recession defect was analyzed, Class I was predominant. A total of 255 Miller class I and II gingival recessions were treated. Four studies used a split mouth design[20,22,29,30], and the other three used parallel groups[19,21,31]. The follow-up period of the trials were 6[29,30], 12[19,20,22,31] and 24 months[21]. Seven participants drop out the respective studies[20,29] either because of relocation or refusal to complete the research.

Most of the selected studies excluded smokers[20-22,29,31]. However, two papers did not mention the smoking habits of the included participants[19,30].

Risk of bias

Two studies were considered of low bias risk[22,31] and the other five were considered of unclear risk of bias (Figure 2)[19-21,29,30].

Table 1. Characteristics of the studies.

Study/ Country	Study design	Follow-up	Sample Size (baseline)	Participants	Recession areas (Miller's classification)/ number of recessions	Source of Funding
Azaripour et al., 2016/ Germany	Parallel RCT	12 months	N= 40 (15 Male and 25 Female) Age Range: 19-64 years (38.6 ± 12.8 years)	Test group: N baseline = 15 N end of trial = 15 Control group: N baseline = 15 N end of trial = 15	At least one Miller class I or II buccal gingival recession defect ≥ 1 and < 6 mm in depth. N = 71 (42 test; 29 control)	Department of Operative Dentistry and Periodontology of the University Medical Central, Mainz.
Bittencourt et al., 2012/ Brazil	Split-mouth RCT	12 months	N= 24 (13 Male and 11 Female) Age Range: 18-55 years (34 years)	Test group: N baseline = 24 N end of trial = 24 Control group: N baseline = 24 N end of trial = 24	Presence of bilateral Miller Class I or II gingival recessions (> 2 mm) in maxillary canines or premolars. N = 48 (24 test; 24 control)	Research Funding Agency of Bahia State, Brazil.
Burkhardt et al., 2005/ Switzerland	Split-mouth RCT	12 months	N= 10 (4 Male and 6 Female) Mean Age: 32-44 years (mean not mentioned)	Test group: N baseline = 10 N end of trial = 8 Control group: N baseline = 10 N end of trial = 8	Presence of bilateral canine root denudations of Class I or II. N = 20 (10 test; 10 control)	No
Francetti et al., 2005/ Italy	Parallel RCT	12 months	N= 24 (Male and Female not mentioned) Age: not mentioned	Test group: N baseline = 12 N end of trial = 12 Control group: N baseline = 12 N end of trial = 12	Buccal recession at least 2 mm deep; no loss of interdental bone or soft tissue (Class I or II Miller's). N = 24 (12 test; 12 control)	No
Jindal et al., 2015/ India	Split-mouth RCT	6 months	N= 7 (6 Male and 1 Female) Mean Age: 18-67 years (mean not mentioned)	Test group: N baseline = 7 N end of trial = 7 Control group: N baseline = 7 N end of trial = 7	Bilateral isolated or multiple Miller's Class I or Class II gingival recession ≥2 mm when measured from cement enamel junction (CEJ) on anterior teeth or premolar. N = 30 (15 test; 15 control)	No
Nizam et al., 2015/ Turkey	Parallel RCT	24 months	N= 24 (11 Male and 13 Female) Age Range: 19-41 years (mean not mentioned)	Test group: N baseline = 15 N end of trial = 13 Control group: N baseline = 15 N end of trial = 12	Presence of Miller class I or class II gingival recession >2 mm in at least one canine or premolar tooth. N = 42 (21 test; 21 control)	No
Pandey and Mehta, 2013/ India	Split-mouth RCT	6 months	N= 10 (Male and Female not mentioned) Age Range: 20-45 years (mean not mentioned)	Test group: N baseline = 10 N end of trial = 10 Control group: N baseline = 10 N end of trial = 10	At least two sites of Miller's class I or class II gingival recession labially in different quadrants with thick and wide interproximal papilla not smaller than the recession defect. N = 20 (10 test; 10 control)	No

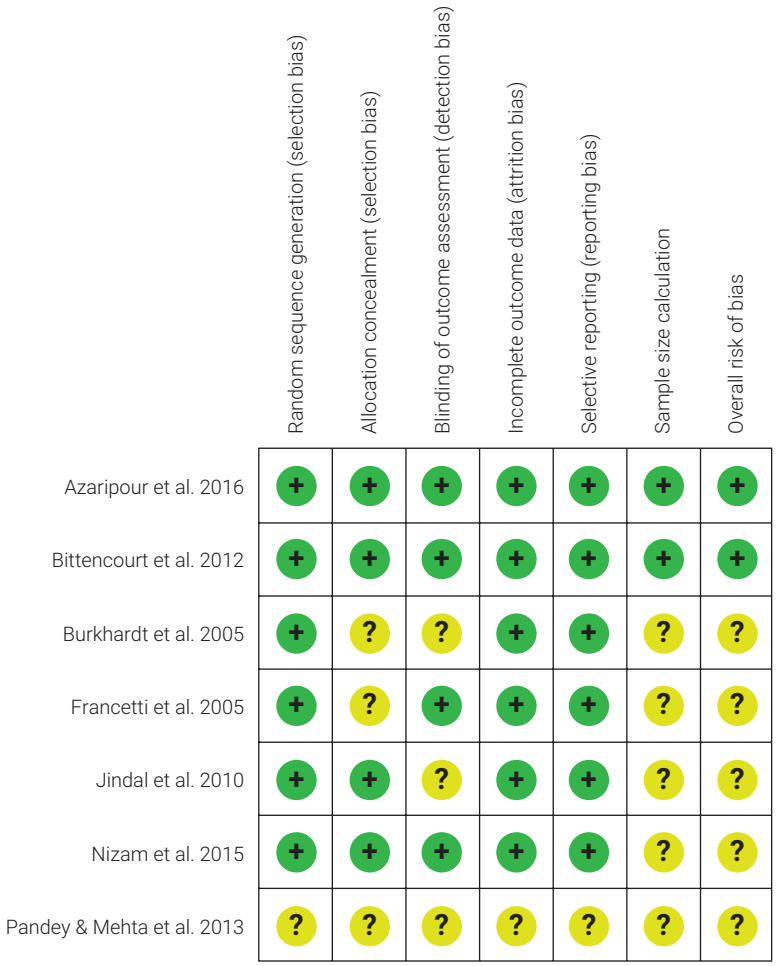


Figure 2. Risk of bias.

In four studies, treatment was randomly assigned by coin toss[20-22,29] and two studies used computer-generated random sequence[19,31]. One publication did not report how random sequence was generated[30]. Four studies reported that allocation concealment was made properly[21,22,29,31] and three studies did not report this information[19,20,30].

Effects of interventions

Individual outcomes of studies

The individual outcomes of studies are present in Table 2. Five of the included trials used MRC as primary outcome[19,21,22,30,31]. As secondary outcomes, six trials used PRC and CRC[19-22,29,31]. Although Pandey and Mehta[30] (2013) did not use PRC and CRC as outcome, they used MRC, CAL gain and KTT (in mm). The use of magnification promoted significantly greater MRC in Bittencourt et al.[22] (2012) and Nizam et al.[21] (2015) studies. These two trials and the study of Burkhardt and Lang[20] (2005) showed that

Table 2. Participants, Interventions, outcomes and results.

Study	Interventions	Microsurgical equipment	Aesthetic condition	PRC/ MCR mm	CRC sites/ %	CAL mm	KTW mm
Azaripour et al., 2016	Test group: MMTT + CTG Control group: CAF + CTG	Zeiss microscope "PICO", setting varies between 0.4 to 0.6 (x 4-7 magnification), microsurgical instruments.	Patient's opinion: satisfactory (test and control); Professional's opinion (RES): Test: 9.2 ± 1.1 Control: 9.2±1.3	Test: 97.3 ± 7.6%/ 2.1 ± 1.1 Control: 98.3 ± 9.2%/ 2.3 ± 1.2	Test: 37/ 88.1% Control: 28/ 96.6%	Not reported	Test: 0.48 ± 0.6 Control: 0.36 ± 0.6
Bittencourt et al., 2012	Test group: technique proposed by Tibbetts and Shanelec and modified by Campos et al. + CTG (microsurgery) Control group: technique proposed by Tibbetts and Shanelec and modified by Campos et al. + CTG (conventional technique)	Microscope at x8 to x12 magnification (SM Plus, Opto Eletrônica, São Paulo, SP, Brazil); microsurgical instruments.	Patient's opinion: Test: 100% Control: 79.1% Professional's opinion: not reported	Test: 98%*/ 2.46 ± 0.38* Control: 88.3%/ 2.24 ± 0.64	Test: 21/ 87.5%* Control: 14/ 58.3%	Test: 1.96 ± 0.82 Control: 1.99 ± 0.69	Test: 1.51 ± 1.01 Control: 1.37 ± 1,18
Burkhardt et al., 2005	Test group: microsurgery Control group: macrosurgery The surgical procedure was performed according to the technique described by Harris (1992) using free connective tissue grafts covered by a double-pedicle papilla flap.	OPMI® Pro magis at 15 magnification (Carl Zeiss), microsurgical instruments.	Not reported	Test: 98.0 ± 3.4%* Control: 89.9 ± 8.5%	Test: 5/ 62.5%* Control: 2/ 25%	Not reported	Not reported
Francetti et al., 2005	Test group: 6 CAF + CTG, 1 CAF + GTR, 4 CAF + CTG + EMD, 1 semilunar flap (microsurgery) Control group: 9 CAF + CTG, 1 CAF + GTR, 2 CAF (macrosurgery) The type of surgical technique was chosen in relation to the anatomic features of the site.	The microscope used had a fiber-optic illumination system, and the magnification varied between 5x and 30x (Carl Zeiss Omni Pro55), microsurgical instruments.	Patient's opinion: not reported Professional's opinion: qualitative (scarring, gingival margin, and papillae appearance). Test: better results of scarring and gingival margin*	Test: 86%/ 2.67 ± 0.87 Control: 78%/ 2.63 ± 0.91	Test: 58.3% Control: 33.3%	Test: 2.63 ± 0.86 Control: 2.38 ± 1.15	Test: 1.79 ± 0.69 Control: 1.7 ± 1.51

continue

continuation

Study	Interventions	Microsurgical equipment	Aesthetic condition	PRC/ MCR mm	CRC sites/ %	CAL mm	KTW mm
Jindal et al., 2015	Test group: microsurgery Control group: macrosurgery A partial thickness flap, with two vertical incisions placed at least one-half to one tooth wider mesio-distally than the area of gingival recession and placement of connective tissue graft, retrieved from palate to recipient was done according to the Langer and Langer technique.	Surgical microscope (Enforte) at a magnification of 10x, 6-0 vicryl sutures.	Patient's opinion: not reported Professional's opinion: qualitative (scarring, gingival margin, and papillae appearance). Better esthetic outcomes in test, when compared to control (no statistically significant difference).	Test: 67.58% Control: 61.78%	Test: 4/ 26.67% Control: 3/ 20%	Test: 3.13 Control: 2.43	Not reported
Nizam et al., 2015	Test group: CPF + CTG (microsurgery) Control group: CPF + CTG (macrosurgery)	Microscope under x3.5 magnification, using the equipment designed for microsurgery (blades, needle holder, scissors, and tissue forceps).	Patient's opinion (VAS scale): The aesthetic scores of the interventions were significantly and similarly improved during all evaluation time points compared with baseline (scores between 8 and 9). Professional's opinion: not reported.	Test: 95.82 ± 8.41%*/ 3.62 ± 0.85* Control: 83.46 ± 16.21%/ 2.96 ± 0.69	Test: 15 Control: 9	Test: 3.44 ± 0.97* Control: 2.80 ± 0.74	Test: 2.24 ± 1.17 Control: 2.09 ± 0.84
Pandey and Mehta, 2013	Test group: free rotated papilla autograft + CAF (microsurgery) Control group: free rotated papilla autograft + CAF (macrosurgery)	Microscope (Serwell Company, Chennai) under x10 magnification, microsurgical instruments.	Not reported	Test: 2.05 Control: 2.13	Not reported	Test: 0.7 Control: 0.5	Not reported

KTW: keratinized tissue width; CPF: coronally positioned flap; CRC: Complete root coverage; MRC: Mean root coverage; EMD: enamel matrix derivate; CAF: coronally advanced flap; MMTT: modified microsurgical tunnel technique; CTG: subepithelial connective tissue graft; RES: Root coverage aesthetic score; GTR: guided tissue regeneration; VAS: visual analog scale; CAL: clinical attachment level; LMCAF: laterally moved coronally advanced flap.

the intervention with magnification promoted significantly more PRC than conventional surgery. In addition, more sites with CRC were found in the test group in the studies of Bittencourt et al.[22] (2012) and Burkhardt and Lang[20] (2005).

Moreover, when CAL gain was analyzed, two papers were not included[20,31]. Just one study found out that magnification promotes significantly more CAL gain when compared to control group[21]. On the other hand, four papers analyzed KTW change and none of them showed significant differences between groups[19,21,22,31]. Four studies evaluated PPD change and no differences were found between control and test groups[19,21,22,31]. One study evaluated KTT change, and no differences were detected between groups[22].

Two trials observed that the length of surgery was greater using microscopes, when compared to conventional technique (72 ± 8 min *versus* 51 ± 5 min[20]; 73 ± 12 min *versus* 55 ± 8 min)[21] and one study did not found differences between groups (test: 60 min *versus* control: 54 min)[22].

Divergences among studies were observed as regards to aesthetic condition change. As regards professional`s opinion, in one parallel study, using the root coverage aesthetic score (RES), both conventional surgery and surgery under magnification were related with acceptable esthetic (Test: 9.2 ± 1.1/ Control: 9.2 ± 1.3)[31]. In another split-mouth study, the use of magnification resulted in 100% aesthetic satisfaction, while conventional surgery was associated with 79.1% satisfaction[22]. The parallel study of Nizam et al.[21] (2015) also used visual analog score (VAS) to obtain patient's opinion. The aesthetic scores of conventional surgeries and the technique with magnification were significantly improved, with no differences between groups. Two trials used a qualitative scale to obtain professional's opinion using pictures of treated sites, as follows: scarring, gingival margin, and papillae appearance[19,29]. Although Francetti et al.[19] (2005) found better results for scarring and gingival margin in the magnification group, Jindal et al.[29] (2015) observed no difference between groups regarding esthetic outcomes.

Pooled outcomes

Pooled estimates of MRC (in mm) were available in 5 studies[19,21,22,30,31] and showed no difference between the use of magnification and conventional treatment (mean difference = 0.20 mm, 95% CI -0.10-0.50; I^2 = 35%, p = 0.18; low quality) (Figure 3 and Table 3). Six studies were summarized in the meta-analysis of PRC[19-22,29,31], and indicated that magnification resulted in greater PRC than conventional technique (mean difference = 7.38%, 95% CI 3.66-11.09; I^2 = 0%, p < 0.0001; low quality) (Figure 3 and Table 3).

CRC data was available for 6 studies[19-22,29,31]. Results indicated that magnification did not increased the chance of CRC (RR = 1.35, 95% CI 0.94-1.92; I^2 = 62%, p = 0.10; very low quality) (Figure 3 and Table 3). Meta-analysis of CAL gain[19,21,22,30] showed no difference between the use of microscope and conventional technique (mean difference = 0.25 mm, 95% CI -0.11-0.61; I^2 = 21%, p = 0.17; low quality) (Supplementary Material 1 and Table 3). Moreover, similar results were found when pooled outcomes were calculated in 5 studies that evaluated KTW (mean difference: 0.08 mm, 95% CI -0.10-0.27; I^2 = 0%, p = 0.39; very low quality) (Supplementary Material 1 and Table 3)[19,21,22,30,31].

Figure 3. a) Forest plot of random effects meta-analysis evaluating MRC on magnification.

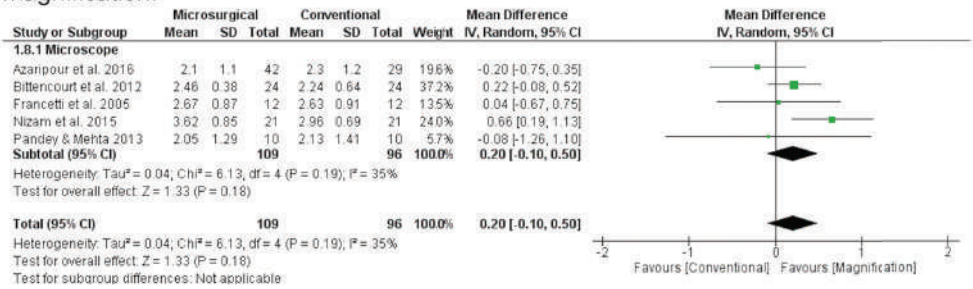


Figure 3. b) Forest plot of random effects meta-analysis evaluating PCR on magnification.

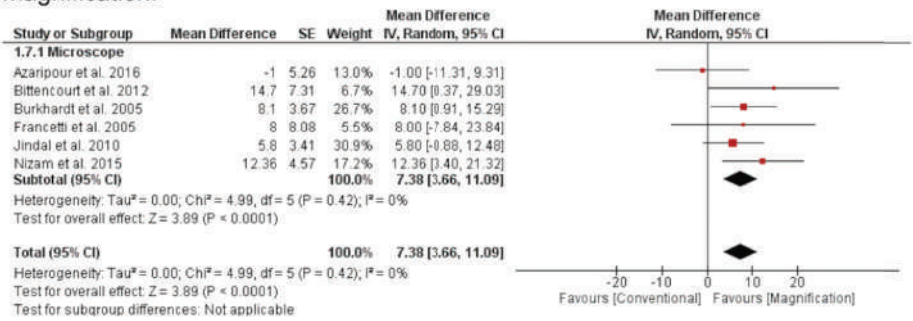


Figure 3. c) Forest plot of random effects meta-analysis evaluating CRC on magnification.

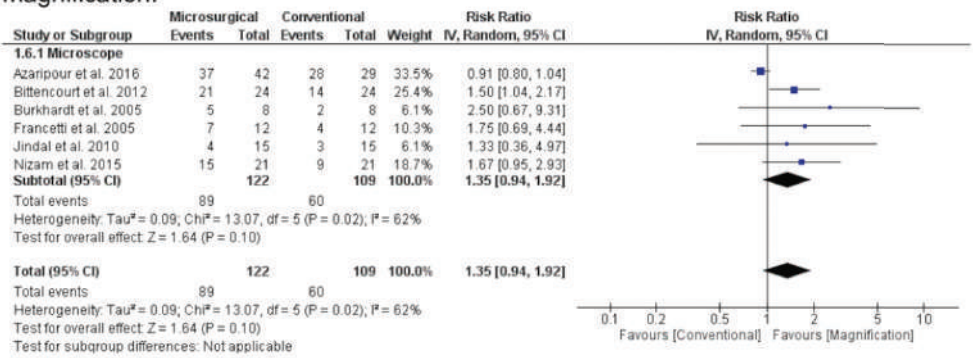


Figure 3. Forest plot of random effects meta-analysis evaluating MRC, PRC and CRC on magnification.

Meta-analysis for PPD and KTT were not conducted since few studies presented these variables.

Adverse effects

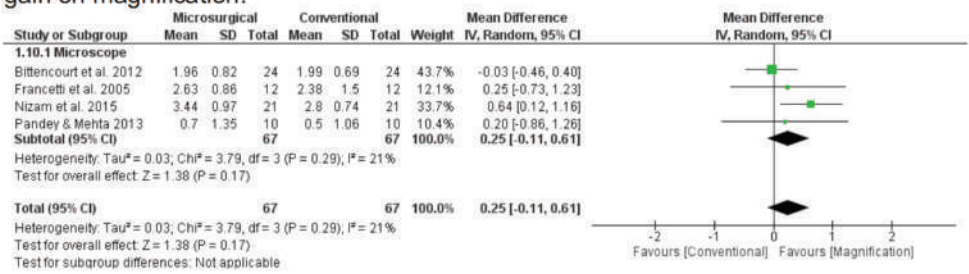
One study reported absence of complications associated with conventional surgery and the use of magnification[19]. One study reported that in the conventional technique groups, three subjects had dentin hypersensitivity and 10 had postoperative pain,

Table 3. GRADE summary of findings table for root coverage surgery under magnification *versus* conventional root coverage surgery.

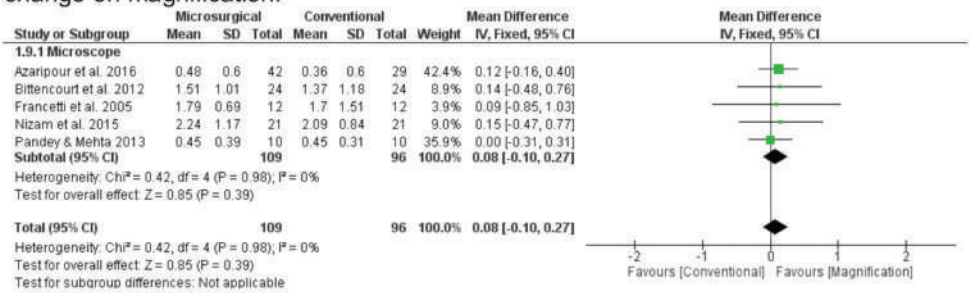
Certainty assessment							№ of patients		Effect		Quality of evidence	Importance
№ of studies	Study design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	Root coverage surgery with magnification	Comventional root coverage surgery	Relative (95% CI)	Absolute (95% CI)		
Mean root coverage (follow up: range 6 months to 24 months; assessed with: mm; Scale from: 2.0 to 4.4)												
5	Randomized trials	serious[a]	not serious	not serious	serious[b]	none	114	113	-	mean 0.26 mm more (0.07 more to 0.46 more)	low ⨁⨁◯◯	CRITICAL
Percentage of root coverage (follow up: range 6 months to 24 months; assessed with: %; Scale from: 4 to 23)												
6	Randomized trials	serious[a]	not serious	not serious	serious[b]	none	119	118	-	mean 7.41 higher (4.26 higher to 10.57 higher)	low ⨁⨁◯◯	CRITICAL
Complete root coverage (follow up: range 6 months to 24 months; assessed with: Number of events; Scale from: 2 to 37)												
6	Randomized trials	serious[a]	serious[c]	not serious	serious[b]	none	119	118	-	mean 1.35 more (1.04 more to 1.75 more)	Very low ⨁◯◯◯	CRITICAL
Keratinized tissue width (follow up: range 6 months to 24 months; assessed with: mm; Scale from: 0.0 to 5.0)												
4	Randomized trials	serious[a]	not serious	not serious	very serious[b]	none	114	113	-	mean 0.15 mm more (0.02 fewer to 0.32 more)	Very low ⨁◯◯◯	IMPORTANT
Clinical attachment level (follow up: range 6 months to 24 months; assessed with: mm; Scale from: 0.5 to 4.3)												
5	Randomized trials	serious[a]	not serious	not serious	serious[b]	none	99	98	-	mean 0.33 mm more (0.1 more to 0.57 more)	low ⨁⨁◯◯	IMPORTANT

Author(s): Moro MG, Souto MLS, Rovai ES, Cesar Neto JB, Holzhausen M, Pannuti CM.
Question: Root coverage surgery under magnification compared to conventional root coverage surgery in healthy patients with gingival recession.
Setting: Brazil, Germany, Switzerland, Italy, India, Turkey
Bibliography: Azaripour et al. (2016); Bittencourt et al. (2012); Burkhardt et al. (2005); Francetti et al. (2005); Jindal et al. (2015); Nizam et al. (2015); Pandey and Mehta (2013).
CI: Confidence interval
Explanations
a. According to the table of risk of bias, the most of studies were classified as unclear risk of bias due to the fails of randomization and allocation, blind of examiners, as well, sample size calculation.
b. The sample size of studies is small and just two studies reported how it was calculated. Also, the confidence interval does not rule out a null effect or harm.
c. The moderate heterogeneity could be explained by the use of different periodontal surgical techniques and regarding the range of magnification.

Supplementary material 1. Forest plot of random effects meta-analysis evaluating CAL gain on magnification.



Supplementary material 1. Forest plot of random effects meta-analysis evaluating KTW change on magnification.



Supplementary Material 1. Forest plot of random effects meta-analysis evaluating CAL gain and KTW change on magnification.

while 10 participants had postoperative pain in the magnification group[22]. Three trials did not report information about the presence of postoperative complications[20,29,31]. In another study, one subject in each group had postoperative hemorrhage and one participant in the test group had partial necrosis and swelling in the donor area[21]. Moreover, one trial showed that less subjects in test group (20%) had postoperative pain when compared to control group (60%)[30].

DISCUSSION

The findings of this review suggest that magnification has a controversial influence on clinical outcomes in root coverage procedures. Surgeries performed under magnification may result in higher PRC than the ones performed without magnification. On the other hand, when analyzing the other outcomes, including the primary outcome, magnification did not promote additional benefit. Magnification was associated with approximately 7% more root coverage than the conventional technique. Although this percentage was considered statistically significant, the clinical relevance of this improvement must be discussed. The clinician should analyses if it is worth invest on magnification for gain more 7% of root coverage than conventional technique. Moderate heterogeneity between studies was detected in meta-analysis of CRC (62%), whereas pooled estimates of MRC and PRC showed low heterogeneity (35% and 0%, respectively), what may reinforce the reliability of such findings.

The rationale use of magnification in periodontal surgery involves a combination of practical considerations associated with scientific evidences that indicates, in some clinical situations, that magnification may be an advantage for both the practitioner and the patient. However, it is difficult to directly compare the available devices and to identify which magnification yielded the best results. Loupe was defined as a double monocular telescope with converging lenses side by side to focus on the operative field. The range of magnification varies between 1.5 and 6 x[32]. The microscope provides a greater range of magnification (4-45 x). It incorporates an optical system coated with achromatic lenses and has a high optical resolution due to the enhanced depth of focus and field of view[33].

Microscope allows the adjustment of magnification according to the preference of the user in each step of the procedure. The microscope magnification of the trials selected for this review ranged from 3 to 30 x. Further, the values of magnification also varied within the same study. Azaripour et al.[31] (2016) used a magnification that varied between 4 and 7x, and the magnification of Francetti et al.[19] (2005) and Bittencourt et al.[22] (2012) studies varied between 5 and 30 x; and 8 and 12 x, respectively. The studies of Burkhardt and Lang[20] (2005), Jindal et al.[29] (2015), Nizam et al.[21] (2015), and Pandey and Mehta[30] (2013) applied just one value of magnification (15 x, 10 x, 3.5 x and 10 x, respectively).

The use of different surgical techniques also difficult comparisons. The majority of the studies used coronally positioned flap (CPF) in association with subepithelial connective tissue graft (CTG)[21,22,29]. Other studies used double-pedicle papilla flap[20], and free rotated papilla autograft + coronally advanced flap (CAF)[30]. Azaripour et al.[31] (2016) compared different techniques (modified microsurgical tunnel technique + CTG versus CPF + CTG), while Francetti et al.[19] (2005) used different techniques, according to the patient's need.

Azaripour et al.[31] (2016) was the only study that included upper first molars. The others included incisors, canines and premolars (maxilla and mandible)[29]; anterior area from maxilla and mandible[19]; canines and premolars from maxilla[21,22]; or upper canines[20]. Despite the present interesting findings, it should be considered that RC may vary according to tooth types due to the anatomic characteristics as recession width, frenum attachments and lip muscles[34,35]. Another point is about the operators. The use of magnification is associated with a well-trained and experience operator, while the conventional surgery can be performed by a less trained operator. The use of magnification is associated with an additional financial investment, training time and potential longer surgical time[36,37]. These factors induced the operator to get better and promoted more precise surgeries.

The precision and refinement promoted by magnification may result in better final visual analyze[38]. Esthetic evaluation was conducted by Francetti et al.[19] (2005) and Bittencourt et al.[22] (2012) that found superior results for surgery with magnification.

Two studies followed patients for 6 months[29,30], the majority of the investigations followed the subjects for 12 months[19,20,22,31] and Nizam et al.[21] monitored the subjects for 24 months. Although some studies claim that the longer the follow-up time, the changes are more stable[39], other studies have reported that results obtained after 6

months are stable over time up to 12 months[40,41] or even after 3 years of follow-up[42]. Tissue stability is also associated with other aspects, including surgical technique, tissue thickness and mainly oral hygiene habits of the patients.

Within the limits of our knowledge, this is the second systematic review investigating the influence of magnification on root coverage procedures and some important differences have to be highlighted. While the present review included seven trials, the previous review was limited to the inclusion of four studies[2]. This difference could be explained due to the publication of recent papers addressing magnification and also, no restrictions for surgical technique. Another difference is that meta-analysis in the Kang et al.[2] (2015) review included only two studies that used CTG in the surgical procedure[20,22].

Despite our interesting findings, some limitations must be addressed. Five studies were classified as unclear risk of bias[19-21,29,30]. Studies that present unclear or high risk of bias tend to overestimate the effect of treatment and decrease the reliability of the trials' conclusions. Moreover, according to GRADE, three outcomes (MRC, PRC and CAL change) were related to low quality and two outcomes (CRC and KTW change) were related to very low quality, which indicated that further research is recommended to confirm whether the estimates are close to real values.

Still, when patient related outcomes are analyzed, the use of microscope did not interfere positively on discomfort, postoperative pain and esthetic evaluation[22,31]. In this sense, well-conducted studies are needed, in order to focus not only in clinical aspects, but also evaluating the perspective of the practitioner. Data regarding physical lesions caused by work, fatigue after working hours and frequency of pain in neck and column could bring interesting information for the field. These data could contribute not only to the understanding of the potential benefits of magnification on clinical results, but also whether the use of magnification devices could favor the quality of life of a practitioner during his career and after retirement.

In conclusion, there is low evidence that magnification can increase PRC in root coverage surgeries. However, more randomized trials with the use of magnification are necessary, in order to prove that this benefit is clinically relevant, in order to justify the use of this device.

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