

THE OUTCOMES OF RIDGE AUGMENTATION VIA TUNNELING TECHNIQUE: A META-ANALYSIS AND SYSTEMATIC REVIEW

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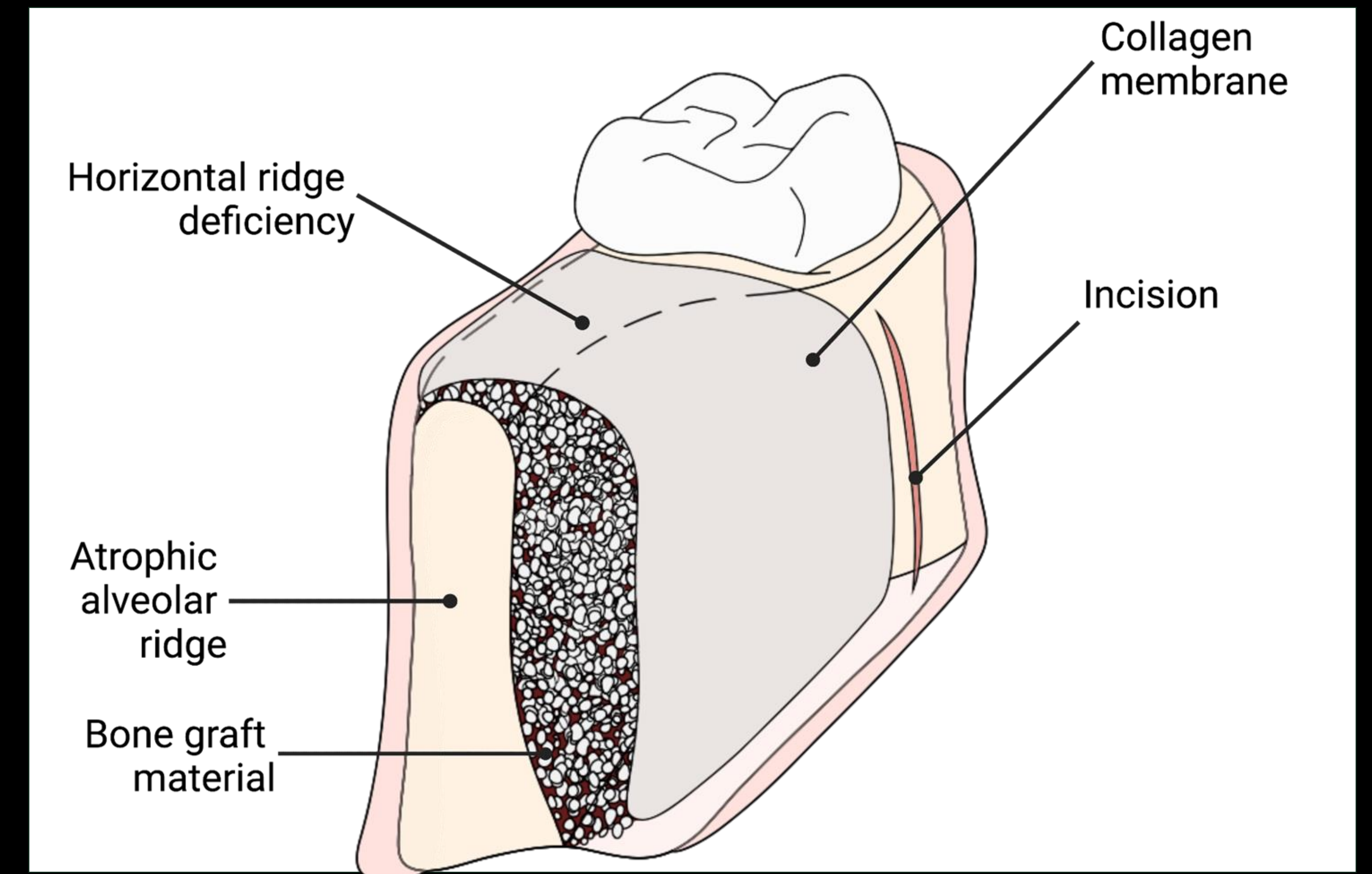
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AIM: To evaluate the **effectiveness and potential complications** of using tunneling ridge augmentation(RA) approaches. Reviewing available techniques and current evidence, this study summarized the **techniques and the complications of tunnelling RA techniques and provided the meta-analysis for their efficacy and potential factors affecting the outcomes.** This present finding will provide guidance for clinicians in selecting the technique and inspire future research for RA using minimally invasive techniques.



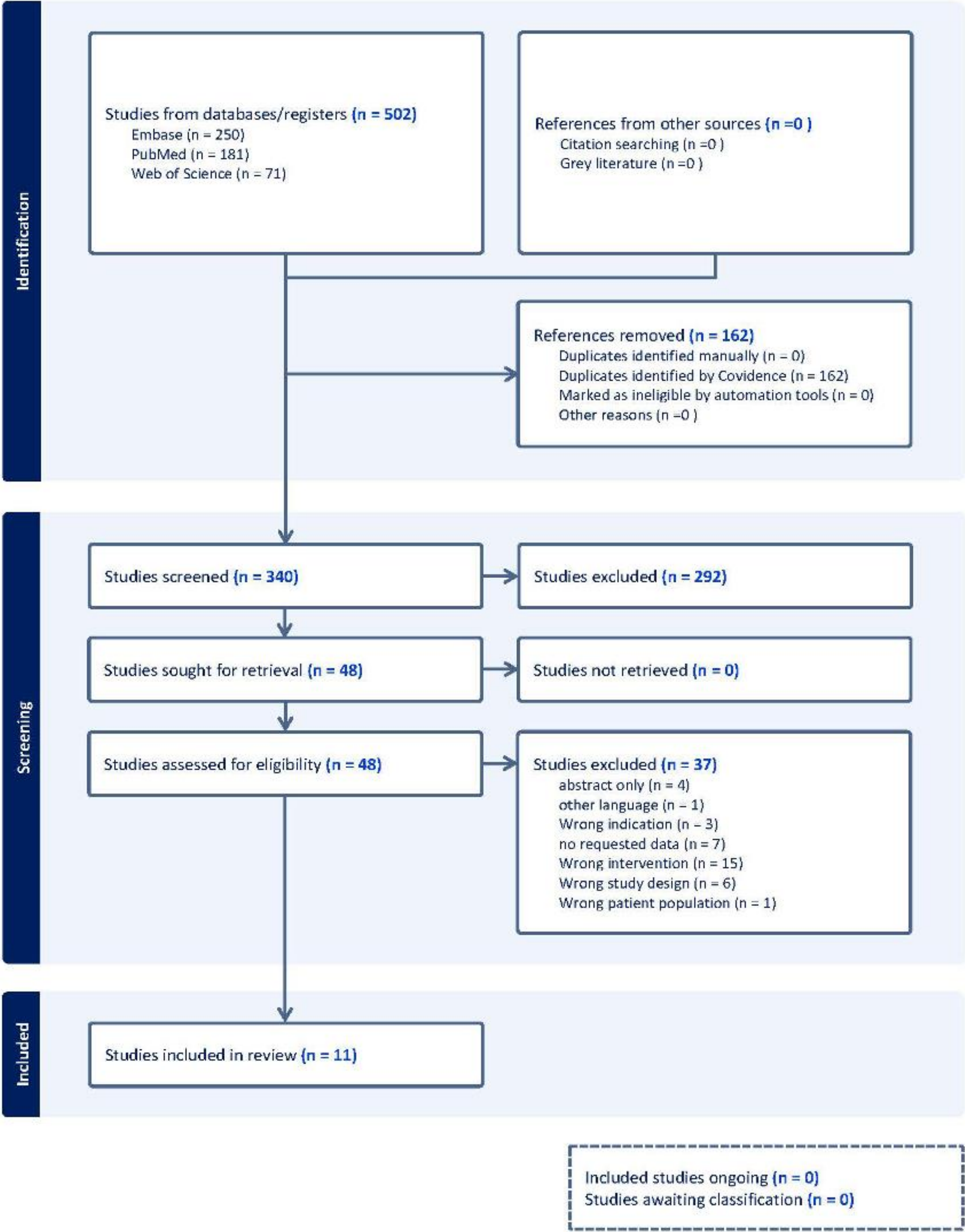
MATERIALS AND METHOD

A literature search was performed in October 2023 across three electronic databases: PubMed, Embase and Web of Science. The articles selected were published from 1st January ,1980 to 28th February,2025.

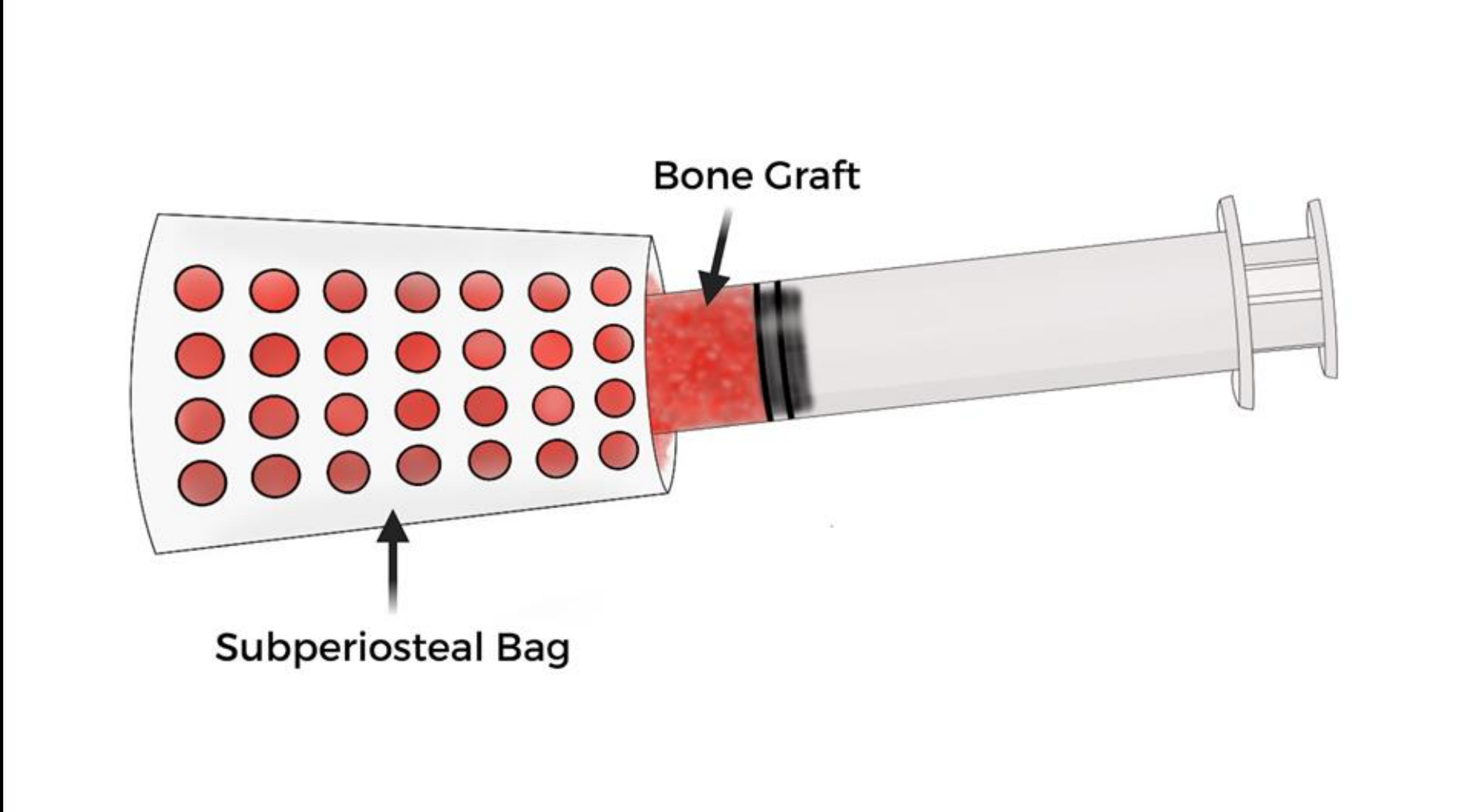
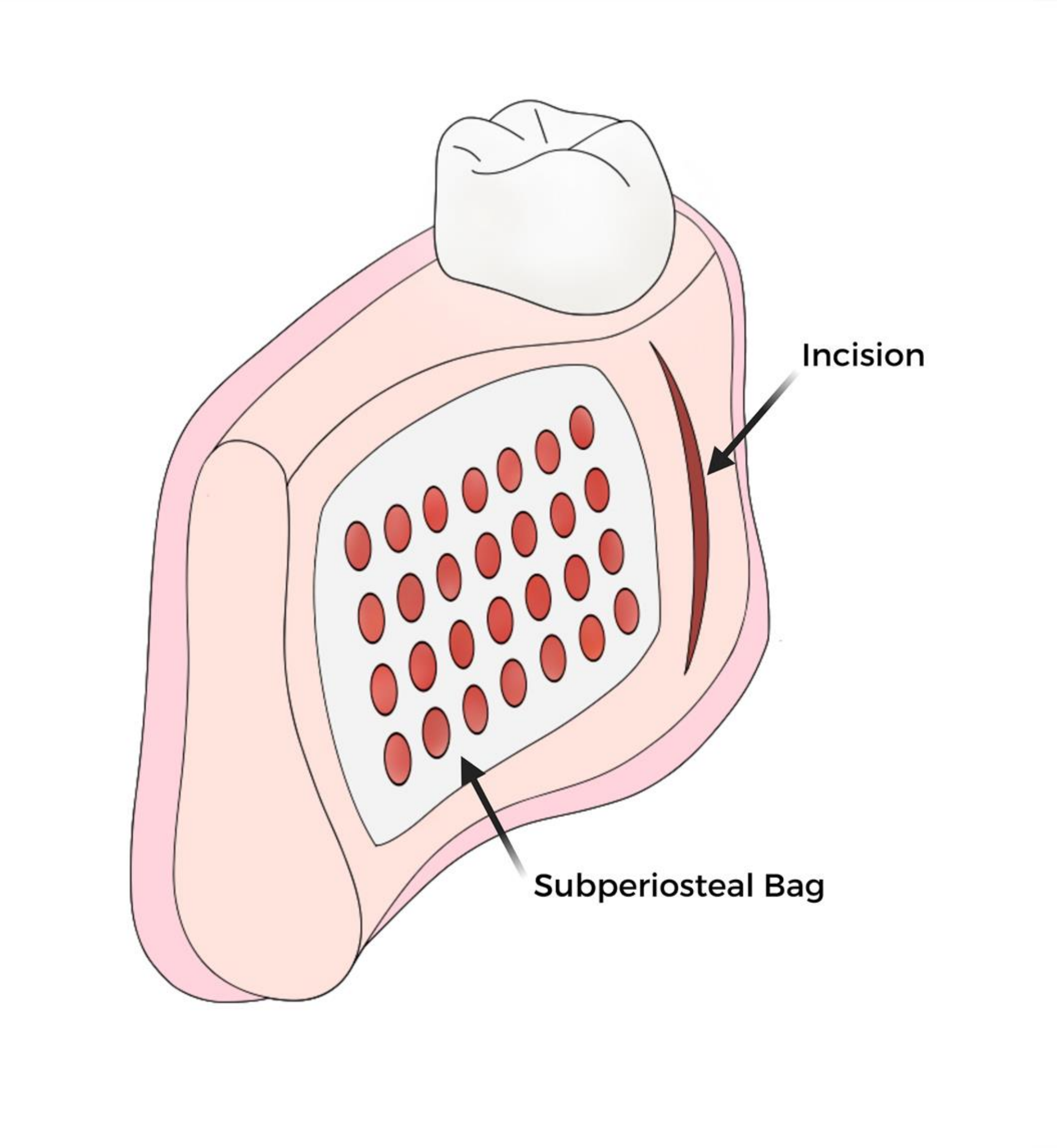
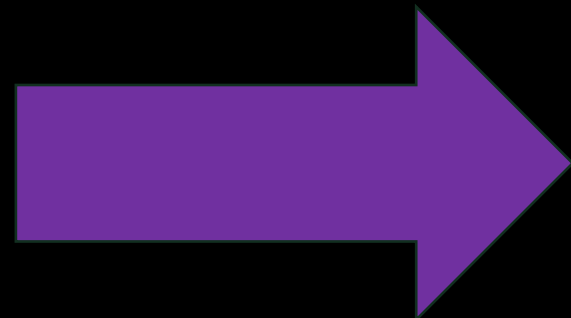
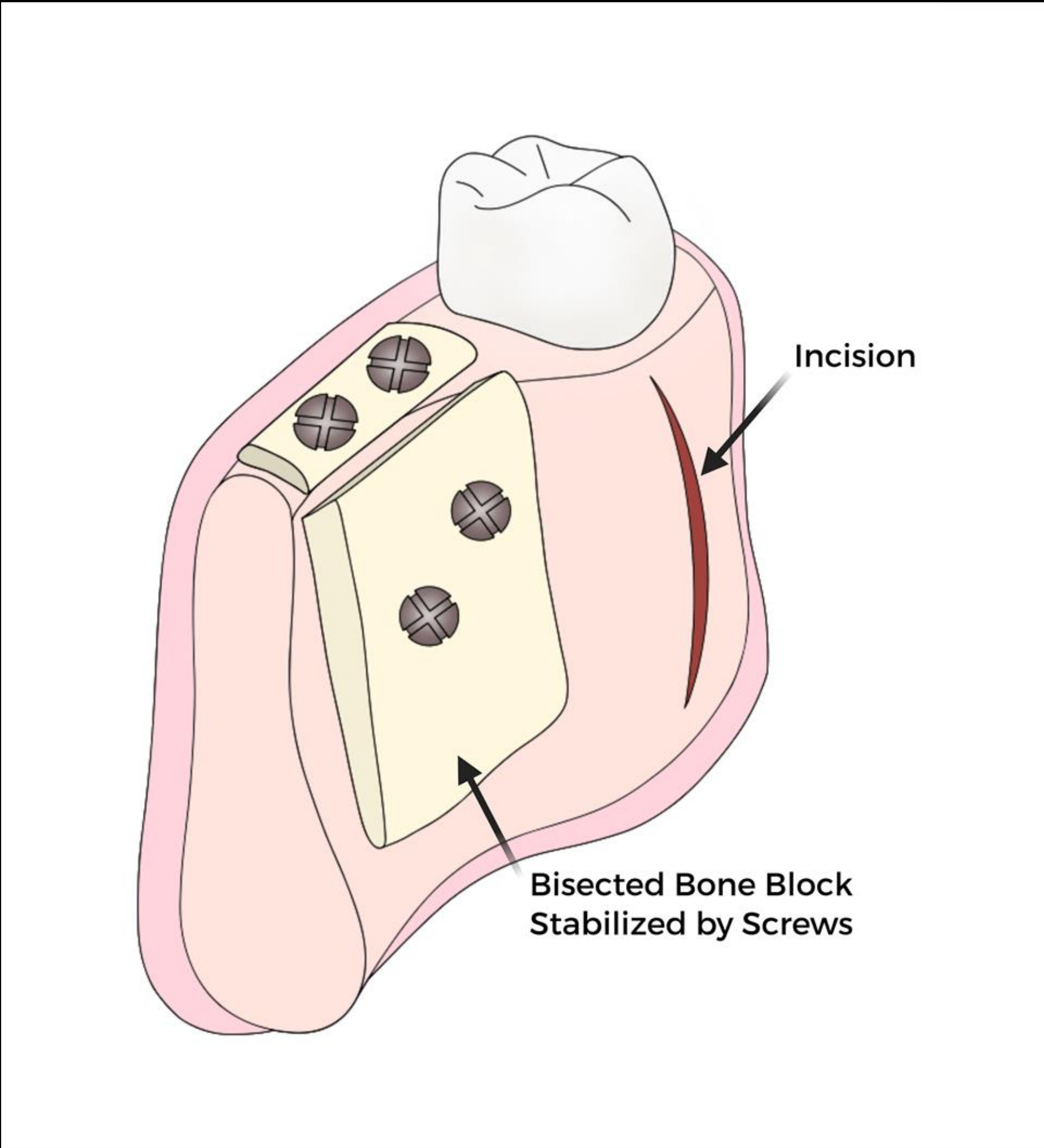
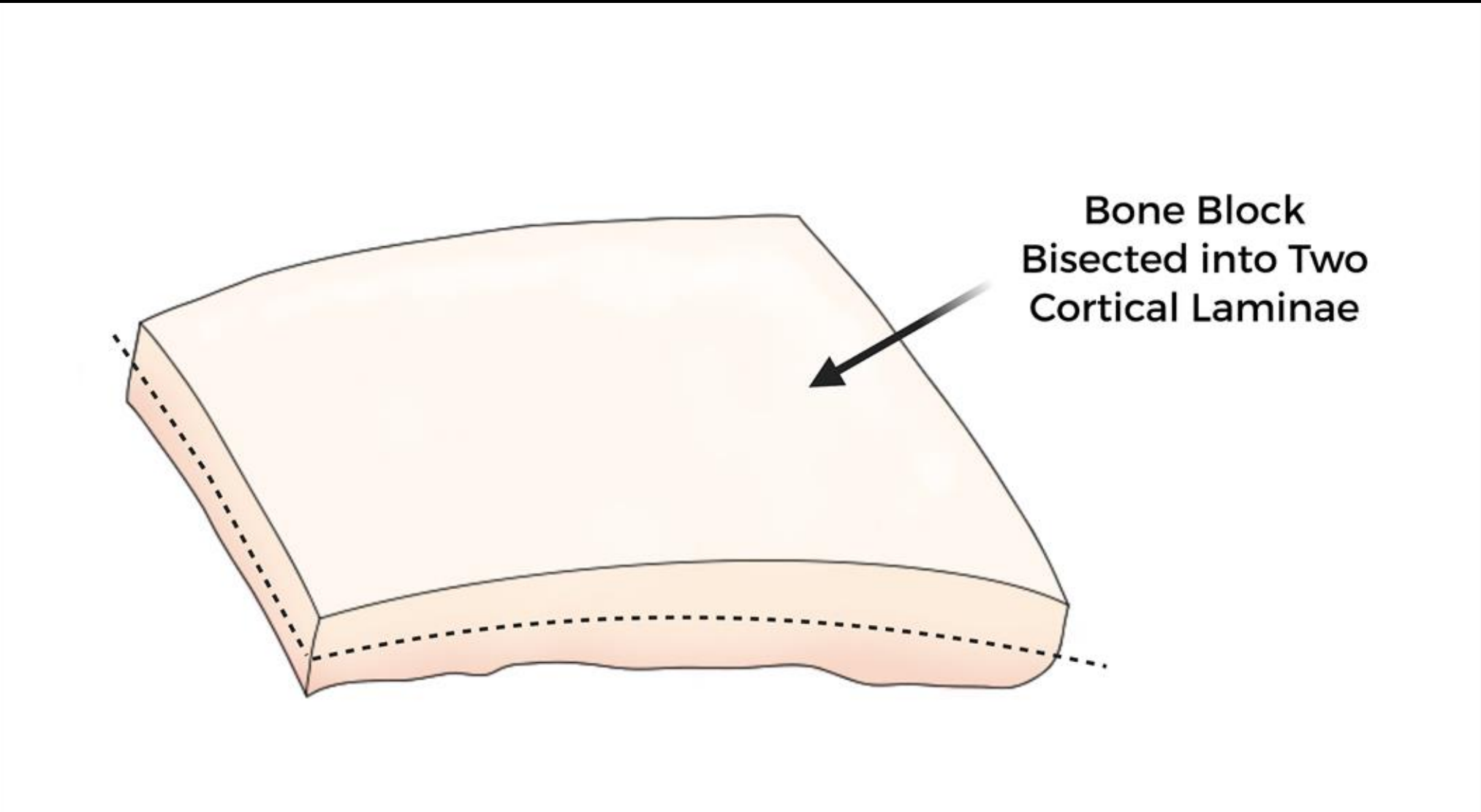
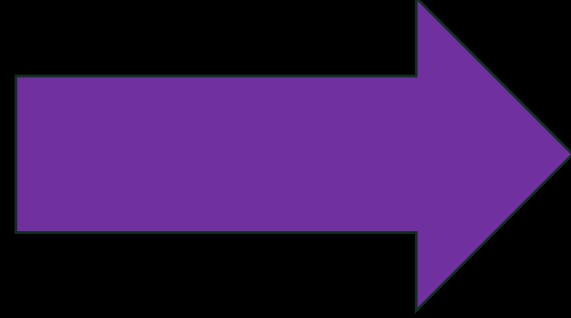
Study selection criteria:

- 1.The studies must be published in English.
- 2.The study should have been performed on human subjects.
- 3. The study can be randomized and non-randomized prospective or retrospective human case-control or cohort comparative studies evaluating the efficacy of ridge augmentation via tunneling techniques
- 4.≥ 5 participants in clinical studies
- 5. The study should report quantitative value of ridge dimensional changes.

Exclusion criteria: In vitro studies, case reports, animal studies, narrative review, unpublished data, communications, or expert opinions will be excluded.



Author/Paper	Surgical Technique
DeStavola & Tunkel 2013 Restoy-Lozano et al 2015 Khoury & Hanser 2019 Khoury & Hanser 2022	Bone was harvested from the external oblique ridge and split into two thin cortical plates .
Lee et al. 2017	A laparoscopic approach was used to deliver a combination of growth factor and anorganic bovine bone graft into a subperiosteal pouch.
Kakar et al 2018 Wychowanski et al 2020 Ramadan et al 2024	Subperiosteal pouch technique: A primary tunnel (pouch) was formed subperiosteally and bone graft was placed using the tunnelling technique
Byun et al 2020 (COIR) 2020, Byun 2020 (JCM)	Soft tissue expander-expansion of the soft tissue via tissue expander (TET) for two weeks prior to the placement of bone materials below the periosteum using the tunneling tecjnique.
Rasperini et al 2021	Subperiosteal membrane bag- collagen membrane bag containing a xenograft, which was then inserted into the bony defect using the tunneling technique.

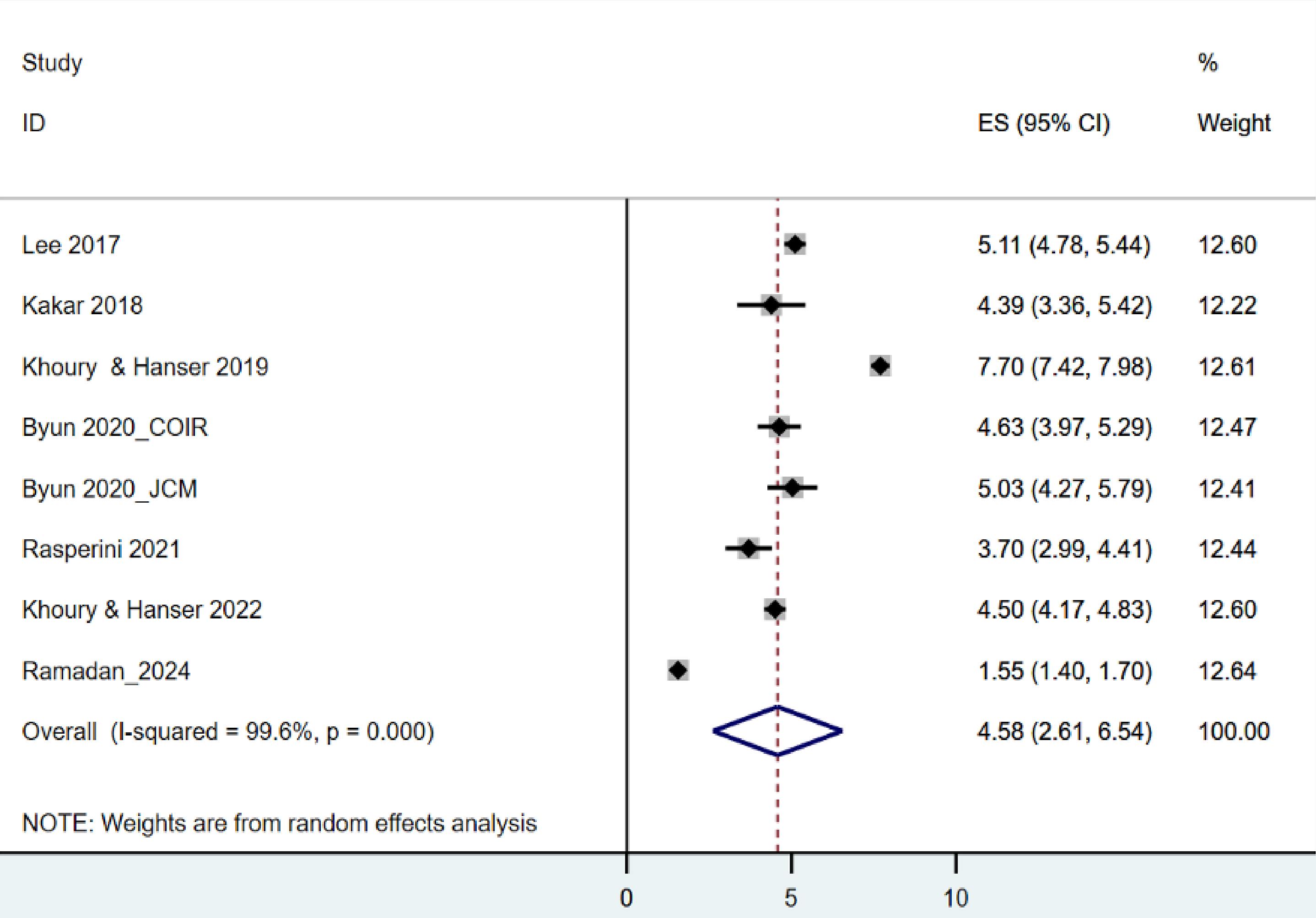


RESULT

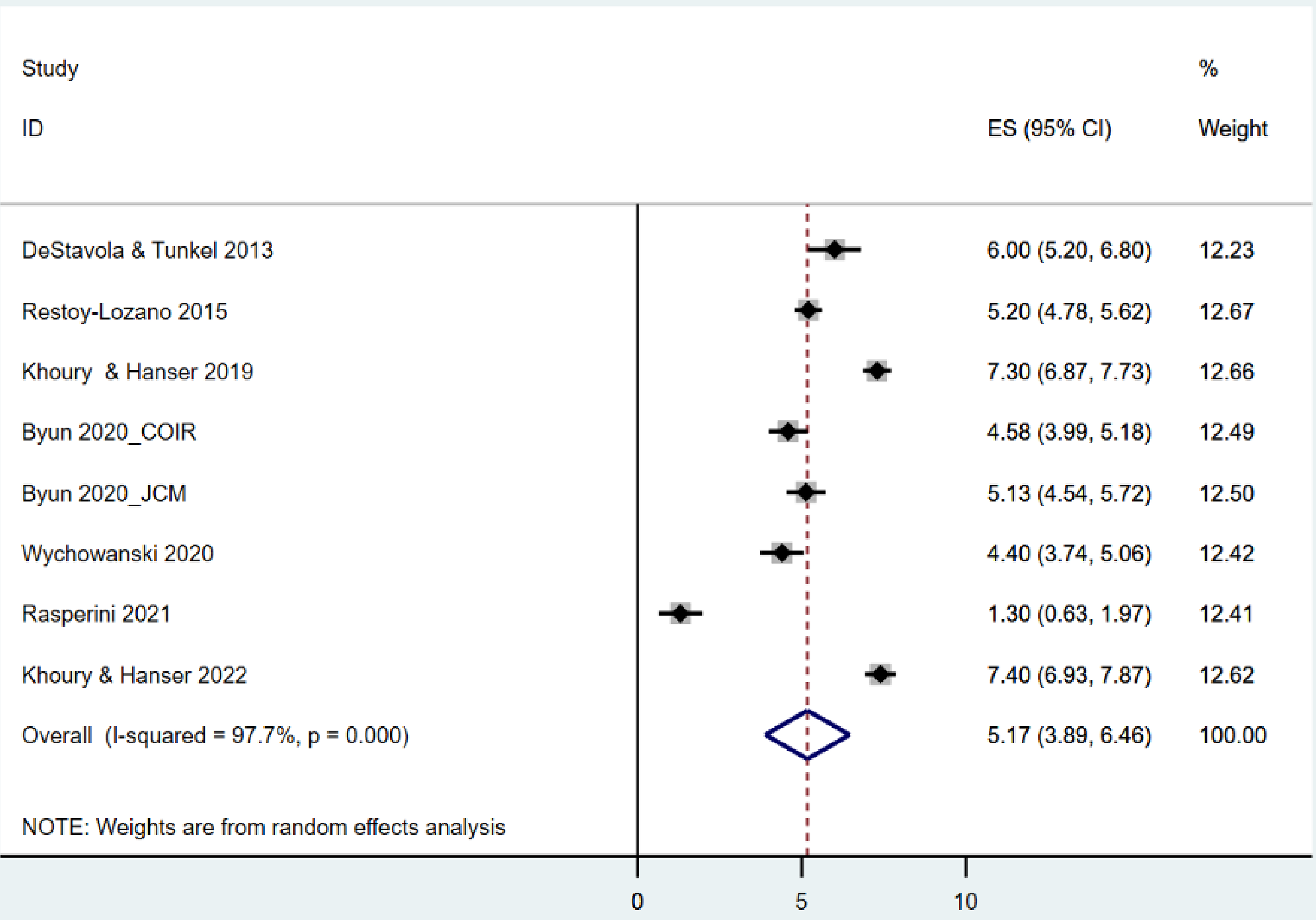
The test group showed **significant HBG or VBG** in responses to the treatment compared to baseline.

- Compared to the control group, the HBG was not significantly different between the two groups. However, the test group had significantly **greater VBG** than the control.
- Meta-regression showed that the types of bone grafts had a **significant impact on VBG** in favor of autogenous grafts.
- The use of membrane **did not show a significant impact** on either HBG or VBG.

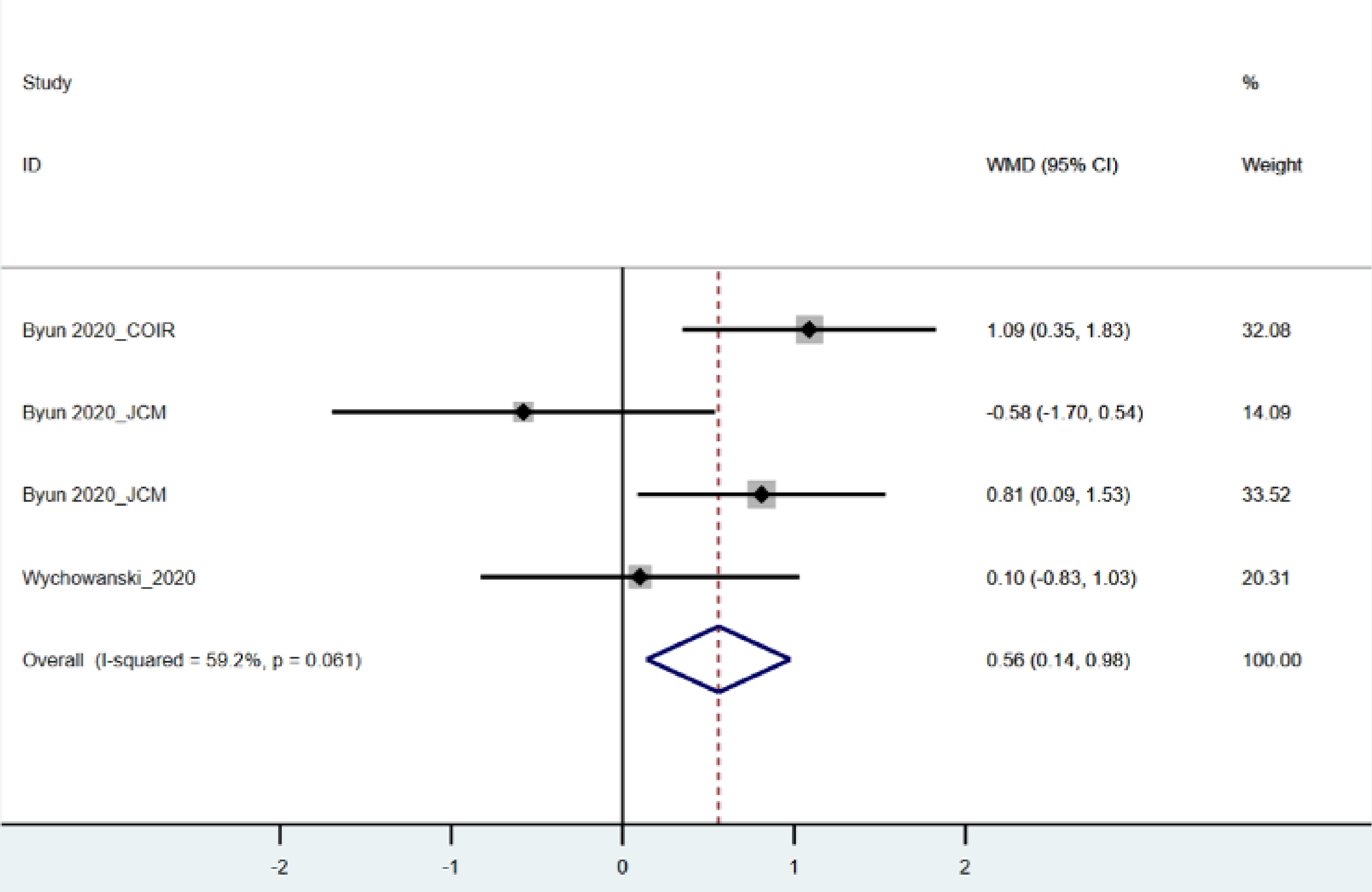
Weighted horizontal bone gain (HBG) after the tunneling procedure (random effects model)



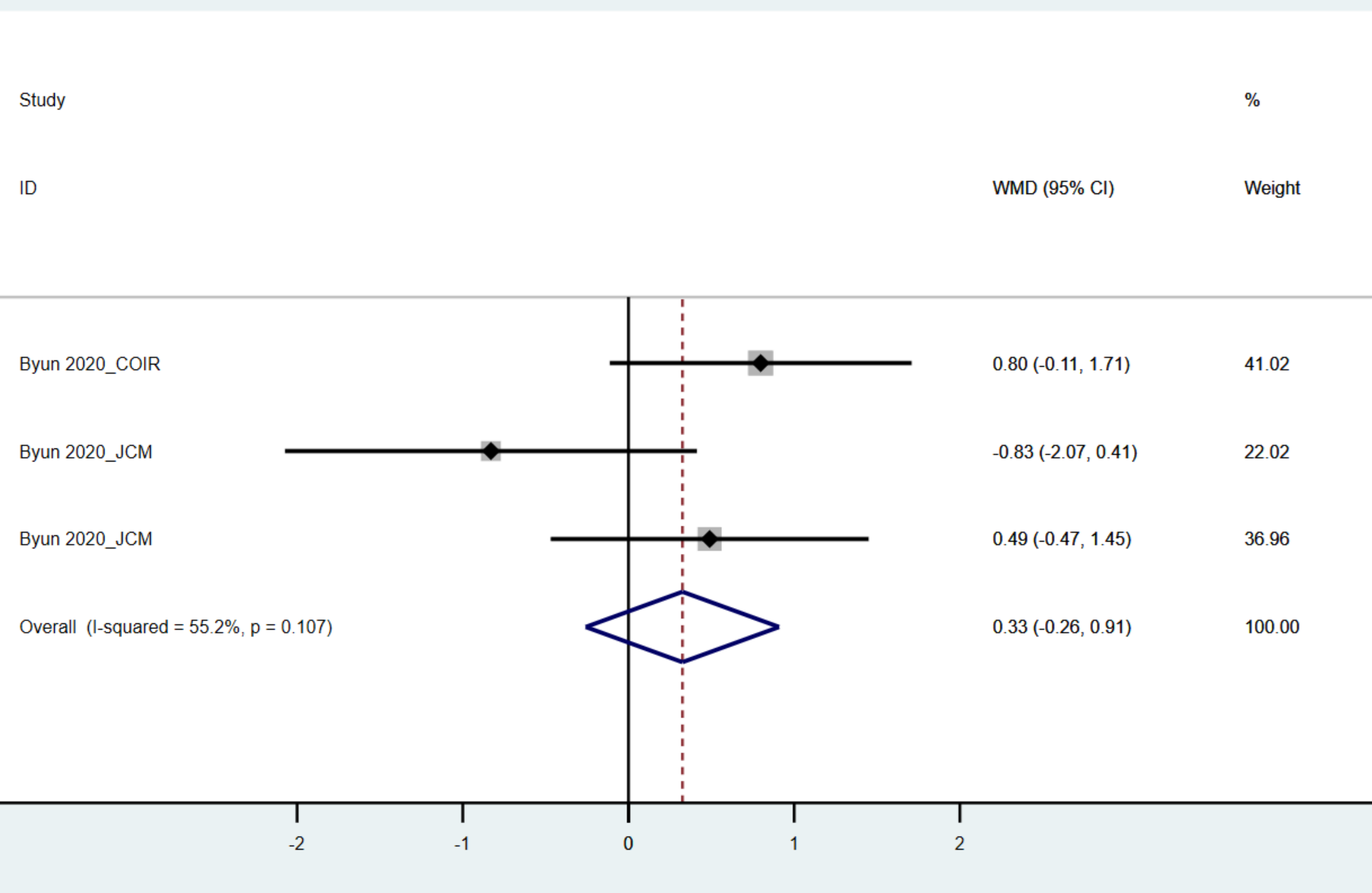
Weighted vertical bone gain (VBG)) after the tunneling procedure (random effects model)



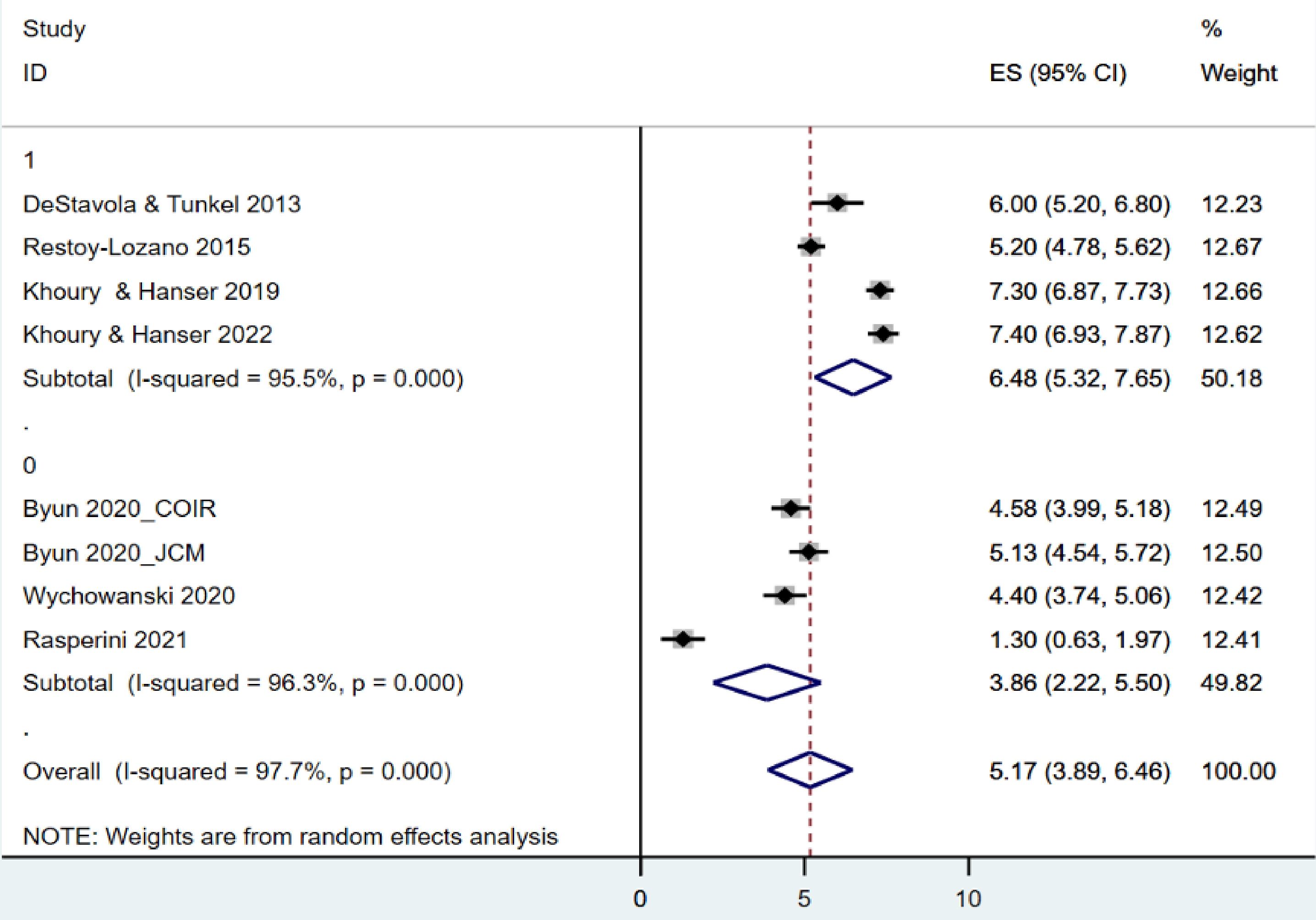
Weighted mean difference (WMD) in vertical bone gain (VBG) between the test group and the control group (fixed effects model)



Weighted mean difference (WMD) in horizontal bone gain (HBG) between the test group and the control group (fixed effects model)



Weighted vertical bone gain (VBG) after the tunneling procedure based on the bone graft type



DRAWBACKS

1. Technique sensitivity
2. Smaller sample size
3. Heterogeneity of study designs

COMPLICATIONS

1. The use of tunneling RA approach may significantly decrease the complication rate and patient morbidity, possibly because of better blood supply and wound stability.
2. However, similar to the flapped approach, the complications can still occur and vary in severity ranging from minor soft tissue to complete graft loss

CONCLUSION

1. Tunneling ridge augmentation is an effective minimally invasive technique for achieving clinically significant bone gain.
2. The approach can reduce patient morbidity and complication rates compared with conventional flapped techniques.
3. Overall, this technique represents a valuable and patient-centered approach for ridge augmentation in contemporary implant dentistry.

FUTURE DIRECTIONS

1. Conduct well-designed randomized controlled trials comparing tunneling and conventional ridge augmentation techniques.
2. Incorporate long-term follow-up and histologic evaluation to assess bone quality and stability.
3. Standardize surgical protocols and report patient-centered outcomes to improve comparability and clinical relevance.