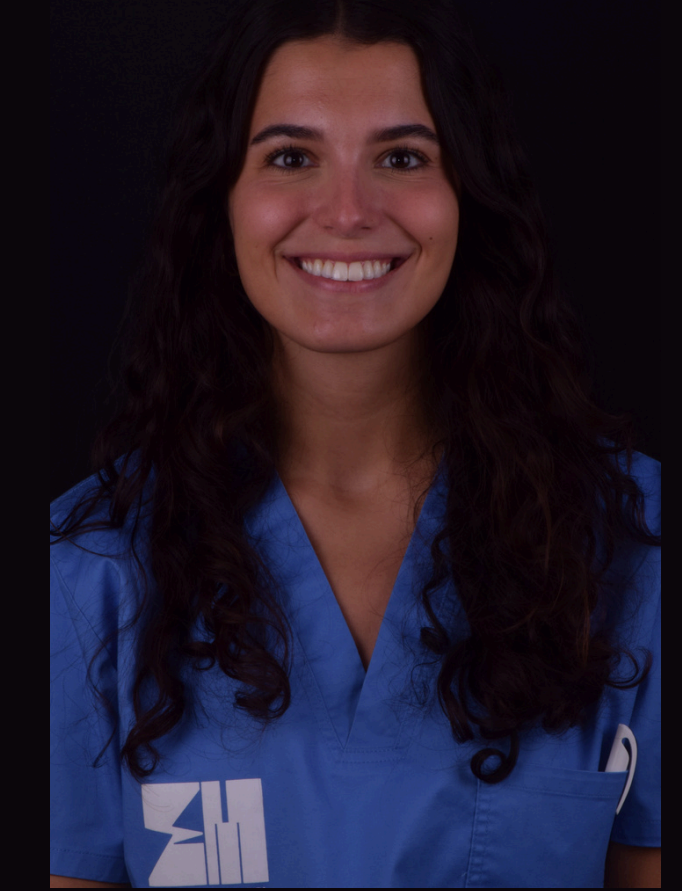


# Regenerating Alveolar Bone for Implant Placement: The Efficacy of Autogenous Mineralized Dentin Matrix - A Systematic Review and Meta-Analysis



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**Introduction:** One type of autogenous graft that has garnered increasing attention is the use of a patient's extracted tooth. This approach offers a significant advantage by eliminating the need for a secondary bone harvesting site. Moreover, it is comparable to autogenous bone in both composition and the formation mechanism, making it a promising option for alveolar bone augmentation following tooth extraction [1]. Bone and dentin share similar biochemical compositions and formation mechanisms [2]. Both teeth and maxillofacial bones originate from neural crest cells during embryonic development [3]. Due to this biological similarity, dentin has been explored as a potential bone substitute since the 1960s. Its high mineral content, osteo-compatibility, osteoconductivity, and osteoinductive properties make it suitable for bone grafting applications [4,5].

**Objectives:** In this review, we evaluated the efficacy of AMD as a method for alveolar ridge preservation in cases of delayed implant placement.

**Materials and Methods:** A comprehensive search through PubMed, Google Scholar, Cochrane Library, and B-on repositories was conducted without time constraints up to July 2024 to identify peer-reviewed human studies. These studies assessed the percentage of newly formed bone and residual graft following bone regeneration with AMD grafts after tooth extraction, specifically in the context of delayed implant placement.

**Results:** The study of the risk of bias made it possible to verify whether there were methodological flaws in the studies included in this systematic review while also evaluating the quality of this review. All studies included had an overall low risk of bias (Figures 1 and 2). Our analysis included four selected studies involving 55 patients and 67 sockets. The findings suggest that AMD grafts resulted in an average (and 95% confidence interval) of 43.8% [36.6%, 50.8%] newly formed bone (Figure 3) and 15.2% [7.2%, 23.2%] residual graft (Figure 4). The meta-regression of the effect of mean age on the percentage of newly formed bone showed that with an increase in mean age, there is a mean increase tendency in the percentage of newly formed bone ( $p=0.003$ ) (Figure 5). The meta-regression of the effect of male/female ratio on the percentage of residual graft showed that with the increase in males in the study, there is an increase in the percentage of residual graft ( $p<0.001$ ) (Figure 6).

Delayed implant placement was a feasible surgical option for all patients.

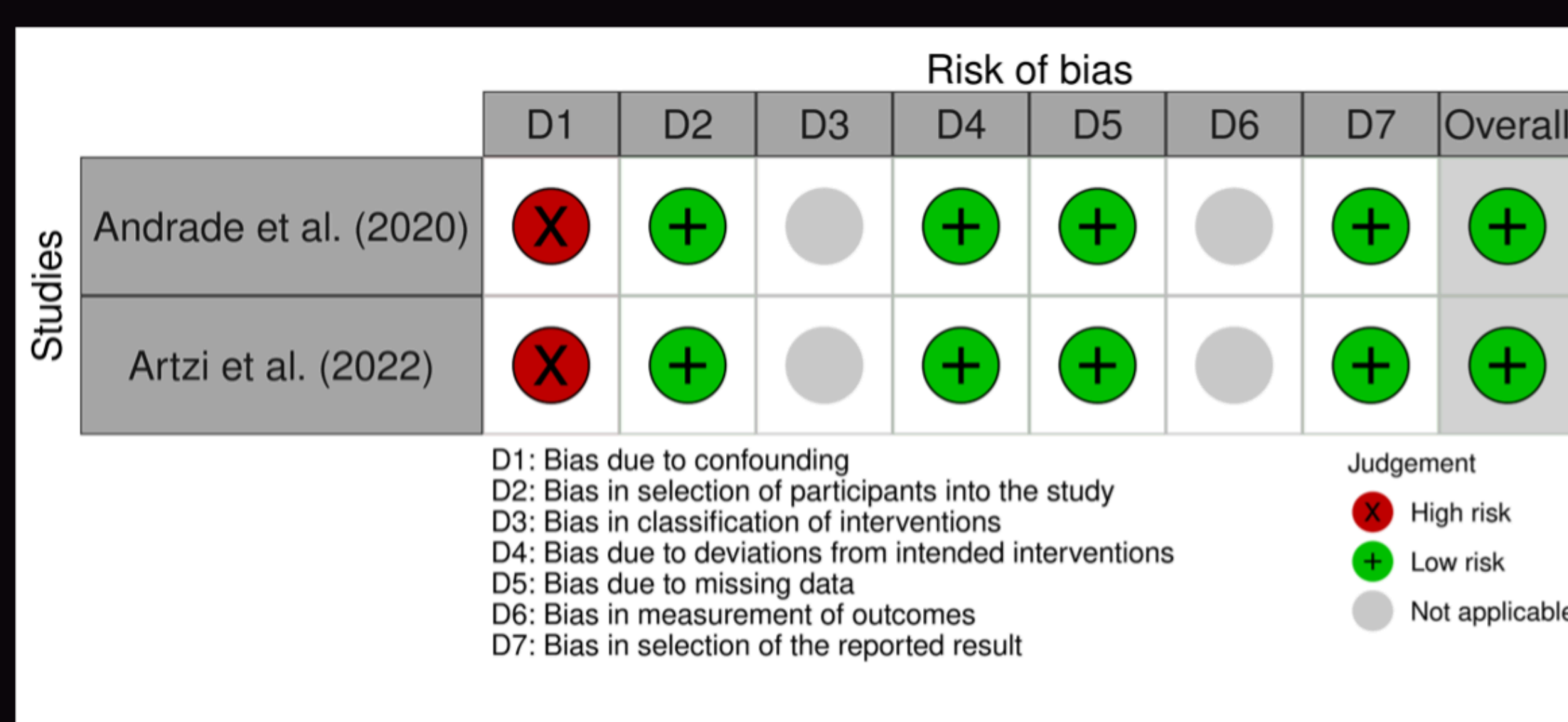


Figure 1. Traffic light plot of the risk of bias analysis of the non-randomized controlled trials.

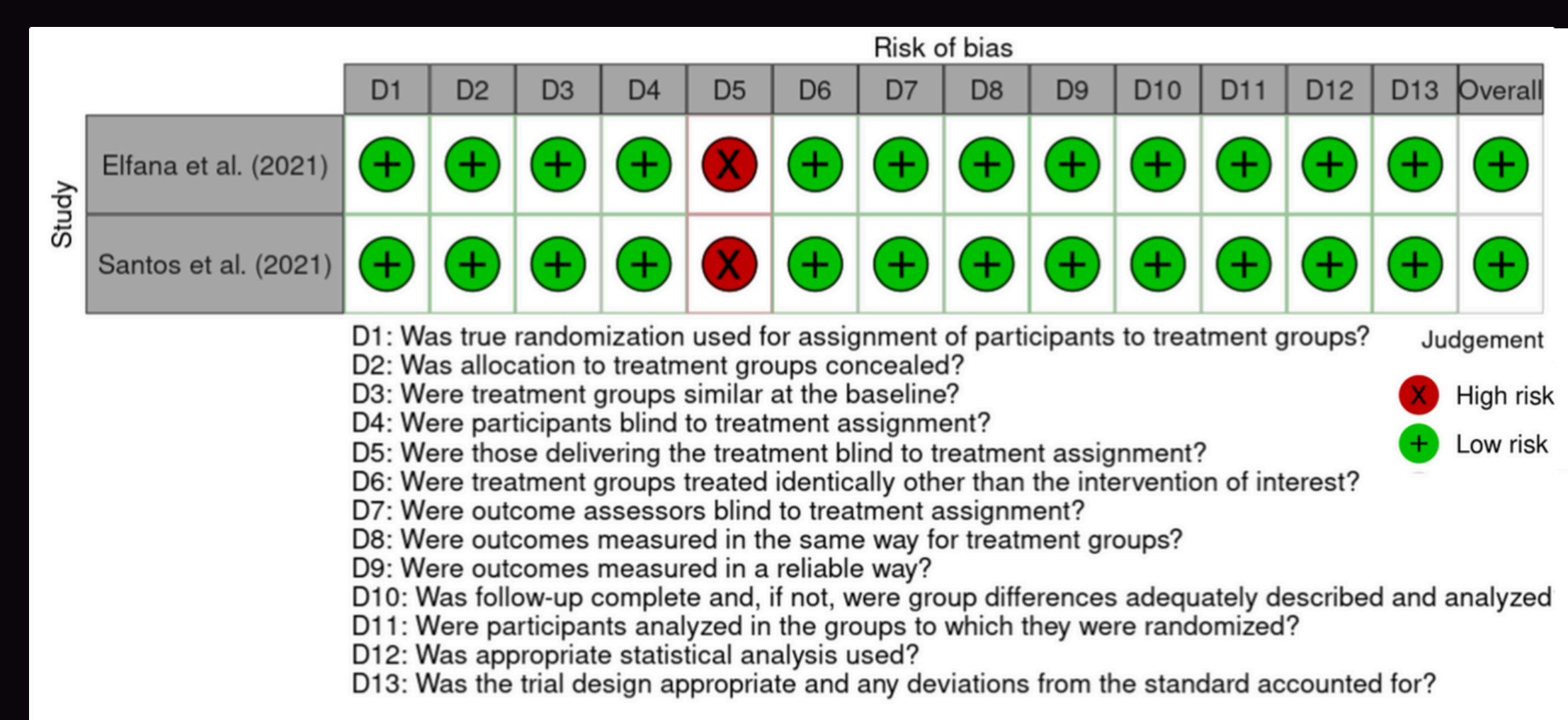


Figure 2. Traffic light plot of the risk of bias analysis of the randomized controlled trials.

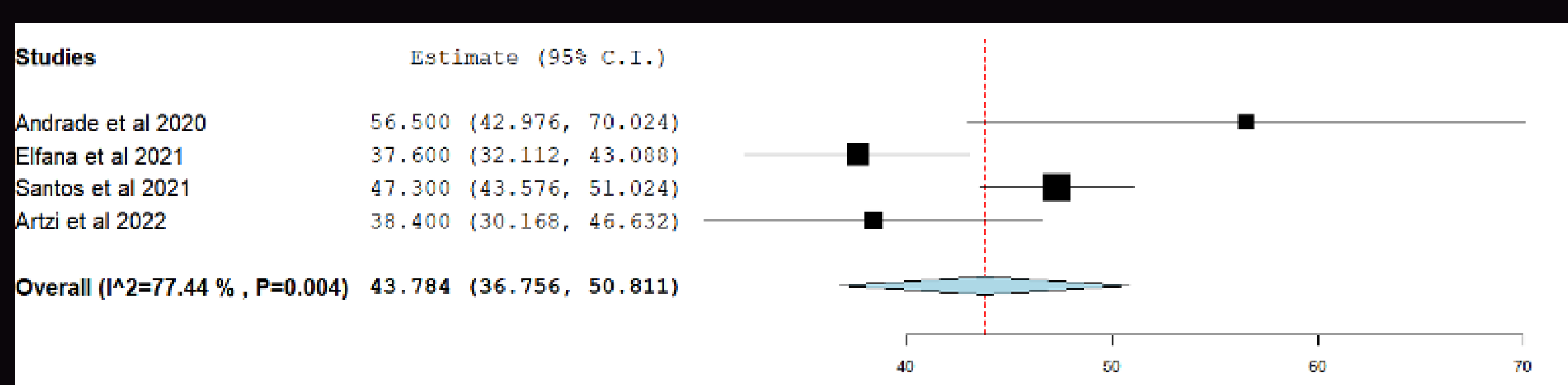


Figure 3. Forest plot graph of newly formed bone (%). I<sup>2</sup> represents the heterogeneity index. The dashed red line represents the meta-analytic mean [1, 6-8]

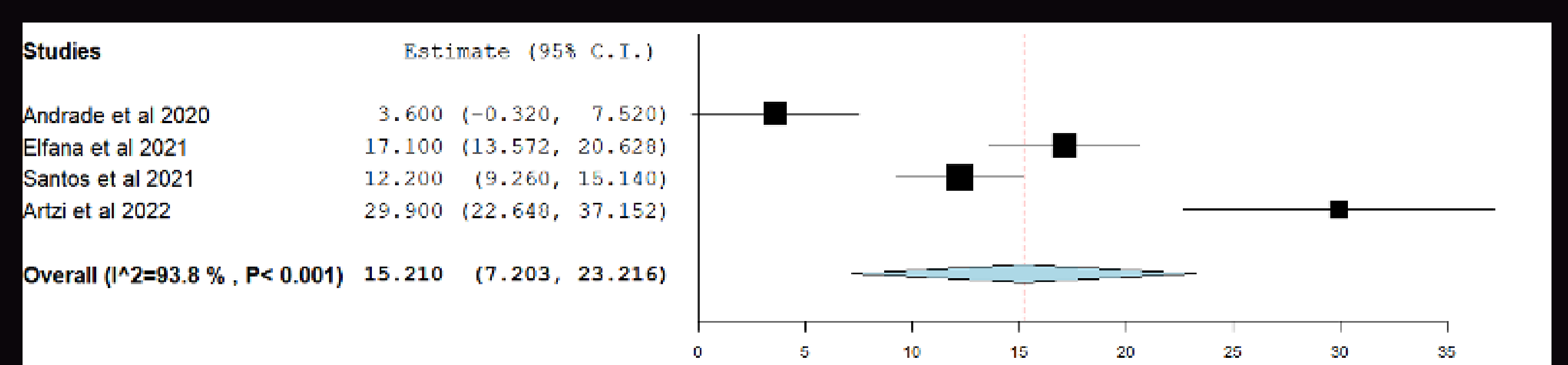


Figure 4. Forest plot graph of residual graft (%). I<sup>2</sup> represents the heterogeneity index. The dashed red line represents the meta-analytic mean [1, 6-8]

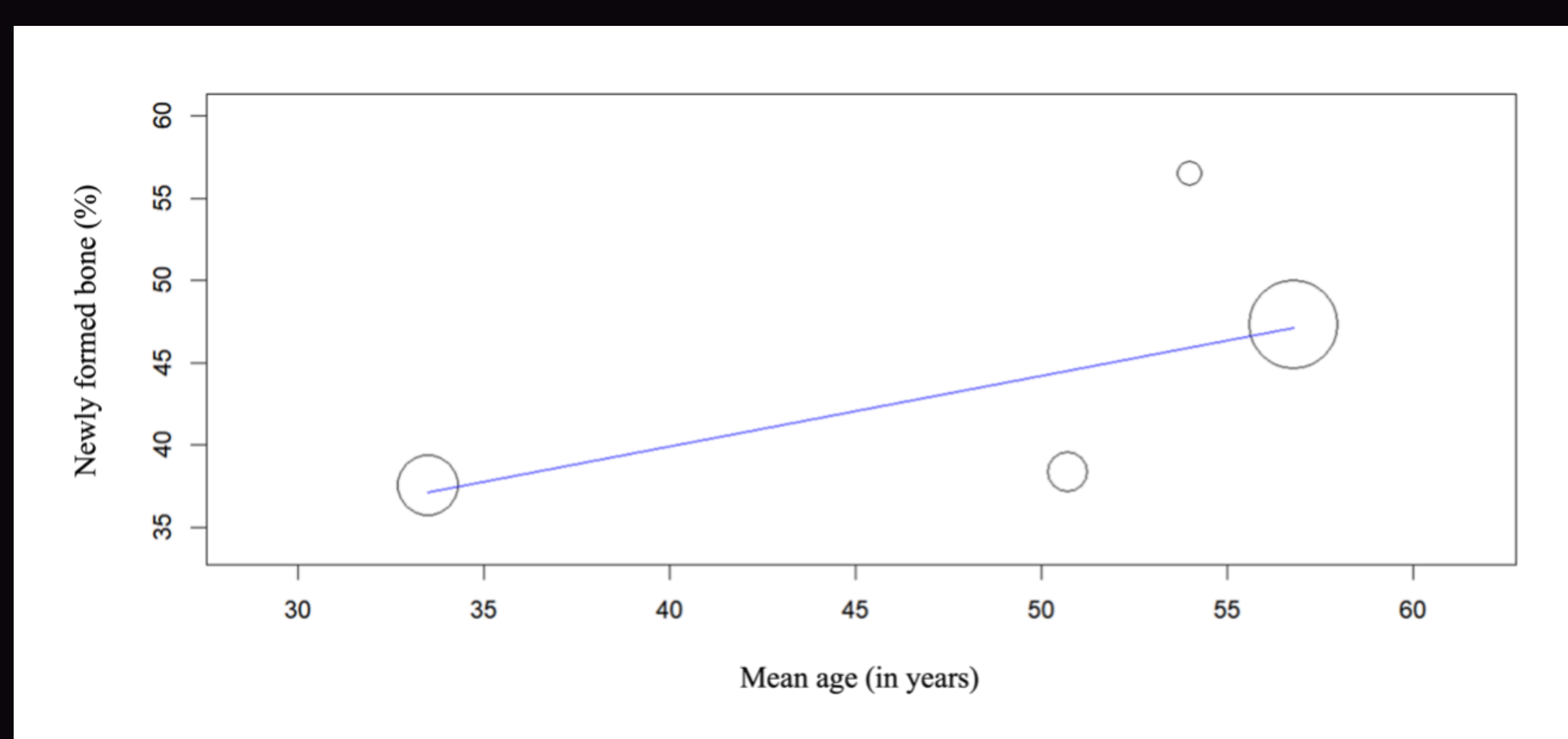


Figure 5. Meta-regression of the effect of mean age on the percentage of newly formed bone.

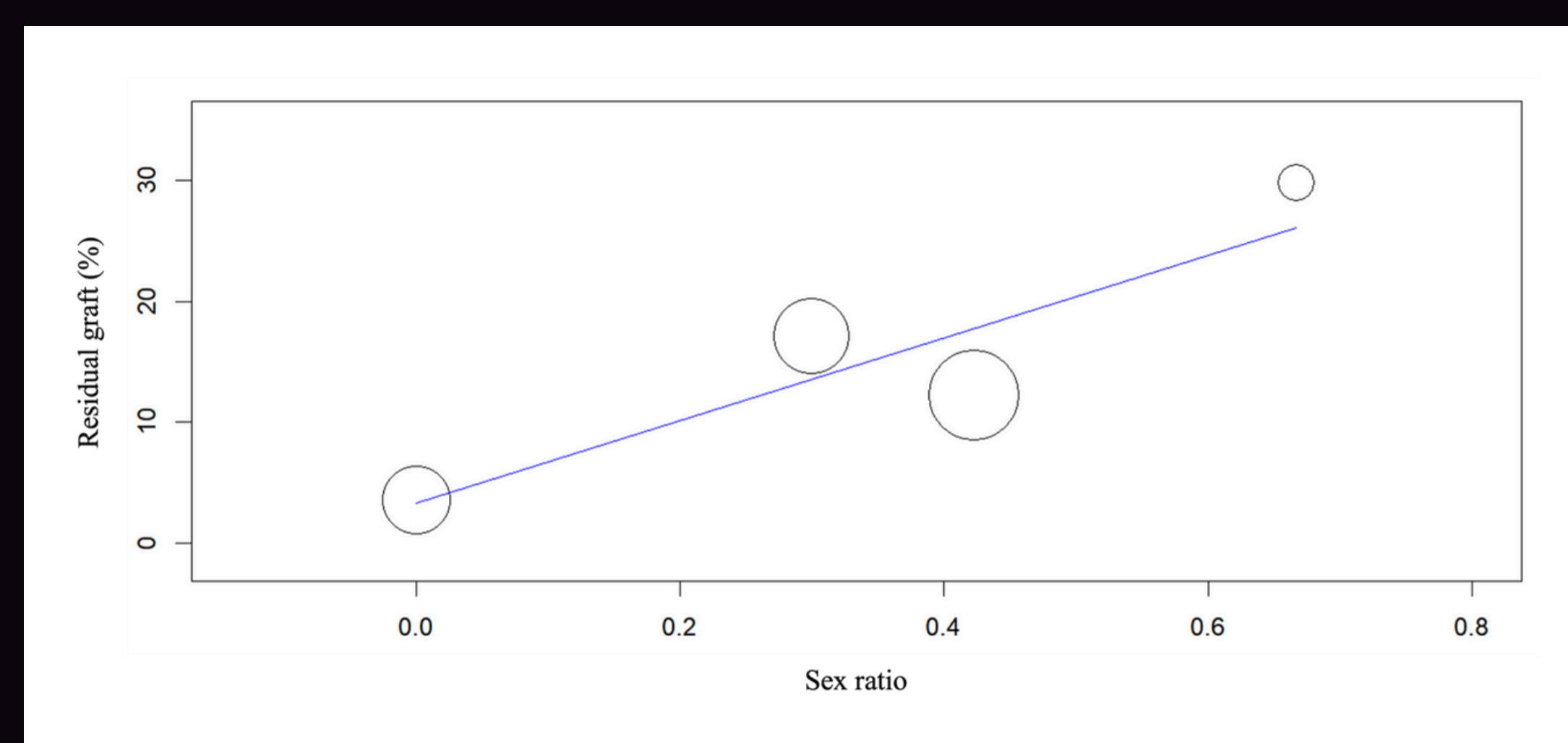


Figure 6. Meta-regression of the effect of male/female ration on the percentage of residual graft.

**Discussion:** This study is pioneering in that it represents the inaugural systematic review with meta-analysis to include mineralized dentin exclusively. No studies have explicitly focused on this area, rendering this research unique and innovative.

Further research is needed to address the above limitations. Long-term studies with larger patient groups and diverse patient populations are further needed to validate externally the efficacy of AMD for alveolar ridge preservation. Standardized protocols for preparing and applying AMD should be established to minimize variability and improve potential comparability between studies.

**Conclusions and clinical relevance:** Within the limitations of this review and given the limited number of studies available, AMD shows a promising trend in promoting newly formed bone. Additionally, AMD appears to be effective and safe, indicating its potential as an alternative to other bone graft materials in ARP procedures prior to dental implant placement. However, the high degree of heterogeneity across studies underscores the sensitivity and variability of these findings. Further randomized controlled trials with larger sample sizes and longer follow-ups are required to corroborate these findings.

References: [1] Santos, A.; Botelho, J.; Machado, V.; Borrecho, G.; Proença, L.; Mendes, J.J.; Mascarenhas, P.; Alcoforado, G. Autogenous Mineralized Dentin versus Xenograft granules in Ridge Preservation for Delayed Implantation in Post-extraction Sites: A Randomized controlled clinical trial with an 18 months follow-up. *Clin. Oral Implants Res.* 2021, 32, 905–915. [2] Qin, C.; Brunn, J.C.; Cadena, E.; Ridall, A.; Tsujigawa, H.; Nagatsuka, H.; Nagai, N.; Butler, W. The Expression of Dentin Sialophosphoprotein Gene in Bone. *J. Dent. Res.* 2002, 81, 392–394. [3] Yoshida, T.; Vivatbutsiri, P.; Morriss-Kay, G.; Saga, Y.; Iseki, S. Cell lineage in mammalian craniofacial mesenchyme. *Mech. Dev.* 2008, 125, 797–808. [4] Canto-Diaz, A.; De Elío-Oliveros, J.; Del Canto-Diaz, M.; Alobera-Gracia, M.; Del Canto-Pingarron, M.; Martínez-González, J. Use of autologous tooth derived graft material in the post-extraction dental socket. Pilot study. *Med. Oral Patol. Oral Cir. Bucal* 2018, 24, e53. [5] Yeomans, J.D.; Urist, M.R. Bone induction by decalcified dentine implanted into oral, osseous and muscle tissues. *Arch. Oral Biol.* 1967, 12, 999–1006, IN3–IN4, 1007–1008, IN5–IN6. [6] Artzi, Z.; Netanel, E.; Renert, U. Autogenous Particulate Dentin in Socket Site Preservation Procedures: Histologic and Histomorphometric Observations. *Int. J. Oral Maxillofac. Implants* 2022, 37, 373–380. [7] Andrade, C.; Camino, J.; Nally, M.; Quirynen, M.; Martínez, B.; Pinto, N. Combining autologous particulate dentin, L-PRF, and fibrinogen to create a matrix for predictable ridge preservation: A pilot clinical study. *Clin. Oral Invest.* 2020, 24, 1151–1160. [8] Elfana, A.; El-Kholy, S.; Saleh, H.A.; Fawzy El-Sayed, K. Alveolar ridge preservation using autogenous whole-tooth versus demineralized dentin grafts: A randomized controlled clinical trial. *Clin. Oral Implants Res.* 2021, 32, 539–548.