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Postoperative Oral Corticosteroids to Control Pain and Swelling Following Dentoalveolar, Periodontal, and Implant Surgery: A Systematic Review

by

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Focused Clinical Question: In generally healthy patients receiving third molar, periodontal, or dental implant surgery, do postoperative oral corticosteroids effectively limit pain and swelling compared with placebo or alternative medications?

Clinical Scenario: In September of 2020, a 23-year-old male with history of traumatic loss of teeth #8 and 9 in a playground accident at age ten presents to the Army Postgraduate Dental School, Fort Gordon, Georgia, in good general and periodontal health, complaining of an unesthetic smile. He reports no systemic conditions, allergies, or medications. Examination reveals a moderate horizontal alveolar ridge deficiency in the maxillary anterior (Figs. 1 and 2). The dentition is minimally restored, and the patient desires dental implant therapy. After completing a consent process involving verbal and written components, the patient elects alveolar ridge augmentation (Figs. 3 through 7). The practitioner considers postoperative oral corticosteroids to minimize pain and discomfort but instead administers 8 mg of intravenous dexamethasone immediately prior to the procedure. The patient reports minimal postoperative discomfort and swelling through the first postoperative week (Fig. 8). Favorable alveolar ridge dimensions for implant placement were appreciated three months following the procedure (Fig. 9).

Keywords: steroids, dexamethasone, methylprednisolone, analgesia, pain management, patient reported outcome measures

Background

In periodontics, as in virtually all surgical disciplines, clinicians over the last several decades have increasingly attended to patient-centered as well as clinical therapeutic outcomes.[4,5] In addition to retention of healthy natural teeth, comfortable function, and successful replacement of missing teeth, our patients also seek to avoid perioperative discomfort, minimize treatment time, hasten return to normal activities, and optimize esthetics.[4-13] Postoperative pain and swelling can be particularly distressing, with the potential to alter the patient's acceptance of future treatment.[13] In a recent retrospective analysis of 3900 oral, periodontal, and implant surgeries, dentinal hypersensitivity (6%) and excessive pain (4%) were the most frequent postoperative complications.[6] Factors such as procedural complexity,[7] surgery duration,[8-10] and operator experience[9] have positively correlated with postoperative morbidity following various intraoral procedures.

Intuitively, certain procedures in periodontics may more likely produce excessive postoperative discomfort, and limited evidence supports this assumption. For example, in a multivariate analysis of 304 consecutive periodontal procedures, mucogingival surgery was associated with 6 and 3.5 times more pain, compared with gingivectomy and osseous surgery, respectively.[10] Augmentation procedures utilizing periosteal releasing incisions (PRIs) to achieve wound closure have also been associated with postoperative swelling and discomfort.[11] In a randomized controlled clinical trial, variants of the standard PRI technique produced significantly less postoperative discomfort without concomitant reduction in swelling.[11]

Corticosteroids represent a class of anti-inflammatory medications with wide applicability in medicine and dentistry. Although clinicians in various dental disciplines have utilized perioperative corticosteroids to some degree, most data on this topic originates from investigators providing third molar surgery (TMS), and multiple formulations, dosages, routes, and sites of administration have been assessed.[1,2,14-24] Apart from use in dentoalveolar surgery, authors have proposed perioperative corticosteroids for reducing discomfort and swelling following surgical treatment of periodontitis, palatal graft procedures, dental implant surgery, and endodontic therapy.[25-33]

A conveniently packaged oral methylprednisolone taper‡ is an attractive commercially available option for periodontists seeking to limit postsurgical morbidity.[34] Moreover, use of this regimen in the acute management of sports injuries[35] suggests potential benefit for patients receiving intraoral surgical procedures. Few studies, however, specifically assess the efficacy of postoperative oral corticosteroid regimens in the absence of preemptive dosing[36-38] or evaluate the effect of corticosteroids on patient-centered outcomes following procedures commonly provided in contemporary periodontics.[25-30] Our purpose was to assess evidence supporting postoperative oral corticosteroids for reduction of pain and swelling following third molar, periodontal, or dental implant surgery.

Search Strategy

In accordance with PRISMA guidelines,[39] two reviewers (JW and TJ) independently conducted a comprehensive literature search of the PubMed/MEDLINE and Cochrane databases in January of 2021 with the following terms forming the basis of the search strategy

("mh" indicates MeSH heading, "tw" indicates text word, and "*" indicates root word search): (periodont* [tw] OR free gingival graft [tw] OR gingival graft OR palatal graft [tw] OR connective tissue graft [tw] OR root coverage [tw] OR gingival augmentation [tw] OR sinus elevation [tw] OR ridge augmentation [tw] OR guided bone regeneration [tw] OR guided tissue regeneration [tw] OR osseous surgery [tw] OR resective surgery [tw] OR crown lengthening [tw] OR third molar [tw] OR dentoalveolar [tw] OR dento-alveolar [tw] OR dental implants [mh]) AND (postoperative [tw] OR post-operative [tw] OR postsurgical [tw] OR post-surgical [tw]) AND (corticosteroid* [mh] OR steroid* [mh] OR prednisolone [mh] OR methylprednisolone [mh] OR dexamethasone [mh] OR betamethasone [mh] OR prednisone [mh]). To locate articles not captured in our database search, we appraised the bibliographies of the full-text articles selected for screening as well as previous systematic reviews. Additionally, we manually searched relevant journals (Table 1).

Inclusion / Exclusion Criteria and Data Collection

For this analysis, we included controlled human clinical studies comparing the efficacy of postoperative oral corticosteroids to other medications and/or placebo following third molar, periodontal, or dental implant surgery. Pain, swelling, or both needed to be assessed during the postoperative period. We excluded uncontrolled studies, studies utilizing nonoral routes of administration, studies combining oral corticosteroids with adjunctive ultrasound or laser therapy, studies involving only preemptive corticosteroid dosing, studies involving facial trauma or orthognathic surgery, studies involving nonsurgical endodontic therapy, case reports, surveys, opinion articles, animal studies, and in vitro studies. Two reviewers (JW and TJ)

screened titles and abstracts, and disagreements were resolved through discussion with the senior author (WG). We applied eligibility criteria to the selected full text articles.

Risk of Bias Assessment

We utilized version two of the Cochrane risk-of-bias tool for assessing risk of bias at the study level.[40] Based on assessment of five bias domains, we assigned one of three risk levels for each included study—low risk of bias, some concerns, or high risk of bias.

Search Outcome

The outcome of our search is summarized in Fig. 10. Our database and manual searches identified 129 and 138 records, respectively. After removing 50 duplicates, we screened 217 records and selected 84 articles for full-text review. Of these, 74 articles were excluded, and 10 were included in the qualitative synthesis (Table 2).[22-24,27-30,36-38] Heterogeneity among included studies in surgical procedures performed, corticosteroid regimens, and outcome assessment methods precluded pooling of data for meta-analysis.

Characteristics of Included Studies

Publications meeting inclusion criteria consisted of ten randomized controlled clinical trials. Oral corticosteroid regimens assessed included dexamethasone,[24,27-30,36,37] betamethasone,[38] and methylprednisolone.[22,23] Seven studies utilized preemptive in addition to postoperative dosing.[22-24,27-30] Pain and/or swelling was assessed after TMS in six studies, [22-24,36-38] coronally advanced flap with connective tissue graft in one study,[27] implant placement in one study,[28] and open flap debridement in two studies.[29,30] Only three of ten studies assessed

in this review[36-38] utilized postoperative oral steroids only—without preemptive dosing—and all ten studies presented high risk of bias.[22-24,27-30,36-38] Included studies involved a total of 634 participants. Findings of individual studies are summarized in Table 2.

Discussion

The purpose of this report was to assess available evidence supporting postoperative oral corticosteroids to limit pain and swelling after intraoral surgical procedures. All studies included in this review reported at least one statistically significant benefit of postoperative oral corticosteroids for reduction of pain and/or swelling following dentoalveolar, periodontal, or dental implant surgery.[22-24,27-30,36-38] In some studies, oral corticosteroids were not superior to placebo or an NSAID for all outcomes of interest.[27,28,30,37,38]

To produce insensibility to postsurgical pain without loss of consciousness, an analgesic medication must modify at least one of three processes: production of noxious inflammatory products at the injured site, nociception, or central pain perception.[41] Moreover, targeting more than one of these pillars may reduce postsurgical pain additively or synergistically.[41,42] Corticosteroid effects on pain are complex. These medications reliably reduce levels of inflammatory mediators, limiting fluid transudation and edema.[1,2,43] In fact, reducing tissue tension, thus lessening tension-induced pain, may represent the predominant mechanism for corticosteroid-mediated postoperative analgesia.[1,2,43] In rodent models, investigators have reported conflicting effects of corticosteroids on nociception, some authors finding no influence.[44-47] Owing to suppression of β-endorphin levels, corticosteroids may exert a negative

influence on central pain perception.[2,48,49] Indeed, dexamethasone antagonizes some forms of environmentally-induced analgesia (EIA).[48]

While some authors suggest that co-therapy using a corticosteroid and an NSAID may reduce pain synergistically,[2,3] concomitant use of these medications may elevate risk of untoward gastrointestinal effects, especially when other risk factors are present.[50-52] Five studies meeting our inclusion criteria compared analgesia produced with steroids versus NSAIDs, with variable findings.[27,28,30,36,38] Chopra and colleagues found that patients receiving ibuprofen following TMS experienced statistically significant analgesia, relative to placebo, earlier than those receiving betamethasone.[38] The NSAID but not the corticosteroid produced statistically significant pain reduction on the day of surgery.[38] Consistent with this finding, Pillatti and coworkers assessed, at one-hour intervals, immediate pain following periodontal surgery and reported that oral dexamethasone was superior to placebo at only one time point.[30] Conversely, celecoxib compared with control produced statistically greater analgesia over the first four postoperative hours.[30]

Oral surgeons have extensively studied various perioperative corticosteroid regimens in the setting of dentoalveolar surgery.[1,2,14-24] Perioperative corticosteroids have consistently reduced pain, swelling, and trismus following TMS. [1,2,14-24] Superior results have been associated with parenteral rather than enteral and preoperative rather than postoperative corticosteroid administration.[1] Nevertheless, optimal medications, doses, and routes/timing of administration remain unclear.[1,2,53] Moreover, although TMS is considered a reliable and representative model for acute postsurgical pain,[1,54] few direct assessments of corticosteroid

effects following periodontal or implant procedures are available.[27-30] Additionally, we identified only three studies in the dental literature assessing postoperative oral steroids without any preemptive enteral or parenteral dosing.[36-38]

Clinical Bottom Line

Evidence supporting postoperative oral corticosteroids for the described purpose appears limited, with high risk of bias for all relevant studies. Thus, practitioners must exercise caution in drawing conclusions from the available data. However, the broader TMS literature, which is unconstrained by timing and route of administration, indicates that various corticosteroid regimens have consistently reduced pain, swelling, and trismus following TMS.[1,2,14-24] Superior results have been associated with parenteral rather than enteral and preoperative rather than postoperative corticosteroid administration.[1] Accordingly, based on indirect evidence, practitioners providing periodontal or dental implant surgery may consider preemptive and parenteral corticosteroid administration to maximize patient benefit.

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Footnotes

‡Medrol Dosepak, Pfizer, New York, NY

References

1. Herrera-Briones FJ, Prados Sa´nchez E, Reyes Botella C, Vallecillo Capilla M. Update on the use of corticosteroids in third molar surgery: systematic review of the literature. *Oral Surg Oral Med Oral Pathol Oral Radiol* 2013;116:e342–e351.

2. Ngeow WC, Lim D. Do corticosteroids still have a role in the management of third molar surgery?. *Adv Ther* 2016;33:1105-1139.

3. Jarrah MH, Al-Rabadi HF, Imrayan M, Al-share' AA. Single dose of dexamethasone with or without ibuprofen effects on post-operative sequelae of lower third molar surgical extraction. *J R Med Serv* 2015;22:41–45.

4. Zangrando MS, Eustachio RR, de Rezende ML, Sant'ana AC, Damante CA, Greghi SL. Clinical and patient-centered outcomes using two types of subepithelial connective tissue grafts: A split-mouth randomized clinical trial. [published online ahead of print September 30, 2020]. *J Periodontol*; doi:10.1002/JPER.19-0646.

5. Ribeiro FV, Casarin RC, Palma MA, Júnior FH, Sallum EA, Casati MZ. Clinical and patient-centered outcomes after minimally invasive non-surgical or surgical approaches for the treatment of intrabony defects: A randomized clinical trial. *J Periodontol* 2011;82:1256-1266.

6. Askar H, Di Gianfilippo R, Ravida A, Tattan M, Majzoub J, Wang H-L. Incidence and severity of postoperative complications following oral, periodontal, and implant surgeries: A retrospective study. *J Periodontol* 2019;90:1270–1278.

7. Bui CH, Seldin EB, Dodson TB. Types, frequencies, and risk factors for complications after third molar extraction. *J Oral Maxillofac Surg* 2003;61:1379-1389.

8. Tan WC, Krishnaswamy G, Ong MM, Lang NP. Patient-reported outcome measures after routine periodontal and implant surgical procedures. *J Clin Periodontol* 2014;41:618-624.

9. López A, Nart J, Santos A, Alcázar J, Freixa O. Assessment of morbidity after periodontal resective surgery. *J Periodontol* 2011;82:1563-1569.

10. Curtis Jr JW, McLain JB, Hutchinson RA. The incidence and severity of complications and pain following periodontal surgery. *J Periodontol* 1985;56:597-601.

11. Zazou N, Diab N, Bahaa S, El Arab AE, Aziz OA, El Nahass H. Clinical comparison of different flap advancement techniques to periosteal releasing incision in guided bone regeneration: A randomized controlled trial. *Clin Implant Dent Rel Res* 2021;23:107-116.

12. Shah EB, Modi BB, Shah MA, Dave DH. Patient Centered Outcomes in Periodontal Treatment-An Evidenced Based Approach. *J Clin Diagn Res* 2017;11:ZE05. doi:10.7860/JCDR/2017/24260.9631.

13. Tavelli L, Barootchi S, Di Gianfilippo R, et al. Patient experience of autogenous soft tissue grafting has an implication for future treatment: A 10 to 15-year cross-sectional study. [published online ahead of print September 18, 2020]. *J Periodontol*; doi:10.1002/JPER.20-0350.

14. Baxendale BR, Vater M, Lavery KM. Dexamethasone reduces pain and swelling following extraction of third molar teeth. *J Anesth* 1993;48:961-964.

15. Graziani F, D'Aiuto F, Arduino PG, Tonelli M, Gabriele M. Perioperative dexamethasone reduces post-surgical sequelae of wisdom tooth removal. A split-mouth randomized double-masked clinical trial. *Int J Oral Maxillofac Surg* 2006;35:241-246.

16. Holland CS. The influence of methylprednisolone on post-operative swelling following oral surgery. *Br J Oral Maxillofac Surg* 1987;25:293-299.

17. Moore PA, Brar P, Smiga ER, Costello BJ. Preemptive rofecoxib and dexamethasone for prevention of pain and trismus following third molar surgery. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod* 2005;99:E1-E7. https://doi.org/10.1016/j.tripleo.2004.08.028.

18. Grossi GB, Maiorana C, Garramone RA, Borgonovo A, Beretta M, Farronato D, Santoro F. Effect of submucosal injection of dexamethasone on postoperative discomfort after third molar surgery: a prospective study. *J Oral Maxillofac Surg* 2007;65:2218-2226.

19. Moraschini V, Hidalgo R. Effect of submucosal injection of dexamethasone after third molar surgery: a meta-analysis of randomized controlled trials. *Int J Oral Maxillofac Surg* 2016;45:232-240.

20. Chen Q, Chen J, Hu B, Feng G, Song J. Submucosal injection of dexamethasone reduces postoperative discomfort after third-molar extraction: A systematic review and meta-analysis. *J Am Dent Assoc* 2017;148:81-91.

21. Markiewicz MR, Brady MF, Ding EL, Dodson TB. Corticosteroids reduce postoperative morbidity after third molar surgery: a systematic review and meta-analysis. *J Oral Maxillofac Surg* 2008;66:1881-1894.

22. Christensen J, Matzen LH, Vaeth M, Wenzel A, Schou S. Efficiency of bupivacaine versus lidocaine and methylprednisolone versus placebo to reduce postoperative pain and swelling after surgical removal of mandibular third molars: a randomized, double-blinded, crossover clinical trial. *J Oral Maxillofac Surg* 2013;71:1490-1499.

23. Schultze-Mosgau S, Schmelzeisen R, Frölich JC, Schmele H. Use of ibuprofen and methylprednisolone for the prevention of pain and swelling after removal of impacted third molars. *J Oral Maxillofac Surg* 1995;53:2-7.

24. Schmelzeisen R, Frölich JC. Prevention of postoperative swelling and pain by dexamethasone after operative removal of impacted third molar teeth. *Eur J Clin Pharmacol* 1993;44:275-277.

25. Berridge JP, Johnson TM, Cheng AW, Swenson DT, Miller Jr PD. Focus on epithelialized palatal grafts. Part 3: Methods to enhance patient comfort at palatal donor sites. *Clin Adv Periodontics* 2019;9:177-184.

26. Steffens JP, Santos FA, Sartori R, Pilatti GL. Preemptive dexamethasone and etoricoxib for pain and discomfort prevention after periodontal surgery: A double-masked, crossover, controlled clinical trial. *J Periodontol* 2010;81:1153-1160.

27. Giorgetti AP, Matos RD, Casarin RC, Pimentel SP, Cirano FR, Ribeiro FV. Preemptive and postoperative medication protocols for root coverage combined with connective tissue graft. *Braz Dent J* 2018;29:23-29.

28. Bahammam MA, Kayal RA, Alasmari DS, et al. Comparison between dexamethasone and ibuprofen for postoperative pain prevention and control after surgical implant placement: A double-masked, parallel-group, placebo-controlled randomized clinical trial. *J Periodontol* 2017;88:69-77.

29. Steffens JP, Santos FA, Pilatti GL. Postoperative periodontal pain prevention using two dexamethasone medication protocols: a double-blind, parallel-group, placebo-controlled randomized clinical trial. *Am J Dent* 2011;24:354-356.

30. Pilatti GL, André dos Santos F, Bianchi A, Cavassim R, Tozetto CW. The use of celecoxib and dexamethasone for the prevention and control of postoperative pain after periodontal surgery. *J Periodontol* 2006;77:1809-1814.

31. Nagendrababu V, Pulikkotil SJ, Jinatongthai P, Veettil SK, Teerawattanapong N, Gutmann JL. Efficacy and safety of oral premedication on pain after nonsurgical root canal treatment: a systematic review and network meta-analysis of randomized controlled trials. *J Endod* 2019;45:364-371.

32. Jorge-Araújo AC, Bortoluzzi MC, Baratto-Filho F, Santos FA, Pochapski MT. Effect of premedication with anti-inflammatory drugs on post-endodontic pain: a randomized clinical trial. *Braz Dent J* 2018;29:254-260.

33. Praveen R, Thakur S, Kirthiga M. Comparative evaluation of premedication with ketorolac and prednisolone on postendodontic pain: a double-blind randomized controlled trial. *J Endod* 2017;43:667-673.

34. Tarnow DP, Wallace SS, Froum SJ, Rohrer MD, Cho SC. Histologic and clinical comparison of bilateral sinus floor elevations with and without barrier membrane placement in 12 patients: part 3 of an ongoing prospective study. *Int J Periodontics Restorative Dent* 2000;20:116-125.

35. Langer P, Fadale P, Hulstyn M, Fleming B, Brady M. Survey of orthopaedic and sports medicine physicians regarding use of medrol dosepak for sports injuries. *Arthroscopy* 2006;22:1263-1269.

36. Lima CAA, Favarini VT, Torres AM, da Silva RA, Sato FRL. Oral dexamethasone decreases postoperative pain, swelling, and trismus more than diclofenac following third molar removal: a randomized controlled clinical trial. *Oral Maxillofac Surg* 2017;21:321-326.

37. Sabhlok S, Kenjale P, Mony D, Khatri I, Kumar P. Randomized controlled trial to evaluate the efficacy of oral dexamethasone and intramuscular dexamethasone in mandibular third molar surgeries. *J Clin Diagn Res* 2015;9: ZC48–ZC51. doi: 10.7860/JCDR/2015/13930.6813.

38. Chopra D, Rehan HS, Mehra P, Kakkar AK. A randomized, double-blind, placebo-controlled study comparing the efficacy and safety of paracetamol, serratiopeptidase, ibuprofen and betamethasone using the dental impaction pain model. *Int J Oral Maxillofac Surg* 2009;38:350-355.

39. Moher D, Liberati A, Tetzlaff J, Altman DG; PRISMA Group. Preferred reporting items for systematic reviews and meta-analyses: The PRISMA statement. *J Clin Epidemiol* 2009;62:1006-1012.

40. Sterne JA, Savović J, Page MJ, et al. RoB 2: a revised tool for assessing risk of bias in randomised trials. *Br Med J* 2019;366:14898. doi: https://doi.org/10.1136/bmj.l4898

41. Laskin DM. Application of current pain management concepts to the prevention and management of postoperative pain. *J Am Dent Assoc* 2013;144:284-286.

42. Derry CJ, Derry S, Moore RA. Single dose oral ibuprofen plus paracetamol (acetaminophen) for acute postoperative pain. *Cochrane Database Syst Rev* 2013;6:CD010210. https://doi.org/10.1002/14651858.CD010210.pub2.

43. Ata-Ali Mahmud FJ, Ata-Ali Mahmud F, Peñarrocha Oltra D, Peñarrocha Diago M. Corticosteroids use in controlling pain, swelling and trismus after lower third molar surgery. *J Clin Exp Dent* 2011;3:469-475.

44. Kingery WS, Castellote JM, Maze M. Methylprednisolone prevents the development of autotomy and neuropathic edema in rats, but has no effect on nociceptive thresholds. *Pain* 1999;80:555-566.

45. Hamm RJ, Knisely JS. Ontogeny of an endogenous nonopioid and hormonally mediated analgesic system, *Dev Psychobiol* 1987;20:539–548.

46. Ratka A, Veldhuis HD, DeKloet ER. Corticosteroid effects on morphine-induced antinociception as a function of two types of corticosteroid receptors in brain. *Neuropharmacology* 1988;27:15–21.

47. Pieretti S, Capasso A, DiGiannuario A, Loizzo A, Sorrentino L. The interaction of peripherally and centrally administered dexamethasone and RU 38486 on morphine analgesia in mice. *Gen Pharmacol* 1991;22:929–933.

48. MacLennan AJ, Drugan RC, Hyson RL, Maier SF, Madden J, Barchas JD. Corticosterone: a critical factor in an opioid form of stress-induced analgesia. *Science* 1982;215:1530–1532.

49. Hargreaves KM, Shmidt EA, Mueller GP, Dionne RA. Dexamethasone alters plasma levels of beta-endorphin and post-operative pain. *Clin Pharmacol Ther* 1987;42:601–607.

50. Piper JM, Ray WA, Daugherty JR, Griffin MR. Corticosteroid use and peptic ulcer disease: role of nonsteroidal anti-inflammatory drugs. *Ann Intern Med* 1991;114:735-740.

51. Russell RI. Defining patients at risk of non-steroidal anti-inflammatory drug gastropathy. *Ital J Gastroenterol Hepatol* 1999;31:S14-S18.

52. Chan FK, Graham DY. Prevention of non-steroidal anti-inflammatory drug gastrointestinal complications–review and recommendations based on risk assessment. *Aliment Pharmacol Ther* 2004;19:1051-1061.

53. Salerno, A, Hermann, R. Efficacy and safety of steroid use for postoperative pain relief: update and review of the medical literature. *J Bone Joint Surg* 2006; 88:1361-1372.

54. Meechan JG, Seymour RA. The use of third molar surgery in clinical pharmacology. *Br J Oral Maxillofac Surg* 1993;31:360-365.

Figures

FIGURE 1 Baseline clinical appearance, facial view. We noted a moderate horizontal alveolar ridge deficiency in the maxillary incisor area. After a thorough review of treatment options, the patient elected guided bone regeneration under moderate sedation for site development prior to dental implant placement.

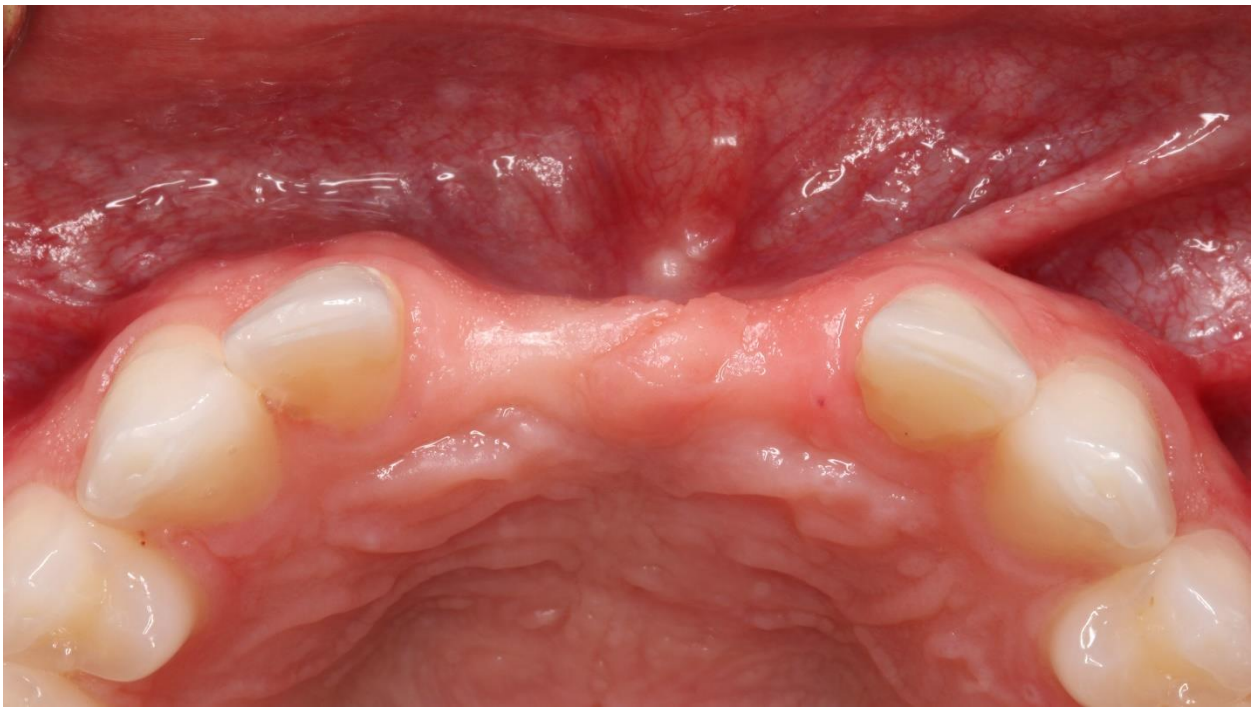

FIGURE 2 Baseline clinical appearance, occlusal view. Guided bone regeneration involves a periosteal releasing incision to achieve wound closure, increasing the potential for postoperative swelling and discomfort. Our plan to minimize pain and swelling included 8 mg intravenous (IV) dexamethasone preoperatively combined with postoperative oral analgesics (800 mg ibuprofen 3 times daily, reserving 5/325 mg oxycodone/acetaminophen for breakthrough pain). Because our patient requested moderate sedation, preemptive IV corticosteroid administration was convenient. Administering corticosteroids preoperatively and through an IV route may enhance efficacy.[1] Our patient lacked any risk factor for peptic ulcer disease. Providing a single preemptive corticosteroid dose with a postoperative oral nonsteroidal anti-inflammatory drug may reduce pain synergistically while minimizing risk of gastrointestinal side effects.[2,3]

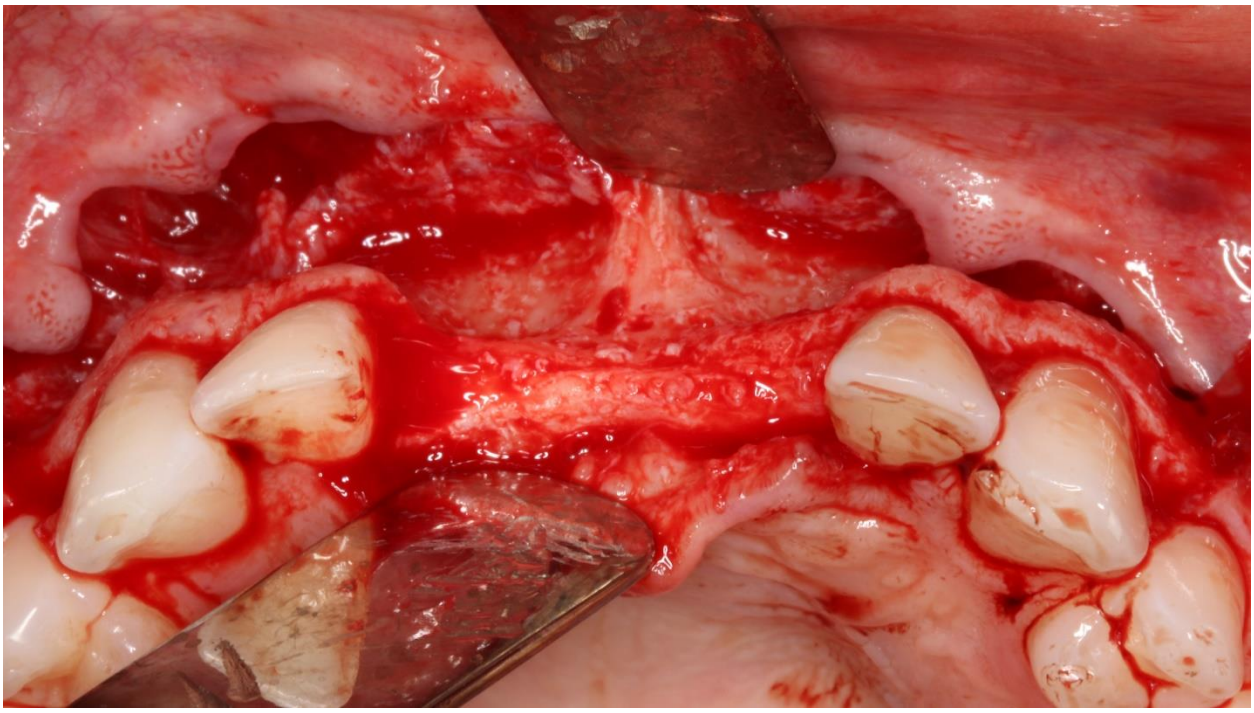

FIGURE 3 Alveolar ridge deficiency.

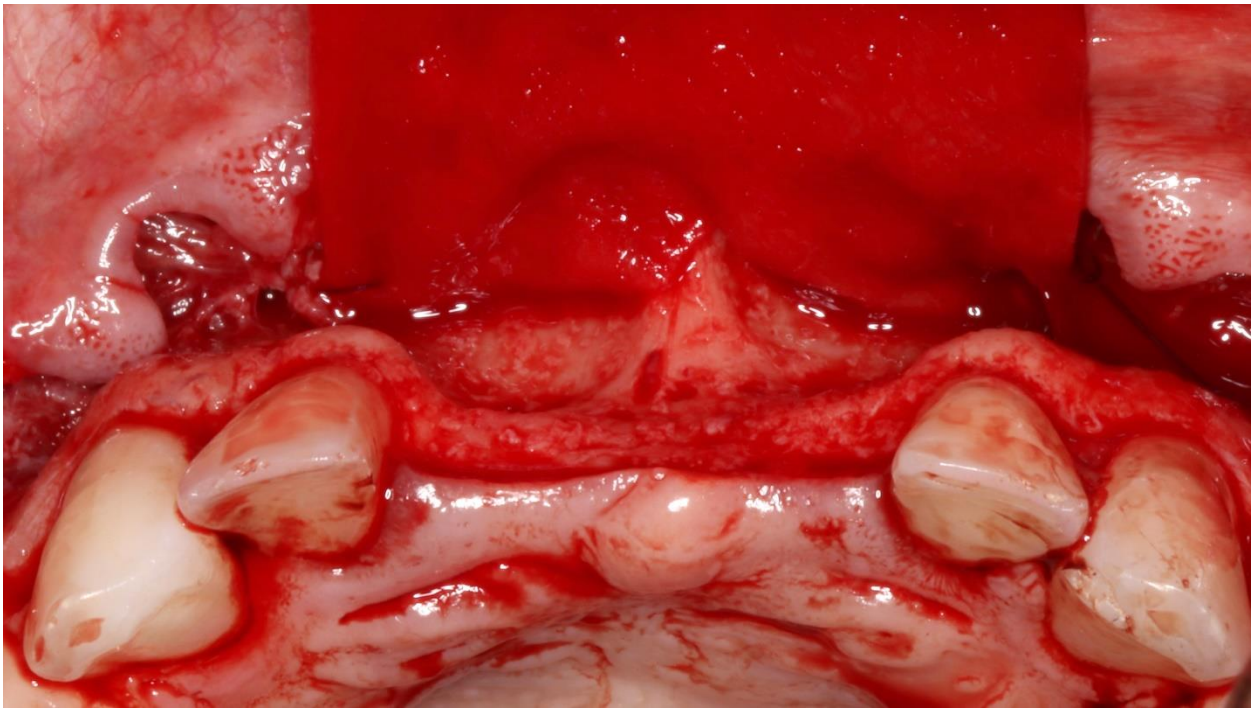

FIGURE 4 Barrier membrane fixed apically.

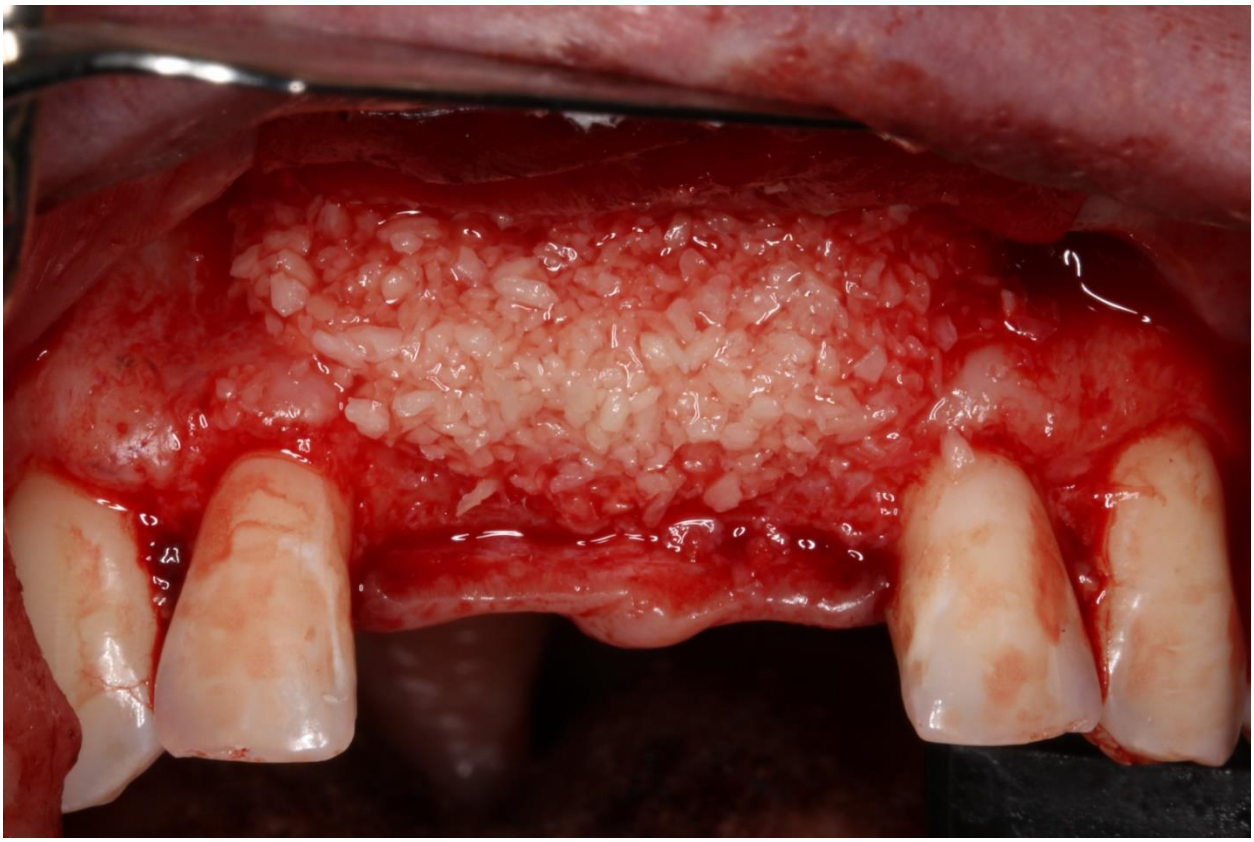

FIGURE 5 Graft applied.

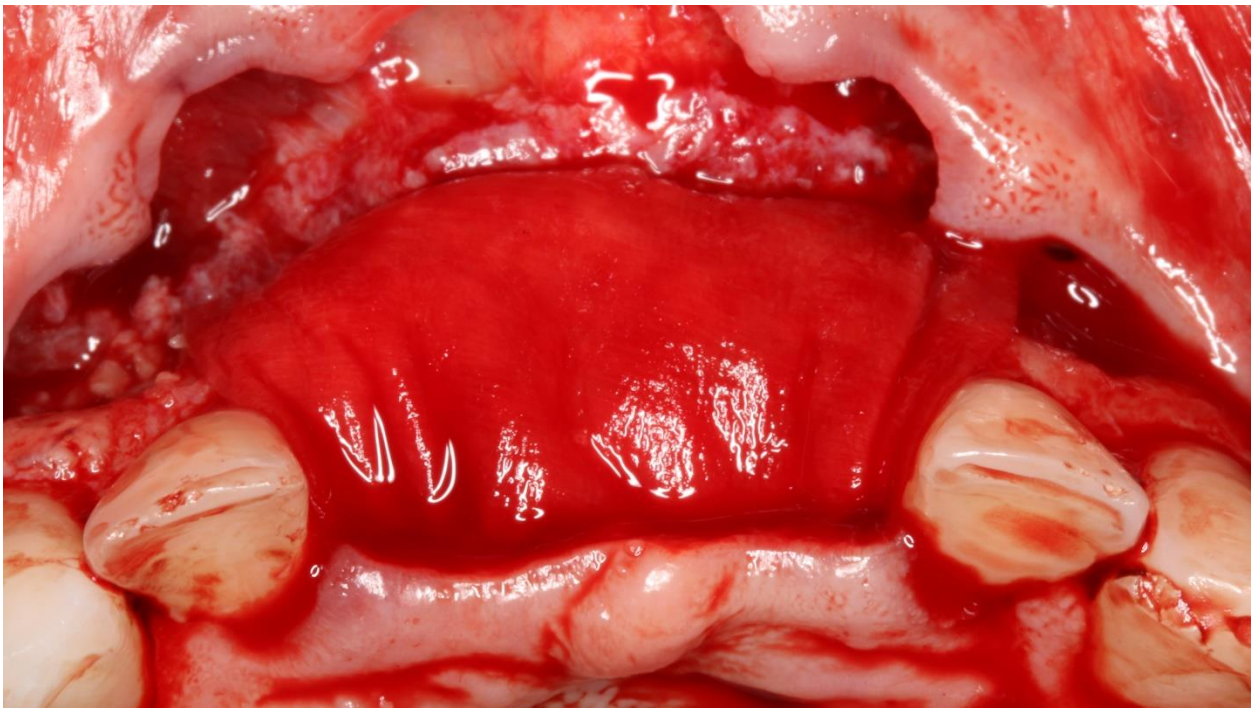

FIGURE 6 Membrane stabilized.

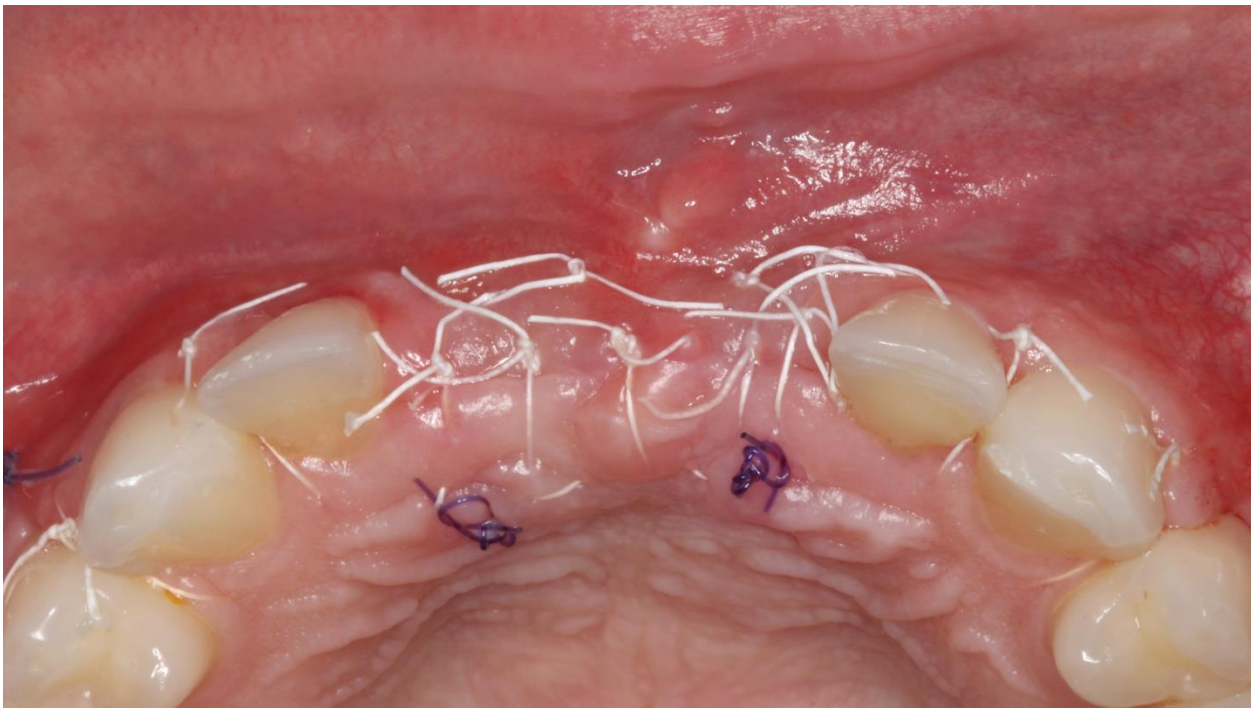

FIGURE 7 Wound closure for primary intention healing.

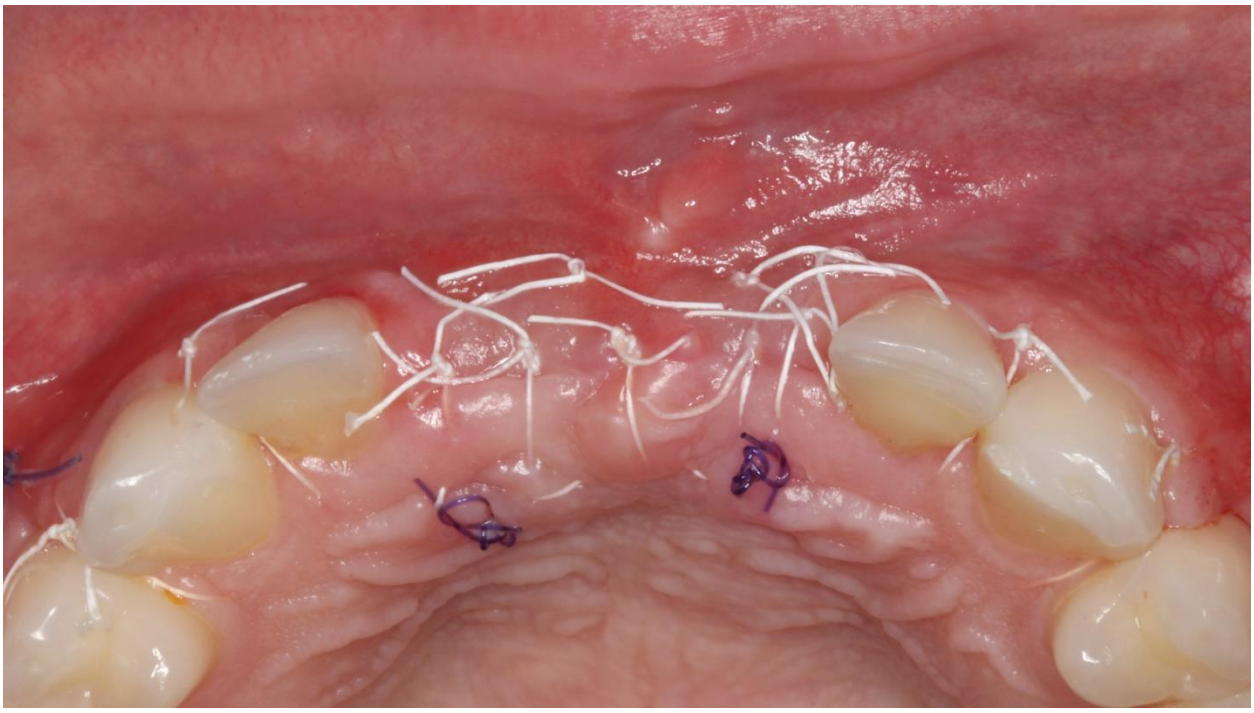

FIGURE 8 Clinical appearance at postoperative week one. The patient reported minimal swelling and discomfort, without any need for an opioid analgesic.

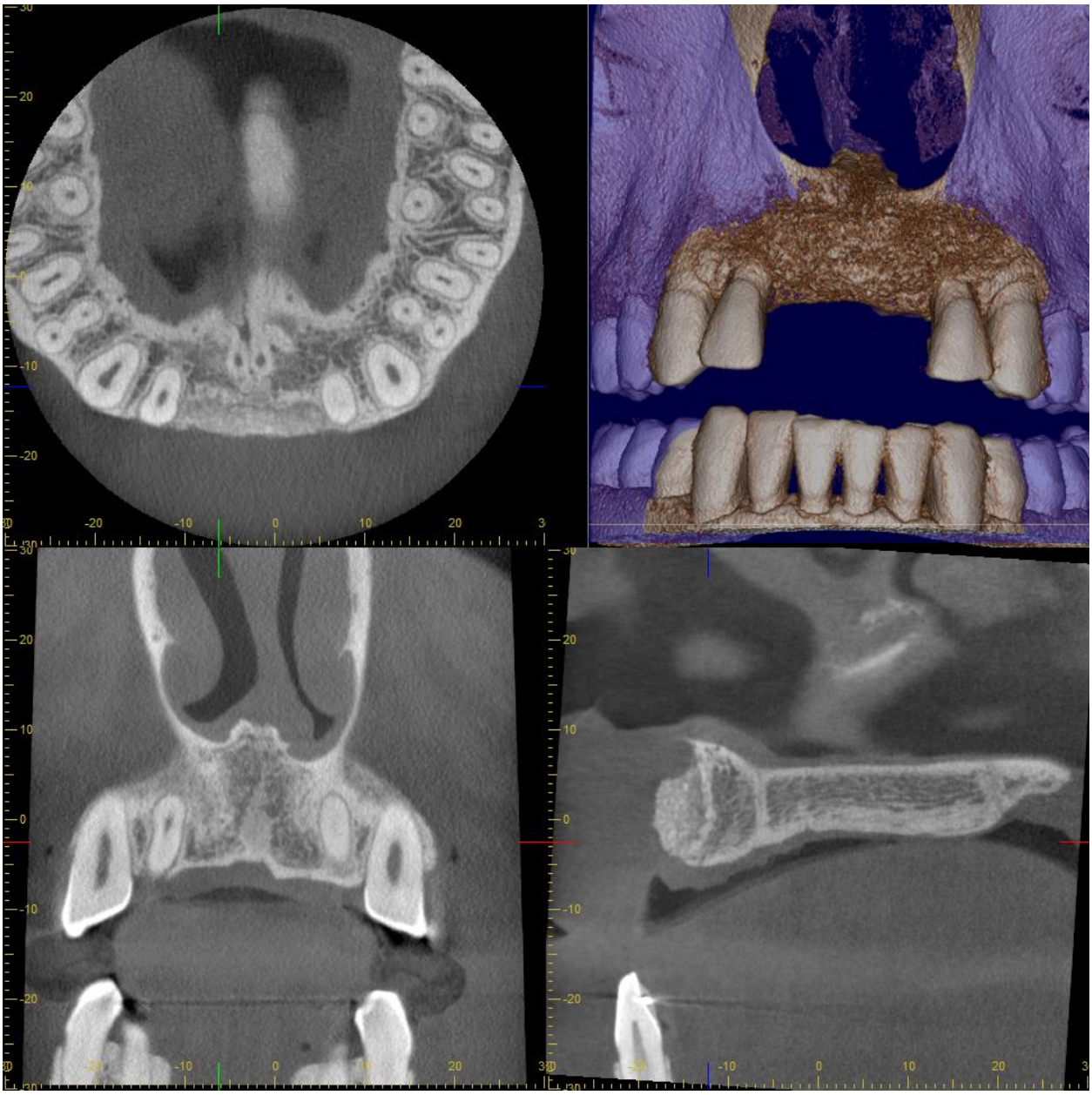

FIGURE 9 Cone-beam computed tomography volume approximately three months following alveolar ridge augmentation.

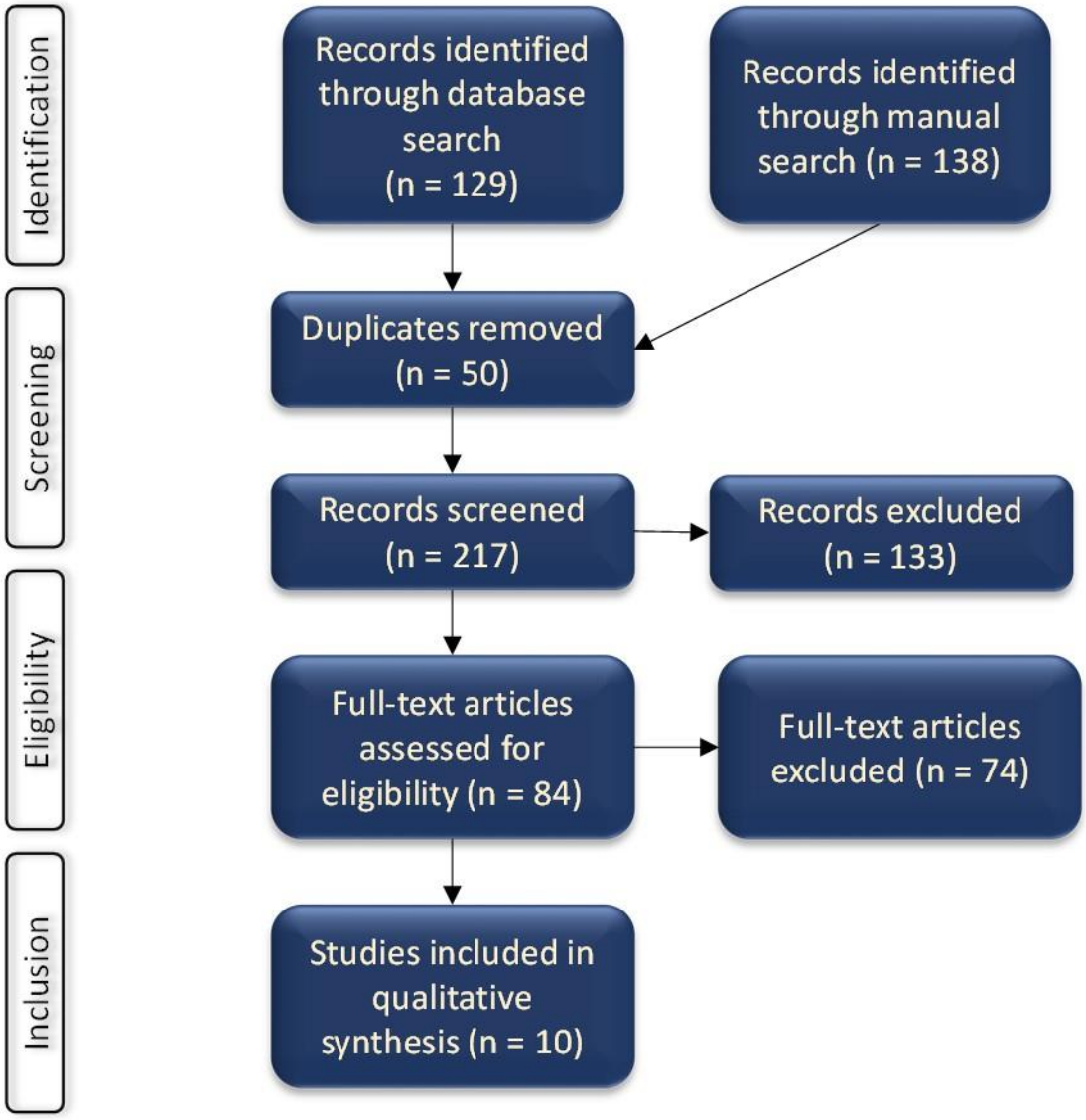

FIGURE 10 Schematic of search strategy.