References

As of September 5th, 2025

Basic study

1. **Bone Substitute Fabrication Based on Dissolution-Precipitation Reactions**. Ishikawa K. 2010. Materials. 3:1138-1155.
2. **Fabrication of low crystalline B-type carbonate apatite block from low crystalline calcite block**. Ishikawa K, Matsuya S, Kin X, Lei Z, Yuasa T, Miyamoto Y. 2010. Journal of the Ceramic Society of Japan. 118(5):341-344.
3. **Effects of low crystalline carbonate apatite on proliferation and osteoblastic differentiation of human bone marrow cells**. Nagai H, Kobayashi-Fujioka M, Fujisawa K, Ohe G, Takamaru N, Hara K, Uchida D, Tamatani T, Ishikawa K, Miyamoto Y. 2015. J Mater Sci Mater Med. 26(2):99.
4. **In vivo evaluation of carbonate apatite in canine peri-implant model**. Shigemitsu Y, Yamanaka K, Kato S, Yamamoto K, Masuda H, Ishihara Y, Funabashi H, Kumagai T. 2017. 95th General Session & Exhibition of the IADR. 2845.
5. **Evaluation of synthetic carbonate apatite bone substitute: A Preliminary study in dog**. Yamanaka K, Shigemitsu Y, Kato S, Yamamoto K, Kumagai T. 2017. American Academy of Periodontology 2017 Annual Meeting. 178.
6. **In vivo evaluation of carbonate apatite granule in rabbit femoral defect model**. Masuda H, Shigemitsu Y, Yamamoto K, Yamanaka K, Ishihara Y, Kumagai T. 2017. The 65th Annual Meeting of Japanese Association for Dental Research. 051.
7. **Biological evaluation of carbonated apatite granules for use as bone graft substitutes**. Yamanaka K, Shigemitsu Y, Masuda H, Ishihara Y, Kumagai T. 2018. EuroPerio 9. PR554.
8. **Compositional and histological comparison of carbonate apatite fabricated by dissolution-precipitation reaction and Bio-Oss**. Fujisawa K, Akita K, Fukuda N, Kamada K, Kudoh T, Ohe G, Mano T, Tsuru K, Ishikawa K, Miyamoto Y. 2018. J Mater Sci Mater Med. 29:121.
9. **In vivo evaluation of carbonate apatite in dog mandibular bone**. Shigemitsu Y, Yamanaka K, Yamamoto K, Masuda H, Ishihara Y, Kumagai T. 2018. 96th General Session & Exhibition of the IADR. 2798.
10. **In vivo and in vitro evaluation of carbonate apatite in canine peri-implant model**. Suzuki T, Shigemitsu Y, Yamamoto K, Masuda H, Ishihara Y, Yamanaka K, Kumagi T. 2018. European Association for Osseointegration 27th Annual Scientific Meeting. 12387.
11. **Physical and histological comparison of hydroxyapatite, carbonate apatite, and β-tricalcium phosphate bone substitutes**. Ishikawa K, Miyamoto Y, Tsuchiya A, Hayashi K, Tsuru K, Ohe G. 2018. Materials. 11:1993.
12. **Bone replacement ability of synthetic carbonate apatite bone graft substitute in rabbit femur**. Suzuki T, Shigemitsu Y, Yamamoto K, Masuda H, Ishihara Y, Yamanaka K, Kumagai T. 2019. Academy of Osseointegration 2019 Annual Meeting.

13. **Microvascular Changes and Bone Formation After Carbonate Apatite Granule Graft**. Matsuo M, To M, Okudera T. 2019. 97th General Session & Exhibition of the IADR. 2528.
14. **Bone Regeneration of Canine Peri-implant Defects Using Synthetic Carbonated Apatite**. Tabuchi N, Shigemitsu Y, Yamanaka K, Yamamoto K, Masuda H, Ishihara Y, Kumagai T. 2019. 97th General Session & Exhibition of the IADR. 3179.
15. **Histological comparison of three apatitic bone substitutes with different carbonate contents in alveolar bone defects in a beagle mandible with simultaneous implant installation**. Mano T, Akita K, Fukuda N, Kamada K, Kurio N, Ishikawa K, Miyamoto Y. 2019. J Biomed Mater Res B Appl Biomater. 108(4):1450-1459.
16. **Carbonate apatite bone replacement: learn from the bone**. Ishikawa K. 2019. Journal of the Ceramic Society of Japan. 127(9):595-601.
17. **Morphological study of bone formation and microvascular changes after Carbonate Apatite granules graft**. Matsuo M, Okudera T, To M. 2019. European Association for Osseointegration 28th Annual Scientific Meeting. 15546.
18. **Comparison of the vertical bone defect healing abilities of carbonate apatite, beta-tricalcium phosphate, hydroxyapatite and bovine-derived heterogeneous bone**. Sato N, Handa K, Venkataiah VS, Hasegawa T, Njuguna MM, Yahata Y, Saito M. 2020. Dent Mater J. 39(2):309-318.
19. **Replacement process of carbonate apatite by alveolar bone in rat extraction socket ~In vitro and in vivo analysis using the bone substitute Cytrans Granules~**. Zhang X, Atsuta I, Ayukawa Y, Narimatsu I, Ueda N, Zhang J, Gu J, Kihara M, Koyano K. 2020. Academy of Osseointegration 2020 Annual Meeting.
20. **Effect of Cytrans Granules as a Bone Substitute on Oral Mucosal Healing in Rat Extraction Socket**. Atsuta I, Koyano K, Ayukawa Y, Egashira Y, Narimatsu I, Zhang X, Hu J, Sugi T, Wachi S, Ueda N. 2020. 98th General Session & Exhibition of the IADR. 1335.
21. **Resorption property of Carbonate Apatite Bone Graft Substitute**. Yamanaka K, Shigemitsu Y, Yamamoto K, Tabuchi N, Ishizuka S, Kimura N, Kato S, Kumagai T. 2020. 98th General Session & Exhibition of the IADR. 2510.
22. **The impact of the size of bone substitute granules on macrophage and osteoblast behaviors in vitro**. Fujioka-Kobayashi M, Katagiri H, Kono M, Schaller B, Iizuka T, Safi AF. 2021. Clin Oral Invest. 25:4949-4958.
23. **Replacement Process of Carbonate Apatite by Alveolar Bone in a Rat Extraction Socket**. Zhang X, Atsuta I, Narimatsu I, Ueda N, Takahashi R, Egashira Y, Zhang J, Gu J, Koyano K, Ayukawa Y. 2021. Materials. 14:4457.
24. **Effect of carbonate apatite as a bone substitute on oral mucosal healing in a rat extraction socket: in vitro and in vivo analyses using carbonate apatite**. Egashira Y, Atsuta I, Narimatsu I, Zhang X, Takahashi R, Koyano K, Ayukawa Y. 2022. International Journal of Implant Dentistry. 8:11.
25. **Efficacy of bone grafting materials in preserving the alveolar ridge in a canine model**. Suehiro F, Komabashiri N, Masuzaki T, Ishii M, Yanagisawa T, Nishimura M. 2022. Dental Materials Journal. 41(2):302-308.

26. **Osteoclast behaviors on the surface of deproteinized bovine bone mineral and carbonate apatite substitutes in vitro**. Fujioka-Kobayashi M, Miyamoto Y, Ishikawa K, Satomi T, Schaller B. 2022. Biomed Mater Res A. 110(8):1524-1532.

27. **Alveolar ridge preservation in beagle dogs using carbonate apatite bone substitute**. Fukuda N, Ishikawa K, Miyamoto Y. 2022. Ceramics International. 48:1796-1804.

28. **Synergistic Effect of Carbonate Apatite and Autogenous Bone on Osteogenesis**. Atsuta I, Mizokami T, Jinno Y, Ji B, Xie T, Ayukawa Y. 2022. Materials. 15:8100.

29. **Preclinical evaluation of the effect of periodontal regeneration by carbonate apatite in a canine one-wall intrabony defect model**. Takeuchi S, Fukuba S, Okada M, Nohara K, Sato R, Yamaki D, Matsuura T, Hoshi S, Aoki K, Iwata T. 2023. Regenerative Therapy. 22:128-135.

30. **Comparison of bioresorbable bone substitutes, carbonate apatite and β-tricalcium phosphate, for alveolar bone augmentation with simultaneous implant placement.** Fukuda N, Kudoh K, Akita K, Takamaru N, Ishikawa K, Miyamoyo Y. 2023. Oral Sci Int. 1-8.

31. **Evaluation of carbonate apatite as a bone substitute in rat extraction sockets from the perspective of mesenchymal stem cells.** Takahashi R, Atsuta I, Narimatsu I, Yamaza T, Zhang X, Egashira Y, Koyano K, Ayukawa Y. 2023. Dent Mater J. 42(2):282-290.

32. **Effects of combined application of fibroblast growth factor (FGF)-2 and carbonate apatite for tissue regeneration in a beagle dog model of one-wall periodontal defect.** Nagayasu-Tanaka T, Anzai J, Takedachi M, Kitamura M, Harada T, Murakami S. 2023. Regenerative Therapy. 23:84-93.

33. **Periodontal Tissue Regeneration by Transplantation of Autologous Adipose Tissue-Derived Multi-Lineage Progenitor Cells With Carbonate Apatite**. Takedachi M, Kawasaki K, Sawada K, Sakura K, Murata M, Shimomura J, Kawakami K, Morimoto C, Miki K, Takeshita N, Iwayama T, Okura H, Matsuyama A, Saito M, Kitamura M, Murakami S. 2023. Cell Transplantation, 32.

34. **Preclinical evaluation of a new synthetic carbonate apatite bone substitute on periodontal regeneration in intrabony defects**. Imber JC, Imber LC, Roccuzzo A, Stähli A, Muñoz F, Weusmann J, Bosshardt DD, Sculean A. 2023. J Periodont Res. 59(1):42-52.

35. **Poly(lactic acid/caprolactone) bilayer membrane achieves bone regeneration through a prolonged barrier function**. Abe GL, Sasaki J, Tsuboi R, Kohno T, Kitagawa H, Imazato S. 2024. J Biomed Mater Res. 112:e35365.

36. **Evaluation of Eruption of Permanent Teeth in Beagle Dog Extraction Sites Filled with Carbonate Apatite**. Kibe T, Nakazono K, Yamashita K, Tada R, Ono Y, Ishihata K. 2024. Materials. 16:7624.

37. **Resorbable bilayer membrane made of L-lactide-ε-caprolactone in guided bone regeneration: an in vivo experimental study**. Watanabe T, Hasuike A, Wakuda S, Kogure K, Min S, Watanabe N, Sakai R, Chaurasia A, Arai Y, Sato S. 2024. Int J Implant Dent. 10:1.

38. **Combined Effects of Fibroblast Growth Factor-2 and Carbonate Apatite Granules on Periodontal Healing: An In Vivo and In Vitro Study**. Miyata N, Mori S, Murakami T, Bizenjima T, Seshima F, Imamura K, Saito A. 2024. Biomedicines. 12:1664.

39. **Preclinical Evaluation of a Poly (Lactic Acid/Caprolactone) Bilayer Membrane and a Carbonate Apatite for Periodontal Regeneration: A Canine One-Wall Intrabony Defect Model**. Yamaki D, Fukuba S, Okada M, Takeuchi S, Hoshi S, Schmidlin PR, Iwata T. 2024. J Periodont Res. 60(5):504-514.
40. **The effect of L-lactide-ε-caprolactone copolymer membrane on alveolar bone preservation: A comparative study using the open healing approach.** Takabayashi M, Yahata Y, Handa K, Kyaw MS, Suresh VV, Saito M. 2025. Regenerative Therapy. 30:20-30.
41. **Effects of Carbonate Apatite and Bone Mixture on Bone and Soft Tissue Integration in a Rat Implant Model**. Xie T, Atsuta I, Narimatsu I, Ji B, Koyano K, Ayukawa Y. 2025. Clin Implant Dent Relat Res. 27:e70077.

Clinical study

1. **Maxillary Sinus Floor Augmentation Using Low-Crystalline Carbonate Apatite Granules With Simultaneous Implant Installation: First-in-Human Clinical Trial**. Kudoh K, Fukuda N, Kasugai S, Tachikawa N, Koyano K, Matsushita Y, Ogino Y, Ishikawa K, Miyamoto Y. 2019. J Oral Maxillofac Surg. 77:985.
2. **Application of low-crystalline carbonate apatite granules in 2-stage sinus floor augmentation: a prospective clinical trial and histomorphometric evaluation**. Nakagawa T, Kudoh K, Fukuda N, Kasugai S, Tachikawa N, Koyano K, Matsushita Y, Sasaki M, Ishikawa K, Miyamoto Y. 2019. J Periodontal Implant Sci. 49(6):382-396.
3. **Clinical Assessment of Maxillary Sinus Floor Augmentation Using Carbonate Apatite: A 30-month Follow-up Study**. Ogino Y, Matsushita Y, Koyano K. 2019. 18th Biennial Meeting of the International College of Prosthodontists.
4. **Comparison of the performances of low crystalline carbonate apatite and Bio-Oss in sinus augmentation using three dimensional image analysis**. Nagata K, Fuchigami K, Kitami R, Okuhama Y, Wakamori K, Sumitomo H, Kim H, Okubo M, Kawana H. 2021. Int J Implant Dent. 7:24.
5. **Staged Sinus Floor Elevation Using Novel Low-Crystalline Carbonate Apatite Granules: Prospective Results after 3-Year Functional Loading**. Ogino Y, Ayukawa Y, Tachikawa N, Shimogishi M, Miyamoto Y, Kudoh K, Fukuda N, Ishikawa K, Koyano K. 2021. Materials. 14:5760.
6. **An exploratory clinical trial to evaluate the safety and efficacy of combination therapy of REGROTH and Cytrans granules for severe periodontitis with intrabony defects**. Kitamura M, Yamashita M, Miki K, Ikegami K, Takedachi M, Kashiwagi Y, Nozaki T, Yamanaka K, Masuda H, Ishihara Y, Murakami S. 2022. Regenerative Therapy. 21:104-113.
7. **Surgical Periodontal Therapy Using Recombinant Human Fibroblast Growth Factor-2 in Combination with Carbonate Apatite Granules for Stage III Grade B Periodontitis: A Case Report with 1-year Follow-up.** Murakami T, Imamura K, Watanabe-Egawa N, Tomita S, Saito A. 2022. Bulletin of Tokyo Dental College. 63(3):145-153.
8. **Safety and feasibility assessment of biodegradable poly (L-lactic acid/ε-caprolactone) membrane for guided bone regeneration: A case series of first-in-human pilot study**. Ogata K, Ohba S, Sumita Y, Asahina I. 2022. Journal of Dental Sciences. 17(1):368-376.

9. **Two Cases of Bone Augmentation with Carbonate Apatite.** Shibazaki S, Nakagawa T, Morikawa S, Miyashita H. 2023. Academy of Osseointegration 2023 Annual Meeting.
10. **Double-sided entire papilla preservation technique in the combination periodontal regenerative therapy: A case report**. Ogawa Y, Yoshikawa K, Ishikawa T, Saito A, Imamura K. 2023. Clin Adv Periodontics. 14(2):100-107.
11. **Novel Synthetic Carbonate Apatite as Bone Substitute in Implant Treatments: Case Reports**. Funato A, Katayama A, Moroi H. 2023. Int J Periodontics Restorative Dent. 44(3):257-266.
12. **Clinical outcomes of periodontal regenerative therapy with carbonate apatite granules for treatments of intrabony defects, Class II and Class III furcation involvements: A 9-month prospective pilot clinical study**. Fukuba S, Okada M, Iwata T. 2023. Regenerative Therapy. 24:343-350.
13. **A prospective study of the assessment of the efficacy of a biodegradable poly (L-lactic acid/ε-caprolactone) membrane for guided bone regeneration**. Shido R, Ohba S, Tominaga R, Sumita Y, Asahina I. 2023. J Clin Med. 12:5994.
14. **Effectiveness and Practicality of A Novel Barrier Membrane for the Open Window in Maxillary Sinus Augmentation with A Lateral Approach and Risk Indicators for Bone Graft Displacement and Bone Height Decrease: A Prospective Study in Humans**. Yamaguchi K, Munakata M, Sato D, Kataoka Y, Kawamata R. 2023. Bioengineering. 10:1110.
15. **Carbonate apatite increases gene expression of osterix and bone morphogenetic protein 2 in the alveolar ridge after socket grafting**. Kitazawa T, Takai H, Kono T, Okada H, Ogata Y. 2023. J Oral Sci. 66(1):15-19.
16. **Volume change after maxillary sinus floor elevation with apatite carbonate and octacalcium phosphate**. Nagata K, Kamata M, Okuhama Y, Wakamori K, Okubo M, Tsuruoka H, Atsumi M, Kawana H. 2024. Int J Implant Dent. 10:7.
17. **Retrospective study on the effect of adipose stem cell transplantation on jaw bone regeneration**. Kizu Y, Ishii R, Matsumoto N, Saito I. 2024. Int J Implant Dent. 10:3.
18. **Ridge Preservation and Augmentation Using a Carbonated Apatite Bone Graft Substitute: A Case Series**. Taniguchi Y, Koyanagi T, Takagi T, Kitanaka Y, Aoki A, Iwata T. 2024. Dent J. 12:55.
19. **Treatment of Mandibular Class III/IV Furcation Defects with a Combination Plastic Regenerative Technique: A Case Series**. Suzuki E, Katayama A, Funato A, Rasperini G. 2024. Int J Periodontics Restorative Dent. 44(4):398-407.
20. **A systematic review of a novel alloplast carbonate apatite granules**. Nunn ME, Courtney Rudick C, Nikaido M, Miyamoto T. 2024. Front Dent Med. 5:1418039.
21. **Clinical outcomes of guided tissue regeneration with carbonate apatite granules and poly(lactic acid/caprolactone) membrane for the treatment of intrabony defects and mandibular Class II furcation involvements: A 12-month prospective pilot clinical study**. Okada M, Fukuba S, Yamaki D, Iwata T. 2024. Regenerative Therapy. 26:767-774.
22. **Application and evaluation of carbonate apatite granules for mandibular bone defect reconstruction after jawbone cyst**

enucleation – a retrospective case series. Fukuda N, Takamaru N, Akita K, Kudoh K, Ishikawa K, Miyamoto Y. 2024. Oral and Maxillofacial Surgery. 29:14.

23. **Guided Bone Regeneration Using Carbonated Apatite Granules and L-Lactic Acid/ε-Caprolactone Membranes: A Case Series and Histological Evaluation.** Taniguchi Y, Koyanagi T, Kitanaka Y, Yamada A, Akira A, Iwata T. 2025. Dent J. 13:85.
24. **Preservation therapy for vertically fractured teeth with periodontal tissue regeneration using FGF-2**. Iwasaki M, Takedachi M, Sawada K, Miki K, Murakami S. 2025. Clin Adv Periodontics. In press.