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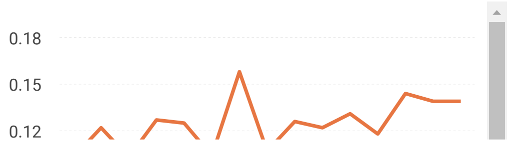

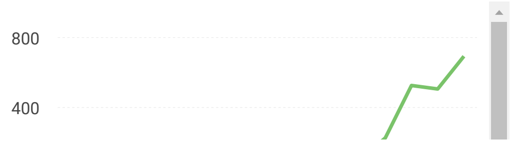

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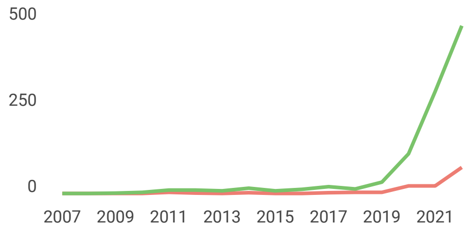

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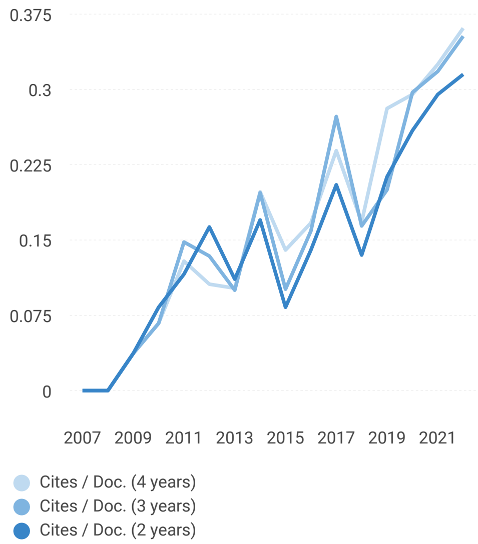

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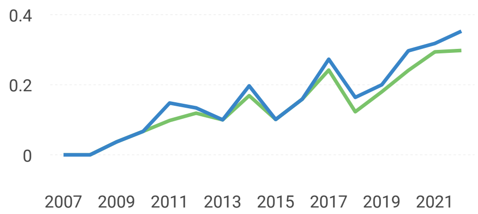

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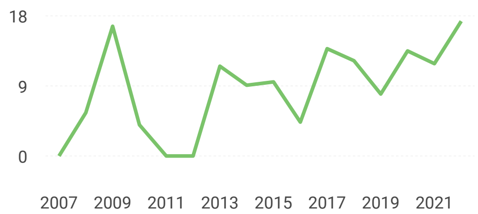

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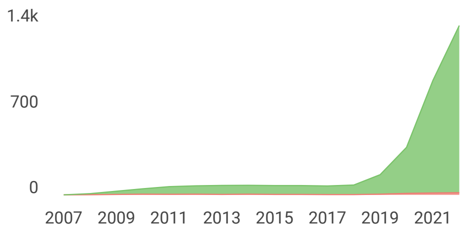

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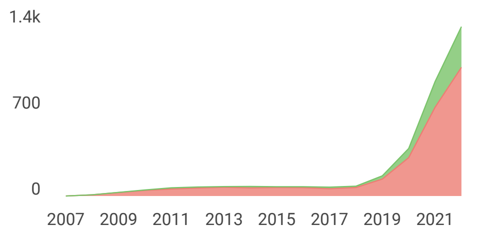

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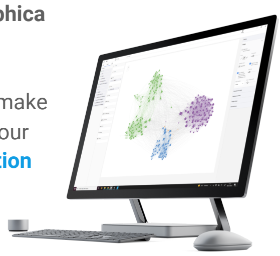

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REVIEW ARTICLE

Potential of Bovine Amniotic Membrane and Hydroxyapatite as Biocomposite Materials for Enhanced Bone Formation

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ABSTRACT

Alveolar bone resorption will occur in 40–60% within three months after tooth extraction. Socket preservation is performed to reduce the occurrence of alveolar bone resorption for successful implant restoration. One of the successes of implant restoration is in the quality and quantity of alveolar bone. The combination of the bovine amniotic membrane and hydroxyapatite is expected to be a candidate for socket preservation material. This review article aimed at explaining the potential of bovine amniotic membrane and hydroxyapatite that can act as biocomposite materials for socket preservation to enhance bone formation.

Keywords: Socket preservation, Bovine amniotic membrane, Hydroxyapatite, Biocomposite

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INTRODUCTION

After tooth extraction, alveolar bone formation plays an important role in wound healing. During three months of wound healing, alveolar bone resorption will occur in the range of 40–60% (vertical and horizontal), varying in each individual (1). Socket preservation is performed to reduce or stop bone resorption and maintain adequate soft and hard tissues. Adequate soft and hard tissues will support the success of the prosthesis and implant so that it can last a long time in the oral cavity (2). Socket preservation can be done by adding bone replacement materials from autograft, allograft, xenograft, alloplastic material. Currently, the material preservation socket is still being developed to maintain bone adequacy prior to implant placement (3).

Bone tissue consists of collagen and hydroxyapatite (HA). The combination of the two materials into a biocomposite will maximize the properties of the material used for biomedical applications (4). Biocomposite materials produced with a combination of collagen and HA with several techniques can be an option to optimize bone regeneration, because they have a composition and structure similar to natural bone (5). Bovine amniotic membrane has abundant growth factor and collagen with osteoinductive properties (6), while HA has good osteoconductive properties as a bone substitute (7). This review article aimed at explaining the potential of bovine amniotic membrane and hydroxyapatite as candidates for biocomposite materials in the preservation of alveolar bone to enhance bone growth.

BOVINE AMNIONTIC MEMBRANE

With a thickness of 0.02 to 0.5 mm, the amniotic membrane is situated in the deepest part of the placenta which encompasses the embryo. This membrane is a slight, sturdy, translucent, avascular compound layer (8). The amniotic membrane consists of three main layers: a solitary epithelial layer, basement membrane, and avascular mesenchyme with collagen as the main content. Type IV collagen is mainly found in the amniotic membrane's basement. Collagen types I, III, IV V, VI, XV can be distinguished in the solid and porous layers of amniotic membrane (9). According to a previous study (10), mRNA expression by RT-PCR on the amniotic membrane shows the content of EGF, TGF-α, KGF, HGF, bFGF, TGFβ, KGFR, and HGFR. This regeneration mechanism is due to the role of the amniotic membrane: immunomodulating and immune privilege; anti-microbial; pain decrement; anti-scarring and anti-inflammatory; tissue repair with upgraded bone remodelling, chondrogenesis, and osteogenesis; angiogenesis and fibrogenesis; enhanced formation of extracellular structure; and mesenchymal stem cell powerful source (11).

One source of the amniotic membrane comes from bovine. Some of the advantages of the bovine amniotic membrane are the ease of legality, ethics, and not affected by ritual beliefs such as the human amniotic membrane. Based on a study (12), the bovine amniotic membrane has similarities to the human amniotic membrane. The bovine amniotic membrane is proven non-toxic, has a molecular load of 70 kDa, and can accelerate the formation of collagen during the wound healing process. Another study (13) analysed the expression of BMP-2 by applying the amniotic membrane to the alveolar bone socket after extraction. Amniotic membrane is good for soft tissue healing; limitation of the amniotic membrane is that it is easily biodegradable, making it difficult to maintain the structural integrity necessary for bone regeneration (14). Easy biodegradation occurs because the collagen content in the amniotic membrane is easily absorbed (15). This causes bone healing to occur only in the marginal area, making it less effective at reducing resorption from alveolar bone (16). Combination or mineralization with other materials will optimize the occurrence of bone regeneration (17, 18).

BOVINE HYDROXYAPATITE

As a non-organic mineral, hydroxyapatite (HA) exhibits a distinctive apatite lattice structure, which is $(A_{10}(BO_4)_6X_2)$ with A, B, and X denoted by Ca^{2+}, PO_4^{3-}, and OH_2, respectively (19). Natural sources or non-organic components (e.g., plants, biogenic sediments, bones of mammals and marine animals) can synthesize it (20). The composition and morphology of bovine bone is similar to that of human bone. Studies in patients with the application of bovine hydroxyapatite to fractured bones, showed an excellent healing rate of 80.36%. This is because BHA has chemical similarities to the human bone, biocompatibility by stimulating osteoconduction, and can be integrated without triggering a reaction (21). However, the osteoconductive properties causes the HA to not be well absorbed in the extraction socket. This causes the healing and formation of alveolar bone to be delayed (22).

BIOCOMPOSITE

A biocomposite is made out of at least two particular constituent materials, with one of which obtained naturally, combined to generate a new form with enhanced performance over each of the former materials (23). Biocomposites generally consist of two elements which are a combination of organic and inorganic materials (24). Collagen which is an organic material acts as a matrix and hydroxyapatite acts as a filler (25). The combination of bovine amniotic membrane and hydroxyapatite will combine two biomaterial properties that will produce new biocomposite materials. This new material is expected to have a synergistic ability to regenerate bone tissue. Bovine amniotic membrane growth factors such as TGFβ and FGF2 will stimulate fibroblasts to form collagen types I and III which play a role in wound healing (26). Collagen formed will bind to calcium ions from hydroxyapatite for the process of osteogenesis (27). Hydroxyapatite with calcium phosphate content, will stimulate osteoblast gene expression (28). An in vivo study (29) shows that the biocomposite combination of HA and collagen implanted into the substance bone will be absorbed by osteoclasts through phagocytosis followed by the new bone formed by osteoblasts in the surrounding area (30).

CONCLUSION

Bovine amniotic membrane have abundant collagen and growth factor. Bovine hydroxyapatite is the main inorganic mineral in bone. This biocomposite material can act as a candidate for enhancing the regeneration of post-extraction alveolar bone.

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REFERENCES

1. Nisar N, Nilesh K, Parkar MI, Punde P. Extraction socket preservation using a collagen plug combined with platelet-rich plasma (PRP): A comparative clinico-radiographic study. J Dent Res Dent Clin Dent Prospects. 2020;14(2):139-145.
2. Kalsi AS, Kalsi JS, Bassi S. Alveolar ridge preservation: Why, when and how. Br Dent J. 2019;227(4):264-274.
3. Willenbacher M, Al-Nawas B, Berres M, KΔmmerer PW, Schiegnitz E. The effects of alveolar ridge preservation: A meta-analysis. clinical implant dentistry and related research. 2016;18(6), 1248–1268.
4. Yang Y, Zhang Y, Yan Y, Ji Q, Dai Y, Jin S, et al. A sponge-like double-layer wound dressing with chitosan and decellularized bovine amniotic membrane for promoting diabetic wound healing. Polymers. 2020;12(535), 1–13.
5. Chen L, Wu Z, Zhou Y, Li L, Wang Y, Wang Z, et al. Biomimetic porous collagen/hydroxyapatite scaffold for bone tissue engineering. Journal of Applied Polymer Science. 2017;134(37), 1–8.
6. Singh M, Madhan G. Comparison of ability of platelet-rich fibrin vs CollaPlug in maintaining the buccal bone height of sockets following extractions

in 20 patients. J Heal Sci Res. 2017;8(1):1-6.
7. Zhao R, Yang R, Cooper PR, Khurshid Z, Ratnayake J. Bone grafts and substitutes in dentistry : A review of current trends and developments. 2021;26(3007):1-27.
8. Tang K, Wu J, Xiong Z, Ji Y, Sun T. Human acellular amniotic membrane : A potential osteoinductive biomaterial for bone regeneration. J Biomater Appl. 2017;32(6):754-764.
9. Gunasekaran D, Thada R, Felciya G, et al. Physicochemical characterization and self-assembly of human amniotic membrane and umbilical cord collagen : A comparative study. Int J Biol Macromol. 2020;165:2920-2933.
10. Koizumi N, Inatomi T, Sotozono C, Fullwood NJ, Quantock AJ, Kinoshita S. Growth factor mRNA and protein in preserved human amniotic membrane. Curr Eye Res. 2000;20(3):173-177.
11. Chopra A, Thomas BS. Amniotic membrane: A novel material for regeneration and repair. J Biomimetics Biomater Tissue Eng. 2013;18(1):1-8.
12. Siswanto R, Rizkawati DM, Ifada AA, Putra AP, Rachmayani F, Widiyanti P. Bovine freeze dried amniotic membrane (FD-AM) covered sterile gauze for wound dressing. Asian Acad Soc Int Confrence. Published online 2013:68-71.
13. Indrawati DW, Munadziroh E, Indah T, Sulisetyawati B, Mahardhika P, Fadhlallah E. Sponge amnion potential in post tooth extraction wound healing by interleukin - 6 and bone morphogenetic protein - 2 expression analysis : An animal study. Dent Res J (Isfahan). 2019;16:283-288.
14. Dimitriou R, Mataliotakis GI, Calori GM, Giannoudis PV. The role of barrier membranes for guided bone regeneration and restoration of large bone defects: Current experimental and clinical evidence. 2012;10(81):1-24.
15. Castro-ceseca AB, Camacho-villegas T. Effect of starch on the mechanical and in vitro properties of collagen- hydroxyapatite sponges for applications in dentistry. Carbohydrate Polymers. 2016;148:78-85.
16. Fickl S, Zuhr O , Wachtel H, Stappert CFJ, Stein JM, Hьrzeler MB. Dimensional changes of the alveolar ridge contour after different socket preservation techniques. Journal of Clinical Periodontology. 2008;35(10):906-913.
17. Dewey MJ, Johnson EM, Slater ST, Milner DJ, Wheeler MB, Harley BAC. Mineralized collagen scaffolds fabricated with amniotic membrane matrix increase osteogenesis under inflammatory conditions. Biorxiv. 2020; 217.
18. Sabouri L, Farzin A, Kabiri A, Milan PB, Farahbakhsh M, Mehdizadehkashi A, et al. Mineralized human amniotic membrane as a biomimetic scaffold for hard tissue engineering applications. ACS Biomaterials Science and Engineering. 2020;6(11):6285–6298.
19. Ratnayake JTB, Mucalo M, Dias GJ. Substituted hydroxyapatites for bone regeneration: A review of current trends. J Biomed Mater Res - Part B Appl Biomater. 2017;105(5):1285-1299.
20. El-Fadhlallah PM, Yuliati A, Soesilawati P, Pitaloka P. Biodegradation and ompressive Strength Test of Scaffold with Different Ratio as Bone Tissue Engineering Biomaterial. JIDMR. 2018;11(3):1636–1639.
21. Arifin A, Mahyudin F, Edward M. The clinical and radiological outcome of bovine hydroxyapatite (Bio Hydrox) as bone graft. J Orthop Traumatol Surabaya. 2020;9(1):9.
22. Kamboj M, Arora R, Gupta H. Comparative evaluation of the efficacy of synthetic nanocrystalline hydroxyapatite bone graft (Ostim®) and synthetic microcrystalline hydroxyapatite bone graft (Osteogen®) in the treatment of human periodontal intrabony defects: A clinical and denta scan study. J. Indian Soc. Periodontol. 2016;20(4):423-428
23. Rudin A, Phillips C. Biopolymers. In: The elements of polymer science & enginering. Elsevier. 2013;521-535.
24. Kaczmarek B, Sionkowska A. Chitosan/collagen blends with inorganic and organic additive—A review. Advances in Polymer Technology. 2018;37(6): 2367-2376
25. Oosterlaken BM, Vena MP, de With G. In Vitro Mineralization of Collagen. Advanced Materials.2021;33(2004418):1-27
26. Primadina N, Basori A, Perdanakusuma DS. Proses penyembuhan luka ditinjau dari aspek mekanisme seluler dan molekuler. Qanun Medika - Medical Journal Faculty of Medicine Muhammadiyah Surabaya. 2019;3(1):31-43.
27. Brasinika D, Tsigkou O, Tsetsekou A, Missirlis YF. Bioinspired synthesis of hydroxyapatite nanocrystals in the presence of collagen and L-arginine: Candidates for bone regeneration. Journal of Biomedical Materials Research - Part B Applied Biomaterials. 2016;104(3):458–469.
28. Bal Z, Kaito T, Korkusuz F, Yoshikawa H. Bone regeneration with hydroxyapatite-based biomaterials. Emergent Materials. 2020;3(4):521–544.
29. Hiratsuka T, Uezono M, Takakuda K, et al. Enhanced bone formation onto the bone surface using a hydroxyapatite/collagen bone-like nanocomposite. J Biomed Mater Res - Part B Appl Biomater. 2020;108(2):391-398.
30. Yuliati, Kusumaningsih T, Rananda I, Soesilawati P. Increasing macrophages in tooth extraction wound healing after induction of freeze-drying gel aloe vera 90% on cavia cobaya. Mal J Med Health Sci. 2020;4(16):87-91.

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by Octarina FKG

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REVIEW ARTICLE

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[2] Department of Dental Material, Faculty of Dental Medicine, Universitas Airlangga, Surabaya 60132, Indonesia

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One source of the amniotic membrane comes from bovine. Some of the advantages of the bovine amniotic membrane are the ease of legality, ethics, and not affected by ritual beliefs such as the human amniotic membrane. Based on a study (12), the bovine amniotic membrane has similarities to the human amniotic membrane. The bovine amniotic membrane is proven non-toxic, has a molecular load of 70 kDa, and can accelerate the formation of collagen during the wound healing process. Another study (13) analysed the expression of BMP-2 by applying the amniotic membrane to the alveolar bone socket after extraction. Amniotic membrane is good for soft tissue healing; limitation of the amniotic membrane is that it is easily biodegradable, making it difficult to maintain the structural integrity necessary for bone regeneration (14). Easy biodegradation occurs because the collagen content in the amniotic membrane is easily absorbed (15). This causes bone healing to occur only in the marginal area, making it less effective at reducing resorption from alveolar bone (16). Combination or mineralization with other materials will optimize the occurrence of bone regeneration (17, 18).

BOVINE HYDROXYAPATITE

As a non-organic mineral, hydroxyapatite (HA) exhibits a distinctive apatite lattice structure, which is $(A_{10}(BO_4)_6X_2)$ with A, B, and X denoted by Ca^{2+}, PO_4^{3-}, and OH_2, respectively (19). Natural sources or non-organic components (e.g., plants, biogenic sediments, bones of mammals and marine animals) can synthesize it (20). The composition and morphology of bovine bone is similar to that of human bone. Studies in patients with the application of bovine hydroxyapatite to fractured bones, showed an excellent healing rate of 80.36%. This is because BHA has chemical similarities to the human bone, biocompatibility by stimulating osteoconduction, and can be integrated without triggering a reaction (21). However, the osteoconductive properties causes the HA to not be well absorbed in the extraction socket. This causes the healing and formation of alveolar bone to be delayed (22).

BIOCOMPOSITE

A biocomposite is made out of at least two particular constituent materials, with one of which obtained naturally, combined to generate a new form with enhanced performance over each of the former materials (23). Biocomposites generally consist of two elements which are a combination of organic and inorganic materials (24). Collagen which is an organic material acts as a matrix and hydroxyapatite acts as a filler (25). The combination of bovine amniotic membrane and hydroxyapatite will combine two biomaterial properties that will produce new biocomposite materials. This new material is expected to have a synergistic ability to regenerate bone tissue. Bovine amniotic membrane growth factors such as TGFβ and FGF2 will stimulate fibroblasts to form collagen types I and III which play a role in wound healing (26). Collagen formed will bind to calcium ions from hydroxyapatite for the process of osteogenesis (27). Hydroxyapatite with calcium phosphate content, will stimulate osteoblast gene expression (28). An in vivo study (29) shows that the biocomposite combination of HA and collagen implanted into the substance bone will be absorbed by osteoclasts through phagocytosis followed by the new bone formed by osteoblasts in the surrounding area (30).

CONCLUSION

Bovine amniotic membrane have abundant collagen and growth factor. Bovine hydroxyapatite is the main inorganic mineral in bone. This biocomposite material can act as a candidate for enhancing the regeneration of post-extraction alveolar bone.

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REFERENCES

1. Nisar N, Nilesh K, Parkar MI, Punde P. Extraction socket preservation using a collagen plug combined with platelet-rich plasma (PRP): A comparative clinico-radiographic study. J Dent Res Dent Clin Dent Prospects. 2020;14(2):139-145.
2. Kalsi AS, Kalsi JS, Bassi S. Alveolar ridge preservation: Why, when and how. Br Dent J. 2019;227(4):264-274.
3. Willenbacher M, Al-Nawas B, Berres M, K∆mmerer PW, Schiegnitz E. The effects of alveolar ridge preservation: A meta-analysis. clinical implant dentistry and related research. 2016;18(6), 1248–1268.
4. Yang Y, Zhang Y, Yan Y, Ji Q, Dai Y, Jin S, et al. A sponge-like double-layer wound dressing with chitosan and decellularized bovine amniotic membrane for promoting diabetic wound healing. Polymers. 2020;12(535), 1–13.
5. Chen L, Wu Z, Zhou Y, Li L, Wang Y, Wang Z, et al. Biomimetic porous collagen/hydroxyapatite scaffold for bone tissue engineering. Journal of Applied Polymer Science. 2017;134(37), 1–8.
6. Singh M, Madhan G. Comparison of ability of platelet-rich fibrin vs CollaPlug in maintaining the buccal bone height of sockets following extractions

in 20 patients. J Heal Sci Res. 2017;8(1):1-6.
7. Zhao R, Yang R, Cooper PR, Khurshid Z, Ratnayake J. Bone grafts and substitutes in dentistry : A review of current trends and developments. 2021;26(3007):1-27.
8. Tang K, Wu J, Xiong Z, Ji Y, Sun T. Human acellular amniotic membrane : A potential osteoinductive biomaterial for bone regeneration. J Biomater Appl. 2017;32(6):754-764.
9. Gunasekaran D, Thada R, Felciya G, et al. Physicochemical characterization and self-assembly of human amniotic membrane and umbilical cord collagen : A comparative study. Int J Biol Macromol. 2020;165:2920-2933.
10. Koizumi N, Inatomi T, Sotozono C, Fullwood NJ, Quantock AJ, Kinoshita S. Growth factor mRNA and protein in preserved human amniotic membrane. Curr Eye Res. 2000;20(3):173-177.
11. Chopra A, Thomas BS. Amniotic membrane: A novel material for regeneration and repair. J Biomimetics Biomater Tissue Eng. 2013;18(1):1-8.
12. Siswanto R, Rizkawati DM, Ifada AA, Putra AP, Rachmayani F, Widiyanti P. Bovine freeze dried amniotic membrane (FD-AM) covered sterile gauze for wound dressing. Asian Acad Soc Int Confrence. Published online 2013:68-71.
13. Indrawati DW, Munadziroh E, Indah T, Sulisetyawati B, Mahardhika P, Fadhlallah E. Sponge amnion potential in post tooth extraction wound healing by interleukin - 6 and bone morphogenetic protein - 2 expression analysis : An animal study. Dent Res J (Isfahan). 2019;16:283-288.
14. Dimitriou R, Mataliotakis GI, Calori GM, Giannoudis PV. The role of barrier membranes for guided bone regeneration and restoration of large bone defects: Current experimental and clinical evidence. 2012;10(81):1-24.
15. Castro-ceseca AB, Camacho-villegas T. Effect of starch on the mechanical and in vitro properties of collagen- hydroxyapatite sponges for applications in dentistry. Carbohydrate Polymers. 2016;148:78-85.
16. Fickl S, Zuhr O , Wachtel H, Stappert CFJ, Stein JM, Hьrzeler MB. Dimensional changes of the alveolar ridge contour after different socket preservation techniques. Journal of Clinical Periodontology. 2008;35(10):906-913.
17. Dewey MJ, Johnson EM, Slater ST, Milner DJ, Wheeler MB, Harley BAC. Mineralized collagen scaffolds fabricated with amniotic membrane matrix increase osteogenesis under inflammatory conditions. Biorxiv. 2020; 217.
18. Sabouri L, Farzin A, Kabiri A, Milan PB, Farahbakhsh M, Mehdizadehkashi A, et al. Mineralized human amniotic membrane as a biomimetic scaffold for hard tissue engineering applications. ACS Biomaterials Science and Engineering. 2020;6(11):6285–6298.
19. Ratnayake JTB, Mucalo M, Dias GJ. Substituted hydroxyapatites for bone regeneration: A review of current trends. J Biomed Mater Res - Part B Appl Biomater. 2017;105(5):1285-1299.
20. El-Fadhlallah PM, Yuliati A, Soesilawati P, Pitaloka P. Biodegradation and ompressive Strength Test of Scaffold with Different Ratio as Bone Tissue Engineering Biomaterial. JIDMR. 2018;11(3):1636–1639.
21. Arifin A, Mahyudin F, Edward M. The clinical and radiological outcome of bovine hydroxyapatite (Bio Hydrox) as bone graft. J Orthop Traumatol Surabaya. 2020;9(1):9.
22. Kamboj M, Arora R, Gupta H. Comparative evaluation of the efficacy of synthetic nanocrystalline hydroxyapatite bone graft (Ostim®) and synthetic microcrystalline hydroxyapatite bone graft (Osteogen®) in the treatment of human periodontal intrabony defects: A clinical and denta scan study. J. Indian Soc. Periodontol. 2016;20(4):423-428
23. Rudin A, Phillips C. Biopolymers. In: The elements of polymer science & enginering. Elsevier. 2013;521-535.
24. Kaczmarek B, Sionkowska A. Chitosan/collagen blends with inorganic and organic additive—A review. Advances in Polymer Technology. 2018;37(6): 2367-2376
25. Oosterlaken BM, Vena MP, de With G. In Vitro Mineralization of Collagen. Advanced Materials.2021;33(2004418):1-27
26. Primadina N, Basori A, Perdanakusuma DS. Proses penyembuhan luka ditinjau dari aspek mekanisme seluler dan molekuler. Qanun Medika - Medical Journal Faculty of Medicine Muhammadiyah Surabaya. 2019;3(1):31-43.
27. Brasinika D, Tsigkou O, Tsetsekou A, Missirlis YF. Bioinspired synthesis of hydroxyapatite nanocrystals in the presence of collagen and L-arginine: Candidates for bone regeneration. Journal of Biomedical Materials Research - Part B Applied Biomaterials. 2016;104(3):458–469.
28. Bal Z, Kaito T, Korkusuz F, Yoshikawa H. Bone regeneration with hydroxyapatite-based biomaterials. Emergent Materials. 2020;3(4):521–544.
29. Hiratsuka T, Uezono M, Takakuda K, et al. Enhanced bone formation onto the bone surface using a hydroxyapatite/collagen bone-like nanocomposite. J Biomed Mater Res - Part B Appl Biomater. 2020;108(2):391-398.
30. Yuliati, Kusumaningsih T, Rananda I, Soesilawati P. Increasing macrophages in tooth extraction wound healing after induction of freeze-drying gel aloe vera 90% on cavia cobaya. Mal J Med Health Sci. 2020;4(16):87-91.

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