Slov Vet Res

DOI 10.26873/SVR-1829-2024
UDC 611.018.46:615.849:616-089.23:616-091.8:637.412:639.112
Pages: 201–7

Original Research Article

The Effect of Eggshell Hydroxyapatite Powder and Autologous Bone Marrow on the Healing of Bone Defects in Rabbits

Key words

hydroxyapatite;
avian eggshell powder;
autologous bone marrow aspiration;
bone gap

Received: 5 August 2023
Accepted: 28 March 2024

Nadia Hameed Rija AL-Falahi[1], Ali Ghazi Atiyah[2]*

[1]Department of Surgery and Obstetrics, College of Veterinary Medicine, University of Baghdad, Baghdad, [2]Department of Surgery and Obstetrics, College of Veterinary Medicine, University of Tikrit, Tikrit, Iraq

***Corresponding author:** alighazivet@tu.edu.iq

Abstract: The repair of bone defects remains a challenge for clinical orthopedic surgery. Therefore, the present study was designed to evaluate the effect of using eggshell hydroxyapatite (eHA), which was prepared previously from avian eggshell by hydrothermal method and autologous bone marrow aspirated from the femoral bone, on the healing of bone gap defect on the radius bone of the right forelimb in rabbits. This study was conducted on 28 male rabbits divided randomly into four groups each (n=7); in all experimental animals (10 mm length × 2mm width), a bone gap was induced at the mid-shaft of the radius bone reaching the marrow cavity at the right forelimb. The defect in GI was left open as a control group without any additives. In GII, the bone gap was filled with eHA powder; in GIII, it was filled with eHA powder. The bone gap was filled with autologous bone marrow, and in GIV, the bone defect was equally filled with a combination of eHA and bone marrow. Experimental animals were followed up clinically, radiographically at (2, 4, 6, 8) weeks post-operatively, and histopathologically at (4, 6) weeks post-operatively. The radiological and histopathological findings revealed promising results in treated groups compared to a control group, with the best results in the combination of eHA and autologous bone marrow. In conclusion, the use of eHA and autologous bone marrow is considered a beneficial graft material in bone defect regeneration.

Introduction

Bones have potential healing and regeneration, but the healing of bones cannot be accomplished by themselves in case of large bone defects, which remain a considerable challenge in orthopedic surgery and may result from infections, trauma, tumors, and congenital abnormalities (11). A primary goal for orthopedic surgery is to avoid the requirement of a second surgical bone harvest site through synthetic biomaterials as an alternative method for reconstructing or repairing missing bone (1). These materials are used to promote the healing of bone defects. Traditionally, when there is missing bone, it is replaced with material from the patient or a donor. Different sources of bone grafts have been utilized to stimulate bone healing in cases of bone defects (2). Hydroxyapatite (HA) is a biomaterial comprising calcium and phosphorous, vital minerals found in bones (3). Hydroxyapatite can be synthesized from organic-based materials or inorganic components. The conventional method of obtaining HA involves working with reagent chemicals, making these synthetic routes expensive and time-consuming (4). Natural HA is believed to have metabolic activity and a dynamic response to the environment compared to synthetic HA (5, 6). Calcium-rich Eggshells have promising possibilities as sources of HA; In fact, processed eggshell HA has already demonstrated encouraging results in bone regeneration (5).

Recently, Synthetic biomaterials alone do not have sufficient osteoinductive or angiogenic properties for healing bone defects. Therefore, many recent studies have illustrated that

osteoprogenitor cells, especially cells derived from bone marrow (BMSCs), alone or combined with biomaterials, have successfully regenerated bone tissue (7, 8). The bone marrow serves as a source of stem cells responsible for regularly regenerating blood components and non-hematopoietic stem cells, like mesenchymal stem cells (MSCs). Multiple reports have highlighted the plasticity of stem cells derived from the bone marrow and their capacity to differentiate into cell lines (9). This study aims to assess how effective avian eggshell powder and autologous bone marrow aspiration (BMA) are in promoting the healing process of radius bone gaps in sexually mature male rabbits.

Materials and methods

Ethical statement

Animal management procedures were undertaken following the guideline requirements of the Animal Care and Use Committee at the College of Veterinary Medicine, Tikrit University, Iraq (369 -10/2/2022).

Rabbits care and experimental design

The study used twenty-eight New Zealand White male rabbits, aged between 6- 8 months and weighing 1- 1.8 kg, obtained from the animal house center at the College of Veterinary Medicine Tikrit University, who was in good health. These rabbits were kept in separate cages (1 × 0.5 meters) and fed on commercial pellets (Lone Star, Netherland). They provided water ad libitum under the same conditions for 15 days before the surgery to allow them to acclimatize. Before the surgery, they were treated with a deworming medication (0.02 mg/kg), ivermectin. A bone gap defect measuring 10 mm in length and 2mm in width was created using a speedy electrical drill, and irrigation was done using sterile saline solution (0.9%). These defects were created in the midshaft of the radius bone in all experimental animal groups, and then the animals were divided into four groups. In GI, the bone defect was left open without any additives as a control. In group GII, the defects were filled with eggshell hydroxyapatite powder prepared using hydrothermal methods described by Atiyah and coauthors. (10). In group GIII, the bone gaps were filled with bone marrow aspirated from the femoral bone of each animal of the same group used a bone marrow aspiration needle directed along the medial aspect of the greater trochanter inside the femur then aspirate approximately 1 ml of bone marrow with a sterile syringe and apply 0.5 ml to fill the defect. Lastly, in group GIV, a combination of eggshell hydroxyapatite powder (0.5 mg) with autologous bone marrow aspirated (0.5 ml) in each animal of the same group was used to fill the bone gaps

Surgical protocol

The experimental animals were first tranquilized using Acepromazine at a dosage of 1 mg/kg. After ten minutes, they were further anesthetized using a combination of 2% of Xylazine hydrochloride at a dosage of (5mg/kg), and 10% of Ketamine at a dose (50mg/kg) through intramuscular injections. The surgeons made an incision of 3- 4 cm long on the inside of the right forelimb by carefully using blunt scissors; they separated the muscles to reveal the radius bone. To create a gap in the shaft of the radius bone (10 mm long by 2mm wide), they used a drill and flushed it with sterile saline solution (0.9%) to reach the marrow cavity. The bone gap was left empty in the GI, while in GII, the defect was filled with eHA powder, and in GIII, the bone defect was filled with 0.5ml autologous bone marrow aspirated from the femoral bone. In GIV, the bone defect was filled with an equal mixture of autologous bone marrow aspirated from the femoral bone with eHA powder. The muscles were approximated with 3/0 polydioxanone (PDS) by a simple continuous suture, and the skin was closed using 3/0 silk by a simple interrupted suture pattern. Meloxicam was given as analgesia at a dosage of 0.5 mg/ kg for three days, and enrofloxacin antibiotic was given at a dose of 5-10 mg/kg IM for three days postoperatively. Experimental animals were followed up clinically (daily for the first week post-surgery) and radiographically at (2, 4, 6,8) weeks postoperatively using an X-ray machine (65 kV) and (8 mAs) to observe the bone reaction. After the operation, bone specimens were taken from euthanized animals in all groups using an overdose of 10% Ketamine HCL anesthesia administered through intramuscular injection of 5 ml and evaluated histopathologically at the fourth and sixth weeks post-operative. The specimens were preserved in 10% neutral buffer formalin (NBF) for 48 hours. After that, they were decalcified using a 10% formic acid solution for two weeks. Following several chemical processes, the samples were sectioned into 5µm with a microtome (Leica SP 1600; Leica Microsystems, Germany), and finally stained with Hematoxylin and Eosin. They were then viewed under a light microscope (AX80T; Olympus, Tokyo, Japan).

Results

Clinical Evaluation

All experimental animals could not bear weight on the operative limb during the first three days post operation without any indications of infection or rejection at the fractured site post-surgery, and all wounds healed with first intention.

Radiological evaluation

In the GI (control group) at the 2nd-week post-operation, the bone gap appeared in the shaft of the radius bone with a slight periosteal reaction at the bone gap margins (Fig. 1.

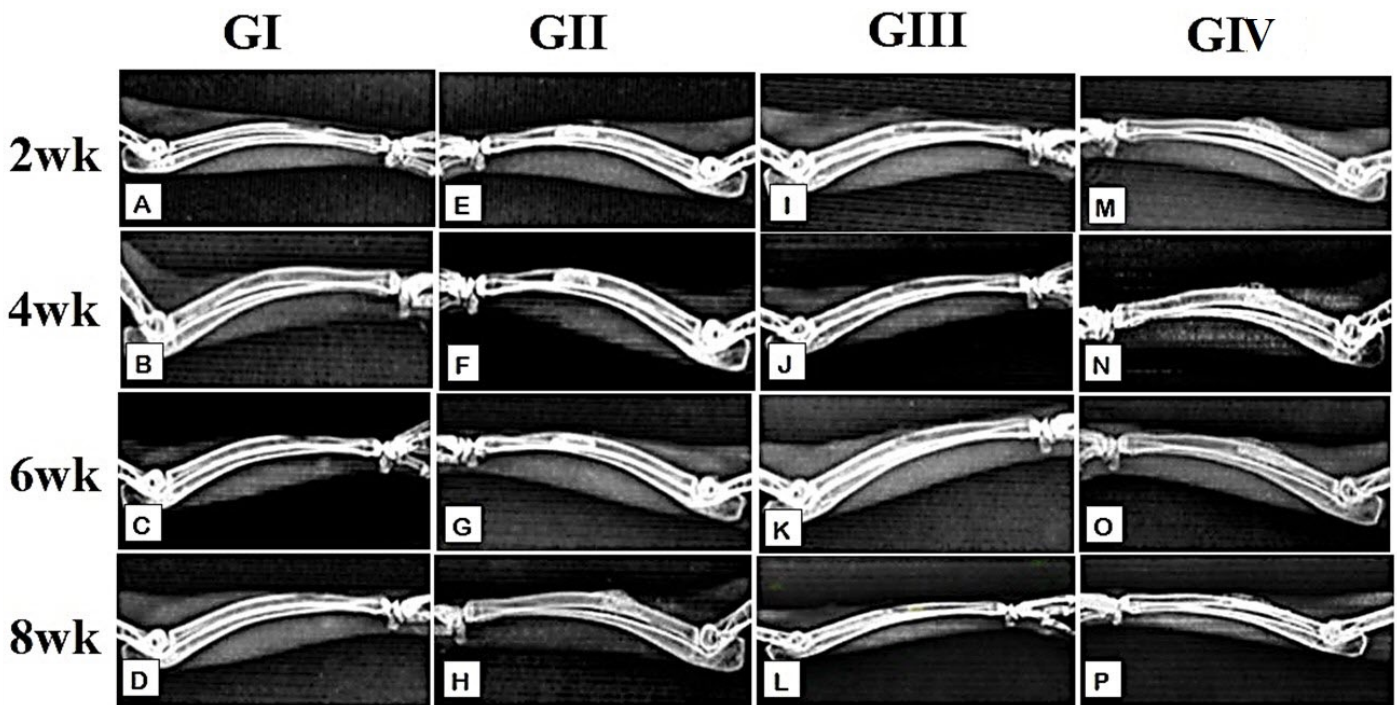

Figure 1: Lateral view radiographs of radius bone in rabbits at (2,4, 6,8) weeks post operatively. (A, B, C, D) GI group. (E, F, G, H) The GII group. (I, J, K, L). The GIII group. (M, N, O, P) the GIV group

A), which increased with time progress and partially closed at the 8th-week post operation (Fig. 1. B, C and D). In the GII, the eggshell powder that filled the radius gap appeared as a radiopaque area compared to normal bone with a slight periosteal reaction, specifically at the distal end of the bone gap at 2 weeks postoperatively (Fig. 1. E). The periosteal reaction increased in the fourth week, and the powder still appeared as a radiopaque material that filled the radius bone gap (Fig. 1. F). In the sixth week, there was a radiolucent area in the middle of the eggshell powder (Fig. 1. G). In the eighth week, the periosteal reaction increased, and the powder appeared less opaque in the bone gap (Fig. 1. H). In the GIII, the bone gap appeared in the shaft of the radius bone with a slight periosteal reaction in the second week (Fig. 1. I). In the fourth week, the bone gap still appeared at the shaft of the radius bone (Fig. 1. J). In the sixth week, the bone gap partially closed from the distal part of the bone gap (Fig. 1. K). At 8 weeks, the bone gap closed, and the marrow cavity appeared along the mid-shaft of the bone (Fig. 1. L). In the GIV in the second week, the composite of eggshell powder with bone marrow appeared as a radiopaque area in the bone gap (Fig. 1.M). In the fourth and sixth weeks, the periosteal reaction appeared at the gap periphery (Fig. 1. N and O). In the eighth week, the composite appeared remodeled with the bone gap and took on the regular shape of the normal bone (Fig.1.P).

Histopathological Evaluation

The histopathological sections of bone defect in the control group GI at the fourth week post operation showed excessive granulation tissue formation surrounded by newly formed thin irregular bone trabeculae. Other sections showed the formation of new cartilage and irregular, thin bone trabeculae (Fig. 2A). In the GII at the same period, the histopathological sections of bone defect showed calcified cartilage that formed variably thickened of anastomosed bone trabeculae, with thick bone trabeculae at the fracture site lined by osteoblasts (Fig. 2B). In the GIII at fourth week post operation, the histopathological sections of the bone defect showed newly formed irregular fragments of bone trabeculae and areas of hemorrhage with normal appearance of adipocytes and bone marrow cells (Fig. 2C). In the GIV at the same time, the histopathological sections of the bone defect showed a marked network of fibrovascular tissue and variably sized bone trabeculae lined by osteoblasts that surrounded non- absorbable eHA powder particles that appeared as a golden-brown particle (Fig. 2D).

In the sixth week post-operation, the histopathological sections in the control group GI showed granulation tissue bound fragment bone, with thickening trabecular and lamellar bone at the end of the fracture speared into granulation tissue, which infiltrated by mononuclear cells (Fig. 3A). In GII, Sections in the bone at sixth week post-operation showed thickening trabecular bone elongated from one side of the fractured bone (Fig. 3B). In GIII, sections in the bone at the same period showed marked fibrin-rich blood clots with inflammatory cells filling the site of the defect (Fig. 3C). While in GIV, sections in the bone at the same period showed markedly different sizes of bone

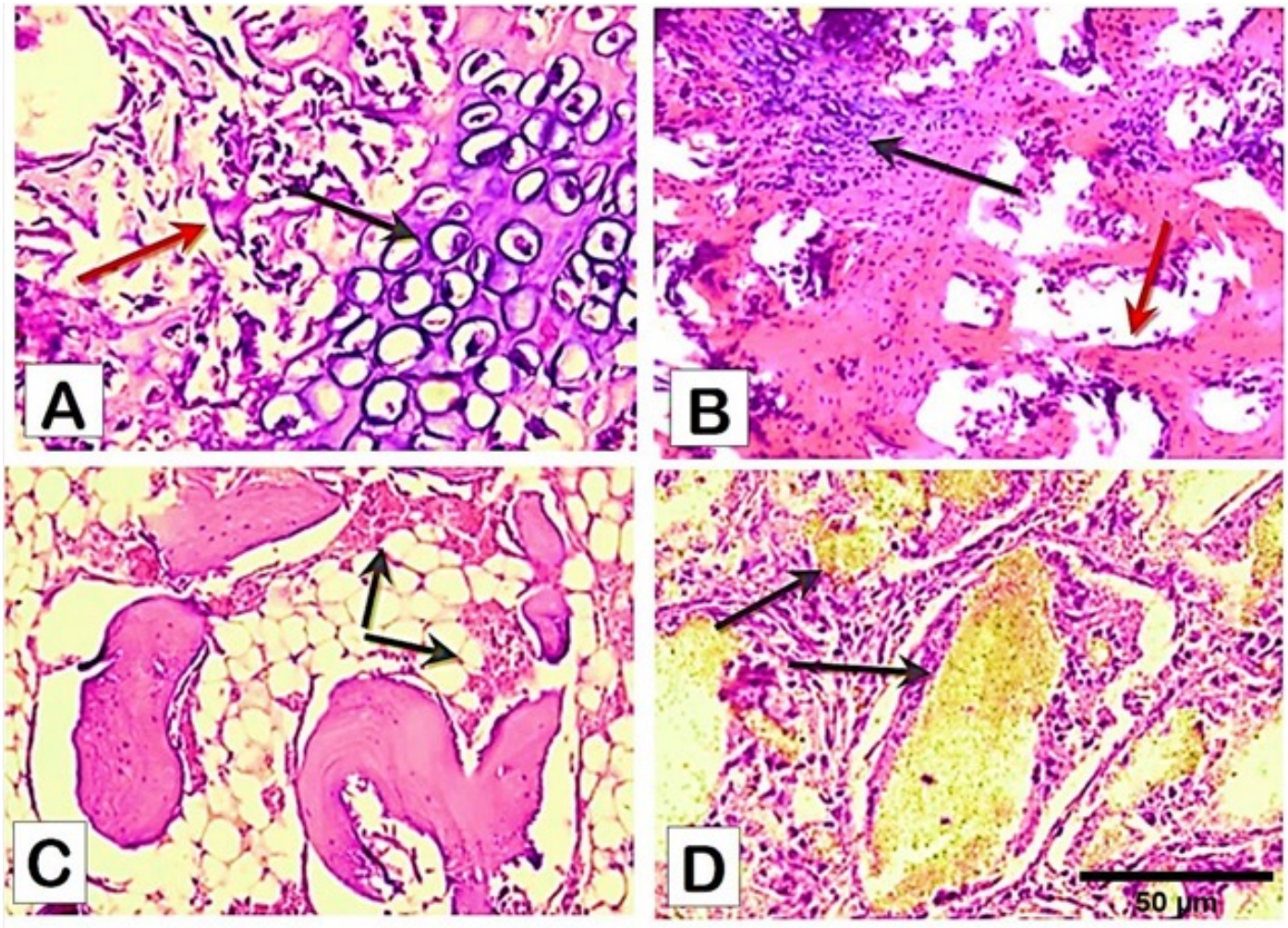

Figure 2: Histopathological sections of bone defect at fourth week post-operation. (A) The GI group shows the formation of new cartilage (black arrow) and irregular thin bone trabeculae (red arrow) (H&E 40X). (B) The GII group shows calcified cartilage (black arrow) that formed variably thickened of anastomosed bone trabeculae with thick bone trabeculae at the fracture site lined by osteoblasts (red arrow) (H&E 20X). (C) The GIII group shows marked fibrin-rich blood clots with inflammatory cells filling the defect site (black arrows) (H&E 20X). (D) The GIV group shows a marked network of fibrovascular tissue and variably sized bone trabeculae lined by osteoblasts surrounding nonabsorbable eHA powder particles that appeared as a golden brown particle (black arrows) (H&E 40X)

trabeculae lined by osteoblasts, surrounded by the residue of non-absorbable eHA powder particles, and spaces between the bone trabeculae filled with blood (Fig. 3D).

Discussion

Autografts are considered the gold standard in orthopedic reconstructive surgeries. They have a high success rate because of their disadvantages, which include restricted supply, donor site dismalness, and inflated costs. Another option is allografts, which wipe out the likely downsides of the autografts. However, their related constraints incorporate sickness transmission chance and a high disappointment rate in vivo because of decellularization and disinfection strategies (12). These drawbacks lead to a requirement for an elective uniting choice for bone reconstruction and regeneration. Thus, due to its profitable, plentiful stockpile and adaptable elements, Tissue engineering has emerged as a promising choice for bone medicines.

The current treatment choice uses bone tissue engineering through biomaterials, stem cells, or a combination (13). In the current study, eHA powder and autologous bone marrow aspirated were used as bone gap-filling material to heal bone defects. The clinical observations of experimental animals in the current study showed that they could bear weight on the operative limb after three days post-operation. This may be attributed to the supporting of the ulna bone to the fractured radius bone in the present study, and this was confirmed by some authors who said that when the fracture includes both the radius and ulna, the lameness appears more clinically than in cases of distal radial fracture with intact ulna (14, 15). Also, other clinical observations in the current study showed no signs of infection or rejection at the operation site, indicating the similarity of hydroxyapatite to an inorganic component of natural bone (16). Also, hydroxyapatite components, including calcium and phosphate ions, do not cause adverse local or systemic toxicity (10, 17).

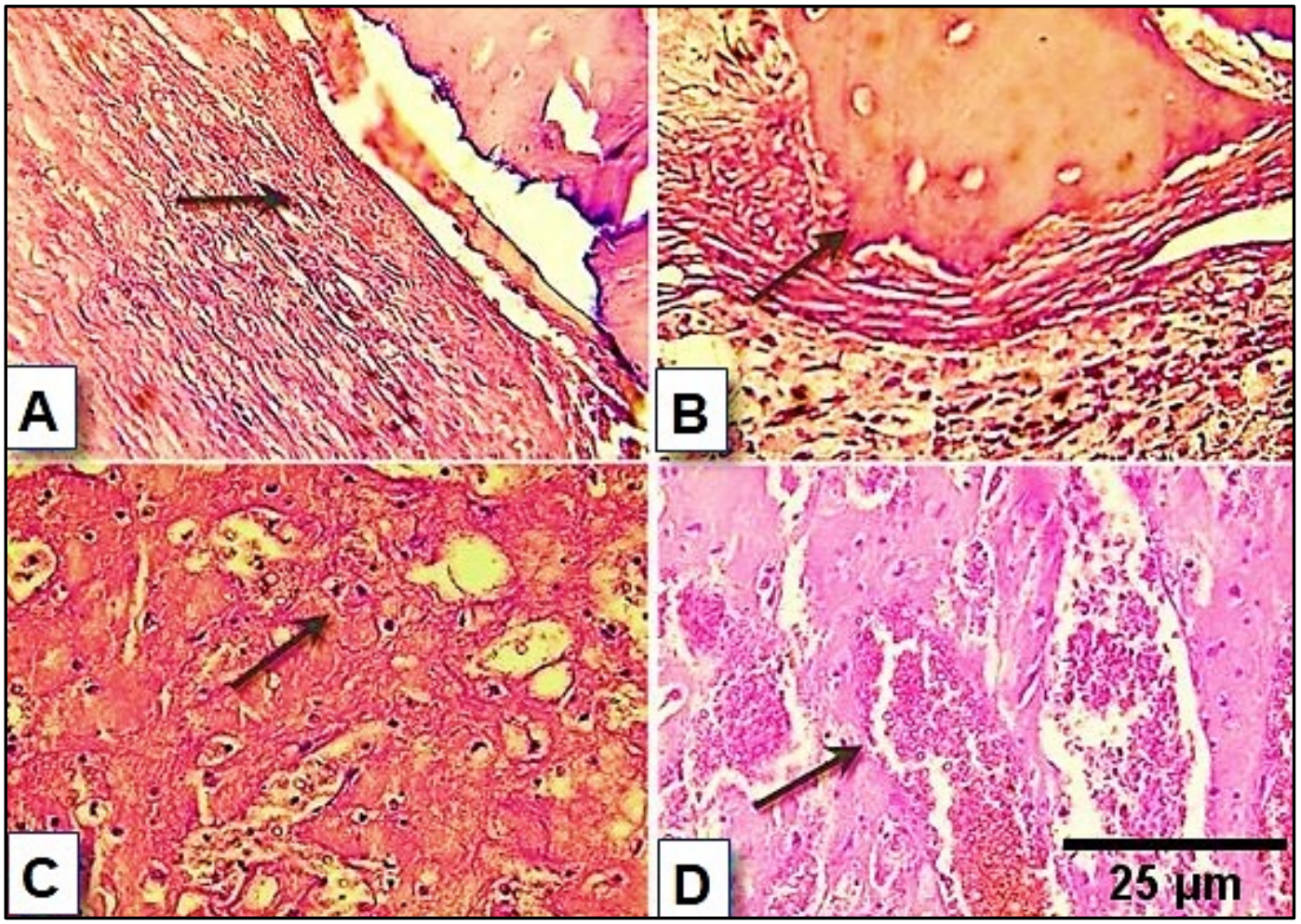

Figure 3: Histopathological sections of bone defect at the sixth week post-operation. (A) The GI group shows granulation tissue bound fragment bone, with thickening trabecular and lamellar bone at the end fracture speared into granulation tissue, which infiltrated by mononuclear cells (black arrow) (H&E 10X). (B) The GII group shows thick trabecular bone elongated from one side of the fractured bone (black arrow) (H&E 10X). (C) The GIII group shows a marked fibrin-rich blood clot with inflammatory cells filling the site of the defect (black arrow) (H&E 40X). (D) The GIV group shows marked variably sized bone trabeculae lined by osteoblasts surrounded by residue of non-absorbable eHA powder particles and spaces between the bone trabeculae filled with blood (black arrow) (H&E 40X)

The radiological findings of the present study showed adequate healing in the bone gap in all treated groups compared to the untreated control group, which appeared to have little bone formation. The eHA in treated groups GII and GIV showed a radiopaque eHA material occupying the bone gap, and the bone gap margin partially resorbed at the end of the eighth week. These results were confirmed by other studies (18, 19). Some authors explained that the improvement of bone repair could be because of the capacity of the HA to work with bone adsorption and calcium discharge, which stimulate osteoblast differentiation and bone development (20). Other studies indicated that the bioceramic scaffold architecture utilized in bone repair, such as porous structures, should be similar to natural bone to encourage cell ingrowth, proliferation, and differentiation (21). In the present study, using autologous bone marrow alone in GII and combination with eHA in GIV gave better bone gap regeneration results than the control group. These outcomes were explained by some authors (22, 23), who said that the cellular content of bone marrow, such as blood cells, cytokines, growth factors, and stem cells, all types of cells involved in the enhancement of rapid responses for inflammatory processes with an early huge role in bone fracture repair; and these results were confirmed by other researchers (15). Other studies confirmed that using bone marrow in transverse fractures in the distal radius of dogs gives good results in its reaction to fractured bone regeneration in the sixth and tenth weeks.

The histopathological findings in the present study showed markedly different sizes of bone trabeculae lined by many osteoblasts in groups planted with eHA. Some authors explained that egg shells contain large amounts of calcium carbonate, which can serve as a hydroxyapatite source and promote osteoblast cell formation and differentiation. Thus, the number of osteoblasts in eHA- the eHA-treated group will be much higher (24-26). These results come from the results of other authors (27). On the other hand, other studies concluded that Hydroxyapatite has biocompatible properties that can down-regulate and

migrate macrophages. This will lead to a decrease in the number of osteoclasts and an increase in the number of osteoblasts so that the bone healing process can occur faster (26). Other researchers indicated hydroxyapatite in the bone defect area stimulates osteoprogenitor cells to become osteoblasts. Hydroxyapatite also makes it easier for osteoprogenitor cells to occupy a suitable medium with actual bone conditions to proliferate and differentiate into osteoblast cells (27). In addition, the use of autologous bone marrow in combination with eHA powder in the present study showed the best healing of bone gaps, and this may be related to the characteristics of eHA in addition to the ability of bone marrow in bone defect regeneration due to its components of MSCs, hematopoietic stem cells, blood cell components, stromal cells populations, and growth factors (28). Others expressed that the injection of bone marrow percutaneously at the fractured site with the use of a composite graft gives good results in the treatment of simple bone cysts, congenital tibial pseudoarthrosis, and delayed bone union in troublesome clinical conditions such as cancer patients (29, 30).

Conclusion

We concluded that the use of avian eHA powder and autologous bone marrow aspiration is a beneficial grafting material that can fill the bone holes without immune rejection and have the ability to promote healing activity at the site of bone defects, and further studies will needed for clinical application of these grafting materials as a scaffold applications.

Acknowledgments

The authors are grateful to Dr. Omar Husian Kalaf in the Pathology Department at the College of Veterinary Medicine, University of Baghdad, for his help and valuable notice in completing this study.

Author's Contribution. NH and AG made contributions to the idea of the publication and organization of work and writing the manuscript.

Competing interest. The authors declare that they have no competing interests.

References

1. Pawelec K, eds. Bone repair biomaterials: regeneration and clinical applications. 2nd ed. Cambridge: Woodhead Publishing, 2018.
2. Kattimani VS, Chakravarthi PS, Kanumuru NR, et al. Eggshell derived hydroxyapatite as bone graft substitute in the healing of maxillary cystic bone defects: a preliminary report. J Int Oral Health 2014; 6(3): 15–9.
3. Agbeboh NI, Oladele IO, Daramola OO, Adediran AA, Olasukanmi OO, Tanimola MO. Environmentally sustainable processes for the synthesis of hydroxyapatite. Heliyon 2020; 6(4): e03765. doi: 10.1016/j.heliyon.2020.e03765
4. Szcześ A, Hołysz L, Chibowski E. Synthesis of hydroxyapatite for biomedical applications. Adv Colloid Interface Sci 2017; 249: 321–30. doi: 10.1016/j.cis.2017.04.007
5. 5. Ahmad Fara ANK, bin Yahya MA, Abdullah HZ. Preparation and characterization of biological hydroxyapatite (HAp) obtained from Tilapia fish bone. Adv Mat Res 2015; 1087: 152–6. doi: 10.4028/www.scientific.net/AMR.1087
6. Sobhi BM, Ismael EY, Mansour AS, Elsabagh M, Fahmy KNE. Effect of nano-hydroxyapatite as an alternative to inorganic dicalcium phosphate on growth performance, carcass traits, and calcium and phosphorus metabolism of broiler chickens. J Adv Vet Res 2020; 10(4): 250–6.
7. Vidal L, Brennan MÁ, Krissian S, et al. In situ production of pre-vascularized synthetic bone grafts for regenerating critical-sized defects in rabbits. Acta Biomat 2020; 114: 384–94. doi: 10.1016/j.actbio.2020.07.030
8. Stamnitz S, Klimczak A. Mesenchymal stem cells, bioactive factors, and scaffolds in bone repair: from research perspectives to clinical practice. Cells 2021; 10(8): 1925. doi: 10.3390/cells10081925
9. Jiang Y, Jahagirdar BN, Reinhardt RL, et al. Pluripotency of mesenchymal stem cells derived from adult marrow. Nature 2002; 418(6893): 41–9. doi: 10.1038/nature00870
10. Atiyah A, Al-Falahi N, Farhan F. Synthesis and structure of eggshell hydroxyapatite bone implant. Online J Vet Res 2018; 22(6): 495–500.
11. Alonzo M, Primo FA, Kumar SA, et al. Bone tissue engineering techniques, advances, and scaffolds for treatment of bone defects. Curr Opin Biomed Eng 2021; 17: 100248. doi: 10.1016/j.cobme.2020.100248
12. Andric T, Taylor BL, Whittington AR, Freeman JW. Fabrication and characterization of three-dimensional electrospun scaffolds for bone tissue engineering. Regen Eng Transl Med 2015; 1: 32–41. doi: 10.1007/s40883-015-0004-1
13. Szpalski C, Wetterau M, Barr J, Warren SM. Bone tissue engineering: current strategies and techniques—part I: scaffolds. Tissue Eng Part B Rev 2012; 18(4): 246–57. doi: 10.1089/ten.TEB.2011.0427
14. Manchi G, Brunnberg MM, Shahid M, et al. Radial and ulnar fracture treatment with paraosseous clamp-cerclage stabilisation technique in 17 toy breed dogs. Vet Rec Open 2017; 4(1): e000194. doi: 10.1136/vetreco-2016-000194
15. Thanoon M, Eesa M, Abed E. Effects of platelets rich fibrin and bone marrow on the healing of distal radial fracture in local dogs: comparative study. Iraqi J Vet Sci 2019; 33(2): 419–25. doi: 10.33899/ijvs.2019.163169
16. Goel SC, Singh D, Rastogi A, Kumaraswamy V, Gupta A, Sharma N. Role of tricalcium phosphate implant in bridging the large osteoperiosteal gaps in rabbits. Indian J Exp Biol 2013; 51(5): 375–80.
17. Dorozhkin SV. Calcium orthophosphate (CaPO4)-based bioceramics: preparation, properties, and applications. Coatings 2022; 12(10): 1380. doi: 10.3390/coatings12101380
18. Park JW, Bae SR, Suh JY, et al. Evaluation of bone healing with eggshell-derived bone graft substitutes in rat calvaria: a pilot study. J Biomed Mater Res A 2008; 87(1): 203–14. doi: 10.1002/jbm.a.31768

19. Kim SH, Kim W, Cho JH, Oh NS, Lee MH, Lee SJ. Comparison of bone formation in rabbits using hydroxyapatite and β-tricalcium phosphate scaffolds fabricated from egg shells. Adv Mat Res 2008; 47: 999–1002. doi: 10.4028/www.scientific.net/AMR.47-50.999

20. El-Ghannam A, Amin H, Nasr T, Shama A. Enhancement of bone regeneration and graft material resorption using surface-modified bioactive glass in cortical and human maxillary cystic bone defects. Int J Oral Maxillofac Implants 2004; 19(2): 184–91.

21. Chocholata P, Kulda V, Babuska V. Fabrication of scaffolds for bone-tissue regeneration. Materials (Basel) 2019; 12(4): 568. doi: 10.3390/ma12040568

22. Travlos GS. Normal structure, function, and histology of the bone marrow. Toxicol pathol 2006; 34(5): 548–65. doi: 10.1080/01926230600939856

23. Korf-Klingebiel M, Kempf T, Sauer T, et al. Bone marrow cells are a rich source of growth factors and cytokines: implications for cell therapy trials after myocardial infarction. Eur Heart J 2008; 29(23): 2851–8. doi: 10.1093/eurheartj/ehn456

24. Woeckel VJ, Alves RDAM, Swagemakers SMA, et al. 1α, 25-(OH) 2D3 acts in the early phase of osteoblast differentiation to enhance mineralization via accelerated production of mature matrix vesicles. Journal of cellular physiology. 2010; 225(2): 593–600. doi: 10.1002/jcp.22244

25. Lu H, Cui L, Zuo C, Lin S, Wu T. Evaluation of morphological parameters of bone formation in Sprague–Dawley rats of different ages by in vivo fluorochrome labeling. Ital J Zool (Modena) 2015; 82(1): 33–40. doi: 10.1080/11250003.2014.984781

26. Shafiu Kamba A, Zakaria ZAB. Osteoblasts growth behaviour on bio-based calcium carbonate aragonite nanocrystal. BioMed Res Int 2014; 2014: 215097. doi: 10.1155/2014/215097

27. Fuadiyah D, Ratnawati R, Kurniawati S, et al. Effect of chicken eggshell powder on osteoblast, osteocyte, and osteoprotegerin (OPG) expressions in alveolar bone defect healing of wistar rats. Mal J Med Health Sci 2023; 19(suppl. 5): 58–65.

28. Gayathri SB, Kamaraj P. Macrophage and osteoblast response to micro and nano hydroxyapatite: a review. Nano Vis 2011; 1(1): 1–13.

29. Ardhiyanto HB. Stimulasi osteoblas oleh hidroksiapatit sebagai material bone graft pada proses penyembuhan tulang. Stomatognatic 2012; 9(3): 162–4.

30. Sugaya H, Yoshioka T, Kato T, et al. Comparative analysis of cellular and growth factor composition in bone marrow aspirate concentrate and platelet-rich plasma. Bone Marrow Res 2018; 2018: 1549826. doi: doi: 10.1155/2018/1549826

Vpliv prahu hidroksiapatita iz jajčne lupine in avtolognega kostnega mozga na celjenje kostnih poškodb pri kuncih

N. H. R. AL-Falahi, A. G. Atiyah

Izvleček: Sanacija kostnih defektov ostaja izziv za klinično ortopedsko kirurgijo. Zato je bil namen te raziskave oceniti učinek uporabe hidroksiapatita iz jajčne lupine (eHA), predhodno pripravljenega iz jajčne lupine ptic s hidrotermalno metodo, in avtolognega kostnega mozga, pridobljenega iz stegnenice, na celjenje kostnega defekta na radialni kosti desne sprednje okončine pri kuncih. Študija je bila izvedena na 28 samcih kuncev, naključno razdeljenih v štiri skupine (n = 7); pri vseh poskusnih živalih (dolžina 10 mm × širina 2 mm) je bila ustvarjena kostna vrzel na sredini desne koželjnice, ki je segala do kostnega mozga. Vrzel v skupini GI je ostala odprta kot kontrolna skupina brez kakršnihkoli dodanih snovi. V skupini GII je bila kostna vrzel zapolnjena s prahom eHA. V skupini GIII je bila kostna vrzel zapolnjena z avtolognim kostnim mozgom, v GIV pa s kombinacijo eHA in kostnega mozga. Poskusne živali so bile klinično spremljane, rentgensko pregledane 2 tedna ter 4, 6 in 8 tednov po operaciji, histopatološko pa 4 tedne in 6 tednov po operaciji. Radiološke in histopatološke ugotovitve so pokazale obetavne rezultate v zdravljenih skupinah v primerjavi s kontrolno skupino, pri čemer so bili najboljši rezultati pri kombinaciji eHA in avtolognega kostnega mozga. Sklenemo lahko, da uporaba eHA in avtolognega kostnega mozga velja za koristen presadni material pri regeneraciji kostnih defektov.

Ključne besede: hidroksiapatit; prah iz lupine ptičjih jajc; avtologna aspiracija kostnega mozga; kostna vrzel