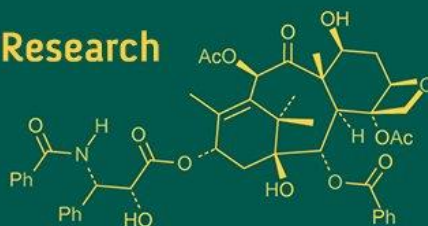


International Journal of Advanced Biochemistry Research



ISSN Print: 2617-4693
ISSN Online: 2617-4707
NAAS Rating (2026): 5.29
IJABR 2026; 10(6): 474-476
www.biochemjournal.com
Received: 26-03-2026
Accepted: 29-04-2026

Lavlesh Mishra
M.V.Sc. Scholar, Veterinary Surgery
and Radiology, CoVSc & A.H.,
NDVSU, Jabalpur, Madhya Pradesh,
India

Dharmendra Kumar
Professor at Department of Veterinary
Veterinary Surgery and Radiology,
CoVSc & A.H., NDVSU, Jabalpur,
Madhya Pradesh, India

Neelam Tandia
Associate Professor, Department of
Veterinary Veterinary Surgery and
Radiology, CoVSc & A.H., NDVSU,
Jabalpur, Madhya Pradesh, India

Priya Singh
Assistant Professor, Department of
Veterinary Veterinary Surgery and
Radiology, CoVSc & A.H. Rewa,
NDVSU, Jabalpur, Madhya Pradesh,
India

Shailesh Kumar Patel
Assistant Professor, Department of
Veterinary Pathology, CoVSc & A.H.,
NDVSU, Jabalpur, Madhya Pradesh,
India

Amit Jha
Assistant Professor, Department of
Veterinary Veterinary Surgery and
Radiology, CoVSc & A.H., NDVSU,
Jabalpur, Madhya Pradesh, India

Himanshi Majhi
M.V.Sc. Scholar, Veterinary Surgery
and Radiology, CoVSc & A.H.,
NDVSU, Jabalpur, Madhya Pradesh,
India

Atul Kumar Kushwaha
M.V.Sc. Scholar, Veterinary Surgery
and Radiology, CoVSc & A.H.,
NDVSU, Jabalpur, Madhya Pradesh,
India

Nitin Soni
M.V.Sc. Scholar, Veterinary Surgery
and Radiology, CoVSc & A.H.,
NDVSU, Jabalpur, Madhya Pradesh,
India

Tulika Sharma
M.V.Sc. Scholar, Veterinary Surgery
and Radiology, CoVSc & A.H.,
NDVSU, Jabalpur, Madhya Pradesh,
India

Mavle Siddharth Umesh
M.V.Sc. Scholar, Veterinary Surgery
and Radiology, CoVSc & A.H.,
NDVSU, Jabalpur, Madhya Pradesh,
India

Corresponding Author:
Lavlesh Mishra
M.V.Sc. Scholar, Veterinary Surgery
and Radiology, CoVSc & A.H.,
NDVSU, Jabalpur, Madhya Pradesh,
India

Effect of static magnetic field and platelet-rich plasma on fracture healing in rabbits: A comparative experimental study

Lavlesh Mishra, Dharmendra Kumar, Neelam Tandia, Priya Singh, Shailesh Kumar Patel, Amit Jha, Himanshi Majhi, Atul Kumar Kushwaha, Nitin Soni, Tulika Sharma and Mavle Siddharth Umesh

DOI: <https://www.doi.org/10.33545/26174693.2026.v10.i6f.8663>

Abstract

The present study was undertaken to evaluate and compare the effect of static magnetic field (SMF), platelet-rich plasma (PRP), and their combination on fracture healing in rabbits. Twenty-four healthy adult male New Zealand White rabbits were randomly divided into four groups comprising six animals each. A transverse fracture was surgically induced in the midshaft region of the radius under xylazine-ketamine anesthesia. Group A served as control and received immobilization only, Group B received immobilization along with static magnetic field therapy, Group C received platelet-rich plasma therapy, while Group D received a combination of static magnetic field and platelet-rich plasma therapy. Physiological, clinical and radiographic parameters were evaluated at regular postoperative intervals. The results revealed earlier pain reduction, decreased exudation, improved weight bearing, and accelerated radiographic healing in Group D compared to other groups. Serum alkaline phosphatase activity increased significantly during the active healing phase, especially in Group D, indicating enhanced osteoblastic activity. The study concluded that combined application of static magnetic field and platelet-rich plasma significantly enhances fracture healing in rabbits.

Keywords: Fracture healing, Static magnetic field, Platelet-rich plasma, Rabbits, Radiography, Bone regeneration

Introduction

Fracture is defined as a break in the continuity of bone with or without displacement of fragments (Tyagi and Singh, 2017) [10]. Fracture healing is a complex biological process involving cellular proliferation, biochemical reactions, and tissue remodeling. Healing of fractures generally occurs through sequential stages including inflammation, soft callus formation, hard callus formation, and remodeling. Although bone possesses an inherent capacity for regeneration, several therapeutic interventions have been developed to accelerate and improve the quality of healing.

Various methods such as bone grafting, hydroxyapatite implants, ultrasound therapy, electrical stimulation, and magnetic field therapy have been employed to enhance fracture repair (Oryan *et al.*, 2013) [7]. Among these modalities, static magnetic field therapy and platelet-rich plasma have gained considerable attention because of their regenerative and osteogenic properties (Wang *et al.*, 2023) [11].

Magnetic fields are known to stimulate endothelial proliferation, osteoblastic differentiation, collagen synthesis, and matrix calcification (Cho *et al.*, 1999) [1]. Static magnetic field therapy improves blood circulation, oxygen availability, and calcium ion deposition at the fracture site, thereby enhancing callus formation and tissue repair (Gujjalapudi *et al.*, 2016) [2].

Platelet-rich plasma (PRP) is an autologous concentration of platelets enriched with growth factors and cytokines. When applied at the fracture site, PRP releases bioactive molecules that stimulate angiogenesis, cellular proliferation, and bone regeneration (Wroblewski *et al.*, 2010) [12]. Keeping these beneficial effects in view, the present investigation was designed to evaluate and compare the effects of static magnetic field, platelet-rich plasma, and their combined application on fracture healing in rabbit.

Materials and Methods

The present study was conducted on healthy adult male New Zealand White rabbits of similar age at College of Veterinary Science and Animal Husbandry, Rewa. The animals were procured from certified animal house and was maintained on standard diet and ad libitum water. Seven days acclimatization period was provided to the animals prior to the initiation of the experimental procedures. Group D received a combination treatment consisting of splint immobilization, static magnetic field therapy, and platelet-rich plasma administration.

Anaesthesia and surgical procedure

The rabbits were anesthetised by inducing using xylazine hydrochloride @ 5 mg/kg body weight intramuscularly followed by ketamine hydrochloride @ 50 mg/kg body weight intramuscularly. The anterolateral aspect of the radius was aseptically prepared before the surgery. Animals were positioned in lateral recumbency. The forelimb was painted with povidone iodine and an incision was given on lateral aspect between elbow and carpal joint. The muscles were separated using artery forceps to visualize radius bone. A complete transverse fracture was created in the midshaft region of radius using an orthopedic wire saw through gentle to-and-fro movements. The muscles were sutured using absorbable suture material in simple continuous fashion and skin was sutured using non absorbable suture material in simple interrupted pattern. Post-operatively the rabbits were treated with enrofloxacin @ 5mg/kg and meloxicam @ 0.5mg/kg for three days. Immediately after surgery wooden splints were applied medio-laterally to the test limb for immobilization. Radiographic evaluation was done for the assessment of healing.

Application of static magnets

Two neodymium permanent magnets measuring 20 mm × 5 mm × 2 mm. were fixed medially and laterally for the duration of six hours daily at the fracture site using bandages.

Preparation and application of platelet rich plasma

Platelet-rich plasma was prepared following the modified double centrifugation method described by Jeong *et al.* (2020) [5]. Blood was initially centrifuged at 160 × g for 10 minutes to separate plasma and buffy coat. The separated fraction underwent second centrifugation at 400 × g for 10 minutes. Platelet-poor plasma was discarded and the remaining platelet-rich fraction was collected as platelet rich plasma (PRP). Prepared PRP was transplanted directly at the fracture site on 0, 7th and 14th postoperative days (Jee *et al.*, 2016) [4].



Application of platelet rich plasma static magnetic field

Statistical analysis

The data was analysed by employing statistical method as described by Snedecor and Cochran (1968) [9] using version 20 of SPSS software.

Results and Discussion

Radiographic Findings

In the present study, radiographic examinations were performed using 8 x 10" radiographic films with exposure factors of 56 kVp, 10 mAs, and a focal film distance (FFD) of 90 cm (Singh *et al.*, 2009) [8]. Radiographs were taken on the 0, 14th, 28th, 42nd and 56th postoperative days to evaluate callus formation and fracture union, following the protocol described by Hammer *et al.* (1985) [3]. In present study radiographic examination revealed accelerated callus formation and earlier fracture union. Periosteal reaction and bridging callus formation appeared. On postoperative day 42, radiograph demonstrated advanced callus formation with evidence of radiographic union in most animals. Complete radiographic union was observed by 56th postoperative day. The enhanced radiographic healing observed in magnetic field-In the present study, radiographic examinations were performed using 8 x 10" radiographic films with exposure factors of 56 kVp, 10 mAs, and a focal film distance (FFD) of 90 cm (Singh *et al.*, 2009) [8]. Radiographs were taken on the 0, 14th, 28th, 42nd and 56th postoperative days to evaluate callus formation and fracture union, following the protocol described by Hammer *et al.* (1985) [3]. In present study radiographic examination revealed accelerated callus formation and earlier fracture union. Periosteal reaction and bridging callus formation appeared. On postoperative day 42, radiograph demonstrated advanced callus formation with evidence of radiographic union in most animals. Complete radiographic union was observed by 56th postoperative day. The enhanced radiographic healing observed in magnetic field-treated animals may be attributed to increased vascularization, collagen synthesis, osteoblastic differentiation, and calcium ion deposition. PRP likely accelerated healing through release of growth factors that promoted angiogenesis and osteogenesis (Meglei *et al.*, 2025) [6].



Radiographs (A) After surgery (B) 14th day (C) 28th day (D) 42nd day (E) 56th day

Conclusion

The present study demonstrated that static magnetic field therapy and platelet-rich plasma individually enhanced fracture healing in rabbits. However, combined application of static magnetic field and platelet-rich plasma produced superior healing outcomes compared to either therapy alone. The combination therapy resulted in improved radiographic union. Therefore, combined application of static magnetic field and platelet-rich plasma may be considered an effective therapeutic strategy for enhancing fracture healing in clinical veterinary practice.

References

1. Cho MR, Thatte HS, Silvia MT, Golan DE. Transmembrane calcium influx induced by AC electric fields. *FASEB J*. 1999;13(6):677-683.
2. Gujjalapudi M, Anam C, Mamidi P, Chiluka R, Kumar AG, Bibinagar R. Effect of magnetic field on bone healing around endosseous implants: An *in vivo* study. *J Clin Diagn Res*. 2016;10(10):ZF01-ZF04.
3. Hammer RR, Hammerby S, Lindholm B. Accuracy of radiologic assessment of tibial shaft fracture union in humans. *Clin Orthop Relat Res*. 1985;199:233-238.
4. Jee CH, Eom NY, Jang HM, Jung HW, Choi ES, Won JH, *et al*. Effect of autologous platelet-rich plasma application on cutaneous wound healing in dogs. *J Vet Sci*. 2016;17(1):79-87.
5. Jeong W, Kim YS, Roh TS, Kang EH, Jung BK, Yun IS. The effect of combination therapy on critical-size bone defects using non-activated platelet-rich plasma and adipose-derived stem cells. *Childs Nerv Syst*. 2020;36(1):145-151.
6. Meglei AY, Nedorubova IA, Basina VP, Chernomyrdina VO, Goldshtein DV, Bukharova TB. The combined potential of PRP and osteoinductive carrier matrices for bone regeneration. *Int J Mol Sci*. 2025;26(17):8457.
7. Oryan A, Alidadi S, Moshiri A. Current concerns regarding healing of bone defects. *Hard Tissue*. 2013;2(2):1-12.
8. Singh S, Singh HN, Gangwar AK, Devi KS, Waghaye JY. Effect of *Asparagus racemosus* on fracture healing in rabbits: A radiographic and angiographic study. *Indian J Vet Surg*. 2009;30(1):13-16.
9. Snedecor GM, Cochran WC. Statistical methods. 6th ed. Kolkata: Oxford and IBH Publishing Co.; 1968.
10. Tyagi RPS, Singh J. Ruminant surgery. 13th ed. New Delhi: CBS Publishers and Distributors Pvt. Ltd.; 2017. p. 338-379.
11. Wang S, Liu Y, Lou C, Cai C, Ren W, Liu J, *et al*. Moderate static magnetic field promotes fracture healing and regulates iron metabolism in mice. *Biomed Eng Online*. 2023;22(1):107.
12. Wroblewski AP, Mejia HA, Wright VJ. Application of platelet-rich plasma to enhance tissue repair. *Oper Tech Orthop*. 2010;20(2):98-105.