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Studies on management of radius fractures in dogs using point contact fixator plate system (PC-FIX)

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Abstract
The efficacy of Point Contact Fixator plate system (PC-Fix) for the treatment of radius fractures was studied in clinical cases presented to Department of Veterinary Surgery and Radiology, Veterinary College Hospital, KVAFSU, Bengaluru. Six cases of radial fractures were selected for the study. The most frequent occurrence of radial fractures was observed in male dogs of Non-descript breed, aged less than one year. The right radius was commonly affected, with closed, transverse, distal diaphyseal fractures being prevalent. The Point Contact Fixator plate system (PC-Fix) offered sufficient stability, effectively holding the fracture fragments in place. Clinical assessment of weight bearing and grading of lameness was performed in all the cases at the appropriate intervals of the study. Five out of six dogs progressed to achieve normal weight bearing by the end of the study. One dog out of the six clinical cases experienced complications during the fracture healing period, resulting in a failure to improve in terms of limb function. Post-operative radiographic assessment showed excellent bone healing with the formation of bridging callus at the fracture site. Point Contact Fixator plating (PC-Fix) was a beneficial option for managing Radius fractures in dogs, potentially yielding positive outcomes in terms of functional restoration and fracture stabilisation.

Keywords: Dogs, radius fractures, point contact fixator plate system (PC-FIX), radiography.

Introduction
Trauma stands out as the predominant cause of fractures in small animals, brought about by bending, torsional, shearing, and compression forces. These forces can lead to various fracture types, including oblique, wedge fragment, spiral, or comminuted fractures. In dogs, fractures are frequently observed in the femur, followed by the tibia and radius-ulna (Harasen, 2003) [4]. Fracture management is a major concern in Veterinary practice as it requires proper diagnosis and surgical skills to restore the anatomical conformation of the pet animals. Techniques used for Radius and Ulna fracture stabilisation included casts, external skeleton fixation, intramedullary pinning, rigid plates with screws, reconstruction plates and biodegradable plates associated with autogenous cancellous bone grafts (Haas *et al*., 2003) [3]. The primary objectives in treating fractures involve preserving intramedullary and periosteal vascularization, achieving anatomical reduction, applying inter-fragmentary compression to bone fragments, and facilitating an early return to normal locomotory function (Newton and Nunamaker, 1985) [8]. Development of Point Contact Fixator (PC-Fix) design has nearly eliminated the disruption of the periosteal blood supply by drastically reducing the implant to bone interface and application of monocortical screws that engage into the screw hole helps in the preservation of the endosteal blood supply (Tepic and Perren, 1995) [12]. When compared to conventional plating, Point Contact Fixator (PC-Fix) plating may offer considerable benefits, such as less contact with the bone, a better blood supply beneath the plate, better vascularization and localized, isolated points of contact reducing the risk and spread of infection, an improved healing process which does not require internal remodeling of larger necrotic areas of bone (Perren and Buchanan, 1995) [9]. The study was undertaken to document the clinical efficacy of Point Contact Fixator (PC-Fix) for the repair of radius fractures in dogs.

Materials and Methods

The present clinical study on stabilisation of radius fractures using Point Contact Fixator (PC-Fix) was conducted in six clinical cases of dogs presented to the Department of Veterinary Surgery and Radiology, Veterinary College Hospital, Hebbal, Bengaluru. Routine clinical, orthopaedic and radiographic examinations were performed to diagnose the fractures of radius and ulna. After confirming, six cases of radius fractures of skeletally mature animals was selected, and the fracture was reduced and stabilised by the Point Contact Fixator (PC-Fix) plates (Figure 1).

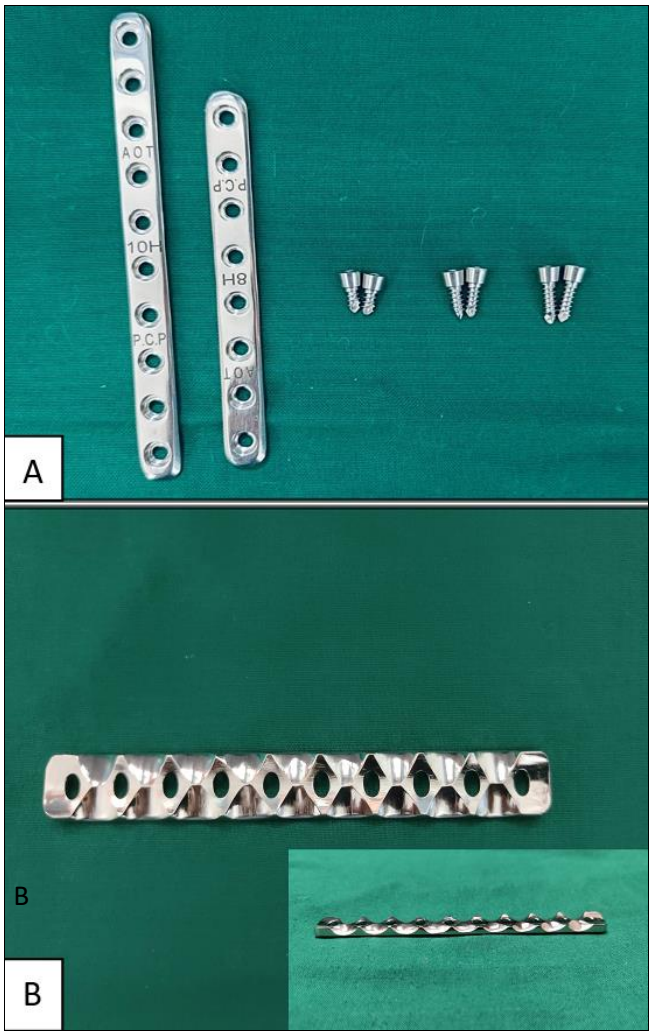


Fig 1: A: PC-Fix plates and monocortical screws with conical head used for the study. B: Bottom surface of plate showing pointed contact surfaces.

Radiographic examination

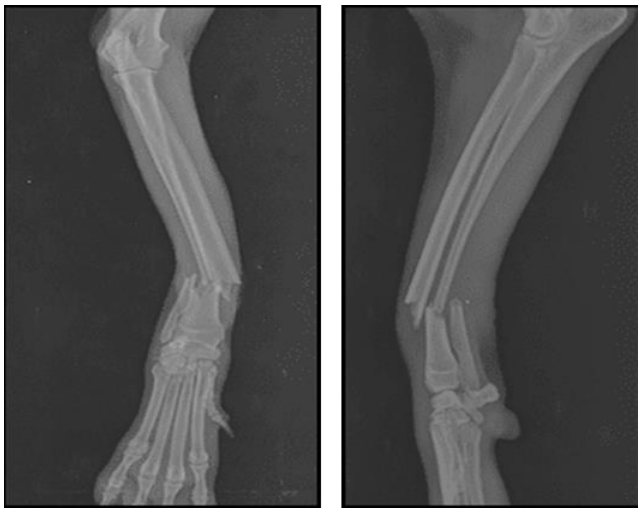
All six dogs were subjected to pre-operative radiographic examination in two orthogonal views. Plain anterio-posterior and medio-lateral views of affected limb including the concerned joints were obtained. The type and site of the fracture were ascertained from these radiographs. Similarly radiographic measurements of contralateral limbs were taken for selecting suitable plates and screws. Pre-operative radiographs of the dogs with radius fractures were presented in Figure 2.

Pre-operative preparation

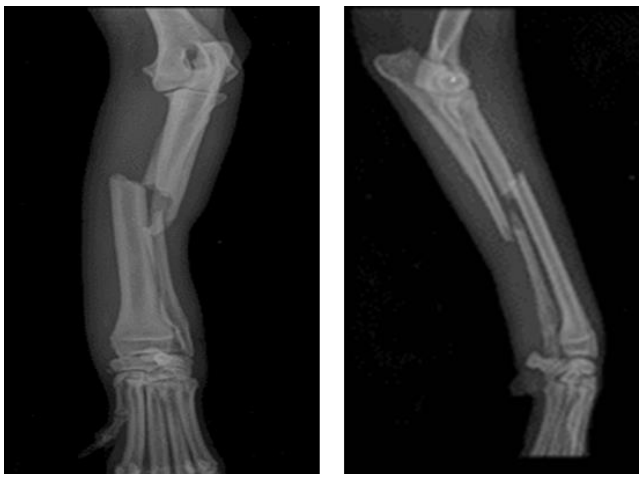
The owners were advised to withhold food for 12 hours and water for about 6 hours prior to surgery. The affected limb was prepared aseptically by clipping the hair surrounding the fracture site taking care to include upper and lower joints. The operating site was shaved and swabbed with surgical spirit and 7.5% Povidone iodine scrub. All the dogs were given injection Ceftriaxone (Intacef Pet® injection IP, 500 mg Vial, Intas.

Case 1

Case 2



Case 3



Case 4

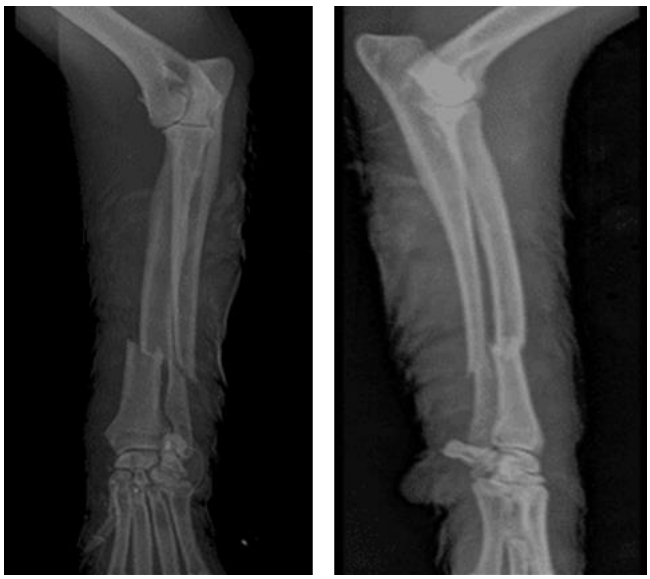


Fig 2: Pre-operative radiograph showing fractures of radius-ulna

Pharmaceuticals Ltd., Ahmedabad-10) @ 25 mg/kg body weight intravenously as Pre-operative antibiotic and injection Meloxicam (Melonex® BP, (5mg/mL), Intas pharmaceuticals Ltd., Ahmedabad-30) at the rate of 0.2 mg/kg body weight subcutaneously as pre-emptive analgesia, 30 minutes prior to the surgery.

Anaesthesia

Atropine sulphate (Atropy® injection IP, (1 mg/mL), Martin and brown biosciences, Baddi, HP) at the rate of 0.04 mg/kg body weight intramuscularly followed 10-15 minutes later by Xylazine hydrochloride (Xylapro® injection USP, (20 mg/mL), Pharma corporation of India, Bengaluru) at the rate of 1 mg/kg body weight intramuscularly was administered as pre-anesthetic medication. General anaesthesia was induced and maintained with 2.5 per cent Thiopentone sodium (Thiosol sodium® injection IP, 500 mg vial, Neon Laboratories Ltd., Mumbai-93) at the dose rate of 12.5 mg/kg body weight intravenously after 10-15 minutes of pre-anaesthetic medication to the effect.

Surgical Procedure

All the dogs were placed on lateral recumbency with the affected limb upwards. Area below the carpal joint was covered with protective bandage using sterile roller gauze. A linear skin incision was made along the cranio-lateral border of the affected radius at the fractured site and extended further based on the required length. The subcutaneous tissues were then incised to expose the radial diaphysis. The extensor tendons were elevated to expose the cranial surface of the radius. The fracture site was thus exposed.

Suitable sized Point Contact Fixator (PC-Fix) plate with number of holes based on the length of the bone was placed on fracture site and held firmly with bone holding forceps. The bone was pre drilled with 2.2 mm and 2.7 mm drill bits for plates of 2.7mm and 3.5mm size respectively, using a low speed high torque electric drill. Screws of suitable length was then placed at the pre drilled hole and tightened using a hexagonal orthopaedic screw driver to secure the plate to the bone. After completion of plating, subcutaneous tissue was closed using no. 1-0 Polyglactin 910 (Vicryl®, Ethicon, Johnson & Johnson Ltd., Aurangabad-36) in simple continuous suture pattern. Skin suturing was done using no. 2-0 Polyamide suture material (Trulon®, Healthium Medtech Pvt. Ltd., Bengaluru-58) in horizontal mattress suture pattern (Fig.3).

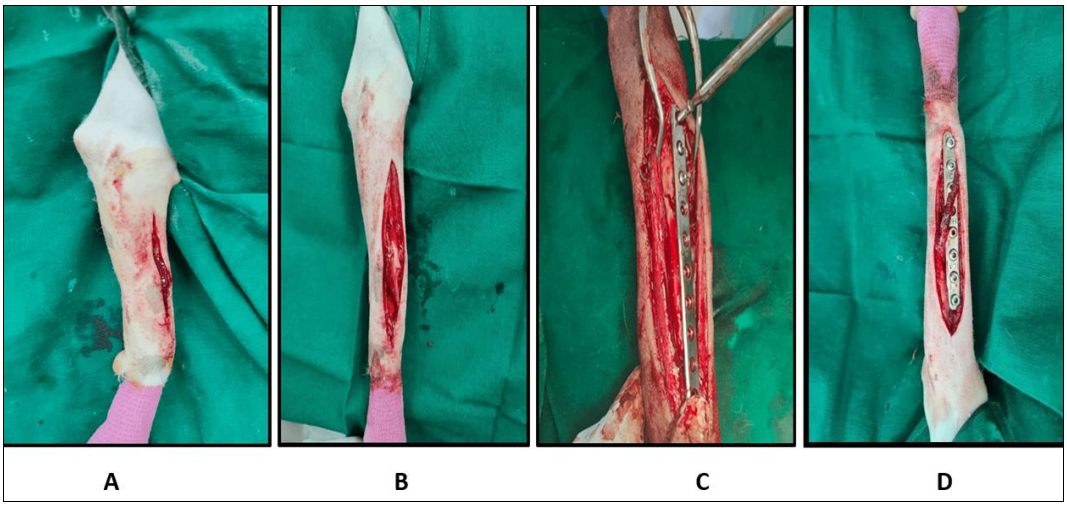


Fig 3: Surgical procedure, A: Skin incision, B: Exposure fracture fragments, C: Tightening of screw and fixing of plates to the bone, D: Completed bone plating

Post-Operative Care and Management

The incision site was covered with a thin layer of sterile gauze bandage dipped in 5% Povidone iodine solution. Over this Robert jones bandage was applied for limb immobilization. Tablet Cephalexin was administered orally for ten days at the dose rate of 25 mg/kg twice daily to prevent any infections, and Carprofen was administered orally for three days at dose rate of 2 mg/kg once daily as analgesic. Surgical wound dressing was done on alternative days. Skin sutures were removed on the 10th post-operative day.

Results and Discussion

Post-Operative Lameness grading

The lameness score in dogs subjected to radius fracture repair with PC-Fix plates was evaluated pre-operatively and post-surgery on 0th, 7th, 14th, 28th, 45th and 60th day as per the guidelines of Vasseur *et al.* (1995) [13]. Prior to surgery, all animals exhibited grade V lameness (inability to bear weight on the limb at rest or while walking). Additionally, the affected limb appeared shorter compared to the normal limb. This was in agreement with Piermattei *et al.* (2006) [10].

Among the six dogs of study, five dogs achieved Grade I lameness (complete weight bearing at rest and walk) during the period of study. Grade III lameness (partial weight bearing at rest and walk) was achieved after 7th post-operative day in five dogs whereas, Grade IV lameness (partial weight bearing at rest and non-weight bearing at walk) was observed in one dog. Five out of six dogs further progressed to achieve Grade I lameness by the 60th post-operative day (Fig.4). This may be attributed to implants superior mechanical rigidity and stability and adequate stabilisation of the fracture fragment. This was in accordance with Kumar (2021) [6]. However, one dog out of the six clinical cases experienced complications during the fracture healing period, resulting in a failure to improve in terms of limb function. Grade IV lameness persisted in this dog till completion of study period and this was due to periosteal reaction and osteomyelitis developed during the post-operative period.

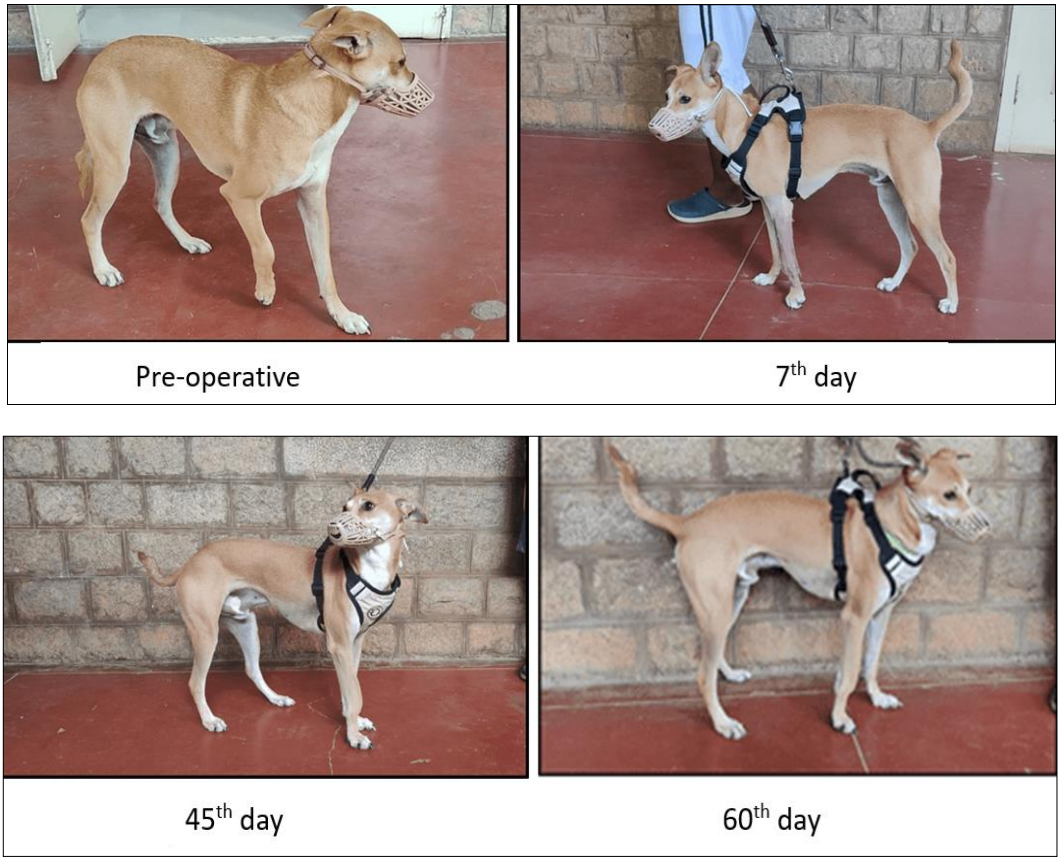


Fig 4: Picture showing weight bearing on pre and post-operative days in a dog (Case 2)

This complication might be due to contamination of the fracture site due to injury of the skin or during surgical interference. Similar findings were reported by Johnson *et al.* (1994) [5], Miller *et al.* (1998) [7], Rahal *et al.* (2003) [11] and Gibert *et al.* (2015) [2].

Radiographic Observations

Post-operative radiographs taken immediately after surgery showed proper positioning of the plate and screws at the cranial aspect of the radius, providing correct alignment and apposition of the fracture fragments. Stability of the implant and fragments were observed to be adequate. Post-operative 14th day anterio-posterior and medio-lateral radiographs revealed no alteration in alignment of the plate in all cases. There was reduction in the fracture gap indicating fracture healing process. Post-operative 28th day anterio-posterior and medio-lateral radiographs of the affected radius stabilized with PC-Fix plates revealed no alteration in alignment of the plate in all cases. There was visible callus formation bridging the ulnar fracture site. Post-operative 60th day radiographs showed good evidence of callus formation with satisfactory bone healing in five out of six dogs. Similar findings were reported by Kumar (2021) [6] and Abhiram (2022) [1]. The implant stability was found to be satisfactory in all the six dogs. The fracture line disappeared and restitution of cortico-medullary continuity was observed on radiographs. This implies that stable and rigid internal fixation of the fractured fragments contributed to minimal callus formation and facilitated early remodeling (Figure 5). However in one dog complications in fracture healing like periosteal reaction and osteomyelitis were noticed (Figure 6). Later this was managed clinically with Clindamycin tablet @ 15 mg/kg twice daily for one month (Figure 7).

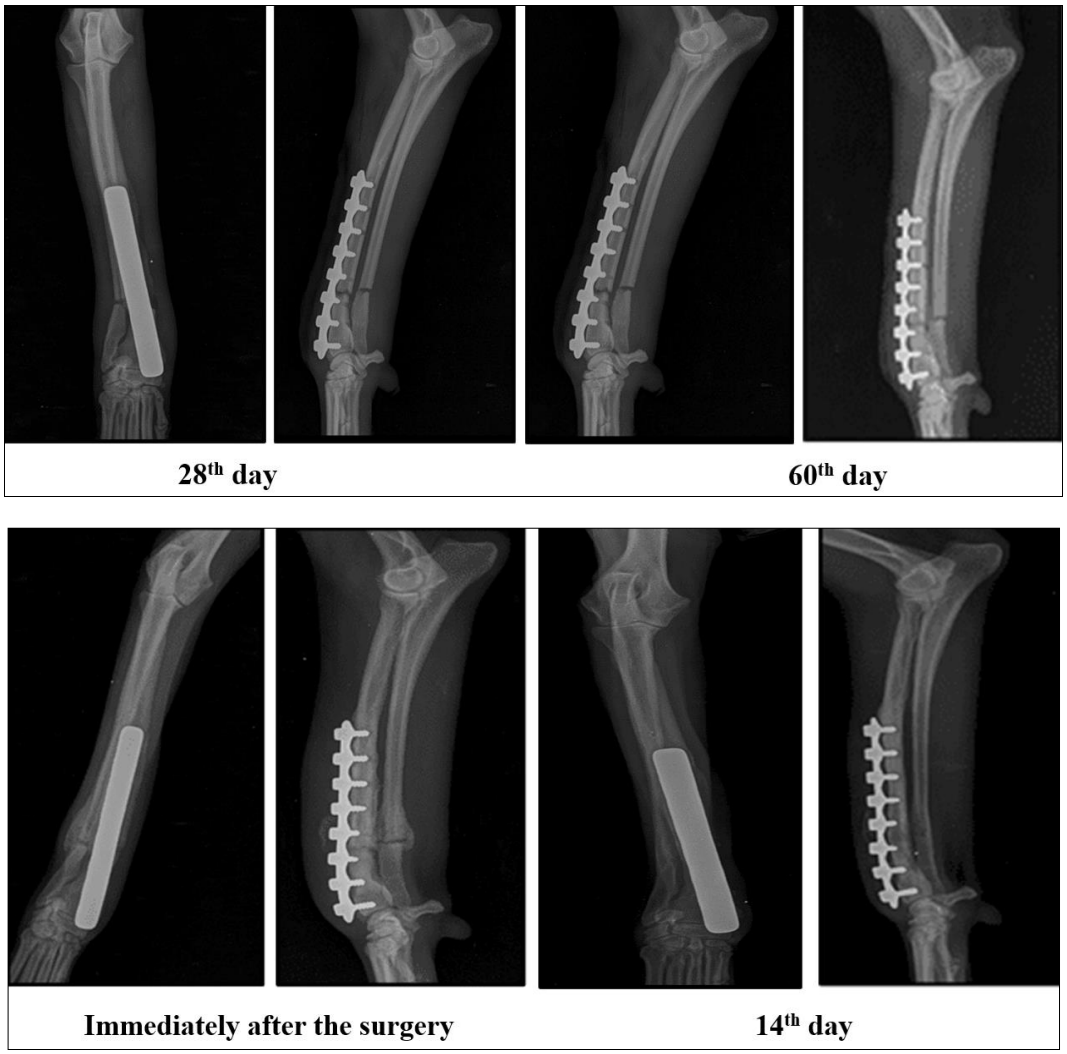


Fig 5: AP and ML view of post-operative radiographs

Fig 6: Radiographs showing osteomyelitis and periosteal reactions (Case 3).

Fig 7: AP and ML radiographic view of operated limb (Case 3) post Clindamycin therapy.

Conclusion

Point Contact Fixator (PC-Fix) plate system was well tolerated by all the dogs in the study and was found to be satisfactory throughout the study period in all the cases. No implant failure was noted till the completion of the study period. Point Contact Fixator (PC-Fix) plating may offer considerable benefits, such as less contact with the bone, a better blood supply beneath the plate, better vascularization and an improved healing process which does not require internal remodeling of larger necrotic areas of bone. Moreover use of monocortical screws enabled in minimising stress induced osteopenia, giving adequate stability and strength to the bone even after implant removal. It potentially yielded positive outcomes in terms of surgical procedure, functional restoration, bone stability and fracture fixation. Overall the point only contact with the bone and monocortical screws imparted less stress on fractured bone and early recovery.

Conflict of Interest

Not available

Financial Support

Not available

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