ISSN No:-2456-2165

Clinical Outcomes of Locking Compression Plating Technique in Long Fracture of Dog with or without Osteoinducer by using Ct Scan: 12 Cases

Abhijit Nikam[1],
[1]MRes., Scholar., Animal Science, Life Science Department,
Aberystwyth University, Aberystwyth, Wales, United Kingdom(UK).

Ramprasad P. Mandade[2],
[2]M.V. Sc. Scholar., Department of Veterinary Surgery & Radiology, Nagpur Veterinary College, Maharashtra Animal and Fishery Sciences University,
Seminary hills, Nagpur-440006, India

Govind V. More[3]
[3]M.V. Sc. Scholar., Department of Veterinary Pharmacology & Toxicology, Nagpur Veterinary College, Maharashtra Animal and Fishery Sciences University,
Seminary hills, Nagpur-440006, India

Abstract:- The research was carried out on twelve canines that presented with long fractures at Veterinary clinical complex, Nagpur veterinary college, Nagpur. The fracture was identified pre-operatively with orthopaedic and radiographic examinations. Fracture stabilization using the method of open reduction and internal fixation was used in all twelve canines. This procedure included the utilization of 3.5mm locking compression plates. Preoperative planning was carried out using demographic data in conjunction with clinical and radiological examination. Using locking plates in a locking way, a stable fixation was obtained. Consistent scoring and evaluation of stance, gait, discomfort, and lameness revealed progressive improvement. By the 45th day after surgery, all patients were able to fully bear their weight without showing any signs of lameness. In all of instances, primary bone healing began in the 14th day after surgery, and by the 45th day after surgery, full cortical continuity had been seen. When used to lengthy bone fractures in dogs, the locking compression plating technique effectively compressed the spaces between the fracture fragments, leading to radiographic primary union and excellent functional outcomes. Applying the locking compression plating technique to a dog's fracture of the long bone resulted in efficient inter-fragmentary compression, full radiographic primary union, and superb functional results. secure plates in addition to the usual screws for the cortex and the cancellous bone. Good fracture stability was achieved by selecting the right size of plate and screws based on body weight and kind of fracture. We used radiographs and lameness grading to see how well the fracture had healed after stabilization. All of the animals demonstrated weight bearing, functional limb utilization, and excellent joint mobility by the 45th day postoperatively, on average. The functional output was outstanding throughout the study. All patients had an average recovery duration of 45th day postoperatively . After the operation, the radiographs indicated that the fractures had healed beautifully, with no visible fracture lines and a little amount of callus that had healed into a bridge. Findings from this research support the use of locking compression plates to stabilize long bone fractures, allowing for faster limb ambulation and recovery.The research did not include records of frequently seen problems such as osteomyelitis, delayed union, malunion, and nonunion.The application of the LCP plate was determined to be efficacious in the management of long bone fractures in canines by the use of early pain-free ambulation.

Keywords:- *Fracture healing, Dogs, long bone fracture, Locking compression plate, Radiology.*

I. INTRODUCTION

Bones are a vital anatomical component of vertebrate organisms. Tendons facilitate muscle attachments and provide both strength and mobility. The bones experience both physiological and sometimes supra physiological stresses.

Bone fractures frequently result from external stresses, such as falls or car accidents, that exceed the physiological limits of the bone. If the pressures applied to a bone surpass its limit and ultimate strength, it will result in the shattering of its anatomical integrity. The kind of fracture and extent of soft tissue injuries are determined by the direction and quantity of the force exerted on the bone (Burns, 2010).

Various treatments, such as external fixation, internal fixation, and immobilization by casting, bracing, or splinting, have been used to treat fractures of long bones. Small animals, such as dogs and cats, have a higher occurrence of long bone fractures owing to the rise in the number of cars in urban areas. (Aithal *et. al*., 1999).

The locking compression plating system is a modern approach to reducing fractures in unstable diaphyseal and metaphyseal fractures.The use of an internal fixator with locking mechanism enables the production of callus by enhancing the flexibility in stabilization (Egol*et. al*., 2004).

The Locking Compression Plate (LCP) allows for the insertion of both conventional and locking head screws into specifically designed combination holes. The implementation of this novel plate hole design allowed for the use of both conventional screws and locking head screws (LHS), leading to enhanced stability at a fixed angle (Farley *et. al.*,1992).

Computed tomography may be useful in assessing fractures of long bones when clinical examination and conventional radiography do not provide sufficient information about the healing process. (Ethan *et. al.*, 1986)

The use of computed tomography (CT) in medical practice has been quickly rising due to the decreased cost, greater accessibility, and advancements in knowledge and technology. The applications of contrast CT technology in veterinary research, particularly in regards to bone, vascular, and soft tissues, need exploration and comparison across various species. CT is crucial for diagnosing several ailments and has applications in surgical improvements, anatomical studies, and education worldwide. (Matthew Keane *et. al.* , 2017)

Computed tomography (CT) has been used to examine several bone and development abnormalities. CT scanning is valuable for seeing both macroscopic and microscopic aspects of anatomy. It may reveal fractures, general morphology, micro fractures, bone thickness, trabecular bone deformation and architecture, as well as bone curvature and angles in their original position. When considering the large range of activities that may be applied to the typical human body, CT and µCT are extensively used in the study of illnesses, disorders, and other research areas. Local mechanical strain may be inferred by measuring cortical bone thickness and trabecular bone deformation. These indications are likely associated with various bone illnesses, as well as fractures and traumatic occurrences. (Cornette *et. al*,2015)

Platelet-rich plasma (PRP) is a highly concentrated solution of key growth factors that play a crucial role in the early stages of healing and bone regeneration. These growth factors include platelet-derived growth factor (PDGF), transforming growth factor beta, insulin-like growth factor, and epidermal growth factor.(Lenza, 2013).

II. MATERIALS AND METHODS

The present study was conducted on 12 clinical cases of dogs having long bone fracture presented to the Department of Veterinary Surgery & Radiology, Nagpur Veterinary College, Nagpur selected for the study. The dogs were divided into 2 groups, viz. Group I and Group II consisting of 6 dogs each. Fracture of group I wastreated by locking compression plate along with osteogenic inducer (PRP) whereas the case of group II weretreated with locking compression plate without osteoinducer.

Table 1: Plan of research

Sr. No.	Group	Treatment
1.	I (n=6)	Bone Plating With PRP
2.	II (n=6)	Bone Plating Without PRP

A. *Radiographic examination*

The pre-operative radiographs were taken of the affected bone in anterio-posterior (AP) and lateral (L) view to evaluate the type of the fracture, the position of the fracture fragments along with any splinter which might result into bone loss.

B. *Selection of locking compression plates and self-tapping locking head screws*

The size of Locking compression plate (LCP) and self-tapping locking head screws to be used were determined on pre-operative radiographs as well on actual assessment of fractured fragments during surgery. The LCP and the self-tapping locking head screws used were made up of 316L stainless steel. The plates with combination holes comprising of dynamic compression unit (DCU) for standard cortical screws and threaded hole for locking head screw were used. A3.5 mm LCP of six, seven, eight and nine holes with self-tapping 3.5 mm locking head screws were used in the present study.

C. *Pre-operative medication*

All dogs were injected with Cefotaximeat the dose rate of 20 mg/ kg body weight, intravenously andinjection Meloxicam was administered at the dose rate of 0.2 mg/kg body weight intramuscularly for pain management. Fluid therapy i.e. Ringers lactate (RL)at the dose rate of 20 to 40 ml / kg body weight intravenously, was administered to all the cases during pre-anaesthetic preparation to maintainhydration.

D. *Preparation of site*

The surgical site was aseptically prepared by shaving and scrubbing with chlorohexidine gluconate, cetrimide and isopropyl alcohol solution Aceptik4forfour times and then povidone iodine5paint was applied.

E. *Anaesthesia*

Pre-operatively,all the animals were kept off fed for 12 hours. In all the dogs Inj. Atropine sulphateat the dose rate of 0.04 mg/kg body weight and Inj. Dexamethasoneat the dose rate of 0.5 mg/kg body weight was administered subcutaneously half an hour prior to surgery as pre anaesthetics. Later on the dogs were sedated with Inj. Diazepam hydrochloride at the dose rate of 1 mg/kg body weight intravenously. Induction of anaesthesia was done with thiopentone at the dose rate of 4 mg/kg body weight intravenously, followed by maintenance with Isofluraneat 2% to2.5%

F. *Preparation of Platelet rich Plasma*

Intravenous blood was collected from each animal before the implantation procedures and automated platelet count was obtained. A minimum platelet count of 1000,000/ml was required for which total 5.0ml of intravenous blood was collected in a disposable sterile syringe. The blood was placed in vacuum glass tubes containing 0.5ml of 10% tri sodium citrate solution and a cycle of 1200 rpmcent rifugation was performed for 10 minutes at 22°C for platelet separation.

Locking dynamic compression, also known as a locking compression plate (Miller and Goswami, 2007), is applied to the tension surface of the bone. Specifically, it is applied to the lateral surface in the case of the femur, the anterolateral aspect in the case of the radius and ulna, and the medial aspect of the tibia. The LCP was secured in place by a minimum of three screws on each side of the pieces, ensuring the appropriate size was chosen and maintained.

G. Surgical procedure

Following anatomical dissection, the shattered pieces were revealed and the table surface of the fragments was freshened using a periosteal elevator and bone gouge. Subsequently, traction applied on the distal part of the limb to bring the fracture fragment together in a precise and aligned manner by careful manipulation. After proper alignment, they were held in position with Lowman's bone clamp. Then locking compression plate of proper size was applied on the tensile surface of the bone i.e. over the total length of the bone and then it was placed under the jaws of Lowman's bone clamp with little manipulation.

The drill sleeve was attached to the threaded part of the hole of plate to ensure correct angulation (90°). Holes were drilled in the threaded hole using drill sleeve, drill bit and an electric drill. Normal saline drip was continuously sprinkled during drilling to prevent heat necrosis of the bone. The length of the screws required were measured with depth gauge and the locking head screws of appropriate length were driven with locking hexagonal screw driver into the bone plate. Initially the first proximal and last distal hole was fixed with locking head screw to ensure fixing of the plate to the fractured fragments. Further, Lowman's bone clamp was removed and all the other holes on the bone plate were drilled and fixed with locking head screws (Leighton, 1993). After complete fixation of the fractured fragments with LCP, the surgical site was flushed with normal saline containing Amikacin. The wound was sutured with polygalactin& skin with nylon.

H. Post operative CT scan

General anesthesia was induced for CT scan. Fasting of dog was done by withholding water for minimum6 hours and food for 12 hours prior to CT scan. This prevent complications during induction and maintenance of anesthesia during CT scan.

I. General post-operative care andmanagement

- An Elizabethan collar was placed around the dogs' necks to prevent them from engaging in self-mutilation and injuring the surgical site.
- The owner was advised to closely monitor the dog for any indications of discomfort or biting at the surgery site.
- The dogs were given Inj. Cefotaxime at a dosage of 20 mg/kg body weight by deep intramuscular injection for 10 days after surgery.
- Analgesics, such as Meloxicam, were given intramuscularly at a rate of 0.2 mg/kg body weight for 5 days after surgery.
- A povidone iodine solution was used to clean the surgery wound, and Pendistrin-SHointment13 was used to treat it.
- Movement of the affected limb was restricted for fifteen days with complete rest; moderate exercise, such as short-distance walking, was subsequently recommended.
- The skin sutures were removed on 10th post-operative day.
- Bone plate was kept at the site. Removal was decided as per the case andsituation.

J. Special post-operative care andmanagement

- The dressing of the wound was done for first three days after surgeryand then on alternate days for early and appropriate woundhealing.
- One Tablet Serratiopeptidase 14OID was given orally for five post-operative day

The surgical wounds healed well in all the dogs without any complications. The skin sutures were removed on the 12thpostoperative day in all the dogs. To determine the orientation of the fracture, radiographs of the afflicted limb in anterio-posterior (AP) and mediolateral (ML) views was taken before surgery and immediately after surgery in all the dogs. Radiographs of the affected bone was taken immediately after surgery, as well as on 7th, 14th, 28th and 45th day later to examine the fracture fragment alignment, callus formation, plate and screw status and fracture healing in both the groups. Parameters was evaluated in radiography including plate and screw position, Bone fragment alignment, Bone fragment anatomical apposition, Callus production, Implant material employed and its response with bone, Fracture healing in the radiographic stage.

III. RESULTS AND DISCUSSION

In present study, total 12 clinical cases of the dogs with long bone fracture presented at Veterinary clinical complex, Nagpur veterinary college , Nagpur for study. The dogs were divided into 2 groups, viz. Group I and Group II consisting of 6 dogs each. Fracture of group I wastreated by locking compression plate along with osteogenic inducer (PRP) whereas the case of group II weretreated with locking compression plate without osteoinducer.Locking compression bone plating was done to immobilise the fracture. The healing of the long bone fracture bones was assessed by evaluating the different parameters at different time intervals. Pre operative medio lateral (ML) and anterio-posterior (AP) radiographs of long bone of affected limb were taken.

The details of study of case in both groups were recorded and deplected in table 2. This study revealed that Non descript dogs (n-10) had higher prevalence followed by beagle (n-1) and spitz (n-1) breeds. The total of 8 male dog and twofemale dog between age groups of 1-4 years were recorded. Etiologicalfactors responsible for fracture of lone bone in dog (n-12) were due to automobile accidents with four wheelers / two wheelers.

Table 2: Detail of cases and types of fracture included in Group I

Case No.	Breed	Gender	Age	Etiology	Affected bone	Time elapsed Since injury (Days)	Types and location of fracture
1	**Non Descript**	**M**	**1 yr**	**Automobile accident**	**Tibia Fibula**	**4 days**	**Simple transverse proximal third**
2	Beagle	M	2 yr	Fall from height	Tibia Fibula	7 days	Spiral mid shaft
3	Non Descript	F	1.5 yr	Automobile accident	Radius ulna	9 days	Simple transverse midshaft
4	Non Descript	M	4 yr	Automobile accident	Femur	1 days	Transverse at distal third
5	Non Descript	M	2.5 yr	Automobile accident	Tibia Fibula	10 days	Simple transverse midshaft
6	Non Descript	M	2 yr	Automobile accident	Radius ulna	8 days	Simple transverse midshaft

Table 3: Detail of cases and types of fracture included in Group II

Case No.	Breed	Gender	Age	Etiology	Affected bone	Time elapsed Since injury (Days)	Types and location of fracture
1	Non Descript	M	1 yr	Automobile accident	Radius ulna	4 days	Proximal third diaphyseal transverse fracture
2	Beagle	M	2 yr	Automobile accident	Radius ulna	7 days	simple mid shaft
3	Spitz	F	1.5 yr	Automobile accident	Tibia Fibula	9 days	Oblique midshaft
4	Non Descript	M	4 yr	Automobile accident	Femur	1 days	Simple Transverse midshaft
5	Non Descript	M	2.5 yr	Automobile accident	Tibia Fibula	10 days	Simple transverse midshaft
6	Non Descript	M	2 yr	Automobile accident	Femur	8 days	transverse distal third

A. Weight bearing

Weight bearing of affected limb was recorded from 1st, 7th , 14th , 30th post operative day. The weight bearing was recorded and analysed critically and it was scored at different levels by observing while standing, walking and running as per observations by to Aithals (1996).

The detail of weight bearing on 7thdayduring standing, walking & running in groupI and II is give in table 4 and 5 respectively.

Table 4 : Details of weight bearing on 7th day in group I

Case . no	Standing	Walking	Running
1	Touching toe	Touching toe	Carrying limb
2	Touching toe	Touching toe	Carrying limb
3	Touching toe	Touching toe	Carrying limb
4	Touching toe	Touching toe	Carrying limb
5	Touching toe	Touching toe	Carrying limb
6	Touching toe	Touching toe	Carrying limb

Table 5: Details of weight bearing on 7th day in group II

Case . no	Standing	Walking	Running
1	Touching toe	Carrying limb	Carrying limb
2	Touching toe	Carrying limb	Carrying limb
3	Touching toe	Carrying limb	Carrying limb
4	Touching toe	Carrying limb	Carrying limb
5	Touching toe	Carrying limb	Carrying limb
6	Touching toe	Carrying limb	Carrying limb

All dogs in groups I and II exhibited toe contact when in a standing posture. During the experiment, it was observed that all the subjects in group I exhibited toe touching, whereas the subjects in group II demonstrated limb carrying. All dogs in groups I and II exhibited limb carriage during the running posture on day 7.

The detail of weight bearing on 14thday during standing, walking & running in groupI and II is give in table 6 and 7 respectively.

Table 6: Details of weight bearing on 14th day in group I

Case . no	Standing	Walking	Running
1	Touching toe	Touching toe	Touching toe
2	Touching toe	Touching toe	Touching toe
3	Touching toe	Touching toe	Touching toe
4	Touching toe	Touching toe	Touching toe
5	Touching toe	Touching toe	Touching toe
6	Touching toe	Touching toe	Touching toe

Table 7: Details of weight bearing on 14th day in group II

Case . no	Standing	Walking	Running
1	Touching toe	Touching toe	Carrying limb
2	Touching toe	Touching toe	Carrying limb
3	Touching toe	Touching toe	Carrying limb
4	Touching paw	Touching toe	Carrying limb
5	Touching paw	Touching toe	Carrying limb
6	Touching toe	Touching toe	Carrying limb

In group I while standing, walkingand running alldog shows touching toe.In group II while standing threecases shows touching toe and threecases shows touching paw. In walking allcases showedtouching toe. While running carrying limb seen in all cases.

The detail of weight bearing on 30thdayduring standing, walking & running in group I and II is give in table 8and 9respectively.

Table 8: Details of weight bearing on 30th day in group I

Case . no	Standing	Walking	Running
1	Touching Paw	Touching Paw	Touching Paw
2	Touching Paw	Touching Paw	Touching Paw
3	Touching Paw	Touching Paw	Touching Paw
4	Touching toe	Touching toe	Carrying limb
5	Touching Paw	Touching Paw	Touching Paw
6	Touching Paw	Touching Paw	Touching Paw

Table 9: Details of weight bearing on 30th day in group II

Case . no	Standing	Walking	Running
1	Touching Paw	Touching Paw	Touching Paw
2	Touching toe	Touching toe	Touching Paw
3	Touching Paw	Touching Paw	Touching Paw
4	Touching Paw	Touching paw	Touching toe
5	Touching Paw	Touching Paw	Touching toe
6	Touching toe	Touching toe	Touching toe

In group I while standing and walking six cases showedtouching paw and one case showedtouchingtoe. In running sevencase showedtouching paw and onecase showed carrying limb.In group II while standing fourcases showedtouching paw and twocases show touching toe. While walking two cases showedtouching toeand four case showedtouching of paw. Inrunning threecases shows touching toe,threecases shows touching paw.

In locking compression plating the less time required to attain normal gait could be due to minimum contact of plate to periosteum of bone which could have reduced pain and also helped in good amount of soft callus formation on both sides of plate (cis and trans cortex) providing extra stability at the fracture site. Minimal exposure of fracture fragments together with gentle manipulation of bone segments during surgery could also have helped in reduction of pain and excellent limb usage by the cases.

In all cases no change in the shape of the limb with respect to angulation, rotation and muscle atrophy was observed during the entire study in all the cases. Normal shape of the operated limb in all the cases could be due to rigid and stable fixation in all cases was observed. During this study no change in shape of limb in the cases could be due to the rigid and stable fixation provided by the locking compression plates in group was observed. The absence of joint stiffness, rotational deformities and limb shortening added to normal usage of the affected limb. In all cases not observed any soft tissue damage on post operatively

B. *Post operative Radiographic and CT Examination*

To determine the orientation of the fracture, radiographs of the affected limb in anterio-posterior (AP) and mediolateral (ML) views was taken before surgery and immediately after surgery and on 0th ,7th, 14th, 28thand 45th day post surgery and the following parameters were evaluated in both the groups.

Table 10: Position of fracture fragments in CT and Radiography at different intervals in group I

Case No.	0thday	14th day	28th day	45th day
1	In Place	In Place	In Place	In Place
2	In Place	In Place	In Place	In Place
3	In Place	In Place	In Place	In Place
4	In Place	In Place	Bending of plate	Slight Bending of plate
5	In Place	In Place	In Place	In Place
6	In Place	In Place	In Place	In Place

Case number 4 exhibited plate bending with angulation of the fracture fragment during the 28th day after the operation. The bending was rectified while under general anesthesia, but a minor bending with angulation persisted until the 45th day.

Table 11: Position of fracture fragments in CT and Radiography at different intervals in group II

Case No.	0thday	14th day	28th day	45th day
1	In Place	In Place	In Place	In Place
2	In Place	In Place	In Place	In Place
3	In Place	In Place	In Place	In Place
4	In Place	In Place	In place	Displacement of screw
5	In Place	In Place	In Place	In Place
6	In Place	In Place	In Place	In Place

Displacement of screw & angulaion of fracture fragment were seen in case no 4 in grp II at 45th day post operatively.

C. *Position of screw and plate in CT and Radiography*

Position of screws and plate in CT & Radiograph at 0th, 14th, 28th and 45th day wasrecorded in cases of group I and II and is given in table no. 4.38 and 4.39 respectively.

Table 12: Position of screw and plate in CT and Radiograghy at different intervals in group I

Case No.	0th day	14th day	28th day	45th day
1	In Place	In Place	In Place	In Place
2	In Place	In Place	In Place	In Place
3	In Place	In Place	In Place	In Place
4	In Place	In Place	Bending of plate	Slight Bending of plate
5	In Place	In Place	In Place	In Place
6	In Place	In Place	In Place	In Place

Table 13: Position of fracture fragments in CT and Radiography at different intervals in group II

Case No.	0th day	14th day	28th day	45th day
1	In Place	In Place	In Place	In Place
2	In Place	In Place	In Place	In Place
3	In Place	In Place	In Place	In Place
4	In Place	In Place	In pl	Displacement of screw
5	In Place	In Place	In Place	In Place
6	In Place	In Place	In Place	In Place

All instances in group I demonstrate the existence of a screw and plate, with the exception of one case (case 4) where the plate is seen to deform on the 30th day. Afterwards, the deformed plate is rectified using general anesthesia. On the 16th day, the same sample displays a little distortion of the plate. All occurrences in Group II, except for case 4, exhibit the existence of a screw and plate. Nevertheless, in this specific instance, there is observable proof of screw displacement on the 60th day.

D. *Radiographic callus formation in Commuted Radiography and CT scan evaluated by callus index*

A study was done on radiographic callus development in a CT scan using the callus index to measure bone formation score. In the same way, the union score was noted as the fracture line being gone from both the computed radiograph and the CT scan, according to Lane and Sandhu (1987).

ISSN No:-2456-2165

X-rays were taken before surgery, right after surgery 0th day, and then again on days 14th ,28thand 45th day after surgery.

Radiographic rating based on Lane and Sandhu's (1987) method was used to judge how well the fracture had healed. The radiography review was based on how well the bones formed and joined together.

No callus development was seen between the broken pieces in groups I and II prior to the operation, resulting in a score of 0. According to Newton (1985), complete fracture refers to a situation where there is a complete break in the bone, leading to intense inflammation and pain at the fracture site. Without proper immobilization, the formation of callus between the fractured fragments becomes impossible.

Table 14: Bone formation score on commuted Radiograph in group I

Bone formation score	**Case no.**	**0th day**	**14th day**	**28th day**	**45th day**
	1	0	0	2	3
	2	0	0	2	4
	3	0	0	2	4
	4	0	0	2	2
	5	0	0	2	3
	6	0	0	2	4

On day 0, radiographic examination after fracture fixation showed no signs of callus development in any instances (score 0). One possible explanation is that the mobility of fracture fragments before immobilization hindered the development of callus.

On the 14th day after surgery, according to the Radiolographic scoring method, Six cases demonstrate a lack of evidence for bone development, with a score of 0.

In a study conducted by Sirin et al. (2013), eight cases each of humeral, radial, femoral, and tibial fractures were treated with immobilization using a locking compression plate (LCP). On the 10th day after the surgery, radiographic examination showed that the sharp ends of the fractured fragments had disappeared and early callus formation had occurred.

On the 28thday after the operation, according to the Radiographic scoring method, all six cases with a score of 2. Sirin *et. al.* (2013) conducted a study involving eight cases of humeral, radial, femoral, and tibial fractures. These fractures were immobilized using a locking compression plate (LCP). On the 25th day after the operation, radiographic examination showed that the fracture line had disappeared and callus formation had occurred.

On the 45th postoperative day, according to the Radiological Scoring System, one case had a score of 2, two cases had a score of 3, and three cases had a score of 4.

Sirin *et. al.*,(2013) examined eight cases each of humeral, radial, femoral, and tibial fractures. These fractures were immobilized using a locking compression plate (LCP). On the 60th day after the operation, radiographic examination showed that the cortical integrity of the fractures was maintained and reshaping had started. Schwandt and Montavon (2005) found full bridging and callus remodeling 53 days following surgery.

Haaland *et al*. (2009), the average duration for healing appendicular fractures in dogs using LCP was 7 weeks.

Desouza (2012) observed periosteal callus formation at a slight distance from the fracture gap. This is because there is a greater blood supply away from the fracture site compared to at the site itself. As a result, the osteoblasts become more mature and the cartilaginous callus begins to mineralize at the outer edges, which can be seen on X-ray images. Based on the aforementioned facts, it may be inferred that pain and swelling gradually diminish and a soft callus develops between the shattered pieces. This corresponds closely to the period when the fragmented pieces are no longer in motion, often two to three weeks after the operation. The soft callus stage is characterized by the formation of callus. The precursor cells inside the cambial layer of the periosteum and endosteum are induced to differentiate into osteoblasts. Intramembranous appositional bone development initiates on these surfaces far from the fracture site and the splinters, resulting in the formation of a cuff of woven bone around the periosteum and filling the intramedullary canal. The process of capillaries growing into the callus and a rise in blood vessel formation occurs thereafter. In proximity to the fracture site and the region affected by bone loss, mesenchymal progenitor cells undergo rapid cell division and movement through the callus. These cells then transform into fibroblasts or chondrocytes, which produce their own extracellular matrix. Gradually, they replace the blood clot that formed initially.

Egol*et. al.*, (2004) suggested that locked plating structures depend on secondary bone healing when there is no anatomical alignment and interfragmentary compression. This healing process is triggered by the movement between bone fragments in the millimeter range.

Platelet-rich plasma (PRP) may enhance the formation of new bone and is nontoxic, nonimmunoreactive, and accelerates existing wound-healing pathways Yamada (2004).

ISSN No:-2456-2165

Table 15: Bone formation score on computed Radiograph in group II

Bone formation score	**Case no.**	**0th day**	**14th day**	**28th day**	**45th day**
	1	0	0	2	3
	2	0	0	2	3
	3	0	0	2	4
	4	0	1	3	3
	5	0	1	2	4
	6	0	1	3	3

On day 0, in all instances, the radiographic scan after fracture fixation showed no signs of bone growth and had a union score of 0. Possibly, the lack of callus development was due to the mobility of fracture pieces before immobilization.

On the 14th day after surgery, based on the Radiolographic scoring method, there were three cases with a score of 1 and three cases with a score of 0.

On the 28th postoperative day, four cases were assigned a score of 2 and two cases were assigned a score of 3 according to the Radiographic grading method.

On the 45th day after surgery, based on the Radiolographic scoring method, two patients had a score of 4 and four cases had a score of 3.

IV. CONCLUSION

On the basis of observation recorded during present study, following conclusions are drawn :

- Group I exhibited earlier weight bearing when standing, walking, and running in comparison to group II.
- The radiographic evaluation revealed an initial periosteal response and callus development in group I, in comparison to group II.
- PRP, or Platelet-Rich Plasma, is an osteoinductive substance that attracts platelets and releases a high concentration of platelet growth factors, aiding in the process of bone repair.Furthermore, it contains antibacterial characteristics that may help in the prevention of illness.
- CT images are typically more easily interpreted than conventional radiographs due to their ability to provide a cross-sectional depiction of anatomy, which eliminates the issue of superimposition of body parts. However, in order to accurately recognize and describe structures, a thorough understanding of cross-sectional anatomy is necessary.
- Computed tomography (CT) produces pictures by measuring the absorption of x-rays, which is similar to the process used in radiography. Nevertheless, pictures are obtained in sequential sections, ensuring the elimination of overlapping structures. CT pictures have superior contrast resolution compared to radiography. CT pictures provide exceptional anatomical visualization of patients. Multi-planar or 3-dimensional (3D) reformatting of images allows for a comprehensive evaluation of bone.
- Based on the abovefinding , it was determined that platelet-rich plasma is beneficial for bone healing in instances of fractures. Additionally, CT scan is a contemporary diagnostic method for evaluating fracture healing, surpassing radiography in effectiveness.

Fig. 1: Radiographically midshaft overriding transverse type of femur fracture (Lateral View)

ISSN No:-2456-2165

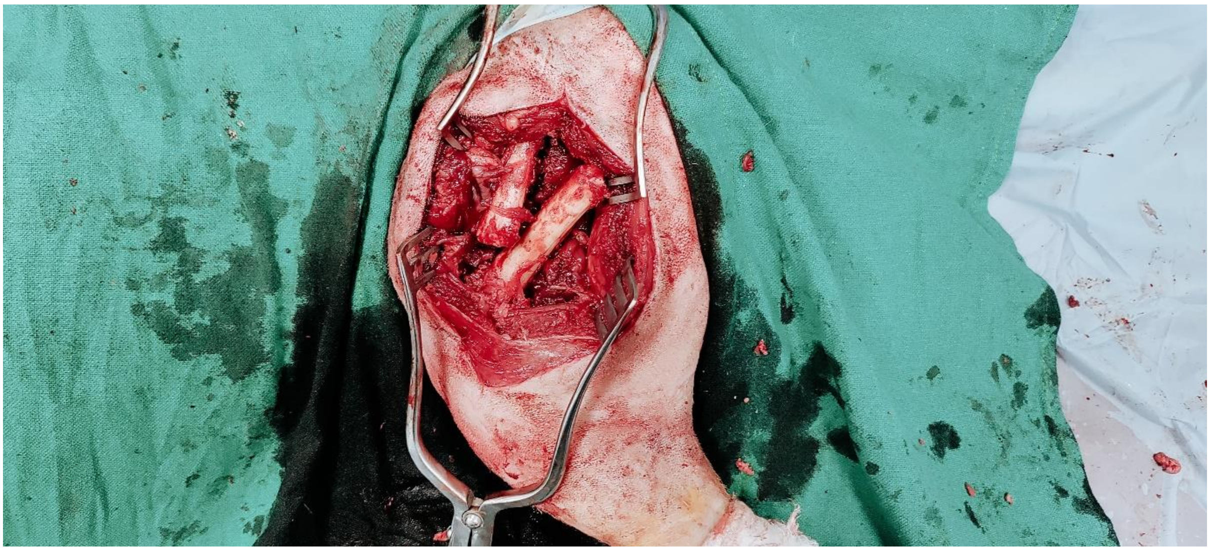
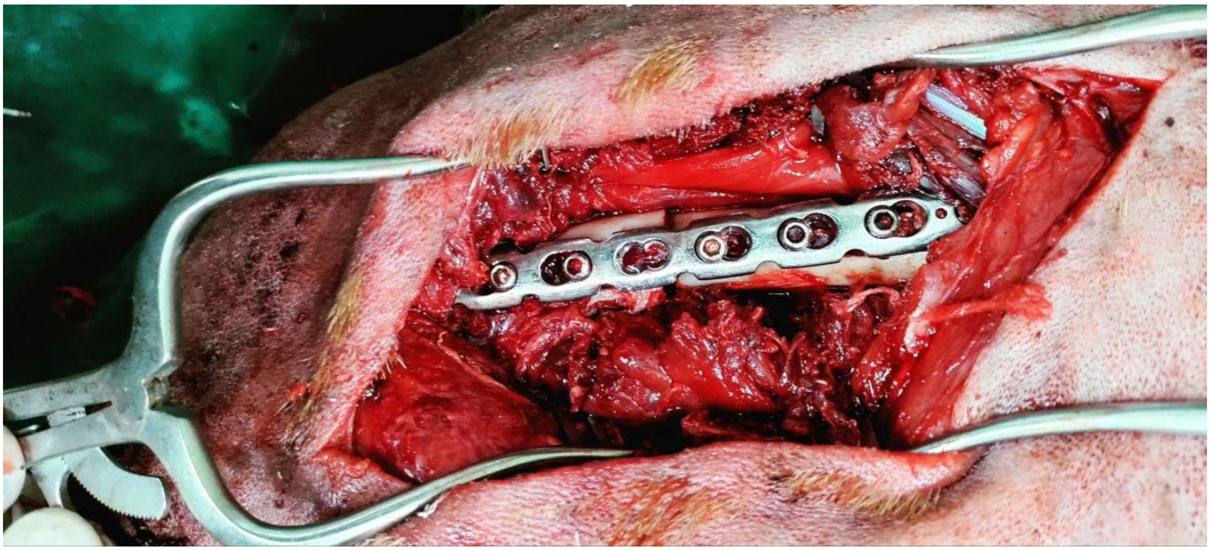
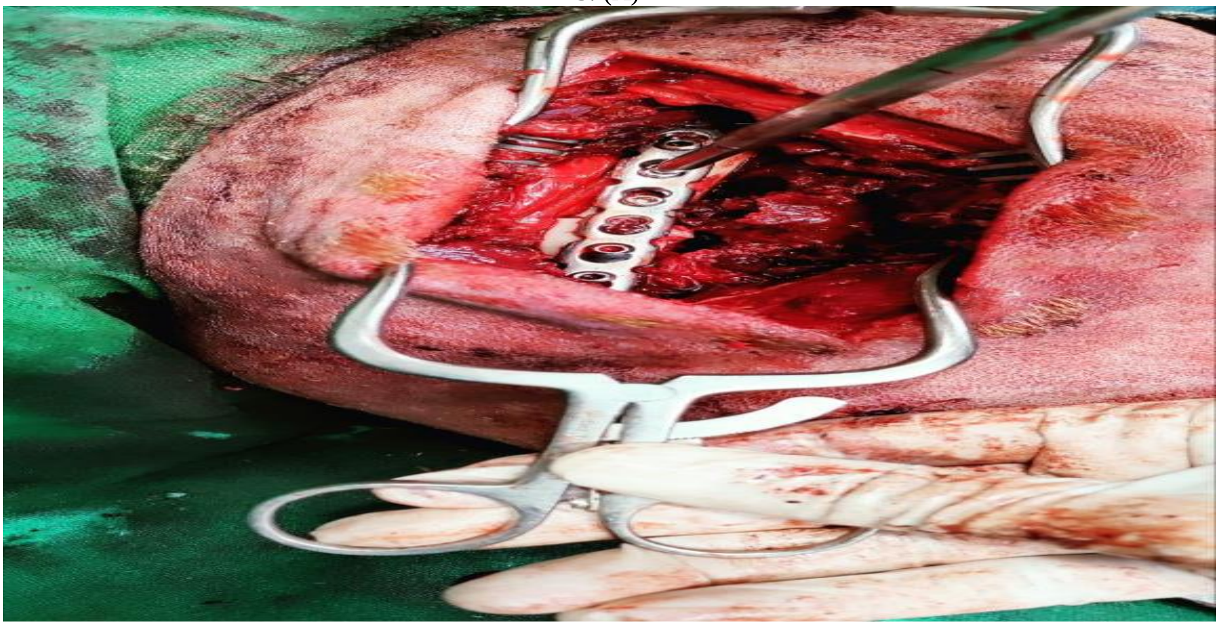


Fig. 2: Exteriorization of bone of both the ends of femur fracture



3. (A)



3(B)

Fig. 3(A and B) : Application of the plate along with screw on the bone

Fig. 4: Close Apposition of muscles after suturing

Fig. 5: Skin incision closed with nylon by using horizontal mattress sutures

V. GROUP I

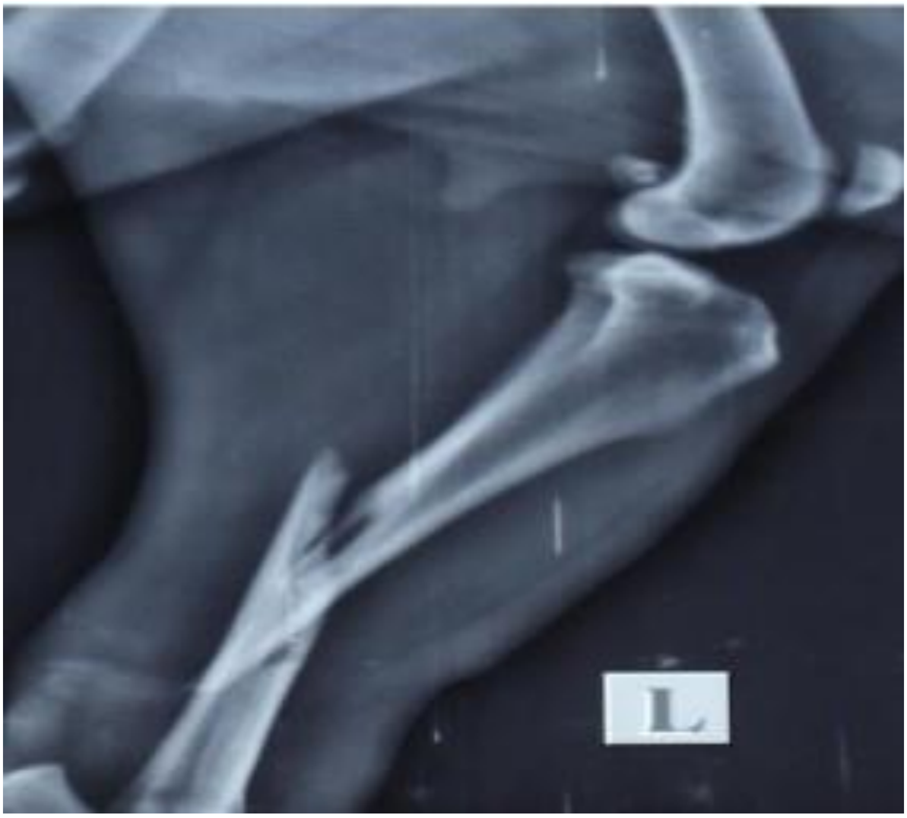


Fig. 6: Radiograph showing complete oblique fracture mid shaft left tibia fibula in Lateral view (before surgery)

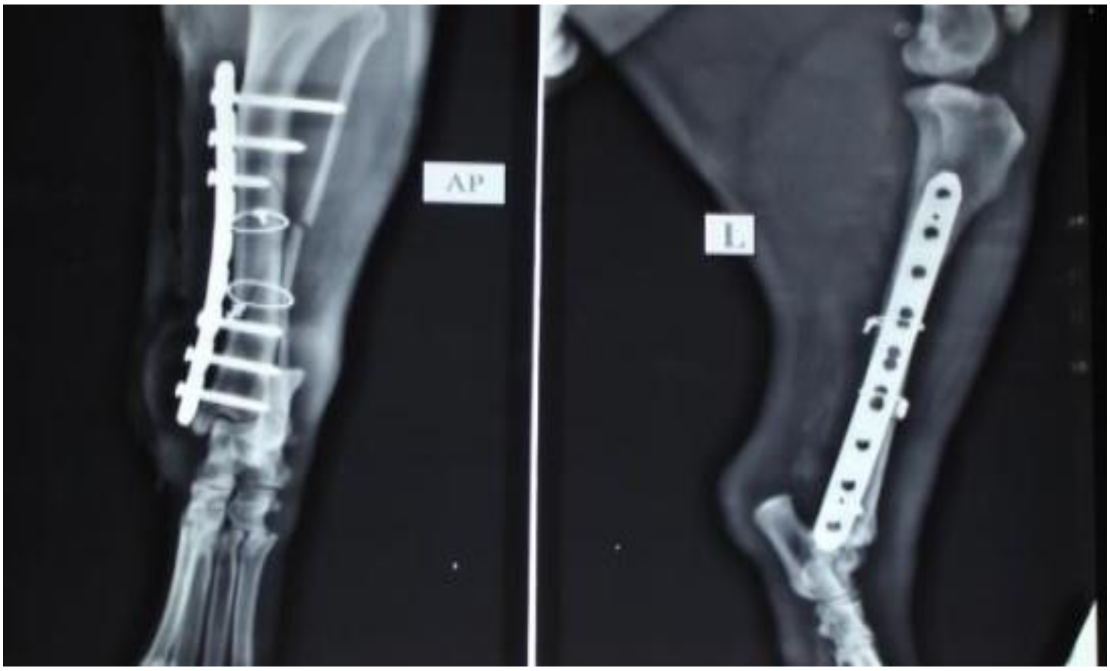


Fig. 7: Radiograph showing plate & screw in position in AP & Lateral view of left tibia & fibula (after surgery)

Fig. 8: Radiograph showing plate & screw in position in AP &Lateral view of lefttibia& fibula (14thpost operative day)

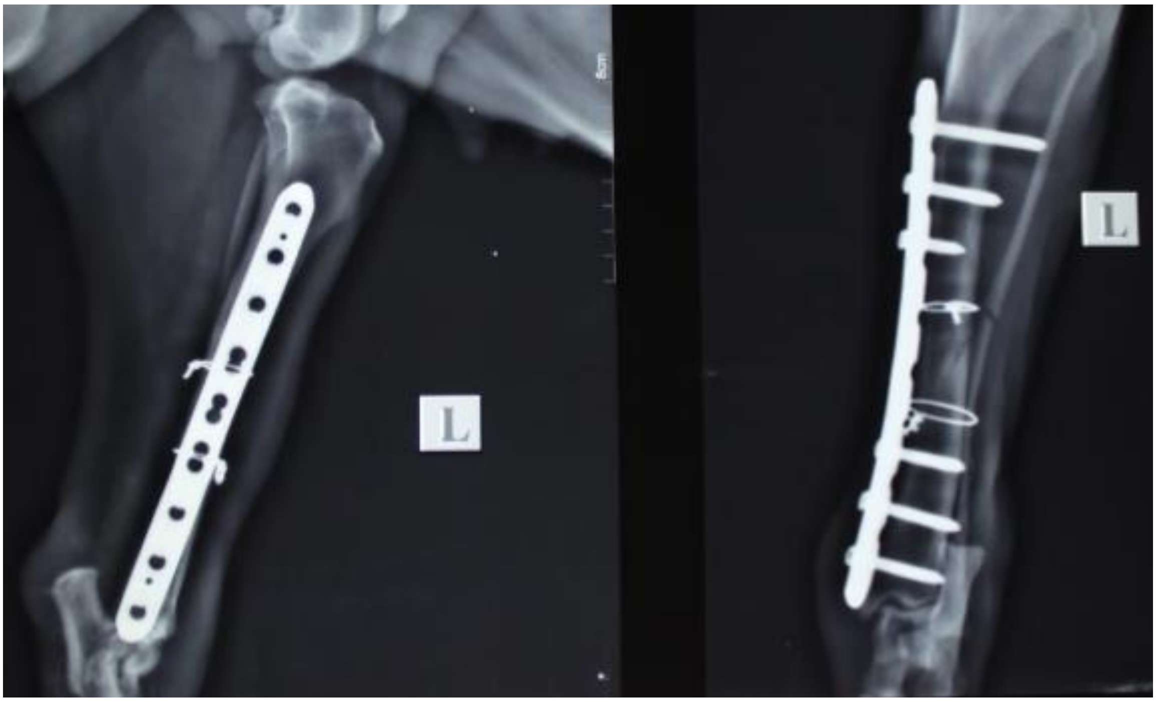


Fig. 9: Radiograph showing plate & screw in position in AP & Lateral view of left tibia & fibula (28th day post operative day)

ISSN No:-2456-2165

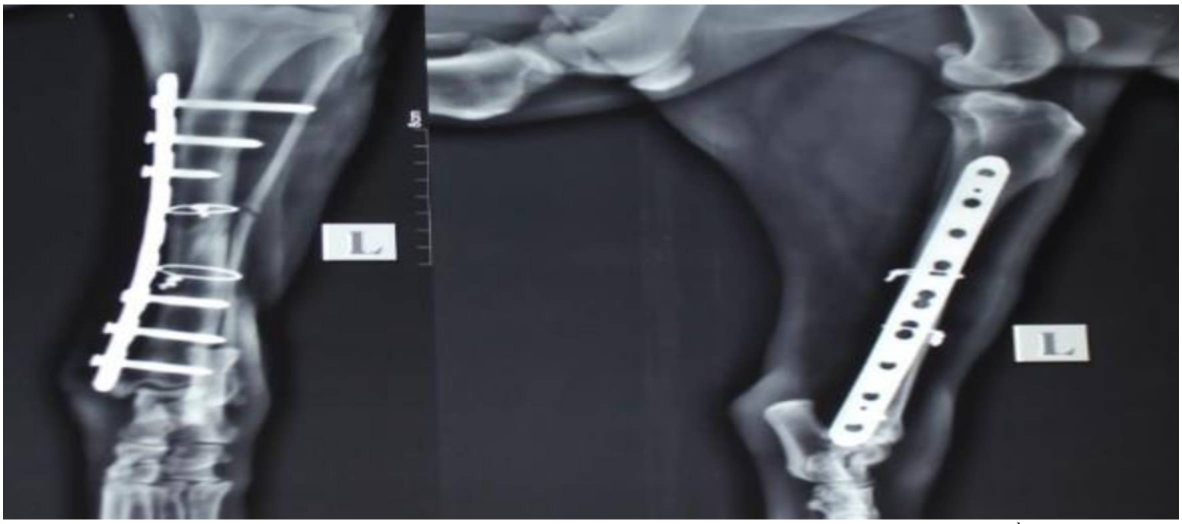


Fig. 10: Radiograph showing plate & screw in position in AP &Lateral view of left tibia& fibula (45th post operative day)

VI. GROUP II

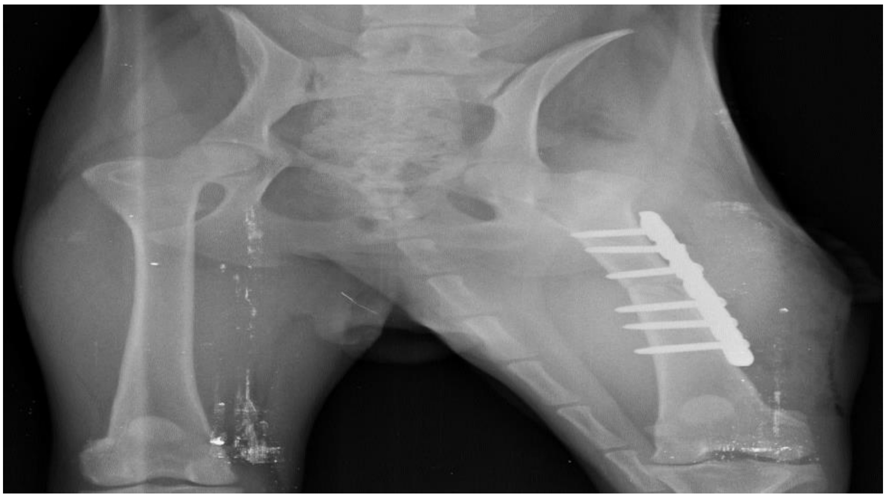


Fig. 11: Radiographs showing ventrodorsal view shows the status of callus on 7th day

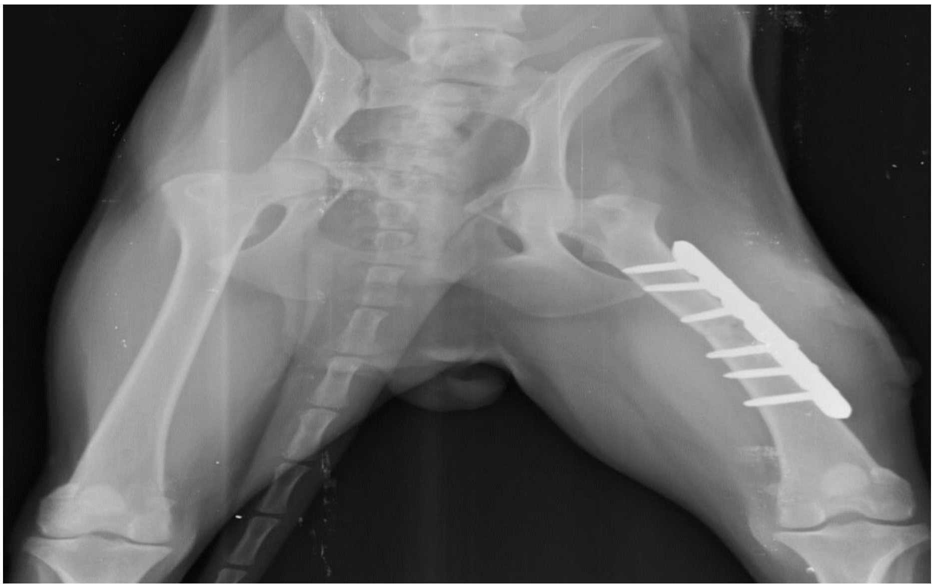


Fig. 12: Radiographs showing ventrodorsal view on 14thday postoperatively

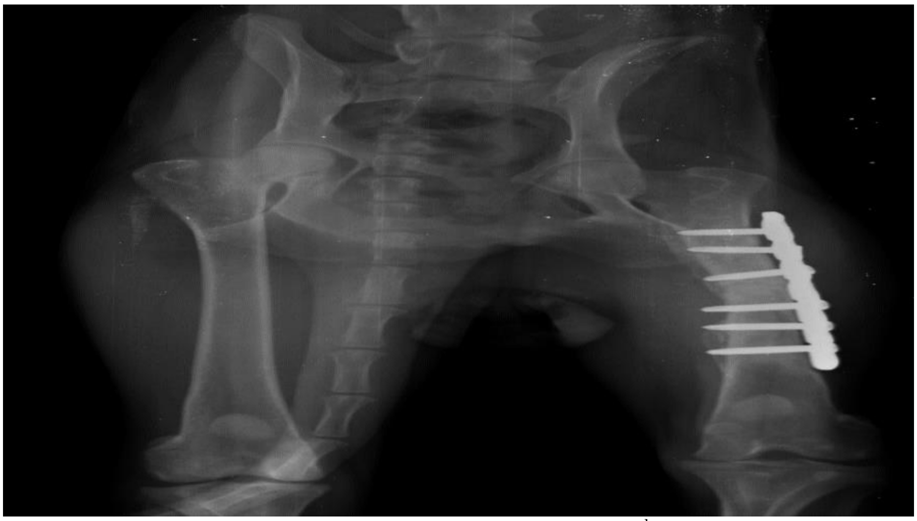


Fig. 13: Radiographs showing ventrodorsal view on 28thday postoperatively

Fig. 14: Radiographs showing ventrodorsal view on 45thday postoperatively with complete healing of bone

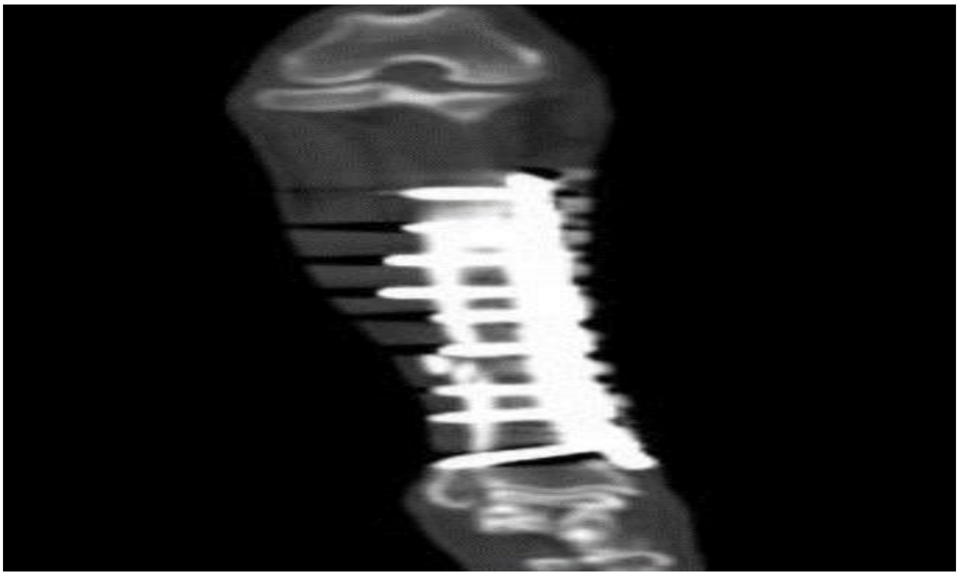


Fig. 15: CT images shows tibial fracture in coronal section with 1mm thickness &1.9 mmdistance (28th day post operative) Group I

ISSN No:-2456-2165

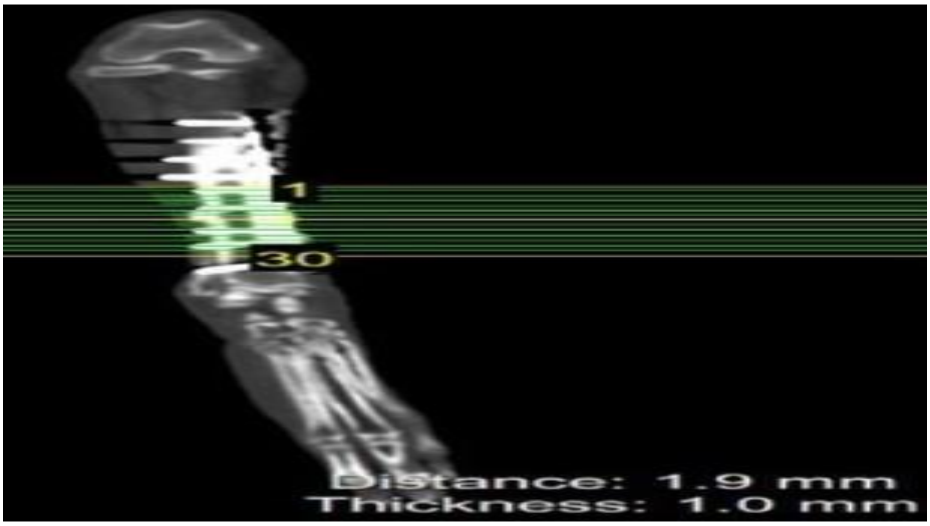


Fig. 16: CT images shows tibial fracture in axial section with 1mm thickness & 1.9 mm distance


Fig. 17: CT images shows Tibial fracture in 3D view (anticlock) (28^{th} day post operative) Group I

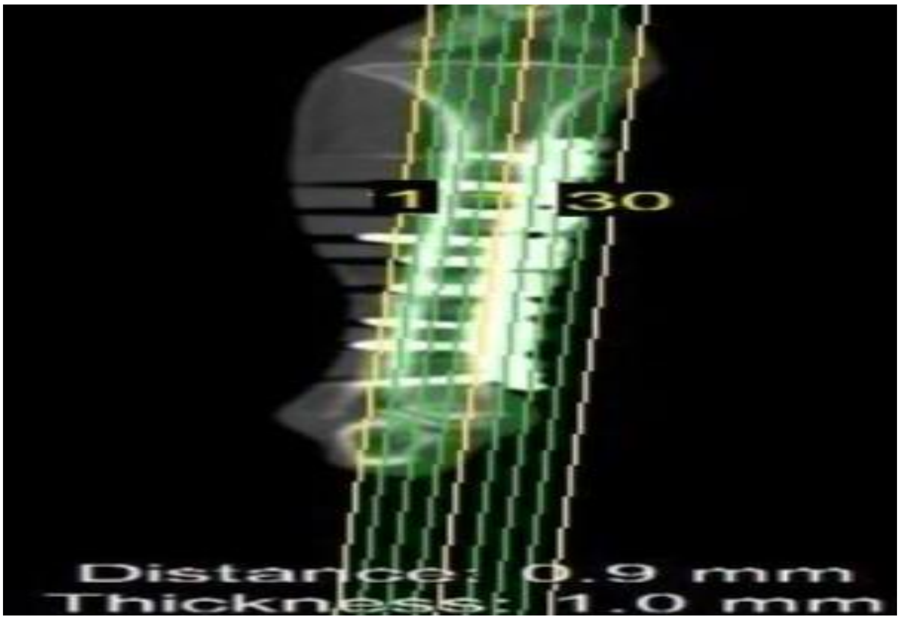


Fig 18 : CT images shows Tibial fracture in Saggital section with 1mm thickness& 0.9 mm distance (45^{th}post operative day) GroupI

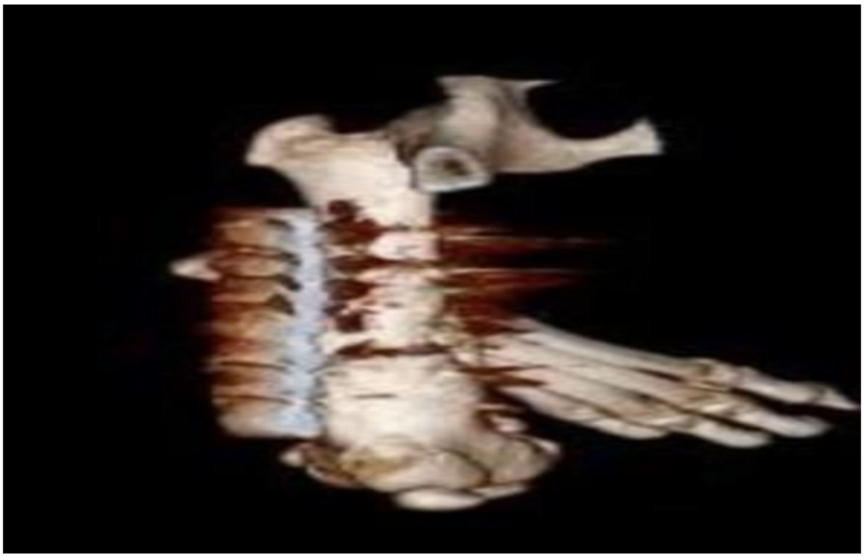


Fig. 19: CT images shows Femur fracture in 3D view (45 °) Group II (14th day post operative day)

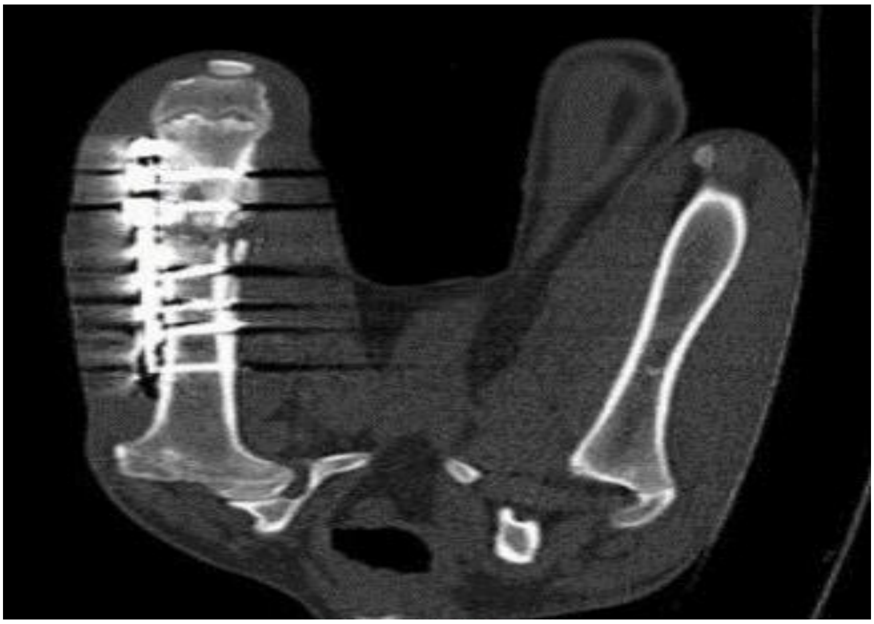


Fig. 20: CT images shows coronal view Femur fracture Group II (14thpost operative day)

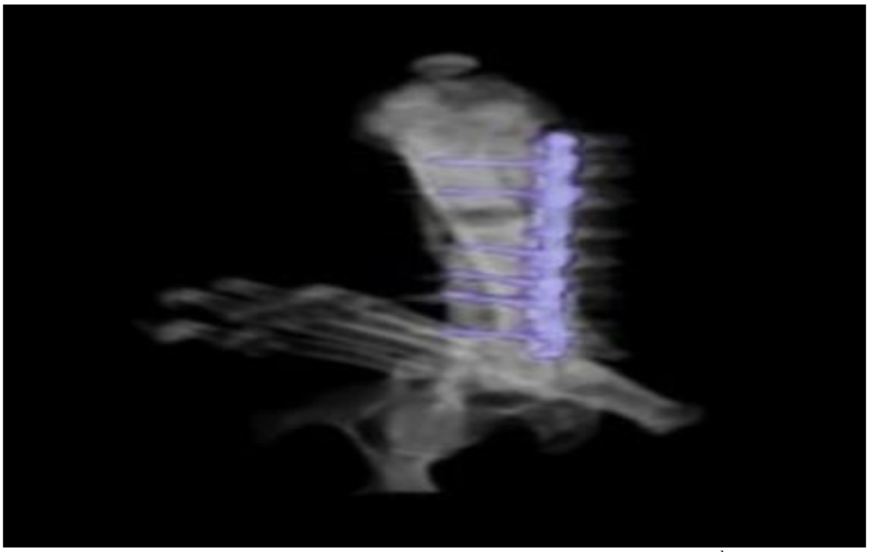
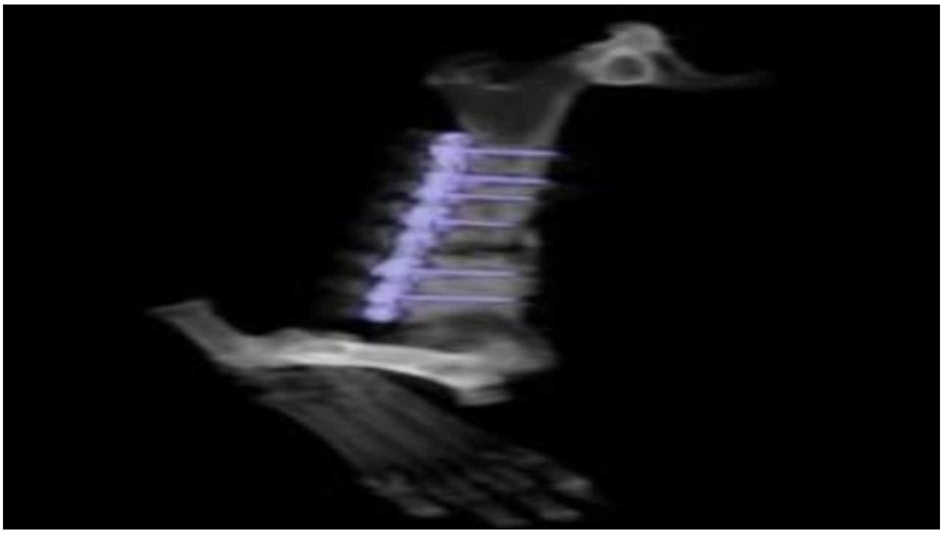


Fig. 21: CT images shows Femur fracture in 3D view (anticlock) Group II (14th day post operative day)

ISSN No:-2456-2165

22(A)



22(B)

Fig. 22 (A and B) : CT images shows Femur fracture in 3D view Group II (28th post operative day)

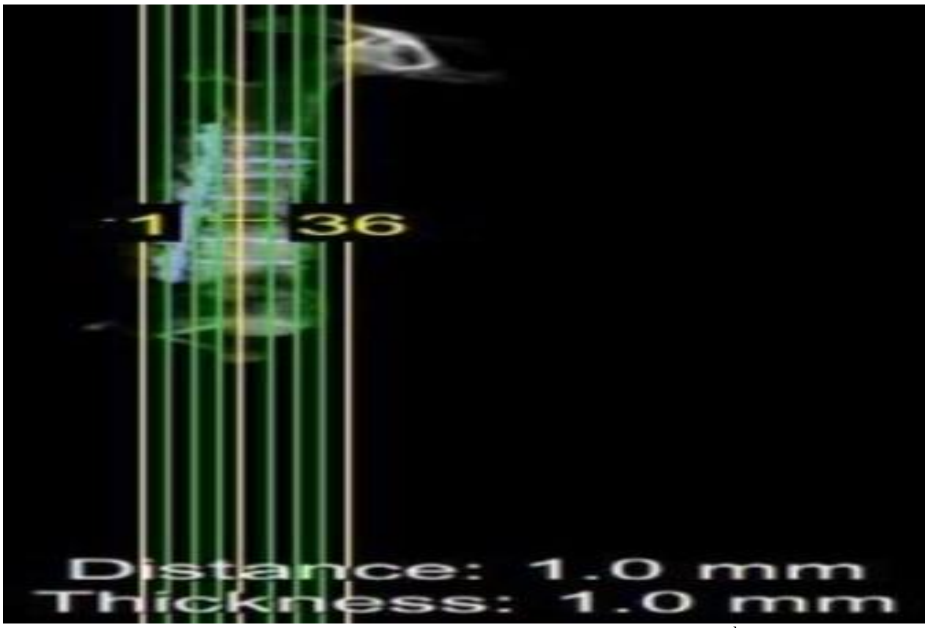


Fig. 23: CT images shows Femur fracture in saggital view Group II (28th post operative day)

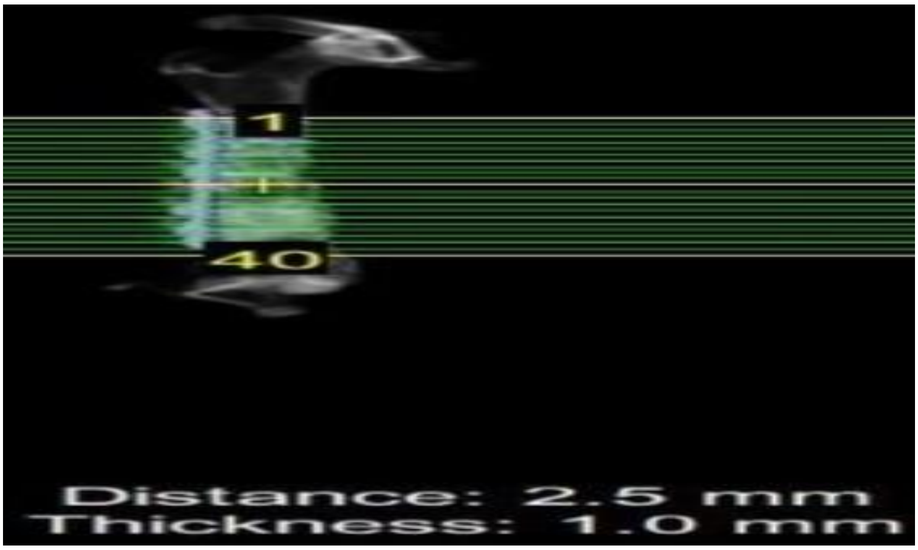


Fig. 24: CT images shows Femur fracture in axial view Group II (14th post operative day)

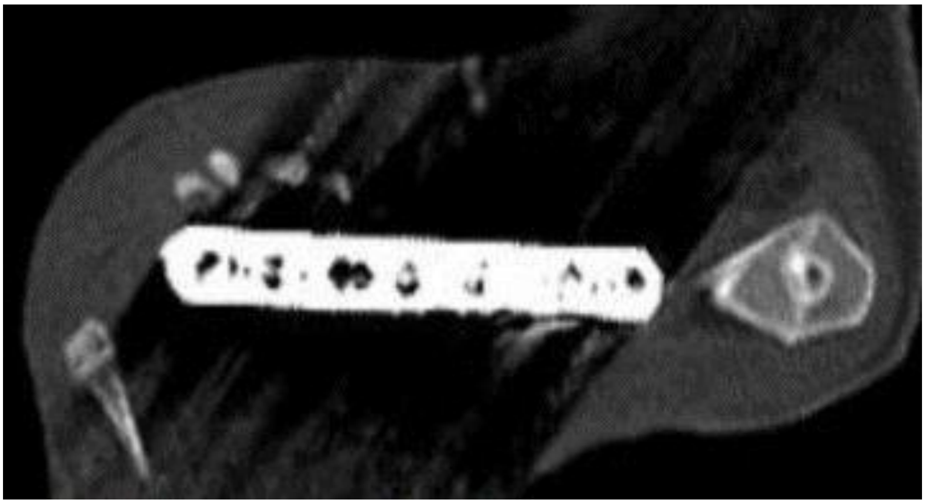


Fig. 25: CT images shows Femur fracture in saggital view Group II (45th post operative day)

Fig. 26: Carrying limb before surgery left femur fracture

Fig. 27: Touching toe of affected limb at 28th day post operatively

Fig. 28: Complete weight bearing of affected left Tibia on 45th day post operative day group I

Fig. 29: Complete weight bearing of affected left Tibia on 45thpost operative daygroup

- **How to cite this article::** Nikam, A.V. , Mandade, R. P., More, G. V. (2023). Clinical outcomes of locking compression plating technique in long bone fracture of dog with or without Osteoinducer by using CT Scan : 12 Cases
- **Source of support**: Nil
- **Conflict of interest:** None

REFERENCES

[1]. Aithal, H.P. (1996) A study on incidence of fractures in animals and management of supracondylar fracture in dogs. Ph.D thesis submitted to Indian Veterinary Research Institute, Izzatnagar (U.P.).

[2]. Aithal, H.P., G. R. Singh, andG. S. Bisht (1999) Fractures in dogs: survey of 402 cases. *Indian Journal of Veterinary Surgery*20: 15-21.

[3]. Burns, C. G. (2010) Influence of Locking Bolt Location on the Mechanical Properties of an Interlocking Nail in the Canine Femur. Master's Thesis, Graduate School of The Ohio State University, USA.

[4]. Cornette R, Tresset A, Herrel A. (2015).The shrew tamed by Wolff's law: Do functional constraints shape the skull through muscle and bone covariation. *Journal ofMorphology*.276(3):301-309.

[5]. Desouza, F. (2012) Internal fixation of distal third fractures of long bones in dogs. M.V.Sc. & A.H.thesis (Surgery and Radiology), Nanaji Deshmukh Veterinary Science University, Jabalpur.

[6]. Egol K, Kubiak E, Fulkerson E, Kummer F and Koval K (2004) Biomechanics of locked plates and screws. *Journal of Orthopaedic Trauma*.18(8):448-493

[7]. Ethan, M.Braunstein, M. D. , Steven A. Goldstein, Ph.D. , Janet Ku, M.S., Patrick Smith, M.D., and Larry S. Matthews, M.D.(1986). Computed tomography and plain radiography in experimental fracture healing, *Skeletal Radiol*15:27-31

[8]. Farley, R., L. Susan, C. Ritchie and S. Herring, (1992) Quantitation of skeletal alkaline phosphatase isoenzyme activity in canine serum. *J. Bone and Min. Res*. 7(7): 24.

[9]. Lane, J. M. and H. S. Sandhu (1987) Current approaches to experimental bone grafting. *Orthop. Clin. North. Am*. 18(2): 213-25

[10]. Leighton, R. L. (1993)Small Animal Orthopaedics, Mosby year book, Europe, London 3: 22

[11]. Lenza M, Ferraz S.D.B. and Carai D, Platelet rich plasma for long bone healing, Plamaricoemplaquetas para consolidacao de ossoslongos. einstein.2013; 11(1):122-12

[12]. Matthew Keane, Emily Paul, Craig J Sturrock, Cyril Rauch and Catrin Sian Rutland, (2017) Computed Tomography -Advanced Applications, Computed Tomography in Veterinary.

[13]. Miller, D. L. and T.Goswami (2007) A review of Locking compression plate biomechanics and their advantages as internal fixators in fracture healing. *Clin. Biomech*.22(10): 1049-62

[14]. Newton, C. D. (1985) Etiology, Classification and Diagnosis of Fractures In: Textbook of small animal orthopaedics, 1sted. J. B. Lippincott Publishing Co., Philadelphia: 185-188

[15]. Schwandt C. S and P. M. Montavon, (2005)Locking compression plate fixation of radial and tibial fractures in a young dog. *Vet. Comp. Orthop. Traumatol*. 18(3):194-8

[16]. Sirin, O. S., U. Kaya and B. Olcay (2013) Clinical and Radiological Outcomes of Locking Compression Plate System in Dogs with Diaphyseal Fractures: 32 Cases. Journal of the faculty of Veterinary Medicine, Kafkas University 19:13-18.