

TREATMENT OF FRACTURE OF TIBIA IN CALVES AND ITS RADIOGRAPHIC EVALUATION

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THESIS

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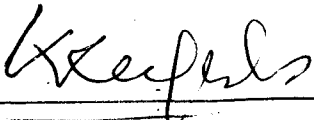
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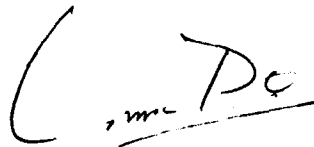
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TABLE OF CONTENTS

	P a g e
INTRODUCTION ..	1
REVIEW OF LITERATURE ..	3
MATERIALS AND METHODS ..	15
RESULTS ..	21
DISCUSSION ..	62
SUMMARY ..	69
TABLES ..	74
REFERENCES ..	77

LIST OF TABLES

Page

Table No.

1. Clinical symptoms following immobilisation of fractured tibia in Groups I and II 74

2. Radiographic evaluation following immobilisation of fracture tibia in Groups I and II. 75

...

LIST OF ILLUSTRATIONS

Fig. No:

1. Special instrument used for pinning.
2. Normal tibia.
3. Fractured tibia immobilized with Plaster of Paris.
4. Fractured tibia immobilized with intramedullary pin and Plaster of Paris.
5. Radiograph of 12th day. Fracture immobilized with Plaster Cast alone.
6. Radiograph of second day. Fracture immobilized with Plaster Cast alone.
7. Radiograph of 11th day. Immobilized fracture with Plaster Cast alone.
8. Bone cropped on 106th, 93rd and 52nd day after immobilisation with intramedullary pin and Plaster Cast.
9. Radiograph of 9th day after pinning.
10. Radiograph of 15th day after pinning.
11. Radiograph of 21st day after pinning.
12. Radiograph of 43rd day after pinning.
13. Radiograph of 52nd day after pinning.
14. Radiograph of 62nd day after pinning.
15. Radiograph of 71st day after pinning.
16. Radiograph of 85th day after pinning.
17. Radiograph of normal tibia after medullography.
18. Radiograph of 88th day after pinning after medullography.
19. Radiograph of 52nd day after pinning - after medullography.
20. Bone cropped on 71st day after pinning.
21. Animal after treatment of fracture by intramedullary pinning - showing dropping of right fetlock.

INTRODUCTION

INTRODUCTION

The incidence of fractures of tibia is common in cattle. Of the fractures of long bones in cattle, it is assessed that 10% will be tibial fracture.

The usual method of reduction of fracture and retention by means of plaster-of-paris bandage, has limited value in the immobilisation of tibia. This is because the stifle joint cannot be included in the plaster cast. When the animal stands up, the plaster cast usually slips down.

Modified Thomas Splint and pinning techniques have been advocated. In this connection, it has to be remembered that cattle are not good subjects for anaesthesia, cannot be kept in slings like horses and develop decubitus ulcers when retained in recumbency for few days. Frequent attempts of getting up will disturb the alignment of the fragments, often resulting in non-union or faulty union.

The present study is undertaken with the object of exploring the effect of immobilisation in the treatment of fracture of tibia in calves using plaster-of-paris coaptation alone and intramedullary pinning reinforced by plaster cast and their radiographic evaluation on the progress of healing of fracture.

REVIEW OF LITERATURE

REVIEW OF LITERATURE

The technique of internal fixation of fractures in large animals, was reported by Kendrick (1951). He immobilised the fractures using four half pins and plaster of paris coaptation.

Kirk (1952) had mentioned the advantages of pinning over plaster cast and described various kinds of pinning and metallic bone plating techniques in small and large animals.

Vincent (1952) described the technique of intramedullary pinning for the repair of tibial fractures in dogs.

Reichel (1956) adopted transfixation with Steinmann pin along with a light plaster of paris cast in fractures of long bones in horses and cattle and had recorded good results in 57 out of 64 cases.

A method of fracture fixation using the Mondy nail was described by Garner (1958) where the nail was inserted

into the marrow cavity through an incision at the fracture site and transfixed at various levels by screws.

Jones and Jones (1958) reviewing 14 cases of fracture repair of long bones using Jones splint had stated that it was not only simple, but also effective in immobilising difficult comminuted fractures.

Lawson (1958) used Rush pins for the treatment of fractures in dogs and cats and found this particularly useful in fractures close to joints especially when only small segments of bone were to be fixed.

Lundvall (1960) reviewed the methods of treatment adopted in 151 fractures of long bones. Intramedullary pinning and stainless steel plates were adopted only in a limited number of cases. According to him osteomyelitis was common after the insertion of intramedullary pin even with the most rigid aseptic technique and it was difficult to avoid the insertion of the pin into the joint capsule.

Ray et al. (1964) stated that inadequate immobilisation interfered with healing. In highly vascular areas, fracture healing was noticed even with minimum immobilisation.

As one of the methods for treating fracture in dogs, Anderson (1965) adopted Kuntscher nail of appropriate diameter to fill the medullary canal. When nail remained tight, there was direct bone formation in the fibroblastic stroma of the organising fracture haematoma. The small amount of cartilage that was present, was transformed into bone, by enchondral ossification, but most of the new bone was formed directly without going through the cartilaginous stage. In the fractures treated without fixation, there was marked over-riding and angulation of the fragments.

Kuntscher (1965) describing the surgical techniques for intramedullary pinning recommended the following:

- 1) nailing must be performed blind under roentgenographic control without direct exposure of the fracture site.

and 2) the nail must be strong enough to resist the stress caused by muscular contraction, joint movement and weight-bearing.

Fellenbaum and Jonas (1968) repaired bilateral fractures of the radius and ulna in a German Shepherd dog using Jonas splints for reduction of radius and modified Thomas' splints, for additional support.

Mohanty et al. (1970) studied repair of fracture of bovine radius, femur and tibia in experimental as well as in clinical cases. They found that intramedullary pinning gave better results than bone plating and modified Thomas' splints in cases of femoral fractures. Thomas' splint was better than other methods in cases of fractures of tibia. They observed that tibial fractures were common at the distal third and healing was usually slow. They had stated that infection during and after pinning was an important complication.

Singh et al. (1971) recommended the use of autogenous cancellous strips of bone to bridge the gap and to maintain the natural length of the fractured bone.

Gill and Tyagi (1972) found co-aptation to be the simplest and the safest technique for tibial fractures, but slight rotation was observed after healing.

Experimental correction of tibial and metatarsal fractures was attempted by transfixation and bone plating in 20 buffalo calves by Tyagi and Gill (1972). Transfixation was found to be useful in the treatment of oblique fractures of the tibia in heavy animals while bone plating was satisfactory in transverse fractures.

Verschooten et al. (1972) described repair of 18 cases of tibial fractures in cattle. In transverse fractures of tibia transfixation by means of Steinmann pins and an external methylmethacrylate bridge was mostly indicated. Spiral fractures in the length of the tibia could be treated by cirelage and plaster of paris bandage, or by combination of screwing and transfixation. In general they found that perfect reduction and rigid immobilisation of the bone fragments were seldom achieved. A periosteal bone bridge united the fractured bone ends. Pins were removed eight to 12 weeks post-operatively

according to the radiological and clinical appearance.

Braden et al. (1973) found that intramedullary pinning along with half Kirschner splint were more satisfactory than intramedullary pinning alone or intramedullary pinning with bone plating in fractures of femur in dogs.

Ramakumar et al. (1973) treated a case of distal oblique fracture of tibia in a four year old cow by the use of a hanging pin cast. The advantage of this technique was reported to be prevention of rotation and slipping of the cast.

Winstanley (1974) reported that the vascular changes were well developed by the fifth week in compression osteosynthesis.

In an experimental study of fractures of third carpal bones in horses, Adams et al. (1975) found that internal fixation using compression technique caused less fibrocellular proliferation in the subchondral area. The healing of fracture was more advanced with internal fixation when compared to those treated without fixation.

Alcantara and Stead (1975) treated distal femoral fractures of dogs and cats using Rush pins, oblique lag screw, cross Kirshner wire and retrograde intramedullary pinning and obtained best results by using Rush pins.

Angelo et al. (1975) adopted sterile homogenous bone meal transplantation in a Hariana bull calf for a compound multiple fracture of right metatarsal bone at its proximal third. Radiographs taken 37 days post-surgically revealed the formation of callus indicating clinical union and attributed that bone meal might have provided a net-work for the crawling in of pre-osteogenic cells.

A light cast with an open webbed fibreglass tape impregnated with a polyester resin was advocated by Horney and Dingwall (1975) to fix limbs of cattle and horses in the repair of fractures and in the treatment of tendon injuries.

Jones (1975) had reviewed the progress in the immobilisation methods of fractures in horses.

Rao (1975) used bamboo splints and gypsum plaster

along with modified Thomas' splints to immobilise a compound comminuted metacarpal fracture in a bull.

Sharma (1975) reported the successful use of double Rush pin in epiphyseal femoral fractures in eight dogs.

Vaughan (1975) reported complications like infection resulting in osteomyelitis and deformities due to periosteal new bone formation during internal fixation in dogs. These complications could be corrected by debridement and antibiotic therapy.

White and Wheat (1975) successfully reduced proximal tibial epiphyseal fractures in two foals by expansion and compression between two transversely placed Steinmann pin and fixing up with Charnley apparatus or turn buckles in between, to achieve rigid fixation. A cast was also applied keeping the limb in the extended position.

Braden and Brinker (1976) in radiographic and gross pathoanatomic studies in 36 young adult dogs, evaluated bone healing in intramedullary pinning.

intramedullary pinning along with half Kirschner device and tension bone plates. By radiographic evaluation it was found that the success rate was 64.2 per cent in intramedullary pinning, 100 per cent in intramedullary pinning along with half Kirschner device and 91 per cent in bone plating.

Rankumar et al. (1976) immobilised a case of spiral fracture of humerus in a buffalo heifer by intramedullary pinning with Kuntscher clover leaf nail. The animal could bear weight on the affected limb on the eighth day. At the end of six weeks the nail was removed. The X-ray had revealed complete bridging of the fracture line.

Denny (1978) had reviewed the recent trends in equine fracture treatment.

Prasad et al. (1979) treated five cases of compound metatarsal fractures in bovines. Four cases were treated with plaster cast coaptation with aluminium splints and the other one by bone plating. Though periodic radiographic examination revealed varying degree of osteomyelitis in all cases, all the cases were cured.

Singh and Nigam (1979) explored the feasibility of homogenous onlay bone plate in the treatment of metatarsal fractures in bovine and compared it with standard metallic plating and simple coaptation techniques. The healing pattern with the bone plate was found to be similar to that of stainless steel plate but complete union was delayed by two weeks.

Sorensen *et al.* (1979) studied the effect of intra-medullary methyl-methacrylate and reaming, on the circulation in the tibia after bilateral osteotomy of the diaphysis and plate fixation in dogs. They found that it was the impairment of circulation caused by reaming and the presence of cement more detrimental to bone survival and repair, than the chemical trauma or heat of polymerisation.

Proximal fractures of tibia in three new born calves were treated by transfixation pinning, bone screws and interfragmentary compression by Hamilton and Tulleners (1980). Transfixation allowed unrestrained activity without relying on the holding power of the cortex of the tibia. Radiographic examination had revealed callus

formation in all the cases by the fourteenth day. In one case, though the fracture had healed, there was osteomyelitis and infectious arthritis of the stifle joint.

Hunt *et al.* (1980) had reviewed the complications of 100 cases of diaphyseal fractures in dogs. Osteomyelitis was one of the most serious complication in internal fixation. Achieving adequate reduction and stabilisation were the difficulties encountered in external fixation. Gangrene resulting from tight casts, muscular atrophy and osteoporosis were reported to be the other complications.

Rankumar *et al.* (1980) reported a technique of cross pinning in six cases of compound subarticular fractures of bovine long bones wherein the bone fragments were aligned and Steinmann pins were introduced obliquely through the skin and cortex on the lateral aspect of one fragment, and driven through the opposite cortex of the other fragment and the skin. A second pin was similarly introduced from the medial side to cross the former at an obtuse angle. The protruding ends of the pins on each side were bent and enclosed in a plaster cast. Broad spectrum antibiotics were administered post operatively and the wounds were

irrigated with warm hypertonic saline solution and dressed with BIPP. In four animals recovery was uneventful and the pins were removed within 4-9 weeks.

Stick and Derksen (1980) reported the successful repair of an open comminuted proximal femoral fracture in a seven day old foal using intramedullary pin of half an inch size. Radiographic evaluation of the fracture was made periodically. At four weeks, periosteal callus formation could be seen and at six months of age, a healed fracture with remodelling of the callus was noticed.

MATERIALS AND METHODS

MATERIALS AND METHODS

The experimental study was conducted on 16 apparently healthy male calves, aged six to nine months and weighing 38 kg to 75 kg. The animals were examined for endo-parasites and the infested animals were treated.

The experimental animals were divided into two groups, viz.

Group I - Consisting of six animals and

Group II - Consisting of ten animals.

These animals were numbered serially from I/1 to I/6 in Group I and II/1 to II/10 in Group II.

In Group I, after creating fracture of tibia, immobilisation was effected by external immobilisation using light bamboo splints and plaster of paris cast.

In Group II, after creating fracture of tibia, immobilisation was effected by intramedullary pinning with Kuentcher Cloverleaf nail reinforced with external immobilisation using light bamboo splints and plaster

of paris east.

Special instruments used for pinning: (Fig.1)

1. Kuntscher Cloverleaf nail
2. Reamer
3. Guide wire
4. Driver
5. Extractor
6. Wire saw.

All the instruments and other surgical sundries were sterilised by autoclaving before use.

Site

The site chosen was on the medial aspect of the left leg. The fracture was created on the tibia transversely either on the middle or lower third.

Pre-operative preparation.

The animal was starved for 24 hours prior to surgery.

To choose the nail of the correct size, the length of the tibia and diameter of the medullary

canal were assessed from a radiograph taken on the previous day (Fig.2).

The left hind limb was washed and cleaned from the stifle to the hoof. The medial aspect of the leg and cranial aspect of the stifle joint upto the cranial tuberosity of tibia were prepared for aseptic surgery. The animal was secured on the left lateral recumbency. The limb was draped suitably.

Anaesthesia.

Narcosis was induced by slow intravenous administration of chloral hydrate 10% solution at the rate of 1 ml per kg body weight. In addition, lidocaine hydrochloride 2% solution* 8 to 20 ml was administered epidurally at the sacro-coccygeal site.

A longitudinal incision, 8 cm long was made on the medial aspect of the leg commencing from the middle to the lower third of the tibia. The incision was made deeper to cut through the subcutis and periosteum, taking care not to injure the saphenous

* Xylocaine - Astra or Gesicain - Suhrid Geigy.

vessels and the nerves crossing in the mid-shaft region. These vessels and nerves were isolated and retracted. By blunt dissection, the periosteum was separated all around the tibia at the proposed site of fracture. A wire saw was guided between the separated periosteum and the tibia and the shaft was divided transversely at its middle or lower third.

In Group I, the skin, subcutaneous fascia and the incised periosteum were closed by vertical mattress sutures using monofilament nylon. After reducing the fracture, light bamboo splints were applied after padding the region with cotton and a plaster of paris cast was applied from the stifle to the fetlock region. A window was cut at the site of fracture to facilitate dressing of the wound. A radiograph was taken to check up the reduction of fracture (Fig.3).

In Group II, the lips of the wound were retracted by means of Allis forceps. The proximal fragment of the tibia was exteriorised and a reamer was introduced into the medulla which was guided upwards to

pierces the cranial tuberosity of the tibia. When the reamer could be palpated subcutaneously a small skin incision was made just over it and the reamer was withdrawn. A guide wire was introduced through the skin incision and the drilled hole and with its help, the sterilised Kuentscher Clover nail was directed downwards through the proximal fragment of tibia. With the use of a driver, the nail was driven into the medullary cavity after holding the fragments in alignment, till it was anchored into the distal epiphysis. The guide wire was withdrawn. The skin along with the periosteum and fascia was closed by vertical mattress sutures using monofilament nylon.

The suture line was sealed with Tr. Benzoin Co. Reduction of the fracture was checked up radiographically (Fig.4). The Kuentscher nail was pushed in or withdrawn according to the radiographic assessment of reduction. Using light bamboo splints and padding with cotton, a plaster of paris cast was applied from the stifle to the fetlock. Two windows were cut, one

at the site of incision made to create the fracture and other at the site of incision made to introduce the Kuentscher Cloverleaf nail. The wound was dressed and bandaged. Daily dressing of the wound was carried out. Antibiotics were administered post-operatively as and when required. The sutures were removed when the skin incision was healed up. The Kuentscher nail was extracted after six weeks. In cases of delayed formation, nail was extracted later on the basis of radiological assessment.

Animals were kept under observation usually for a period of 60 days and the following observations were recorded:

- 1) Clinical symptoms after immobilisation in Groups I and II.
- 2) Complications encountered during the period of observation and
- 3) The progress of healing of fracture as evidenced by weekly radiographs.

RESULTS

RESULTS

Group-I

Animal No. I/1.

The animal was feeding and drinking normally after recovery from anaesthesia. On the third post-operative day, the animal could stand up without assistance, but was not bearing weight on the fractured limb. Consequent on the application of plaster cast there was slight oedema above the plaster cast which subsided on the third day. Enteromycin* was administered intramuscularly daily for three days. Window was cut on the plaster cast at the site of fracture. The skin wound was cleaned and dressed with sulphamileamide and bandaged daily.

There was slight febrile reaction from fifth day. The total and differential counts of leucocytes on the sixth day did not show significant variation.

A soft swelling, pitting on pressure was noticed at the site of fracture on the ninth day. On exploratory puncture the swelling was found to contain pus. After incising at the most dependent part, the pus was

* Chloramphenicol - Deys.

drained, cavity irrigated with hypertonic saline and gauze dipped in Tr. Iodine was inserted. Cleaning and dressing were continued.

The infection had gained access to the medullary canal. Cleaning and dressing were continued for seven more days. Presence of sequestrum and sloughing off of the skin and adjacent tissues were noticed. Displacement of the fragments was obvious.

Since no improvement could be noticed the animal was sacrificed on the 16th post operative day.

A radiograph taken after the application of plaster cast revealed apposition of the fragments (Fig.3).

When a radiograph was taken on the 12th day, it was found that there was posterior downward displacement of the proximal fragment with anterior upward displacement of the distal fragment (Fig.5-a).

The animal was sacrificed on the 16th day.

Animal No. I/2.

The animal recovered from anaesthesia uneventfully

and was normal in habits. On the second post-operative day the animal could stand up without any assistance. But it was not bearing weight on the left hind limb. Following the application of plaster cast there was slight oedema above the plaster cast which subsided on the next day. Enteromyocetin was administered intramuscularly daily for three days. The total and differential counts of leucocytes estimated on the sixth day did not reveal any significant variation. Window was cut on the plaster cast at the site of fracture and the skin wound was cleaned and dressed with sulphamylamide powder and bandaged till 11th post-operative day, when sutures were removed. There was slight febrile reaction from the 14th day.

A swelling, soft and pitting on pressure was noticed at the site of fracture on the 14th day. On exploratory puncture, presence of pus was noticed. After incising, the pus was drained, cavity irrigated with hypertonic saline and gauze dipped in Tr. Iodine was inserted. Cleaning and dressing of the wound were continued.

The infection had gained access to the medullary

canal and sequestrum was also seen while treating the abscess. Cleaning and dressing were continued for four more days, but sequestrum was still present. In addition, necrosis of the tissues at the site of fracture was also present. Since no improvement could be noticed the animal was sacrificed on the 18th post-operative day.

A radiograph taken subsequent to the application of plaster cast revealed apposition of the fragments.

A radiograph on the 12th day revealed that the distal fragment had displaced anteriorly with posterior displacement of the proximal fragment (Fig.5-b). The animal was sacrificed on the 18th day.

Animal No.1/3.

The animal was feeding and drinking normally after recovery from anaesthesia. The animal could stand up without assistance on the same day, but it was not bearing weight on the left hind limb. Following the application of plaster cast there was slight oedema above the plaster cast which subsided on the third day. Enteromycetin was administered intramuscularly daily

for three days. Window was cut on the plaster cast at the site of fracture and the skin wound was cleaned and dressed with Sulphanilamide powder and bandaged. There was a slight febrile reaction from the seventh day.

An abscess had developed at the incision site where the fracture was created, by the eighth day. After incising, the pus was drained, cavity irrigated with hypertonic saline and gauze dipped in Tr. Iodine was inserted. Cleaning and dressing of the wound were continued. The plaster cast became loose.

Cleaning and dressing were continued for two more days. Gangrene of tissues at the site of fracture was present. While treating the wounds, separation of the fragments could be clearly noticed.

Since no improvement could be noticed the animal was sacrificed on the tenth post-operative day.

The radiograph taken on the next day of reduction and immobilisation with plaster cast, showed displacement of the fragments (Fig.6).

The animal was sacrificed on the 10th day.

Animal No. I/4.

The animal was normal in habits throughout the period of observation. On the second post-operative day the animal could stand up without assistance. But it was not bearing weight on the left hind limb. Following the application of plaster cast there was slight oedema above the plaster cast which subsided on the third day. Enteromycetin was administered intramuscularly daily for three days. Window was cut on the plaster cast at the site of fracture and the wound was cleaned and dressed with Sulphamylamide powder and bandaged.

There was abscess formation by the eighth day. After incising, the pus was drained, cavity irrigated with hypertonic saline and gauze dipped in Tr. Iodine was inserted. Cleaning and dressing were continued. The plaster cast became slightly loose. There was slight febrile reaction from the tenth day.

The infection had gained access to the medullary canal. Cleaning and dressing were continued for seven more days. While treating the wounds, separation of

the fragments could be clearly noticed and the medullary canal accessible for cleaning. The tissues at the site of fracture had become necrotic and started sloughing off. Since no improvement could be noticed the animal was sacrificed on the 15th post-operative day.

A radiograph taken subsequent to the application of plaster cast revealed reduction and apposition of the fragments. When a radiograph was taken on the 11th day, it was found that the apposition had been disturbed. There was overriding of the fragments (Fig.7). The animal was sacrificed on the 15th day.

Animal No.1/5.

The animal recovered from anaesthesia and was unable to get up. Following the application of plaster cast, there was slight oedema above the plaster cast which subsided on the third day. Enteromycin was administered intramuscularly daily for three days. Window was cut on the plaster cast at the site of fracture and the skin wound was cleaned, dressed with Sulphanilamide powder and bandaged.

Studies on leucogram revealed relative neutrophilic leucocytosis on the seventh day. From the seventh day, there was slight febrile reaction.

A soft swelling, pitting on pressure was noticed at the site of fracture. Exploratory puncture on the seventh day revealed that the swelling contained pus. After incising, the pus was drained, cavity irrigated with hypertonic saline and gauze dipped in Tr. Iodine was inserted. Cleaning and dressing were continued. The plaster cast became damp and slightly loose and was reapplied.

Cleaning and dressing were continued for two more days. But pus was in abundance. There was severe local oedema, and foul-smelling pus was oozing out from the wound. The distal extremity had been separated from its alignment with the proximal extremity. Tissues at the site of fracture had become necrotic and started sloughing off. Since no improvement was noticed, the animal was sacrificed on the ninth post-operative day.

A radiograph taken subsequent to the application of plaster cast revealed apposition of the fragments. When the radiograph was taken on the seventh day, it was found that there was displacement of the fragments with a gap in between. The animal was sacrificed on the ninth day.

Animal No. I/6.

The animal was feeding and drinking normally after

recovery from anaesthesia. On the fourth post-operative day the animal could stand up without assistance. But it was not bearing weight on the left hind limb. Following the application of plaster cast there was slight oedema above the plaster cast which subsided on the third day. Enteromycetin was administered intramuscularly daily for three days. Window was cut on the plaster cast at the site of fracture and the skin wound was cleaned and dressed with Sulphanilamide powder and bandaged. There was slight febrile reaction by the fourth day. Studies on leucogram revealed relative neutrophilic leucocytosis on the seventh day.

A soft swelling pitting on pressure was noticed at the site of fracture. Exploratory puncture on the seventh day revealed that contents of the swelling was pus. After incising, the pus was drained, cavity irrigated with hypertonic saline and gauze dipped in Tr. Iodine was inserted. The plaster cast became slightly loose and damp.

Infection had gained access into the medullary canal. There was severe local oedema, and foul smelling pus was oozing out in abundance from the wound. The reduction of the fracture was found to have been completely disturbed. There was necrosis and sloughing off of the skin and adjacent

tissues. Since the condition became worse, the animal was sacrificed on the seventh post-operative day.

A radiograph taken subsequent to the application of plaster cast revealed apposition of the fragments with a small gap. When a radiograph was taken on the seventh day, it was found that the apposition had been disturbed. There was overriding of the fragments. The animal was sacrificed on the seventh day.

Group II

Animal No. II/1.

The animal recovered from anaesthesia and was normal in habits. The animal was able to stand up when assisted, on the day of operation and without assistance by the fourth day. But it was not bearing weight on the left hind limb. Slight oedema was noticed at the left stifle following the application of the plaster cast which subsided on the fifth day. Munoaycin Forte * was administered intramuscularly daily four five days. Windows were cut on the plaster cast at the fracture site and at the cranial tuberosity of the tibia where the nail was introduced. The skin wounds were cleaned, dressed with Aureomycin dusting powder ** and bandaged till the ninth post-operative day when the sutures were removed.

* Fortefied Procaine Penicillin, Streptomycin and Polyvalent antigen.- GLAXO.

** Chlorotetracycline 2% - CYNAMID.

By the ninth day, rise of temperature was noticed. By 15th day a soft swelling, pitting on pressure was noticed at the site of the incision made to introduce the Kuentcher nail. By 17th day, on removal of the plaster cast, another soft fluctuating swelling was observed at the site of fracture. By exploratory puncture both the swellings contained pus. After incising, the pus was drained, cavity irrigated with hypertonic saline and gauze dipped in Tr. Iodine was inserted. The infection had gained access to the medullary canal and sequestrum was also seen while treating the abscess. The animal was lame through out the period of observation. The quantity of sequestrum was on the increase during the subsequent days. Even after continued dressing of the wound and removing the sequestrum, no improvement could be noticed and hence the animal was sacrificed on the 30th post-operative day.

A radiograph was taken on the fifth day. The fragments were in apposition, but there was a gap at the anterior part of the fracture line. The radiograph taken on the tenth day did not reveal any sign of osseous proliferation. A distinct enlargement was noticed at the

cranial tuberosity of the tibia. Radiograph on 15th day revealed periosteal proliferation both on the proximal and distal fragments away from the fracture site. There was no proliferative reaction apparent at the site of fracture. Since the animal was sacrificed on the 30th post-operative day more radiographs could not be taken.

Animal No. II/2.

The animal was feeding and drinking normally after recovery from anaesthesia. The animal was able to stand up when assisted, on the same day of operation and without assistance by the third post-operative day, but it was not bearing weight on the left hind limb. Slight oedema noticed on the stifle region consequent to application of the plaster cast, subsided by the fourth day. Mupromycin was administered intramuscularly daily for five days. There was febrile reaction from third day. Windows were cut on the plaster cast at the fracture site and at the cranial tuberosity of the tibia where the nail was driven. The skin wounds were cleaned, dressed with Auromycin dusting powder and bandaged till the ninth post-operative day when the stitches were removed.

By 11th day, a soft fluctuating swelling, pitting on pressure was noticed at the site of fracture. On exploratory puncture the swelling was found to contain pus. After incising, the pus was drained. The suppuration was found to be extending to the medullary canal also. Cavity was irrigated with hypertonic saline and gauze dipped in Tr. Iodine was inserted. However, the presence of pus was noticed to be on the increase during the subsequent six days. The animal was lame throughout the period of observation. Even after local treatment of the wound and administration of antibiotics, no improvement could be noticed and hence the animal was sacrificed on the 16th post-operative day.

A radiograph on the fifth day revealed that the fragments were in apposition, but a small gap at the anterior part of the fracture line was evident. The radiograph taken on the tenth day did not reveal any sign of osseous proliferation. Radiographic evaluation could not be continued since the animal was sacrificed on 16th post-operative day.

Animal No. II/3.

The animal recovered from anaesthesia and was

normal in habits. The animal was able to stand up when assisted, on the day of operation and without assistance by the third day. But it was not bearing weight on the left hindlimb till 30th post-operative day. Slight oedema was noticed at the left stifle following the application of the plaster cast which subsided on the fourth day. During the first week, temperature was normal. No antibiotics were administered during the above period. Windows were cut on the plaster cast at the site of fracture and the site of incision made to introduce the Kuntscher nail. The wounds were cleaned, dressed with Aureomycin dusting powder and bandaged till eighth post-operative day when the sutures were removed.

By the tenth day febrile reaction was noticed. Miconycin was administered intramuscularly daily for five days. On 11th day there was pus escaping from the site of the incision made to introduce the nail. The pus was drained off, cavity irrigated with hypertonic saline and gauze dipped in Tr. Iodine was inserted.

By 16th day, a soft swelling, pitting on pressure

was noticed at the site of fracture. On exploratory puncture, swelling contained pus. After incising, pus was drained, cavity irrigated with hypertonic saline and gauze dipped in Tr. Iodine was inserted. On the subsequent days the abscess cavity was cleaned and dressed with sulphanilamide powder. Intramuscular injection of Mumomycin was continued daily for five more days.

The temperature was reduced and the quantity of pus decreased. The abscess at the site of incision made for introducing the nail healed up. At the fracture site the infection had gained access to the medullary canal and sequestrum was also seen while treating the abscess. The quantity of sequestrum was on the increase during the subsequent days.

By the fourth week the animal could use the fractured limb also. But the animal showed lameness of the fractured limb. Drooping of the right fetlock was noticed by the fifth week.

Even after continued administration of antibiotics and local treatment of the wounds, no improvement could

be noticed and hence the animal was sacrificed on the 36th post-operative day.

A radiograph was taken on the tenth day. The fragments were in apposition at the caudal aspect but there was a gap at the cranial aspect of the fracture line. A radiograph on the 15th day revealed apparent periosteal reaction on the proximal and distal fragments. Reaction on the distal fragment was comparatively less.

In the radiograph taken on the 23rd day, periosteal reaction was well apparent on the proximal fragment but poor on the distal fragment. Radiographs on the 31st and 36th days revealed periosteal reaction on both the fragments, but more on the proximal fragment. There was slight lipping of the proliferated tissue on the caudal aspect of the proximal fragment just above the fracture line. The fracture line was getting obliterated. Reaction zones were noticed on the proximal and distal fragments away from the fracture line at the regions where the pin was pressing on the cortex. The osseous proliferation was radiographically more apparent on the 36th day than on the 31st day. Radiographic evaluation could not be

continued since the animal was sacrificed on 36th post-operative day.

Animal No. II/4.

The animal was feeding and drinking normally after recovery from anaesthesia. The animal was able to stand up when assisted, on the day of operation and without assistance by the fifth post-operative day. But it was not bearing weight on the left hind limb till 12th day. There was straining for defecation on the second post-operative day, which was relieved by a soap water enema. The plaster cast was removed periodically for observing infection, if any, and reapplied. Slight oedema noticed on the stifle region consequent on application of the plaster cast, subsided by fourth day. Bistrepen* was administered intramuscularly daily for five days. Windows were cut on the plaster cast at the fracture site and at the cranial tuberosity of the tibia where the nail was introduced. The skin wounds were cleaned, dressed with sulphanilamide powder and bandaged till ninth post-operative day when the stitches were removed.

* Streptopenicillin - ALEMBIC.

On 15th day, the pressure sores found on either side of hock when the plaster cast was removed were cleaned and dressed.

From the third week onwards improvement was gradual. There was no incidence of infection. The animal used to walk better, but slight lameness of the hind limb and dropping of the fetlock of the right hind limb could be seen. The muscles of the left hind limb showed disuse atrophy.

During the ninth week the animal was normal in habits. The fetlock and pastern joints of both the hind limbs were found to be slightly dropped. There was slight lameness. On 69th day the pin was removed aseptically through an incision made at the cranial aspect of the stifle joint where the tip of the pin was palpated. The bony growth around the tip of the pin was cut and removed before the extraction of the pin. The skin incision was closed with simple interrupted sutures and sealed with Tr. Benzoin Co. A plaster of paris cast was applied as an additional support which was removed after two weeks. Enteromycetin* was administered

* Chloramphenicol - Deys.

intramuscularly daily for five days from the day when the pin was removed. There was oedema around around the skin incision which subsided by one week. The suture line was cleaned with spirit and sutures were removed on the eighth day.

The animal started using the limb when the oedema subsided. The animal was bearing weight on the limb but there was dropping of the fetlock and slight lameness. Slight rotation of the limb distal to the fracture and disuse atrophy of the muscles were present.

The animal was sacrificed on the 106th day and the tibia was cropped and macerated. The size of the callus had reduced. The callus was smooth on the cranial aspect of the tibia and rough on the caudal aspect. The fragments had been firmly united but the hole drilled on the proximal extremity for introducing the nail had not been obliterated. There was slight rotation of the distal fragment (Fig.8-a).

A radiograph was taken on the 9th day. The pin was intact and the fragments were in apposition. There

were no reaction zones (Fig.9). A radiograph on the 15th day did not reveal any proliferative reaction (Fig.10). In the radiograph taken on the 21st day, periosteal proliferation was noticed on both the proximal and distal fragments. There was lipping of the callus on the caudal aspect (Fig.11). The radiograph on 28th day revealed more apparent periosteal proliferation. The callus between the two fragments was continuous on the caudal aspect. The fracture line was still clear. The radiograph on 36th, 43rd (Fig.12) and 52nd days (Fig.13) revealed continuous and more dense callus both on the cranial and caudal aspects. On the 52nd day the fracture line became narrow and less clear and the callus was more radio-opaque. Radiographs taken on 62nd (Fig.14) and 69th days showed well developed callus uniting the two fragments. Fracture line was still apparent but not distinct. Callus was more developed and extensive on the caudal aspect of the bone. Proliferative osseous reaction was noticed at the proximal end of the bone where the tip of the pin projected from the bone. A radiograph was taken on the 71st day (Fig.15) after the removal of the nail. The callus was well developed

uniting the two fragments and was radio-opaque. The callus on the caudal aspect was well developed. Fracture line was completely obliterated but it was still apparent. In another radiograph taken on the 85th day (Fig.16), the callus was more radio-opaque and was having the same density as that of the adjacent cortical bone. The callus was more on the caudal aspect. Fracture line had become indistinct. The radiograph taken on the 91st day revealed that the callus was more dense but the size had reduced. The fracture line was indistinct. The animal was sacrificed on the 106th day.

Animal No. II/5.

The animal recovered from anaesthesia and was normal in habits. The animal was found to be restless after recovery from narcosis and hence Siquil* 20 mg was administered intramuscularly. On the second day, the animal could stand up when assisted and by the fourth day without assistance. But it was not bearing weight on the left hind limb till 29th post-operative day. Bistrepen was administered intramuscularly daily for five days. Slight oedema was noticed at the left

* Triflupromazine hydrochloride - SARABHAI.

stifle following the application of the plaster cast which subsided on the fifth day. After cutting windows on the plaster cast at the fracture site and above the cranial tuberosity of the tibia where the nail was driven, the skin wounds were cleaned, dressed with sulphanilamide powder and bandaged till the ninth post-operative day when the sutures were removed.

On the 12th day, a small quantity of pus was noticed from the skin wound made to introduce the nail. The pus was drained, cavity irrigated with hypertonic saline and gauze dipped in Tr. iodine was inserted. By the fourth week a soft swelling, pitting on pressure was noticed at the site of fracture. On exploratory puncture the swelling contained pus. The abscess was treated as before. The infection had gained access to the medullary canal and sequestrum was also seen while treating the abscess. The quantity of the sequestrum was on the increase during the subsequent two weeks. By the end of fourth week the animal was found to be bearing weight on the fractured limb, inspite of the infection. Drooping of the fetlock could be noticed by the fourth week. The animal showed lameness of the

fracture limb and slight disuse atrophy of muscles.

During the fifth week sequestrum was subjected to sensitivity test. It was sensitive only to chloramphenicol and Kanamycin. Enteromycetin was administered intramuscularly for six days, but sequestrum was still present. Cleaning and dressing were continued for another two weeks. No improvement could be noticed and hence the animal was sacrificed on the 57th post-operative day.

On 15th day a radiograph was taken. The fractured ends were in apposition with the pin intact. The radiographs taken on the 22nd and 28th day revealed proliferative reaction on the proximal and distal fragments which was more on the caudal aspect. The reaction zone on the distal fragment was little away from the fracture line. On 28th day there was osseous proliferation at the proximal end of the bone where the tip of the pin projected. The radiograph taken on the 37th day revealed more apparent periosteal reaction on both the fragments, but more on the caudal aspect of the bone. The proliferative changes on the distal fragment was about 2 cm away from the fracture line. The callus on

the proximal fragment projected over the caudal aspect with slight lipping. The radiograph on the 46th day revealed that callus was more radio-opaque. The callus on the proximal fragment was lipping well over the distal fragment. The proliferative reaction on the distal fragment was away from the fracture line. There was no noticeable continuity between the callus of the two fragments. The fracture line was getting obliterated. The animal was sacrificed on the 57th day.

Animal No. II/5.

The animal was normal in feeding habits throughout the period of observation. On the second post-operative day the animal could stand up without assistance but it was not bearing weight on the left hind limb till tenth post-operative day. Slight oedema noticed on the stifle region consequent on the application of plaster cast subsided by fourth day Dicrysticin* was administered intramuscularly daily for five days. Windows were cut on the plaster cast at the fracture site and at the site of incision made for the intro-

* Streptopenicillin - SARABHAI.

duction of the nail. The skin wounds were cleaned, dressed with sulphanilamide and bandaged till ninth post-operative day when the stitches were removed. On the tenth day the animal was found to bear weight on the fractured limb also.

During the second and third weeks there was no rise in temperature. Animal was normal in habits. The plaster cast was removed periodically for observing infection if any and reapplied. Cleaning and dressing of the suture lines were continued.

On the 22nd day onwards there was febrile reaction. A soft swelling pitting on pressure was noticed at the site of incision. On exploratory puncture the swelling contained pus. After incising, the pus was drained, cavity irrigated with Iodine lotion and gauze dipped in Tr. iodine was inserted. Enteromycetin was administered intramuscularly daily for five days. The animal was limping on the fractured limb. The abscess had healed up within a week.

The animal was normal in habits. The pressure sores found on removal of the plaster cast were cleaned

and dressed with Sulphanilamide powder.

On the 61st day the nail was extracted aseptically by incising the skin at the site where the tip of the pin could be palpated. The incision was closed by vertical mattress sutures and the plaster cast was applied as an additional support and retained for two weeks. There was oedema around the skin incision in the stifle which subsided in a week. Enteromycetin was administered intramuscularly daily for five days and dressing the skin wound was continued for another eight days when the sutures were removed.

After the removal of the nail the animal was not bearing weight on the fractured limb till the 70th day. There was no rise in the body temperature. The use of the limb was almost normal. Slight dropping of the fetlock joints of both the hind limbs was noticed. The animal was lame on the left hind limb, but to a lesser degree. There was disuse atrophy of the muscles. There was a slight rotation of the limb distal to the fracture. The animal was sacrificed on the 93rd day and the tibia was macerated.

The size of callus had reduced. It was rough and dense on the cranio-lateral aspect and was firmly uniting the fragments. The hole drilled for introducing the nail had not been completely filled. There was slight rotation of the distal fragment (Fig.8-b).

A radiograph on 31st day revealed proliferative reaction on the caudal aspect of the bone both on the proximal and distal fragments. Reaction was very little at the cranial aspect.

In the radiograph taken on the 39th day there was well developed callus on the caudal aspect and the callus was continuous with the proximal and distal ends. Fracture line was obliterated on the caudal aspect only. Callus was clearly radio-opaque. Reaction at the fracture ends on the cranial aspect was mild.

A radiograph taken on the 45th day revealed the presence of a well developed callus bridging the gap on the cranial aspect also. Fracture line was getting obliterated. The cortical bone on the caudal aspect of the fractured bone had undergone sclerosis and was indistinct from the callus.

A radiograph was taken on the 59th day, after removing the plaster cast. The callus was well developed. The fracture line was getting obliterated. Callus on the caudal aspect was bigger and extensive than that on the cranial aspect.

Radiographs on the 60th and 69th days after removal of the pin revealed a well formed callus. Fracture line had been completely obliterated. Callus was extensive on the caudal aspect. Callus on the cranial aspect of the fracture line was restricted to the site of fracture where as on the caudal aspect the callus was very extensive on both the fragments. Callus was radio-opaque on the 67th day. The size of the callus was becoming less pronounced.

When the radiograph was taken on 74th day it was found that the size of the callus was still reduced. Fracture line was completely obliterated. Eventhough the callus was becoming low it was still extensive on the caudal aspect.

On the 88th day, medullographs of the normal and healing tibia were taken. Conrary-420* was injected

* Sodium Iothalamate injection B.P - MAY & BAKER.

at the distal end of the tibia after drilling a hole. In the normal tibia the medullary vein and external saphenous vein were clearly outlined. Emissary veins from the distal end of the tibia draining the site of injection was also outlined (Fig.17). In the healed tibia, the medullary vein was continuous. Emissary veins were more from the site of the healing fracture (Fig.18).

Animal No. II/7.

The animal recovered from anaesthesia and was normal in habits. On the second post-operative day the animal could stand up when assisted but not bearing weight on the left hind limb. The animal could stand up without assistance on the third day but not bearing weight on the left hind limb till 25th post-operative day. Dicyclicin was administered intramuscularly daily for five days. Windows were cut on the plaster cast at the fracture site and at the site of incision made for introducing the Kuentscher nail. The skin wounds were cleaned, dressed with sulphanilamide powder and bandaged till eight post-operative day when the sutures were removed. Slight oedema was noticed at the left stifle

following the application of the plaster cast which subsided on the fifth day.

There was rise in temperature from the third day onwards. Enteromycin was administered intramuscularly daily for five days, but febrile reaction did not subside. Dressing of the wound was continued as before.

During the third week the temperature became normal. Cleaning and dressing of the suture lines were continued. The plaster cast was removed occasionally for observing infection, if any, and reapplied. There was no sign of infection. The pressure sores found on the medial aspect of the hock were cleaned and dressed with sulphanilamide powder.

The animal showed lameness of the fractured limb. Dropping of the fetlock of both the hind limbs was seen. There was disuse atrophy of the muscles and slight rotation of the limb distal to the fracture.

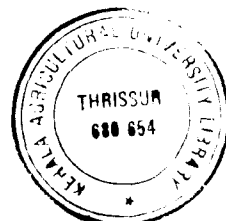
The animal was sacrificed on the 52nd day and the bone was macerated. The callus was more dense and irregular on the caudal aspect of the distal

fragment. There was an oblique strip of callus formed on the cranio-lateral surface of the bone starting from just lateral to the cranial tuberosity. The callus was well formed at the site of fracture uniting the fragments (Fig.8-c).

On the 16th day a radiograph was taken. The fractured ends were in apposition with the pin in position. Apposition was more at the caudal aspect of the bone. There was a small gap at the cranial aspect of the bone.

A radiograph on the 22nd day revealed periosteal proliferation both on the proximal and distal fragments. Caudal aspect of the bone showed more reaction than the cranial surface. The fragments were in apposition. A zone of proliferation was noticed at the cranial aspect of the proximal fragment where the pin was touching the cortical bone.

Radiographs on 29th and 38th days revealed more clear periosteal proliferation which was more towards the caudal aspect. There was developing dense callus



bridging the two fragments at the fracture site. Oss-
eous proliferation was noticed at the proximal end of
the bone where the tip of the pin projected. On the
38th day, callus became more radio-opaque and well
developed and the fracture line was getting obliterated.
Sclerotic changes of the cortical bone was noticed
where the nail was pressing the cortex.

A radiograph was taken on the 50th day where the
callus was well developed and continuous with both the
fragments. Callus was more extensive on the caudal
aspect. The callus was more radio-opaque and firmly
uniting the two fragments.

Medullography of the fractured tibia was done on
the 52nd day with the pin insitu and immediately after
removal of the pin (Fig.19) using Conray-420 as the
contrast medium. The contrast medium had drained
through the emissary veins.

Animal No. II/8.

The animal was normal in feeding habits through-
out the period of observation. The animal was able to

stand up when assisted on the day of operation and without assistance by fourth day. But it was not bearing weight on the left hind limb till the 30th day. Slight oedema noticed on the stifle region consequent on the application of plaster cast subsided on the fourth day. There was rise in temperature. Dicyrsticin was administered intramuscularly daily for five days. Windows were cut on the plaster cast at the fracture site and above the cranial tuberosity of the tibia where the nail was introduced. The skin wounds were cleaned, dressed with sulphanilamide powder and bandaged till the eight post operative day when the sutures were removed. The febrile reaction did not subside after a course of Dicyrsticin. Thereafter Enteromycetin was administered intramuscularly daily for five days and the febrile reaction subsided.

The plaster cast was removed as and when required to observe wound infection, if any, and reapplied. No untoward reaction could be noticed from the third to tenth week. Animal was bearing weight on the fractured leg by the end of fourth week but there was lameness.

The pressure sores were cleaned and dressed with sulphamilsamide powder. Towards the end of sixth week the use of the limb appeared to be normal except for the atrophy of muscles, dropping of the fetlock and lameness. There was slight rotation of the limb distal to the fracture. The animal was sacrificed on the 71st day and the healed bone was macerated and preserved. The callus had firmly united the fragments. The callus was dense, rough and continuous on the caudal aspect whereas, it was less dense, rough and continuous on the cranial aspect (Fig.20).

On 15th day a radiograph was taken. The pin was in position. Periosteal reaction was noticed on the proximal and distal fragments. There was continuity between the proliferated tissue on the caudal aspect but absent on the cranial aspect.

Radiographs on 29th and 36th days revealed well developed callus on the caudal aspect. Fracture line was not distinct at the caudal aspect but quite clear on the cranial aspect. Distinct zone of proliferation was noticed on the cranial aspect about half a

centimeter away from the fracture line and a low zone of reaction at the proximal fragment cranially. The radiograph on the 36th day revealed that the callus between the two fragments was continuous on the caudal aspect. There was slight lipping of the callus developing on the cranial aspect of the proximal fragment. The callus was radio-opaque. Osseous reaction was noticed on the proximal end of the bone where the pin was projecting.

A radiograph was taken on the 50th day. The callus was radio-opaque and extensive on the caudal aspect and was continuous. Callus on the cranial aspect was low and dense. Fracture line was still distinct. Medullography was performed on the same day using Conray-420 as the contrast medium. The emissary veins were seen drained into the Saphenous vein. Medullary vein was not distinct. A radiograph taken on the 57th day revealed well developed and extensive callus on the caudal aspect. Callus of the two fragments were continuous. The callus was firmly uniting the fragment. Fracture line was still distinct. Radiographs on 64th and 71st days revealed well developed

and extensive callus on the caudal aspect which was indistinguishable from the adjacent cortical bone. The fracture line had almost completely obliterated on the caudal aspect whereas it was distinct on the cranial aspect.

Animal No. II/9.

The animal started taking food and water immediately after recovery from narcosis and thereafter the animal was normal in feeding habits throughout the period of observation. On the second post-operative day the animal could stand up without any assistance. But it was not bearing weight on the left hind limb till 30th day. Following the application of plaster cast there was slight oedema at the stifle region which subsided on the fifth day. There was rise in temperature from the third day onwards. Dicrysticin was administered intramuscularly daily for five days. Windows were cut on the plaster cast at the fracture site and above the cranial tuberosity of the tibia where the nail was introduced. The skin wounds were cleaned, dressed with sulphanilamide powder and bandaged till tenth post-operative day when the sutures were removed. Since the

febrile reaction did not subside after a course of Dicrysticin, Enteromycetin was administered intramuscularly daily for five days, when the febrile reaction subsided.

The plaster cast was removed periodically to observe infection, if any, and reapplied.

No untoward reaction could be noticed from the third to seventh week. Animal was bearing weight on the fractured limb by 30th day but there was lameness.

The pressure sores were cleaned and dressed with sulphanilamide powder. Towards the end of sixth week the use of limb appeared to be normal except for slight disuse atrophy of muscles, dropping of the fetlock and slight lameness. There was slight rotation of the limb distal to the fracture. The animal was sacrificed on the 49th day and the bone was macerated and preserved. The callus was well developed firmly uniting the fragments.

A radiograph on 22nd day revealed the pin in position. The fragments were in apposition but with a gap. There was no periosteal proliferation.

A radiograph was taken on 30th day removing the plaster cast. There was periosteal proliferation close to the fracture line both on the cranial and caudal aspects in both the fragments. Proliferation was more on the caudal aspect.

On 38th day a radiograph was taken. The callus was more dense and had become radio-opaque and was continuous on the caudal aspect. Fracture line was distinct.

The radiographs on 44th and 49th days revealed more radio-opaque and continuous callus on the caudal aspect. The callus was firmly uniting the fragments. On 49th day the fracture line was indistinct on the cranial aspect but it was distinct on the caudal aspect.

Animal No. II/10.

The animal was normal in habits throughout the period of observation. The animal could stand up on the same day of operation without assistance. But it was not bearing weight on the left hind limb till the 29th post-operative day. There was slight oedema at

the stifle region following the application of plaster cast which disappeared on the sixth day. Dicyrysticin was administered intramuscularly daily for five days. Windows were cut on the plaster cast at the site of fracture and above the cranial tuberosity of the tibia where the nail was inserted. The skin wounds were cleaned, dressed with sulphanilamide powder and bandaged till ninth post-operative day, when the sutures were removed. There was a slight rise in body temperature from the second day onwards which did not subside after a course of Dicyrysticin. Then a course of Enteromycetin was administered intramuscularly daily for five days when the febrile reaction subsided.

From third to eighth week there was no untoward reaction. Animal began bearing weight on the fractured leg by the end of the fourth week but there was lameness. The plaster cast applied on the day of operation was removed by the end of the fifth week. The pressure sores were cleaned and dressed with sulphanilamide powder. Towards the end of seventh week the use of the limb was almost normal. Drooping of the fetlock joints of both the hind limbs was noticed. The animal was lame on the

left hind limb, but to a lesser degree. Disuse atrophy of the muscles of the limb was present. There was slight rotation of the limb distal to the fracture.

The animal was sacrificed on the 55th day.

A radiograph on the 19th day revealed the presence of periosteal reaction on both the fragments close to the fracture line on either side. On 29th day a radiograph was taken. The periosteal reaction was clear on both the fragments. It was extensive both on the cranial and caudal aspects but not continuous. The callus was slightly radio-opaque.

The radiograph taken on the 37th day revealed the presence of radio-opaque callus which was dense on the cranial surface, but less so on the caudal aspect.

In the radiograph taken on the 43rd day, the fracture lines were distinct. The callus on the cranial aspect was dense and continuous. There was lipping of the callus from the distal fragment on the caudal aspect. The callus was more radio-opaque. The radiograph on 48th day revealed a dense, continuous and radio-opaque callus on the

cranial aspect. The callus had become continuous on the caudal aspect also, but the callus was less dense. Callus was uniting the two fragments. A radiograph was taken on 55th day after removal of the pin. The fracture line had been obliterated completely.

DISCUSSION

DISCUSSION

The present study was conducted in 16 apparently healthy cross-bred calves aged from six to nine months and weighing 38 to 75 kg. Narcosis by intravenous injection of 10% chloral hydrate solution at the rate of 1 ml/kg body weight and epidural anaesthesia using eight to 20 ml 2% lidocaine hydrochloride solution were employed throughout the study. Fracture of the tibia was created either on the middle or the lower third after incising the skin on the medial aspect separating the periosteum and then sawing it with a wire saw.

In Group I consisting of six animals the skin incision was apposed by inserting a series of mattress sutures using monofilament nylon. The fracture was reduced, light bamboo splints were applied and then plaster of paris cast was put on and the animals were kept under observation.

In Group II consisting of ten animals Kuentscher Cloverleaf nail was introduced for internal fixation.

The skin wound was sutured as in Group I and plaster of paris cast was applied for additional support.

Recovery from the anaesthesia was uneventful and the animals were normal in feeding habits thereafter. Of the sixteen animals, two animals could stand up without assistance on the day of operation, while 13 could stand up on the second to fifth day and one could not get up.

In Group I during the period of observation, no animal could bear weight on the fractured limb. While in Group II excepting Nos. II/1 and II/2 the animals started bearing weight on the fractured limb between 10 to 30 days. Ramkumar *et al.* (1976) had reported that the animal could bear weight on the eighth day in a case of spiral fracture of humerus in a buffalo heifer.

In Group I, after reduction of fracture and the application of plaster cast oedema of the stifle region above the plaster cast was observed which disappeared in two to three days while in Group II the

oedema disappeared within four to six days. This may be because of the pressure of the plaster cast.

In Group I, the skin sutures were removed only in one animal (I/2) and in Group II the sutures were removed in all animals within eight to ten days. In Group I, Enteromycetin was administered intramuscularly daily for three days post-operatively whereas in Group II, a course of antibiotics viz. Munomycin or Streptopenicillin was administered initially. In one animal (II/3) the course of Munomycin was started only on the tenth post-operative day. In all animals of Group II except II/1, II/2 and II/3, a course of Enteromycetin was also administered. This was done after sensitivity test of the pus. Chloramphenicol (Enteromycetin) and Kanamycin were found sensitive while it was resistant to Penicillin, Streptomycin and Tetracyclines.

In Group I, wound infection characterised by abscess formation was noticed within seven to 14 days post-operatively. In spite of evacuation of pus after incision and local treatment, infection gained access

to the medullary canal. In Group II, local infection characterised with abscess formation was noticed by the 11th to 15th day in four animals and by 25th day in one animal and the rest five animals did not show any local infection. This may be because of the administration of a course of chloramphenicol (Enteromycesin) based on the sensitivity test.

Infection during and after intramedullary pinning was an important complication according to Mohanty *et al.* (1970). All the six animals of Group I and four animals of Group II showed infection gaining access into the medullary cavity, inspite of antibiotics and local treatment of wounds. The findings of the present study are in agreement to the earlier findings of Lundvall (1960) in horses, Vaughan (1975) and Hunt *et al.* (1980) in dogs, Prasad *et al.* (1979) in cattle and Hamilton and Tulleners (1980) in new born calves.

In all cases of Group I, infection locally and into intramedullary canal was a serious complication. To some extent, it could be prevented by administration of antibiotics, preferably after sensitivity test.

Lundvall (1960) had stated that osteomyelitis was common inspite of the most rigid aseptic techniques. It is interesting to note that, had there been no local infection, and the immobilisation being proper, the union of the fracture was quite satisfactory. Braden and Brinker (1976) had recorded 64% successful results in intramedullary pinning in fractures of dogs. In the present study, had infection not supervened as in all animals of Group I and the four animals of Group II, the results would have been comparable to the results in dogs by Braden and Brinker (1976).

In all the recovered cases, rotation was a feature, as revealed clinically and radiographically. This finding is in agreement with the earlier observations of Gill and Tyagi (1972).

In all the recovered cases dropping of the right fetlock was obvious (Fig.21).

In Group I and II, apposition of the fragments was normal on reduction as revealed in the radiographs. In Group I, the subsequent radiographs revealed that

alignment had been deviated, apposition changed with upward or downward displacement of the fragments. This was not noticed in Group II, wherein intramedullary Kuentscher Cloverleaf nail had been introduced, supported by plaster of paris cast.

In tibial fractures plaster of paris cast might not have been successful since it could not efficiently immobilise the stifle joint above. In Group II, proper immobilisation was achieved because of the intramedullary pinning.

In all cases wherein immobilisation had been effective and infection prevented, periosteal proliferation of the osteogenic tissues could be noticed on both the fragments by the third and fourth week. No such periosteal proliferative changes could apparently be seen in the radiographs during the first and second week. By the fifth and sixth week periosteal reaction had been more apparent with lipping on the fracture edges, obliterating the fracture line and revealing the formation of a primary callus. The callus had become more dense and radio-opaque by seventh and eighth week

making the callus indistinguishable from the adjacent fragments in its density. This is in agreement to the earlier findings of Stick and Derksen (1980) in horses and Ramakumar et al. (1976) in fracture of the humerus in a buffalo heifer.

SUMMARY

SUMMARY

The present study was conducted on 16 apparently healthy cross-bred bull calves aged from six to nine months and weighing 38 to 75 kg. They were divided into two groups, viz:

Group I, consisting of six animals and

Group II, consisting of ten animals.

Marcosis by intravenous injection of 10% Chloralhydrate solution and epidural anaesthesia by injecting 8 to 20 ml of 2% Lidocaine hydrochloride solution were employed.

Fracture of the tibia was created either at the middle or at the lower third by incising the skin medially and sawing the tibia with a wire saw.

In Group I, the skin wound was sutured, the fracture reduced and plaster cast put on after applying light bamboo splints.

In Group II, Kuntscher Cloverleaf nail was introduced with the help of a guide wire and was anchored into the distal fragment. Plaster of paris

cast was put on as additional support.

Recovery from anaesthesia was uneventful and the animals were normal in feeding habits. Of the 16 animals, two could stand up without assistance on the day of operation, while 13 from the second to the fifth day and one did not get up.

None of the animals in Group I could bear weight on the fractured limb. In Group II, excepting two animals, the rest could bear weight by the 10th to 30th day. In all the animals, oedema of the stifle region probably due to the pressure of the plaster cast, persisted for two to six days.

Antibiotics were administered post-operatively. In Group I, Enteromycetin was administered. In Group II, a course of Miconycin or Strepto-penicillin was first administered. Later, a course of Chloramphenicol was administered on the basis of the sensitivity test of the pus.

Wound infection, characterised with abscess formation was apparent in all the animals of Group I and only in five animals in Group II.

In Group I, wherein plaster cast alone was used, the reduction of the fragments had been disturbed resulting in upward or downward displacement of the fragment. In Group II, such displacement was not apparent, because of the intramedullary Kuntscher Cloverleaf nail.

Radiographs after reduction of the fracture and immobilisation, had shown proper apposition of the fragments in all cases. But in Group I, displacement of the fragments was apparent, when the radiographs were taken by the next week.

Periosteal proliferation of osteogenic tissues could be noticed on either fragments by third to fifth week. From the fifth to sixth week periosteal reaction had become more prominent with lipping of the fracture edges. By the seventh to eighth week, obliteration of the fracture line and tendency for callus formation were present. Proliferative osteogenic reaction was in progress resulting in organisation of the callus as revealed by increased density. By this time, the callus had become indistinguishable from the adjacent bone radiographically.

In cases, where there had been infection localised at the site to commence with and later extending into the medullary canal, the results were not satisfactory.

Had there been proper immobilisation and local infection effectively checked, the union of the fracture was quite satisfactory. It is seen that, plaster cast alone will not bring about adequate retention of the fragments in tibial fractures. Upward or downward displacement of fragments was likely to occur. Introduction of Kuntscher Clover-leaf nail into the medullary canal and anchoring it into the distal epiphysis, with plaster cast as an additional means of support would be a satisfactory means of retaining the fracture, until callus formation has taken place.

Administration of antibiotics has been found essential. It is preferable to choose the specific antibiotic on the basis of sensitivity test. It is interesting to note that, none of the animals had shown satisfactory callus formation when infection supervened.

Infection was of a localised nature to begin with, but later gaining access into the medullary canal.

From the results of the present experimental study, it is seen that,

- 1) internal fixation by using Kuntscher Cloverleaf nail supported by plaster cast and administration of antibiotics would be a satisfactory technique, and
- 2) reduction followed by immobilisation with plaster cast alone will not be a satisfactory means in the treatment of tibial fractures in calves.

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Fig.1



Fig.2



Fig.3



Fig.4



Fig. 5



Fig. 6



Fig.7



Fig.8



FIG. 9



FIG. 10



Fig. 11



Fig. 12



Fig. 13



Fig. 14



Fig. 15



Fig. 16



Fig. 17



Fig. 18



Fig. 19



Fig. 20



Fig.21

TREATMENT OF FRACTURE OF TIBIA IN CALVES AND ITS RADIOGRAPHIC EVALUATION

BY

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ABSTRACT OF A THESIS

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ABSTRACT

The present study was conducted on 16 apparently healthy cross-bred bull calves aged from six to nine months and weighing 38 to 75 kg. They were divided into two groups, viz:

Group I consisting of six animals; and

Group II consisting of 10 animals.

Under chloral narcosis and epidural anaesthesia, fracture of tibia was created either on the middle or at the lower third after incising the skin medially and sawing the tibia with a wire saw.

In Group I, the skin wound was sutured, fracture reduced and plaster cast applied. Enteromyectin was administered intramuscularly. None of the animals could bear weight on the fractured limb. Wound infection and abscess formation was apparent. Though reduction was proper initially, the fragments showed displacement later.

Subsequent radiographs did not show any progressive osteogenic reaction and in none of the animals clinical union was noticed.

In Group II, Kuentscher Cloverleaf nail was directed into the medullary canal with the help of the guide wire and was anchored into the distal fragment. The wound was sutured and plaster of paris cast was applied as an additional support. Excepting two animals, the rest could bear weight by the 10th to 30th day. Streptopenicillin or Muncomyein was first administered. This was later followed by a course of Chloramphenicol after sensitivity test of the pus. Periosteal proliferation was apparent on either fragments by third to fifth week which became more prominent by the fifth to sixth week. Lipping of the fracture edges, obliteration of the fracture line and the formation of the callus ~~was~~ observed by the seventh to eighth week. Later, organisation of the callus took place. Of the ten cases, clinical union had taken place in six animals as evidenced by the dense callus in radiographs.

In other cases extension of the local infection into the medullary canal had resulted in non-union of fracture even though osteogenic reaction was in progress inspite of the infection.

From the results of the present study it is seen that, (1) Internal fixation using Kuntscher Cloverleaf nail supported by plaster cast and administration of antibiotics would be a satisfactory technique, and

(2) reduction followed by immobilisation with plaster cast alone will not be satisfactory in the treatment of tibial fractures in calves.

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