Project ID: 533

Competitive Research Grant (CRG)

Sub-Project Completion Report
on

Establishment of suitable fracture management techniques in the different species of animals at Sahidul Alam Quadery Teaching Veterinary Hospital (SAQTVH) in Chittagong

Project Duration

May 2017 to September 2018

Chittagong Veterinary and Animal Sciences University (CVASU),

Khulshi, Chittagong-4225, Bangladesh

Submitted to

Project Implementation Unit-BARC, NATP 2

Bangladesh Agricultural Research Council

Farmgate, Dhaka-1215

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Project Implementation Unit
National Agricultural Technology Program-Phase II Project (NATP-2)
Bangladesh Agricultural Research Council (BARC)
New Airport Road, Farmgate, Dhaka – 1215
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Edited and Published by:

Project Implementation Unit
National Agricultural Technology Program-Phase II Project (NATP-2)
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Acknowledgement

The execution of CRG sub-project has successfully been completed by Chittagong Veterinary and Animal Sciences University (CVASU), Chittagong using the research grant of USAID Trust Fund and GoB through Ministry of Agriculture. We would like to thanks to the World Bank for arranging the grant fund and supervising the CRGs by BARC. It is worthwhile to mention the cooperation and quick responses of PIU-BARC, NATP 2, in respect of field implementation of the sub-project in multiple sites. Preparing the project completion report required to contact a number of persons for collection of information and processing of research data. Without the help of those persons, the preparation of this document could not be made possible. All of them, who have made it possible, deserve thanks. Our thanks are due to the Director PIU-BARC, NATP 2 and his team who have given their whole hearted support to prepare this document. We hope this publication would be helpful to the agricultural scientists of the country for designing their future research projects in order to technology generation as well as increasing production and productivity for sustainable food and nutrition security in Bangladesh. It would also assist the policy makers of the agricultural sub-sectors for setting their future research directions.

Published in: September 2018

Printed by: [Name of press with full address]

Acronyms

Acronyms	Elaboration
BARC	: Bangladesh Agricultural Research Council
CVASU	: Chittagong Veterinary and Animal Sciences University
SAQTVH	: Sahidul Alam Quadery Teaching Veterinary Hospital
FPAS	: Fracture Patient Assessment Score
NATP	: National Agricultural Technology Program
ND	: Non Descriptive
NO	: Number
BB	: Black Bengal
JP	: Jamnapari
HF	: Holstein Friesian
PO	: Post-operative
Rt	: Right
Lt	: Left
Tk	: Taka

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Executive Summary

The study was conducted with the objectives to determine the incidence of long bone fractures in the different species of animals (dogs, cats, goats and cattle) and to establish a suitable treatment strategy for long bone fractures. For this study a total of 6163 clinical cases of ailments were recorded from May, 2017 to April, 2018 coming in the Sahidul Alam Quadery Teaching Veterinary Hospital (SAQTVH) at CVASU, Chittagong. Out of the total of 6163 cases, 829 (13.45%) were surgical cases and among them 85 (10.25%) were recorded as long bone fracture cases that included dogs (20), cats (19), goats (36) and cattle (10). Highest incidence of fractures was found in goats (42.35%) followed by dogs (23.52%), cats (22.35%) and cattle (11.76%). Most of the fracture cases were associated with the male animals (55.29%) followed by the female animals (44.71%). Animals in the age group of < 6 months old were more vulnerable to fractures than any other age groups. Incidence was more in the hind limbs (67.05%) followed by forelimbs (34.12%). Causes of fractures were found to be highest with the case of falling from height (34.11%) followed by trauma by fighting, beating etc. (21.18%) then unknown (20%), automobile accident (12.94%) and stuck in cot (11.76%). Two methods of fracture management techniques, external fixation (using the modified Robert Jone's bandage method with or without bamboo split and crepe bandage) and internal fixation (by intramedullary pinning with or without wiring) were studied. Out of the 85 fracture cases 65 cases (dogs- 15, cats- 14, goats- 30 and cattle- 6) were management by external fixation technique while, the rest 20 cases (dogs- 5, cats- 5, goats- 6 and cattle- 4) were managed by internal fixation technique. Response to treatment in the case of external fixation technique was higher (71.77%) than the internal fixation technique (9.41%). The overall success rate of fracture treatment was 81.18%. Post fracture management complications were recorded only with 4 cases (4.70%) under external fixation management compared to the internal fixation management, where the complications were recorded with 12 cases (14.12%) with an overall complication rate of 18.82%. Common complications were recorded as seroma formation (3.52%), pin migration/pin loosening (5.88%), infection (4.71%), implant failure (1.18%) and death (3.52%). External fixation technique of fracture management was found to be cheaper (Tk. 470.00) than the internal fixation technique (Tk. 1450.00). On the basis of the above findings, it was concluded that external fixation technique of fracture management is better than internal fixation technique.

CRG Sub-Project Completion Report (PCR)

A. Sub-project Description

1. Title of the CRG sub-project:
Establishment of suitable fracture management techniques in the different species of animals at Sahidul Alam Quadery Teaching Veterinary Hospital (SAQTVH) in Chittagong

2. Implementing organization:
Chittagong Veterinary and Animal Sciences University

3. Name and full address with phone, cell and E-mail of PI/Co-PI (s):

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4. Sub-project budget (Tk):
4.1 Total: 11, 95,710/-
4.2 Revised (if any):

5. Duration of the sub-project:
5.1 Start date (based on LoA signed): May, 2017
5.2 End date : 30 September 2018

6. Justification of undertaking the sub-project:

Long bone fractures are very common practice in the field of veterinary profession. Hind limbs are more affected than fore limbs. Metatarsal and metacarpal fractures are more common in calves, sheep and goats. Femur and tibial bone fractures are more common in dogs and cats. Long bone diaphyseal fractures are common in dogs and among them fractures of the shaft of tibia are the most common (Zaal and Hazewinkel, 1996). Tibial diaphyseal fractures account for 75% to 81% of all tibial fractures (Boone *et al.,* 1986) in dogs. The majority of fractures are caused due to road traffic accidents followed by various traumatic incidents and gunshot injuries (McCartney, 2007). Due to inadequate knowledge and proper management technique along with ignorance of proper postoperative care, every year a

large number of animals have to go for amputation as well as advice for slaughter. Sometimes there may be some severe traumatic patients and complications of severe blood loss leading to anaemia, osteomyelitis, mal-union, non-union, etc. Specially in small animals, suitable fracture management technique is highly demanding. Therefore, proper fracture management technique is very important in Bangladesh. It was hoped that this research work will help finding out easy, sustainable and economic fracture management techniques in Bangladesh. The research outcomes will reduce the complications of fractures and will also reduce the culling rate of food animals.

7. Sub-project goal:

The goal of this study was to establish an easy, economic and field based suitable fracture management techniques in livestock and pet animals and also to develop the skills of the veterinarians.

8. Sub-project objective (s):

a. To study the incidence of long bone fractures in the different species of animals (cattle, goats, dogs and cats).

b. To establish the suitable fracture management techniques by evaluating the preoperative and postoperative analysis of the patients.

9. Implementing location (s):

Sahidul Alam Quadery Teaching Veterinary Hospital (SAQTVH), Chittagong Veterinary and Animal Sciences University (CVASU), Chittagong.

10. Methodology in brief:

10.1. Study of the incidence of long bone fractures in the different species of animals

Study areas, duration and population of animals

The study was conducted on at least 10 animals of each species of dog, cat, goat and cattle belonging to different breeds, sex, age and body weight presented to SAQTVH from April 2017 to September 2018.

Selection of animals and data recording

All clinical cases presented with history of trauma and symptoms suggestive of fractures were selected for the study. Animals under study were examined physically and confirmed radiographically. Data of the animals on breed, sex, age, type, location and nature of fractures were then recorded for future analysis.

10.2. Establishment of suitable fracture management techniques

Selection of cases

Animals presented with history and clinical signs suggestive of diaphyseal and metaphyseal fractures were subjected to detailed physical, orthopedic, radiographic examination to confirm the diagnosis and for classification of the fractures. The fracture management cases were selected on the basis of fracture patient assessment score (FPAS). For FPAS the mechanical, biological and clinical factors, those influence fracture healing were considered.

Study design

Animals with diaphyseal and metaphyseal fractures free from any concurrent neurologic, metabolic or infectious diseases were selected and divided according to species and following techniques were applied for evaluation of fracture management.

Group-I: External fixation: External cooptation by bandage technique (Modified Robert Jone's Bandage with or without bamboo split and crepe bandage) involving at least 5 cases from each of the species of dog, cat, goat and cattle.

Group II: Internal fixation: Intramedullary pining with or without wiring involving at least 5 cases from each of the species of dog, cat, goat and cattle.

Parameters studied

a) **Lameness evaluation-** A lameness grade was assigned on the basis of severity of clinical signs on preoperatively and 1st, 7th, 14th, 30th and 60th postoperative day in all groups of animals to assess the response to treatment. Weight bearing was graded as follows (Vasseuret *et. al*., 1995):

Grade I	Normal weight bearing on all limbs at rest and when walking.
Grade II	Normal weight bearing at rest, favors affected limb while walking.
Grade III	Partial weight bearing at rest and while walking.
Grade IV	Partial weight bearing at rest and does not bear weight on affected limb while walking.
Grade V	Does not bear weight on limb at rest or while walking.

b) **Functional limb outcome-** Functional limb outcome was evaluated on the 60th postoperative day and categorized as excellent, good, fair and poor in all the groups of animals (Clark, 1986).

c) **Radiographic Evaluation-** Fracture healing was evaluated through radiographic examination on different interval on preoperatively and postoperatively.

Complications

Intraoperative complications and post-operative complications were recorded.

Postoperative care and maintenance

Postoperatively all cases in group II were administered antibiotic and antihistaminic for 5 days intramuscularly and pain killer for 3 days subcutaneously. Restricted movement was advised for 2 weeks and cold application also advised for 3 days to reduce the inflammation. Sutures in surgical site were removed after wound healing.

Equipments used for the study

The equipments used at different stages of the study are presented in Figure 1.

Figure 1: Equipment facilities used to run the project

X-ray machine

C-arm machine

Operation table

Inhalation anesthetic machine

monitor

Hematology analyzer

Statistical Analysis

All data were organized in the Microsoft excel spreadsheet and by using software STATA 11. Percentages of proportionate prevalence of fractures in different species, breed, sex, age; incidence of fracture location, nature of fractures, methods of fracture managements and overall complications were analyzed.

11. Results and discussion:

11.1. Study of the incidence of long bone fractures in the different species of animals

To find out the incidence/ occurrence of fracture in the different species of animals a total of 6163 cases were handled. Out of the 6163 cases 829 were surgical cases (12.45%) and out of the surgical cases 85 were long bone fracture cases (10.25%). Table 1 and figure 2 represents the overall occurrence of fractures among the different species. The results revealed that out of the total 85 fracture cases highest incidence of fractures was found in goats (42.35%) followed by dogs (23.52%), cats (22.35%) and cattle (11.76%).

Table 1. Incidence of fractures according to species

Species	Total number	Proportionate prevalence (%)
Dog	20	23.52
Cat	19	22.35
Goat	36	42.35
Cattle	10	11.76
Total	**85**	**100%**

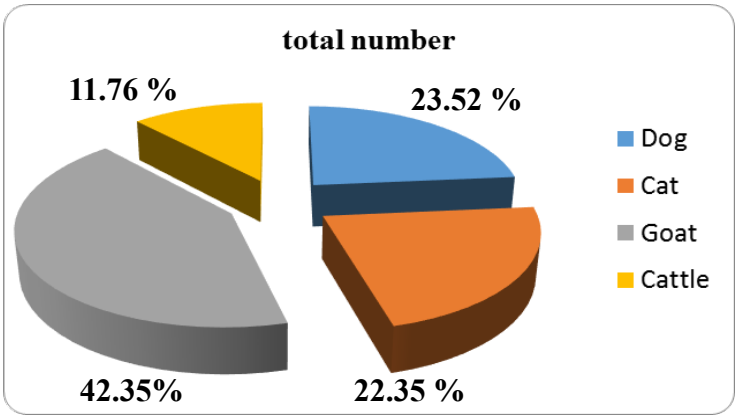


Figure 2: Incidence of fractures in the different species of animals

Table 2. Incidence of fractures according to breeds

Species	Breeds	No. of animals	Percentage (%)
Dog	• Indigenous • Spitz • German shepherd	10 8 2	11.76 9.41 2.35
Cat	• Indigenous • Persian	17 2	20.00 2.35
Goat	• Cross (BB x JP) • Black Bengal (Indigenous) • Jamnapari	14 6 16	16.47 7.05 18.82
Cattle	• Indigenous • Cross (Indigenous x HF)	7 3	8.23 3.52
Total		**85**	**100**

Note: BB= Black Bengal; JP= Jamnapari; HF= Holstein Frisian

Table 2 shows the incidence of fractures in the different breeds of animals under different species. The results show that for all the species occurrence rate was higher in the indigenous breeds excepting goats where incidence was higher in Jamnapari. In the dogs, incidence of fractures was 11.76% in the indigenous breed followed by Spitz (9.41%) and German shepherd (2.35%). In the cats it was 20% in the indigenous breed and 2.35% in Persian breed. For goats the occurrence was highest in Jamnapari (18.82%) followed by Black Bengal x Jamnapari crosses (16.47%) and Black Bengal (7.05%). In cattle the incidence was 8.23% in the indigenous breed and 3.52% in the cross bred (Indigenous x Holstein Friesian) animals.

Table 3. Incidence of fractures according to sex

Species	Sex		No
	Male (%)	Female (%)	
Dog	13 (15.29)	7 (8.24)	20
Cat	9 (10.58)	10 (11.75)	19
Goat	19 (22.24)	17 (20.00)	36
Cattle	6 (7.05)	4 (4.71)	10
Total	**47 (55.29)**	**38 (44.71)**	**85**

Table 3 shows the incidence of fractures according to sex. Most of the fractures were associated with the male animals (55.29%) followed by the female animals where the incidence of fracture was found to be 44.71%.

Table 4. Incidence of fractures according to age in the different species of animals

Species	Age (month)	No	Percentage
Dog	< 6 months	12	14.12
	6-12 months	6	7.05
	More than 12 months	2	2.35
Cat	< 6 months	14	18.82
	6-12 months	5	3.33
	More than 12 months	0	0
Goat	< 6 months	27	31.76
	6-12 months	8	9.41
	More than 12 months	1	1.17
Cattle	< 6 months	7	8.23
	6-12 months	3	3.53
	More than 12 months	0	0
Total		**85**	**100**

Table 4 shows the incidence of fractures according to age in the different species of animals. Animals in the age group of < 6 months old were more vulnerable to fractures than any other age groups. In the same age group the incidence was highest in goats (31.76%) followed by cats (18.82%), dogs (14.12%) and cattle (8.23%).

Table 5. Occurrence of fractures based on environmental exposure (open and closed)

Criteria	Involved species				Total (%)
	Dog	Cat	Goat	Cattle	
Closed fracture	19	19	36	8	82 (96.47)
Open fracture	1	-	-	2	3 (3.52)
Total	**20**	**19**	**36**	**10**	**85 (100)**

Table 5 shows the occurrence of fractures based on environmental exposure (open and closed).The highest incidence of fractures was found with the closed fractures which were about 96.47% as against the open fractures which were about 3.52%.

Table 6. Occurrence of unilateral and bilateral limb fractures

Criteria	Involved species				Total (%)
	Dog	Cat	Goat	Cattle	
Unilateral fracture	18	17	35	8	78 (91.76)
Bilateral fracture	2	2	1	2	7 (8.23)
Total	**20**	**19**	**36**	**10**	**85 (100)**

Table 6 shows the occurrence of unilateral and bilateral limb fractures. Unilateral fractures were found to occur at a higher rate (91.76%) than the bilateral fractures (8.23%).

Table 7. Incidence of fractures based on the different bones affected

Fracture locations	Affected species												Total (%)
	Dog			Cat			Goat			Cattle			
	Epi	Meta	Dia	Epi	Meta	Dia	Epi	Meta	Dia	Epi	Meta	Dia	
Forelimb													
Scapula	-	-	-	-	-	-	1	-	-	-	-	-	1 (1.18)
Humerus	-	-	-	-	1	2	1	-	2	-	1	-	7 (8.24)
Radius/Ulna	-	2	4	-	-	-	-	-	-	-	-	-	7 (8.24)
Metacarpal	-	-	-	1	-	1	2	6	1	-	-	2	13 (15.29)
Digit	-	-	-	-	-	-	-	-	-	-	-	-	0
Hindlimb													
Femur	2	1	5	1	4	4	1	1	2	-	1	1	23 (27.05)
Tibia/Fibula	1	1	4		1	2	1	1	5	-	2	1	19 (22.35)
Metatarsal	-	-	-	-	1	-	-	2	6	-	2	-	11 (12.94)
Digit	-	-	-	-	-	-	1	2	-	-	-	-	3 (3.52)
Pelvis	-	-	-	-	1	-	-	-	-	-	-	-	1 (1.18)
Total	**20**			**19**			**36**			**10**			**85 (100)**

Epi = Epiphyseal, Meta = Metaphyseal and Dia = Diaphyseal

Table 7 represents the incidence of fractures based on the different bones affected. The study revealed that incidence was more in hind limbs (67.05%) followed by forelimbs (34.12%). It was also found that higher incidence of fractures occurred in femur (27.05%) followed by tibia/fibula (22.35%), metacarpal (15.29%), metatarsal (12.94%), humerus (8.23%), radius/ulna (8.23%), digits (3.52%), scapula (1.18%) and pelvis (1.18%).

Table 8. Incidence of fractures based on the nature of fractures

Fracture direction	Affected species				Total (%)
	Dog	Cat	Goat	Cattle	
Transverse	6	4	15	3	28 (32.94)
Oblique	14	15	19	6	54 (63.53)
Spiral	-	-	1	-	1 (1.18)
Comminuted	-	-	1	1	2 (2.35)
Total	**20**	**19**	**36**	**10**	**85 (100)**

Table 8 shows the incidence of fracture based on the nature of fractures. Highest number of fractures was found to be associated with oblique, 54 cases (63.53%) followed by transverse, 28 cases (32.94%) then comminuted, 2 cases (2.35%) and spiral, 1 (1.18%) cases.

Table 9. Risk factors/ causes of fractures in the different species

Criteria	Involved species				Total (%)
	Dog	Cat	Goat	Cattle	
Automobile accident	7	-	3	1	11 (12.94)
Falling from height	5	8	11	5	29 (34.11)
Trauma by fighting, beating, etc.	2	4	8	4	18 (21.18)
Stuck in the cot	-	-	10	-	10 (11.76)
Unknown	6	7	4	-	17 (20.00)
Total	**20**	**19**	**36**	**10**	**85 (100)**

Table 9 represents the causes of fractures in the different species of animals. Many factors were responsible for the occurrence of fractures. The most common causes of fracture were found to be associated with falling from height (34.11%) followed by trauma by fighting, etc. (21.18%) then unknown (20.00%), automobile accident (12.94%) and stuck in cot (11.76%). The fractures due to stuck in the cot were found to occur only in goats.

11.2. Establishment of suitable fracture management techniques

Out of a total of 85 fracture cases handled, 65 cases (76.47%) were managed using external fixation technique (Group- 1) and only 20 cases (23.52%) were handled using internal fixation technique (Group- 2). Detail of the distribution of fracture management under two groups is shown in Table 10.

Table 10. Distribution of the cases of fracture management in two groups

Methods	Involved species				Total (%)
	Dog (%)	Cat (%)	Goat (%)	Cattle (%)	
External Fixation (Group-1)	15 (17.65)	14 (16.47)	30 (35.29)	6 (7.05)	65 (76.47)
Internal fixation (Group-2)	5 (5.88)	5 (5.88)	6 (7.05)	4 (4.71)	20 (23.52)
Total	**20**	**19**	**36**	**10**	**85 (100)**

External fixation fracture management technique involved the bones of both hind and fore limbs. Both for the metacarpal of fore limb and tibia/fibula of hind limb highest numbers of fractures, 16 (24.62%) cases each, were handled followed by metatarsal of hind limb 10 (15.38%) cases. Detail of the distribution of fracture that involved different bones of fore and hind limbs is shown in Table 11.

Table 11. Distribution of fracture management cases in the different bones (External fixation)

Involved bones		Involved species				Total (%)
		Dog	Cat	Goat	Cattle	
Fore limb	Scapula	-	-	1	-	1 (1.54)
	Humerus	-	2	1	-	3 (4.62)
	Radius/Ulnar	5	1	1	-	7 (10.77)
	Metacarpal	-	1	12	3	16 (24.62)
	Digit	-	-	-	-	-
Hind limb	Pelvis	-	1	-	-	1 (1.54)
	Femur	4	5	-	-	9 (13.85)
	Tibia/Fibula	6	3	6	1	16 (24.62)
	Metatarsal	-	1	7	2	10 (15.38)
	Digit	-	-	2	-	2 (3.08)
Total		**15**	**14**	**30**	**6**	**65 (100)**

Figure 3 shows the pictures of some fracture management using External fixation technique in dogs, cats, goats and calves.

Figure 3: Pictorial presentation of some fracture management (External fixation) in the different species of animals

Dogs

Case-7:CR

Preoperative patient conditionAutomatic | X-ray view showing R/U fracture | Managed by applying MRJ bandage | PO 15 days X-ray view

Case-12:

Preoperative patient condition

X-ray showing bilateral R/U fracture

Applied MRJ bandage

PO 14 days' x-ray view

PO 30 days' x-ray view

Case-10

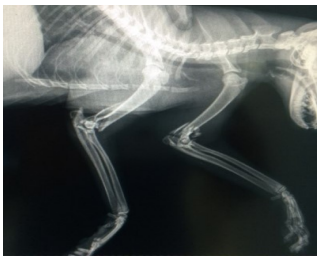
Clinical condition and X-ray view

Operative and postoperative condition

Cat

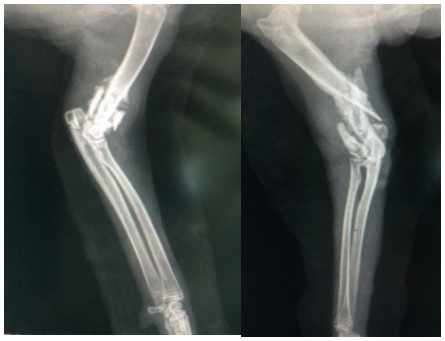
Case-**Figure**

Recumbent patient



X-ray showing bilateral

Management Vital sign



PO 20 days' x-ray view

PO 45 days' x-ray view

Postoperative patient condition after recovery

Goats

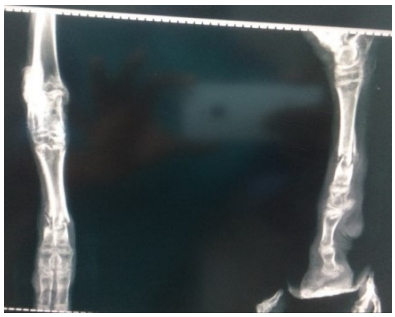
Case-5:

Non weight bearing limb

Preoperative x-ray view

MRJ bandage applied

Intraoperative x-ray view



PO 15 days x-ray view

Weight bearing noticed after 15 days of PO

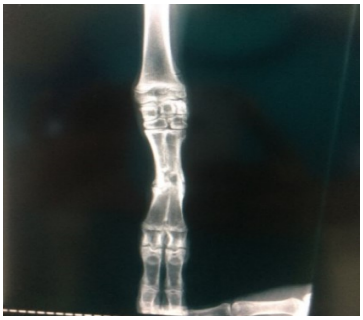
Case-14:

Pre-bandage patient condition

X-ray view

Applied MRJ bandage

Intraoperative x-ray view



PO 30 days x-ray view

PO 30 weight bearing condition

Calf

Case-2:

Non weight bearing limb

X-ray view

Fracture management by using fiber glass cast

Bone remodeling after PO day 120

Weight bearing limb

Table 12. Distribution of fracture management cases in the different bones (Internal fixation)

Involved bones		Involved species				Total (%)
		Dog	Cat	Goat	Cattle	
Fore limb	Humerus	-	-	2	-	2 (10.00)
	Radius/Ulnar	-	1	-	-	1 (5.00)
Hind limb	Femur	5	3	3	2	13 (65.00)
	Tibia/Fibula	-	1	1	2	4 (20.00)
Total		**5**	**5**	**6**	**4**	**20 (100)**

Table 12 shows the distribution of the cases of fracture management in the different bones using internal fixation technique in group II. Out of the 20 cases that were handled using internal fixation technique involvement of femur was the highest in number, 13 cases (65%) followed by tibia/fibula, 4 cases (20%) then humerus, 2 cases (10%) and radius/ulnar, 1 case (5%).

Figure 4 shows the pictures of some fracture management using Internal fixation technique in dogs, cats, goats and calves.

Figure 4: Pictorial presentation of some fracture management (Internal fixation) in the different species of animals

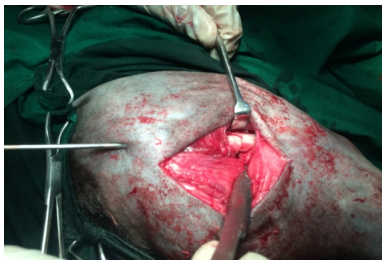
Dog

Case-3:

Fracture affected dog

X-ray view

Fracture fragments



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Post-operative x-ray view

Periosteal callus after PO day 15

Case-4:

Non weight bearing leg

X-ray showing Right femur fracture

Fractured bone fragments

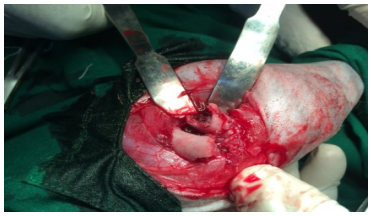
Intramedullary pinning

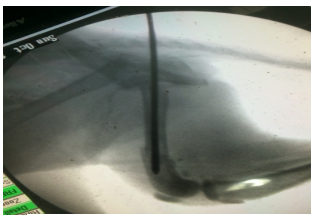
Intraoperative checking of pin insertion by C-arm

Postoperative x-ray view

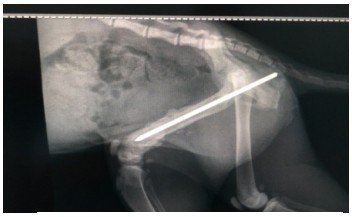
Cat

Case-2:





Postoperative



PO 18 days

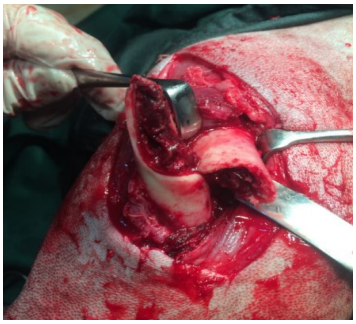
days (remodeling of bone)

Goat

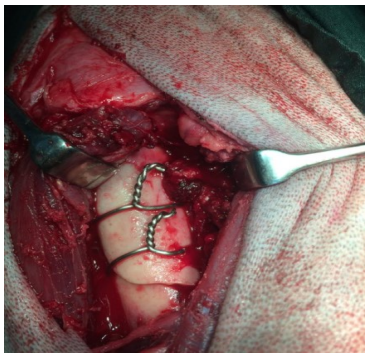
Case-2:

Preoperative patient condition

Preoperative x-ray (Left humerus fracture)



Fractured bone fragments



Pinning and wiring

Intraoperatively checked by C-arm

PO 10 days x-ray view

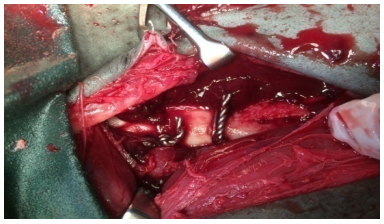
Calf

Case-

Preoperative shaving PO 66

Right midshaft oblique femur fracture

Retrograde IMP



Fixation by wiring

Postoperative x-ray

PO checkup after 15 days and weight bearing noticed

Assessment of the response to treatment

a) Lameness evaluation: A lameness grade was assigned on the basis of severity of clinical signs on pre and post fracture management on 1st, 7th, 14th, 30th and 60th postoperative day in all groups of animals to assess the response to treatment.

Table 13. Assessment of overall response to treatment using lameness evaluation grading

Fracture management technique	Total No. of cases handled (%)	No. of cases showed improvement (%)	No. of cases failed to improve (%)
External fixation (Group I)	65 (76.47)	61 (71.77)	4 (4.70)
Internal fixation (Group II)	20 (23.53)	8 (9.41)	12 (14.12)
Total	85 (100)	69 (81.18)	16 (18.82)

Table 13 shows the results of assessment of the response to treatment using lameness evaluation. Out of a total of 85 fracture cases given treatment 61 cases (71.77%) under external fixation technique (group I) showed gradual improvement of lameness from grade V to grade I at 60th postoperative day. The four cases (4.70%) that failed to improve included dog case number 12, cat case number 5 and 6 and cattle case number 1. On the other hand, under internal fixation technique (group II) 12 cases (14.12%) failed to improve that included dog case number 1 & 2, cat case number 1, 2, 3 & 5, goat case number 1, 4 & 5 and cattle case number 1, 2 & 3.

b) **Functional limb outcome:** Functional limb outcome was evaluated on the 60th post fracture management and categorized as excellent, good, fair and poor.
Accordingly all the cases from group I and II those showed improvement from grade V to grade I, functional limb outcome for those cases was evaluated to be in the "good" category in post fracture management excepting the 16 cases from group I and group II, those failed to improve from grade V to grade I also failed to be categorized as "good".

c) **Radiographic Evaluation**: Fracture healing was evaluated through radiographic examination at different intervals during pre- and post-fracture management.
Both for the patients from group I and II, secondary bone healing (periosteal callus formation) was noticed in most of the cases excepting the cat case number 6 from group I and cat case number 5 and cattle case number 1 & 3 from group II where no bone healing was observed probably due to implant failure and death however, delayed bone healing was noticed in dog case number 12, cat case number 5, cattle case number 1 from group I and in goat case number 5 from group II.

Table 14. Economic analysis between External and Internal fixation techniques of fracture management

Comparison of cost between External and Internal fixation			
Materials used for immobilization in External fixation	**Cost (Tk)**	**Materials used for immobilization in Internal fixation**	**Cost (Tk)**
Cotton (half pound)	150	Steinmann pin	350
Roll gauge	50	Orthopedic wire	100
Crepe bandage	50	Suture materials (catgut, vicryl, nylon, silk, etc)	300
Micropore or Adhesive tape	120	Cotton (half pound)	150
		Roll gauge	50
Bandaging charge	100	Operation charge	500
Total	**470**	**Total**	**1450**

Table 14 shows that external fixation technique of fracture management was less expensive requiring only Tk. 470.00 compared to the internal fixation technique that required Tk. 1450.00.

Table 15. Overall complications in two groups out of a total of 85 fracture cases handled

Complications	External fixation (Group I) Involved species					Internal fixation (Group II) Involved species					Total for both the groups (%)
	Dog	Cat	Goat	Cattle	Total	Dog	Cat	Goat	Cattle	Total	
Seroma formation	-	-	-	-	-	1	1	1	-	3	3 (3.52)
Seroma formation and implant failure	-	-	-	-	-	-	-	-	1	1	1 (1.18)
Pin migration/ pin loosening	-	-	-	-	-	1	2	1	1	5	5 (5.88)
Infection	1	1	-	1	3	-	-	1	-	1	4 (4.71)
Death	-	1	-	-	1	-	1	-	1	2	3 (3.52)
Total	1	2	-	1	4	2	4	3	3	12	16 (18.82)

Table 15 shows the rate of different types of complications under treatment groups I and II, out of a total of 85 fracture cases handled. Major complications were found to be due to pin migration/pin loosening- 5 cases (5.88%) followed by infection- 4 cases (4.71%), seroma formation- 3 cases (3.52%), death- 3 cases (3.52%) and seroma formation with implant failure- 1 case (1.18%).

Figure 5 shows the pictures of some complications of fracture management, both under the External and Internal treatment groups.

Figure 5: Pictorial presentation of complications of fracture management in the treated animals

Complications

Infection in right fore-limb of cat (7th postoperative day), Group- 1; case -5 Preoperative condition

X-ray showing splinted part of bone remaining and cause of further infection in cat (Group- 1; case- 5)

Pin migration with seroma formation in cat (10th postoperative day), Group-2; case- 3 Proximal and distal fragment

Infection in dog (Group- 1; case- 12)

Amputation in calf due to infection (Group- 1; case- 1)

Infection in calf (10th postoperative day), Group-2; case- 2

Seroma formation in calf (18th postoperative day) due to implant failure (Group- 2, case- 1)

12. Research highlight/findings:

- Overall incidence of long bone fracture was 10.25%
- Incidences of fractures were more in goats (42.35%) followed by dogs (23.52%), cats (22.35%) and cattle (11.76%).
- Most of the fracture cases were associated with the male animals (55.29%) followed by the female animals (44.71%).
- Animals in the age group of < 6 months old were more vulnerable to fractures than any other age groups.
- Causes of fractures were found to be highest with the case of falling from height (34.11%) followed by trauma by fighting, beating, etc. (21.18%) then unknown (20%), automobile accident (12.94%) and stuck in cot (11.76%).
- Internal fixation technique was determined to be more expensive requiring Tk. 1450.00 compared to the external fixation technique that required only Tk. 470.00.
- Post operative complications occurred more in group-II (14.12%) where internal fixation technique of fracture management was adopted compared to group-I (4.71%) where external fixation technique was adopted.

B. Implementation Position

1. Procurement:

Description of equipment and capital items	PP Target		Achievement		Remarks
	Phy (#)	Fin (Tk)	Phy (#)	Fin (Tk)	
(a) Office equipment					
(b) Lab &field equipment	100%	340000	100%	338316	
(c) Other capital items	100%	191585	100%	191220	

2. Establishment/renovation facilities: Not applicable

Description of facilities	Newly established		Upgraded/refurbished		Remarks
	PP Target	Achievement	PP Target	Achievement	

3. Training/study tour/ seminar/workshop/conference organized: Not applicable

Description	Number of participant			Duration (Days/weeks/ months)	Remarks
	Male	Female	Total		
(a) Training					
(b) Workshop					

C. Financial and physical progress

Items of expenditure/activities	Total approved budget	Fund received	Actual expenditure	Balance/ unspent	Physical progress (%)	Reasons for deviation
A. Contractual staff salary	417125	392540	391910	630	93.96	
B. Field research/lab expenses and supplies	340000	317186	338316	-21130	99.50	VAT & TAX payment from RPA Fund
C. Operating expenses	112000	102943	102943	0	91.91	-
D. Vehicle hire and fuel, oil & maintenance	40000	35000	25000	10000	62.50	-
E. Training/workshop/ seminar etc.	0	0	0	0	0.00	-
F. Publications and printing	70000	58058	58058	0	82.94	
G. Miscellaneous	25000	22543	24996	-2453	99.98	VAT & TAX payment from RPA Fund
H. Capital expenses	191585	191220	191220	0	99.81	-
Total	**1195710**	**1119490**	**1132443**	**-12953**	**94.71**	**-**

D. Achievement of Sub-project by objectives: (Tangible form)

Specific objectives of the sub-project	Major technical activities performed in respect of the set objectives	Output (i.e. product obtained, visible, measurable)	Outcome (short term effect of the research)
i) To study the incidence of long bone fracture in the different species of animals (cattle, goat, dog, cat).	• All the information related to incidence study like species, breed, sex, age, type, location and nature of fractures, risk factors were recorded using a structured questionnaire • Analysis of relevant data. • Risk factor analysis of the fracture cases	• A total of 6163 clinical cases were recorded • Among the cases recorded surgical cases were 7.43% • Among the surgical cases fracture cases in dogs, cats, cattle and goats were 9.75% • Incidences of fractures were more in goats (42.35%) followed by dogs (23.52%), cats (22.35%) and cattle (11.76%). • Causes of fractures were found to be highest with the case of falling from height (34.11%) followed by trauma by fighting, beating etc. (21.18%) then unknown (20%), automobile accident (12.94%) and stuck in cot (11.76%).	Incidence of long bone fractures in goat was more than cattle, dog and cat which indicates that goats should be given more importance for fracture management at SAQTVH
ii) To establish the suitable fracture management technique by evaluating the preoperative and postoperative analysis of the patients.	• Selection of animals with diaphyseal and metaphyseal fractures. • Management of fractures in two groups: Group I- External fixation by applying Modifined Robert Jone,s bandage Group II- Internal fixation by applying Intramedullary pining with or without wiring. • Economic analysis of the fracture management techniques	• Less complications found in Metacarpal, metatarsal, tibia/fibula and radius/ulnar fractures in External fixation technique in all species • Femur and humerus fracture was found suitable for applying Internal fixation technique of fracture management. • Internal fixation technique was more expensive (Tk. 1450) compared to External fixation technique (Tk. 470).	Applying the fracture management techniques will help survival and wellbeing of different farm and pet animals that in turn will help better income generation of the farmers. Further extension of this service countrywide will have significant impact in the animal welfare as well as increasing agricultural productivity.

E. Materials Development/Publication made under the Sub-project:

Publication	Number of publication		Remarks (e.g. paper title, name of journal, conference name, etc.)
	Under preparation	Completed and published	
Technology bulletin/booklet/leaflet/flyer, etc.	-		
Journal publication	-	-	-
Information development	-	-	-
Other publications: Conference paper	-	1	Paper presentation in 24th BSVER, BAU

F. Technology/Knowledge generation/Policy Support (as applied):

i. Generation of technology (Commodity & Non-commodity)

Modified Robert Jone,s Bandage (cotton and bandage roll applied in internal rotation with moderate pressure and outer crepe bandage) that uses external fixation fracture management technique on affected limb up to proximal and distal joint which is a novel approach used first time in the country. Furthermor, techniques like intramedullary pinning which is suitable for long bone fracture management using internal fixation fracture management technique specially for hemerus and femur fractures was an innovation in the local perspective.

ii. **Generation of new knowledge that help in developing more technology in future**

Further research is needed to reduce complications as well as the cost of internal fixation technique of fracture management.

iii. Technology transferred that help increased agricultural productivity and farmers' income

Applying the fracture management techniques will help survival and wellbeing of different farm and pet animals that in turn will help better income generation of the farmers. Further extension of this service countrywide will have significant impact in the animal welfare as well as in increasing agricultural productivity.

iv. Policy Support

The knowledge generated through this research work will help developing new policy and practices for animal welfare and animal health in Bangladesh. A coordinated effort is necessary to influence the policymakers to take necessary steps concerning animal fracture management at clinical settings in Bangladesh.

G. Information regarding Desk and Field Monitoring

i) Desk Monitoring [description & output of consultation meeting, monitoring workshops/seminars etc.):

This was the first orthopaedic research grant from BARC in Bangladesh. Scientists attended in the annual progress evaluation workshop were happy for such kind of research support and also satisfied with the activities of research.

ii) Field Monitoring (time & No. of visit, Team visit and output):

1. Dr. Shah Md. Ziqrul Haq Chowdhury, NATP-2, BARC, Livestock Division, 30/3/2018 to 31/3/2018
2. Mr Manzur Hossain Bhuyan, Deputy Director, NATP-2, BARC, 18/02/2018

The team monitored all the project activities in detail including research and procurement activities. They also interviewed the project personnel and checked all the items procured with budget of the project. They expressed their satisfaction on the overall progress of the project activities.

H. Lesson Learned

i) The novel orthopaedic management technique was effective and can be implemented successfully with the minimum settings.
ii) The technology used was cost-effective that helped to a great extent in reducing the sufferings of animals
iii) Further modification can reduce the cost of surgery in future

I. Challenges (if any)

- Poor quality postoperative management by owners
- Lack of interest with expert doctor
- Selling of animals under study by the farmers

Signature of the Principal Investigator
Date …….
Seal

Counter signature of the Head of the organization/authorized representative
Date ……..
Seal

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