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Dr. M Ramya Krishna

NTR College of Veterinary
Science, Gannavaram, Andhra
Pradesh, India

Dr. V Devi Prasad

NTR College of Veterinary
Science, Gannavaram, Andhra
Pradesh, India

Dr. K Rambabu

NTR College of Veterinary
Science, Gannavaram, Andhra
Pradesh, India

Dr. C Pavan Kumar

NTR College of Veterinary
Science, Gannavaram, Andhra
Pradesh, India

Dr. M Srivani

NTR College of Veterinary
Science, Gannavaram, Andhra
Pradesh, India

Dr. G Vani

NTR College of Veterinary
Science, Gannavaram, Andhra
Pradesh, India

Corresponding Author:

Dr. M Ramya Krishna

NTR College of Veterinary
Science, Gannavaram, Andhra
Pradesh, India

Evaluation of fracture healing following repair of orthopaedic complications in dogs

**M Ramya Krishna, V Devi Prasad, K Rambabu, C Pavan Kumar, M
Srivani and G Vani**

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Abstract

The present study was conducted to evaluate radiographical and haemato-biochemical changes in dogs with orthopaedic complications managed by conservative treatment and revisional surgeries. Seventeen dogs were divided into two groups: Group I (n=8) received conservative management, and Group II (n=9) underwent revision surgeries. Outcomes were assessed using radiographic and haemato-biochemical parameters. Although Group II showed higher initial radiographic scores, both groups achieved comparable healing at later stages. Haematological findings indicated preoperative anaemia in Group II, with reduced haemoglobin, TEC, and PCV, which improved postoperatively. Elevated ESR and TLC suggested inflammation and infection, returning to normal by day 60. Biochemical parameters revealed calcium and phosphorus within normal limits. ALP levels were elevated in Group II, indicating increased bone activity and delayed healing. LDH and CPK were initially high but declined over time. CRP levels decreased significantly during recovery, reflecting resolution of inflammation and improved healing status.

Keywords: Orthopaedic complications, haemato-biochemical, dogs, conservative management, revisional surgeries

Introduction

The primary aim of fracture treatment is to restore the function of the injured limb as soon as possible with minimal complications (Shahar, 2000). It is important to recognize early signs of complications in fracture consolidation, which allows for early correction of the problem and increases the chances of success (Jackson and Pacchiana., 2004). In the present paper the repair of complications was done and their outcome was evaluated based on radiographic and haemato-biochemical parameters.

Materials and Methods

The present study was conducted on 17 clinical cases of dogs with orthopaedic complications presented to the Department of Veterinary Surgery and Radiology, NTR College of Veterinary Science (NTR C.V.Sc), Gannavaram. The complications were managed through conservative treatment in group I, whereas in Group II, they were managed through revision surgeries and the outcome was evaluated. Radiographic evaluation of fracture healing was by obtaining standard lateral and cranio-caudal views, while ventro-dorsal views were obtained for pelvic fractures. Follow-up radiographs were obtained periodically to evaluate fracture healing based by assigning the fracture healing scores (0–3) as recommended by (Cook *et al.*, 1999) (Table. 1).

Table. 1: Fracture healing scores

Score	Fracture healing
0	Complete radiographic healing
1	Appropriate progression towards healing, but not completely healed radiographically.
2	Inappropriate progression towards healing.
3	No evidence of healing, failure (The term failure could not be adopted during the early periodic intervals).

Hematological parameters including haemoglobin (Hb), total erythrocyte count (TEC), packed cell volume (PCV), erythrocyte sedimentation rate (ESR), total leucocyte count (TLC), and differential leucocyte count (DLC) were estimated. The serum was analyzed for calcium, phosphorus, alkaline phosphatase (ALP), lactate dehydrogenase (LDH), creatine phosphokinase (CPK), and C-reactive protein (CRP).

Results and Discussion

In group I, the after correction through traction and counter traction, the loss of reduction of fracture fragments was corrected (Fig 1 and 2). A bridging callus was noticed after application of a U splint for a case of non-union of an oblique fracture of radius and ulna approximately after 45 days (Fig 3 and 4). The corrected pin migration could be shown radiographically in case of tension band wiring done for the calcaneal fracture in a German Shepherd dog (Fig 5 and 6). The plain radiographs were also extremely helpful in diagnosing the refractory osteomyelitis which showed signs of atrophic non-union with osteolysis (Fig 7 and 8). Radiographic healing of the fracture was observed with bridging callus as early as 45 days following revisional surgery for a transverse over-riding distal diaphyseary fracture of radius and ulna (Fig 9 and 10) in case 1 while on 60th POD in case 2 (Fig 11) and 90 days in case 3 of group II (Fig 12). Complete radiographic union was noticed 93rd POD in case no.6, (Fig 13) only after 102 days in case 4 (Fig 14) and 115th day in case 5 (Fig 15).



Fig 1: Photograph showing non-union of over - riding fracture fragments of radius and ulna



Fig 2: Photograph showing reduced fracture fragments by gravity driven traction and counter traction method

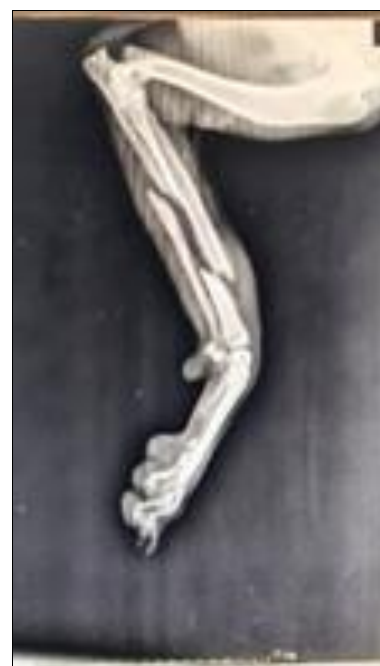


Fig 3: Skiagram showing non-union of oblique fracture of radius and ulna



Fig 4: Skiagram showing formation of bridging callus



Fig 5: Skiagram showing proximal pin migration



Fig 6: Skiagram showing repositioned pin



Fig 7: Photograph showing osteomyelitis



Fig 8: Photograph showing osteomyelitis got worsened compared to Fig. 7



Fig 9: Skiagram showing non-union of Colle's fracture complete absence of callus formation



Fig 10: Radiographic healing of the fracture was observed with bridging callus as early as 45 days following revisional surgery



Fig 11: Radiographic healing of the fracture was observed with bridging callus as early as 60 days following revisional surgery



Fig 12: Skiagram showing complete remodelling was observed after 90 days



Fig 13: Skiagram showing remodelled bone on 93rd postoperative day



Fig 14: Complete radiographic union of fracture noticed 102 days following revision surgery



Fig 15: Skiagram showing bone healing following 115th POD

The progress of radiographic healing was assessed and the details of fracture healing scores were given in table 2 and 3 in groups I and II respectively. The mean $\pm$ SE radiographic healing scores at different times intervals in both the groups were given in table no. 4. In Group I, the mean score decreased significantly ($p < 0.05$) from 2.28 ± 0.36 on the preoperative day to 0.43 ± 0.43 by the 60th postoperative day, indicating progressive fracture healing. A significant reduction was observed between all early intervals (preoperative, 15th POD, and 30th POD), while the differences among later intervals (30th, 45th, and 60th POD) were not significant, suggesting stabilization of healing. In Group II, the mean score also showed a significant ($p < 0.05$) reduction from 3.00 ± 0.00 preoperatively to 0.67 ± 0.21 at the 60th postoperative day. The decrease was gradual and statistically significant across most intervals, although no significant difference was observed between the 45th and 60th POD, indicating a plateau phase of healing. Overall, both groups demonstrated progressive radiographic healing characterized by a transition from inappropriate or absent healing (scores 2–3) during early intervals to appropriate progression and near-complete healing (scores 0–1) during later postoperative periods.

Between the groups, a significant difference ($p < 0.05$) was observed during the preoperative day and 15th POD, with Group II showing higher (worse) scores compared to Group I. However, no significant difference was observed during later intervals (30th, 45th, and 60th POD), indicating comparable healing outcomes in both groups over time. Overall, both groups demonstrated progressive radiographic healing characterized by a transition from inappropriate or absent healing (scores 2–3) during early intervals to appropriate progression

Table 2: Radiographic evaluation of dogs in group I in the present study (n=7)

S. No	Case No.	Preoperative	15 th POD	30 th POD	45 th POD	60 th POD
1	1	1	0	0	0	0
2	2	3	1	0	0	0
3	3	3	1	1	0	0
4	5	2	1	0	0	0
5	6	3	2	1	1	0
6	7	1	1	0	0	0
7	8	3	3	3	3	3
Mean $\pm$ SE		2.28 $\pm$ 0.36	1.28 $\pm$ 0.36	0.71 $\pm$ 0.42	0.57 $\pm$ 0.42	0.43 $\pm$ 0.43

*Radiographic evaluation was done for n=7, as one animal (case-4) has undergone limb amputation

Table 3: Radiographic evaluation of dogs of group - II in the present study (n=6)

S. No	Case No.	Preoperative	15 th POD	30 th POD	45 th POD	60 th POD
1	1	3	1	1	0	0
2	2	3	1	1	1	0
3	3	3	3	1	1	1
4	4	3	3	2	1	1
5	5	3	3	1	1	1
6	6	3	1	1	1	1
Mean $\pm$ SE		3 $\pm$ 0	2 $\pm$ 0.45	1.17 $\pm$ 0.17	0.83 $\pm$ 0.17	0.67 $\pm$ 0.21

*Radiographic evaluation was done for n=6, as three animal (case-7,8,9) had undergone limb amputation

and near-complete healing (scores 0–1) during later postoperative periods. Uhthoff *et al.* (2006) [31] considered closure of the fracture gap and the formation of an external bridging callus as key radiographic indicators of progress under normal physiological healing. Denny and Butterworth (2006) [6] suggested that when expected radiographic evidence of bone healing was absent, orthopaedic clinicians should suspect the presence of complications, including delayed union, non-union, malunion, osteomyelitis, fracture disease, fracture associated sarcoma or fat embolism. Menghini *et al.* (2023) [20] defined fracture union as the presence of bridging

callus across at least three cortices and recommended serial radiographic examinations to assess healing progression and detect complications. Slunsky *et al.* (2017) [27] recommended survey radiography as an essential tool for monitoring fracture healing and detecting early signs of implant related complications.

Table 4: The mean $\pm$ SE values of fracture healing scores in groups I & II during different periodic intervals

Group	Preoperative day	15 th POD	30 th POD	45 th POD	60 th POD
I	2.28 $\pm$ 0.36 ^{aA}	1.28 $\pm$ 0.36 ^{bA}	0.71 $\pm$ 0.42 ^c	0.57 $\pm$ 0.42 ^c	0.43 $\pm$ 0.43 ^c
II	3 $\pm$ 0 ^{aB}	2 $\pm$ 0.45 ^{bB}	1.17 $\pm$ 0.17 ^c	0.83 $\pm$ 0.17 ^d	0.67 $\pm$ 0.21 ^d

Means bearing different superscripts within a row (a, b) and within a column (A, B) differs significantly ($P < 0.05$)

The details of various hematological parameters estimated were given in table. 5

The values of haemoglobin and TEC were lesser preoperatively which tended to increase non-significantly in group I, but significantly ($P < 0.05$) in group II up to the 60th POD. The values of PCV increased non significantly in group I and significantly ($P < 0.05$) from preoperative to the 60th POD. Based on the above three values, in the present study all the animals in group II had considerable anaemia, when compared to group I. The ESR values varied non-significantly from preoperative to the 60th POD in group I. In group II, the values were the highest on preoperative day, which decreased significantly ($P < 0.05$) and reached normal value by the 60th POD. The difference between the groups was also significant at all time intervals except on 60th POD. The TLC values varied non-significantly within the normal physiological ranges in group I. In group II, the highest values were recorded on preoperative day and decreased significantly ($P < 0.05$) by the 60th POD and reached normal levels. The difference between the groups was also significant on preoperative, 15th and 60th POD. The details of differential leucocyte values were furnished in table no. 5.

Table 5: The mean $\pm$ SE values of hematological parameters in groups I & II during different periodic intervals

Parameter	Group	Preoperative	15 th POD	30 th POD	45 th POD	60 th POD	Total mean
Hb (g/dL)	I	11.84 $\pm$ 0.44	11.87 $\pm$ 0.42 ^A	12.1 $\pm$ 0.36	12.07 $\pm$ 0.31	12.16 $\pm$ 0.33	11.99 $\pm$ 0.16
	II	10.73 $\pm$ 0.38 ^a	10.92 $\pm$ 0.15 ^{abB}	11.42 $\pm$ 0.13 ^b	12.13 $\pm$ 0.12 ^c	12.93 $\pm$ 0.08 ^d	11.63 $\pm$ 0.14
TEC (Millions/ μ L)	I	5.94 $\pm$ 0.21 ^A	5.91 $\pm$ 0.21 ^A	6.14 $\pm$ 0.17 ^A	6.12 $\pm$ 0.14	6.24 $\pm$ 0.17	6.07 $\pm$ 0.08
	II	4.81 $\pm$ 0.18 ^{aB}	5.05 $\pm$ 0.08 ^{aB}	5.5 $\pm$ 0.09 ^{bB}	6.06 $\pm$ 0.07 ^c	6.52 $\pm$ 0.05 ^d	5.59 $\pm$ 0.09
PCV (%)	I	35.7 $\pm$ 1.31	35.8 $\pm$ 1.21 ^A	36.07 $\pm$ 1.12	36.34 $\pm$ 0.92	36.51 $\pm$ 0.97 ^A	36.08 $\pm$ 0.47
	II	29.67 $\pm$ 2.21 ^a	32.5 $\pm$ 0.64 ^{abB}	34.92 $\pm$ 0.45 ^{bc}	37.42 $\pm$ 0.47 ^c	40.5 $\pm$ 0.31 ^{dB}	35 $\pm$ 0.68
ESR (mm/hr)	I	9.12 $\pm$ 1.12 ^A	9.87 $\pm$ 1.06 ^A	9.37 $\pm$ 0.7 ^A	8.5 $\pm$ 0.71 ^A	7.75 $\pm$ 0.68	8.92 $\pm$ 0.39
	II	38.17 $\pm$ 5.08 ^{cB}	31.17 $\pm$ 2.49 ^{cB}	22.5 $\pm$ 1.28 ^{bB}	13.5 $\pm$ 1.29 ^{aB}	7.42 $\pm$ 0.23 ^a	22.55 $\pm$ 1.86
TLC (Thousand/ μ L)	I	11.75 $\pm$ 0.81 ^A	12.34 $\pm$ 1.09 ^A	11.95 $\pm$ 0.78	11.40 $\pm$ 0.42	11.06 $\pm$ 0.12 ^A	11.7 $\pm$ 0.81
	II	18.54 $\pm$ 1.31 ^{dB}	16.12 $\pm$ 0.69 ^{cB}	13.58 $\pm$ 0.62 ^b	10.91 $\pm$ 0.5 ^a	8.96 $\pm$ 0.08 ^{aB}	13.62 $\pm$ 0.55
Neutrophils (%)	I	68.87 $\pm$ 2.26 ^A	67.62 $\pm$ 2.32 ^A	66.75 $\pm$ 1.60	65.37 $\pm$ 1.23	68 $\pm$ 0.65 ^A	67.32 $\pm$ 0.76
	II	78.08 $\pm$ 2.61 ^{cB}	74.67 $\pm$ 2.13 ^{bcB}	69.83 $\pm$ 2.28 ^b	63.08 $\pm$ 1.89 ^a	58.5 $\pm$ 0.93 ^{aB}	68.83 $\pm$ 1.30
Lymphocytes (%)	I	20.25 $\pm$ 2.17 ^A	21.62 $\pm$ 2.18	21 $\pm$ 1.22	21.62 $\pm$ 0.8 ^A	21.25 $\pm$ 0.77 ^A	21.15 $\pm$ 0.67
	II	14.25 $\pm$ 1.38 ^{aB}	16.42 $\pm$ 1.55 ^a	21.17 $\pm$ 1.69 ^b	27.25 $\pm$ 1.38 ^{cB}	31.67 $\pm$ 0.58 ^{dB}	22.15 $\pm$ 1.03
Eosinophils (%)	I	5.75 $\pm$ 0.45 ^{bA}	5.75 $\pm$ 0.45 ^{bA}	5 $\pm$ 0.33 ^b	5.87 $\pm$ 0.23 ^b	3.87 $\pm$ 0.44 ^{aA}	5.25 $\pm$ 0.02
	II	2 $\pm$ 0.12 ^{aB}	3.42 $\pm$ 0.43 ^{bB}	4.17 $\pm$ 0.38 ^b	5.33 $\pm$ 0.39 ^c	6.17 $\pm$ 0.38 ^{cB}	4.21 $\pm$ 0.24
Monocytes (%)	I	4.62 $\pm$ 0.26	4.5 $\pm$ 0.27	4.87 $\pm$ 0.29	4.62 $\pm$ 0.26	4.25 $\pm$ 0.16	4.57 $\pm$ 0.11
	II	4.58 $\pm$ 0.19 ^{ab}	4.92 $\pm$ 0.29 ^b	4.58 $\pm$ 0.15 ^{ab}	4.17 $\pm$ 0.27 ^{ab}	4.08 $\pm$ 0.29 ^a	4.47 $\pm$ 0.11

Based on the findings of ESR, TLC and DC it was concluded that, leucocytosis and infection were present in group II, when compared to group I. Based on the values of Hb, PCV and

TEC, in the present study all the animals that were presented after having been treated with surgical procedures had considerable anaemia, when compared to those that were

treated with external co-optaion. Leucocytosis was observed preoperatively in all the dogs in which complications were recorded following orthopaedic surgeries. The values gradually decreased and reached normal values by the end of 60th postoperative day. Thrall *et al.* (2012) [30] also reported anaemia with decreased Hb, PCV, and TEC in dogs with chronic inflammatory, traumatic, or orthopaedic diseases. The authors considered anaemia to compromise tissue oxygen delivery, adversely affecting the fracture healing and bone regeneration following orthopaedic procedures. The postoperative anaemia without any regenerative response can be attributed to acute blood loss during or after surgery (Cowgill, 2003) [4].

Foy *et al.* (2015) [9] reported that in cases of prolonged orthopaedic complications, limited iron availability was responsible for the reduced hemoglobinization of reticulocytes. Meléndez-Lazo *et al.* (2015) reported that osteomyelitis or implant-associated complications suppressed erythropoiesis and impaired iron utilization, resulting in an inadequate reticulocyte response relative to the degree of anaemia, confirming the concept of anaemia of inflammation in dogs with chronic orthopaedic complications. Persistent lymphopenia is thought suggestive of ongoing inflammation, infection, or systemic stress, seen in dogs with implant infections or delayed bone healing (Stokol, 2015) [28]. The higher preoperative values of ESR were observed in group II that reached normal values towards the end of 60th POD in the present study. In group I, the values remained normal at all the time intervals. Khan *et al.* (2011) [13] reported that the erythrocyte sedimentation rate (ESR) increased during inflammatory and infectious conditions and reflected the acute inflammatory response associated with tissue injury. The authors noted that ESR values gradually returned toward normal as the inflammatory process subsided.

The details of various serum biochemical parameters estimated in the present study are given in Table 6. Mukhopadhyay *et al.* (2011) [21] recommended that assessment of biochemical parameters such as alkaline phosphatase, calcium, and phosphorus helped in monitoring the progress of fracture healing over shorter time intervals. Paskalev *et al.* (2005) [23] suggested that prolonged elevation of bone-related enzymes could indicate altered bone turnover or impaired fracture healing. In the present study, there were no significant changes in the serum calcium and phosphorus values in both groups. Meller *et al.* (1984) [19] and Hegade *et al.* (2007) [11] also reported only transient changes in the calcium levels during fracture healing. Contrary to this finding, Duffy *et al.* (2018) [7] observed hypocalcemia in dogs with chronic bone disease, reflecting inflammatory bone pathology and osteoblastic activity. Chaurasia *et al.* (2019) [2] explained that serum calcium levels temporarily decreased during early healing due to deposition of minerals at the fracture site and later increased as bone repair advanced. The localized disturbances in mineral metabolism contributed to impaired callus formation, although the serum calcium and phosphorus levels remained within reference ranges (Gieling *et al.* 2019) [10] and (Marshall *et al.* 2022) [17].

Elevated preoperative values of CRP were observed in both the groups, which gradually decreased significantly at different time intervals in both the groups. The postoperative C-reactive protein (CRP) was a more sensitive and responsive indicator of surgical infection and inflammation than the total white blood cell (WBC) count (Sumalai *et al.*, 2025) [29]. The serum C-reactive protein (CRP) concentrations increase rapidly following fractures and orthopaedic surgical procedures in dogs, reaching peak levels during the early postoperative period and gradually decline as healing progresses (Yamamoto *et al.*, 1992) [32]. In normal healing, CRP levels

Table. 6: The mean $\pm$ SE values of serum biochemical parameters count in groups I & II during different periodic intervals

Parameter	Group	Preoperative	15 th POD	30 th POD	45 th POD	60 th POD	Total mean
Calcium (mg/dL)	I	9.54 $\pm$ 0.08 ^{abA}	9.41 $\pm$ 0.04 ^{aA}	9.6 $\pm$ 0.05 ^b	9.52 $\pm$ 0.04 ^{abA}	9.55 $\pm$ 0.06 ^{abA}	9.52 $\pm$ 0.02
	II	8.65 $\pm$ 0.17 ^{aB}	9 $\pm$ 0.11 ^{bB}	9.47 $\pm$ 0.06 ^c	9.99 $\pm$ 0.06 ^{dB}	10.42 $\pm$ 0.06 ^{eB}	9.5 $\pm$ 0.09
Phosphorous (mg/dL)	I	4.12 $\pm$ 0.1 ^{aA}	3.8 $\pm$ 0.09 ^{cA}	3.5 $\pm$ 0.09 ^{dA}	3.41 $\pm$ 0.08 ^{dA}	3.95 $\pm$ 0.04 ^{bA}	3.76 $\pm$ 0.08
	II	4.46 $\pm$ 0.21 ^{bB}	4.54 $\pm$ 0.13 ^{bB}	3.87 $\pm$ 0.08 ^{cB}	3.93 $\pm$ 0.07 ^{cB}	4.57 $\pm$ 0.06 ^{abB}	4.27 $\pm$ 0.11
ALP (IU/L)	I	85.25 $\pm$ 8.66 ^A	90.00 $\pm$ 8.73 ^A	89 $\pm$ 8.45 ^A	86.5 $\pm$ 7.22 ^A	84.87 $\pm$ 5.65 ^A	87.12 $\pm$ 3.33
	II	233 $\pm$ 15.45 ^{bB}	276.92 $\pm$ 21.2 ^{bB}	326.25 $\pm$ 22.38 ^{cB}	237.25 $\pm$ 16.87 ^{bB}	162.08 $\pm$ 5.51 ^{aB}	247.1 $\pm$ 10.29
LDH (IU/L)	I	370.25 $\pm$ 43.95 ^c	333.37 $\pm$ 35.62 ^c	301.12 $\pm$ 29.63 ^{bc}	232 $\pm$ 21.34 ^{ab}	189 $\pm$ 15.57 ^a	285.15 $\pm$ 16.84
	II	509 $\pm$ 68.14 ^d	419 $\pm$ 38.34 ^d	309.91 $\pm$ 17.61 ^c	212.67 $\pm$ 11.89 ^{ab}	160.08 $\pm$ 5.08 ^a	322.13 $\pm$ 22.94
CPK (IU/L)	I	812.5 $\pm$ 284.54 ^b	563.75 $\pm$ 178.98 ^{ab}	359.5 $\pm$ 92.79 ^{ab}	216 $\pm$ 33.73 ^a	157 $\pm$ 17.59 ^a	421 $\pm$ 76.81
	II	1363.33 $\pm$ 144.66 ^a	952.75 $\pm$ 71.18 ^b	569.17 $\pm$ 27.29 ^c	280 $\pm$ 10 ^d	161.67 $\pm$ 5.2 ^e	665.38 $\pm$ 51.67
CRP (mg/L)	I	85.37 $\pm$ 23.51 ^{cA}	57.75 $\pm$ 18.45 ^{bcA}	37.75 $\pm$ 13.52 ^{bA}	17 $\pm$ 7.38 ^{abA}	3.25 $\pm$ 3.1 ^{aA}	40.22 $\pm$ 13.19
	II	117 $\pm$ 18.77 ^{a2B}	81.16 $\pm$ 9.45 ^{bB}	64.25 $\pm$ 4.13 ^{cB}	24.75 $\pm$ 2.49 ^{dB}	5.17 $\pm$ 0.7 ^{eB}	58.47 $\pm$ 7.31

decline gradually, whereas persistent elevation or secondary increases may indicate postoperative complications such as surgical site infection or implant-associated inflammation (Christensen *et al.*, 2015) [3]. Lofqvist *et al.* (2018) [15] reported that, CRP levels progressively declined as postoperative inflammation resolved, but persistently elevated in postoperative infection in dogs, following orthopaedic surgery.

In the present study, between the groups, group II had higher values of AKP, when compared to those of group I. Similar to the results of the present study, Singh *et al.* (1976) [26] Delmas, (1995) [5], Komnenou *et al.* (2005) [14], Rani *et al.* (2012) [25] and Duffy *et al.* (2018) [7] also observed a consistent elevation in serum alkaline phosphatase activity throughout the fracture

healing period, which was associated with enhanced osteoblastic activity and active bone regeneration. Nyman *et al.* (1991) [22] suggested that serum alkaline phosphatase could serve as a useful biochemical indicator for identifying delayed or complicated bone union.

However, the values of CPK and LDH were found elevated in both the groups although the values were comparatively higher in group II, that remain elevated even at 60th POD. Lactate dehydrogenase is released into circulation during cellular injury and tissue necrosis, and increased serum levels may occur in conditions involving infection, bone damage and malignancy (Farhana and Lappin, 2023) [8]. The elevated levels of lactate dehydrogenase (LDH), creatine phosphokinase (CPK) and alkaline phosphatase (ALP) which

were associated with extensive bone destruction, tissue necrosis, and inflammatory processes (Brozmanová and Skrovina, 1977). Since LDH originated from multiple tissues, its diagnostic specificity for bone disease was considered limited, although it could serve as an adjunct indicator of cellular damage in orthopaedic conditions (Kaneko *et al.*, 2008) ^[12]. Creatine kinase was a cytosolic enzyme released into the bloodstream following muscle injury or cellular damage and elevated serum CK activity is commonly associated with muscle trauma, inflammation, and tissue necrosis (Farhana and Lappin, 2023) ^[8]. These results are quite similar to those of Phaneendra *et al.* (2018) ^[24] and Malin and Witkowska-Piłaszewicz (2022) ^[16], who also observed elevated levels of CRP, CPK and LDH during the early postoperative period that decreased progressively as fracture healing advanced in dogs following repair of compound tibial fractures.

Conclusion

Overall, both groups demonstrated progressive radiographic healing characterized by a transition from inappropriate or absent healing (scores 2–3) during early intervals to appropriate progression and near-complete healing (scores 0–1) during later postoperative periods. In the present study, all the animals that were presented after having been treated with surgical procedures had considerable anaemia, leucocytosis and elevated ESR, when compared to those that were treated with external co-optaion. Elevated preoperative values of CRP were observed in both the groups, which gradually decreased significantly at different time intervals in both the groups. In the present study, between the groups, group II had higher values of AKP, when compared to those of group I. However, the values of CPK and LDH were found elevated in both the groups although the values were comparatively higher in group II, that remain elevated even at 60th POD.

Conflict of Interest

Not available

Financial Support

Not available

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