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Effect of synovial fluid on intercondylar fracture in cats

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ABSTRACT

Intraarticular fractures communicate with synovial fluid, which contains collagenases that retard bone healing. Joint movement will cause the fracture fragments to more, further impairing union. When intraarticular fractures are comminuted, the fragments tend to float apart owing to loss of soft tissue support. Surgical treatment of supracondylar or intercondylar distal femoral fractures remains a significant surgical challenge with significant complication rates. Fifteen young-adult DSH intact male, from different owner were present to the clinic of Islamic Azad University with sings of fractures. In eight cases stabilization was attained with an intercondylar lag screw correctly. In others seven cats fragments was not attained and fracture line had 2mm distance. Radiographic evaluation of bone healing in the eight cases that stabilization was attained correctly showed that seven cases of these cats were healed and one case was not healed, but in other seven cases with 2 mm distance between two fragments healind didn't occur.

Key words: synovial fluid, intercondylar fracture, cats.

INTRODUCTION

Bone is a specialized form of connective tissue that functions as an integral part of the locomotors system. Bones act as lever arms during motion, provide resistance to the effects of gravitational force on the body, and provide protection and support to adjacent structures. Bone also serves as a reservoir of mineral for systemic mineral homeostasis. Normal bone healing is an ongoing process, which can be affected by various factors. Fracture repair and bone healing can be promoted by administration of some drugs, among which are growth factors that parathormone hormone and anabolic steroid hormones [1].

These elbow fractures most often result from motor vehicle accidents and falls from a significant height. Occasionally, these fractures occur after minimal trauma, as incomplete ossification of the condyle is the underlying pathology. The intercondylar fracture is accompanied by a transverse, oblique, or comminuted fracture through the medial and lateral epicondyloid crests [2,3].T-Y, fractures occur most frequently in mature animals and usually result from trauma exerting torsional stress [4].

Intraarticular fractures communicate with synovial fluid, which contains collagenases that retard bone healing. Joint movement will cause the fracture fragments to more, further impairing union. When intraarticular fractures are comminuted, the fragments tend to float apart owing to loss of soft tissue support.

Surgical treatment of supracondylar or intercondylar distal femoral fractures remains a significant surgical challenge with significant complication rates. Adverse events include infection, decreased range of motion, need for bone grafting, malunion, and nonunion [5].Synovial fluid is a dialysate of blood to which glycosaminoglycan (GAG) has been added by the synoviocytes [4].

Normal joint synovial fluid is a plasma filtrate that contains hyaluronic acid, proteins, enzymes, cytokines, and scanty cells. Among these contents, hyaluronic acid, which can be synthesized by the synovial membrane and secreted into the joint cavity to increase the viscosity and elasticity of the articular cartilage and lubricate the surfaces between the synovium and cartilage, might play a potential inhibitory role in tendon-to-bone healing, because experimental and clinical data have suggested that covering an operation field with soluble hyaluronic acid reduces postoperative adhesions. Enzymes and cytokines in synovial fluid are important regulators of metabolism in the joint environment [6]. Synovial fluid contains a cocktail of different substances that might have partially inhibiting effects on osseous healing of the graft [6].SF contains growth factors, proinflammatory cytokines, inhibitors of osteoblast proliferation, and hyaluronate, it is likely that the fluid mediates activating as well as inhibitory attributes towards osteoblasts [7]. Synovial fluid is known to contain various metalloproteinases. Joint fluid proteins increase with inflammatory conditions either because of a decrease in this polymerized state of hyaluronic acid or as a result of an increase in the capillary permeability of the subsynovium. Both situations cause joint effusion. In inflammatory conditions, the protein electrophoretic pattern of synovial fluid is altered, sugars are decreased, the cell population increases, and cell type ratios change [4].

Blocking the activity of such matrix metalloproteinases may enhance the healing process [8].Alpha-2 macroglobulin (α2-macroglobulin) is a plasma glycoprotein and an endogenous inhibitor of matrix metalloproteinases. The α2-macroglobulin molecule is synthesized mainly in the liver as well as locally by macrophages and fibroblasts. It also has been located within the joint cavity during periods of synovial inflammation [8]. The goal of this research evaluation of synovial fluid effct on intercondylar fracture in cats.

MATERIALS AND METHODS

Fifteen young-adult DSH intact male, from different owner were present to the clinic of Islamic Azad University with sings of fractures (pain on manipulation of the joint, swelling, non-weight-bearing lameness). Diagnostic imaging was taken for definitive diagnosis (figure 1).

The animals received preoperative prophylactic antibiotics in the form of intravenous cefazolin sodium (22mg/kg). The animal was then anesthetized with intramuscular ketamine hydrochloride (Alfasan; 15 mg/kg) and xylazine (Rompun; 1 mg/kg). Fore limb was shaved, scrubbed with Betadine, and draped in a sterile fashion.

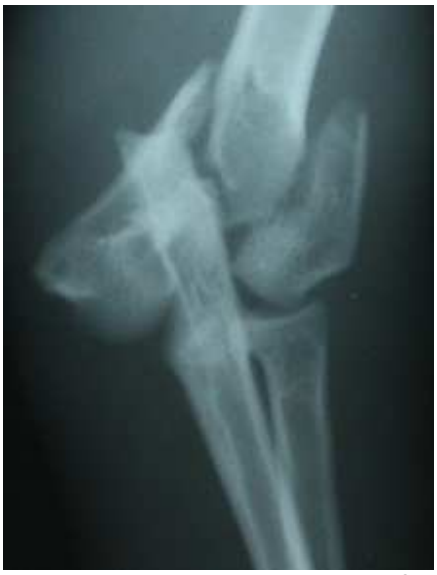

Figure 1. Fracture in cats that were present to the clinic of Islamic Azad University

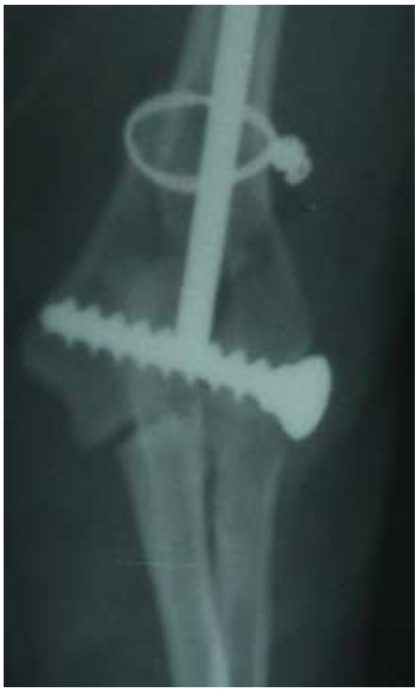

Figure 2. Stabilization was attained with an intercondylar lag screw correctly.

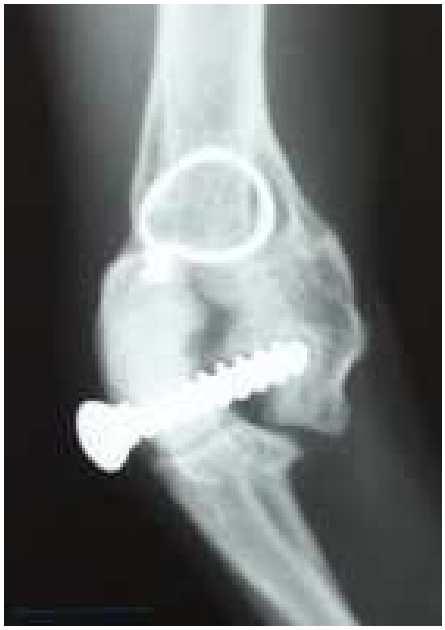

Figure 3. Fracture line had 2mm distance

Using a lateral or medial approach, the fracture area was exposed. The fracture was reduced, and a pointed reduction forceps was applied across the epicondyles. In eight cases stabilization was attained with an intercondylar lag screw correctly. In others seven cats fragments was not attained and fracture line had 2mm distance (figure 2, 3).

For radiographic evaluation Standard lateromedial and craniocaudal radiographic projection were made before and immediately after surgery and it was repeated at 15, 30, 45 and 60 days after surgery. Radiographic evaluation of bone healing was done with considering the disappearance of radiolucency.

Statistical differences between groups were evaluated with mann-whitney u-test to analyze data among groups. The significant level was set at $p<0.05$.

RESULTS

Radiographic evaluation of bone healing in the eight cases that stabilization was attained correctly showed that seven cases of these cats were healed and one case was not healed, but in other seven cases with 2 mm distance between two fragments healing didn't occur. There is no significant difference in the amount of callus formation between group 1 and group 2 until 15^{th} day, but there is significant difference on 30^{th} and 60^{th} day between two groups.

Ranks

	GROUP	N	Mean Rank	Sum of Ranks
DATA	CONTROL	7	4.00	28.00
	TREATMENT	8	11.50	92.00
	Total	15		

DISCUSSION

There are three types of collagenase enzymes: interstitial collagenase (MMP1), neutrophil collagenase (MMP8), and collagenase 3 (MMP13). Collagenases are characterized by their ability to degrade triple helical regions of interstitial collagen types I, II, and III at a specific, single site following a glycine residue located about three-fourths of the distance from the N terminus. MMP1 is produced by macrophages and is found in synovial fluid or synovial tissue. Polymorphonuclear leukocytes contain MMP8 in specific granules. Interleukin-1 (IL1) and tissue necrosis factor-alpha (TNF-α) also directly induce the release of matrix metalloproteinases from target cells. IL1, IL6, and TNF increase collagenase release [8, 9].

Synovial fluid constituents may be increased by regulated lymphatic drainage of membrane peptidases or by increased synovial blood flow. Previous authors have suggested that synovial fluid influx through a small gap between the tendon and the tunnel may slow the rate of healing. Synovial fluid also may impair healing by diluting the initial hematoma and preventing fibrin clot formation [8].

Concentrations of proteins such as α2-macroglobulin, fibrinogen, and IgM are also elevated in inflammatory synovial fluids [10]. The concentration of α2-macroglobulin in plasma is 250 mg/dL and, because of its large molecular weight, it is not present in noninflammatory synovial fluid. This inhibitor is active against almost all matrix metalloproteinases, regardless of their specificities, and it accounts for >95% of the collagenase inhibitory capacity in serum. The mechanism of inhibition involves covalent bonding to metalloproteinases following hydrolysis of the proteins, leading to inactivation of the enzymes. On the basis of these characteristics, α2-macroglobulin might be considered as an augmentation agent for tendon-bone healing as various other agents or methods have been used in previous studies [11,12].

Berg et al evaluated the healing behavior of an interarticular bone tunnel exposed continuously to a synovial environment in an animal model. They found that peripheral-third bone tunnel healing was significantly than articular-third tunnel healing at all time intervals and that tunnel ingrowth was delayed and incomplete in the articular third of the tunnel. This finding suggests that synovial fluid is a potential inhibitory factor for bone ingrowth in the empty bone tunnel [13].Fuchs et al. incubated osteoblasts in the presence of synovial fluid or partially purified synovial fluid in vitro. They found that synovial fluid stimulated proliferation of osteoblasts and induced the expression of alkaline phosphatase and type I collagen but not osteocalcin. They suggested that synovial fluid might inhibit osteoblast differentiation related to bone tunnel healing after cruciate ligament reconstruction [7].

CONCLUSION

According to studies and the results of this study seems despite that there are discrepancies, synovial fluid has inhibitory effect on intercondylar fracture.

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