A MODIFICATION OF TIE-IN EXTERNAL FIXATION TECHNIQUE VIA ACRYLIC IN SMALL ANIMALS

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Abstract: Tie-in technique, know as the combination of intramedullary pin and external fixator, is being an alternative to the plate fixation in cats and small breed dogs. Intramedullary pin shows resistance against axial forces while the schanz pins applied on fracture fragments resists the rotational and compression forces. In this study, intramedullary applied Steinmann pins and externally applied schanz pins are tied together with acrylic instead of rots and clamps aiming a rigid fixation, carried out on Tibia, Femur and Humerus fractures in cats and dogs. After open reduction, intramedullary pin was applied retrograde and area was closed as routine. For cases with body weight below 7kg (e.g. cats) one for every single fracture fragment, for cases with body weight above 7kg, two or three schanz pins were applied to pass through both cortex. Later on, proximal end of the pin which was applied intramedullary was bent to the lateral side. Applied schanz pins were bent on one another to be compatible with intramedular pin, then were tied to each other with cerclage wires. This connection was then expected to dry and harden after applying acrylic. A rigid fixation took place with the acrylic applied. With this study done with 10 cats (6 Femur, 3 tibia, 1 humerus) and 6 dogs (4 tibia, 2 femur), long-term results of the modified tie-in technique were evaluated. This technique was applied at the same time on a femur and tibia fracture of one cat. Cat has been observed tolerating the apparatus very well and was able to use related extremities on the 4th postoperative day. The modification of this tie-in technique which is generally used on small dog breeds and cats has also been used on a medium sized dog and no major complications were observed.

As a result, it has been concluded that, this procedure can be used on cats and dogs for being safe, effective, low cost and a method to be used in clinical practice as routine.

Keywords: Acrylic, cat, dog, external fixation, extremity, fracture, Tie-in.

Introduction

External fixation is widely used on fracture fragment, joint stabilization and extremity deformations in veterinary medicine. Advantages of external fixation system compared to other methods are arranged as follow; versatile setup of external fixation, possible treatment of wounds in open fractures, protection of the vascularization on fracture line and low cost. (8).

Pins in arcylic external fixators are connected to columns filled with

polymethylmethacrylate (PMMA) instead of connection rods. These columns can be hand-shaped as well as taking shape by plastic tubes of different sizes filled with polymethylmethacrylate. It hardens during exothermic polimerization of methyl methacrylate monomers and the necessary fixation is provided. PMMA has some advantages compared to the standard clamp-connection bar combination. These are; low cost and being radiolucent, enable pinning as it can shape the columns. This case faciliates open wound treatment as well as reducing pin tract morbidity and increases extremity function if musculotendinous structres are protected. Anatomically shaped PMMA columns are very hard and resistant to breakage. Type IA and IB (Unilateral uniplanar, Unilateral biplanar) are the most severe complication is bending or even braking of the connection bars observed in external fixations. Nowadays, bars made up of carbon fibre or titanium are used instead of stainless steel to prevent these complications. However, studies show that PMMA columns get better results in point of average hardness, efficiency and eventual resistance. (1).

Intramedullary pin applications show resistance agains twisting force on fracture line but extra fixation applications are needed in order to prevent rotational and compression forces. If the intramedullary pin application is connected to the fixator apllied externally, this method is called Tie-in. Acrylic in external fixators take place of clamp and connection bars in traditional external fixator systems. Use of intramedullary pin application with the combination of arcylic in cats and dogs have been reported in the literatures previously. However, the combination of these two applications with Tie-in configuration has only been reported in cats, avians and exotic animals (3,9).

The aim of this study is to investigate the durabilty of this method which has recieved successful results before and the effect on cats and dogs. Hypoteshis of this study is; Arcylic type IA and tie-in intramedullary pin combination will provide a rigid enough fixation of long bone fracture treatment in cats and dogs.

Material and Method

In this study performed on ten cats (6 Femur, 3 Tibia, 1 Humerus) and six dogs (4 Tibia, 2 Femur) long term resulst of the modified tie in method we developed have been evaluated.

General anasthesia protocol of the cases: Induction of general anasthesia 4 mg/kg intravenous propofol (Pofol® %1, Fresenius Kabi, Germany), and maintenance is done with

(Isoflurane®, Eczacıbaşı-Baxter, Turkey) and oxygen mixture. Preoperative analgesia was ensured with morphine (Morfin HCL ®,Galen, Türkiye) 0.8mg/kg IM and meloksikam (Anaflex®, Hektaş, Turkey) 0.3 mg/kg SC (7 days) was used postoperatively. Related extremity was shaved after general anasthesia and was layed down on the operation table sideways lying lateral position. Asepsis of the shaved area was provided by 10% benzalkonium chloride firts (Zefiran®, ilsan), 10% iodine solution after (Batticon®, Adeka). After the process, area was deliminated with sterile operation towels.

While intramedullary applied pin showed resistance againts axial forces, schanz pins applied on fracture fragments showed resistance against compression and rotational forces. In this study, intramedullary applied Steinmann pin and externally applied schanz pins were connected together with acrylic instead of rot and clamps to provide a rigid fixation and this method was performed on cats' and dogs' tibia, femur and humerus bones.

Intramedullary pin, following limited-open or fully-open surgical approach and reduction, was applied retrograded and area was closed as a routine. Thickness of the pin applied intramedullary varied between 1.5 mm and 3 mm considering the case. Intramedullary aplied pins were taken care to be up the 40-50 % of the medullary diameter. Thickness of the externally aplied schanz pins were chosen between 1.5 mm to 2 mm. Before the application of external pins, no path was opened with drills to prevent pin loosening. Additionally, this pin was directed to the distal and proximal of the long bone as far as posibble from fracture line. Area was closed as routine after the fracture reduction and fixation was provided.

In cats (cases with lower than 7kg) on for each fracture fragment, for cases higher than 7kg, two or three schanz pins were applied to pass both two cortexes. Later on, intramedulary applied pin was twisted to the lateral instead of being cut at the proximal. Applied schanz pins were twisted againts long bone's long axis parallely compatiple with intramedullary pin and lateral twisted parts of the pins were connected to each other by cerclage wires. Acrylic was anticipated to dry and harden after being applied on the pins connected together.

Oxytetracyclin spray(Neo-Caf®, Intervet) was applied 3 times a day to the base of the pins to prevent any pin base infection complications. Cases were physicaly and radiologicaly

controlled on the postoperative 10. 30. And 42. days and suspended after 4-8 week according to the callus formation of external fixer fracture line and recovery. Cases were followed for a while.

Discussion and Results

Description of the study material, fracture classification , treatment results and follow-up periods of the cases are presented in Table 1.

It was observed that the cases were all well adapted to the acrylic external fixator. Related extremity was able to be used in short time after the operation.

In case number 3, symptoms of osteomyelitis were determined because the fracture was open. Three weeks after the operation, intramedullary pin was removed in order to free the medullar cavity to prevent any infections after the fistulation of the related extremity was observed. As a result of the treatment, infection was inhibited and functional healing was provided.

In case number 8, arcylic external fixator was applied to femur and tibia fractures on the same extremity. Case was able to use the extremity in a short time however, symptoms of necrosis on tibia, atrophy, cooling was observed one week after the operation. External fixator in tibia was removed but externally applied schanz pin complication lead to a progress of necrosis and amputation of the extremity had to be attended.

Another osteomyelitis event was observed in case no:11 . Forming of the osteomyelitis was connected to the dog being a shelter dog and pin site care not being taken well enough (Figure 1-4). Antibiotic teatment was used in this case and entire external system was unraveled and extremity was taken into a supportive bandage. Functinal healing was achivedin this case.

Sufficient callus formation without complication was achieved in comminuted fracture of tibia in case 10 (Figure 5-8)

Some researchers were united in the view of Type 1 A external fixation systems not being durable for heavier patients and did not provide sufficient fracture stability. (2, 4, 5, 6) In studies, addition of intramedular pin on to traditional 6 pinned type 1 A external fixation was proven to improve durability (7).

This study showed that, acrylic type 1A and tie-in intramedullary pin combination

provide a rigid fixation in cats and even dogs. Breakage or loosening of the fixator was observed in none of the cases. Only in one of the cases making up the study material, functional healing could not be achived and resulted in the amputation of related extremity. The reasons to this are ignoring the safe corridors when applying external fixation and surgeon mistakes. In complicated cases (case no3 and11) the reason was not the failure of the system but one of them being open fracture and the other case having shelter and postoperative care deficiency.

Another and actual reason of this study is the traditional external fixators being too much in cost. Acrylic external fixation combinated with intramedullary pin is low in cost and also durable. Bars and clamps needed in other external systems are not needed with this technique.

Tie-in acrylic combination may increase the risk of morbidity compared to intramedullary pin applied itself or to the type 1A external fixation method. However in this situation, excision of the intramedullary pin is simple with this method. Intramedullary pin being applied itself has the risk of pin migration and consequently creating sciatic nerve damage. With this technique, there is no risk of sciatical damage due to the twisting of intramedullary pin and fixing with acrylic. As referred before, it provides a rigid fixation compared to type 1 A external fixation being used alone. In addition, this method is especially advanced in treatment of open fractures as the fixator being easily excised and no implant is left inside the body. This method used in study provides an alternative in diaphyseal fractures of long bones of cats and dogs as being low in cost and easy to apply.

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Table 1. Signalment, Fracture classification, Treatment method, Outcome and Follow-up data of the cases.

Case	Signalment	Fracture Classification	Treatment method	Result	Follow-up
1	C, ♂, 2Y, Mix	Diaphyseal F	IMp+2 Schanz	FR.	3 M
2	C, ♀, 3Y, Mix	Diaphyseal F	IMp+2 Schanz	FR.	3 M
3	C, ♀, 4Y, Mix	Diaphyseal F	IMp+2 Schanz	OM, FR.	5 M
4	C, ♀, 2Y, Mix	Diaphyseal F	IMp+2 Schanz	FR.	2 M
5	C, ♂, 18M,Mix	Diaphyseal T	IMp+2 Schanz	FR.	3 M
6	C, ♂, 2Y, Mix	Diaphyseal F	IMp+2 Schanz	FR.	3 M
7	C, ♂, 10M, Mix	Diaphyseal T	IMp+2 Schanz	FR.	3 M
8	C, ♀, 1Y, Mix	Diaphyseal F,T	IMp+2 Schanz	Amputation	3 M
9	D, ♀, 3Y, RW	Diaphyseal T	IMp+6 Schanz	FR.	2 M
10	C, ♀,18M,Mix	Diaphyseal T	IMp+2 Schanz	FR.	3 M
11	D, ♂, 2Y, Mix	Diaphyseal F	IMp+6 Schanz	OM, FR.	5 M
12	D, ♀,3Y, Mix	Diaphyseal F	IMp+6 Schanz	FR.	2 M

13	D,♂,10M,Mix	Diaphyseal T	IMp+6 Schanz	FR.	2 M
14	D, ♂, 3Y, Mix	Diaphyseal T	IMp+6 Schanz	FR.	2 M
15	C, ♀,11A, Mix	Diaphyseal H	IMp+2 Schanz	FR.	2 M
16	D, ♂, 2Y, Mix	Diaphyseal T	IMp+6 Schanz	FR.	2 M

C=Cat, D=Dog, ♀=Female, ♂=Male, Y=Years, M=Month, F=Femur, T=Tibia, Parç=Parçalı, H=Humerus, IMp= Intramedullary pin, FR= Functional recovery, OM= Osteomyelitis

Figure 1. Radiographic appearance of case11 Postoperative 10th day. **Figure 2**. Same case postoperative 21. days.

Figure 3. Radiographic view of case 11 after implant removal. **Figure 4.** View of case 11 just before implant removal.

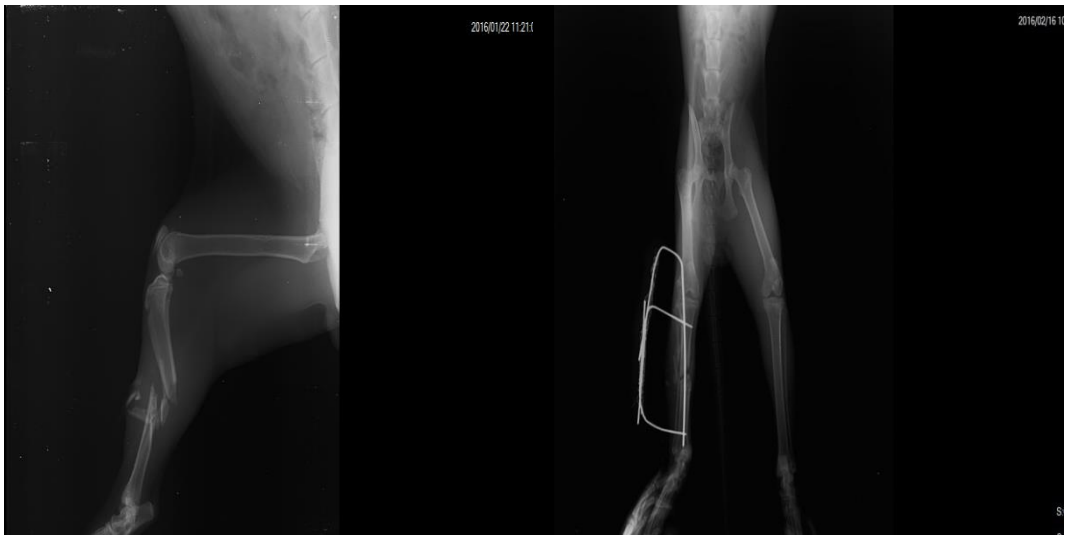

Figure 5. Preoperative radiographic appearance of case 10.

Figure 6. Same case postoperative 25. days.

Figure 7. Same case postoperative 70. days.

Figure 8. Radiographic view of case 10 after implant removal.