

Evaluation of Acrylic Pin External Fixation (APEF) System in Metacarpal Fractures of Newborn Calves: Cheap But Effective? ^[1]

Ece ÖZTAŞ ¹ Sırrı AVKİ ² 

^[1] This article was presented at 14th Congress of Veterinary Surgery (23-26 October 2014, Antalya, Turkey)

¹ Mehmet Akif Ersoy University, Health Sciences Institute, Master Program of Veterinary Surgery, TR15030 Burdur - TURKEY

² Mehmet Akif Ersoy University, Faculty of Veterinary Medicine, Department of Surgery, TR15030 Burdur - TURKEY

Article Code: KVFD-2014-12635 Received: 19.11.2014 Accepted: 23.01.2015 Published Online: 08.02.2015

Abstract

In this study, the effectiveness of acrylic pin external fixation (APEF) system was investigated in healing of newborn calves' metacarpal fractures. Six newborn calves with closed metacarpal fracture were used. Fracture healing was monitored by scoring "walking-weight bearing" "radiographic healing" and "pin tract infections" in postoperative days 10, 20, 40 and 80. Calves were able to walk without support at postoperative day 1 and able to walk normally at day 40. In all cases, radiological fracture healing was observed on day 40 and APEF system was removed. After day 10 controls, no pin track infection was observed in any case.

Keywords: Calf, Metacarpal fracture, APEF, Fracture healing

Neonatal Buzağuların Metakarpal Kırıklarında Akrilik Pin Eksternal Fikzasyon (APEF) Sisteminin Değerlendirilmesi: Ucuz Ama Etkili mi?

Özet

Bu çalışmada, akrilik pin eksternal fikzasyon (APEF) sisteminin neonatal buzağuların metakarpal kırıklarında etkinliği araştırıldı. Çalışmada kapalı metakarpus kırığı teşhis edilen 6 neonatal buzağı kullanıldı. Olguların kırık iyileşmesi, postoperatif 10, 20, 40 ve 80. günlerde "yürüme-ağırlık yüklenebilme", "radyografik iyileşme" ve "pin dibi enfeksiyonu" skorlamaları ile değerlendirildi. Postoperatif 1. günden itibaren desteksiz yürüyebilen olguların, 40. günde normal yürüyebildikleri dikkat çekti. Olguların tümünde 40. günde radyolojik olarak kırık iyileşmesi izlendi. Postoperatif 10. gün kontrollerinden itibaren hiçbir olguda pin dibi enfeksiyonu izlenmedi.

Anahtar sözcükler: Buzağı, Metakarpal kırık, APEF, Kırık iyileşmesi

INTRODUCTION

Metacarpal and metatarsal bone fractures are 50% of the bovine fractures ^[1]. Due to excessive fetal limb tractions during dystocia, this ratio is higher among newborn calves ^[2-5]. In treatment of newborn calf fractures, external or internal osteosynthesis techniques can also be utilized beside conservative methods ^[3-9]. For the choice of treatment technique, client's economic status is at least as decisive as the shape and location of the fracture ^[4,5]. Acrylic pin external fixation (APEF) system has significant advantages compared with conventional external skeletal

fixators ^[6,10-12]: no restrictions of transcortical pin diameter, size, type and number; no need for a precise and complex planning for transcortical pin inserting points before operation; transcortical pins do not need to be placed in a specific vertical direction; no need for preassembly complex planning of fixator frames; minor risk of transcortical pin or connecting bar loosening; plastic tubes constructed for acrylic substance filling are flexible and lightweight; cheap and ease of use. In rural practices, APEF seems to be the cheapest external fixator system for the economic requirements of livestock production ^[6], and in this study, it was aimed to present the effectiveness of APEF in healing of newborn calves' metacarpal fractures.



İletişim (Correspondence)



+90 248 2132102



sirriavki@hotmail.com

MATERIAL and METHODS

Six newborn calves brought to MAKU Surgery Clinic and had closed metacarpal fracture were used. Under general anesthesia (5% isoflurane-Aerrane Eczacıbaşı Baxter Istanbul and an O₂ flow of 5L min⁻¹), closed reduction was applied with transcortical pins (Ø2-4 mm, nonthreaded) placed by a low-speed drill in type-II (full-pin) configuration (Fig. 1-A). Two flexible plastic tubes (Ø4 cm) were pushed over the lateral and medial pin ends in columnar form (Fig. 1-B). As the plastic tubes were flexible, any adjustment power was provided to the exit direction of the pins. Before the tubes were filled with acrylic material, to ensure the stability between fracture fragments, fixation pins passing through the proximal and distal of the fracture line were tightened with plastic handcuffs (Fig. 1-B). The lumen of the plastic tubes was filled with cold acryl (Pancryl, Rubydent, Istanbul) after each tip was closed and waited for hardening to take the form of a real column (Fig. 1-B).

While hardening is going on, a pair of glove filled with rendered ice was padded on the transcortical pins in both sides. After hardening, the pin ends protruding from plastic tubes and handcuffs between pins were cut. After surgery, animals were allowed for free movements without an extra bandage (Fig. 1-C), and daily pin tract dressing (%10 polyvidone iode, Polyod, Drogan Istanbul) and IM antibiotherapy (1 mg/kg IM ceftiofur HCL, Excenel, Pfizer, Istanbul) was applied for 10 days.

Fracture healing was monitored by scoring "walking-weight bearing", "radiographic healing" and "pin tract infection" in postoperative days 10, 20, 40 and 80 (Table 1) [13-15].

RESULTS

The main "walking-weightbearing" scores of the cases recorded on postoperative days 10, 20, 40 and 80 were

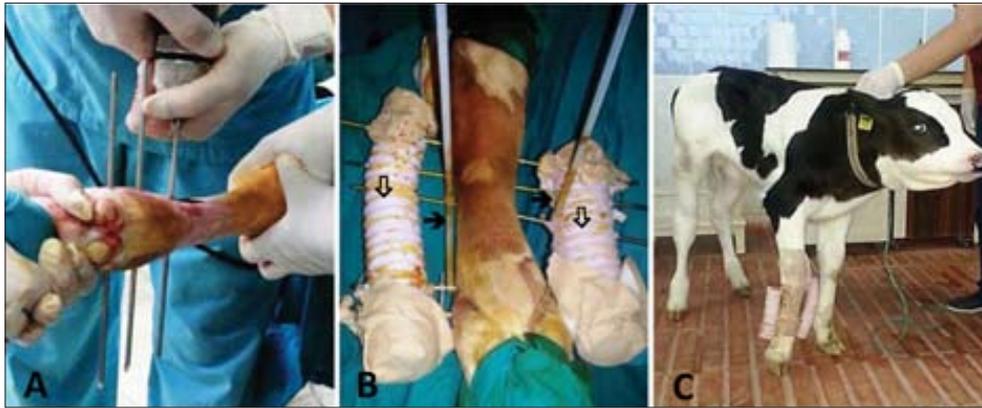


Fig 1. A- Placing nonthreaded transcortical pins by a low-speed drill in type-II configuration, B- Close-up view of a case waited for hardening of the acryl filled into the plastic tubes, ⇒ flexible plastic tubes passed into lateral and medial pin ends, → plastic handcuffs applied between the pins passing through the proximal and distal of the fracture line, C- A case just after APEF application

Şekil 1. A- Vidasız transcortikal çivilerin, düşük devirli matkap yardımıyla II. tip konfigürasyonda yerleştirilmesi, B- Plastik tüplerin içine doldurulan akrilin sertleşmesi için beklenen bir olgunun yakından görünümü, ⇒ transcortikal pinlerin lateral ve medialdeki uçlarından geçirilmiş bükülebilir plastik tüpler, → kırık hattının alt ve üstündeki pinler arasından geçirilerek sıkıştırılan plastik kelepçeler, C- Bir olgunun APEF uygulamasından hemen sonraki görünümü

Table 1. Fracture healing monitoring parameters and scoring critters

Tablo 1. Kırık iyileşmesini değerlendirme parametreleri ve derecelendirme ölçütleri

"Walking-Weightbearing" Scoring	"Radiographic Healing" Scoring	"Pin Tract Infection" Scoring
1: unable to stand and was brought on a stretcher	1: visible fracture line and no peri-/or endosteal callus	1: infection in all pin penetration points
2: can stand by support but keeps the fractured leg hanged	2: partially visible fracture line and a little peri-/or endosteal callus	2: infection in some pin penetration points
3: can stand by support and a little weightbear on the fractured leg	3: partially visible fracture line and peri-/or endosteal callus is present	3: no infection in any pin penetration points
4: can walk but keeps the fractured leg hanged	4: non visible fracture line and completed peri-/or endosteal callus	
5: can walk but weightbearing time of the fractured leg is shortened		
6: can walk normally and weightbear on the fractured leg		

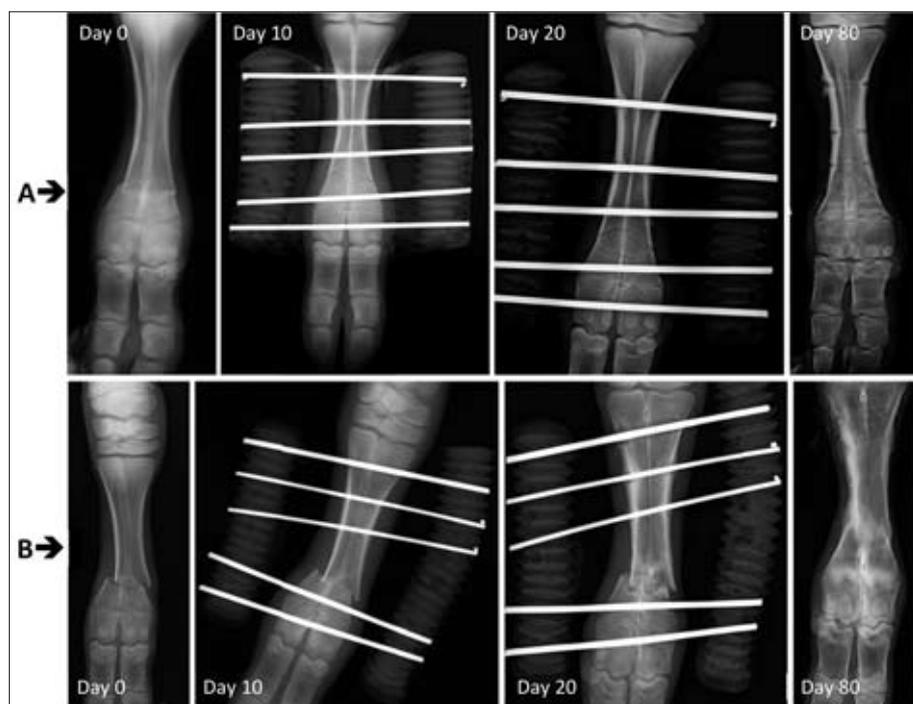


Fig 2. Radiographic appearances of fracture line of case 3 (A) and case 1 (B) on days 0 (preoperative), 10, 20 and 80. Note the fracture lines on day 80 in (A) mimics nearly primer fracture healing and in (B) shows secondary fracture healing

Şekil 2. Üç (A) ve 1 (B) nolu olguların 0 (preoperatif), 10, 20 ve 80. günlerdeki kırık hatlarının radyografik görünüşleri. (A)'da kısmen primer kırık iyileşmesini andıran ve (B)'de sekonder kırık iyileşmesi şeklinde belirginleşen 80. gündeki kırık hatlarına dikkat ediniz

respectively 5, 5.25, 6 and 6. It was noted that calves can walk unassisted from day 1, and can walk normally and weightbear on the involved limb at day 40. The main "radiographic healing" scores for days 10, 20, 40 and 80 were respectively 2.25, 2.75, 3.5 and 4. Except for one case (case no 3), the fracture was healed with secondary bone healing (Fig. 2-A,B). In case 3, the observed healing was near to primary bone healing (Fig. 2-A). On radiographic controls, fracture healing was determined in all cases at day 40 and the APEF system was removed. From the day 10, pin tract infection was not observed in any case. The main pin tract infection scores for days 10, 20, 40 and 80 were respectively 2.75, 3, 3 and 3.

DISCUSSION

The fundamental reason of APEF system comes back on the agenda of bovine practitioners is higher cost of other internal and external fixation devices [6]. Treatment of a calf's metacarpal or metatarsal fracture may have excellent results with circular or linear external fixators but economic considerations of the farmers seem to be an obstacle for veterinary orthopedists. APEF system was really cheap than other external fixators, so the total cost of an APEF system per calf in this study was approximately 38 TL.

Premature pin loosening is an important problem for APEF as in other external fixators systems. One of the main causes for pin loosening in APEF system is heat necrosis of the bone. The source of heat is either polymerization of acryl or high speed drilling of the bone by transcortical pins [10-12]. In this study, transmission of the unavoidable heating during polymerization by transcortical pins into bone was prevented by padding pin-acryl column

connections with gloves filled with rendered ice. On the other hand high speed drilling was avoided during placing the transcortical pins into metacarpus. The second cause for loosening of the transcortical pins in APEF system is pin tract infections [10-12]. Daily pin tract dressing with 10% polyvidone iode and IM antibiotherapy with ceftiofur HCL for 10 days seems to be effective results in our study for preventing these infections.

Fractures that occur shortly after or during birth in calves usually have a favorable prognosis unless the site is open and subsequently becomes infected. This favorable prognosis depends on the calves' great ability to produce periosteal new bone. Healthy and well vascularized bones heal to functional union as early as 3 weeks after treatment [1]. The 6 calves in this study had all closed metacarpal fractures and achieved functional unions recorded at day 40 controls. But more importantly, they could stand up, walk and suck without any support during the first 40 days of life. As a result, the APEF system in neonatal calves was thought to be an alternative technique in the treatment of closed metacarpal fractures.

REFERENCES

- Ferguson JG:** Surgery of the distal limb. In, Greenough PR, Weaver AD (Eds): Lameness in Cattle. 248-261, WB Saunders Co, Philadelphia, 1997.
- Arıcan M:** Sığır Cerrahi Hastalık ve Operasyonları Renkli Atlası. 134-139, Bahçıvanlar Basımevi, Konya - Türkiye, 2006.
- Firet O:** The cases of fractures in calves referred in our clinic and treatment possibilities. *MSc Thesis*, Adnan Menderes Univ, Turkey, 2008.
- Görgül OS, Seyrek-İntaş D, Çelimli N, Çeçen G, Salcı H, Akın İ:** Buzağılarda kırık olgularının değerlendirilmesi: 31 olgu (1996-2003). *Vet Cer Derg*, 10 (3-4): 16-20, 2004.
- Aksoy Ö, Özaydın İ, Kılıç E, Öztürk S, Güngör E, Kurt B, Oral H:**

Evaluation of fractures in calves due to forced extraction during dystocia: 27 cases (2003-2008). *Kafkas Univ Vet Fak Derg*, 15 (3): 339-344, 2009. DOI: 10.9775/kvfd.2008.100-A

6. Chatre JL: L'évolution des traitements des fractures chez les bovins. *Bull Acad Vét France*, 163, 363-368, 2010. DOI : 10.4267/2042/48187

7. Kaya Ü, Şengöz Ö: Treatment of metacarpal bone fracture with application of circular external skeletal fixator constructed with hybrid threaded rods in a calf. *Proceedings of 11th National Veterinary Surgery Congress*, 26-29 June, Kuşadası - Turkey, 180-181, 2008.

8. Sarierler M, Derincegöz OÖ, Gülaydın A, Karahallı A: The treatment of proximal tibial fracture of a calf by using linear external fixator. *Proceedings of 13th National Veterinary Surgery Congress*, 27 June - 1 July, Sarıkamış - Turkey, 155-156, 2012.

9. Sarierler M, Gülaydın A: The treatment of open infected metatarsal fracture in a calf with the Ilizarov external fixator. *Proceedings of 13th National Veterinary Surgery Congress*, 27 June - 1 July, Sarıkamış - Turkey, 147-148, 2012.

10. Kraus KH, Toombs JP, Ness MG: External Fixation in Small Animal

Practice. 60-68, Blackwell Science, UK, 2003.

11. Lewis DD, Cross AR, Carmichael S, Anderson MA: Recent advances in external skeletal fixation. *J Small Anim Pract*, 42, 103-112, 2001. DOI: 10.1111/j.1748-5827.2001.tb02006.x

12. Piermattei D, Flo G, DeCamp C: Handbook of Small Animal Orthopedics and Fracure Repair. 4th ed., 95-99, Saunders Elsevier, USA, 2006.

13. Terosky TL, Wilson LL, Stull CL, Stricklin WR: Effects of individual housing design and size on special-fed Holstein veal calf growth performance, hematology, and carcass characteristics. *J Anim Sci*, 75, 1697-1703, 1997.

14. Blokhuis TJ, de Bruine JHD, Bramer JAM, den Boer FC, Bakker FC, Patka P, Haarman HJTM, Manoliu RA: The reliability of plain radiography in experimental fracture healing. *Skeletal Radiol*, 30, 151-156, 2001. DOI: 10.1007/s002560000317

15. Akman Ş, Göğüş A, Şener N, Bilgiç B, Aksoy B: Sıçan tibia kırıkları sonrası uygulanan diklofenak-sodyum'un kırık kaynaması üzerine etkileri: Deneysel çalışma. *Hacettepe Ortopedi Derg*, 11 (2): 55-60, 2001.