

Comparison between new design interlocking nail with plate fixation and intramedullary pin with external skeletal fixation in long bone fracture in the dogs

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Abstract

New design interlocking nail and plate fixation was used in comminuted femur fracture in an old dog that the results showed primary bone healing and she had been quickly weight bearing in fifteenth day after surgery, and could be walk in twenty day after operation. Another case was a young dog that showed transverse fracture of both humerus and one transverse fracture of femur that were repaired by intramedullary pin and external skeletal fixation. The results showed secondary bone healing of these three bone fractures and she could be walk after 2 months of operation. An old dog did not show any complication but a young dog showed pin migration in femur healing. This study revealed that the superior result in bone healing was found in rigid fixation by new design interlocking nail and plate fixation greater than intramedullary pin with external skeletal fixation.

Key words: dogs, femur fracture, bone, transverse fracture of both humerus.

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1. Introduction

Canine long bone fracture (humerus, femur, radius, and ulna) are the common problems in vehicular accident in street dogs of Thailand. Primary goal of fracture management is to facilitate limb use during fracture healing, a stabilized fracture will be subjected to the same loads as an intact bone: namely axial compression, bending, rotation, and tension³. Internal fixation by intramedullary pin, interlocking nail, wire, plate, and screw device are the suitable methods for long bone fracture repairing unless complicated wound happening. The external skeletal fixation is the suitable method for repairing long bone fracture, especially in cases of complicated wound happening. Combination between internal and external fixation are the most fashion in the current day for ultimate outcome results. Intramedullary pin is used in simple long bone fracture. It has good axial alignment of the fracture and has good resist bending forces

(Ayyappan et al., 2011; Uddin et al., 2017). The commonly problems of intramedullary pin are pin migration and must use ancillary device such as wire and screw in comminuted fracture. Classical interlocking nail is used in a long time in human orthopedic and veterinary orthopedic. This nail consists of transcortical screws and interlocking nail that resist to axial and rotational forces (Igna et al., 2011). This nail must use specific instrument such as drill jig, transcortical screw, interlocking nail that this instrument has so expensive, its limitation uses in low income patient owner. Beside that in the most classical nail, when use normograde fashion that pass nail via inter-trochanteric fossa that can be induce dramatic alterations of the femoral head and neck anatomy including coxa valgus, and femoral subluxation especially in young dog (Dejardin & Cabassu, 2008). Plate fixations and screw are commonly used to stabilize simple and comminuted fracture. The advantage of plate fixation is good rigid fixation, early return to limb function, reduce minimizes

complication such as muscle atrophy, joint stiffness but the disadvantage of plate fixation is wide exposure surgical site that disrupt soft tissue attachments and blood supply in healing process (Scott & McLaughlin, 2007).

Two cases in this report reveals internal fixation by new design interlocking nail that was not use specific instrument when use its combination with wire, and plate fixation in 16-year-old dog with comminuted femur fracture. Another case was 4-month-old dog with both humerus transverse fracture and one femur transverse fracture were repaired by intramedullary pins and external skeletal fixation. Two dogs were different in ages, pattern of long bone fractures, and fixation repairing method.

2. Materials and methods

Cases presentation

A 16-year-old dog (16 kg in body weight) was received vehicular accident. She was sent to Linthong Veterinary Clinic with thermoelastic bandages around left hindlimb. The radiography showed multiple fracture of left femur (Fig. 1). The fracture line was not reduced in the appropriate normal anatomy. The bandage was cut and began surgery for repairing.



Fig. 1. Radiography in old dog showed multiple fracture of femur

Surgical procedures of old dog

A dog was anesthetized with propofol (6 mg/kg) and maintained anesthesia with 2 % isoflurane by anesthesia machine. The femoral diaphysis and metaphysis were approached via a craniolateral skin incision on the femoral shaft to the stifle joint. Superficial fascia and tensor fascia Lata were incised and retracted vastus lateralis and bicep femoris. These muscles were retracted until the distal femur (lateral femoral condyle) was observed (Fig. 2).

New design interlocking nail (BlueSAO^R) fixation (Fig. 3)

At the fracture region, the proximal femur fracture segment was drilled with 2.4 mm drill bit with near (cis) cortex and far(trans) cortex then 4.2 mm drill bit was used for drilled the same hole of cis-cortex. The depth gauge was used for measured the width of the proximal bone segment. The thread was cut by 4.8 mm diameter tap (only cis-cortex). The 4.8 locking screw 22 mm in length was placed in the hole (the thread for trans-cortex was constructed by locking screw because it is self-tapping tip). The second

locking screw was placed to the distal of the fracture segment at the femoral condyle according to above procedure.

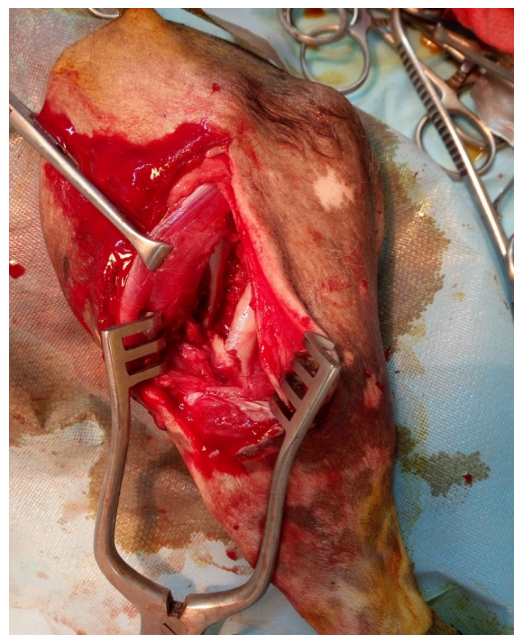


Fig. 2. Multiple fracture with 3 segments of femur bone that were proximal, middle, and distal segments



Fig. 3. New design interlocking nail (BlueSAO^R) instrument, maxillofacial titanium plate, screws, and wire

The 2.5 mm double trocar intramedullary pin was inserted from the fracture line to the proximal segment passed proximal locking screw to trochanteric fossa then retrograde to distal segment passed distal locking screw until the tip of pin engaged distal femur. The fixation screws were placed to the locking screws for locking 2.5 intramedullary pin (Fig. 4).

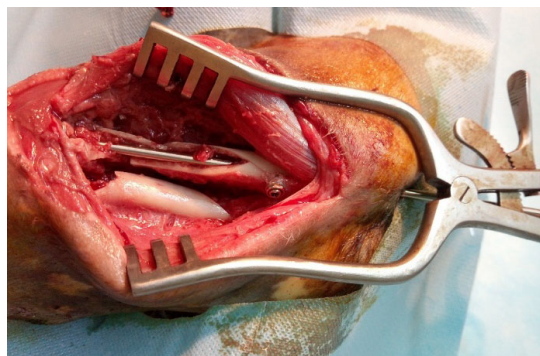


Fig. 4. Interlocking nail repaired proximal and distal fragments that were fixed with interlocking pin and a big third bone fragment

Plate fixation

After completed interlocking nail procedure, 2.5 mm titanium plate was bended then placed on the third bone fragment (the third bone fragment was placed on the fracture site) then 2.0 mm cortical screws were tightened on the plate then cerclage wires were placed for tightening bone fragment with the plate (Fig 5, 6, 7). The muscles were sutured with 2/0 chromic catgut and the skin was closed with 2/0 nylon.

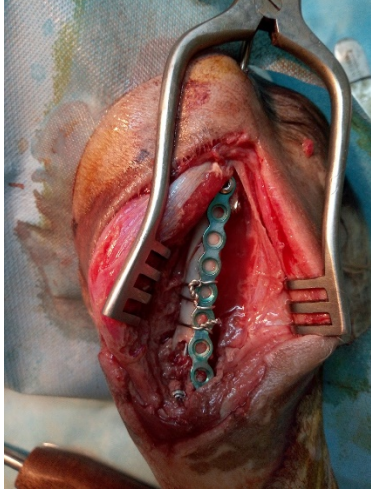


Fig. 5. Finish surgical procedure with interlocking nail, plate, screws, and wire that showed little gap between femur fragment



Fig. 6. Lateral radiography showed finish of operation



Fig. 7. Ventrodorsally radiography showed finish of operation

Surgical procedure of young dog

A 4-month-old-dog (10 kgs in body weights) was received vehicular accident. Radiography showed right transverse fracture of the femur, and both humerus transverse fracture (Fig. 8, 9, 10).



Fig. 8. Radiography in young dog showed transverse fracture of both humerus



Fig. 9. Radiography in young dog showed transverse fracture of femur

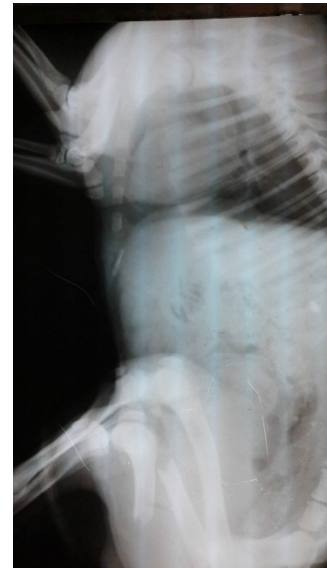


Fig. 10. Radiography in young dog showed 3 long bones fracture

A dog was anesthetized with propofol (6 mg/kg) and maintained anesthesia with 2 % isoflurane. Femur procedure, craniolateral approach was performed by incised superficial fascia and tensor fascia Lata, and retracted vastus lateralis and bicep femoris until saw the femoral shaft. 3.0 mm intramedullary pin was inserted by retrograde fashion to the medullary canal. The muscles and skin were sutured by chromic catgut 2/0 and nylon 2/0, consecutively. The right humerus was repaired by 3.0 intramedullary pin and wire. The skin incision was performed from cranial border of the greater tubercle to lateral epicondyle then incision and retraction of brachial fascia, superficial pectoral, brachiocephalicus, triceps, and brachialis until saw the humeral shaft. The fracture site was repaired by 3.0 mm intramedullary pin by retrograde fashion and full cerclage

wire. The left humerus was repaired by 3.0 intramedullary pin then inserted 2 pieces of pin for external skeletal fixator. The distances between skin and acrylic bar about 1 cm. The muscles and skin were closed by chromic catgut 2/0 and nylon 2/0, consecutively (Fig. 11, 12, 13).



Fig. 11. Radiography in young dog showed both humerus that were fixed with intramedullary pin and external skeletal fixation



Fig. 12. Radiography during intramedullary pin of femur



Fig. 13. Acrylic bar in humeral external skeletal fixation

3. Results and discussion

In old dog, a dog could be stand and walk after 15 days of operation (Fig. 14).



Fig. 14. Old dog could be performed weight bearing after 15 days of operation

The radiography showed primary bone healing with minimal callus formation after 30 days of operation (Fig. 15). The plate, wire, and interlocking nail are in the same appropriate position after surgery. The interlocking nail and plate were selected use because the pattern of fracture were comminuted fracture and a dog had thin cortex bone. The quick return in weight bearing because the property of interlocking nail that good resist in bending force, rotation force, and axial force, including property of plate that excellent resist in rotation force and axial force (Ayyappan et al., 2011; Gemmill, 2016). In 2006, McCartney M et al., revealed 7 of 10 cases with lateral humeral condyle fracture were repaired with plate and screws that did not showed implant failure after 1 year of operation⁵ that good in results similar to the studied by Sarangom S. B. et al. in 2018, that revealed 7 of 8 cases of repairing comminuted femur fracture by locking plate and rod combination no complication or minor complication problem, but 1 case had pin migration problem (Sarangon et al., 2018). Pin migration problem is the major complication that can be excluded by interlocking nail. The interlocking nail provides greater bending stiffness than plates and screws because the nail is placed in the medullary cavity along the neutral axis of the bone (Scott & McLaughlin, 2007). New design interlocking nail (blueSAO^R) in this case can use with single trocar intramedullary pin for normograde fashion or double trocar intramedullary pin for retrograde fashion. I think, it is developed for anti-rotational force in long bone fracture and flexible than classical interlocking nail because it can be inserted pass fracture line by retrograde fashion and can be implanted without additional targeting instrument for example fluoroscopy but it has limitation in diameter of locking screw that it permits intramedullary pin not more than 3.0 mm pass its so that it has limitation use in only cat or small dog. In my experience, the disadvantages of this nail are difficult to insert pin pass two locking screws in one time, and the hole of cis-cortex rupture because the big size of drill bit (4.2 or 5.0 mm) that can induce bone rupture. In 2011, prospective studied by Igna cornel et al., They used classical nail in femoral fracture in 3 dogs and cats that they found excellent clinical outcome (Igna et al., 2011).



Fig. 15. Radiography in old dog showed primary bone healing after 30 days of operation

In young dog, a dog was removed external acrylic bar from left humerus after 1 month of operation and a young dog could be walk and run without stiffness after 2 months of operation. The bone healing was secondary bone healing in all 3 long bones (Fig. 16).



Fig. 16. Radiography in young dog showed secondary bone healing after 60 days of operation

The pin of femur was removed after 3 months of operation because pin migration problems. Intramedullary pin, wire, and external fixator were selected in a young dog because she was a street dog without the owner (intramedullary pin and external fixator are low cost procedure), easy to operation, short procedure times (3 long bones fracture were finish repaired in 2 days), and it was simple fracture.

4. Conclusions

New design interlocking nail and plate are suitable for comminuted long bone fracture in old dog. It provided excellent outcome, excellent rigid fixation, reduced major complication problem for example pin migration, and quickly weight bearing beside that this nail does not use specific orthopedic instrument. Intramedullary pin and external skeletal fixation are good in simple long bone fracture, low cost in surgical instrument, and short time in surgical procedure but may be induce major complication problem.

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