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RESEARCH ARTICLE

Tibial and Fibular Fractures in Dogs and Cats: Retrospective Study

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Abstract

The aim of the present study was to evaluate treatment of 82 dogs and cats with tibial and fibular fractures. Eighty-two (82) cases (47 dogs and 35 cats) with different ages, breeds, and gender admitted to the Clinic of Surgery Department-Faculty of Veterinary Medicine-Zagazig University from March 2017 to March 2021 with a complaint of hind limb lameness and were diagnosed as tibial and fibular fractures through clinical and radiographic examination. Dogs were more susceptible to tibial and fibular fractures than cats with the percentage of 57.32% and 42.68% respectively. Young animals less than one year and male animals were more commonly affected with the percentage of 67.07% (55 case) and 57.32% (47 case), respectively. Diaphyseal fractures were the most commonly reported followed by metaphyseal and physeal with the percentages of 81.71% (67 case), 17.07% (14 case) and 1.22% (1 case), respectively. Closed reduction and external fixation using Robert jones bandage and Gypsona/fiberglass was performed in 52.44% of cases (43 case). Open reduction and internal fixation using bone plate and intramedullary pins with or without cerclage wire was performed in 47.56% of cases (39 case). Regarding to healing of fractured bone successful results were attained in 86.59% of cases (71 case), while the other 13.41% of cases (11 case) had complications of mal-union, implant failure and osteomyelitis. Concerning closed reduction and external fixation, successful healing was reported in 83,72% of cases (36 case), while 16.28% of cases (7 cases) had complications of mal-union (4 cases treated with Robert jones bandage and 3 cases treated with cast/fiberglass). In open reduction and internal fixation, successful healing was reported in 89.74% of cases (35 case), while 10.26% of cases (4 cases) had complications of implant failure in 3 cases treated with intramedullary pins and osteomyelitis in one case treated with bone plate and screws. Open reduction and internal fixation methods are the proper treatment for tibial and fibular fractures if the proper surgical techniques were applied.

Keywords: Tibial fractures, Dogs, IM pins, Bone plate, Gypsona.

Introduction

Bone is a vital system in the body that have numerous important functions and providing a framework for muscular tissue attachment and action. In addition, it surrounds vital organs and protects them. Also, it's essential for the hematopoietic and immune systems that produced from the bone marrow of the bone [1]. Bone fracture is reported as one of the most important clinical problems affecting the bones as it may interfere with the normal biomechanics and structural stability of the bone [1, 2]. Tibial fractures are common in dogs and cats with different types. They represent 21% of long-bone fractures [3] and 11% of the appendicular skeleton fractures [4]. Open fractures are common due to lack of soft tissue at the craniomedial aspect of the tibia. Tibial fractures are the second after those of radius in the rate of non-union ability (25%) and internal fixation is needed [5].

The main goal of fracture treatment is to re-sustain the normal anatomical and

functional structure of the affected site by allowing early use through enhancement of the healing process [6, 7]. As is well-known in medical science, in order to obtain acceptable bone union, it is necessary to preserve the appropriate bone geometry at the fracture site [8]. The rigidity of fixation ultimately depends on the biomechanical characteristics of the fracture, the accuracy of reduction, and the amount of physiologic loading [9].

External fixation of the fractures provides complete weight-bearing with minimal soft tissue trauma at the fracture site and maintaining normal bone length in simple fractures [10- 12] while internal fixation is important in treatment of the most fractures with minimal potential of complications [12, 13]. Choosing the proper fixation method depends on familiarity of the surgeon to fixation technique and equipment, configuration of the fracture, animal size and age and concurrent soft tissue injuries [6]. Therefore, the aim of the present study was to evaluate treatment of 82 dogs and cats with tibial and fibular fractures using different fixation methods including external and internal fixation according to type of the fracture, owner acceptance, facilities, animal size and age.

Material and Methods

Animals

A total of 423 cases of dogs and cats diagnosed with fractures admitted to the Clinic of Faculty of Veterinary Medicine, Zagazig University during the period from March 2017 to March 2021. Eighty-two (82) cases (47 dogs and 35 cats) with a history of hind limb lameness had been diagnosed as tibial and fibular fractures.

Clinical examination

All cases were examined clinically through inspection for assessment of the gait, stand and the cardinal signs of inflammation (swelling and redness), then through local manipulation of the affected part for pain, abnormal movement and crepitus. Data belonging to the history, age, sex, breed and the possible cause were recorded. The general health condition and body parameters including body temperature, pulse rate and respiratory rate were checked for their physiological levels.

Radiographic examination

Before radiography, the animals were sedated using 2% xylazine hydrochloride (Xyla-Ject, ADWIA Co. 10th of Ramadan City, Egypt) at a dose of 1mg/kg body weight intramuscularly (I/M). Anteroposterior (AP) and medio-lateral (ML) radiographs of the affected tibia and fibula were performed for each case using X-ray machine (POX-300 BT, TOSHIBA, ROTANODE^{TM}, Japan) with exposure factors (40-60 KV and 6.3 MAs) according to the size and weight of the affected animal. The radiographs were assessed for the type of the fracture and the method of treatment.

Surgical treatment and postoperative management

All affected cases with tibial and fibular fractures were treated using internal or external fixation devices based on the type and location of the fracture. External fixation with closed reduction was performed using Robert jones bandage or plaster of paris (Gypsona)/ fiberglass. While internal fixation with open reduction was performed using bone plates and screws or intramedullary (IM) pins with or without cerclage wiring. For internal fixation, approach to access the tibia and fibula was performed as previously described by Fossum *et al.* [14] under the effect of general anesthesia using 2.5% thiopental sodium (Thiopental Sodium, E.P.I.C.O. Co. 10th of Ramadan City, Egypt) at a dose of 20 mg/kg body weight intravenously (I/V) for dogs. Cats were generally anesthetized using 5% ketamine hydrochloride (Ketam, E.P.I.C.O. Co. 10th of Ramadan City, Egypt) and 2% xylazine hydrochloride combination at doses of 15mg/kg body weight and 0.5mg/kg body weight I/M, respectively. The surgically treated cases were I/M injected with Cefotaxime (Cefotax, E.P.I.C.O, Egypt) at a dose of 30 mg/kg body weight twice daily for successive five days and Meloxicam (Meloxicam, Amriya for pharmaceutical industries – Alexandria – Egypt) at a dose of 0.2 mg/kg body weight for successive three

days postoperatively. The treated limb was wrapped in supportive bandage for one week postoperatively. Follow up of the treated cases was performed through owner communication for progress of healing or any complications. Additional periodical radiographs were taken, when possible, every two weeks for detection of bone healing.

Results

Clinical examination of the affected dogs and cats revealed non weight bearing lameness due to trauma from one to four days at the affected limb that indicated by dark red skin and swollen area at the site of the fracture. The animals felt severe pain when the affected leg (tibial and fibular area) was palpated. Manipulation of the tibial and fibular area revealed abnormal movement with crepitus. The physiological parameters including temperature, heart rate, and respiratory rate were within the normal limits. The most common cause of tibial and fibular fractures in dogs and cats were differentiated to fall from height in 54.88% of cases (45 case; 25 dogs and 20 cats) and vehicle accident in 45.12% of cases (37 case; 22 dogs and 15 cats).

Incidence of tibial and fibular fractures

Tibial and fibular fractures were reported in 19.38% of cases (82 out of 423) admitted to our clinic over four years. The incidence was high in the left tibia with the percentages of 53.66% (44 case; 26 dogs and 18 cats) than right one with the percentages of 46.34% (38 case; 21 dogs and 17 cats).

Distribution of age, sex and breed

The distribution of age, sex and breed was illustrated in Table (1). The young animals less than one year were the most commonly affected with the percentage of 67.07% (55 case; 30 dogs and 25 cats) than adults with the percentage of 32.93% (27 case; 17 dogs and 10cats). Also, the male dogs and cats were affected more commonly than the females with the percentages of 57.32% (47 case; 25 dogs and 22 cats) and 42.68% (35 case; 22 dogs and 13 cats), respectively. Regarding to breeds, in cats, the fracture was high in Persian cats (80%) than Siamese cats (20%). In dogs, the incidence was high in German shepherd dogs (63.83%) followed by Dobermann pinscher dogs (19.15%), Pitbull dogs (10.64%) and white Griffon (6.38%).

Table 1. Distribution of age, sex and breed of dogs and cats with tibial and fibular fractures.

Items			Number of animals		Percentage		Total number of animals
Age	Immature (below one year)		55 (30 dog and 25 cat)		67.07%		82
	Mature		27 (17 dog and 10 cat)		32.93%		
Sex	Male		47 (25 dog and 22 cat)		57.32%		
	Female		35 (22 dog and 13 cat)		42.68%		
Breed	Cat	Persian	28	35	80%	42.68%	
		Siamese	7		20%		
	Dog	German Shepherd	30	47	63.83%	57.32%	
		Dobermann pinscher	9		19.15%		
		Pitbull	5		10.64%		
		White Griffon	3		6.38%		

Description and location of tibial and fibular fractures:

The tibial and fibular fractures description (either closed or open), location of fracture on the bone and description of the fracture lines were illustrated in Table (2). Most of tibial and fibular fractures were reported with intact skin in 91.46% (75 case; 44 dogs and 31 cats), while 8.54% (7 cases; 3 dogs and 4 cats) of cases were reported with skin injury. The skin injury was appeared as a 1 cm skin wound with protrusion of the tip of the distal bone fragment. Regarding to fracture location, diaphyseal fractures of the tibia were the mostly reported with the percentage of 81.71% (67 case; 41 dogs and 26 cats) followed by metaphyseal fractures with the percentage of 17.07% (14 case; 5 dogs and 9 cats) and Physeal fractures with the percentage of 1.22% (1dog). Transverse fractures were the most commonly reported with the percentage of in 53.66% (44 cases; 27 dogs and 17 cats) followed by oblique fractures with the percentage of in 32.93% (27 case; 12 dogs and 15 cats) and comminuted fractures in 8.54% of cases (7 cases; 4 dogs and 3 cats). Multiple fractures were reported in 4.87% of cases (4 dogs).

Table 2. Description and location of tibial and fibular fractures in dogs and cats.

Items		Number of animals	Percentage	Total number of animals
Description of the fractures	Closed	75 (44 dog and 31 cat)	91.46%	82
	Open	7 (3 dogs and 4 cats)	8.54%	
Location of the fractures	Physeal	1 dog	1.22%	
	Diaphyseal	67 (41 dog and 26 cat)	81.71%	
	Metaphyseal	14 (5 dog and 9 cat)	17.07%	
Description of the fracture line	Transverse	44 (27 dog and 17 cat)	53.66%	
	Oblique	27 (12 dog and 15 cat)	32.93%	
	Multiple	4 dogs	4.87%	
	Comminuted	7 (4 dogs and 3 cats)	8.54%	

Methods of treatment and post-operative complications:

Treatment of tibial and fibular fractures was performed according to the type of the fracture. Closed reduction and external fixation using Robert jones bandage was performed in 15 young cats and Gypsona/fiberglass in 28 case (22 dogs and 6 cat) (Figures1-3). While open reduction and internal fixation was performed in 39 case using bone plate and screws in 15 case with diaphyseal fractures (12 dogs and 3 cats) (Figure 4) and normograde intramedullary pins with or without cerclage wire in 24 case with diaphyseal and metaphyseal fractures (13 dogs and 11 cats) (Figure 5).

Regarding to healing of fractured bone successful results were attained in 86.59% of cases, while the other 13.41% of cases had complications of mal-union, implant failure and osteomyelitis.

Concerning closed reduction and external fixation, successful healing was reported in 83,72% of cases, while 16.28% of cases had complications of mal-union (4 cases treated with Robert jones bandage and 3 cases treated with cast/fiberglass). In open reduction and internal fixation, successful healing was

reported in 89.74% of cases, while 10.26% of cases had complications of implant failure in 3 cases treated with IM pins and osteomyelitis in one case treated with bone plate and screws.

Treated animals with closed reduction and external fixation showed more rapid limb usage than animals treated with open reduction and internal fixation. However, the treated animals with open reduction and internal fixation showed better reduction than those treated with closed reduction and external fixation and the treated animals with bone plates and screws showed progressive healing than those treated with IM pins.

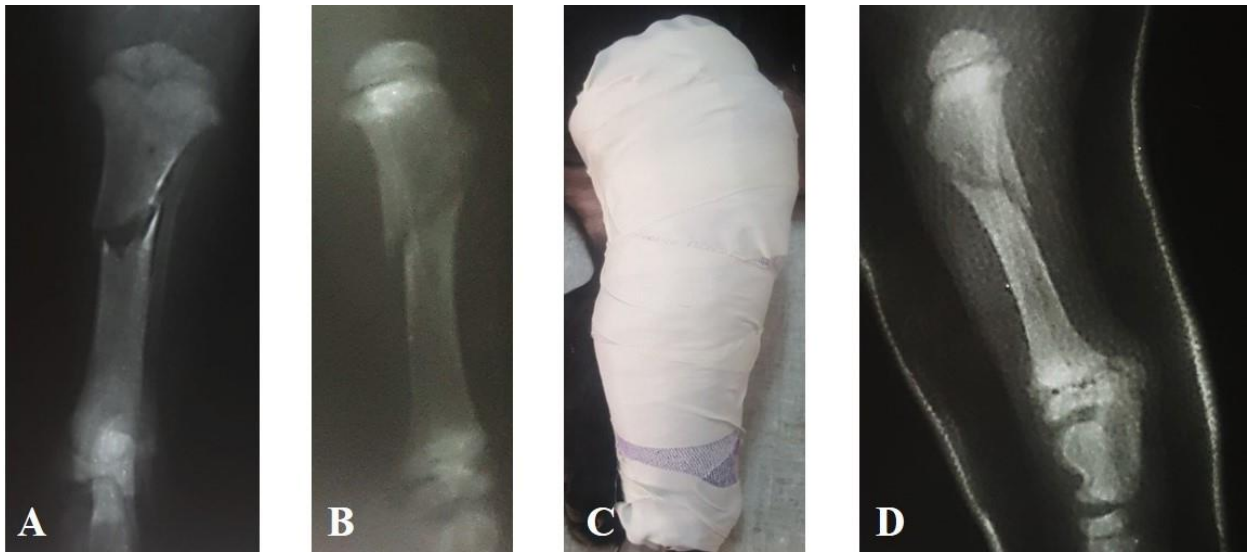

Figure 1. Anteroposterior **(A)** and medio-lateral **(B)** radiographs of a 2months male pit bulldog showing complete, single, oblique, diaphyseal fracture of the right tibia which was treated with external fixation using fiberglass (**C & D)**.

Figure 2. Medio-lateral radiograph **(A)** of a 12months female German Shepherd dog showing complete, single, transverse, diaphyseal fracture of the right tibia and fibula which was treated with external fixation using Gypsona **(B)**.

Figure 3. Medio-lateral radiograph **(A)** of a 6months male Persian cat showing complete, overlapping, transverse, metaphyseal fracture of the right tibia and fibula which was treated with external fixation using full limb bandage with wooden splint **(B).**

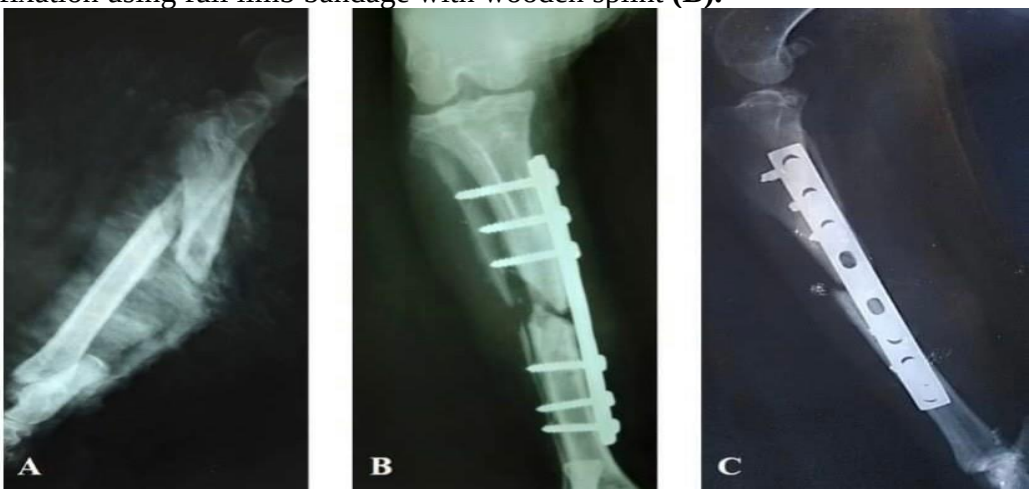

Figure 4. Medio-lateral **(A)** radiograph of a 1.5years male German Shepherd dog showing complete, single, oblique, overlapping, diaphyseal fracture of the left tibia and fibula which was treated with internal fixation using bone plate and screws **(B &C)**.

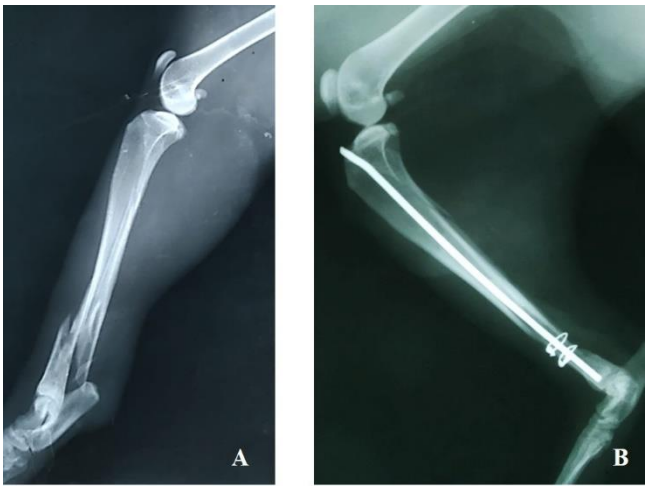

Figure 5. Medio-lateral **(A)** radiograph of a 2years male Siamese cat showing complete, comminuted, oblique, overlapping, diaphyseal fracture of the left tibia and fibula that was treated with internal fixation using normograde IM pin with cerclage wiring **(B)**.

Discussion

Bone fractures constitute a major problem in the practice of dogs and cats [15]. The incidence of fractures in dogs and cats was increased in recent years. This might be due to awareness of owners to the available veterinary services and their interest to rear dogs and cats. Long bone fractures are the most common injuries in dogs and cats [16]. Fractures of the tibia and fibula are the second in their incidence between long-bone fractures and represent 21% of fractures [3] and 11.7% of appendicular skeleton fractures [4]. These results were in agreement with our findings where the incidence of tibial and fibular fractures was 19.38% of all fractures. Young animals are more susceptible to tibial and fibular fractures due to their tendency for vehicular trauma [14] which supports our findings where 67.07% of the tibial and fibular fractures occurred in young dogs and cats below one year of age. This might be attributed to the fact that the bone of younger animals is more fragile than mature ones [17]. German shepherd dogs were the most breed reported with tibial and fibular fractures (63.83%) and this due to increased interest of people in our society to keep this breed of dogs. In the present study, tibial and fibular fractures were more frequent in males than females (57.32% and 42.68% respectively). These findings were in line with that previously reported [18-23] and might be due to males are more active than females and their aggressive nature and wandering habits that make them more susceptible to accident and fractures.

In the present study, the left tibia was reported with higher percentage of fracture than the right one with the percentages of 53.66% and 46.34%, respectively. This result was in line with that previously reported [24]. The results of our study were in agreement with those previously reported [18, 19] where the main causes of tibial and fibular fractures were the road traffic accident or falling from height. Tibial and fibular fractures were observed mostly as closed fractures with the percentage of (91.46%). This result was in agreement with that previously described [25]. Only 7 cases were reported with open fracture this result was in contrast with those previously reported where they reported that the percentage of open fracture of tibia and fibula is more common than other long bone fracture due to low muscle coverage in the medial part of tibia [5]. This might be attributed to rapid administration of cases to the clinic by their owners. Diaphyseal fractures of the tibia and fibula occurred more commonly than the metaphyseal and physeal fractures with the percentage of 81.71%, 17.07% and 1.22% respectively. These results were in accordance with the previously reported [19, 21].

In the present study, closed reduction and external fixation using Robert jones bandage (15 case) and Gypsona / fiberglass (28 case) was performed in 52,43% of cases (43 case) with intact skin. It was reported previously that closed reduction and external fixation was used commonly in simple uncomplicated fractures [18].

Open reduction and internal fixation were performed in 47,56% of cases (39 case) using bone plate and screws (15 case) and intramedullary pins with or without cerclage wire (24 case). It was reported previously that open reduction and internal fixation was used for proper repair of the tibial and fibular fractures [18, 23] using different internal fixation techniques including intramedullary pins with or without cerclage wiring and bone plate and screws [19, 21, 26].

Intramedullary pins are the most common method of stabilization of the tibial and fibular fractures [27] as they provide an axial alignment and resist bending forces occurred over the bone during weight bearing on the other hand intramedullary pins has no effect on the rotational forces at the site of fracture [28]. Bone plating resists the rotational, tension and compression forces in addition to resistance of bending forces [29]. In addition, internal fixation of the tibial and fibular fractures using pins and wires were used more frequently in growing animals, while plate and screws, were used more frequently in adults [25].

In the present study the treated animals with closed reduction and external fixation showed more rapid limb usage than animals treated with open reduction and internal fixation. However, the treated animals with open reduction and internal fixation showed better reduction than those treated with closed reduction and external fixation and the treated animals with bone plates and screws showed progressive healing than those treated with IM pins.

These results were lined with Harasen [21] and Minar *et al*. [23] who reported that the plate fixation has the best prognosis and early limb function followed by Intramedullary pins.

Glyde and Arnett [5] revealed that bone plates and screws are very useful for the tibial fractures repair, while intramedullary pins and external coaptations are suitable for relatively simple tibial fractures, also external coaptations have the ability to prevent bending and rotational forces but they cannot overcome collapse and overriding of the fractured fragments in comminuted fractures or in long oblique fractures.

The most reported complications after fracture treatment were delayed union, malunion, nonunion, pin migration, osteomyelitis and damaged soft tissues [30]. In the present study, successful results were attained in 86.59% of cases, while the other 13.41% of cases had complications of mal-union, implant failure and osteomyelitis.

Concerning closed reduction and external fixation, successful healing was reported in 83,72% of cases, while 16.28% of cases had complications of mal-union (4 cases treated with Robert jones bandage and 3 cases treated with cast/fiberglass). In open reduction and internal fixation, successful healing was reported in 89.74% of cases, while 10.26% of cases had complications of implant failure in 3 cases treated with IM pins and osteomyelitis in one case treated with bone plate and screws.

Conclusion

From the results of this study, it was concluded that the juvenile animals less than 1 year of age were more susceptible to tibial and fibular fractures than the adult one. Open reduction and fixation with IM pins fixation with or without cerclage wires were the most common method of fracture fixation as it is inexpensive, safe and successful if the basic principles of fracture repair are used.

Conflict of Interest

The authors declare no conflict.

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الملخص العربي

كسور عظمتي القصبة والشظية في الكلاب والقطط: دراسة مرجعية

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هدفت هذه الدراسة لتقييم علاج عدد (82) كلباً و قطة يعانون من كسور عظمتي القصبة والشظية .عدد (82) اثنان وثمانون كلباً و قطة (47 كلب و 35 قطة) من مختلف الأعمار، السلالات، والجنس وردت لعيادة قسم الجراحة والتخدير والأشعة - كلية الطب البيطري- جامعة الزقازيق في الفترة من مارس 2017 الي مارس 2021 مصحوبة بشكوي عرج في الأطراف الخلفية وتم تشخيصها علي أنها كسور عظمتي القصبة و الشظية وذلك من خلال الفحص الاكلينيكي واستخدام الأشعة السينية. الكلاب كانت اكثر عرضة لكسر عظمتي القصبة والشظية من القطط بنسبة 57.32% و 42.68 على التوالي. الحيوانات الصغيرة اقل من عام والذكور كانو اكثر عرضة للاصابة بنسبة 67.07% و 57.32%% على التوالي. ويعتبر الجزء جسم عظمة القصبة أكثر الأماكن عرضة للكسر ويليه الجزء الكردوسي للعظمة و اخيرا جزء صفائح النمو بنسبة (81.71%) (67 حالة), (17.07%) (14 حالة) و(1.22%) (حالة واحدة) على التوالي. قد تم اعادة العظمة بدون فتح جراحي مع التثبيت الخارجي باستخدام رباط لكامل الطرف والجبس فى 52.44% من الحالات (43 حالة). تم تثبيت العظمة داخليا مع الفتح الجراحي في (47.56%) من الحالات (39 حالة) بأستخدام الشرائح العظمية في كسور جسم العظمة ل 38.46% من الحالات (15 حالة) و استخدام المسمار النخاعي مع او بدون استخدام سلك من الاستانلس ستيل حول العظمة في كسور المنطقة الجسم والكردوس من العظمة في 61.53% من الحالات (24 حالة). بخصوص التئام العظام، 86.59% من الحالات التي تم علاجها التئمت بدون مضاعفات, في حين ان 13.41% من الحالات عانت من مضاعفات عدم الالتئام, فشل زرع المسمار النخاعي و التهاب العظام. بخصوص التثبيت الخارجي بدون فتح جراحي, 83.72% من الحالات كانت ناجحة, في حين ان 16.28% من الحالات عانت من مضاعفات عدم الالتئام (4 حالات عولجت بعمل رباط للرجل و 3 حالات عولجت بالجبس). وبالنسبة للفتح الجراحي و التثبيت الداخلي, 89.74% من الحالات كانت ناجحة, في حين أن 10.26% من الحالات عانت من مضاعفات مثل فشل زرع المسمار النخاعي في 3 حالات عولجت بالمسمار النخاعي و التهاب العظام في حالة واحدة عولجت بالشرائح العظمية والمسامير. الفتح الجراحي واعادة العظمة وتثبيتها داخليا هو العلاج الأمثل لكسور عظمتي القصبة و الشظية في حالة تطبيق طرق العلاج الجراحية الصحيحة.