Incidence of Non-Union in Long Bone Fractures in 233 Cats

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ABSTRACT

The analysis of the radiographic and clinical records of 233 cats revealed that the incidence of non-union of long bone fractures in cats was 0.85%, with only 2 out of 233 fractures ending in non-union. Data from cats treated prior to referral by a first opinion surgeon and following treatment by a second opinion surgeon were included in this study, where 91% were operated on by the latter only. Previous reports have put the incidence of non-union in cats at 5.2%. In both cases, the cause of non-union was inadequate fixation of distal tibia fractures using an intramedullary pin. Eighty-five percent of cats were treated by external skeletal fixation and a non-union did not occur in this treatment group.

INTRODUCTION

Once the healing process has ended, and the bone fragments will not unite without surgical intervention, then a non-union is present.[1] There are many reports in the literature about non-union in dogs.[2-4] The incidence of non-union in cats has been reported rarely[5-7] whilst a feline experimental tibial non-union model has been developed.[8] Inadequate fixation, severe soft tissue injury, comminution, open wounds, and multiple injuries predispose to the formation of a non-union.[9,10] Additionally, non-union will occur if there is excessive fracture gap motion, large fracture gaps, and if there is a poor local blood supply.[11]

METHODS

A retrospective analysis of clinical and radiographic records of cats treated for long bone fractures from 1990 to 2005 was carried out to ascertain the incidence of non-union. All cats presented during this period were included in the survey, as long as sufficient radiographic data existed to confirm that healing had taken place. Healing was judged to have occurred in accordance with clinical and critically radiographic data. Clinical evidence of bone healing was based on stability, soundness, and lack of pain. For the purposes of this study, any long bone that was not healed on radiographs by 9 months after the original fracture was deemed to be a non-union. Cats operated by first opinion surgeons and second opinion surgeons were included in the analysis.

In an effort to provide some enlightenment as to the highest associations with non-union, the data for injury complexity, multiple injuries, and treatment method were concentrated on specifically. Injury complexity specifically referred to open, comminuted, or infected fractures. If there was a significant other injury, in particular another bone fracture, it was also recorded. Treatment method was categorized to highlight management issues and their relation to non-union. Both cases of distal tibia non-union were managed successfully by providing simple anti-rotational external skeletal fixation without bone grafting (Figures 1-3).

Figure 1. Dorsoventral view of the 12-month postoperative repair performed by first opinion clinic.

RESULTS

Bone fractures occurred predominantly in the hind legs with 38% femurs and 41% tibias (Table 1). Complex injuries as defined in this study as any degree of comminution infection or open fracture were extremely common with only 12% classified as simple. Having more than 1 bone fractured did not predispose to a non-union, as none of the 12 cats in this study with multiple bone fractures developed non-unions. The predominant method of fixation was external skeletal fixation, with 85% of all cats treated by this method. The 2 cats that had non-unions had identical histories, with both cats sustaining mildly comminuted distal tibias fractures that were treated by intramedullary pinning. Only 20 cats treated by first opinion surgeons were included and all of these were subsequently operated on by second opinion surgeons. The 2 non-union cases occurred in this group of 20 cats treated by first opinion surgeons.

Figure 2. Lateral view of the 12-month postoperative repair performed by first opinion clinic.

Figure 3. Dorsoventral view of the 12-week postoperative repair performed by the second opinion clinic, using antirotational external skeletal fixation.

DISCUSSION

This study gives a very low incidence for non-union in cats, being only 0.85%, which is very different to the 5.2% (18 of 344 cats) reported previously.[5] Furthermore, the latter report[5] included all fractures, and not exclusively long bone fractures as in this study, and this would raise their incidence of non-union even higher. If all the non-unions in that study[5] that occurred in long bones only were analyzed, then the incidence of non-union in long bones would then be 8.4%. Given that the number of long bone fractures in cats is similar between this study and the one main paper on feline non-union,[5] the difference in non-union rates highlights the issue of non-union in cats and indicates a need for further studies. In other fracture survey publications, the incidence of feline non-union were reported as 2.1%[6] and 2.5%.[7]

The predisposing factors for non-union are, apart form general health and metabolic issues, local issues to do with bone and soft tissue vascularity and viability complete with level of fixation. In this study, severity of the injuries to bone and soft tissues ranging from grossly infected to severely comminuted was not commonly associated with the occurrence of a non-union. The authors are of the opinion that this reflects the treatment plan rather than disputes the contribution of these factors to the formation of a non-union. However, it can be said from this study that severe tissue damage can be dealt with more effectively in a cat than a dog, and is less likely to lead to non-union.

The causes of non-union in cats in this study are site and treatment choice. The distal tibia can be a difficult area to achieve adequate fixation due to the sparseness of bone, and there is less soft tissue coverage which in itself means less available vascularity to assist repair. Intramedullary pinning is a common method of fracture repair in cats, especially at first opinion clinics. It is well known that its inherent weakness is the inability to resist rotational forces. This weakness would be evident by expressing itself in a critical fashion when used to treat distal tibia fractures, which by their proximity to the foot makes them more prone to rotation in the first place. The rotational forces would lead to shear stress of granulation tissue, which would completely disrupt any opportunity to build a scaffold for resisting motion. In both cases of non-union, the failure to unite was solely due to excessive rotation with associated fracture gap, and elimination of this failing of the initial fixation was the treatment choice without bone grafting. However, bone grafting was kept as an option if after providing anti-rotational stability there was still no healing present, it could be used as an additional procedure later. As both cases went on to heal with the extra stability provided, bone grafting was not required.

Table 1. Fracture Classification.

Bone	No.	+ Complex Injuries	More Than 1 Bone	Treatment Method				
				Pin	ESF	Plate	Cast	Non-Union
Humerus	33	25	2	10	23	0	0	0
Radius/ulna	15	4	0	0	8	5	2	0
Femur	89	81	5	18	71	0	0	0
Tibia	96	96	5	0	96	0	0	2

+ Complex Injuries = any fracture that is open or comminuted to any degree; ESF = external skeletal fixation.

In humans, the most common site for non-union is the distal tibia,[9] whereas in dogs the distal radius is the most common site . The sites of the highest incidences of non-union in the 3 species (human, dog, cat) are in the areas of low soft tissue coverage. Furthermore, when one considers that if distal radius/ulna (toy breeds) fractures were excluded from data, quite possibly the tibia may also be the most common site in dogs, too. In one previous survey by Richardson and Thacher,[7] there were 2 cases of non-union out of 100 feline tibia fractures. Treatment of distal tibia fractures in cats should not be achieved using intramedullary pins on their own.

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