The Management of an Injured Roe Deer (*Capreolus capreolus*) with a Metacarpal Fracture and Cortical Blindness Resulting from a Vehicle Collision

Livia Benato and Steve Bexton

Introduction

Deer–vehicle collisions (DVCs) are widespread across Europe and North America and are increasingly common as traffic volume and vehicle speeds increase (Danielson and Hubbard 1998). Several studies have investigated the types and numbers of incidents, predisposing factors, and the efficacy of preventative measures (Groot Bruinderink and Hazebroek 1996; Langbein and Putman 2006; Langbein 2007; Mastro *et al.* 2008). Many DVC recording schemes exist, but many incidents are unreported and accurate records are often lacking (Groot Bruinderink and Hazebroek 1996; Langbein and Putman 2005). There are 31,000 to 45,000 annual DVCs in England and Wales (Langbein 2007), with around 60,000 in Sweden (Seiler 2004) and over 225,000 in Germany (Kerzel 2005). In the United States, there are approximately 1.5 million DVCs per year (Conover 2001), causing around 1.3 million deer fatalities (Conover 1997).

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Adult roe deer *(Capreolus capreolus).*

Comprehensive records of DVCs involving fallow deer (*Dama dama*) in Ashdown Forest, England showed that over half were killed outright, and over a third survived the impact but sustained severe injuries necessitating dispatch at the roadside (Langbein 2007). DVCs therefore constitute a major animal welfare issue and are a significant cause of mortality in wild deer (Langbein 2007).

Following a vehicle collision, injured deer often remain at the roadside, temporarily unaware of their surroundings due to reduced consciousness, concussion, blindness,

ABSTRACT: Wild deer are frequently involved in collisions with motor vehicles. This paper describes the veterinary care and captive husbandry of a juvenile roe deer *(Capreolus capreolus)* which had been injured in a vehicle collision and also serves to highlight some of the general principles of deer rehabilitation. Cervids require specialized facilities, if they are to be rehabilitated, as they are easily stressed and risk further injury to themselves and to human handlers. This deer suffered a metacarpal fracture that was stabilized by external casting, as well as traumatic cortical blindness which resolved spontaneously with time. It made a full recovery and was subsequently released.

KEY WORDS: *Capreolus capreolus*, cortical blindness, deer-vehicle collision, DVC, metacarpal fracture, rehabilitation, roe deer.

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or shock. If one can safely do so, these deer should be assessed where found to avoid the additional stress and discomfort caused by movement. Statistically, the majority will be seriously injured and require immediate euthanasia, by firearm or lethal injection, to prevent further suffering (Langbein and Putman 2005). Common traumatic injuries that carry a grave prognosis include spinal fractures and dislocations, pelvic fractures (especially in females due to the risk of dystocia), and long bone fractures which are compound, contaminated, or both (Green 2003).

Justifications for moving the casualty include a dangerous location, examination difficulty, minor injuries, and when further investigation is needed such as radiography. A suitable facility must be available locally and, ideally, analgesia or tranquillization should be given beforehand. It is inadvisable to transport an injured deer without suitable restraint, both because of the risk of exacerbating its injuries and the danger of it becoming mobile in a moving vehicle.

Cervids are highly nervous and difficult to manage in captivity, resulting in a risk of injury to animal and handler (Porter 1990). Even small deer have powerful muscles and can kick and jump with great speed and surprising force. Hooves and antlers (if present) are sharp and capable of inflicting severe injury (Green 2003). Major surgery and prolonged convalescence are contraindicated in adult deer due to the negative welfare effects on such fractious animals (Green 2003). However, injured deer can recover with the proper care and suitable facilities. In the authors' experience, juveniles tend to do better than adults because they are relatively calmer and, thus, are less likely to injure themselves and will heal quicker.

Disabled deer are occasionally retained in permanent captivity, but this should only be done after serious consideration of their environmental requirements and subsequent quality of life. There are also reports of three-legged deer able to cope, survive, and breed successfully in the wild (Green 2003).

Case Report

A juvenile female roe deer (*Capreolus capreolus)*, aged approximately 8–10 wk old and weighing 7.8 kg, was presented after being hit by a road vehicle. She was in shock and had a closed fracture of the left metacarpal bone, with swelling of the distal limb, and numerous superficial grazes.

Methods

Intravenous Hartmann's solution was given at a rate of 10 ml/kg/hr to combat hypovolemia. Initial therapy consisted of a one-off, long-acting antibiotic injection (amoxicillin) and vitamin E–selenium toward reducing the risk of post-capture myopathy (Williams and Thorne 1996). Pain was alleviated by restricting the deer's movement, splinting the fracture site to reduce bone movement, and injections of carprofen (Rimadyl Large Animal Solution, Pfizer Ltd., Sandwich, Kent, U.K.) at a dose of 1 mg/kg on alternate days for the first week (Green 2003).

Preliminary radiographic assessment was possible without sedation by temporarily covering the head and eyes with a cloth hood–blindfold to reduce anxiety. X-rays showed a simple mid-shaft fracture of the metacarpus with favorable healing potential (Fig. 1) and a temporary splint dressing was used for support.

Initially, the deer was kept confined in a small plastic shipping crate (1.2 m × 1.0 m × 0.8 m) to restrict movement. Deep hay bedding was used for grip, comfort, and warmth, and disturbance


FIGURE 1. Initial radiograph; fracture of left metatarsus.


FIGURE 2. Fracture repair after 1 wk.


FIGURE 3. Fracture repair after 2 wk.


FIGURE 4. Fracture repair after 3 wk.

was kept to a minimum.

After 24 hours, the deer was bright and alert but was unresponsive to visual stimuli. Examination revealed absence of the menace response (reflex blinking in response to a visual threat). The pupils were equal and of normal size for the light conditions and responded normally to bright light by constriction. The palpebral (blink) reflex was present when the eyelids were touched, and funduscopic examination revealed no obvious abnormalities such as papilloedema or hemorrhage. These findings were suggestive of cortical blindness, which was probably a result of head trauma.

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FIGURE 7. Roe deer being released after a total of 10 wk in captivity.

General anesthesia was induced using the triple combination of medetomidine at a dose of 60 μg/kg (Domitor solution, Pfizer Ltd.), ketamine at a dose of 1.5 mg/kg (Ketaset solution, Fort Dodge Animal Health, Southampton, Hampshire, U.K.), and butorphanol at a dose of 0.1 mg/kg (Torbugesic 1% injection, Fort Dodge Animal Health), all combined in a single intramuscular injection (Fletcher 1995). The deer was kept in sternal recumbency to prevent ruminal tympany, with the head supported upright to prevent gastric reflux. Attempts were made to align the fracture by traction and manipulation, and a lightweight thermoplastic casting material (Vet-lite,® Runlite S.A., Micheroux, Belgium) was used for support. Atipamezole injection (Antisedan,® Pfizer Ltd.) was used at a dose of 300 μg/kg to reverse the anesthetic and, after recovery, the deer was immediately able to bear weight on the affected limb.

FIGURE 5. Fracture repair after 4 wk.

FIGURE 6. Fracture repair after 10 wk.

Food was provided *ad libitum*. Natural browse was collected daily from hedgerows; mostly bramble (*Rubus fruticosus*) and hawthorn (*Crataegus monogyna*), which roe deer prefer (Green 2003). Alfalfa and a proprietary goat mix were also offered, but consumed less. Disturbance was kept to a minimum to reduce stress and the risk of further trauma, as well as the possibility of habituation to humans. It is also important that deer are housed well away from the sights, sounds, and smells of dogs.

Results

After 7 days, the deer was alert and reacted normally to noise and touch by stopping eating and becoming distressed. However, there was still no reaction to visual stimuli, including the menace response. Further radiographs, taken under anesthesia as before, showed early fibrocallous formation and adequate fracture alignment (Fig. 2). The cast was replaced and the deer was moved to a larger enclosure that was far remote from human activity, where it had only minimal disturbance during replenishment of food and water. The new enclosure measured 3 m × 2 m and had deep straw bedding and internal walls lined with thick (55 mm) styrofoampadded stock boarding to cushion against injury. Further remote monitoring was possible via closed-circuit television cameras and showed increasing activity levels over the following days.

The deer's eyesight seemed to return in stages; initially, it reacted to light, then it would watch silent movements, until eventually it started to react normally with fear and panic to human presence. The return of full visual acuity took 20–25 days. Weekly cast changes were necessary because dressings became wet with urine (Porter 1990). Brief anesthesia allowed inspection, radiography (Figs. 3–4), and cast replacement.

After a total of 30 days in captivity, examination under anesthesia revealed the deer had a stable callous, which was confirmed radiographically (Fig. 5). She was moved to a large outdoor enclosure measuring 35 m × 35 m with 2.5-m high solid stockade fencing to prevent escape; two similar-aged roe deer were also provided for company. The enclosure's natural vegetation afforded plenty of cover, and the deer was observed to avoid obstacles in its new, unfamiliar environment, confirming that she could see. The larger area also allowed more exercise to regain muscle strength. After a total of 10 wk in captivity, the deer was darted to allow a final, pre-release assessment that included radiography (Fig. 6). She was also ear-tagged for future identification and released with a similar-aged male roe deer into mixed deciduous woodland close to where she had been originally found (Fig. 7).

Management Implications

Injuries from vehicle collisions are a common cause of roe deer presentations for veterinary examination. Wild deer are fractious and prone to stress and, therefore, difficult to manage in captivity. The prognosis for a full recovery and the time taken to achieve this are the prime considerations when dealing with deer casualties. Prolonged periods in captivity are contraindicated due to the stress involved and the possibility of further self-injury. A balanced compromise is needed between the animal welfare costs of releasing an injured deer (pain, dysfunction, impaired mobility, and increased predation risk) and the stress of keeping it in captivity until recovered.

Temporary cortical blindness following head trauma is not uncommon in roe deer and, in the authors' experience, vision usually returns over 2–3 weeks (unpubl. observations in 28 deer). Blindness immediately following a DVC should, therefore, not be considered an automatic indicator for euthanasia if other injuries are minor. The eyesight seems to return gradually and in stages, with apparent reaction to light, followed by movement detection before full vision returns. An assessment of vision should form an essential part of the examination of deer casualties and is an important pre-release consideration. Such temporary blindness can often have positive animal welfare benefits by reducing awareness and stress, and may even be a survival mechanism in nervous species such as roe deer.

Traumatic bone fractures are a common injury in DVCs (Nisbet *et al.* 2010). Generally, compound fractures, especially if already contaminated, carry a guarded prognosis for healing. Deer with multiple fractures, especially if associated with prolonged recumbency in order to heal, are poor candidates for recovery. Radiography may be necessary to assess the severity and potential for healing (Lewis 1994). Some researchers advise against fracture fixation in deer, due to their ability to heal spontaneously and because of the need for a rapid return to the wild (Fletcher 1987; Green 2003). Conservative management consisting of rest and minimum disturbance is sufficient for many fractures to heal (Fletcher 1987), although, in the authors' experience, injured deer remain active and thus impair fracture repair. Alternatively, deer with a single fracture above the tarsus–carpus can be immediately returned to the wild to allow natural repair (Green 2003). However, the authors are uneasy with this approach because, although some probably do recover, the incidence of nonunion, malunion, and other problems is unknown. Deer with distal limb fractures may require a limb amputation and release as soon as possible afterwards (Green 2003). Fixation methods involving prolonged aftercare and lengthy captivity are not recommended (Green 2003). If fracture stabilization is necessary, it should allow weight bearing as soon as possible (Jones 1994; Toews *et al.* 1998). The priority is a rapid return to the wild, but surgical implants need subsequent removal, which prolongs the time spent in captivity. Additionally, rigid fixation can lead to disturbed limb growth in the young animal (Jones 1994).

Studies have described the successful management of metacarpal fractures in cattle and horses by using external casting (Tulleners 1986, 1996; Nemeth and Back 1991). A thermoplastic casting material was used in this case to provide the necessary support (Claeys *et al.* 2007) that would also facilitate rapid healing and minimize the time spent in captivity. The fracture healed well, with good alignment and no limb shortening (Fig. 5).

The young age of the deer was a major consideration in the choice of method of fracture stabilization, and also in the decision to treat at all, as young deer heal rapidly and are also more tolerant of captivity and less likely to further injure themselves. Care is needed, however, to avoid inducing tolerance of humans; this could compromise post-release survival. A balance is needed between intervention to monitor healing and progress and minimization of human contact and disturbance.

The weaning age of roe deer in captivity is variable, with foraging starting at 2 wk (Wallach *et al.* 2007) and some hand-reared fawns weaning as early as 2 mo old (Bradley 1971). Observations of the food consumption in this case suggested milk was no longer required and the additional handling to administer it was counter-productive.

Post-capture myopathy (PCM) is a well-documented metabolic condition which can affect many species, including wild ungulates, following stress and exertion, e.g., capture, restraint, and transportation (Williams and Thorne 1996; Montané *et al.* 2002). Tranquilizers can be used to reduce stress, improve welfare, and decrease the risk of developing PCM (Mentaberre *et al.* 2010; Nisbet *et al.* 2010). In particular, long-acting neuroleptics can be useful to reduce anxiety (Ebedes and Raath 1999), but can also make assessments of neurological function and behaviour difficult due to their effects on the central nervous system. However, their use is contra-indicated in the very young, the very old, and animals with head trauma or hypovolemic shock (Kaandorp 2005). In the authors' experience of hospitalized wild deer, the benefits of these drugs has been difficult to assess, and they are no substitute for monitoring for signs of anxiety and disturbed behaviour, with modification of management practices in response.

Conclusions

We offer the following criteria for making a decision to rehabilitate wild deer: 1) Suitable facility available, 2) a good chance of making a full recovery in a relatively short time, 3) injuries such that regular interventions are not necessary, and 4) the age of animal (juveniles cope better in captivity and also heal rapidly).

Ideally, there should be systems in place so that live deer casualties can be attended promptly, by a suitably experienced person, for assessment and decision on the best course of action that will avoid unnecessary suffering.

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Literature Cited

Bradley, R. H. 1971. Some observations made during the hand rearing of a roe deer fawn (*Capreolus capreolus*). *Deer* 2(4): 621–629.

Claeys, S., M. Meuron, P. Boeraeve, and M. Balligand. 2007. Mechanical evaluation of a thermoplastic casting material. *Veterinary Record* 161(7): 238–240.

Conover, M. R. 1997. Monetary and intangible valuation of deer in the United States. *Wildlife Society Bulletin* 25(2): 298–305.

Conover, M. R. 2001. Resolving human–wildlife conflicts. Lewis, Boca Raton, Florida, USA.

Danielson, B. J., and M. W. Hubbard. 1998. A literature review for assessing the status of current methods of reducing deer–vehicle collisions. The Task Force on Animal Vehicle Collisions, Iowa Department of Transportation and Iowa Department of Natural Resources. pp. 1–25.

Ebedes, H., and J. P. Raath. 1999. Use of tranquilizers in wild herbivores. *In:* Zoo and wildlife medicine, current therapy, Volume 4, M. E. Fowler and R. E. Miller, (eds.). W.B. Saunders Company, Philadelphia, Pennsylvania USA. pp. 575–585.

Fletcher, J. 1987. Veterinary aspects of deer management 2: Disease. *In Practice* 9(3): 94–97.

Fletcher, J. 1995. Handling farmed deer. *In Practice* 17(1): 30–37.

Green, P. 2003. Deer. *In:* BSAVA Manual of wildlife casualties., E. Mullineaux, D. Best, and J. E. Cooper (eds.). British Small Animal Veterinary Association, Gloucester, UK. pp. 166–181.

Groot Bruinderink, G. W. T. A., and E. Hazebroek. 1996. Ungulate traffic collisions in Europe. *Conservation Biology* 10(4): 1059–1067.

Jones, G. C. 1994. Failures of fracture repair. *In Practice* 16(5): 256–260.

Kaandorp, J. 2005. Use of tranquilizers in zoological medicine. *Verhandlung ber erkrankungen zootiere* 42(1): 16–26.

Kerzel, H. 2005. Wildunfälle: Zur notwendigkeit von verkehrsschutzzäunen und grünbrücken. Grünbrücken für den biotopverbund. Schriftenreihe des landesjagdverbandes Bayern e. V., Band 14 (In German).

Langbein, J. 2007. National deer–vehicle collisions project—England (2003–2005). The Deer Initiative Ltd., P.O. Box 2196, Wrexham, UK. pp. 1–96.

Langbein, J., and R. Putman. 2005. Deer vehicle collisions in Britain—A nationwide issue. *Ecology and Environmental Management – In Practice* 47(1): 1–7.

Langbein, J., and R. J. Putman. 2006. National deer–vehicle collisions project; Scotland 2003–2005. Press Release by Deer Commission for Scotland, *The Scottish Executive*, June 2006.

Lewis, J. 1994. Spinal fractures in deer. *Veterinary Record* 135(17): 415.

Mastro, L. L., M. R. Conover, and S. N. Frey. 2008. Deer–vehicle collision prevention techniques. *Human–Wildlife Conflicts* 2(1): 80–92.

Mentaberre, G., J. R. López-Olvera, E. Casas-Diaz, E. Bach-Raich, I. Marco, and S. Lavin. 2010. Use of haloperidol and azaperone for stress control in roe deer (*Capreolus capreolus)* captured by means of drive-nets. *Research in Veterinary Science* 88(3): 531–535.

Montané, J., I. Marco, J. López-Olvera, X. Manteca, and S. Lavin. 2002. Transport stress in roe deer (*Capreolus capreolus*): Effect of a short-acting antipsychotic. *Animal Welfare* 11(4): 405–417.

Nemeth, F., and W. Back 1991. The use of the walking cast to repair fractures in horses and ponies. *Equine Veterinary Journal* 23(1): 32–36.

Nisbet, H. O., A. Özak, C. Yardimci, and Y. S. Sirin. 2010. Treatment results of traumatic injuries in 20 roe deer (*Capreolus capreolus*): A retrospective study. University of Kafkas *Journal of the Faculty of Veterinary Medicine* 16(4): 617–622.

Porter, S. L. 1990. The medical management of white-tailed deer fawns (*Odocoileus virginianus*). *In:* Wildlife Rehabilitation 8 (selected papers presented at the eighth annual symposium of the National Wildlife Rehabilitators Association, Ithaca, New York USA). pp. 45–57.

Seiler, A. 2004. Trends and spatial patterns in ungulate–vehicle collisions in Sweden. *Wildlife Biology* 10(4): 301–313.

Toews, A. R., J. V. Bailey, and C. Theoret. 1998. External skeletal fixation for the treatment of comminuted fractures in wapiti: 5 cases. *Canadian Veterinary Journal* 39(6): 370–372.

Tulleners, E. P. 1986. Metacarpal and metatarsal fractures in dairy cattle: 33 cases. *Journal of the American Veterinary Medical Association* 189(4): 463–468.

Tulleners, E. P. 1996. Metacarpal and metatarsal fractures in cattle. *Veterinary Clinics of North America Food Animal Practice* 12(1): 199–209.

Wallach, A., M. Inbar, R. Lambert, S. Cohen, and U. Shanas. 2007. Hand-rearing roe deer *Capreolus capreolus*: Practice and research potential. *International Zoo Yearbook* 41(1): 183–193.

Williams, E. S., and E. T. Thorne. 1996. Exertional myopathy (capture myopathy). *In:* Noninfectious diseases of wildlife, 2nd Edition, A. Fairbrother, L. N. Locke, and G. L. Hoff (eds.). Manson Publishing Ltd, London, UK. pp. 181–193.

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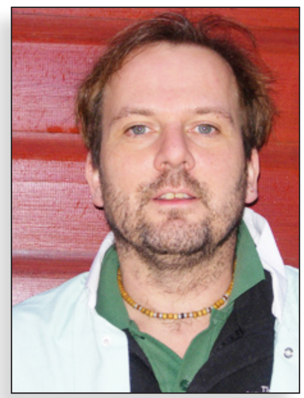
Livia Benato worked with rabbits and exotic animals in a referral clinic in Italy for two years before moving to the U. K., where she gained her General Practitioners Certificate in Exotic Animal Practice while working in wildlife hospitals and exotic animal practices. She started her residency in Rabbit and Exotic Animal Medicine at the University of Edinburgh Hospital for Small Animals in September 2008 and is currently working in their Rabbit Clinic within the Royal (Dick) School of Veterinary Studies Easter Bush Veterinary Centre, Roslin, Midlothian, Scotland. Livia obtained her RCVS Certificate in Zoological Medicine in 2010. She is currently doing research toward gaining her Master of Science degree.



Steve Bexton

Steve Bexton qualified from Glasgow veterinary school in 1991 and spent 5 years in mixed practice before concentrating on wildlife. In 1998, he was appointed as clinical director of Sinai Wildlife Projects in Egypt, a non-governmental organization specializing in the rehabilitation of sick and injured wildlife, especially migratory birds. In 2000, he returned to the U.K. to work at the RSPCA wildlife hospital in Norfolk where he is currently the senior clinician. Steve gained the RCVS Certificate in Zoological Medicine in 2008.

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