

## Partially Forelimb Amputation and Application of An Artificial Limb (Prosthetics) in A Free-Ranging Red Deer (*Cervus elaphus*)

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### Summary

A male red deer (*Cervus elaphus*) of unknown age was admitted to Istanbul University, Faculty of Veterinary Medicine, Department of Surgery with an open fracture at the level of the right proximal third metacarpal bone. The leg was amputated and two months later he received an prosthetic leg and the clinical outcome was discussed.

**Keywords:** Red deer, *Cervus elaphus*, Amputation, Prosthetic limb

## Yabani Bir Kızıl Geyikte (*Cervus elaphus*) Parsiyel Ön Bacak Amputasyonu ve Protez Bacak Uygulaması

### Özet

Istanbul Üniversitesi Veteriner Fakültesi Cerrahi Anabilim Dalı'na sağ metakarpus III'ün proksimalinde açık kırık şikayetiyle getirilen, yaşı bilinmeyen erkek bir kızıl geyiğin (*Cervus elaphus*) sağaltımında bacağın amputasyonunu takiben 2 ay sonra protez bacak uygulanması ve klinik sonuçları değerlendirilmiştir.

**Anahtar sözcükler:** Kızıl geyik, *Cervus elaphus*, Amputasyon, Protez bacak

### INTRODUCTION

Farming of wapiti is becoming increasingly popular in North America and also in western Canada <sup>1</sup>. In many parts of the world the meat (venison) from Red Deer is widely used as a food source <sup>2</sup>.

In the literature, various disorders which has been seen in elks has been reported. These include ocular, pulmonary, musculoskeletal, digestive, central nervous system disorders and neoplasms <sup>1-8</sup>.

Capture myopathy is a life-threatening syndrome due to stress of capture, restraint and transportation in wild mammals and birds. In mammals the syndrome is characterized clinically by muscular stiffness, incoordination, depression, paralysis, metabolic acidosis and death <sup>9</sup>.

Musculoskeletal pathology, including long bone fracture and joint sepsis, have been the most documented

disorders in wapiti <sup>1</sup>. Keppie and Naylor <sup>1</sup> reported that the common diagnosis was fractures, which were seen mostly traumatic long bone fractures among the other lesion or disorders. Several factors should be considered when choosing a treatment option for wildlife with fractured limbs. It has been reported that comminuted fractures of the metacarpus and radius in young and adult wapiti may be managed successfully by use of external skeletal fixation <sup>3</sup>. Financial constraints and temperament of the animal may limit the number of options. Amputation of a limb with prosthesis application is principally a method of saving valuable animals for breeding purposes or animals of sentimental value. Therefore amputation can be a option in catastrophically injured animals especially with open fractures with no financial support by an owner or corporation <sup>2</sup>.

A prosthesis is an artificial device that replaces a missing



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part of the body. There is evidence of the use of prosthesis from the times of the ancient Egyptians. Prostheses were developed for cosmetic, function and sense of wholeness in human. Limb amputation and the fitting of a prosthesis is a well-established procedure in human. There are two basic structural types of the prosthesis: endoskeletal and exoskeletal. The exoskeletal prosthesis are broadly called the socket-type devices. An exoskeletal limb prosthesis has three main parts: the interface, the components, and the cover. The prosthesis attaches to the body at the interface. The interface consists of a socket and a rigid frame. Components are the working parts of the prosthesis. They include terminal devices (artificial fingers, hands, feet, and toes) and joints (wrists, elbows, hips, and knees), as well as metal shafts, which act as bones. Prosthetic covers consist of foam shaped by the prosthetist to look like the missing limb. Attachable prosthetic devices have been used in different animal species including horse, cattle, dog with variable success<sup>10-13</sup>.

Endoskeletal prosthesis are also called permanently attached artificial limb or osseointegrated limb. Osseointegration is a new method of attaching the artificial limb through the dermis into the bone<sup>11,14</sup>.

## CASE HISTORY

A male red deer (*Cervus elaphus*) of unknown age (estimated to 4-5 year-old) was found alive in a forest close to Tekirdağ, Turkey and admitted to the Istanbul University, Faculty of Veterinary Medicine Department of Surgery with an open fracture at the level of the right third metacarpal bone. The animal was in good condition on clinical examination but nervous about the capture. To avoid the capture myopathy the deer kept in a silence stall for a couple of hour for relaxing. It was decided to amputate the forelimb because of the severe soft tissue injuries, and the fracture was irreducible. To sum up the leg was attached only with a small part of skin to the body. But other than the injured leg, the deer was in good health, therefore, amputation was suggested as an alternative to euthanasia. After being fasted for 12 h the animal was sedated with xylazine HCl (Rompun®, Bayer, Germany) at 1.1 mg/kg BW, IM dosage and anesthesia was induced with isofluran first inhalation through a mask at an initial concentration of 5% together with 100% O<sub>2</sub> then followed by intubation and maintained at a concentration of 2.5%. The limb was amputated proximal to the pathologic lesion. The incision location was at the level of the right antebrachio-carpal joint (desarticulation) with the surgeons' personal preference and the amputation was done. The surrounding tissue were sutured with vicryl using mattress suture to cover the bony stump. The skin was closed using prolene with interrupted sutures. Following surgery, the animal was given cefazolin sodium (Iespor, İ.E Ulagay, Turkey) at a dose of 11 mg/kg BW by

intravenous administration. The wound was cleaned daily and ten days after the surgery the sutures were removed. During this recovery period the animal showed difficulty on standing (Fig. 1). Therefore the deer was mostly lying down. In the light of this situation it was decided to apply a prosthetic limb to make the deer more comfortable. The prosthesis has been constructed by the Prostheses Foundation for free of charge, which is a company that usually makes artificial limbs for human amputees. The socket type prosthesis used in this case consisted of a padded sleeve, a stump cover and the prosthetic device that was made of carbon fibre and it was enclosed by a lifelike (hair) protective covering. The padded sleeve was placed on the residual limb and the stump cover placed over it and attached to the prosthetic device. After the artificial limb was being used, the deer became more comfortable. The balance of the body was very good (Fig. 2). Six months later the deer was discharged to a restricted national park. The deer had a good quality of life, a regular appetite and was in good body condition.

The result and the clinical outcome in this case indicate that a prosthetic limb may be used successfully even for the free-ranging animals to make their quality of life higher after limb amputation.



Fig 1. After the amputation of the leg

Şekil 1. Bacağın amputasyonundan sonraki görünüm

## DISCUSSION

Farming of elks is becoming more popular in some countries<sup>1</sup>. However in our country elk (*Cervus elaphus*) is not farmed for the industrial products or as a food source. In the last decade some negative environmental impacts



**Fig 2.** The appearance after the prosthesis application  
**Şekil 2.** Protez bacak takıldıktan sonraki görünüm

and as a result of poaching there is a rapid decrease in the number of red deer thus they are accepted to be endangered animals in Turkey. Thus, in our country it is really important to save a single deer's life in the interest of preserving the species.

In the literature, various disorders which has been seen in elks has been reported. These include ocular, pulmonary, musculoskeletal, digestive, central nervous system disorders and neoplasms<sup>1-8</sup>. As mentioned before farming wapiti is not common in Turkey therefore the certain prevalence of the disorders is not clear.

Capture myopathy is a life-threatening syndrome in wild mammals and birds<sup>9</sup>. In the present case, the animal seemed depressed about the transportation that lasted about 2 and half hour. To avoid capture myopathy the animal kept in a silence and dim stall for a couple of hours for relaxing before the examination. After the rest the deer seemed more stilly. Therefore it can be advised not to manipulate the deer immediately for clinical examination to avoid capture myopathy.

Musculoskeletal pathology, including long bone fracture and joint sepsis, have been the most documented disorders in wapiti and was reported that the common diagnosis was fractures, which were seen mostly traumatic long bone fractures among the other lesion or disorders<sup>1</sup>. Several factors should be considered when choosing a treatment option for wildlife with fractured limbs. Financial constraints and temperament of the animal may limit the number of options. Amputation of a limb with prosthesis

application is principally a method of saving valuable animals for breeding purposes or animals of sentimental value. Therefore amputation can be a option in catastrophically injured animals especially with open fractures with no financial support by an owner or corporation. In this case the leg was terribly injured and because the lack of an owner to pay for the treatment costs amputation was done.

Deer breeding season usually occurs in mid-September through October and in this period battles among competing males are common. Keppie et al.<sup>1</sup> reported that forty-five percent of elk with fractures were admitted during August and September. In this case elk was admitted to our clinic at end of the September and probably was because of fighting associated with rutting season.

It has been reported that most fractures (81%) were seen in elk  $\geq 2$  months, no elk  $> 5$  years was admitted for a fracture<sup>1</sup>. It has been thought that bone strength in young animals is lesser than olders to be unable to withstand high forces generated during trauma. In contrast, in this case the age was unknown but estimated to 4-5 year-old.

There is evidence of the use of prosthesis from the times of the ancient Egyptians. Prostheses were developed for cosmetic, function and sense of wholeness in human<sup>10</sup>. Butt et al. reported about complications including problems in standing and breakdown of the contralateral supporting limb after the amputation. According to the previous paper<sup>2</sup> the breakdown of the contralateral limb was seen mostly in the front limb possibly due to the increased proportion of weight on the front limbs. In this case, the affected limb was the front one and it was obviously clear that the deer was unable to stand without help. Therefore an artificial limb (prosthesis) usage was mandatory in this case.

There are two basic structural types of the prosthesis: endoskeletal and exoskeletal. The exoskeletal prosthesis are broadly called the socket-type devices. Prosthetic covers consist of foam shaped by the prosthetist to look like the missing limb<sup>11</sup>. Our prosthesis was an exoskeletal type (socket-type) and enclosed by a lifelike (hair) protective covering and the deer seemed to be well tolerated.

Attachable prosthetic devices have been used in different animal species including horse, cattle, dog with variable success<sup>11-13</sup>. But to the authors' knowledge this is the first report of prosthesis fitting in a deer in Turkey.

Complications associated with prosthetics are similar to those in human medicine. The microbial environment in the stump-socket is unnatural and can be detrimental to healthy tissues. Common stump prostheses problems include poor fit, pressure necrosis, pain, ulceration<sup>11,12,14</sup>. The complications reported by Kelmer<sup>12</sup> were not seen in

this case. This was probably due to fact that the prosthesis was applied two months after the amputation after complete healing of the wound.

The result and the clinical outcome in this case indicate that a prosthetic limb may be used successfully even for the free-ranging animals to make their quality of life higher after limb amputation. To the authors' knowledge this is the first report of partial limb amputation and prosthesis fitting in a deer in Turkey. The deer had a good quality of life, a regular appetite and was in good body condition for six months during the hospitalization. Documenting more cases is essential in order to try to talk about the prognosis and the patient's quality of life and to provide experience for veterinary surgeons.

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