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# Lumbar Discectomy In A Human-Habituated Western Lowland Gorilla

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## Citation

R Jandial, M Greenberg, H Aryan, W Taylor, M Sutherland-Smith, K Kearns, P Morris. *Lumbar Discectomy In A Human-Habituated Western Lowland Gorilla*. The Internet Journal of Neurosurgery. 2004 Volume 2 Number 1.

## Abstract

The case of lumbar laminectomy in an adult female western lowland gorilla with herniated lumbar disk is presented. The gorilla had developed progressive lower extremity weakness, which progressed to the inability to walk. MRI showed a herniated disk at the L1-L2 level. Surgical laminectomy resulted in complete resolution of symptoms. Prompt diagnosis and treatment, with cooperation between veterinarians, neurosurgeons and anesthesiologists was required in this case to result in a favourable outcome. The differences in the human and gorilla spine are presented

## INTRODUCTION

The gorilla is the largest of the extant primates, a group that includes monkeys, lemurs, orangutans, chimpanzees, bonobos and humans. An adult male gorilla can grow to approximately 170 cm in body length and females can grow to approximately 150 cm in body length. The male gorilla weighs 300 to 500 pounds (136 to 227 kilograms) while the female weighs 150 to 200 pounds (68 to 91 kilograms). Life expectancy is about 35 years in the wild and up to 50 years among human-habituated animals (1). Gorillas are peaceful, family-oriented, plant-eating animals.

Gorillas are quadrupedal and ambulate most of the time in a stooped position using their knuckles to support part of their weight. Along with chimpanzees, they are the only animals able to "knuckle walk." In this posture, the gorilla's back and spine is in an almost horizontal plane parallel to the ground. As such, it is very unusual for a gorilla to develop degenerative disc disease since their intervertebral discs are not subjected to as much downward force as the bipedal human vertebral spine. In addition, the gorilla's spinal musculature is substantial compared to humans, further reducing the force sustained by the vertebrae and intervertebral discs (4).

We report a case of a human-habituated lowland gorilla, Alvila, resident at the San Diego Zoo, who was found to have a herniated intervertebral lumbar disc after being attacked by the gorilla troop's silverback male gorilla. Alvila

was the first gorilla born at the San Diego Zoo. Four generations of her family still reside at the San Diego Zoo and the San Diego Wild Animal Park. Ultimately, Alvila required surgical intervention for her disease.

## CASE REPORT

A 36-year-old female human-habituated western lowland gorilla (*Gorilla gorilla gorilla*), resident at the San Diego Zoo, was noticed by caregivers to walk with a substantial limp after being attacked by the gorilla troop's silverback male gorilla. Upon further examination, it appeared that the animal suffered from right proximal lower extremity weakness. The caregivers noted the limp and, as a result, the overall decreased physical activity of the gorilla. Symptoms progressed over the next several weeks with the animal eventually leading to the inability to ambulate. This prompted the need for physical examination and radiographic testing under general anesthesia. In addition to routine serum analysis and dental examination, the gorilla underwent plain radiograph imaging of her spine (Figure 1.).

**Figure 1**

Figure 1: Anterior-posterior (AP) plain radiograph of the lumbar spine in the gorilla. Note there are only 4 lumbar vertebrae. At this level the size of the vertebrae are very similar to human vertebrae.



When plain radiographs did not lead to a final diagnosis, and because of continued signs of paralysis, magnetic resonance (MR) imaging of her cervical, thoracic and lumbar spine was performed, during a separate anesthetic. The gorilla was found to have a large herniated disk at the L1-2 level on the right (Figures 2,3).

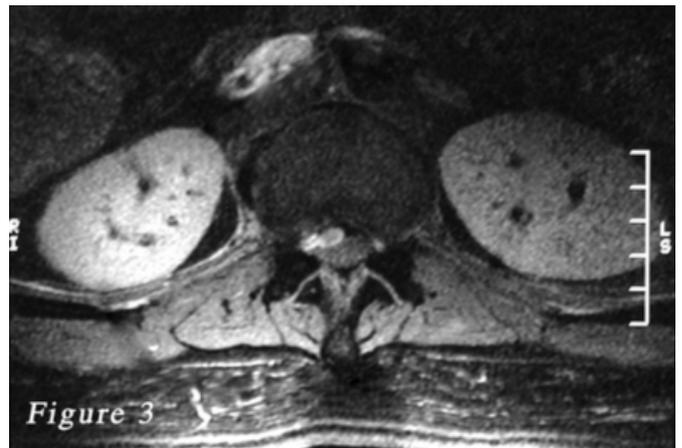
**Figure 2**

Figure 2: T1-weighted sagittal MR imaging of the lumbar spine in the gorilla. Note the loss of lordosis typical of the human lumbar spine. A large herniated disk is identified at the L1-L2 level.



**Figure 3**

Figure 3: T1-weighted axial MR imaging of the lumbar spine showing a right-sided large herniated disk.



This finding appeared to correlate well with the gorilla's symptoms and, as such, the decision was made to perform surgical laminectomy surgery.

After an overnight fast, anesthesia was induced with 10 mg/kg of intramuscular ketamine. Anesthesia was deepened with isoflurane and the animal trachea was intubated with a 13.0 endotracheal tube. For secure intravenous access, a left femoral central venous line was placed. The gorilla was positioned prone on an adjustable radiolucent Kambin frame, which placed the spine into relative kyphosis (Figure 4).

### Figure 4

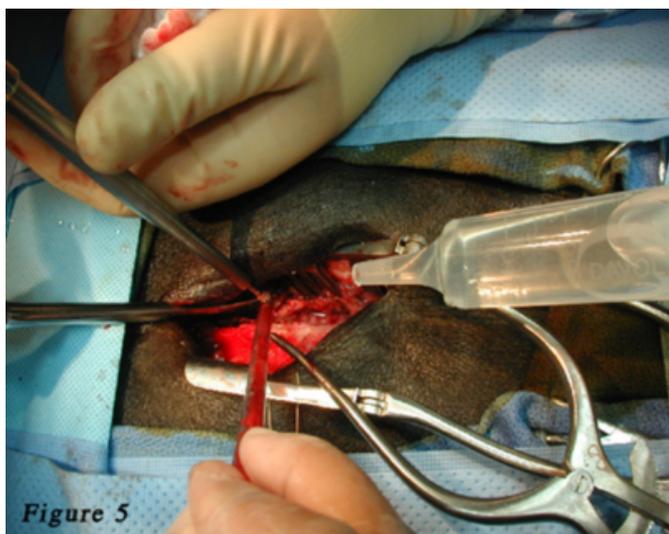
Figure 4: Pre-operative photo of gorilla after positioning for surgery.



The hip portion of the frame was narrowed and the chest portion widened to accommodate the gorilla's frame. Care was taken to protect the chin and eyes using a foam pad. A localizing plain lateral radiograph was obtained with a spinal needle in place in order to identify the operative level. The skin of the dorsal thoracolumbar area was shaved, prepped with Betadine. A linear incision was made with a 10-blade scalpel through the skin. The subcutaneous layers were divided with electrocautery (Figure 5).

### Figure 5

Figure 5: Intra-operative photo of gorilla lumbar spine showing paraspinal musculature.



Dissection was carried out through the subcutaneous fat down to the thoracolumbar dorsal fascia. The spinous processes were palpated. A subperiosteal dissection of the paraspinal musculature was carried out along the L1 and L2 spinous processes on the right, exposing the right facet joint.

The spinal canal was narrow at this level. In order to access the disk space, a high-speed pneumatic drill was used to remove the inferior portion of the L1 lamina, the facet, and the superior portion of L2. This dissection spared the spinous process, the interspinous ligaments, and the entire facet complex on the left. The L2 pedicle was identified. The thecal sac was minimally retracted towards the midline. The L1 and L2 nerve roots were identified. Under loupe magnification, the disk space was incised and a large herniated disk fragment was removed with pituitary rongeurs. A curette was used to free-up loose disk in the disk space and to sweep the epidural space clear. When the disk was incised some clear fluid was noted in the operative field consistent with cerebrospinal fluid. A search did not reveal a laceration in the dura. Nonetheless, a collagen sponge was laid over the dura. During this portion of the procedure an epidural vein was accidentally punctured leading to rapid blood loss, which was stopped using pressure and gelfoam®. The wound was copiously irrigated and the lumbodorsal fascia was closed tightly with 0 Dexon® suture. The subcutaneous tissue deep dermis was closed with 2-0 Dexon® suture. The skin was closed with a running 4-0 Monocryl®. A liquid plastic dressing (Dermabond®) was applied to the wound. The gorilla was transferred to a holding cage and was extubated without difficulty.

Post-operatively the gorilla had no complications related to the surgical procedure. The right leg weakness was immediately improved post-operatively. The gorilla continued to "crutch walk" initially, swinging on the upper extremities and not bearing weight on the lowers. However, by two weeks the limp was no longer noticeable to the zoo caregivers. The wound healed well and there was no evidence of wound infection or CSF leak. The gorilla was reunited with her troop and has reintegrated well socially. With ten months of follow-up, the gorilla continues to do well.

## DISCUSSION

The incidence and prevalence of disk disease in gorillas is unknown, although it is suspected to be quite low (4). The appropriate management for such a rare condition in gorillas is also unknown. There are many considerations when seeking medical intervention in the management of animals. For gorillas, it is accepted that intervention should occur if the condition is due to human activity, e.g. snare entrapment, or is life threatening (5,2,3). While disk disease in gorillas may not be life threatening, it affects the quality of life of the gorilla, and intervention should be considered if there is no

resolution with conservative therapy.

Although clinical signs and symptoms are often suggestive of underlying disease, diagnostic imaging is usually required to confirm the diagnosis and to rule out other disease processes. In humans, magnetic resonance (MR) imaging and, to a lesser extent, computerized tomography (CT) are important in the diagnosis of intervertebral disk disease. The benefits of these imaging studies have also been shown in animals (8). In this instance, a standard human enclosed MR scanner was used. In the largest members of the gorilla species, an open MR scanner would be needed due to the large size and weight of the animal. As in any procedure using MR scanning one must use strict precautions not to introduce any ferromagnetic objects into the field of the scanner to prevent accidental injury to the caretakers, animal or the scanner itself.

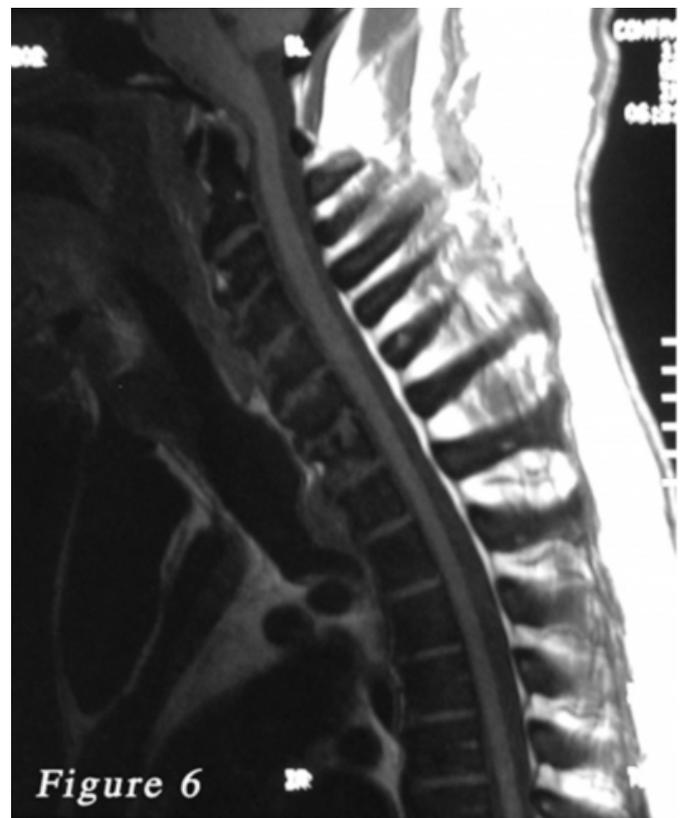
Discectomy and its effect on vertebral stability have not been investigated in gorillas. Conceptually, the stability of the vertebral column is made up of three systems: 1) a passive system consisting of ligaments connecting the vertebrae; 2) an active system composed of the muscles and tendons surrounding the vertebral column; and 3) neural control system that receives and processes information from receptors to control the active system (3). The passive system is divided into dorsal and ventral compartments. The ventral compartment is made up of the vertebral body, the intervertebral disk, and the ventral and dorsal longitudinal ligaments. The dorsal system consists of the vertebral lamina, pedicles, articular facets, joint capsules, ligamentum flavum, the spinous process and their associated ligaments. Alteration and/or dysfunction of any of these systems that is not compensated by the other two systems may lead to spinal injury (7). Because of the high level of this herniation, we chose to remove the facet complex rather than risk retracting on the conus medullaris. Based on the relatively low amount of weight bearing at this level, we felt that the risk of post-operative instability was low. Although we have no evidence of progression of the gorilla's spine disease at this time, this hypothesis will clearly be hard to assess in any scientific fashion under the circumstances.

While the authors are experienced with microdiscectomy in the human spine, there are some differences with respect to the gorilla spine that bears consideration when undertaking an operation such as this. In general, gorilla bones are thicker and the lumbar spine less lordotic compared to humans. While there is the same number of cervical

vertebrae (seven in total), gorillas have one more thoracic vertebra and rib (thirteen), one less lumbar vertebra (four), and one more sacral vertebra than do humans (1). Fortunately for us, the gorilla spine near the thoracolumbar junction is similar to the human thoracolumbar junction in size and configuration. The paraspinal musculature is similar to the human at this level also, while in contrast it is very thick in the cervical region relative to humans, reflecting the disproportionate upper body size in gorillas (Figure 6). In general, in the lower lumbar vertebrae and spine, human vertebral bodies are larger compared to those of the gorillas of the same approximate body weight. This enlargement may be the result of upright posture and locomotion in humans (6).

### Figure 6

Figure 6: MRI scan of gorilla's cervical spine



The skin closure we chose was intended to minimize the profile of the wound and avoid an external dressing, as non human primates have a tendency to pick at wounds. For this reason, our patient was also separated from other animals, to prevent them from grooming the wound.

For best surgical results, one needs to consider the similarities and differences between the gorilla and human vertebral anatomy. We believe that careful pre-operative

planning contributed to the good early post-operative result. Ultimate assessment of the long-term outcome will require additional follow-up.

Note: The San Diego Zoo is operated by the not-for-profit Zoological Society of San Diego. The Zoological Society of San Diego also manages the 2,200-acre San Diego Wild Animal Park and the Center for Reproduction of Endangered Species (CRES).

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