Segmental spinal fixation of a thoracic vertebral fracture in an adult chimpanzee

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A 10-year-old 50-kg male chimpanzee (Pan troglodytes) was referred to the Mississippi State University Animal Health Center for neurologic evaluation after a seizure earlier the same day. The chimpanzee was born in captivity at the Jackson Zoological Park and was determined to have epilepsy when he was 2 years old. Although the chimpanzee was given anticonvulsant medication regularly, his epilepsy was not completely controlled. The chimpanzee had been otherwise healthy, enjoyed frequent outside activity on a non-fenced island enclosure, and had had negative results on all biannual tuberculosis tests.

A complete neurologic examination was not possible because this chimpanzee could be aggressive when handled; however, several neurologic tests could be evaluated. The chimpanzee was in a prone position, its pelvic limbs were flaccid, and there was no overt evidence motor function of the torso or pelvic limbs. It was alert and pulled himself around the cage with its thoracic limbs. Cranial nerves were determined to be normal via evaluation of the menace response, pupillary light reflexes, muscles of facial expression, eye positioning and movement, lip and chin cutaneous sensation, palpebral reflex, physiologic nystagmus, mastication, swallowing, and tongue movement. Motor control of the hands and thoracic limbs were normal, as determined by the chimpanzee’s ability to grasp bars in the transport cage, scratching and grooming movements, flexor reflexes, and coordination. The patellar and pelvic limb flexor reflexes were not detectable. The chimpanzee perceived a hypodermic needle stimulus to the feet and perineal region. After the stimulus, he would look at and feel the area stimulated as if to determine the source of the stimulus, indicating intact sensory function. A panniculus response could not be elicited, but the chimpanzee seemed aware of the stimulus in the manner previously described. Several toes on both feet were abraded, and the chimpanzee would bite and lick his toes frequently. The chimpanzee’s neurologic status was assessed as paraplegia and spinal shock. A cranial thoracic spinal lesion and incomplete paraplegia were suspected on the basis of inability to initiate movements involving the torso, but with preservation of sensation distal to the level of the lesion. A peripheral neuropathy was considered unlikely because the onset was acute.

Anesthesia was induced with a combination of diazepam (10 mg, IM), ketamine (200 mg, IM), and oxymorphone (3 mg, IM). After tracheal intubation, anesthesia was maintained with isoflurane at 1 to 1.5% concentration. Radiography of the vertebral column revealed fracture and subluxation of T4 (Fig 1). The fracture was assumed to have been caused by violent muscle contractions during a seizure or from a fall during the seizure.

The chimpanzee was given prednisolone sodium succinate (500 mg, IV), recovered from anesthesia, and placed in a transport cage for additional evaluation and to allow time to consult with the zoological park administration and staff concerning the feasibility of the recovery, aftercare, and rehabilitation necessary following vertebral surgery in a great ape. Blood and urine samples that were collected from the anesthetized chimpanzee were determined to be normal.

Consultations resulted in a decision to attempt surgical fixation of the fracture. Recovery and rehabilitation were to be facilitated by a team approach that included the services of the zoologist, zoo staff, surgeons at the veterinary college, and a pediatric orthopedic surgeon.

The chimpanzee was given cephalasin (22 mg/kg of body weight, IV, and 22 mg/kg, IM), anesthetized by use of the previous protocol, and positioned in sternal recumbency. After surgical preparation of the operative site, a dorsal approach was made to the thoracic spine. Paraspinous muscles were elevated with periosteal elevators, and the tendinous attachments to the vertebrae were severed with an electroscalpel. A nitrogen-powered drill was used to perform a dorsal laminectomy at

Coden & Shurleff Inc, Randolf, Mass.
T4, preserving a shelf of the dorsal lamina at the proximal and distal ends of the vertebra. The spinous processes of T1 through T8 were removed with Luer bone ronguers, and the ligamentum flavum between each vertebra were removed with curved Beyer-Lempert ronguers. Beaded stainless steel suture wire strands\(^b\) (18 gauge, 61 cm long) were looped to form double strands and passed under and around the laminae from T1 to T8. After all wires were passed, a 4.72-mm diameter, 316L stainless steel, spinal U-rods\(^d\) was positioned over the exposed vertebrae (Fig 2). The looped ends of the wires were cut to form 2 strands of wire. Two sets of looped wire were placed under the laminae of the most proximal and distal vertebrae, so after cutting the loops, 4 sublaminar strands of wire were on these vertebrae. Beginning at the fracture site and working alternately cranially and caudally, the wires were twisted around the curved spinal U-rod with a surgical wire twister.\(^c\) After completing the wire fixation, each of the articular facets and transverse processes were decorticated with Luer bone ronguers. Autogenous bone grafts that were harvested from the spinous processes were placed over the decorticated processes. The incision was closed in 3 layers (muscular, subcutaneous, skin) by use of 0, 2-0, and 3-0 polypropylene, respectively. Postoperative radiography revealed good alignment of the fracture luxation (Fig 3).

The chimpanzee was placed in the transport cage after anesthetic recovery and was given cefazolin (22 mg/kg, IM, q 12 h) for the first 2 postoperative wire twisters, The Anspach Effort Inc, Lakewood, Fla.

\(^d\)Luque Spinal Fixation Wire—Beaded Loop, Zimmer Inc, Warsaw, Ind.
\(^b\)Luque Spinal U-rod, Zimmer Inc, Warsaw, Ind.
operative days. An analgesic (0.1 mg/kg of oxy-
morphine, q 6 h, as needed) was administered
during the first 24 hours after surgery. The chim-
panzee ate well and drank an electrolyte solution
on the day after surgery, but had no apparent
change in neurologic status, including the reflex
status and sensation.

During the first postoperative week, muscle
tone in the pelvic limbs improved, the incision site
was intact and not draining. The chimpanzee con-
tinued to eat well, vocalized when spoken to, and
appeared as active and alert as before surgery. The
chimpanzee was discharged to the care of the
zookeeper and zoo veterinarian with instructions
to remove sutures 14 days after surgery and main-
tain confinement for 1 month.

The chimpanzee’s neurologic status changed
only slightly during the first postoperative month,
but has shown some steady improvement since that
time (a period of 30 months). Two months after
surgery, radiography revealed no change in the
position of the fixation device, and ongoing fracture
healing was evident. As a complication, he de-
veloped a bacterial dermatitis over his back that
responded initially to oral (500 mg of erythromy-
cin, q 6 h) and topical antimicrobial therapy
(bacitracin ointment); however, a superficial fungal
infection developed, and oral and topical grise-
ofulvin was used. Twenty-four months after surgery,
a minor area of excoriation remained, but no active
infection was evident as determined by bacterial
and fungal cultures. Anticonvulsant treatment was
changed from primadone (250 mg, PO, q 24 h) to
phenytoin (100 mg, PO, q 12 h) to provide consist-
tant and adequate 24-hour blood concentrations,
and only 2 seizures have been reported since this
modification. Both seizures occurred while the
chimpanzee was being given griseofulvin, a drug
known to cause decreased blood levels of anticon-
vulsants. The phenytoin dosage was increased (150
mg, PO, q 12 h) during treatment with griseofulvin
and reduced to the previous dosage afterward. Sei-
zures have not occurred since reinstitution of the
original dosage of phenytoin. The chimpanzee’s
current neurologic status is consistent with the
Frankel D classification (preserved useful motor
function distal to the level of injury). He has been
reintroduced into the chimpanzee colony at the
zoological park, and he regained 80 to 90% of the
function of his pelvic limbs during the first year aft
er surgery.

The Luque method of segmental spinal fixation
for repair of vertebral fractures was first described
in 1982 and has been used extensively in the cor-
rection of scoliosis and repair of spinal fractures in
human beings. Strength and rigidity of this fixation
device have been documented in numerous bio-
mechanical evaluations. A major advantage of
this fixation is sufficient strength and rigidity after
surgery to preclude the need for additional exter-
nal support. Additional advantages include the
limiting of postsurgical spinal kyphosis associated
with many spinal fracture repair techniques. This
advantage is achieved because the method allows
the surgeon to contour the U-rod to the desired
shape of the repaired vertebral column, and the
vertebrae incorporated in the fixation are aligned to
the contour of the U-rod by tightening of the sub-
laminar wires. This fixation device can be applied
to any segment of the vertebral column.

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