# Experimental Model of Spinal Cord Compression Injury in Minipigs: A Behavioural and MRI Study

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## Introduction

The most frequently used experimental animals in spinal cord injury (SCI) studies are mice and rats. Recent data demonstrate that therapeutic measures producing positive results in rodents are not effective in humans. That is why the authors decided to study behavioural and MRI changes in a porcine SCI model.

## Methods

Six adult Goettingen-Minnesota (G-M) minipigs weighing 32-35 kg were narcotized by thiopental (10mg/kg, i. v.), intubated, placed on a volume-cycled ventilator and anesthesia was maintained by ET administration of 1.5% sevoflurane with oxygen. The location of the L1 vertebra selected for laminectomy was determined by plain x-rays (Fig. 1), animals were fastened in an immobilization frame, exposed spinal cords were injured by a computer operated apparatus with a disinfected active part (5mm thick circular rod) compressing the spinal medulla with a peak force of 0.8 kg at a velocity of 3cm/sec. (Fig. 2 and 3). During the recovery period, neurol. functions were monitored (Fig. 4). On the 12th postoperative day minipigs were perfusion fixed, the extent and character of neural tissue damage was evaluated by postmortem MRI (4.7T horizontal scanner equipped with 400 mT/m gradient insert and DDR console) of dissected spinal cord segments immersed in Fombin Y to reduce background signals and susceptibility artifacts.

## Results

On the 2nd day following 0,8 kg spinal cord compression injury the experimental animals demonstrated almost complete paraplegia (Fig. 4). However, the neurological deficit improved rapidly - see performance of one of the G-M minipigs on the 12th day after SCI (video). MRI analyses (Fig. 5) showed loss of spinal cord white matter integrity and cavitations in the epicentre of SCI with longitudinal spreading over one segment cranially and one segment caudally.

## Conclusions

The study confirmed reliability and reproducibility of the proposed model of incomplete SCI in minipigs. The MRI changes in the epicentre of injury and in its vicinity did not impede the rapid and substantial recovery of neurological functions.

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Fig. 1. The plain x-ray of a minipig in lateral projection. An injection needle indicates the caudalmost thoracic vertebra

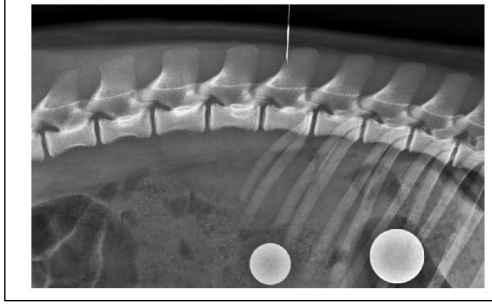

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Fig. 2. A platform with the compression apparatus fixed to the operating table following the $L_1$ laminectomy.

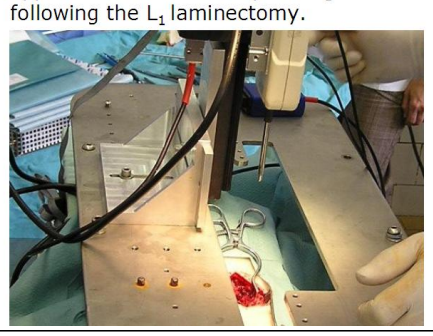
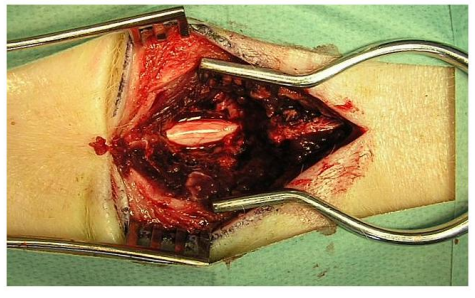


Fig. 3. The situation immediately before SCI through an intact spinal dural sac



## Learning Objectives

By the conclusion of this session participants should be able to discuss in small groups problems related to preclinical experimental models of SCI.

Fig. 4. Three of minipigs next day after SCI

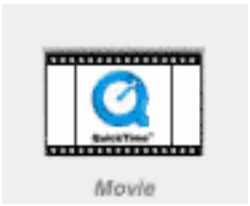



Fig. 5. MR images of spinal cord segments located in epicentre of compression 12 days after SCI