INSTRUCTION MANUAL

505289/505292

Mouse/Rat Spinal Adaptor

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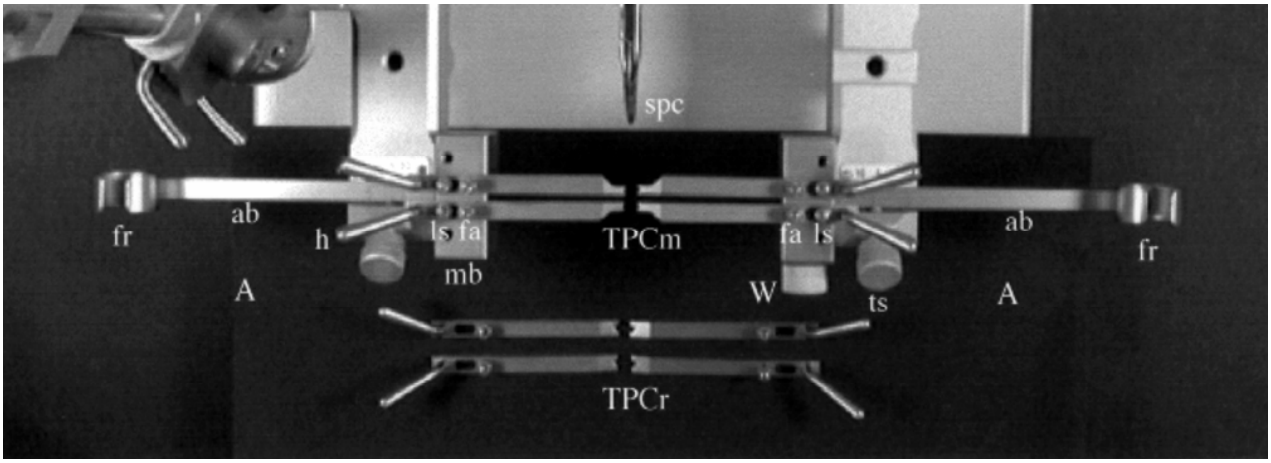
062824

A	spinal clamp assembly	fr	finger ring	TPCm	transverse process clamp for mouse
	(= fr, ab, mb, TPC, h, Is, fa)	h	TPC handle	TPCr	transverse process clamp for rat
ab	assembly bars	mb	mounting block	ts	thumb screw
ls	locking screws	spc	spinous process clamp	W	wrench tool
fa	fine adjust screws				



Overview

The spinal adaptor is compatible with standard stereotaxic devices enabling reliable spinal surgery in rats as well as mice. The animal is first held in approximate position by the spinous process clamp (spc), which is clamped to a spinous process rostral to the area of spinal cord exposure. The left and right spinal clamp assemblies (A) are slid medially so that the transverse process clamps (TPC) are near the point of contact with the vertebrae. The finger rings (fr) are useful in gross adjustment by placing the end of the surgeon's fifth digit within the ring, thus freeing the remaining fingers for other functions. When the left and right assemblies are approximated, the assembly bars (ab) are secured with the thumb screw (ts).

Transverse process clamps (TPCs) are available for rats (TPCr) or mice (TPCm). These are designed primarily for the lumbar vertebrae. Spinal clamps designed for cervical vertebrae will also become available. Note the orientation of the mouse clamps allowing optimal rostro-caudal closeness of the clamps. With the animal in approximate position, the TPC is then finely positioned below the processus mammillaris (pm) and above the transverse process (tp) of the vertebra (see Figure 2B). The transverse process clamp handles (h) are used to maneuver the clamps into position and the locking screws (ls) lock the TPCs down using the wrench tool (W) stored within the TPC mounting blocks (mb). Each TPC can rotate forward or backward, can slide medially or laterally, and can be elevated or lowered with the elevation screws (es). *(Note that with ongoing improvements to the spinal unit, the design of your instrument may be somewhat different than that illustrated herein.)*

Figure 2A

Skeleton of the rat[1]

Figure 2B

Lumbar vertebra in the rat[1] and transverse process clamp positioning

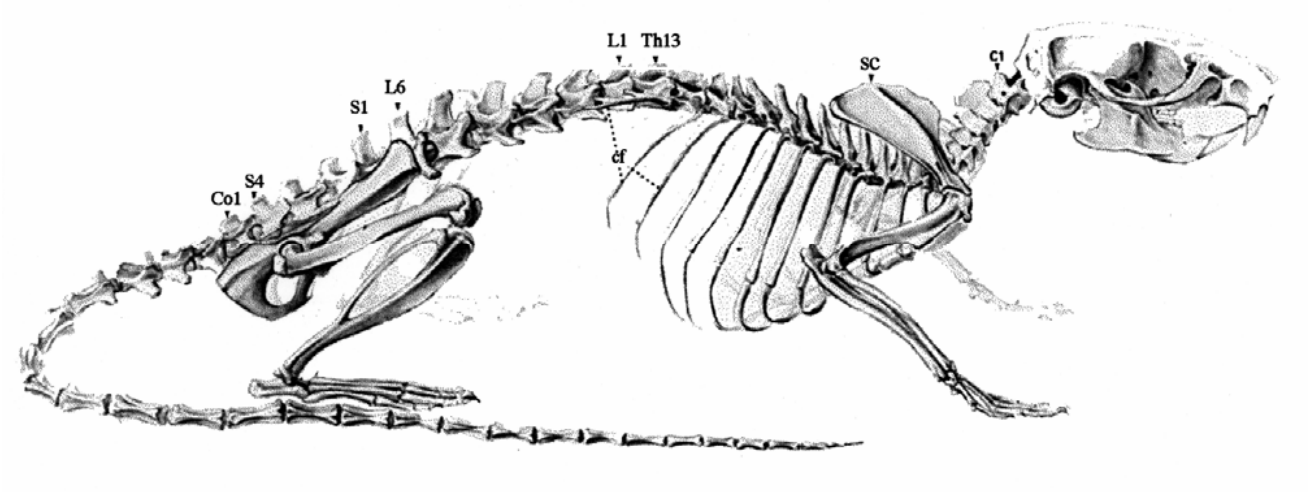


Figure 2A

C1	lst cervical vertebra	SI	1st sacral vertebra
Sc	Scapula	S4	4th sacral vertebra
Thl3	13th thoracic vertebra	Col	1st coccygeal vertebra
L6	6th lumbar vertebra	Cf	costae fluctuantes

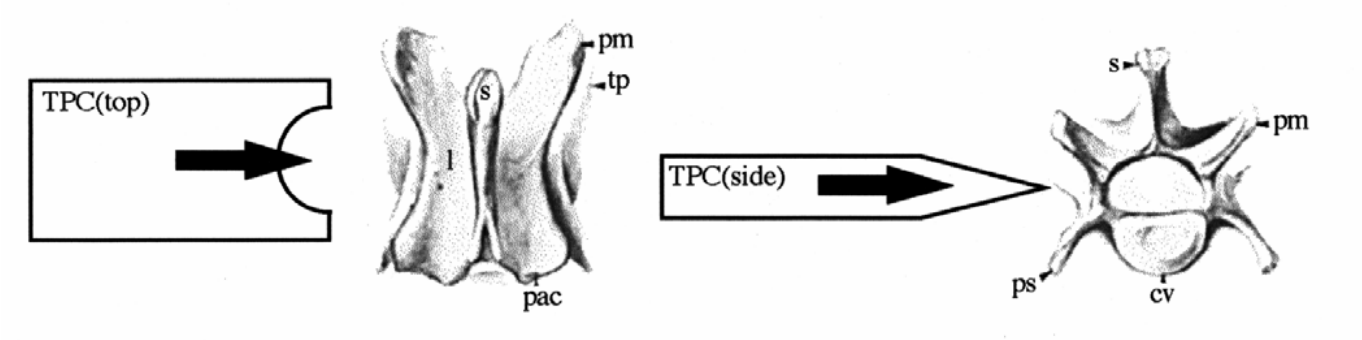


Figure 2B

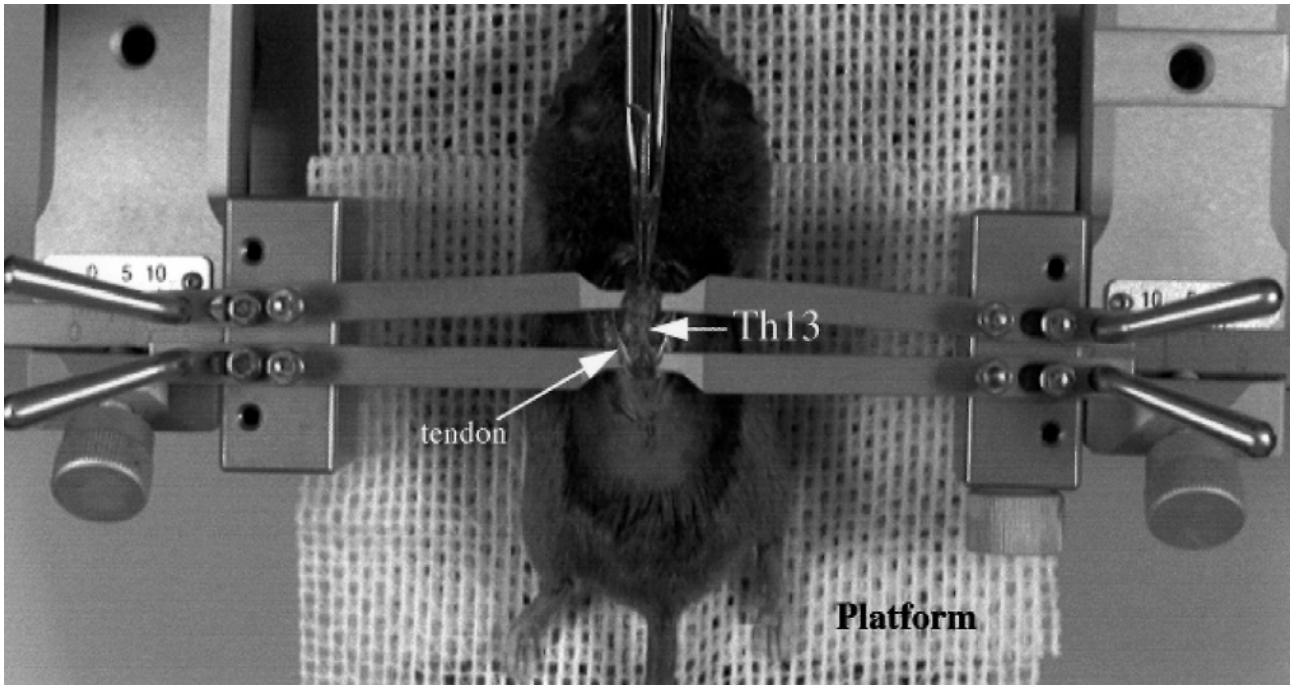
cv	corpus vertebrae	pm.	proc. marnmillaris
l	lamina of vertebral arch	s	spinous process
pac	proc. articularis caud,	tP	transverse process
ps	proc. spinalis	TPC	transverse process clamp

[1] Reprinted from Anatomy and Embryology of the Laboratory Rat; R Hebel and M.W. Stromberg, editors; with permission from BioMed Verlag Worthsee

Figure 3

Spinal procedure in the adult mouse

PROCEDURE *(and surgical tips)*



Preparing the Surgical Field

The following is intended as an example procedure for an L4 preparation in rats and mice and may require modification to suit specific surgical goals. Figure 3 illustrates a lumbar preparation for the mouse.

1) After anesthetizing the experimental animal, shave the hair in the general region where the incision will be made, and clean the skin with antiseptic (e.g. Betadine solution).
2) Palpate landmarks to help determine the spinal region to be exposed. For example, for surgical procedures on the 1A segment of the cord, laminectomy of T13 must be performed. T13 is easily located; as it is just caudal to the insertion of the last rib to the spine, see Figure 2.
   - $ *Remember that due to the differential in development of the spinal cord and the spinal column, the L4 cord segment is at the same level as the 13th thoracic vertebra.*
3) With surgical scissors, incise the skin along the midline along the desired entry site.
   - $ *Incisions with surgical scissors, as opposed to a scalpel, reduces uncontrollable bleeding and the risk of damage to the underlying tissues.*
4) Using blunt dissection technique, free the lateral edges of the spinal column from connective tissue and muscle.
   - $ *Blunt dissection, rather than cutting, reduces bleeding and facilitates healing.*
5) With forceps or a rongeur, remove the tissue from the vertebrae of interest as well as at least two vertebrae rostral and one vertebra caudal to the site of spinal cord exposure.
   - $ *Note the tendons inserting upon the processus mammillari of the vertebrae projecting rostrally and laterally to their respective muscles (see Figure 3). These can serve as landmarks for positioning of the transverse spinal clamps.*

Stabilization

1) Secure the spinous process clamp (SPC) to the spinous process of the 2nd vertebra rostral to the vertebra (e) of interest. This temporarily holds the animal in approximate position to receive the transverse process clamps (TPCs)
   - $ *Smaller animals (e.g., mice & neonatal rats) may require a platform for support and to elevate the body to the level of the spinal clamps.*
2) Slide the left and right spinal clamp assemblies (A) medially such that the pointed ends of the TPCs are approximately 1 mm away from contacting the vertebrae. Lock the spinal clamp assemblies with thumb screws (ts).
   - $ *The TPCs should initially be slid to the lateral-most position on the mounting block (mb) to allow sufficient medial movement after the spinal clamp assemblies have been positioned.*
3) Position the TPCs below the process mammallaris (pm) and above the transverse process (tp, or the process spinalis, ps). The clamps are designed to fit snugly without cutting and may be angled rostrally or caudally (see Figure 3). Lock into position with the locking screw (ls).
   - $ *Place one pair of clamps on the vertebra just rostral and another pair on the vertebra just caudal to the vertebra(e) to receive the laminectomy.*
   - $ *Proper positioning of the TPCs should provide motionless support.*
4) Align the vertebrae by raising or lowering the TPCs using the fine adjustment screws. Center the preparation by sliding both assemblies simultaneously using the finger rings.
   - $ *Precise alignment can be achieved by using the stereotaxic probe carrier (e.g., left and right lateral edges of the vertebral arch should have the same vertical coordinates).*

Surgery

1) After the vertebrae of interest are stable and aligned appropriately, clear the bone of all tissue using forceps or a rongeur; if necessary; scrape the bone with a fine spatula.
2) Laminectomy (removal of the lamina of the vertebral arch) can be achieved with a fine rongeur or using a drill with a dental burr thus exposing the spinal cord. Take care to not disturb the dura overlying the spinal cord.
   - $ *Spinal cord exposure can also be achieved by cutting the interspinous ligaments and the interarcuate ligaments.*
3) Spinal cord surgery can then be performed and the entry sites closed. Procedures involving 1-2 vertebrae may require very little in terms of reconstruction of the dura and vertebrae. Often it is sufficient to simply approximate the paraspinous muscle over the entry site of the cord using absorbable suture.
   - $ *More extensive procedures involving two or more vertebra may require repair of the dura (e.g., with artificial dura and/or fine 10-0 suture) and reconstruction of the vertebrae (e.g., with gel foam, dental acrylic, etc.) thus providing support and protection of the spinal cord.*
   - $ *Reconstruction and closing techniques may best be performed after the animal is removed from the apparatus. Reconstruction and closing techniques may best be performed after the animal is removed from the apparatus.*

4) Remove the animal from the instrument by retracting the left and right spinal clamp assemblies and then releasing the spinous process clamp.
5) Approximate muscle layers and suture fascia with absorbable suture (e.g., 5-0 chromic gut). Close the skin with monofilament nylon suture (e. g., Ethilon 4-0 for rats and 6-0 for mice).

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