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INNOVATIVE ANIMAL-FREE TRAINING TO STEREOTAXIC NEUROSURGERY

Catherine Vogt, DVM,^{1,2,3} Damien Gervasoni, PhD^{1,3,4,5}

ABSTRACT
ID #605

1. Université Claude Bernard Lyon 1
2. WASP Science

3. Université de Lyon
4. Centre de Recherche en Neurosciences de Lyon

5. Centre National de la Recherche Scientifique

BACKGROUND

Stereotaxic neurosurgery in laboratory animals is used in a wide variety of studies in Neurosciences.

- It allows to position one or more optical, electrical, or chemical probes, to inject a dye, tracer, or vector;
- It remains indispensable for exploring brain functions.
- is not taught as a subject per se, but rather passed-on in research laboratories, resulting in a variety of practices and success rates.

There is a need to harmonize practices and enhance neuroscientists' abilities to explore the brain in a valuable and reproducible way.

Here we introduce an animal-free training on stereotaxic neurosurgery compliant with the 3Rs principle.

COURSES MAIN FEATURES

1:3 Teacher-trainee ratio for better support and interactivity
Specialised initial training in neurosurgery

Minimal but essential theory
Focus on techniques and surgical approaches
- to optimize spatial precision and reproducibility
- to minimize risk of irreversible harm to the animal

E-LEARNING & HANDS-ON PRACTICE
HIGH-RESOLUTION SIMULATION DEVICES
Tools for self-evaluation and maintenance of skills

PRE-REQUISITE : Validation of a online course covering elementary concepts of surgery



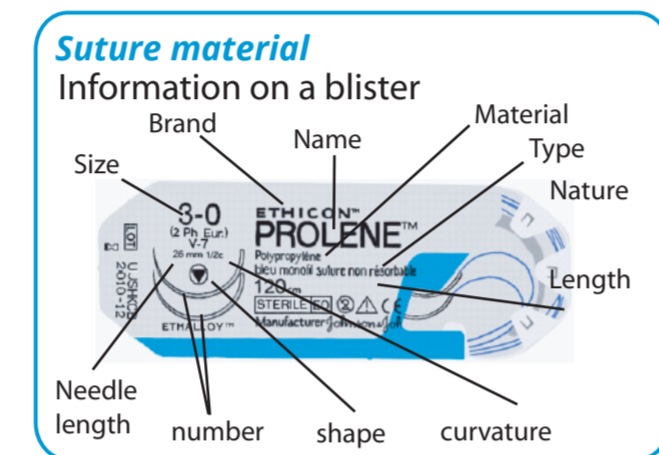
Online course

- Aseptic techniques
- Anaesthesia
- Pain management
- Per-operative animal care
- Incision and suture
- Recovery monitoring
- Post-operative care



Online test for validation

Sample slide



Examples of questions



Identify the five main factors that contributes to surgical asepsis



Replace the following steps of surgical asepsis in the correct order



TRAINING COURSE OBJECTIVES AND CONTENT

OBJECTIVES

SOFT SKILLS

To design a protocol conciling scientific interest/ benefit and animal welfare
Culture of excellence for a better culture of care

THEORY

E-LEARNING & CLASSROOM

Theoretical background of stereotaxy : principles and techniques
Anatomy and functional organisation of the brain
3-dimensional arrangement of vessels and ventricles
Brain atlas, cranial landmarks
Stereotaxic frame, holders, and micropositioners
Surgical approaches to optimize spatial precision and to reduce harm and complications
No living animal

HANDS ON PRACTICE

Stereotaxic frame, holders and micropositioners handling
Rulers and verniers
Calculations of stereotaxic coordinates of a brain target structure and entry point of the brain
High-resolution simulation devices
- to measure coordinates of cranial landmarks and entry points
- to safely prepare the skull for insertion and fixation of a probe

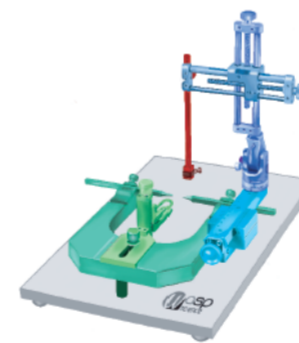
KNOW-HOW

- to build a mental representation a 3D brain structure from a 2D atlas
- to identify the optimal surgical approach
- to plan and carry out the implantation of a probe from precise coordinates
- to minimize surgical complications

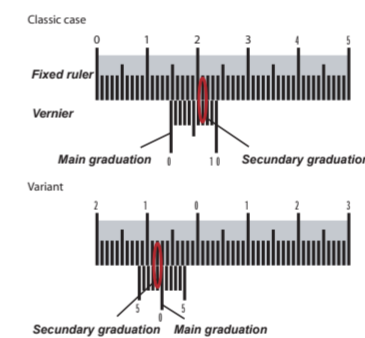
Principles Anatomical reference planes



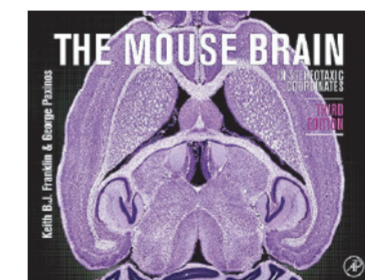
Stereotaxic apparatus Axes, holders and rulers



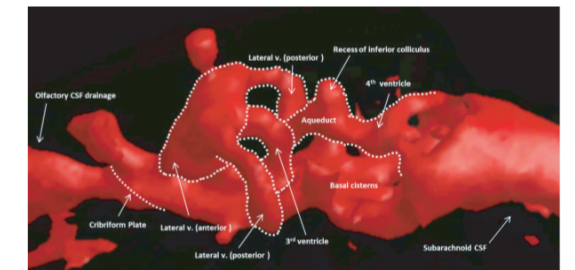
Precision in stereotaxic surgery Ruler and vernier



Stereotaxic atlas Landmarks and coordinates

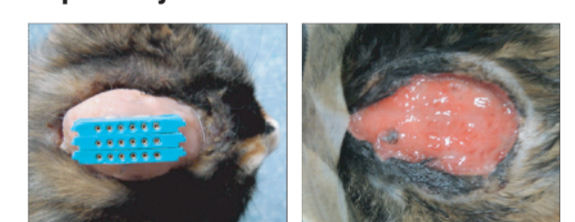


Spatial arrangement of brain ventricles Example of the rat brain ventricles

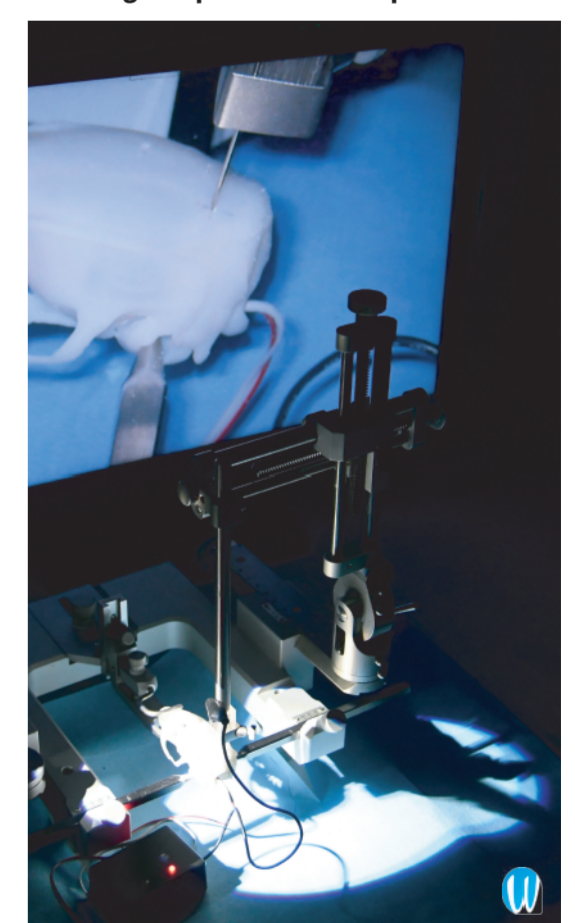


From Murtha et al. (2014)

Common complications Implant rejection



High-resolution simulation Checking the placement of a probe



Preparing the skull for an implantation Placing an anchor screw



High-resolution simulation Drilling the skull



1:3 Teacher/Trainee ratio



Exercises are repeated as needed
Accurate placement of a probe can be checked promptly without the need of histology.
Tools and supports available to maintain skills once back to the laboratory.

Step-by-step performance of a stereotaxic implantation on a high-resolution simulation device



A new tool with predefined targets, allowing a self-evaluation under multiple approaches (different angles)

CONCLUSIONS

Really designed with the 3Rs' principle in mind, this course should contribute to promote more reproducible and compassionate approaches in animal research in Neuroscience.

CONTACTS : damien.gervasoni@univ-lyon1.fr / catherine.vogt@univ-lyon1.fr / contact@wasp-science.com

