



**Division of Research**

<b>SUBJECT:</b> Genotyping, Identification and Use of Proper Nomenclature of Rodents	<b>Effective Date:</b> 9/30/2022	<b>Policy Number:</b> 10.4.8
	<b>Supersedes:</b> 9/27/2019 8/30/2016	<b>Page of</b> <b>1 7</b>
	<b>Responsible Authorities:</b> Principal Investigator Vice President, Research Institutional Animal Care and Use Committee Assistant Vice President for Research, Research Integrity Assistant Vice President for Research, Comparative Medicine	

- I. Background  
The Public Health Service (PHS) policy and the “Guide for the Care and Use of Laboratory Animals” (Guide) require the Institutional Animal Care and Use Committee (IACUC) and the Attending Veterinarian to provide oversight of all experimental procedures and guarantee the welfare of the animals used in biomedical research. As stated in the NIH Guidelines for the Genotyping of Mice and Rats, specific genetic identification of pups in a litter is critical to the efficient pursuit of research and reducing the number of animals involved in a research project. Likewise, this applies to the individual identification of rodents depending on the particular study design. The Guide emphasizes that accurate recording, with standardized nomenclature, of both the strain and substrain or of the genetic background of research animals is essential.
  
- II. Purpose  
The purpose of this document is to provide guidelines to researchers and animal care staff regarding acceptable methods of tissue collection for the purpose of rodent genotyping, individual identification of mice and rats as well as the proper nomenclature of genetically modified animals (GMA).
  
- III. General Statement  
Properly executed procedures will protect the welfare of animals used, avoid exposing the animals to undue stress and pain and provide physiologically stable biologic models for research. The immense variety of mouse and rat strains including genetically modified animals requires adequate nomenclature to ensure the name reflects the most relevant information of the strain/substrain, which can carry spontaneous or induced mutations, transgenes or knock-out/knock-in alleles existing in numerous different genetic backgrounds. Periodic genetic monitoring of genetically engineered animals is

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recommended to ensure that you are continuing to propagate the required strain as genetic drift frequently occurs.

#### IV. Policy

- A. Genomic DNA is required to genotype any genetically modified animal. The amount of DNA needed is dependent upon the analysis method employed. Polymerase Chain Reaction (PCR) and Southern Blot are two commonly used testing methodologies. Flow cytometry can also be used as a method of genotyping for certain specific applications.
- B. For PCR analysis the least invasive methods of DNA collection include the use of small tissue samples from ear punching/notching, buccal/rectal swabs, hair samples, and blood. Based on the requirements of the study, researchers are urged to consider these noninvasive tissue collection sites.
- C. Tail biopsies, suitable for Southern Blot and PCR and often used in mice and rats, involve removing a piece of tissue from the terminal end of the tail and should only be used after alternatives have been considered. The tail contains a variety of tissues, including bone, cartilage, blood vessels and nervous tissue.
- D. The ideal time to collect tail tissue is in between post-natal days 10 and 15. At this age, the tail tip is soft, bones have not completely mineralized and the yield of DNA is highest. In addition, prompt analysis of tissue allows the desired mice and rats to be identified prior to weaning.
- E. Biopsy of the tail tip can be performed **without anesthesia on animals less than or 21 days** of age but requires **anesthesia and post procedural analgesia** if animals are **older than 21 days**. Brief general anesthesia with isoflurane (either via vaporizer or open drop method in a fume hood) is recommended. Post procedural analgesia can be achieved by administration of an NSAID (e.g., Ketoprofen) or an opioid (e.g., Buprenorphine).
- F. The total amount of tissue removed should be the minimum necessary. For tail tissue this would be ideally 2mm of the tip (usually sufficient for PCR) but **not more than 5mm** to avoid developing coccygeal bones.
- G. **Repeated tail biopsies** on a single animal are discouraged, requires general anesthesia and **must be justified in the IACUC protocol**. The use of post-procedural analgesia should be considered in animals less than 21 days of age and is required for animals >21 days of age.
- H. Cage cards are used for the identification of all animals following the recommendation of the Guide. However, for many studies it is advantageous to identify experimental animals individually. Temporary marking systems can be satisfactory for short time periods while permanent identification systems will not wear off rapidly and are more reliable.
- I. **Temporary marking systems** acceptable for rodents include fur clipping and shaving in distinct configurations on the animal's body, non-toxic waterproof dyes and non-toxic colored markers applied in a variety of patterns on light-colored fur or hairless areas on the tail.
- J. **Permanent identification systems** considered acceptable for mice and rats include ear punch/notch, ear tags, microchip transponder and tattoos. Neonates can be identified via digit marking (tattoo) using non-toxic ink injections and toe clipping.
- K. **Toe clipping** may be approved by the IACUC after all other alternatives have been considered and a sound justification must be provided, especially if toe clipping serves a dual purpose of identification and tissue collection for genotyping. Toe clipping must only be used in altricial pre-weanling rodents **up to 7 days of age in rats** and mice.

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Only the most distal bone of the toe (3<sup>rd</sup> phalanx) and only one toe per paw can be removed.

- L. Research faculty and staff performing tissue collection procedures for genotyping and permanent identification methods must be trained and proficient in the procedures.
- M. The Mouse Genome Informatics Database and the Rat Genome Database are the authoritative source of official names for genes, and alleles as well as strains of mice and rats, respectively. The International Committee on Standardized Genetic Nomenclature for Mice established the rules and guidelines for nomenclature of mouse and rat strains.
- N. Investigators who use rodent models are responsible for accurate reporting of the identification of research rodents with regard to strain/substrain and genetic background. To that end, **researchers are strongly encouraged to follow nomenclature guidelines** published by the above mentioned sources, which can be found on the respective websites (MGI-Mouse Nomenclature [www.informatics.jax.org/mgihome/nomen/](http://www.informatics.jax.org/mgihome/nomen/)).

V. Definitions

1. **Genetically modified animal (GMA)** is an animal whose genetic material has been altered by adding, changing or removing certain DNA sequences in a way that does not occur under natural conditions.
2. A mouse or rat **strain** is a group of animals that is genetically uniform, which can be inbred, mutated or genetically engineered/modified. Inbred strains can genetically diverge into **substrains** under a number of circumstances, e.g., a breeding colony of an inbred strain maintained at different locations.
3. **Genotyping** is the process of determining differences in the genetic make-up (genotype) of an individual by examining the individual's DNA sequence using biological assays and comparing it to another individual's sequence or a reference sequence.
4. **Individual identification** means the marking of animals in a unique way to identify individuals in contrast to a group of animals housed in the same enclosure (e.g., via cage cards).
5. **Nomenclature** is a system of terms used in a particular science. In regards to this policy it is an international system of standardized genetic terms and symbols applied to rodent strains/substrains.

VI. Accountability

**The Principal Investigator (PI) will be responsible for:**

- Describing all procedures performed on an animal including the tissue collection for genotyping and individual identification method in sufficient detail in any IACUC protocol.
- Ensuring appropriate training of personnel performing the genotyping or identification procedures and contact the Comparative Medicine staff for support or any concern/problem resolution.
- Securing the usage of proper nomenclature of mouse and rat strains/substrains during the conduct of the research study and in publications.
- Ensuring the use of anesthetics and analgesics as indicated in the Policy

**The IACUC will be responsible for:**

- Reviewing and approving, requiring modifications in (to secure approval) or withholding approval of IACUC protocols and/or amendments, especially assessing

the appropriateness of the procedures described for genotyping and identification of animals.

- Reviewing records on a regular basis during semi-annual site inspections, post-approval monitoring reviews, and whenever concerns regarding the welfare of a particular animal(s) arise.

**The Research Integrity office will be responsible for:**

- Administrative support of the IACUC members to facilitate their regulatory function.
- Maintaining policy and assure regular review and update as necessary by the IACUC.
- Organizing, supporting and recording outcomes of regular inspections of research labs in regards to procedures performed and nomenclature used.

**The Attending Veterinarian/Office of Comparative Medicine (CM) will be responsible for:**

- Ensuring adequate oversight of experimental procedures including consultation during the design of the study, evaluation of recordkeeping, health surveillance of the animal colonies, and the assessment of the well-being of animals on a one-by-one basis.
- Provide training to research and animal care personnel performing collection of tissues for genotyping and identification procedures.

VII. Procedures

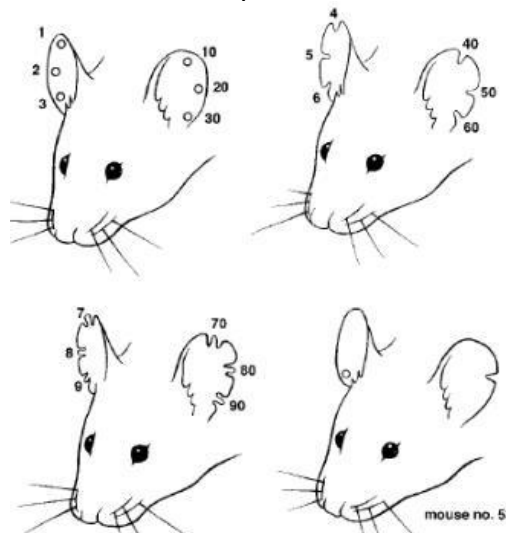
**A. Tail Biopsy**

1. Collection of distal tail tissue ( $\leq 5\text{mm}$ ) can be performed without anesthesia in young animals but general anesthesia and post-procedural analgesia is required for animals older than 21 days or if a repeated sampling in a single animal is necessary. Topical cetacaine or ethyl chloride sprays have been shown **not** to provide appropriate anesthesia/analgesia in mice and should not be used. Anesthetized animals have to be continuously monitored until fully awake.
2. The tail must be swabbed at least once with a disinfectant such as iodine or chlorhexidine. Instruments used to cut the tail tip have to be sterile at the start of the procedure and should be sterilized between animals. This can be achieved by but is not limited to using a hot bead sterilizer, which not only will sterilize the scalpel blade or scissors but also can accomplish hemostasis of the tail wound.
3. Instruments used for cutting must be sharp (autoclaving will dull cutting parts of instruments and regular sharpening is required). Note that disposable scalpel blades are not designed to be used on multiple animals.
4. Bleeding must be stopped before returning the animal to the cage. Hemostasis can be achieved either by cauterization with hot instrument tips (see above comment), styptic powder, silver nitrate or simple digital pressure.
5. The working surface where the tail is cut should be wiped with alcohol in between animals to reduce DNA contamination between samples.

**B. Ear Punch/Notch**

1. Ear tissue can be collected either by ear punching of a circle of tissue or ear notching by removing an edge of the pinna, and can be used for genotyping and identification of the animal at the same time.

2. These methods do not require anesthesia and should be performed on animals close to weaning age or older to ensure the pinnae are large enough. If very young animals are ear punched, holes might close again and identification may be lost.
3. If done correctly ear tissue collection should not cause bleeding. If bleeding occurs ensure proper hemostasis.
4. The instruments used, either commercial punch devices or scissors, must be sterilized/disinfected before usage (e.g., autoclaving, hot bead sterilizer, or cold sterilants) and disinfected between animals. Confirm that the instruments are sharp before starting the procedure.
5. When using the punch holes and/or notches in the ears as identification follow an identification chart. See below example.



From AALAS Learning Library (<http://aalaslearninglibrary.org>)

### C. Toe Clipping

1. Although toe clipping can be used for identification and genotyping purposes it can only be performed on mice and rats up to 7 days of age. Only the most distal phalanx bone and only one toe per paw can be removed. Following these guidelines no anesthesia is required.
2. Instruments used for cutting must be sharp, sterilized before usage and disinfected between animals.
3. Ensure hemostasis before releasing animals into regular housing (see VII.A.4).

### D. Other Genotyping Methods

1. None of the methods described in this section are invasive and therefore they do not require anesthesia.
2. Buccal swabs/saliva collection can already be performed on animals at 2-3 days old. Use individual sterile mini-cotton swabs rubbing against the inner cheeks to collect epithelial cells from the mouth. Care should be taken to ensure gentle swabbing.
3. Hair samples can be collected at the neck line between the shoulder blades. Two (2) tufts of hair are plucked using forceps or hemostats. It is important to avoid contamination with hair/skin cells from cage mates.

4. Fecal pellets can be collected directly from the animal during defecation while being picked up or from the cage floor of single housed animals. Epithelial cells shed in the feces are the target tissue for genotyping.
5. A blood sample (50-100ul) can be utilized for flow cytometric assessment using clonotypic monoclonal antibodies. This method is used when either the sequence for making primers is not available or the expression of transgene product on specific cells is of interest.

#### **E. Ear Tagging**

1. The attachment of a metal or plastic tag with a unique identification number to the base of the ear is a common identification system. Improper placement can lead to pressure necrosis, inflammation and infection, which can result in removing the tag by the animal.
2. Instruments used must be sterilized/disinfected before usage and disinfected between animals.
3. It is recommended to disinfect the site of placement prior to attachment of the tag to avoid infections and the site of placement should be monitored regularly after the procedure.
4. Note that ear tags may not be compatible with advanced imaging procedures.

#### **F. Microtattooing**

1. This is a method using needle and ink to apply a permanent distinctive mark (e.g. number) at the dermis of the tail, toes, ears or foot pad of a rat or mouse. It can be performed on animals as young as 2 days old depending on the tattooing system used. Manual or electric equipment can be used.
2. Anesthesia is not required when it is performed by trained personnel. Adult animals might need to be anesthetized for immobilization.
3. The tattooing site must be disinfected to minimize risk of infection.
4. Commercial electrical equipment is available from various vendors requiring differing proficiencies of personnel.
5. Injecting tattoo ink subcutaneously into the tail, hocks or toes producing a pattern of dots is used for identification of neonatal rats and mice.

#### **G. Microchipping**

1. Microchip transponders implanted usually subcutaneously but also intraperitoneally are often used to track large numbers of animals and data (some microchips can also measure physiologic parameters) when interfaced with compatible computer software.
2. Microchips have to be sterile and implantation must follow aseptic technique.
3. Subcutaneous microchip placement is performed like an injection with a large bore needle while intraperitoneal transponder implantation is considered a survival surgery and must be described accordingly in the IACUC protocol.
4. Microchip transponders can lead to tissue inflammation response or neoplasia with prolonged placement. It might not be compatible with advanced imaging procedures.

VIII. Policy Renewal Date  
9/30/2025

#### References

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POLICY APPROVAL

*Initiating Authority*

Signature: \_\_\_\_\_

Date: \_\_\_\_\_

Name: Daniel C. Flynn, Ph.D., Vice President for Research

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Executed signature pages are available in the Initiating Authority Office(s)