Grip Strength NINGLA_GRS_001

Purpose

The grip strength test is used to measure the neuromuscular function as maximal muscle strength of forelimbs and combined forelimbs and hind limbs. These are assessed by the grasping applied by the mouse on a grid that is connected to a sensor. Three trials are carried out in succession measuring forelimb-strength only, followed by three successive trials measuring the combined forelimb/hindlimb grip strength.

Ontological description: MP:0001515 - abnormal grip strength.

Experimental Design

- **Minimum number of animals :** 7M + 7F
- **Age at test:** Week 52
- **Sex:** We would expect the results of this test to show sexual dimorphism

Equipment

1. Grip strength meter apparatus
2. Balance

Procedure

1. **Set up and use of grip strength meter:**

a. Check the connection of the sensor to the grid is firmly in place to prevent the grid from turning around.
b. Turn the sensor on and select peak mode, which will enable a measurement of the maximal strength exerted by the mouse – the default unit of force measured is delivered in grams. Do *not* apply loads greater than the nominal capacity of the force sensor at the risk of permanently damaging the strength gauge.
c. Reset the display sensor to zero.

2. **Grip strength force:**

a. Remove a mouse from its home cage, gripping the base of the tail between the thumb and the forefinger.
b. *Forelimb measurement:* Lower the mouse over the grid keeping the torso horizontal and allowing only its forepaws to attach to the grid before any measurements are taken. Gently pull the mouse back by its tail ensuring the mouse grips the top portion of

the grid and the torso remains horizontal and record the maximal grip strength value of the mouse that is displayed on the screen. Repeat this procedure twice more to obtain 3 forelimb grip strength measurements.

c. *Forelimb and hindlimb measurement:* Lower the mouse over the grid keeping the torso parallel with the grid and allow both its forepaws and hind paws to attach to the grid before any measurements are taken. Gently pull the mouse back by its tail ensuring the torso remains parallel with the grid and record the maximal grip strength value of the mouse that is displayed on the screen. Repeat this procedure twice more to obtain 3 forelimb/hindlimb grip strength measurements.
d. Place the mouse on the balance and record the weight of the mouse.
e. Make a note of any further observations found during the test e.g. failure to grip the grid.
f. Place the mouse back in its home cage.

3. Clean the grid with ethanol (50%) and allow time to dry before testing each cage of mice.

Notes

Mice with missing digits (e.g. after toe clipping) should be omitted from this test. Behavioural parameters may be influenced by circadian rhythm therefore testing should be routinely carried out around the same time of day to obtain balanced and valid results. Avoid testing immediately after light-dark transition as behavioural outcome may be affected.

The data is analyzed using mixed linear model with body weight as a covariate as specified by the statistical analysis pipeline (https://www.mousephenotype.org/help/data-analysis/statistical-analysis/). Accounting for body weight/size differences in the statistical analysis for grip strength is recommended over normalization against body weight.

The information about the date of the experiment, that is the date when the measurement is performed, is an important parameter which is to be submitted in the Experiment xml file (dateOfExperiment="2013-02-28").

Data QC

1. Calibrate the grip strength meter in accordance with the equipment guidelines.
2. The force sensor is fragile and should never be overloaded.

Metadata and examples

Metadata	**Example**
Equipment ID	ID of the machine used when more than 1 is used having same model and manufacturer. E.g. machine 1, machine 2, machine Minnie, machine Mickey Mouse, etc.
Equipment manufacturer	Manufacturer of the equipment. E.g. Bioseb.

Equipment model	Model of the equipment. E.g. BIO-GT3+MR
Grid model	Model of the grid. E.g. HMGU manufactured grid with only horizontal bars.
Experimenter ID	An ID of any format to be used coherently both inside the same procedure and for all procedures. E.g. Harw_001, or 1/2/3.
Date equipment last calibrated	Most recent date in which the equipment (or any part of) used in the procedure was subject to a calibration event.

Parameters and Metadata

Experimenter ID NINGLA_GRS_012_001 | v1.0

procedureMetadata

Req. Analysis: false **Req. Upload:** true **Is Annotated:** false

---

Forelimb grip strength measurement NINGLA_GRS_001_001 | v1.2

seriesParameter

Req. Analysis: false **Req. Upload:** true **Is Annotated:** true

Unit Measured: g

Increments: 2, 1, 3,

General comments about the mouse NINGLA_GRS_004_001 | v1.1

simpleParameter

Req. Analysis: false **Req. Upload:** false **Is Annotated:** false

---

Equipment manufacturer NINGLA_GRS_006_001 | v1.0

procedureMetadata

Req. Analysis: true **Req. Upload:** true **Is Annotated:** false

Options: Chatillon, Bioseb, Columbus Instruments,

Date equipment last calibrated NINGLA_GRS_014_001 | v1.2

procedureMetadata

Req. Analysis: false **Req. Upload:** false **Is Annotated:** false

---

Forelimb and hindlimb grip strength measurement NINGLA_GRS_002_001 | v1.2

seriesParameter

Req. Analysis: false **Req. Upload:** true **Is Annotated:** true

Unit Measured: g

Increments: 3, 2, 1,

Forelimb and hindlimb grip strength normalised against body weight NINGLA_GRS_011_001 | v1.3

simpleParameter

Req. Analysis: false **Req. Upload:** false **Is Annotated:** false

Derivation: div(meanOfIncrements('NINGLA_GRS_002_001', 1), 'NINGLA_GRS_003_001')

Forelimb grip strength normalised against body weight NINGLA_GRS_010_001 | v1.3

simpleParameter

Req. Analysis: false **Req. Upload:** false **Is Annotated:** false

Derivation: div(meanOfIncrements('NINGLA_GRS_001_001', 1), 'NINGLA_GRS_003_001')

Equipment ID NINGLA_GRS_005_001 | v1.0

procedureMetadata

Req. Analysis: false **Req. Upload:** true **Is Annotated:** false

---

Equipment model NINGLA_GRS_013_001 | v1.0

procedureMetadata

Req. Analysis: true **Req. Upload:** true **Is Annotated:** false

Options: DFIS 2, Ametek, Bio-GT3+MR, Bio-GS2, Bio-GS3, Ametek_old, E-DFD-E-002, BIO-GT3, DFE II, DFE,

---

Forelimb and hindlimb grip strength measurement mean NINGLA_GRS_009_001 | v1.2

simpleParameter

Req. Analysis: false **Req. Upload:** false **Is Annotated:** true

Unit Measured: g

Derivation: meanOfIncrements('NINGLA_GRS_002_001', 1)

Forelimb grip strength measurement mean NINGLA_GRS_008_001 | v1.2

simpleParameter

Req. Analysis: false **Req. Upload:** false **Is Annotated:** true

Unit Measured: g

Derivation: meanOfIncrements('NINGLA_GRS_001_001', 1)

Grid model NINGLA_GRS_007_001 | v1.0

procedureMetadata

Req. Analysis: true **Req. Upload:** true **Is Annotated:** false

Options: 45 Degree cross wired, HMGU plate, Not HMGU plate,

Body weight NINGLA_GRS_003_001 | v1.3

simpleParameter

Req. Analysis: false **Req. Upload:** true **Is Annotated:** false

Unit Measured: g