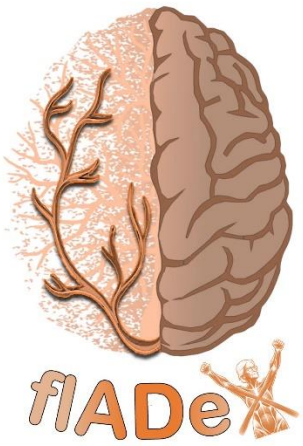

Manual of Procedures FLADEX Project

MOP Chapter 7: MRI session

Promoting Fitness & Health through Physical Activity

UNIVERSIDAD DE GRANADA

Chapter 7. MRI session

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1. Introduction

Magnetic resonance imaging (MRI) is a highly safe and frequently used method for assessing brain structure and function as well as cerebral blood flow (CBF). One of the main objectives of the flADex project is to examine the acute effect of a single bout of moderate aerobic exercise (A) vs. resistance exercise (B) vs. resting condition (C) on CBF (using cutting-edge MRI) in older adults. Therefore, MRI is an indispensable component of the project. It will be performed in the Mind, Brain and Behavior research center (CIMCYC).

2. Equipment required

The equipment required for this evaluation will be as follows:

- Earplug
- A change of clothes to be done after the exercise condition.
- Annex7.1MRI_Instructions_for_MRI_acquisition
- Annex7.2MRI_compatibility_questionnaire
- Annex7.3MRI_quality_control
- Annex7.4MRI_Instructions_for_MRI_acquisition_spanish

2.1. MRI scanner

The scanner to be used will be the one belonging to CIMCYC and it is a 3 Teslas scanner Magnetom Prisma Fit system (Siemens Medical Solutions, Erlangen, Germany) **(Figure 1).** The coil has 64 channels. To ensure maximum visibility of the screen, the lights in the **evaluation room should be turned off during the scan**, in exceptional cases for the participant's comfort the lights can be left on.

Figure 1. MRI scanner

3. Protocol for each visit and MRI sequences:

Figure 2 shows the protocol for each visit/condition. Three different sequences will be implemented:

a) **T1-weighted MPRAGE:** a structural sequence to coregister the pCASL and to delineate specific regions of interest for CBF analysis. This sequence will be performed only once at pre-condition in the 1st condition.

b) TOF: This sequence allows us to identify the carotid arteries. It highlights the flowing blood while suppressing signals from stationary tissues. This sequence will be performed twice per visit, at pre-condition and post-condition.

c) PCASL-resting: a sequence to determine CBF in resting condition. This sequence will be performed once (pCASL-0) before each condition, and three times (pCASL-1,2,3) after each condition.

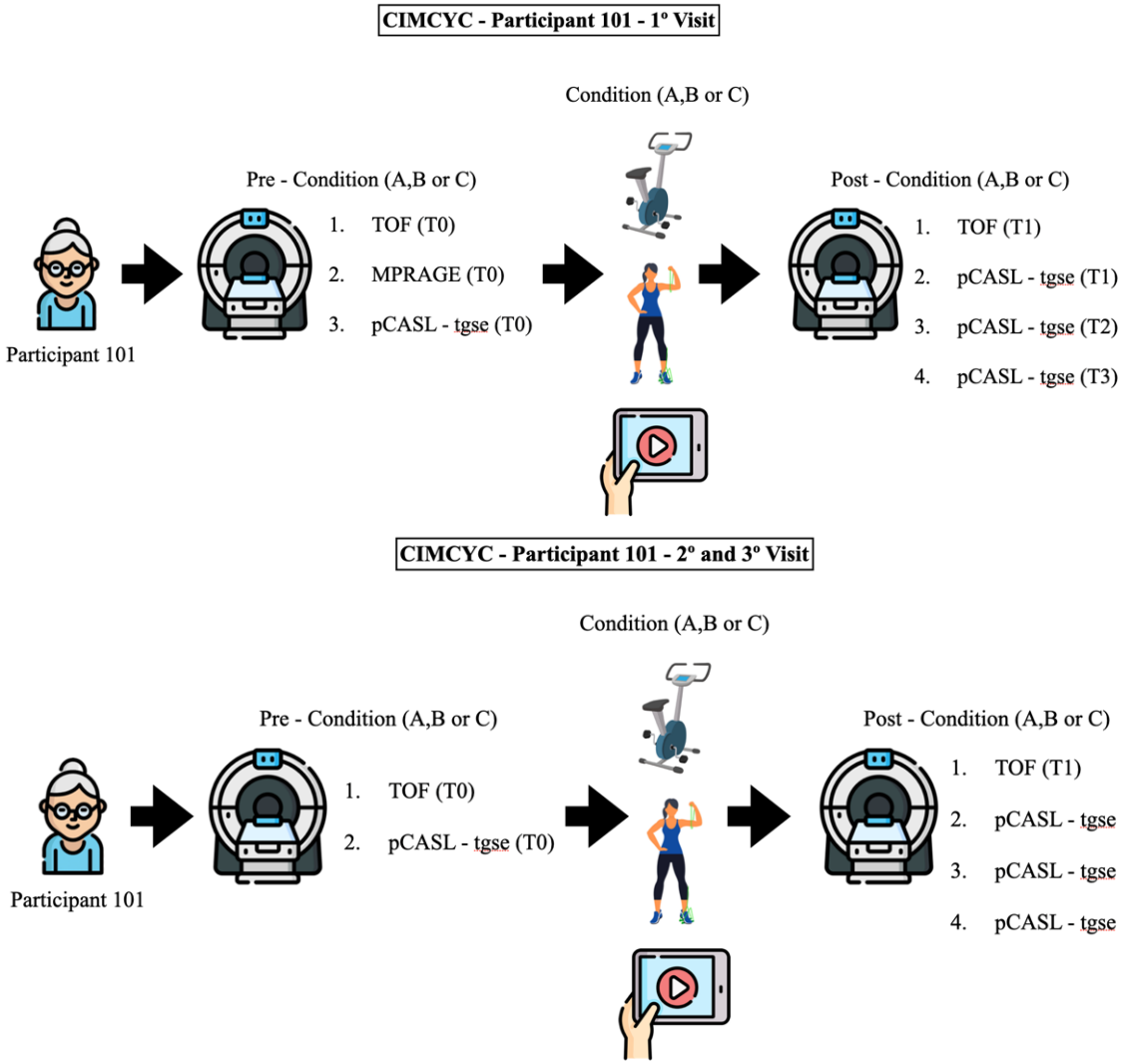

Figure 2. Protocol for each session/visit.

Acquisition parameters for each sequence are detailed in **Table 1.**

Table 1. Acquisition parameter

Sequence/Parameter	AT (seg)	Nº of sclices	TR (ms)	TE (ms)	TI	Flip angle (grades)	Postlabeling delay (s)	Labeling duration (s)	Labeling efficiency	Slice thickness (mm)	Voxel size (mm)	FOV (mm)	Orientation	What on projector?
Secuencia/Parametro	Tiempo de Adquisición	Nº de cortes	Tiempo de repeticion	Tiempo eco	Tiempo de inversion	Angulo de giro		Duración del label		Grosor del corte	Tamaño del voxel	Campo de vision	Orientacion	¿Qué aparece en la pantalla?
Localizer	10	-	-	-	-	-				-	-	-	-	
Head Scout	14	-	3.15	1.37	-	8				1.6	1.6 x 1.6 x 1.6	260	sagittal	Cruz de fijación
fl3d_tra_p3_2-slab	46	-	19	2.82	-	18				1.24	0.8 x 0.8 x 1.2	200	Transversal	
MPRAGE	398	224	2400	2,31	1060	8	-	-	-	0,8	0,8 x 0,8 x 0,8	256	sagittal	
pCASL	431	40	4100	36.8	3.5-2.0-2.0-2.5-2.5-3.0-3.0-3.5-3.5-3.5-4.0-4.0-4.0	120	2.0-0.5-0.5-1.0-1.0-1.5-1.5-2.0-2.0-2.0-2.5-2.5-2.5	1.5	0.7	3.0	2.5x2.5x3.0	240	Transversal	Cruz de fijación
Total en minutos	15,0													

4. Evaluation procedure before conditions

4.1. MRI compatibility

Previous to the MRI evaluation, it is of importance to assess that **the participants are still MRI compatible**, and nothing has changed from the last Agueda MRI scan. For that reason, a series of questions about surgeries and operations, injuries involving metal objects, metal-containing implants such as shunts or other metal devices will be asked during the familiarization session at iMUDS (Annex7.2MRI_compatibility_questionnaire).

- Situation 1: **the participant is found to have a new metallic device** implanted in their body and **is aware that their device is safe** for MRI

Then, further information regarding the device, including the make, model and location on the body will be needed to send to the radiologist (jpmbhg@hotmail.com). Finally, the radiologist must confirm the compatibility of the device for the MRI by sending to the MRI technicians (rmf.efr@ugr.es) an email with the participant ID to make the final decision. This information should be obtained as quickly as possible so as not to delay the evaluation and at the same time ensure that the participant is safe to continue in the study. All this is intended to avoid the participant signing consent to begin the evaluations and then encountering a delay while information is obtained about the safety of the metallic device implanted in his or her body.

- Situation 2: the participant **has become incompatible to MRI** in the last two years.

After following the above-mentioned steps and be sure that the participant has become incompatible to MRI, another participant will be called to be evaluated as explained in Chapter3.Recruitment

4.2. MRI scanner booking

Two previous weeks to the evaluation, the evaluator in charge of the MRI session will book the MRI scanner following these steps:

1. Go to the CIC webpage https://intranet-cic.ugr.es/acceso.php
2. Write the following credentials: Selecciona el tipo de usuario: Usuario UGR. Credenciales de acceso
3. Go to the "*Resonancia magnetica functional"* menu you can find in the left side of the screen, in the penultimate position of the list.
4. Mark those days and time ranges you need.
5. Go to the "*Peticion de servicio"* menu you can find in the left side of the screen, in the first position of the list.
6. Select the *Centro de gasto:* 30BE55F101
7. Write *"flADex mri – Irene Esteban Cornejo"*
8. Check *"He leido y acepto las condiciones."*
9. Copy the **code** that it generates and paste it in the *Resonancia magnetica funcional* menu.
10. Confirm the booking

One previous week to the evaluation, the evaluator in charge of the MRI session will check that the MRI scanner was book correctly.

4.3 Information given to the participant

The participant will be previously informed about important aspects to take into consideration one day before going into the MRI scan in the Annex6.3. Instructions for conditions.

4.4 Information given to the technician

At least three days previous to the evaluation, the evaluator in charge of the MRI session will inform the technicians via email (rmf.efr@ugr.es) about the date and time of the sessions, the participant ID and the visit (1, 2, or 3) and if there is something important to consider regarding any of the participants. Further, the MRI compatibility questionnaire completed per participant in the familiarization visit will be attached.

WEDNESDAY, JANUARY 24th
12:30_ID_Visit-(1-2-3) _important-information
13:30 _ID_ Visit-(1-2-3) _important-information
13:30_ID_ Visit-(1-2-3) _important-information

In addition, to perform the MRI scan, the technician has a Spanish version of the document Annex7.1MRI_Instructions_for_MRI_acquisition which will be the one to follow. Additionally, the technician has been given the PDF file and the file with extension ".exar1" to be loaded in the MRI device and start the project sequences.

5. Evaluation day procedure

1-/The evaluator takes the participant to the 0-floor, where the MRI scanner is.
2-/Before the first MRI scan, the evaluator will tell / remind the participant:

- To keep awake, calm and quite during de evaluation.
- To remove anything with metal in it if it was not done before wards.
- To wear the earplugs
- The communication with the technician will be active during the evaluation.
- If the participant is a woman, we will remind her to remove her bra if it is not a sports bra or has wires or metal elements.

The participant will have the chance to ask any doubt that can arise.
3-/Every time a session/run is acquired, the evaluator will report in REDcap information regarding the technician's name, the date, the starting / ending time of each pCASL-tgse and the starting / ending time of each session. The evaluator will check that **each of the 7 sequences of the CIMCYC - first visit** (MPRAGE, TOF-T0,T1, pCASL-tgse-T0,T1,T2,T3) **and the 6 sequences of the CIMCYC – second and third visits** (TOF-T0,T1, pCASL-tgse-T0,T1,T2,T3) have been completed and will report if there was any problem during the acquisition or any important information to consider for the posterior analyses.
Situation 1: The pCASL-tgse presents artifacts / looks blurred because of movement. (i.e. problem with the MRI scan or any issue with the participant) and **NO MORE** than **15 minutes** has been spent from the acquisition of the previous pCASL
Solution: The pCASL-tgse will be acquired again in the same session if **NO MORE** than **15 minutes** has been spent from the acquisition of the previous pCASL.
The evaluator will note in redcap the reason for the repetition in the same session and the time delay of the acquisition regarding the previous pCASL-tgse sequence.
Situation 2: The pCASL-tgse presents artifacts / looks blurred because of movement. (i.e. problem with the MRI scan or any issue with the participant) and **MORE than 15 minutes** has been spent from the acquisition of the previous pCASL
Solution: The whole visit will be repeated again as this sequence is condition – dependent (i.e. the main aim of the study is to examine the acute effect of a single bout of moderate aerobic exercise (A) vs. resistance exercise (B) vs. resting condition (C) on CBF).
The evaluator will note in redcap the reason for doing an additional visit.

5.1. Earing problems

Some older adults may come to the MRI session with hearing aids. Depending on how bad their hearing is, after they remove their hearing aids upon entering the MRI room, they may have trouble hearing over the microphone while being given directions. If this is the case with any participant, as many directions as possible should be given before they get into the MRI scanner.

5.2. Slice selection for sequence

All sequences will have the same slice selection which will be aligned with AC/PC and configured from the first field map.

5.3. Incomplete MRI scan

There is a possibility that a participant may not complete the entire MRI scan and exit the scanner early. The participant may become fatigued or begin to have anxiety after being in the scanner for only a few minutes. If this is the case, it should be documented on the MRI instrument notes site in REDcap. Considering this, this situation should be reported to the project coordinators ASAP to make the decision as to whether this participant can continue or should be reported as no longer eligible to continue in the study.

6. Post-evaluation day procedure

6.1. Data exportation

The transfer of the images adquired during the MRI session will be carried out **immediately after each visit.** Images will be placed in /Users/heartybrain/MRI_data_raw/Fladexplito230924 under the format shown in figure 3.

Figure 3. Structure folders received from technician

1. The technician logs into the server smb://profith2.ugr.es with the username:xxxx and the password:xxxx
2. The technician will have access to a folder called MRI_data_raw, in where he will upload the folders with the DICOM files corresponding to each participant and session.
3. The person in charge of MRI will check all DICOM files have been correctly uploaded in the server before leaving cimcyc.

6.2. REDcap verification and quality control after each visit.

After each visit, the following steps will be performed:

1. REDcap verification: Check that all MRI images are correctly uploaded in the server and verify it in REDcap (ACP).

2. Quality control: Quality control filters and visual inspection of the sequences will be performed by ACP (MPRAGE) and LSA (pCASL,TOF) on the automated data which are described in the MRI quality control chapter (See **Annex7.3MRI_quality_control)**.

7. Annex index

- Annex7.1MRI_Instructions_for_MRI_acquisition
- Annex7.2MRI_compatibility_questionnaire
- Annex7.3MRI_quality_control
- Annex7.4MRI_Instructions_for_MRI_acquisition_spanish