Landmark Annotation Instructions

Anatomical landmarks on pelvis MRI images in 3D Slicer

1 Overview

In task 1, you will annotate anatomical landmarks on pelvis MRI images. You will use 3D Slicer and provided bone segmentations will help you find the landmarks.

For each subject assigned to you, you will:

- Load the MRI image, the bone segmentation and the landmark template (section 3).
- Annotate 10 landmarks on the right side and 10 landmarks on the left side, 20 in total (section 4).
- Check and save the landmarks (sections 5 and 6).

When all your subjects are done, check your landmark files, zip them and email them to the organizers (sections 7 and 8).

2 Before getting started

All the files you need are provided on the **Resources** page of the CLAP Challenge:

Table 1: *Downloads.*

File	Content
Annotation_Instructions.pdf	This manual
Landmark_Definitions.pdf	Landmark definitions with illustrations
Annotation_Workflow.mp4	Video of the annotation workflow
Landmarks_Template.seg.nrrd	Empty landmark template
Subjects.pdf	The subjects assigned to each participant
CLAP_2027_Task1.zip	Dataset on Zenodo containing two folders: • **Images**: MRI images (001.nii.gz, …) • **Segmentations**: bone segmentations (001.seg.nrrd, …)

Do these steps once, before you annotate your first subject:

1. Download all the files listed above from the **Resources** page https://discourse.caos-international.org/t/resources/45
2. Request access for the dataset on Zenodo, download and unzip it: https://zenodo.org/records/23736184

3. Install the latest stable version of 3D Slicer:
   https://download.slicer.org/
4. Read the **Landmark_Definitions.pdf**. It describes where each landmark is located, with illustrations.
5. Open **Subjects.pdf** and find the row of your participant number (for example **P01**), which you have received from the organizers. Identify the subjects assigned to you and annotate only those subjects.
6. Create an empty folder for your landmarks named after your participant number, for example **P01_Landmarks**.
7. Watch **Annotation_Workflow.mp4**. It shows the workflow of sections 3 and 4 in 3D Slicer.

3 Load the data

Do the following steps for each subject assigned to you (this example uses subject 001):

1. Open 3D Slicer.
2. Go to **File → Add Data** and click **Choose File(s) to Add**.
3. Select three files:
   - Images/001.nii.gz
   - Segmentations/001.seg.nrrd
   - Landmarks_Template.seg.nrrd
4. Check the **Description** column: the image must be loaded as **Volume** and the two .seg.nrrd files as **Segmentation**. Click **OK**.
5. To show the bones in 3D, open the **Data** module, right-click the bone segmentation and select **Create Closed Surface Representation**.

4 Annotate the landmarks

Sections 4.1 and 4.2 explains the landmark annotation procedure using Segment Editor module in 3D Slicer. You need to setup the Segment Editor as explained in the subsequent sections. You may also refer to Figure 1 for visual help.

4.1 Set up the Segment Editor

1. Open the **Segment Editor** module.
2. Set **Segmentation** to **Landmarks_Template** (Fig1, 1).
3. Set **Source volume** to the MRI image (Fig1, 2).

4. Activate the **Show 3D** button (Fig1, 3).
5. Select the **Paint** tool (Fig1, 4).
6. Activate **Sphere brush** and **Edit in 3D views** check boxes (Fig1, 5-6).
7. Expand the **Masking** section and set **Modify other segments** to **Allow overlap**. (Fig1, 7).

4.2 Paint each landmark

1. In the segment editor's list, select a landmark, for example **01_ASIS_RIGHT** (Fig1, 8).
2. Paint the landmark in the **3D view** or in the **slice views**. How you paint depends on the landmark type:
   - **Point:** Set the brush diameter to **3 mm** (absolute, not relative) (Fig1, 9-10). Click once at the exact location on the bone surface. Do not drag the brush.
   - **Area:** Set the brush diameter **between 3 mm to a maximum of 7 mm** (absolute, not relative) (Fig1, 9-10), based on the size of the area you need to paint. Drag the brush and paint the whole area on the bone surface.

> **NOTE 1: Overlapping Landmarks**
>
> Some landmarks overlap, for example **[05,10]** on the trochanter minor, **[06, 07]** on the trochanter major, and **[08, 09]** on the ischial tuberosity.
> Before you paint one of these landmarks, **hide** the overlapping ones by clicking the eye icon  next to them. Otherwise, the brush paints on the surface of the visible landmark instead of on the **bone** surface. When you are done, **show** them again.

> **NOTE 2: Painting Over the Same Region More Than Once Is Fine**
>
> When annotating some landmarks in 3D Slicer, you may need to paint over the same region more than once, for example to correct or extend a marking. Each pass adds to the marking, so it can end up thicker than you intended. This is fine and won't affect the evaluation: the analysis only uses the part of each marking that overlaps with the bone segmentation, and any extra thickness outside the bone is ignored.

> **NOTE 3: Left and right**
>
> In the image views, the patient's **left** side is shown on the **right** side of the screen, and the patient's **right** side is shown on the **left**.
>
> Make sure you paint each landmark in the correct anatomical RIGHT or LEFT side.

3. To review a landmark you have already painted, right-click on the landmark in the segment list and select **Jump slices**. The slice views will move to that landmark's painted region.
4. If necessary, use the **Erase** tool to trim a landmark, or right-click the landmark in the segment list and select **Clear selected segments** to clear it completely.
5. Repeat for all 20 landmarks.

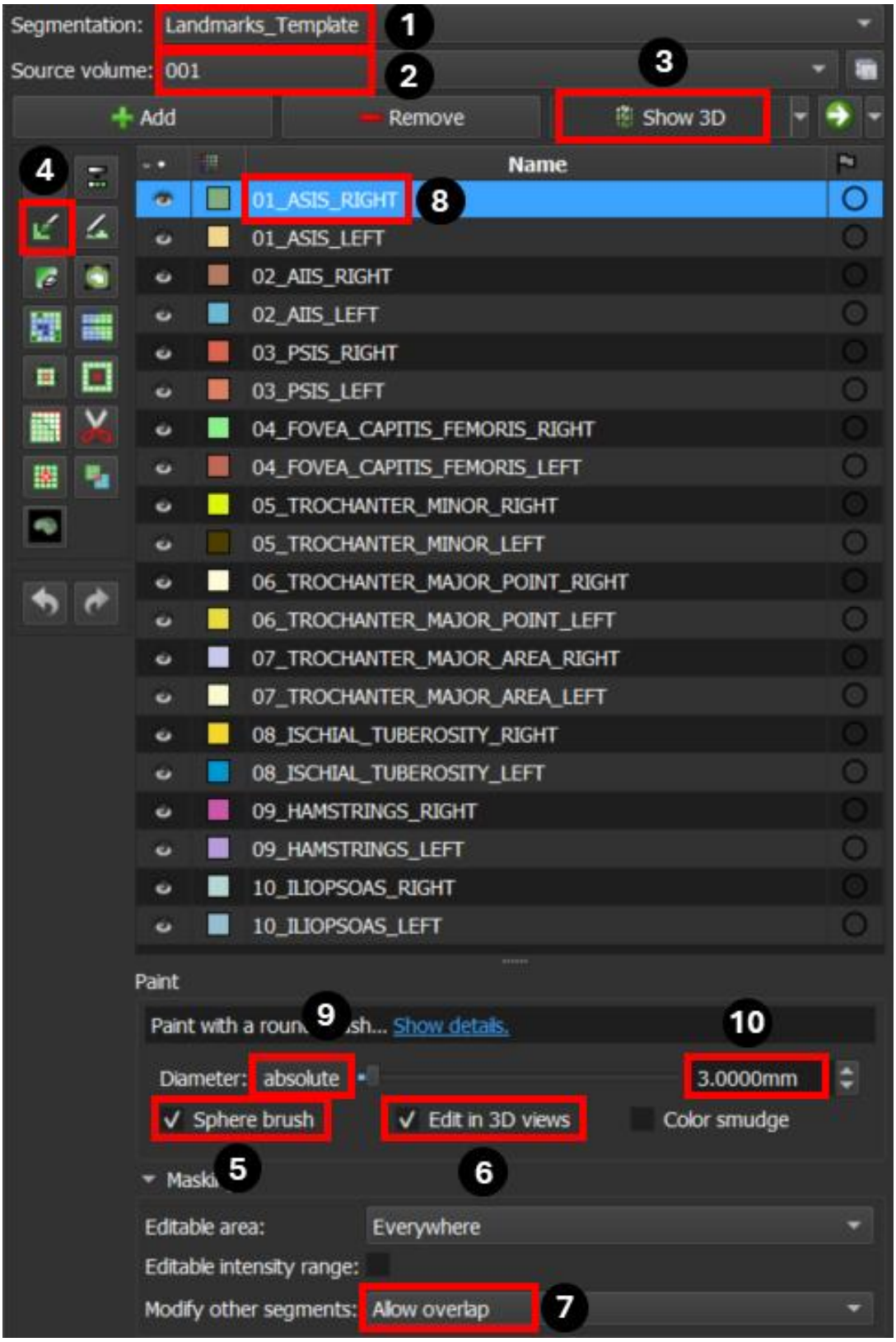

Figure 1: *Segment Editor's settings for landmark annotation*

Table 2: *Landmark list. Each landmark is defined on the RIGHT and LEFT side.*

No.	Landmark	Type
01	ASIS (Anterior Superior Iliac Spine)	Point
02	AIIS (Anterior Inferior Iliac Spine)	Point
03	PSIS (Posterior Superior Iliac Spine)	Point
04	Fovea capitis femoris	Point
05	Trochanter minor	Point
06	Trochanter major	Point
07	Trochanter major	Area
08	Ischial tuberosity	Area
09	Mm. Hamstrings	Area
10	Mm. Iliopsoas	Area

5 Interim check

Before saving and moving to the next subject, check that:

1. The correct MRI image and bone segmentation were loaded.
2. All 20 landmarks were annotated on the correct side.
3. Each “Point” landmark is a single click at the exact location, and each “Area” landmark covers an area.
4. The landmark annotation follows **Landmark_Definitions.pdf**.

6 Save the landmarks

1. Open the **Data** module, right-click **Landmarks_Template** and select **Export to file...**
2. Set the file name to the subject ID, for example **001**, and keep the export format **.seg.nrrd**. The file is saved as **001.seg.nrrd**.
3. Set the folder to your landmarks folder, for example **P01_Landmarks**.
4. Click **Export**.
5. Before the next subject, go to **File → Close Scene**.

Then start again at section 3 with your next subject. When all your subjects are done, continue with section 7.

7 Final check before submission

Check that your landmarks folder has one landmark file for each subject and that each file name matches its subject ID, for example **001.seg.nrrd**.

8 Submission

Zip your landmarks folder (for example to **P01_Landmarks.zip**) and email the zip file to:

biomechanics@caos-international.org