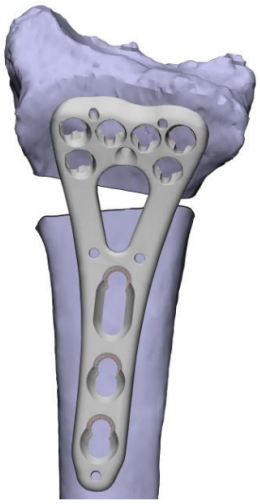
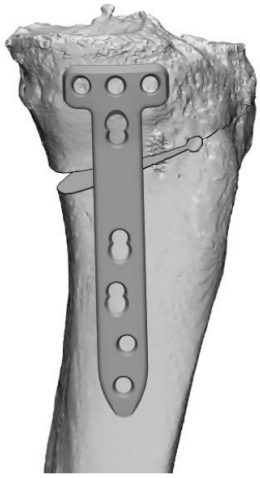
Documentation for MATLAB app

Plate positioner

Bouwen, I. (s2277042), Hoogstrate, L. (s2480433)
Tromop, C.R.L. (s2492539), Verhulst, D.A. (s2268124)





Technical medicine assignment

Technical Medicine
University of Twente
Netherlands
June 26, 2023

Supervisors:
dr. R.A.G. Hoogeslag
prof. dr .ir. G.J.M. Tuijthof
MSc. Q.W.T. Veerman
MSc. C.J. Smees

1 Input for the app: surgical window

The surgical window has to be cut out in 3-matic. You have to use the postoperative tibia, so with the wedge already planned, as the imported file. Using the *"Brush Mark, Wave"* tool under *"Mark"* you can select the right areas described below. See figure 1 for the example of what the surgical window should roughly look like.

- **Lateral limit.** The lateral limit is the tuberosity of the tibia, because that is where the patellar tendon attaches to the bone. It is important that the surgical window is cut out exactly along the edge of the tuberosity and, when you are past that, with a straight line downwards.
- **Medial limit.** The medial condyle of the tibia is the medial limit, because that is where the medial collateral ligament (MCL) attaches to the bone. The boundary of the surgical window is a little bit harder to define here than at the tuberosity, since the medial condyle has a larger area and the MCL attaches somewhere there without an obvious landmark. We decided that the limit should be halfway through the condyle. So, if you have a frontal view to the tibia, turn it 45 degrees to medial, so now you look straight at the medial condyle. Now you can select the surgical window halfway through there with a straight line downwards. For more clarity, see figure 1.
- **Proximal limit.** The proximal limit is the tibia plateau. It is important that the surgical window gets cut out at exactly the edge and that therefore the tibia plateau itself is not included.
- **Distal limit.** Since there are no restrictions in the distal area, the length of the surgical window is determined based on the length of the plate. To have enough margin, we have determined that the length of the surgical window should be around 140 millimeter from the tibia plateau downwards. You can measure this length in 3-matic with the *"Distance"* tool under *"Measure"*.

Once you have determined all the boundaries, the next step is to fill in the entire surgical window. At the wedge, it is important to include only the border, and not the plane adjacent to it into the bone. Furthermore, it is important that the whole selection is filled in completely, and that no individual triangles are left blank.

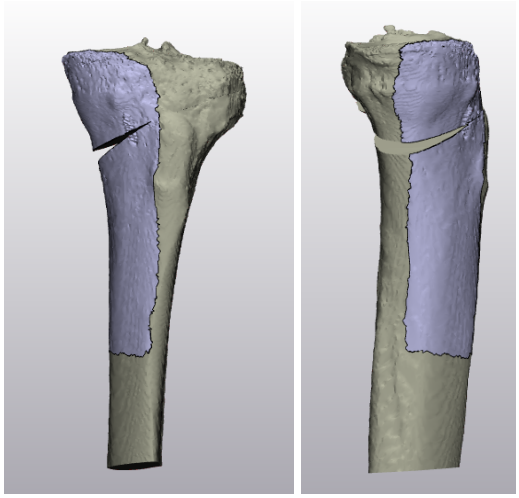


Figure 1: In blue the selected surgical window on the tibia of patient 1. Left a frontal view, right medial.

2 Workflow

When using the app there are a few steps to follow to make sure it works correctly. In the case you load a wrong model please restart the app to make sure there are no errors or unwanted results.

1. **Load the post-op tibia.** Here it is preferred to use only the top half of the bone as this makes the program run much faster. Do make sure that the proximal end of the mesh is closed. If this isn't the case this can give errors or unwanted results.

2. **Load the cut out surgical window.** Make sure this is selected in the way as described in section 1. Before being able to load a surgical window make sure you have selected whether it is a left or right knee. If it's a right knee the window will be flipped to a left knee in the next pop-up. This is because of the way the program works. All results will of course be for a right knee if this is selected. In this **pop-up after loading the surgical window** you need to select the osteotomy. This is necessary for determining the output parameters later. The program will ask you to enter in three points. These are: the upper-left, the lower-left and the innermost point of the osteotomy. The order in which this is done does not matter.

3. **Load the plate.** Loading the correct plate here is very important! Don't just use any plate but be sure to **use the provided one.** This is critical for the correct functioning of the program!

4. **Adjust the input parameters to your needs and wishes.** The pre-programmed values give a good starting point. We recommend changing them after the first run through the program so you have a feeling for what the parameters do.

5. **Run the program.** When you have loaded all necessary models and adjusted the parameters to your needs you can run the program. Note that this can take a while and vary significantly. From five minutes on a fast computer with narrow parameters till an hour on a slow computer with broad parameters.

6. **Placed plate.** After the program has finished computing it will show you the plate position it calculated along with its output parameters. You can use these to check if they match your needs and wishes. If not you can tweak the input parameters and run the program again. Keep doing this until you are satisfied with the outcome.

7. **Export placed plate.** When you are satisfied with the plate position the program calculated you can export the stl-file. To do this you first adjust the name of the file to save. After this click the "Export plate position" button. Next, select the folder to save the stl-file in. When exporting the stl-file the program also automatically saves a .mat structure with all corresponding parameters. This is done with the same name as the stl-file with the addition of '_parameters'.