COMPARISON STUDY USING IMAGISTICAL TOOLS BEFORE AND AFTER SURGICAL INTERVENTION

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Abstract: The purpose of this paper is to demonstrate that using a tomographic image processing program can emphasize its health improvements after appropriate treatment (medical or surgical). This study regards the realization of an abstract model of a knee joint disease, synovitis. For this there was used a set of tomography images from an anonymous patient. After the realization of the model it was done some measurements to highlight the results obtained after the surgery compared to ones before surgery. The software that was used is MIMICS and the set of tomographic images are from a sitting knee before and after surgery.
Keywords: MIMICS, synovitis, CT

1. INTRODUCTION

Since the dawn of modern medicine, doctors were concerned about studying in detail the human body in terms of composition and functionality, as well as the links between systems and subsystems that compose it, to intervene specifically for each condition in part.
The first method of investigation was the dissection of corpses, method condemned by the church.
The crucial moment in the field of non-invasive medical investigations is the discovery of X-rays this time has developed a wide range of investigations based on the same principle.
Currently it is very important that the images acquired using the apparatus of medical imaging can be processed in such a way that the result is easily understood primarily by the doctor (to establish diagnosis and treatment) and from the point of view of the patient, the relationship between doctor and patient is an important aspect of modern medicine.
The role of medical imaging processing software is to: help the doctors in better understanding of the human anatomy and the pathology [1, 2, 3]; help in developing new technics and optimization of surgery; help in prosthetic prototyping; help in case of a high risk surgery it allows to the surgeons to exercise for better understanding of the organ anatomy before the surgery starts
MIMICS is a software specialized to generate anatomical models [4] and analysis of CT (Computer Tomography) images. It allows to import different types of image formats like: DICOM, TIFF, JPEG, and BMP.
Synovitis is an autoimmune disease that causes an inflammation of the synovial membrane. Synovitis has several causes such as arthritis or rheumatic resulting from trauma.
Diagnostics condition of synovitis, in addition to clinical presentation (hot joint, reddened and swollen), consist of the analysis of synovial fluid.
Synovitis is treated with anti -inflammatory drugs. Another treatment is surgical, as in this case of patients suffering from left knee.

2. EXPERIMENTAL METHOD

Mimics (Medical Image Segmentation for Engineering on Anatomy) is a software developed by Materialise for processing medical images. This program is used for 3D medical image segmentation from CT, MRI (Magnetic Resonance Imaging), micro -CT, etc. The software has its applications in different medical areas like: orthopedics, cranium - maxillofacial, cardiovascular, etc.

After the 3D modeling, the virtual model can be printed using a 3D printer offering the possibility to obtain the physical model.

In what follows we used tomographic images for viewing results before and after an operation on left knee, suffering from synovitis.

To carry out the practical test we followed certain steps, knee scans both before the operation and after the knee surgery to finally compare them.

The steps are:

1. Importing images. Importing tomographic imaging is performed in software "Mimics "by going to "File" menu and selecting "Import Images".

2. Select tomography directions and area of interest. These directions are selected based on anatomy. After their selection we will see the three dimensional planes (sagittal, transverse and front (figure1, figure 2)) of the knee.
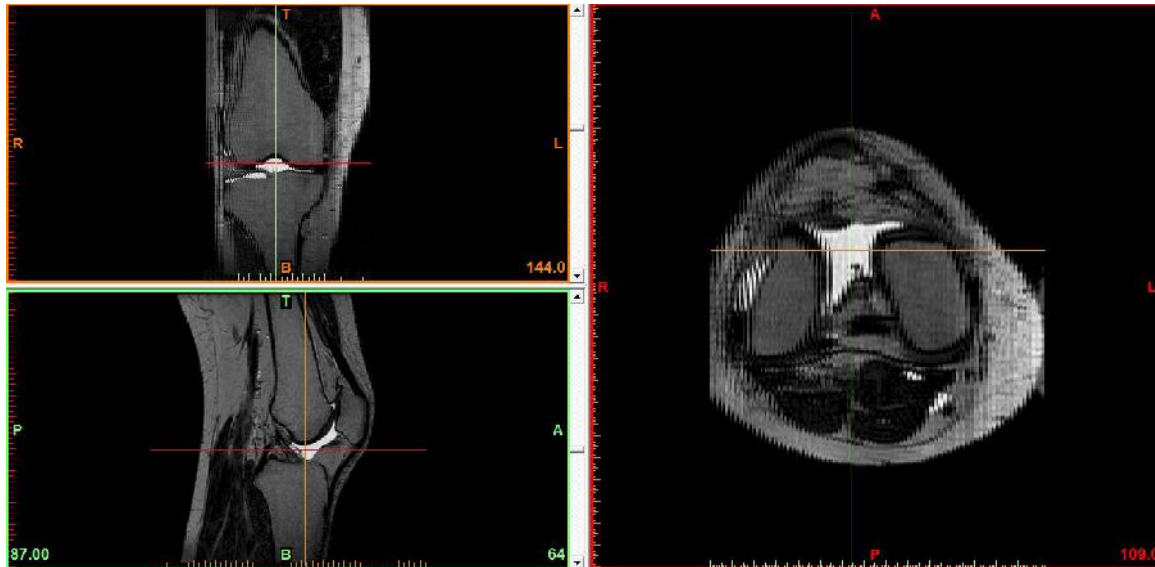

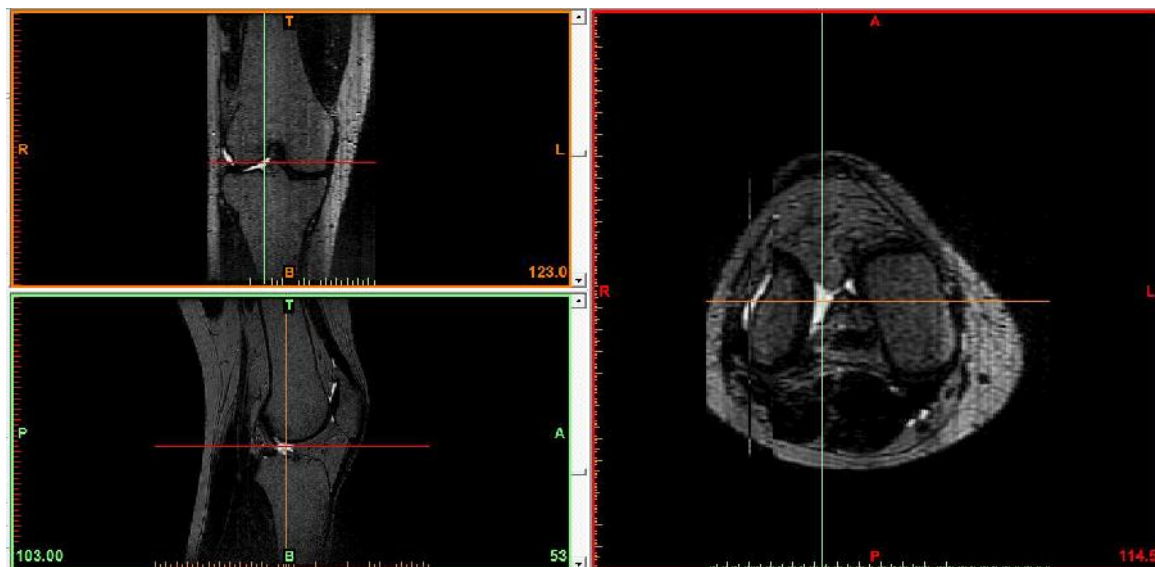**Figure 1:** Before surgery. The area of interest left knee.

Figure 2: After surgery. The area of interest left knee.

3. "Thresholding". Following the selection tool select the area of interest "thresholding" from the "Segmentation". This tool is used for classification of pixels which is a target value measured in Hounsfield. By selecting these pixels it results a "mask" (figure 3, figure 4) containing all the pixels with the same Hounsfield value selected (2207- 3056 HU).

Figure 3: Before surgery. Sagittal plane with green "mask" (selecting the area of interest).

Figure 4: After surgery. Sagittal plane with green "mask" (selecting the area of interest).

4. Create 3D model. With "Region Growing" (figure 5, figure 6) and "Calculate 3D" (figure 7, figure 8) successively tool the software generates the necessary model of the previously selected area of interest from the CT images of the knee.

Figure 5: Before surgery. The result (yellow mask) after using the command "Region Growing" in the frontal plane.
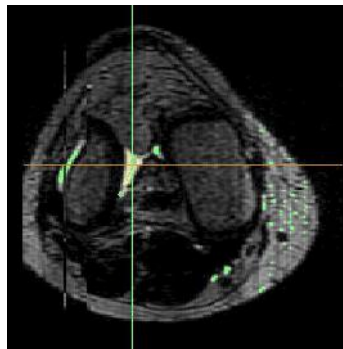

Figure 6: After surgery. The result (yellow mask) after using the command "Region Growing" in the transversal plane.
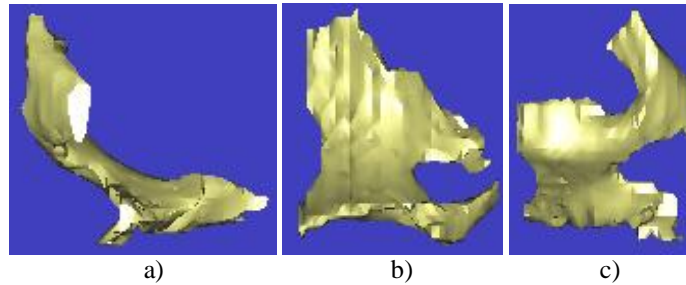
Figure 7: Before surgery. Different perspectives of the 3D model: (a) – sagittal plane left view; (b) – transversal plane above view; (c) - Front plane front view.

Figure 8: After surgery. Different perspectives of the 3D model: (a) – sagittal plane left view; (b) – transversal plane above view; (c) - Front plane front view.

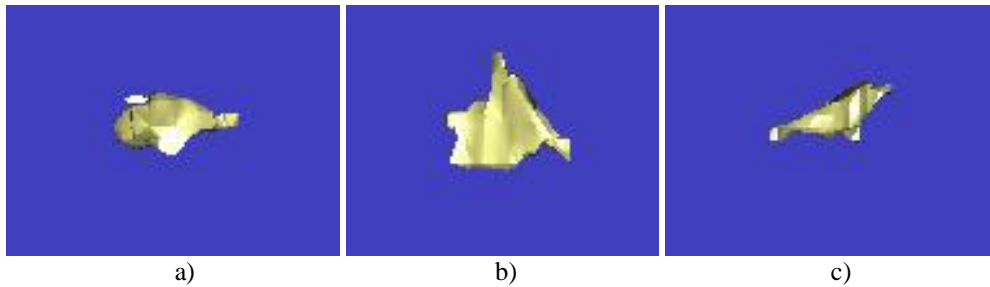5. Measure the 3D model. Measuring 3D model is necessary because in the end we will compare results of scans before and after the operation. The tool used is: "3D Measure Distance".

6. Comparing the morphology of the patient's knee.

3. CONCLUSION

According to the measurements performed on the model it was found a reduction of 65% of the synovial liquid. Besides this there is a visual difference between the two situations suggesting that the surgery had a great impact on the outcome of the initial diagnosis.

Tomographic imaging program has fulfilled the main function of which was to highlight the surgical removal of inflamed synovial fluid.

CT images in imaging software are increasingly used by the doctors. Creating databases structured on organs and diseases would allow, in the future, doctors to make diagnosis more quickly based on comparing patient stored images. This comparison can be done using computer models created and based on the images in the database.

In conclusion tomographic imaging software have an important role in every stage: diagnosis, treatment and control. The diagnostic accuracy of the image allows the doctor to take the best decisions for each case.

4. ACKNOWLEDGMENT

REFERENCES

[1]   Willi A. Kalender (2005) Computed Tomography. Ed. Corporate Publishing;

[2]   Cornelius T. Leondes (2005) Medical Imaging Systems Technology; Methods in General Anatomy. Ed. World Scientific;

[3]   Otto H. Wegener (1992) Whole Body Computed Tomography. Ed. Blackwell Scientific Publications;

[4]   Anderson, N. (2007) *Empirical direction in design and analysis*. Mahwah, NJ: Erlbaum.