

# Device for Testing of Biological Material

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## I. INTRODUCTION

The conjunctive formations which stand at the basis of the ligamentous apparatus of different organs and systems, consists of dynamic structures which react promptly at multiple factors of both the internal and external environment. The structure of these ligaments and their biomechanical properties are a reflection of the morpho-functional of the viscera in different periods of life, normally and pathologic.

Considering the fact that the information concerning the interest problem is not sufficiently described in the specialty literature, we decided to make an analysis of the biographic data about the biomechanical properties of conjunctive tissue with similar structure with the ligamentous apparatus of the spleen.

Peritoneal coats, collected from bovines are characterized by a high elasticity [1]. The average tearing force which goes to a square mm in cross section of the peritoneal slides is equivalent to 6-7 kg. Their presence varies from 12-20% against the initial length of the studied probes.

The extension degree and the tearing force of the aortic wall diminishes with aging by 2-2,5 times [2]. The most extensible are the ascending and abdominal portions, less extensible - stick and descending thoracic portion of the aorta.

Our data [3] states that the greatest force applied at the extension (longitudinally determined), which can be supported by the ligament's slide of uterus from the lot with the age from 41-48 years, is equal with  $20,48 \pm 3,65$  N. The necessary effort for the tearing of the implied ligamentus diminishes with the age, reaching  $7,21 \pm 1,7$  N (after 67 years).

Thus, according to the results obtained (4), and the error values peak loads, caused by enlargement of the coronary ligament of liver samples in all age groups of males (I (17-35ani)  $-14,97 \pm 1,3$  N) (II (36-60 years)  $-16,83 \pm 4,1$  N), (III (> 60 years)  $-15,68 \pm 1,3$  N), average values take precedence over those indices for women taken (I (35ani 16)  $-12,93 \pm 1,7$  N), (II (36-55ani)  $-12,90 \pm 0,7$  N), (III (> 55ani)  $-13,72 \pm 0,9$  N), statistically significant differences have not been determined ( $p > 0,05$ ).

## II. STRUCTURAL SCHEME AND THE DESCRIPTION OF THE DEVICE

The device has a color screen for displaying the data. The internal memory allows saving the results for almost 80 measures, the connection with the computer allows transferring data, for their visualization as a diagram with the help of some special software.

The external look of the device can be seen on Figure 1.



Fig.1. Device for testing of biological material

The device is made of modules. The main one is the microprocessor. His functions are:

- directing the stepper motor;
- tensile force measurement;
- measurement of data and displaying it on the menu screen;
- measurement of data and storing it in the memory.

Sensor used for measuring tensile force is a tensi-metric resistive transducer in the shape of a balanced bridge strain gauge Wheatstone. The exiting signal from the bridge varies proportionally with the tensile force. This signal has low-voltage values – 20...30 mV, this is why it must be amplified with the help of an instrumentation amplifier. The amplified signal is applied at the entrance of the module Converter Analog Digital from the structure of microprocessor for subsequent digital processing.

Stepper motor is a synchronous motor type with apparent poles on both armatures. At the apparition of the command signal on one of the stator poles, the rotor will move until his poles will be aligned in front of the opposite stator poles. This type of rotor rotation is basically from pole to pole.

Motor command is done electronically and displacements are obtained for the well-known motor, which allows us to make strains of the ligaments for a specific length. The microprocessor operates the motor coils using the drivers - controlled circuits for the excitation coils.

The display device is designed to display the device menu, of the measured data and the device status.

Command buttons are necessary for the navigation in the device menu, in manual movement of the mobile arm and to start the measurements automatically.

The memory is necessary for the storage of data. During the measurements, values are saved at every step of tensile strength selected by the user. Connecting the device to the computer you can copy data from the device database, can process them using specialized program, view and print the dependence of tensile force on length stretch.

The internal structure of the device is shown in Figure 2.

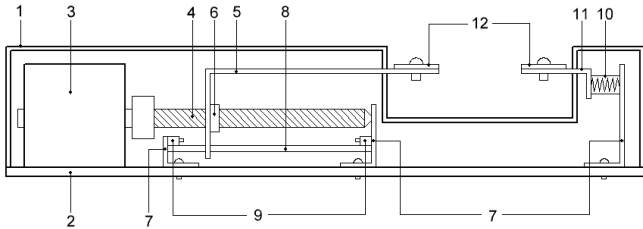


Fig.2.

- 1 – carcass of the device;
- 2 – the platform of the device;
- 3 – a step motor;
- 4 – threaded rod;
- 5 – movable arm;
- 6 – nut;
- 7 – metal mounting bracket;
- 8 – rod;
- 9 – stopper;
- 10 – strain gauge;
- 11 – immovable arm;
- 12 – determining sample clips;

The device for testing of biological material contains a carcass (1), mounted on a platform (2), on which is placed a step motor (3), the shaft of which is connected to a threaded rod (4), on which is mounted by a nut (6) a movable arm (5). One end of the movable arm (5) is freely mounted on a rod (8). On the platform (2) is fixed a strain gauge (10), connected to an immovable arm (11). At the ends of the movable (5) and immovable (11) arms are mounted two clamps (12) for fixations of biological material.

In automatic mode investigations over the biological material, the step motor will make a movement of the moving arm with the step selected by the user, after which it will perform tensile force measurement. Measured force value will be displayed on the screen and stored in the internal memory device, and further can then be transmitted to the computer. At the same time seeking the maximum force, which will break the force investigating the biological material. During the detection of maximum force, the stretch length value is also saved.

Investigation process is interrupted when you press "Stop" or trigger switches to limit arm movement (Stoper). After stopping the investigation process, the screen will display the value of breaking force and length.

The menu allows the device to view the force and length during the investigation, breaking force and length after finishing the investigation, allows to set the step size and record number in memory.

Navigating the menu is done with three buttons that are placed underneath the display. Near each of these buttons are displayed on-screen icons that signify one button functionality. In Figure 5 are icons that can appear for each button.



Fig.3. Icons used to represent function buttons

Home menu page is shown in Figure 4.

In the top of the page, the first display device status. Depending on the operation of the device will be displayed:

- "Hold order" - does not perform any operation and the investigation has not yet occurred;
- "The results of measurement" - the investigation has ended and displays the results;

- "Extension arm" - as the button is pressed to move the mobile arm to the right;
- "Withdraw arm" - the left button is pressed to move the mobile arm to the left;
- "Automatic Mode" - the investigation takes place.
- In the middle of the page is displayed with case, force (in Newtons) and length (in millimeters).



Fig.4. Home menu page

### III. INFORMATIONAL SYSTEM FOR PERSONAL COMPUTER

At the initial stage was in question that BelForce information system to perform the following functions: data acquisition from the device BelForce, backup personal computer in the local directory, the saved data editing (removing erroneous data and the immaterial), graphic visualization of data in the form  $f(F) = \Delta l$ , where  $F$  - tensile force (N)  $\Delta l$  - stretching the sample (mm), removal of data from memory device, print the results.

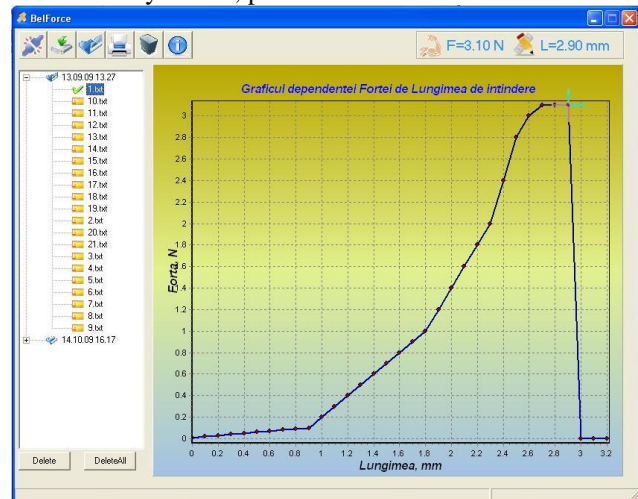


Fig.5. Graphical user interface

The program structure is simple and allows fast access to all functions of the program, obtaining such an easily accessible graphical user interface. The exception is the graphics printing results, where the user can configure the printer, sheet size and other options that are specific to different types of printers. It was created a graphical user interface shown in Figure 5.

In the process of making GUI Standard components were used programming environment Borland C++ Builder. For instrument panel component was used Toolbar1 TToolBar class. Were added to the required number of command buttons using New Button. Component was used in class ImageList1 TImageList and icons have been added for each

command button ImageList1 Add ... .

Then the connection was made between the component and Toolbar1 ImageList1 ImageList1 Images using the property, so it can display icons in buttons ImageList1 surface. The buttons 32x32 pixel size is set to display icons normally.

To achieve the panel information component was used Label1, Label2 TLabel class has been configured to display color and text size. Two components were added and ImageList3 ImageList2 the necessary images were introduced.

List of directories of records (tree form) was created with the component class TreeView1 TTreeView, ImageList4 component was added and the icons were loaded for each directory and file in the list. Two buttons were added to the component control class TButton Button1 and button2. The buttons can erase a file / directory, or all files / directories simultaneously.

To create a state panel was used component StatusBar1 TStatusBar class that allows displaying textual information. For graphical visualization of the status process has been used in class TProgressBar ProgressBar1 component.

After adding all the GUI components and their configuration is going to be written a program code that will perform all the functions and operations by default.

#### IV. CONCLUSION

The developed device allows the accurate determination of the strength and elongation of the sample of biological material until the fracture.

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