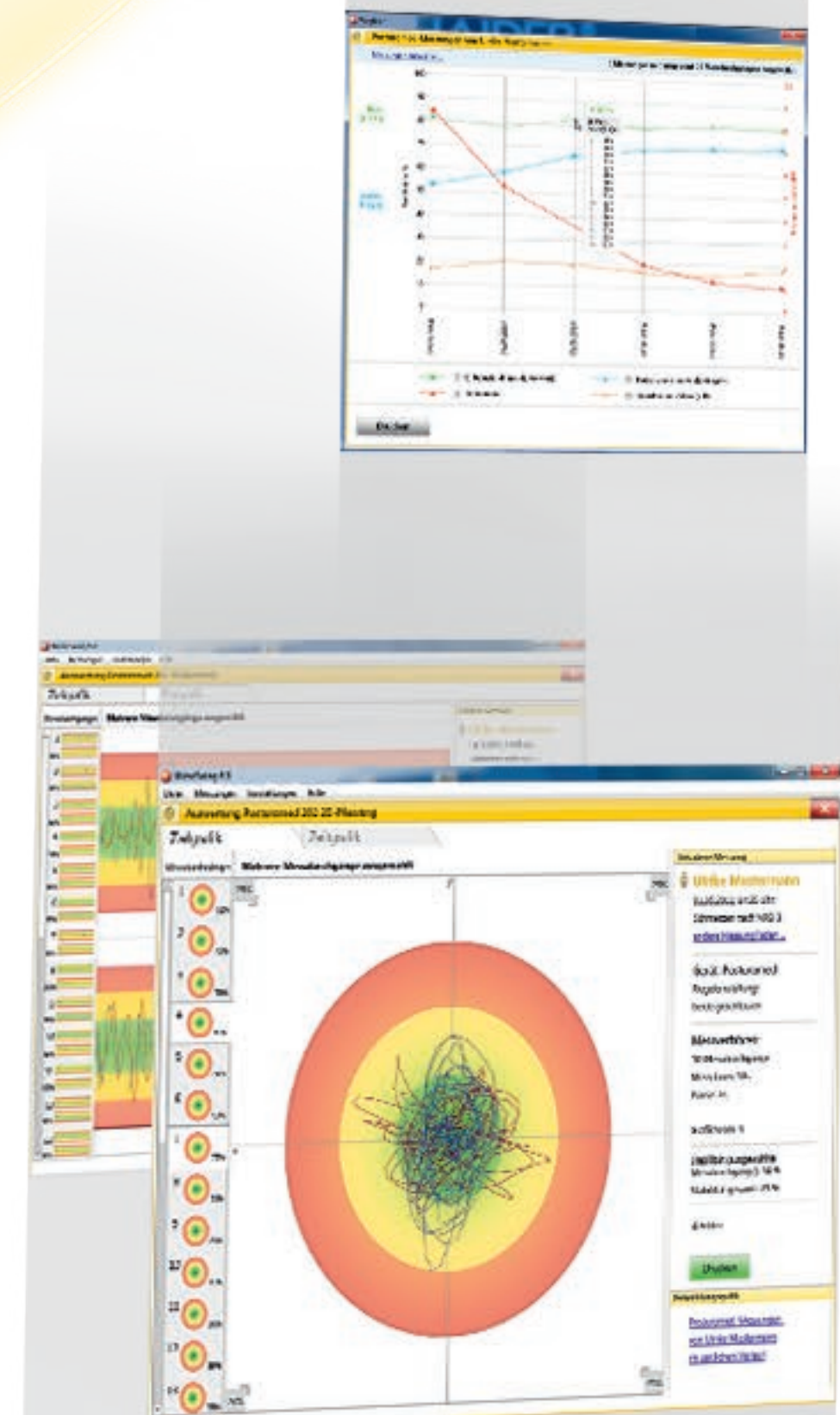# BIOSWING

MicroSwing® 6

(Version 6.04)

User Manual for the Measurement System
with Posturomed® and Torsiomed®:

2D measurement and PosturoCyberneticsTest (PCT)

User Manual

HAIDER®
BIOSWING

Contents

HAIDER®
BIOSWING

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1. Introduction

The MicroSwing® 6 measurement system has been developed for use with Haider BIOSWING® treatment, training and seating systems. It combines the knowledge gained from many years of research and practical use. The software and hardware form a highly sensitive measuring unit, allowing accelerations to be measured, recorded, evaluated and assessed easily. This medical device includes open measurement programmes and standardised tests for indirect quantitative and qualitative assessment of the neuromuscular capacity of people in relation to prevention, rehabilitation, treatment, and recreational and competitive sports. Real-time displays also enable visual feedback training.

The software UI is clear with a logical structure, so it can be navigated by the user intuitively. The simple export function for saved data allows more extensive data processing.
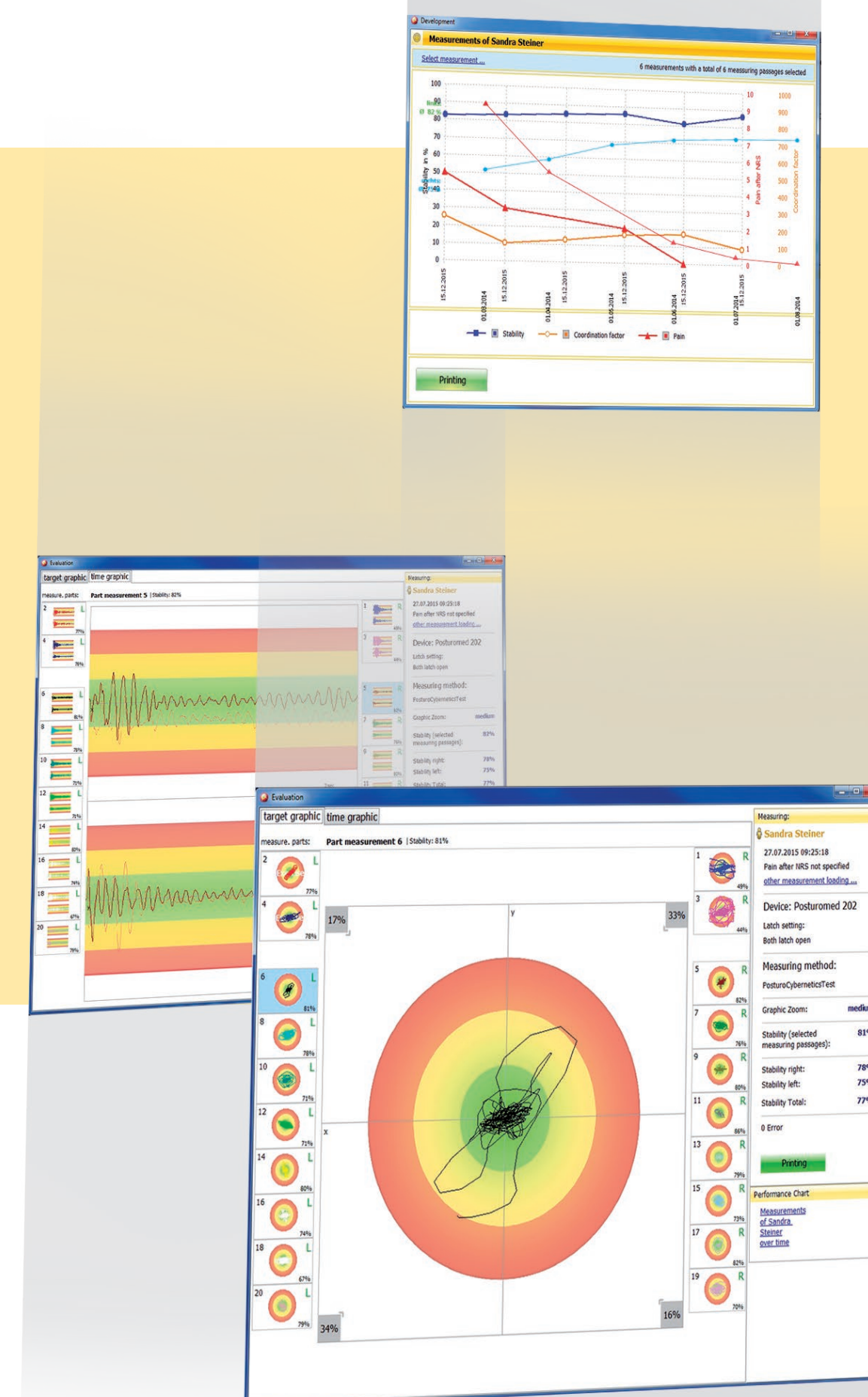
2. Important notes

Please read through the following notes carefully and observe the information they contain. **!**

2.1 Classification in accordance with the German Medical Devices Act

MicroSwing® 6 is a class 1 medical device. For the MicroSwing® 6 measurement system along with its components, the statutory provisions of the German Medical Devices Act apply, as amended.

2.2 Intended use

The MicroSwing® 6 software and hardware must only be used in combination with Haider BIOSWING® treatment, training and seating systems. MicroSwing® 6 is to be used exclusively for ethically sound human applications relating to prevention, rehabilitation, treatment, and recreational and competitive sports.

2.3 Contraindications

Never use the MicroSwing® measurement system if doing so would impair or jeopardise the health of the user or of other persons. Consult with the attending doctor or a trained BIOSWING® consultant to clarify the risks. The MicroSwing® measurement system must only be used by trained staff who can be relied on to use it safely.

2.4 Precautionary measures

Handle the MicroSwing® measurement system and its components with care. Do not expose the components to high temperatures (max. +30°C in operation, max. +50°C not in operation), high humidity levels (max. 75% humidity), high air pressure (max. 1060 hPa) or vibrations. Do not allow MicroSwing® components to come into contact with fluids. Please also observe the technical data in this regard.

To ensure that the MicroSwing® measurement system works with the correct measuring precision, never use MicroSwing® components in the vicinity of devices that could create strong electromagnetic fields. Such devices include televisions, speakers and fluorescent lamps.

If health problems occur while the MicroSwing® measurement system is being used, stop the unit immediately and inform the attending doctor.

Keep the MicroSwing® measurement system and its components out of the reach of children and never leave the measurement system and its components unattended in the presence of third parties.

3. Scope of delivery

The scope of delivery depends on the particular complete package that has been purchased. Software and hardware components can also be added at a later stage.

For further information, please contact your BIOSWING® retail partner or Haider BIOSWING®.

The following components can be obtained individually or as part of complete packages:

- MicroSwing® 6 software CD

- MicroSwing® measuring box 6 for the Posturomed® and Torsiomed® incl. USB cable

- MicroSwing® acceleration sensor 6 for the Posturomed® and Torsiomed® (cable connection)

- Acceleration sensor mount for the Posturomed®

- MicroSwing® cable protection for the acceleration sensor

- MicroSwing® transport case

- MicroSwing® brief installation guide

- BIOSWING® USB data storage medium with the user manual and other electronic documents

- BIOSWING® step mat for the Posturomed® 202

- BIOSWING® titubation grid
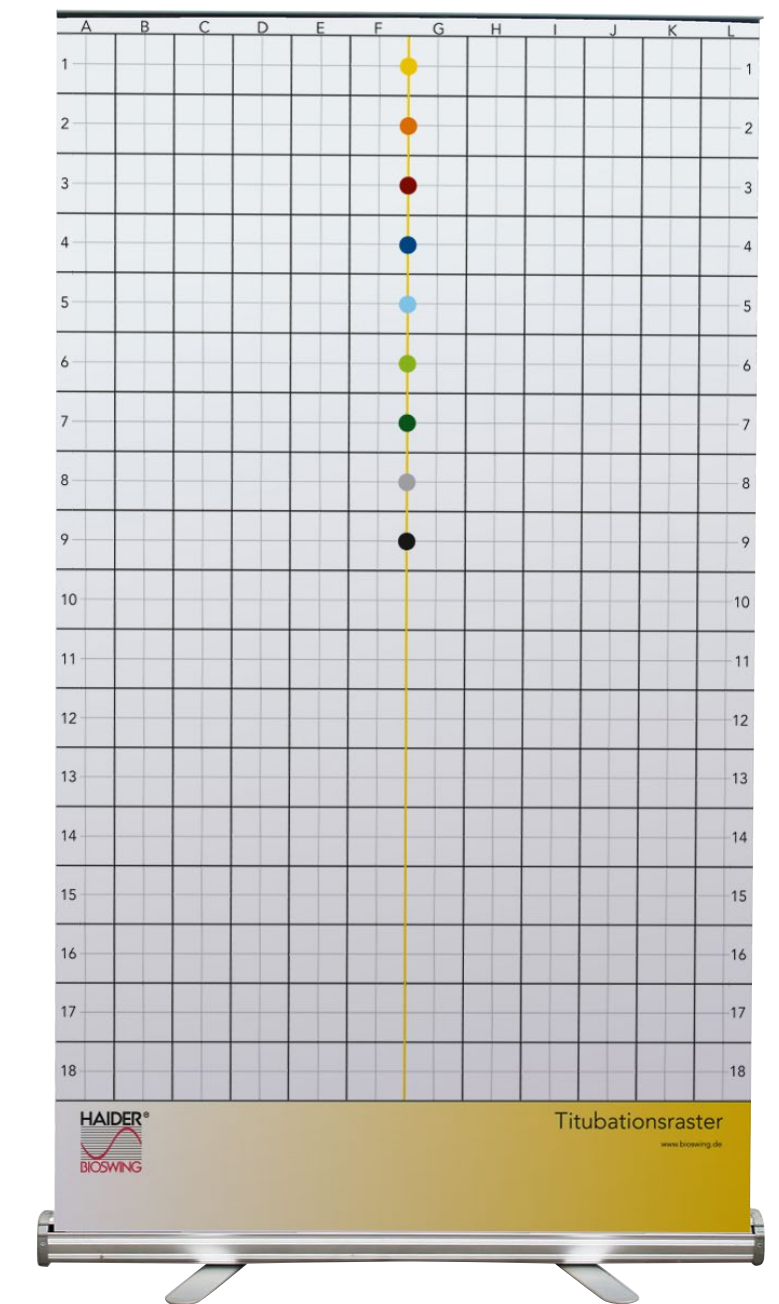
4. Technical data

4.1 Environmental conditions	4.2 Required operating conditions		
For transport and storage, a temperature range of -10°C to +50°C must be observed.	For operation, the following environmental values must be observed:	▪ Temperature: ▪ Relative humidity: ▪ Air pressure:	+10°C to +30°C 30 – 75% 700 – 1060 hPa

4.3 Dimensions and weights

	L x W x H	Weight	Sample rate	Resolution
Posturomed®/Torsiomed® measuring box (HWB11)	85 mm x 65 mm x 27 mm (without USB cable)	68 g without USB cable 118g with 950 mm USB cable		
Posturomed® / Torsiomed® acceleration sensor (HCS11)	29 mm x 21 mm x 14 mm	60 g incl. 330 cm cable	50 Hz	14 bit (16384)
Posturomed® acceleration sensor mount	29 mm x 21 mm x 14 mm	60 g		
Posturomed®/Torsiomed® cable protection	100 mm x 62 mm x 10 mm	308 g		
Step mat for Posturomed® 202	714 mm x 457 mm x 9 mm	1698 g		
Titubation grid	1200 mm x 2080 mm (required floor space)	5200 g		

4. Technical data

4.4 Explanation of symbols on reverse side of measuring box

| SN ABC123 | Serial number |
| Observe instruction manual |
| Manufacturer |
| Year of manufacture |
| Do not dispose of in household waste |

5. Installation

Please read through the following notes carefully and observe the information they contain. **!**

5.1 System requirements

- Processor with 1GHz

- 1 GB RAM

- 100MB free hard disk memory

- DVD-ROM drive (not essential if the software is downloaded from the download section at www.bioswing.de/therapiesysteme)

- USB port

- Windows XP/Windows Vista/ Windows 7/Windows 8/ Windows 10

- Screen resolution min. 1024 x 768 pixels

5.2 Program installation

Insert the "MicroSwing® 6" CD into your PC's CD-ROM drive. Setup then starts automatically. If setup fails to start automatically, you can start installation manually by running the application "Setup.exe" in the main directory of the CD. During installation, follow the setup instructions shown on screen.
Once setup has been completed, a link to MicroSwing® 6 will be displayed on your PC's desktop. Double-click this MicroSwing® icon with the left mouse button to open the application.

Alternatively, for example if your PC does not have a CD-ROM drive, you can also download the program online from the download section at www.bioswing.de/therapiesysteme. Once the program has been downloaded, open the ZIP folder in your download folder and follow the program installation instructions.
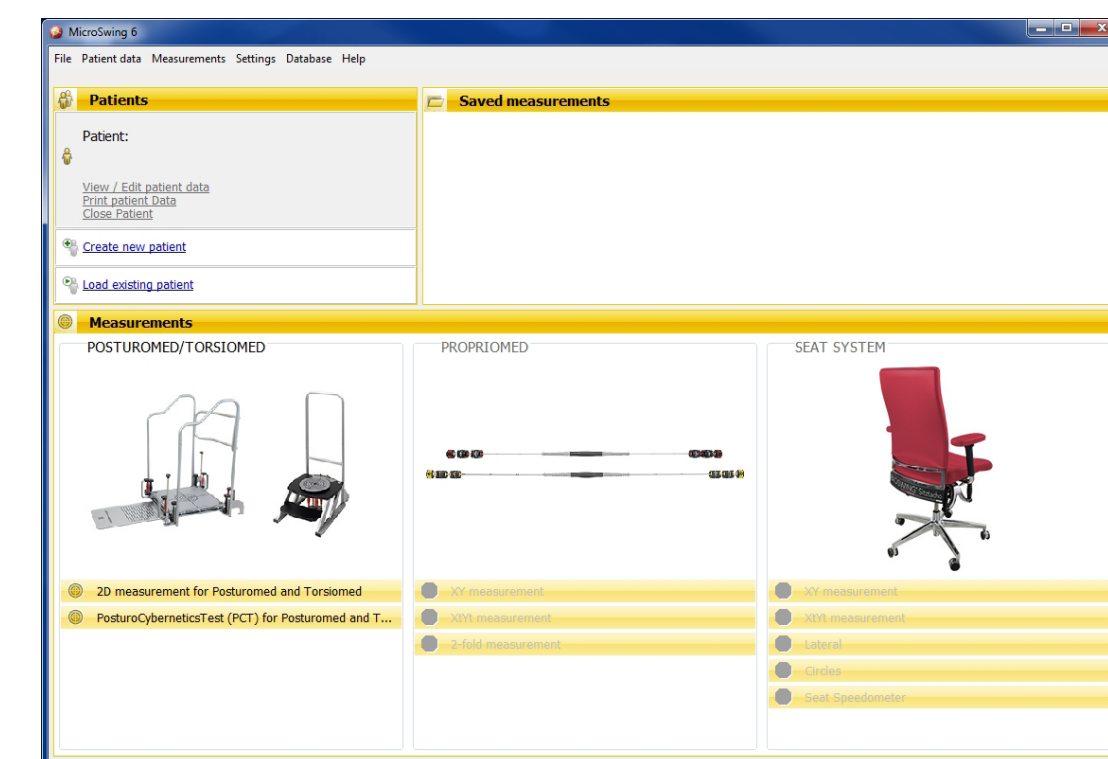
5. Installation

Please read through the following notes carefully and observe the information they contain. **!**
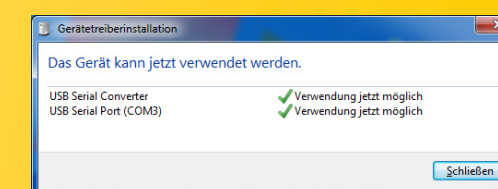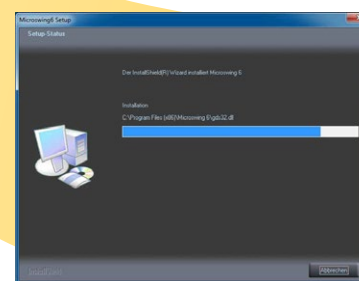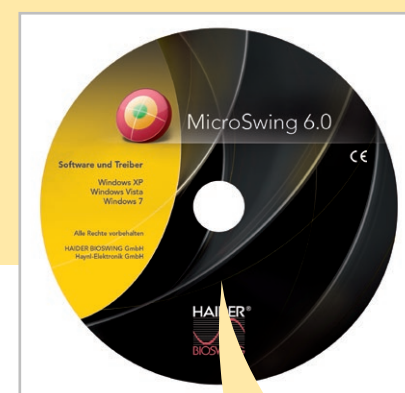
5.3 Opening the software for the first time

When you open the MicroSwing 6 software for the first time, you will be asked for your login data via the window shown to the right, as with all future restarts. Log in for the first time with the user name **"superuser"** and the password **"masterkey"** . Then configure the login data in the database

5.4 Connecting the measuring box and the acceleration sensor

After you have opened the application, the main MicroSwing® 6 window will be displayed on your screen. The individual measurements in the three sections "Posturomed®", "Propriomed®" and "Seating system" are deactivated and greyed out.

Now use the data cable provided to connect the measuring box to a free USB port on your PC. Windows will automatically recognise the measuring box as a new USB device and will install the corresponding driver independently. The green indicator lamp on the measuring box will light up continuously to signal that the measuring box is ready for operation. A few

seconds later, the previously deactivated Posturomed® measurements that were greyed out will be shown in black and can be activated by being left-clicked once. Only the measurements that you have acquired with your complete package are shown in black and can be activated – in this case the measurements "Posturomed®". The acceleration sensor then needs to be connected to the measuring box so that the sensor can be used to take acceleration measurements. Do this by inserting the acceleration sensor's 3.5 mm jack plug into the corresponding round socket (sensors 1 to 4) on the front of the measuring box. The fields are labelled accordingly.

! You can insert the jack plug into any of the four round sockets. Up to four acceleration sensors can be connected at the same time.

5. Installation

5.5 Attaching the sensors	5.5.1 Attaching sensors to the Posturomed®

To enable measurements to be taken, the sensors need to be attached to the Posturomed® or Torsiomed® in the correct position. A special mounting device is available for the Posturomed®. The mounting device for the Torsiomed® has been pre-installed before delivery as of July 2014.

The sensor is attached centrally underneath the Posturomed® 202. To do this, lay the Posturomed® 202 on its left side via its castors. Underneath the Posturomed® there are two parallel steel braces that run from the front to the back. These two steel braces are connected to a transverse steel brace slightly above their centre. Attach the sensor mount to the centre of the transverse brace with the sensor aligned correctly (see below). The sensor is thus attached to the side of the transverse brace that faces the rear. The sensor is now positioned exactly in the centre of the standing platform (in the middle of the circular hole pattern). This central positioning is recommended as it makes the acceleration sensor relatively insensitive to standing platform rotation. The Posturomed® compact has two parallel steel braces on the underside. Attach the sensor mount either centrally to one of the two steel braces or to the outer frame of the standing platform.

Aligning the sensor:

Please ensure that the sensor is aligned correctly. The text on the cable sensor must point upwards, towards the standing platform. The x-axis should be aligned from left to right, latero-lateral to the standing platform. The y-axis should be aligned from front to back, anterior-posterior to the standing platform. (Caution: if the transmitter is attached underneath the Posturomed compact, the axis alignments in the sensor software must be swapped around.) The axis paths are displayed on the sensor, on the treatment surface of the Posturomed® 202 and in the measurement graphics shown on the screen. If the axes are aligned incorrectly, the measurements will be assigned to the wrong coordinates or they may be distorted. Alternatively, you can also manually alter the axis alignment in the individual measurements in the "Sensors" section – (see section 7.1.6).

Fig.: Attaching the sensor , Posturomed® 202 (underside)

Fig.: Attaching the sensor, Posturomed® compact (underside) – Caution: configure the axis direction!

Fig.: Attaching the sensor, Posturomed® compact Alternatively: on the front outer frame of the standing platform

5. Installation

5.5.2 Attaching the sensor to the Torsiomed® (available until the end of 2018!)

The sensor is attached to the left outer edge of the lower plate of the pre-installed fastening device.

Aligning the sensor:
Please ensure that the sensor is aligned correctly. The text on the cable sensor must point upwards, towards the standing platform. The x-axis should be aligned from left to right, latero-lateral to the standing platform. The y-axis should be aligned from front to back, anterior-posterior to the standing platform. The axis paths are displayed on the sensor and in the measurement graphics shown on the screen. If the axes are aligned incorrectly, the measurements will be assigned to the wrong coordinates or they may be distorted. Alternatively, you can also manually alter the axis alignment in the individual measurements in the "Sensors" section –

6. Program UI

This section provides information on the structure of the program UI for MicroSwing® 6. If you have installed MicroSwing® 6 as described in section 5, you will be shown the following main window, split into four sections:

This main window includes:

- The menu bar

- The "Patients" function field

- The "Saved measurements" function field for the currently loaded patient

- The "Measurements" function field for rapid access to measurement start
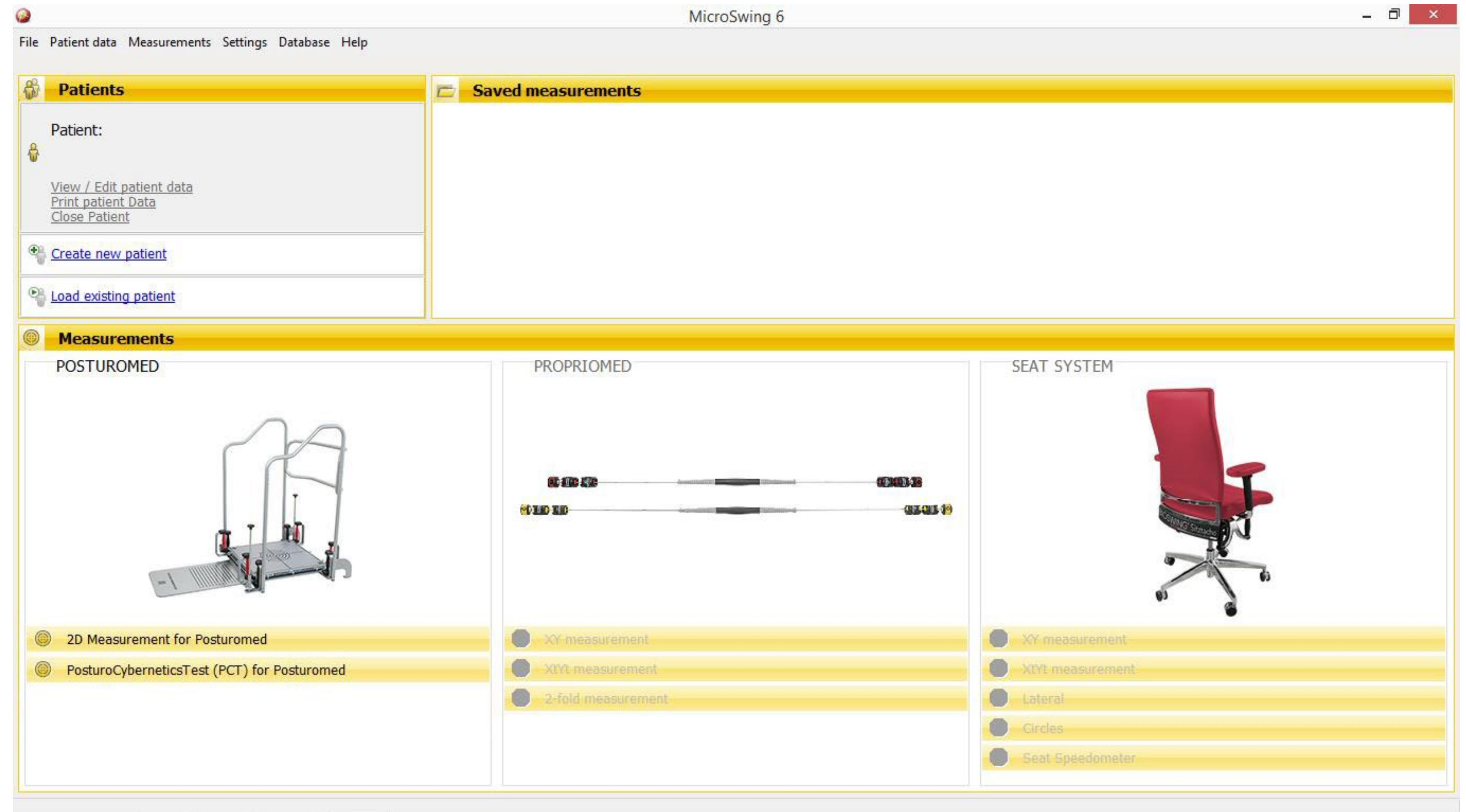
6. Program UI

6.1 The menu bar

The menu bar in the header can be used to access all the functions of MicroSwing® 6. The functions are needed for operation. Additional information is also displayed here.
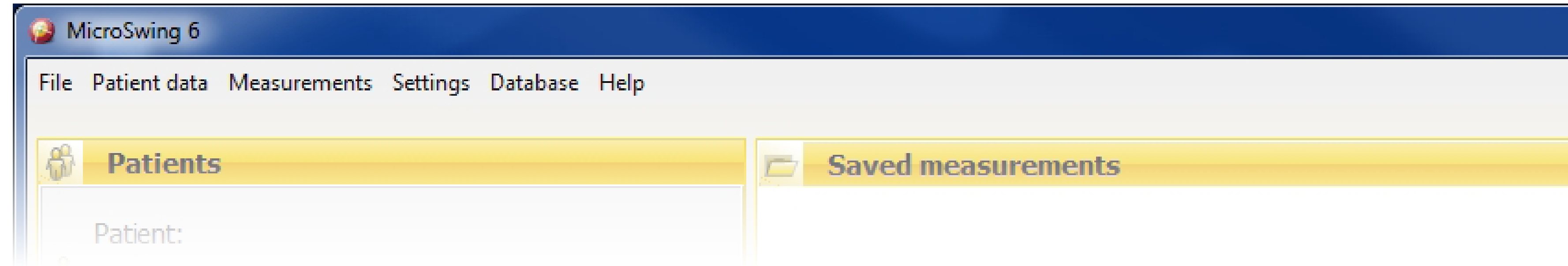
6.1.1 File

This menu item can be used to access the following four dialogue windows, which are explained in more detail in Section 8:

- "Evaluation"

- "Printing"

- "Raw data export"

- GDT jobs

"Evaluation" dialogue window
Left-click this dialogue window once to open it. The dialogue window that opens is explained in Section 8.1 "Evaluating measurement data", along with the functions it contains.

"Printing" dialogue window
Left-click this dialogue window once to open it. The dialogue window that opens is explained in Section 8.2 "Printing measurement data", along with the functions it contains.

"Raw Data Export" dialogue window:
Left-click this dialogue window once to open it. The dialogue window that opens is explained in Section 8.3 "Exporting raw data", along with the functions it contains.

Dialog window "GDT orders":
You open this dialog window by a single click with the left mouse button. The dialog box that opens and its functions are explained in chapter 6.1.5 "GDT Settings".

The "Break up" dialogue window is used to close MicroSwing® 6.
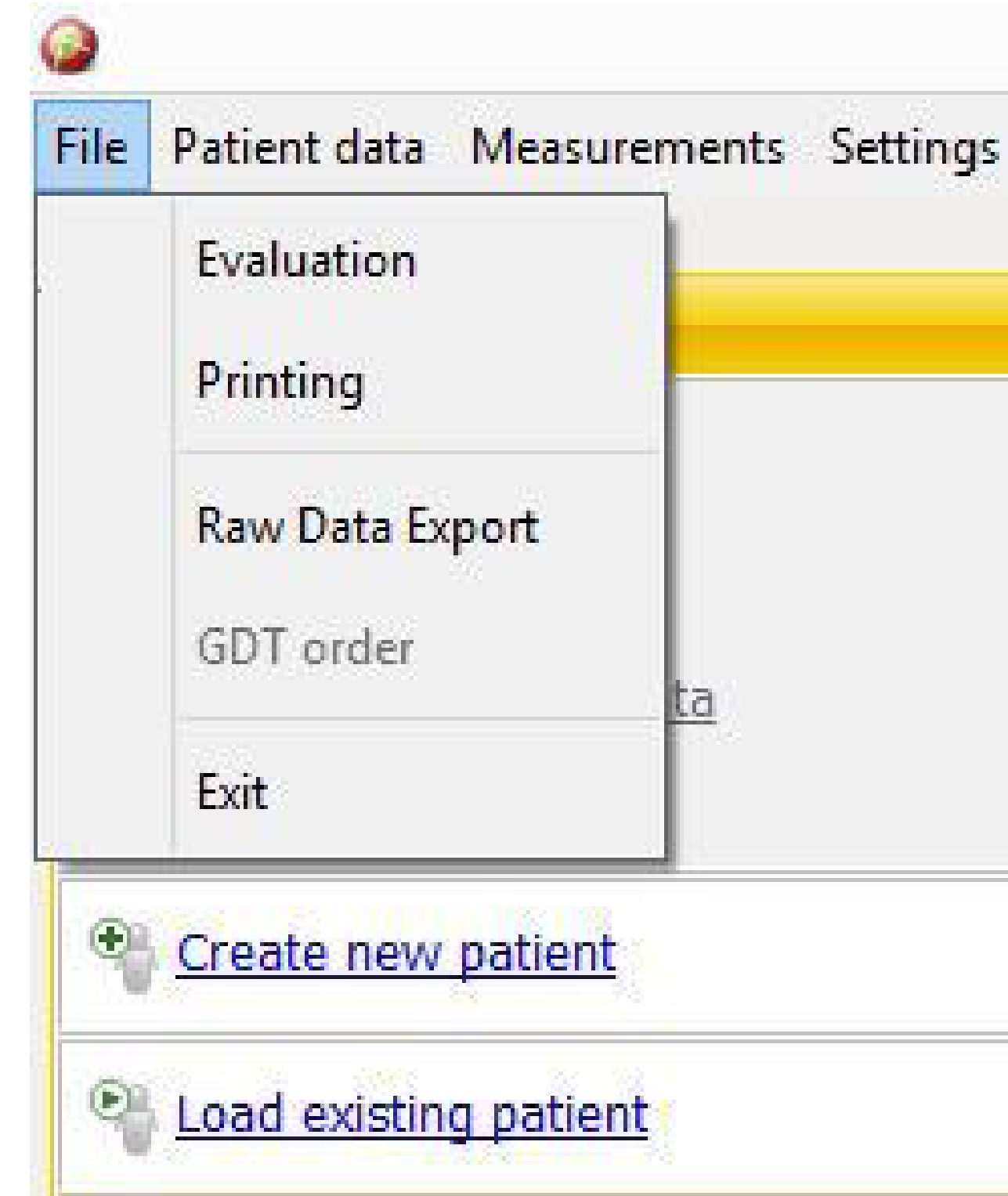
6. Program UI

6.1.2 Patient data

You can use this menu item to manage your patients. This menu item is also available in the top left of the screen as the "Patients" function field. It is explained in 6.2.
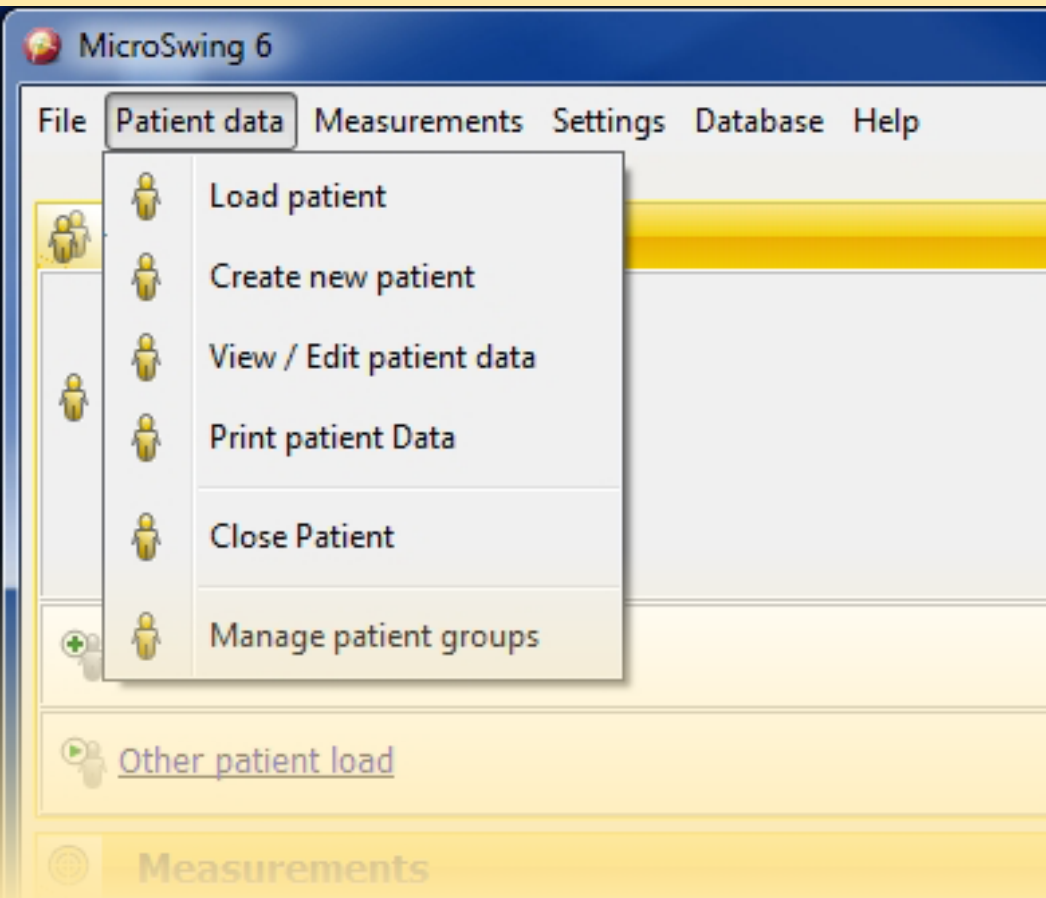
6.1.3 Measurements

This menu item can be used to access the active measurement. This menu item is also available in the bottom half of the screen as the "Measurements" function field . It is explained in 6.4.
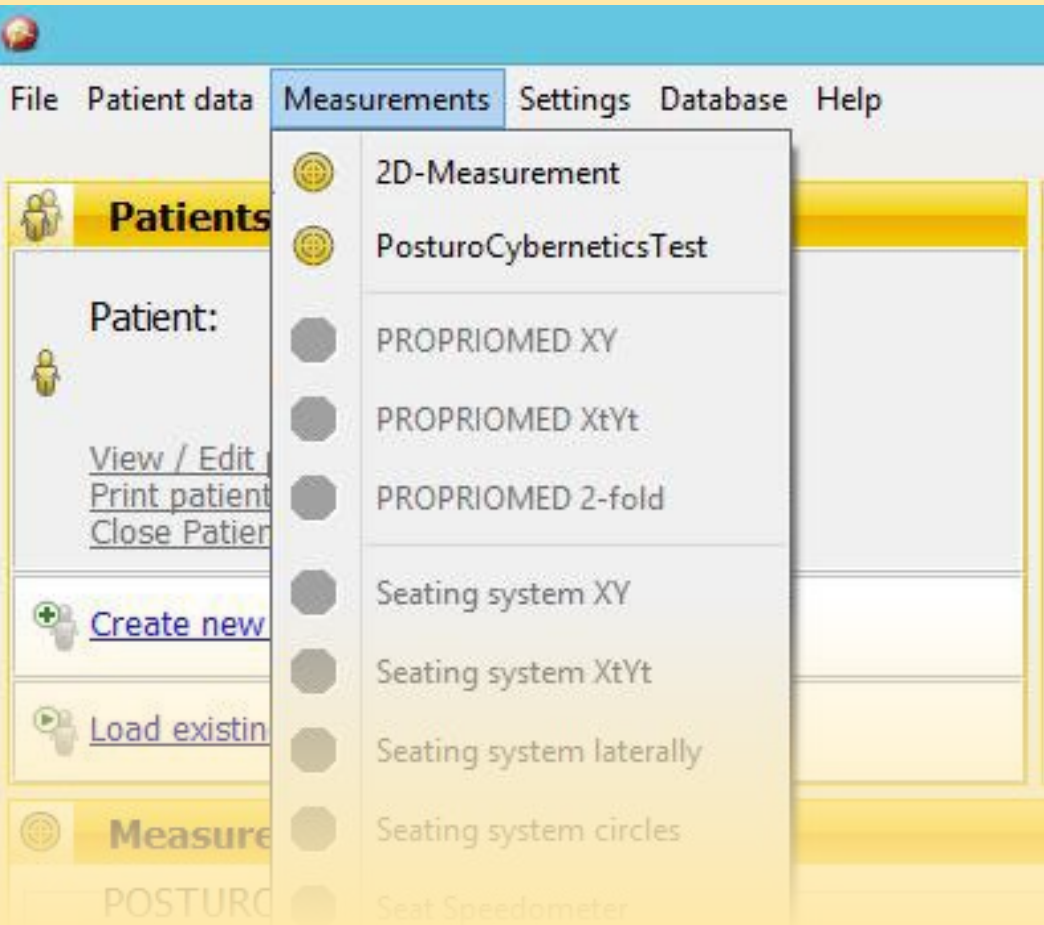
6.1.4 Settings

You can use this menu item to save your institute data to be displayed in the headers of your printouts for your patient data or measurement results, under "Printing options". Under "Autostart threshold" you can set the autostart threshold. Under "Language" you can select your desired language (as of 2019: English, French, German) and via "GDT Settings" you configure the GDT interface.
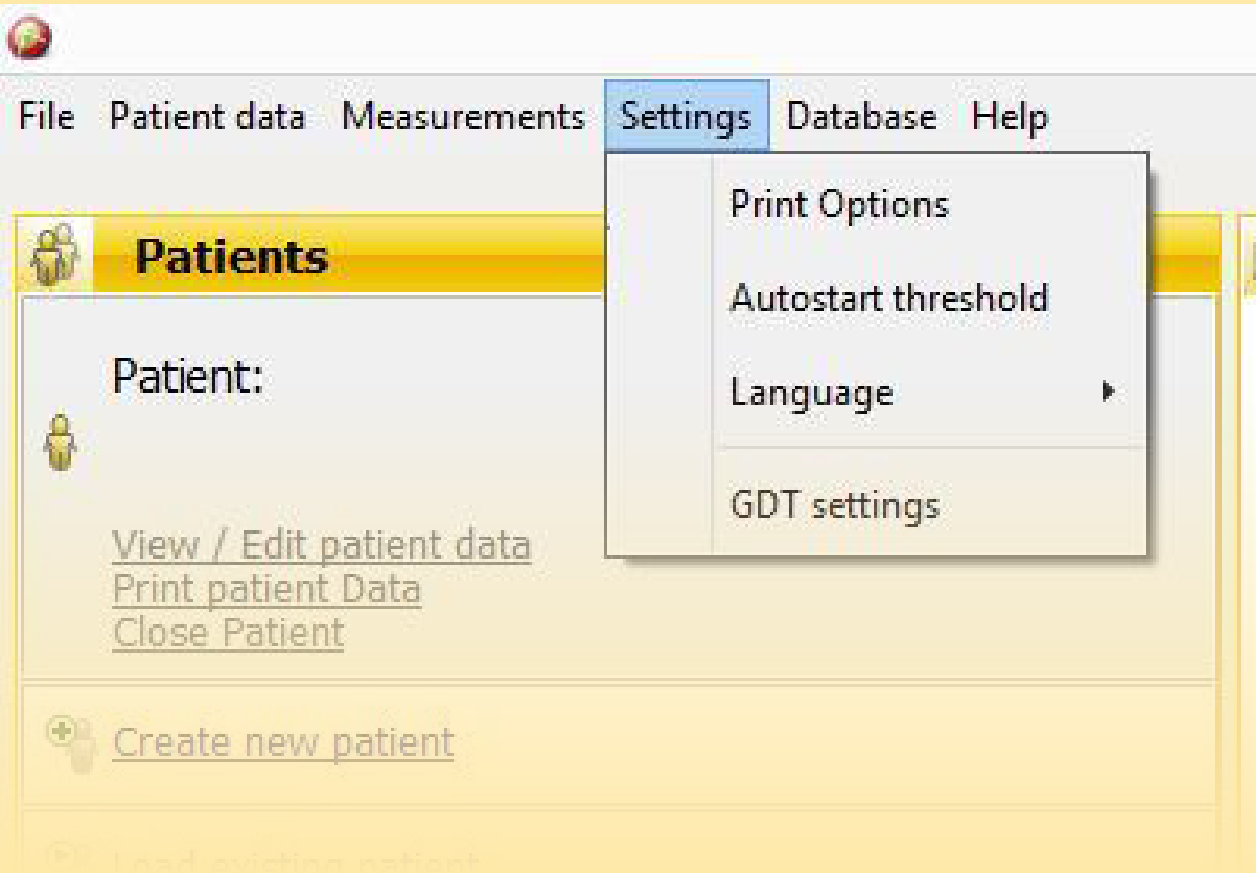
"Print Options": Left-click once to open the following input screen:
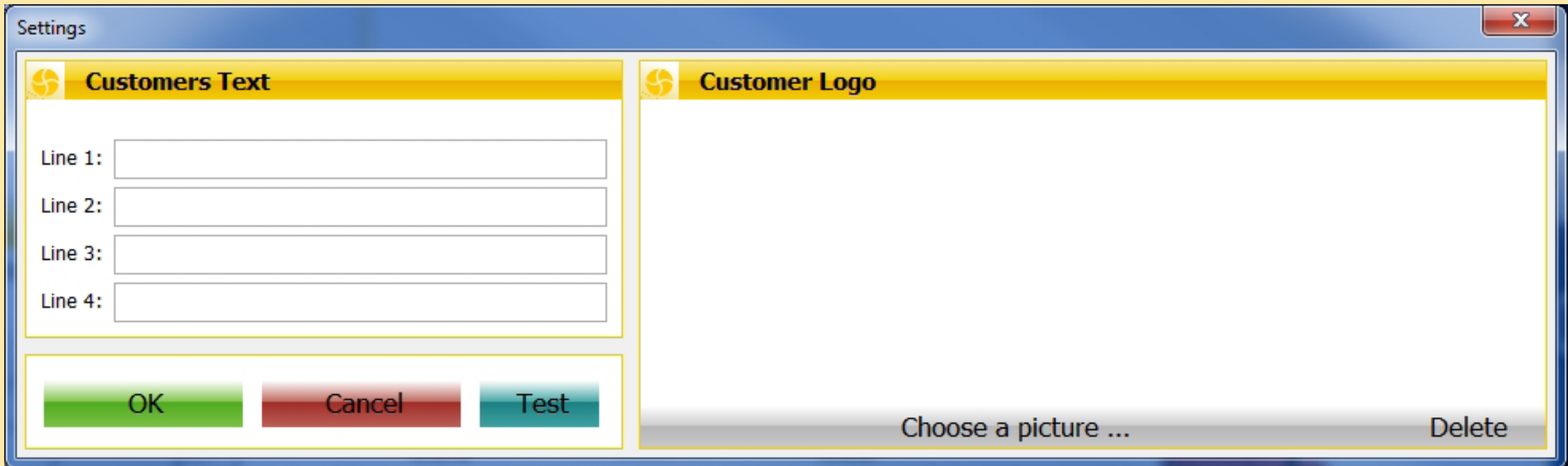
6. Program UI

You can use the left half of the mask to enter information about your institution. This information will then be displayed in the headers of your printouts for patient data and measurement results. If you leave this section empty, the corresponding field in the header will also remain empty.

You can use the right half of the input screen to add your logo or image file (permitted file type .bmp). This logo will then be displayed in the top right of the headers of your printouts for patient data and measurement results. If no file is uploaded, the pre-installed HAIDER BIOSWING GmbH logo will be displayed in the right-hand side of the header.

"Autostart threshold": Left-click once to open the following window:

In this window, you can specify the sensitivity of the autostart threshold. Adjust the slider to determine how large an acceleration stimulus has to be for the software to automatically start measurement (autostart). Lower values make the autostart more sensitive. The autostart threshold merely determines the software's sensitivity regarding the first acceleration stimulus, but not the sensor sensitivity or the overall sensitivity of the system. It only determines whether an intense stimulus is needed to automatically start a measurement or whether a minimal stimulus is sufficient. We recommend setting the autostart threshold to 20%. The value you set will then be remembered so you do not need to reset it every time the program starts up, although you can change the setting at any time.

Einstellungen

StartUp threshold

10%   100%

OK   Cancel
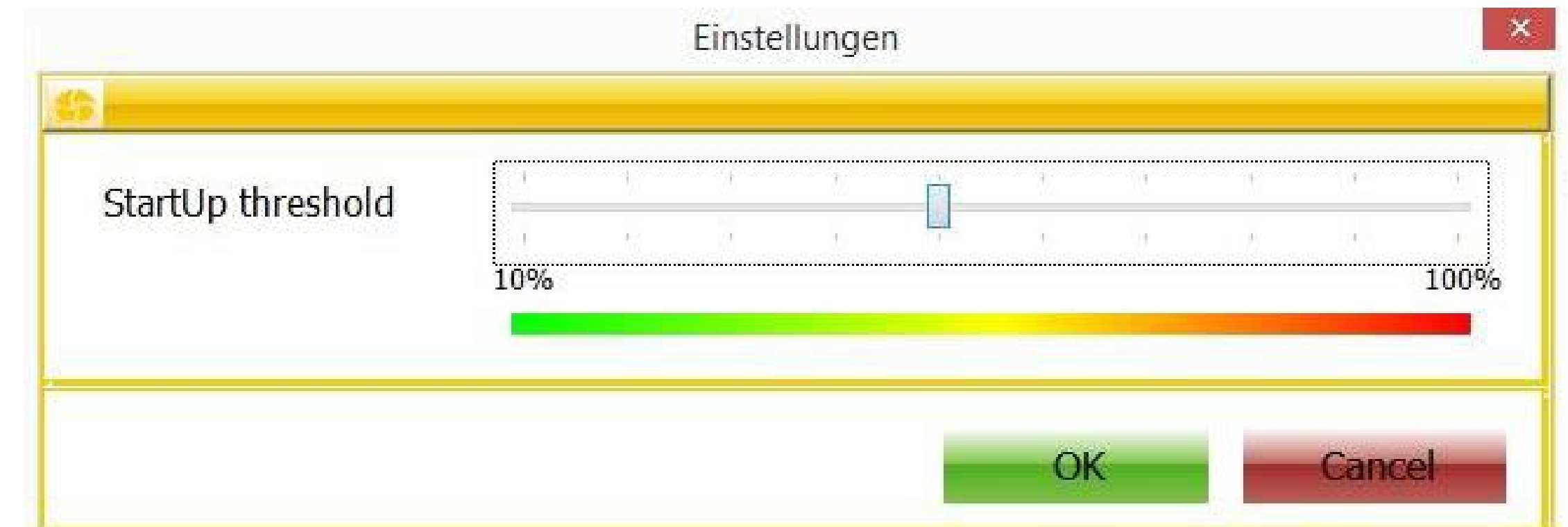
6. Program UI

6.1.5 GDT settings: Configuration of the GDT interface

Under the menu item "Settings – GDT Settings", you can configure the GDT interface. The **"Use GDT" checkbox** is used to enable or disable the GDT interface. If the interface is disabled, no orders are accepted, and no response files are generated.
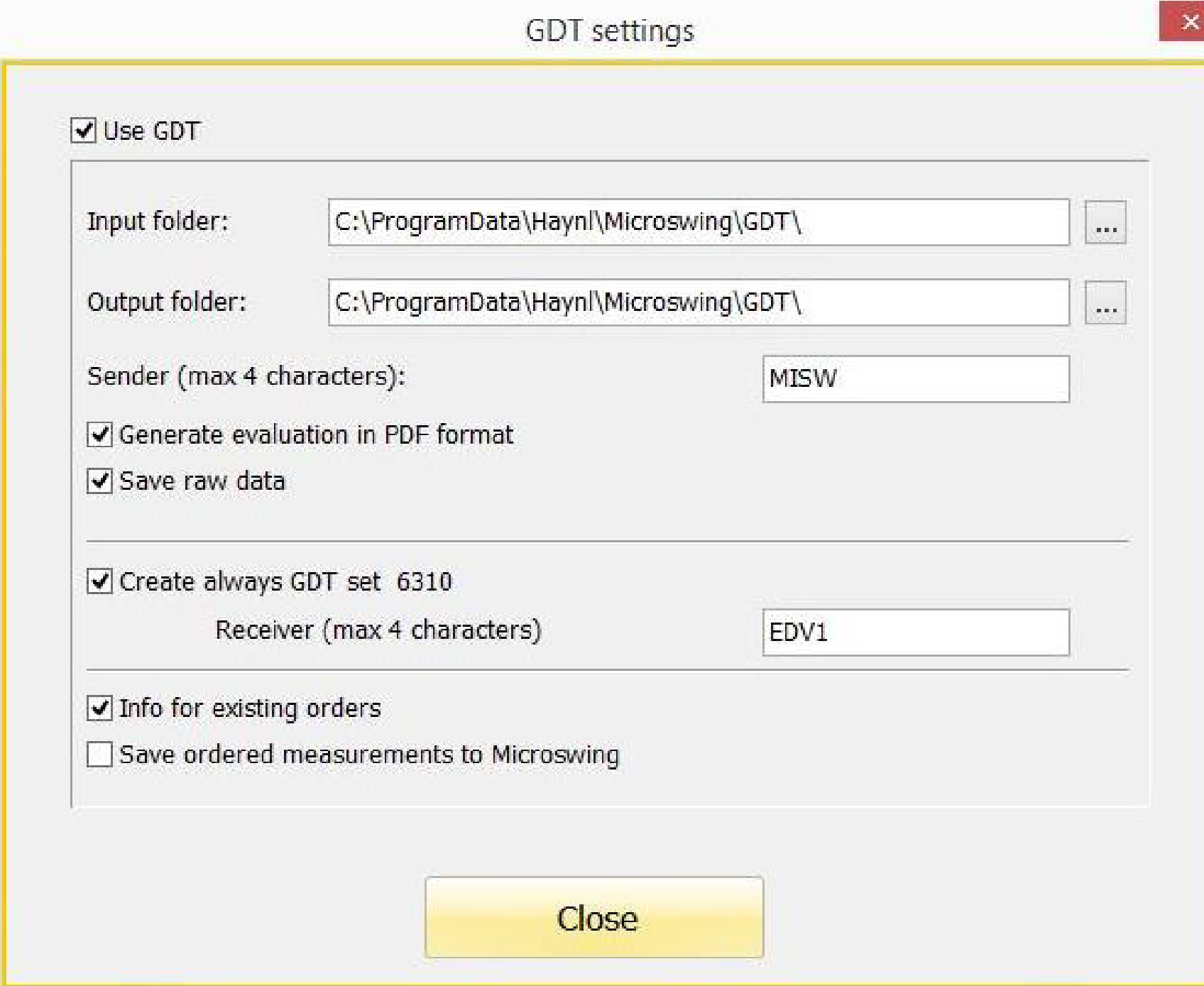
MicroSwing searches for the order files in the **"Inbox" folder**. MicroSwing creates the files with the measurement results in the **"Outbox" folder**. The order files are imported based on the entry in **"Sender initials"**. Only files for which the sender initials match the initials set here will be imported. Furthermore, the initials are also used as the sender initials for all created files with measurement results.

In addition, a PDF analysis can also be generated for every GDT response by enabling the option **"Generate analysis in PDF format"**. If the option **"Save raw data"** is enabled, the raw data for every GDT response is added separately to every partial measurement.

If the option **"Always generate GDT record type 6310"** is enabled, GDT files will be generated for every measurement even if there are no orders. Since there is no client in this case, you can define the addressee here (recipient initials). If the option **"Notification of waiting orders"** is enabled, then a message is displayed every time the software is launched to notify the user of GDT orders that require processing.

If the option **"Save order measurements in MicroSwing"** is enabled, then the data is saved in the internal database for orders in addition to the GDT outputs. If the specified patient is found in the database, he/she will be selected; otherwise, a new patient will be created.

GDT settings

- ☑ Use GDT

  Input folder: C:\ProgramData\Haynl\Microswing\GDT\
  Output folder: C:\ProgramData\Haynl\Microswing\GDT\
  Sender (max 4 characters): MISW
  - ☑ Generate evaluation in PDF format
  - ☑ Save raw data

  - ☑ Create always GDT set 6310
    Receiver (max 4 characters) EDV1

  - ☑ Info for existing orders
  - ☐ Save ordered measurements to Microswing

Close

6. Program UI

6.1.6 Database

This menu item is used to manage the database. In the top section, you can enter filter criteria for searching your database. It is important to note that patients can only be filtered according to the specific criterion if corresponding details were entered when the patient was added (see 6.2.1, "Adding a new patient").

You can use the first menu item to switch the **filter** on (with a blue tick) or off (no tick). You can use the second menu item to select the criteria for filtering your database. Pressing the "Apply" button then filters your database, if the filter is switched on. If the filter is switched off, no filter will be applied. Pressing the "Reset to default" button removes the information you have entered and pressing the "Cancel" button cancels the filtering procedure and closes the window. If the filter is active and you have selected filter criteria, only patients

for whom the filter criteria apply will be displayed in the "Patients" function field under "Load saved patient".

The bottom section of this menu item is concerned with backing up and restoring your data, and exporting and importing them. To **backup your data**, select the sub-menu item "Backup/Restore". In the top half of the window, select a place to save your backup (such as an external data storage medium or another PC) and then left-click the "Secure data" button that is now active. Once the data have been saved, they will be backed up in the target folder as a .bkp file and you can close the window. This function also helps you to transfer your complete data to another PC. To restore your data, select the data from the storage location that you chose earlier in the bottom half of the window and then click the "Data Recovery" button that is now active.
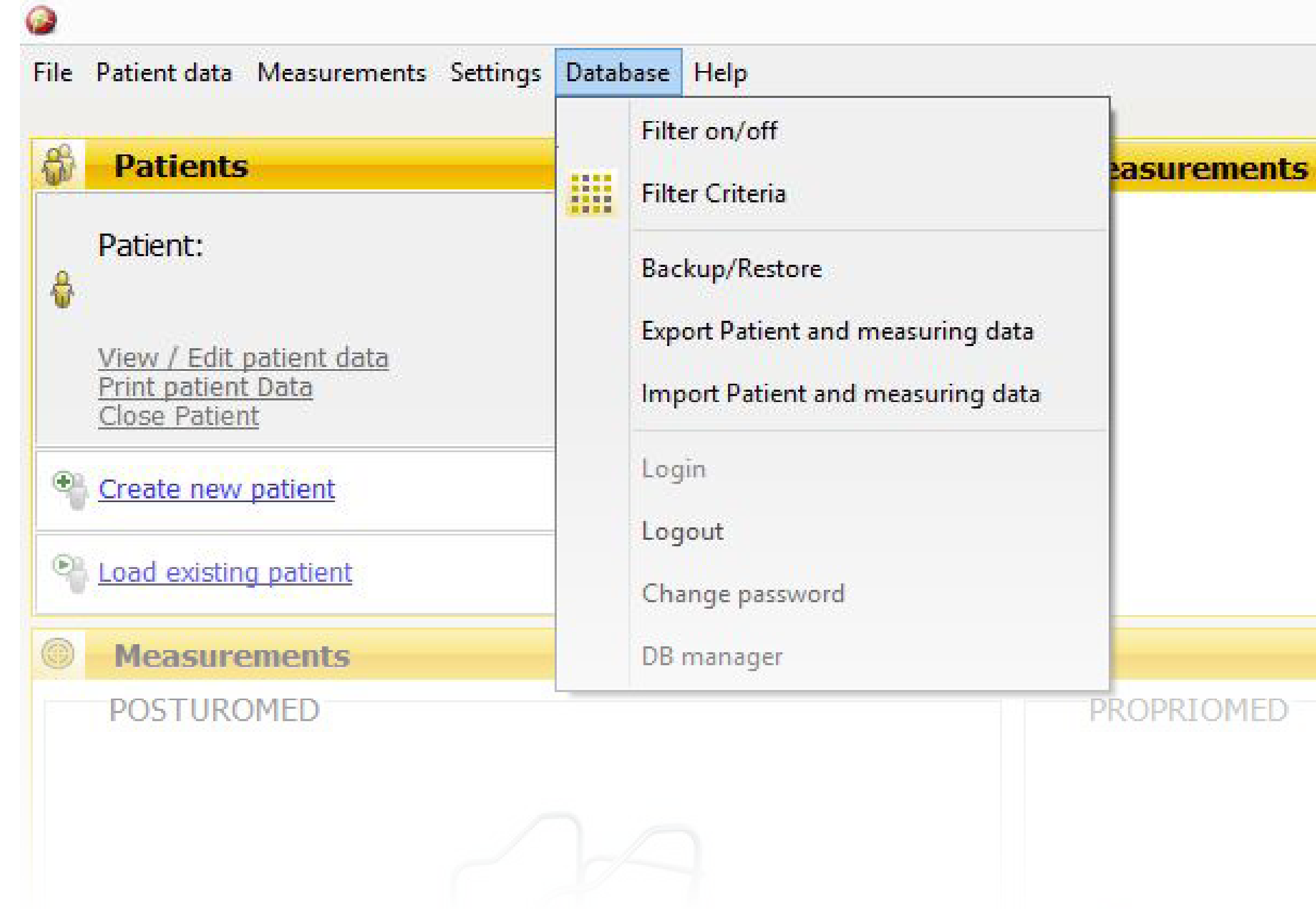
6. Program UI

This allows you to **restore any data** that are lost or to upload your entire database to a new PC. Please note that this restoring process will delete any data that you have recorded since the last backup.

You can use the two following menu items to export and import individual patients or measurement data, for example to or from an external data storage medium or another PC. For the export, select the patient or patients in the left half of the window – if the database is large, you can search for the patients by name, patient number or group in the top left half of the window. In the right half of the window, select the location for saving the exported data. The "Export" button will then be activated. Left-click this button once to start export.

For import, select the menu item "Import patient and measurement data" and search for the data source in the search field in the left half of the window. Once you have opened the data source, all the patients from the external data source will be displayed in the right half of the window, with their names and/or patient numbers. From this list, select the patient or patients you wish to import. The "Import" button will then be activated. Left-click this button once to start import. Once the import has been completed, close the window. The imported patients are now stored under "Patients".

6. Program UI

You or the Administrator can manage your access data via the four lower menu items. This ensures that only personnel authorised by the Administrator are given full access to the software.

Since you are already logged into MicroSwing, the "Login" button is disabled. Left-clicking once on the **"Logout"** button will log you out of the system but will not close the software. You will now have far more restricted access to the system, will not be able to access sensitive patient data, cannot open any measurements and can-

not view any measurement results. In the database, only the **"Login"** button is now active. You can use this button to log in again and gain full access to the software. If GDT measurement tasks are present, a corresponding information window will appear during the login. Click "OK" to confirm this.

You can click the **"Change password"** button to set a new password. The Database Manager ("DB Manager") is used solely by the Administrator to manage other people who have been granted full access to MicroSwing.

Here, you can enter another user name and a password of your choice or modify or delete an existing user. All users who have been registered to date can be seen in the "Users" field. The other users created here do not have access to this DB Manager. This is reserved solely for the Administrator.

In the same window, a new user name and a new password can be defined by the Administrator for his/her own access under **"Administrator password"**. The default user name "superuser" is preselected, and this can be replaced with a new name here.

6. Program UI

6.1.7 Help

This menu item allows you to automatically search for a new update for MicroSwing® 6 via "Update MicroSwing 6". To do this, you will need Internet access on the particular PC. If this PC does not have Internet access, you can also check the latest software version via another Internet access point in the download section at www.bioswing. de/therapiesysteme and download it free of charge.

This menu item also provides information on your MicroSwing® version (press "OK" to close this information window). You can also use it to access the user manuals in .pdf form.
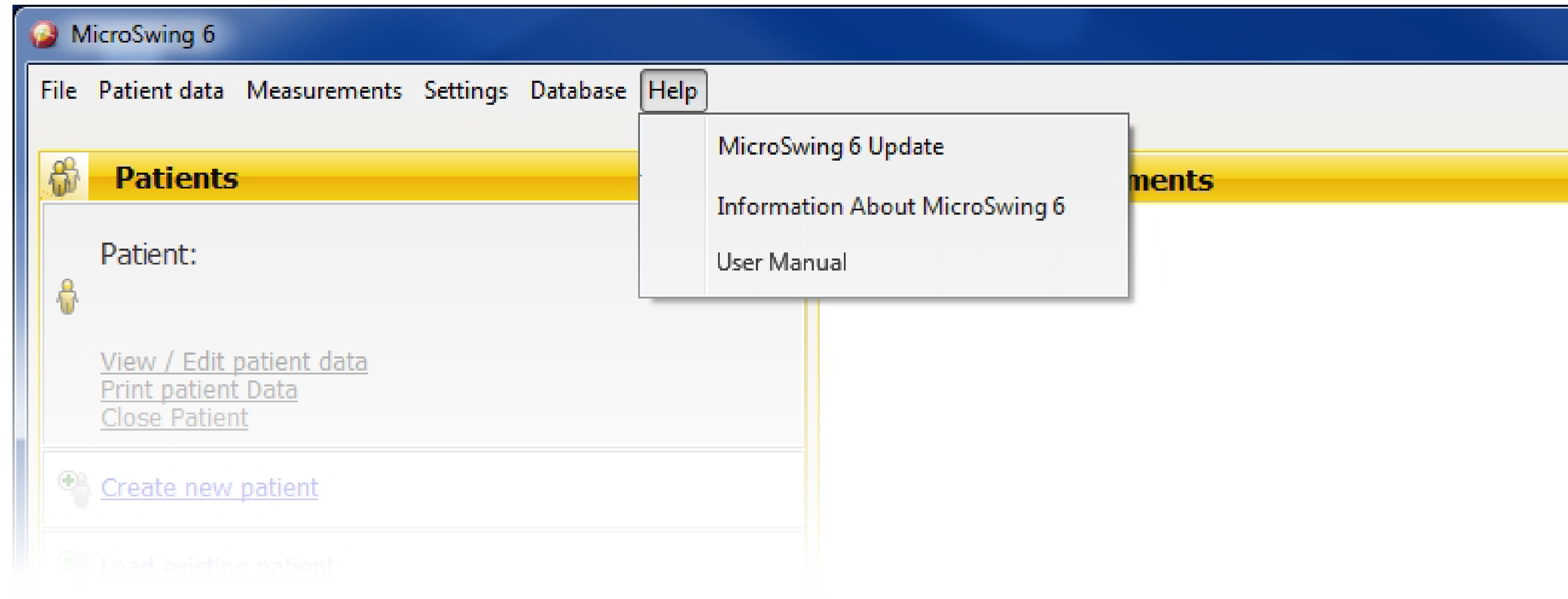
6. Program UI

6.2 The "Patients" function field

You can use this function field to manage your patients. In this field you can add new patients ("Create new patient"), access patients that have already been added ("Load existing patient") and view the accessed patients and edit and print their data.

If you have not added any patients or accessed any patients, the top field, "Patient", will remain deactivated.

File   Patient data   Measurements   Settings   Database   Help

MicroS

Patients

Saved measurements

Patient:

View / Edit patient data
Print patient Data
Close Patient

Create new patient

Load existing patient

Measurements
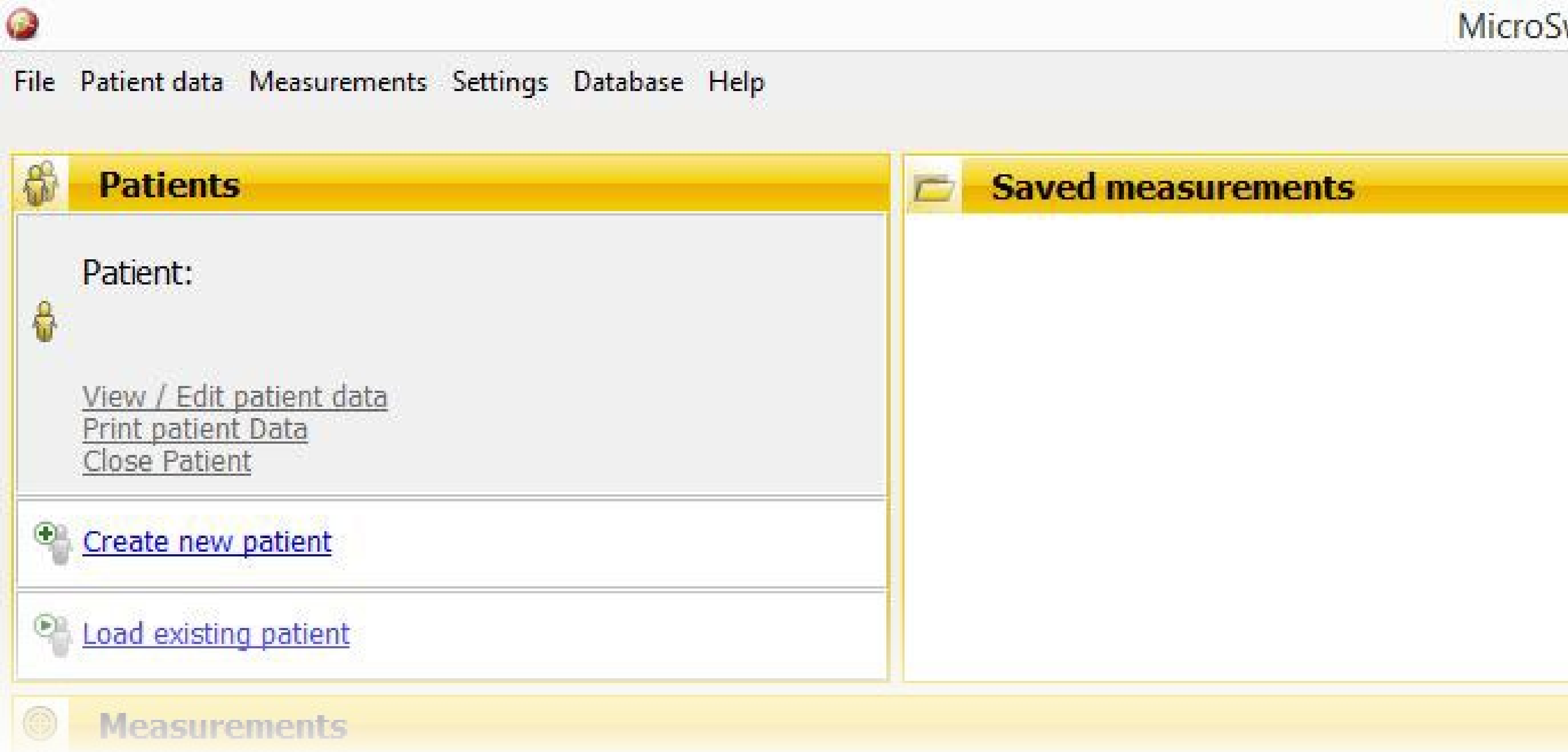
6. Program UI

6.2.1 Adding a new patient

MicroSwing® 6 provides an input mask for adding new patients. To open this input mask, left-click the "Create new patient" field once. The input screen shown will then open in a new window. The basic information in the header ("First name", "Name", "Date of birth") is optional, but it should be filled out as fully as possible to make it easier to find and access your patients in the database in future. You can also add the patient number ("Patient-No.") here.

Beneath the header, there are two optional input sections (tabs).

The information entered under **"Optional patient data"** is incorporated into the filter criteria of the database filter. If you plan on using the database filter, the optional patient data should be filled out in full.

You can use the **"Optional Documentation"** to add diagnoses, medications and other comments on the disease progression of your patients.

Additionally, you can left-click body regions on the graphic on the right to mark the area or areas that your examinations or treatment are focused on or the regions where your patient is experiencing pain or functional impairment. The level of pain experienced by the patient can be entered via the numerical rating scale ("Pain scale") underneath the graphic.

Click the "OK" button to create your new patient data and close the input mask. Click "Cancel" to close the input screen without saving the information you have added. The "Printing" function is deactivated in this dialogue. Once you have clicked "OK" to create your new patient, the patient will be displayed with the patient name on the start screen as "Patient". The buttons in the top box of the "Patients" function field are now shown in blue and they are activated.

Note: You can add a new patient without filling out all the fields in the input screen. You should, however, at least enter the name of the patient as this makes it easier to find the patient in the directory and because the patient name is the only entry shown on the screen during the measurements. This prevents your measurements from being allocated to the wrong patient.

6. Program UI

6.2.2 Loading a saved patient

At any time when measurements are not being performed, you can load a saved patient from your database. Any exercise data that are saved in the following example are automatically allocated to this patient. Various MicroSwing® 6 functions also require a patient to be loaded.

Select the patient by left-clicking the "Load existing patient" button once at the bottom of the function field. A new dialogue window opens – "Load patient" – displaying all the currently saved patients on the left-hand side. When a patient is selected from the list with the mouse, the patient's name is displayed in the right-hand field alongside the list in yellow text. Clicking the green "Load patient" button to confirm loads the currently selected patient in the main function field of the application. The "Load patient" dialogue window closes.

You can use the two search fields above the patient list in the "Load patient" dia-

logue window to search the patient database by name or patient number (if one is stored). The search function reacts dynamically to the information you enter, automatically removing from the displayed list any patients that do not meet the entered criterion. This search function is not case-sensitive.

You can use the "View/Edit patient data" button and the "Print patient Data" button to perform the corresponding function for the currently selected patient.

You can also add a new patient directly from this dialogue, as you might want to do if you find that the patient you are looking for is not present in the file. The corresponding input screen is opened by left-clicking the "Create new patient" field once in the previous dialogue field. When you close this input screen, the patient list is shown once again and it will now include the patient you have just added.
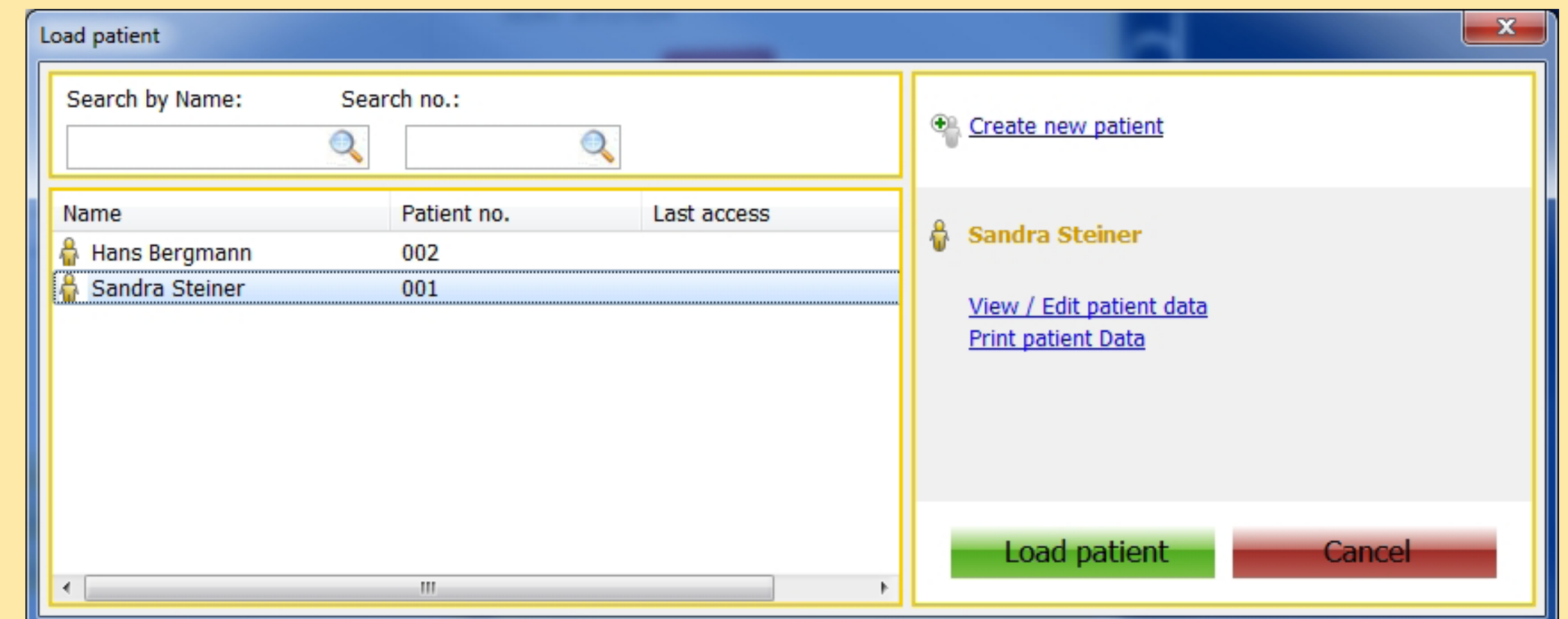
Note:Please note that any search parameters you have entered will still be applied. You may need to reset the search options before your new entry is shown in the list. Press the "Cancel" button to close the dialogue window without loading a new patient into the main function field.

6. Program UI

6.2.3 Viewing/editing patient data

You can edit the data of your saved patients at any time when measurements are not being taken. You can access the corresponding input screen by clicking on the "View/Edit patient data" button. This input screen is basically identical to the one that is used for adding a new patient – the only difference is that the "Printing" button is activated.

Left-clicking the "Printing" button once creates a two-page PDF document containing the patient data from the input screen (see 6.2.4).

You can also use the "Delete Patient" button in the "Patient data" input screen to delete one of your patients and all the connected data and measurement results. This action cannot be undone.

6. Program UI

6.2.4 Printing patient data

MicroSwing® 6 allows you to print out the data that have been recorded for your patient. You can access the corresponding two-page document by pressing the "Print patient Data" button. The document is compiled in the form of a PDF. Once it has been created, it is automatically opened with the standard application your system uses to view PDF files. You can then add notes or text highlights to the document from the PDF viewer. You can convert the document to other formats, save it to a data storage medium or print it out via your connected printer.

Note: The document that is generated does not contain any measurement data relating to the patient.

6.2.5 Closing the patient

You can close a patient loaded from the database at any time when measurements are not being taken by clicking the "Close Patient" button. This empties the list of saved measurements loaded in the yellow function field on the right-hand side. The patient name is removed from the "Patients" function field and the buttons in this field are deactivated. Measurements can be performed in this mode without any patient being loaded. Once they have been completed, these measurements can be allocated to a saved patient or a newly added patient.
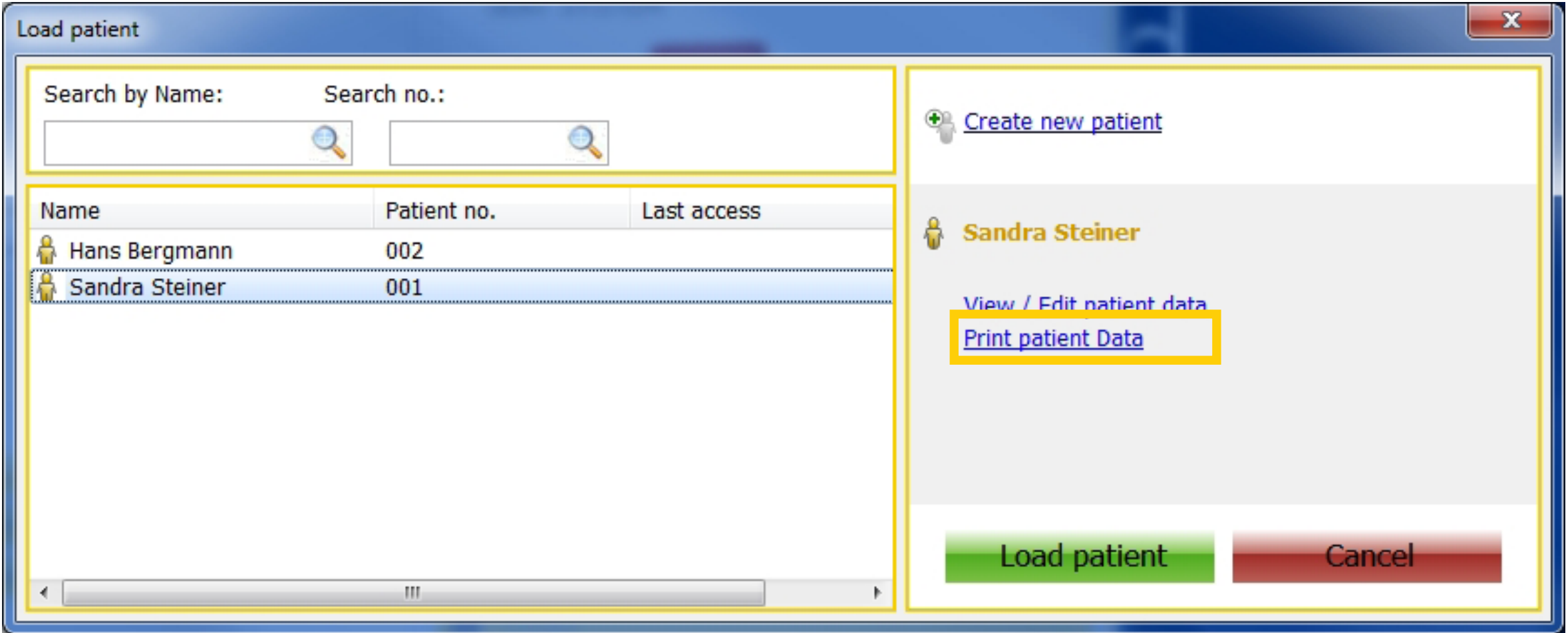
6. Program UI

6.3 The "Saved measurements" function field	6.4 The "Measurements" function field

This function field displays the measurements saved for the currently loaded patient in the form of a list. If no patient has been loaded from the database, this field will be empty.

This function field, which takes up the entire bottom half of the MicroSwing® 6 main window, provides rapid access to the 2D measurements for the Posturomed® and Torsiomed® and to the PosturoCybernetic-sTest for the Posturomed® and Torsiomed®. Measurements that are not available are greyed out. Measurements are not available if the MicroSwing® measuring box is not connected to the computer or the required licence has not been acquired (such as the licence for the Propriomed®). Measurements also cannot be activated if the measuring box, the USB cable or your USB port is defective.

The individual measurements are sorted into three main groups in accordance with the related device (Posturomed® / Torsiomed®, Propriomed®, seating system).

View / Edit patient data
Print patient Data
Close Patient

Create new patient

Load existing patient

Measurements

POSTUROMED

PROPRIOMED

2D Measurement for Posturomed

PosturoCyberneticsTest (PCT) for Posturomed

XY measurement

XtYt measurement
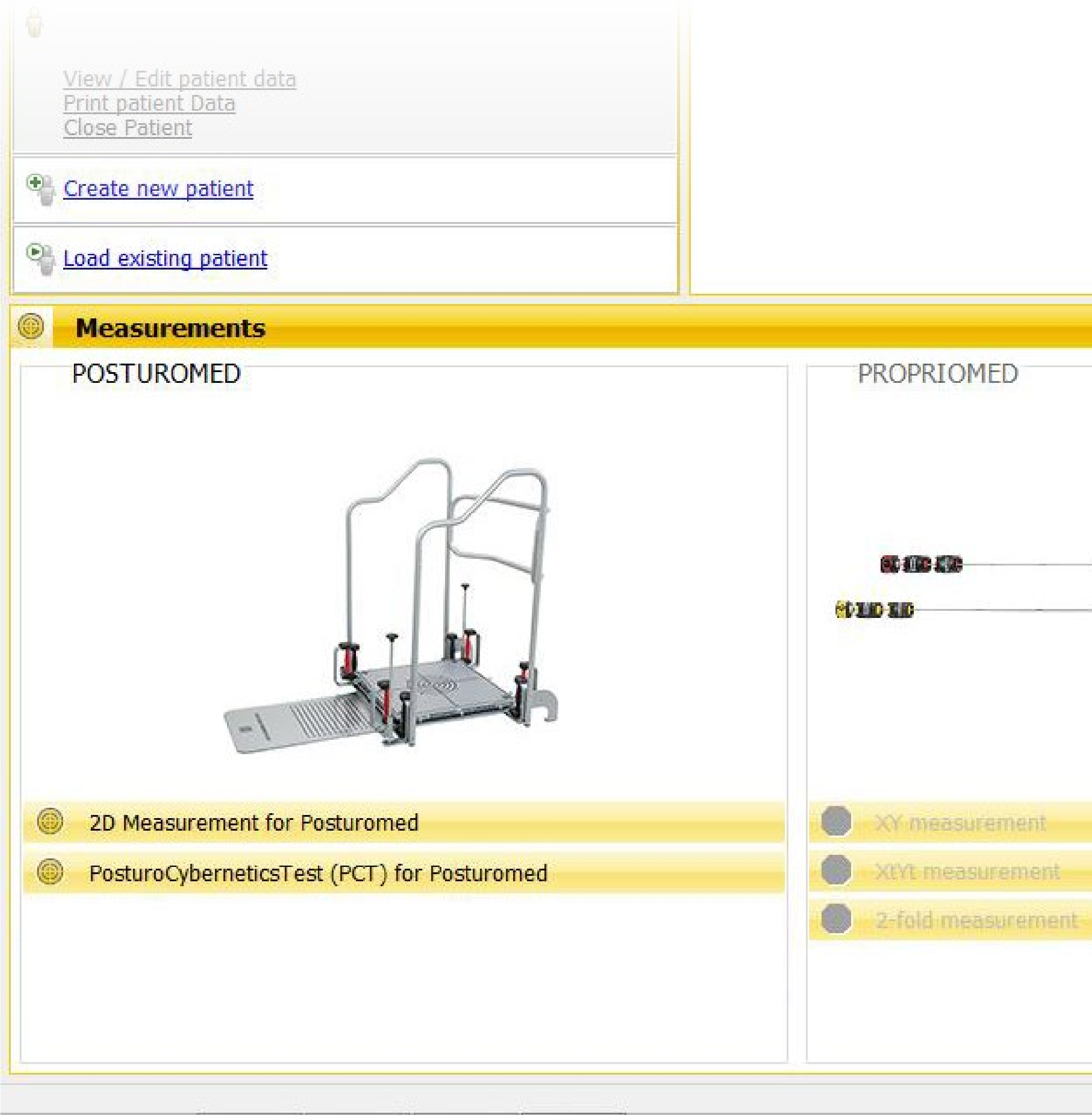
2-fold measurement

7. Measurement procedure

For the Posturomed® and Torsiomed® treatment devices, MicroSwing® 6 provides an "open" measurement programme and a "closed" (i.e. standardised) measurement programme:

- The 2D measurement is an "open" measurement programme

- The PosturoCyberneticsTest (PCT) is a "closed" measurement programme

The measurement values that the measurement system provides do not correspond to the actual deflection of the Posturomed® / Torsiomed® platform from its resting position, but to the relative change of this displacement. This is equivalent to the acceleration experienced by the platform. If the platform is motionless, the effective acceleration is zero, and so are the measurement values.

If, for example, the displacement of the platform changes exclusively along the x-axis of the sensor, an acceleration occurs along this axis and the measurement results received for the x-axis are not equal to zero. A faster displacement equals a greater acceleration and therefore results in a larger measurement value.

While the measurements are carried out, a graph is generated on the basis of the measurement values in a two-dimensional coordinate system and various factors for evaluating the platform accelerations are calculated for the numerical output.
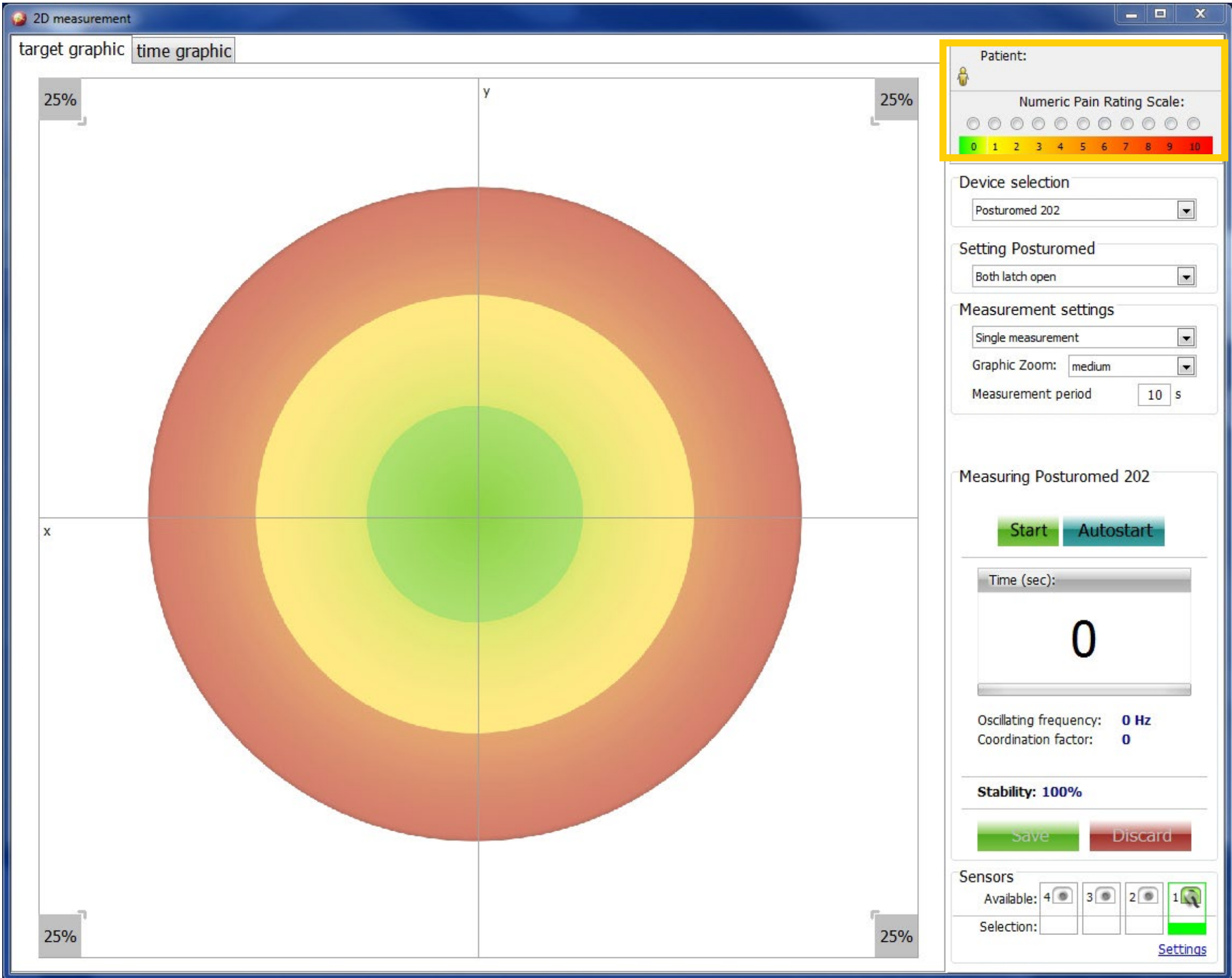
7. Measurement procedure

7.1. 2D measurement

As an "open" measurement programme, 2D measurement allows you to use your own test methods.

Once 2D measurement has been opened with a single click, the following window is displayed. An explanation of the right-hand column is given below, followed by an explanation of the graph.

7.1.1 The "Patient" section

The patient section displays the currently loaded patient. If no patient has been loaded, this field will be empty. Click on the yellow patient icon once to open the "Load patient" window. This window contains all the patients that have been saved so far, with their names and, if they have been entered, their patient numbers. Select your patient from this list and click on the green "Load patient" button to load the patient into your measurement programme. You can also use this window to change to another patient or to add a new patient. Under the patient's name, you can click on the numeric scale to enter your patient's current pain intensity. This pain entry will be displayed in the depiction of results later on and in the progress documentation for the actual measurement time. If the current pain intensity is not entered at this point, no entry for this measurement time will be included in the progress documentation.
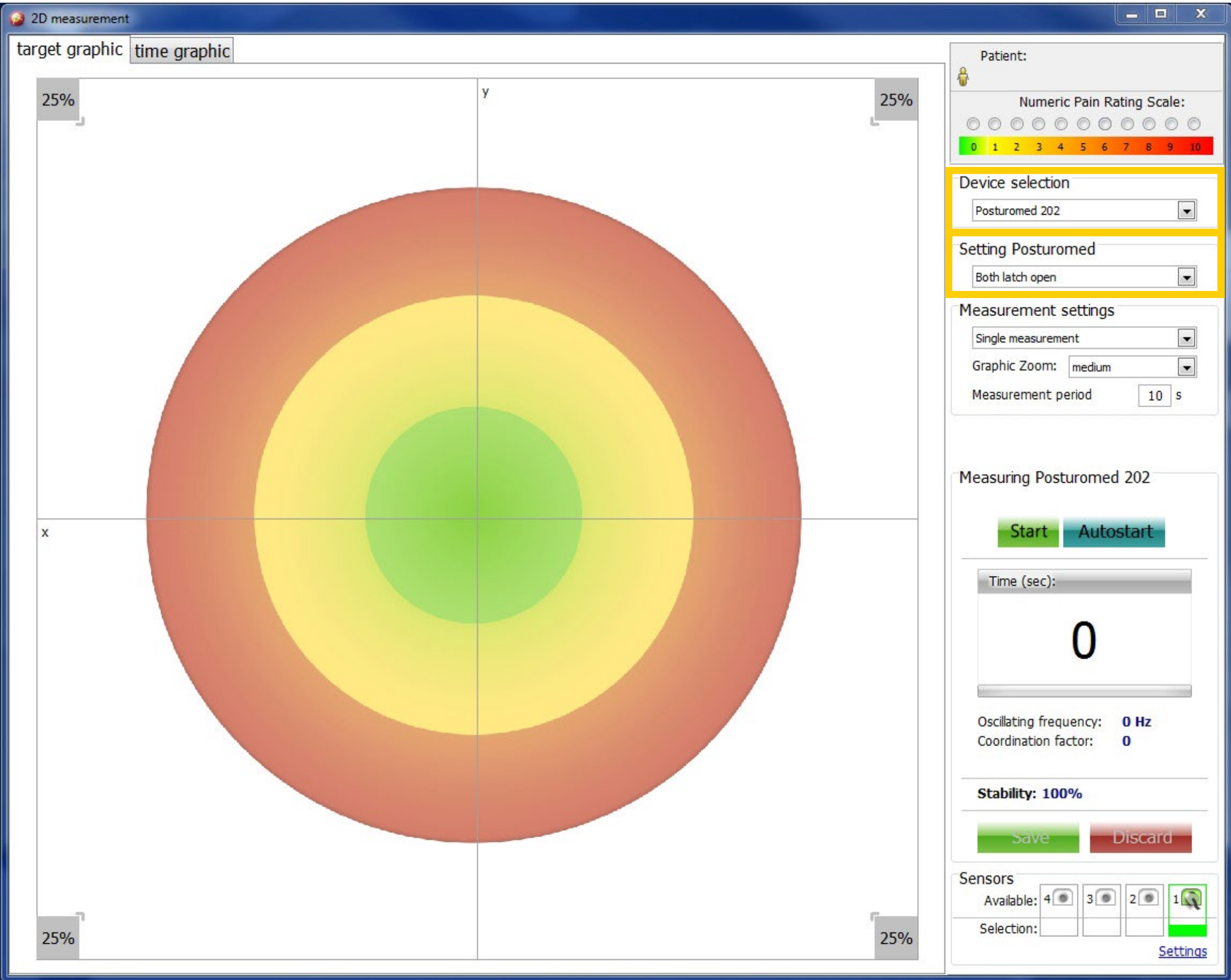
7. Measurement procedure

7.1.2 The "Device selection" section

You can use the device selection section to select the device for the measurement procedure or for the feedback training (Posturomed® 202, Posturomed® Compact or Torsiomed®). This setting has no effect on the measurement or the measurement results, but it is stored in the file name with an appropriate abbreviation so you can immediately tell which measurement procedure was used with which device just by looking at the file name. You can also filter the various measurements by the device used in the progress documentation, although this is only reliable if the devices have been entered correctly. The device selection is also displayed in the evaluation protocol and in the printouts.

7.1.3 The "Setting Posturomed" section

In addition to the device selection section, this field is activated if you select the Posturomed® as a device. You can use this field to select the setting of the two locking bars on the Posturomed® and thus the blocking or release of the second oscillating circuit. Releasing the second oscillating circuit increases the oscillating amplitude of the Posturomed® treatment surface and thus the effort required by the person standing on it. This setting does not affect the measurement software, but it is noted in the evaluation protocol and the printouts.

7. Measurement procedure

7.1.4 The "Measurement settings" section

In this section you can choose which basic type of measurements you wish to perform.

An **individual measurement** involves a one-off measurement with a duration entered in seconds. You can start an individual measurement manually by clicking the "Start" button, or via "Autostart" with the measurement beginning when a movement stimulus is sensed on the treatment surface. The sensitivity of the sensor for the autostart functions is generally set in the menu bar under "Settings" (see Section 6.1.4, "Settings").

A **measurement series** involves several measurement runs being performed in succession. For this option, you should enter the number of measurement runs (max. 20)

in addition to the measurement duration and the pause time between procedures. If a measurement series is activated via "Autostart", the (sub-)measurement only begins when a movement stimulus is sensed on the treatment surface (see Section 6.1.4, "Settings"). If you activate "Start" here, the measurement begins immediately and directly after each pause, regardless of whether the sensor experiences accelerations.

For an individual measurement and for a measurement series, the start of a measurement is indicated by a single audible signal and the end is indicated by a double audible signal. At the end of a complete measurement series and at the end of an individual measurement, you will hear the words "Thank you, measurement complete".

A **Continuous measurement** or **Feedback** involves the acceleration being displayed in an endless loop. The time you enter determines how many seconds will pass before the graph is emptied and a new graph is begun. The purpose of this function is to give you real-time feedback during treatment and it cannot be saved.

You can use the graphic zoom setting to alter the sensitivity of the graph. This has no effect on the numerical results or the raw data. A medium graphic zoom is applied as standard. You can also use the dropdown menu to set the desired zoom level to low or high. A **high graphic zoom** shows a larger displacement for the sensor acceleration for a given measurement value. A **low graphic zoom** shows a smaller displacement for the

sensor acceleration for a given measurement value.

If the measurements you are taking for your subject are especially small, for example if your subject is standing very still on the Posturomed® or Torsiomed®, it is advisable to use the high graphic zoom. If the measurements you are taking for your subject are especially large, for example if your subject is not standing very still on the Posturomed® or Torsiomed® or is to perform deliberately large accelerations (for example in the Posturomed® rehab module), it is advisable to use the low graphic zoom.

7. Measurement procedure
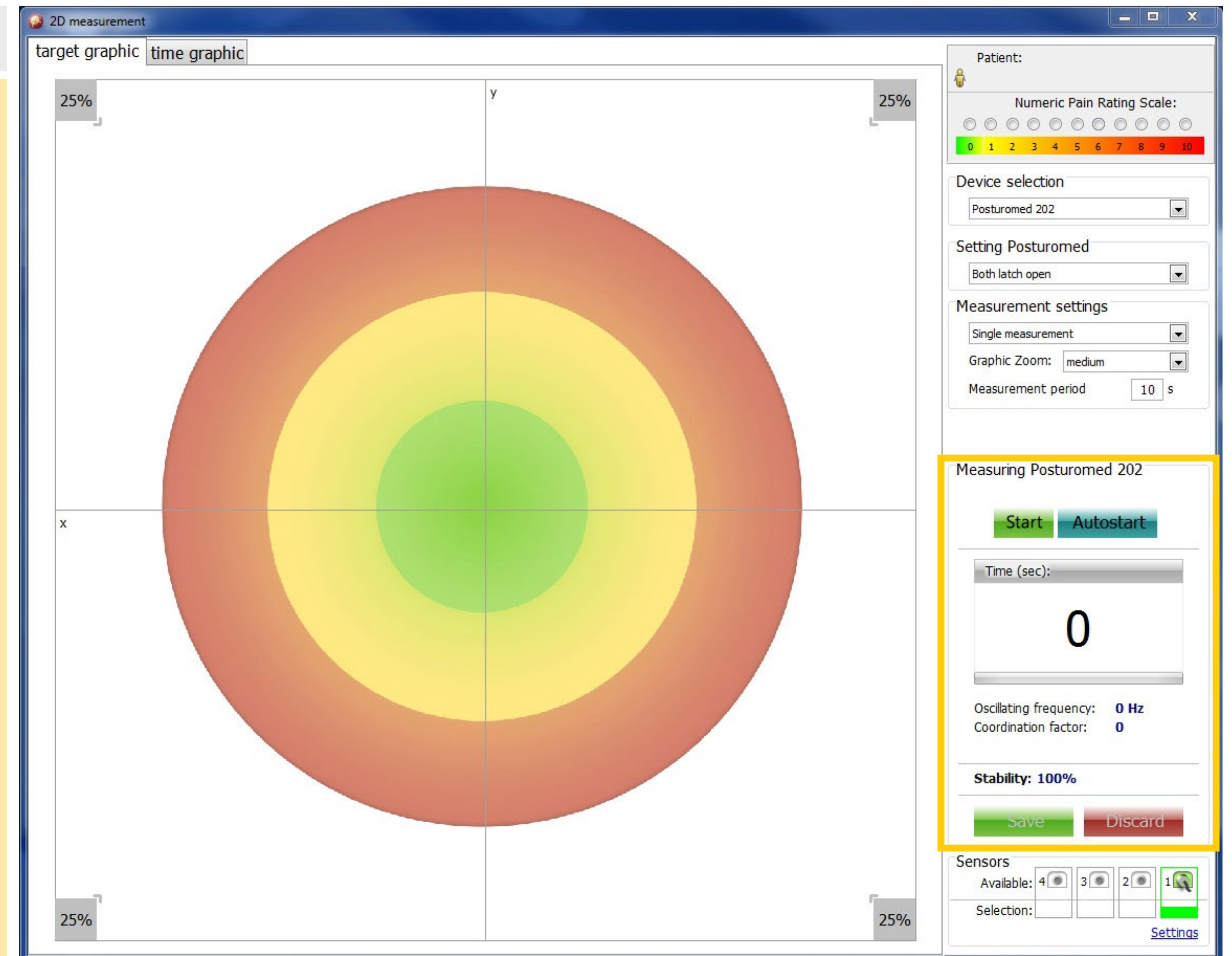
7.1.5 The "Measurement" section

The "Measurement" section contains all the buttons required for controlling a measurement ("Start", "Autostart", "Error" – only for measurement series, "Save", "Discard") and for displaying the progress over time. This section also outputs the numerical results for "Oscillation frequency", "Coordination factor" and "Overall stability" (see Section 8.1, "Evaluating measurement data").

The start button is used to manually initiate the measurement. When the button has been activated, it changes into a stop button that can be used to stop the measurement manually. The autostart button releases measurement but does cause measurements to be started immediately. Measurements only begin once the sensor senses an acceleration that exceeds the autostart threshold. You can set this threshold in the menu bar under "Settings"/"Autostart threshold" to a value between 10% and 100% by clicking or sliding the slider (see page 16). A lower threshold value makes the measurement system respond to sensor accelerations with greater sensitivity.

If your patient makes an error during a measurement run, you can activate the error button to repeat the procedure. If the error button is activated during a pause in a measurement series, the measurement that took place before the pause is cancelled and repeated.

You can click on the "Save" button to save the measurement data. This becomes active when a measurement has been completed If no patient has been loaded, a window will be displayed before the data are saved, asking you to load a saved patient or to create a new patient. Click on "Discard" to discard the measurement and remove the measurement results from the small icons displayed on the left-hand side of the screen.
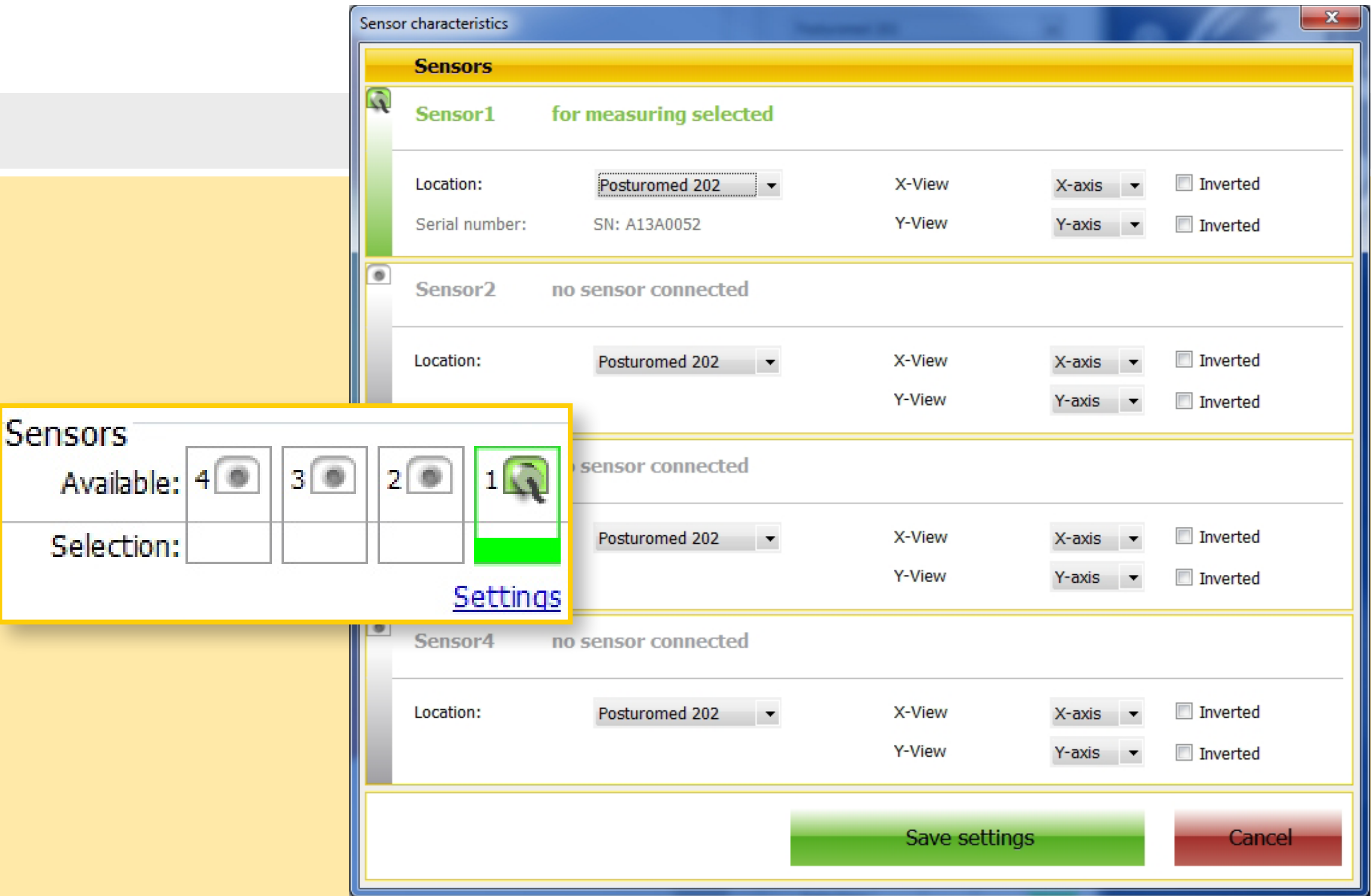
7. Measurement procedure

7.1.6 The "Sensors" section

The bottom right section of the dialogue window contains the "Sensors" display field. This section indicates the number of sensors currently connected to the measuring box ("Available", green outline and green plug icon) and shows which sensors are being used for the current measurements ("Selection", green outline with horizontal bar underneath, selected under "Settings"). If a sensor is connected to the computer via the measuring box, the first sensor is always shown in the dialogue window, regardless of which measuring box port the jack plug was plugged into. The numbers next to the plug icons in the dialogue window do not represent the activated plug but the number of sensors connected within the green outline.

Click on **"Settings"** to access the function field "Sensor properties". Here you can see under "Location" which devices you selected in the currently opened measure-ment program. The **Serial number** of your attached sensor or sensors is displayed underneath "Location". You can also specify which **sensor axis** corresponds to which actual movement axis of the device's treatment surface. The default setting here is for the axes to match, with the sensor measuring the accelerations of the device's x-axis (right to left) along its own x-axis and the device's y-axis along its y-axis. As the sensors are 3D sensors, you can also initiate the z-axis, depending on how the sensor attached to the device is orientated. The sensor axes should correspond to those of the device where possible, however, to avoid confusion later on when the results are interpreted. You can click the **"Inverted"** check box to invert the acceleration directions. Accelerations towards the right will then be shown as being towards the left, accelerations towards the front will be shown as being towards the rear, and vice versa.
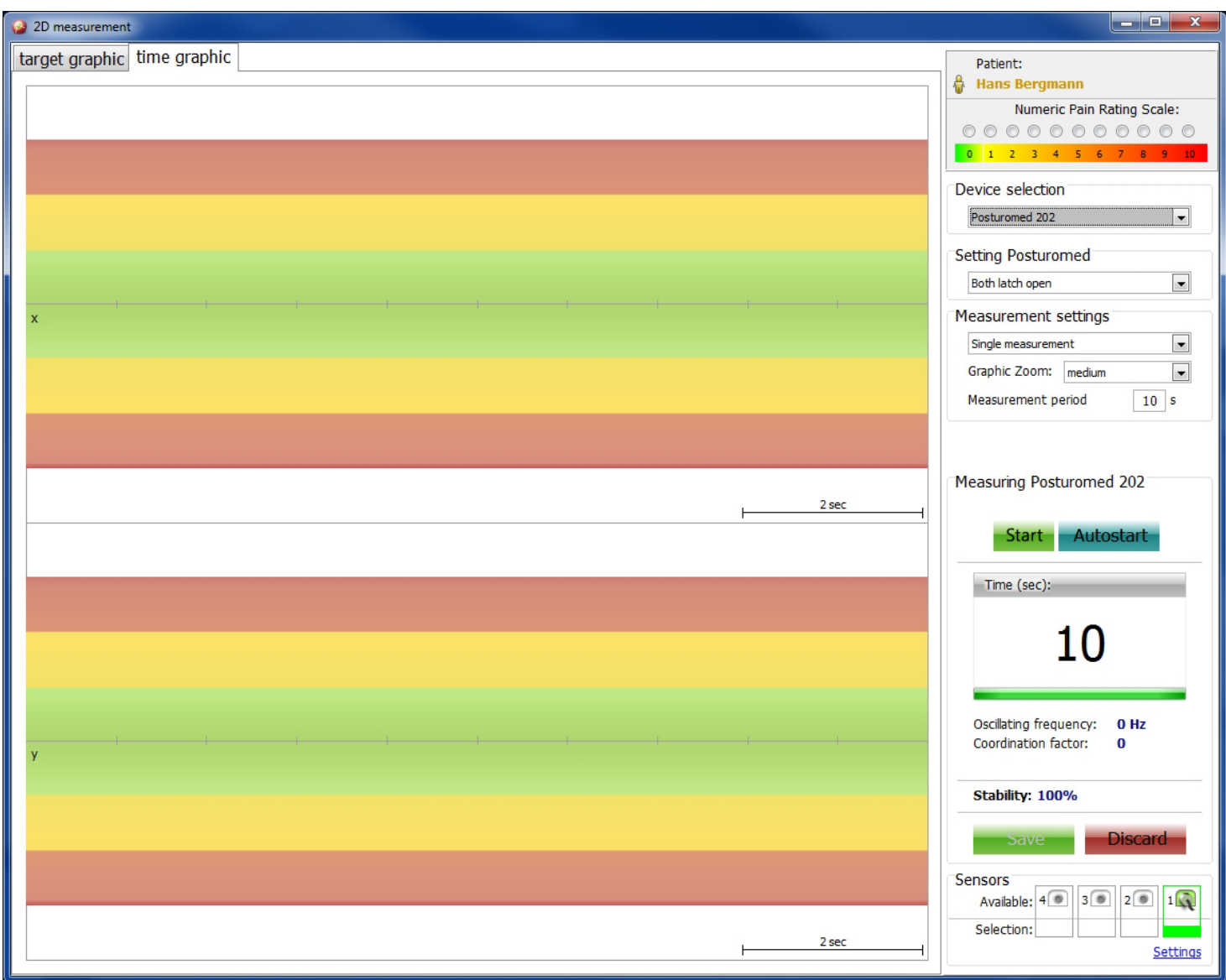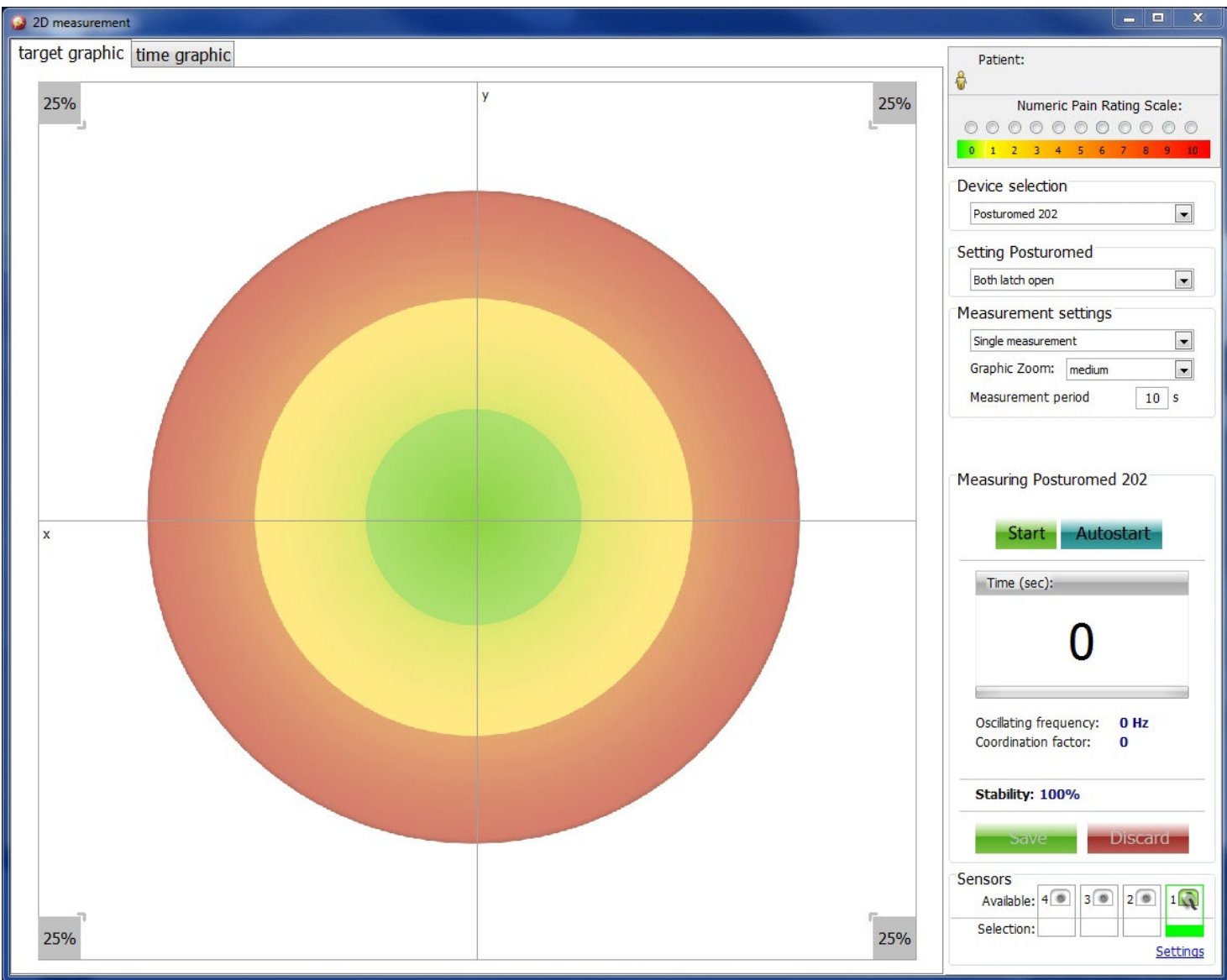
7. Measurement procedure

7.1.7 Graphs

The majority of the screen is taken up by the graph. Each measurement dialogue has one target graph and two time graphs (x- and y-graphs) to visualise the sensor accelerations. If 2D measurement is activated, the target graph is shown first. You can, however, use the two tabs on the left at the top ("target graphic" and "time graphic") to switch back and forth between the graph displays whenever you like before, during and after the measurement runs and during measurement pauses. Each graph contains at least one Cartesian coordinate system in which a graph is drawn. This coordinate system contains a red (outer) area, a yellow (central) area and a green (inner) area. The outer corners of each of the coordinate system quadrants contain information on the percentage share of the acceleration curves. This makes it possible to estimate the main acceleration directions.

During a measurement series, small additional graphs are displayed next to the main graph, one for each measurement run. The additional graphs for the sub-measurements not currently in use are greyed out. The additional graphs are numbered at their top left. Once the sub-measurement has been completed, the stability percentage is shown beneath the graph on the right.

The stability information shown above the main graph for a series of measurements always relates to the measurement that is currently active or, during a pause, to the coming measurement (initially showing 100%). The continuous average overall stability as well as the stability of the even and odd measurement runs is shown in the right-hand column in the "Measurement"/"Overall stability" section.

7. Measurement procedure

7.2 The PosturoCyberneticsTest

The PosturoCyberneticsTest (PCT) is used to measure your patient's motor stability (central motor coordination) rapidly and easily, in standardised form. This is done by making the subject stand on one leg multiple times, either the right or the left, in random order. The patient's first measurement must not last any longer than a total of 10 minutes.

The PCT is evaluated by means of a stability percentage. The stability percentage is based on a mathematical operation, partially derived from oscillation frequency and oscillation amplitude (see Section 8.1.1, "Stability"). The maximum value "100% stability" corresponds to the idle sensor or idle platform. In this case, the frequency and the amplitude are equal to zero. Higher oscillation frequencies and oscillation amplitudes result in lower stability values.

Figure: The defined one-leg stand in PCT: The medial malleolus of the free leg is loosely held at the height of the inner knee of the supporting leg, after the patient has stepped up from the corresponding body length marking on the step mat on to the centre of the Posturomed® (or Torsiomed®). The arms hang loosely by the side of the body and the line of sight is pointed straight ahead. This one-leg stand must be kept as steadily as possible throughout the entire measurement duration of 10 seconds.
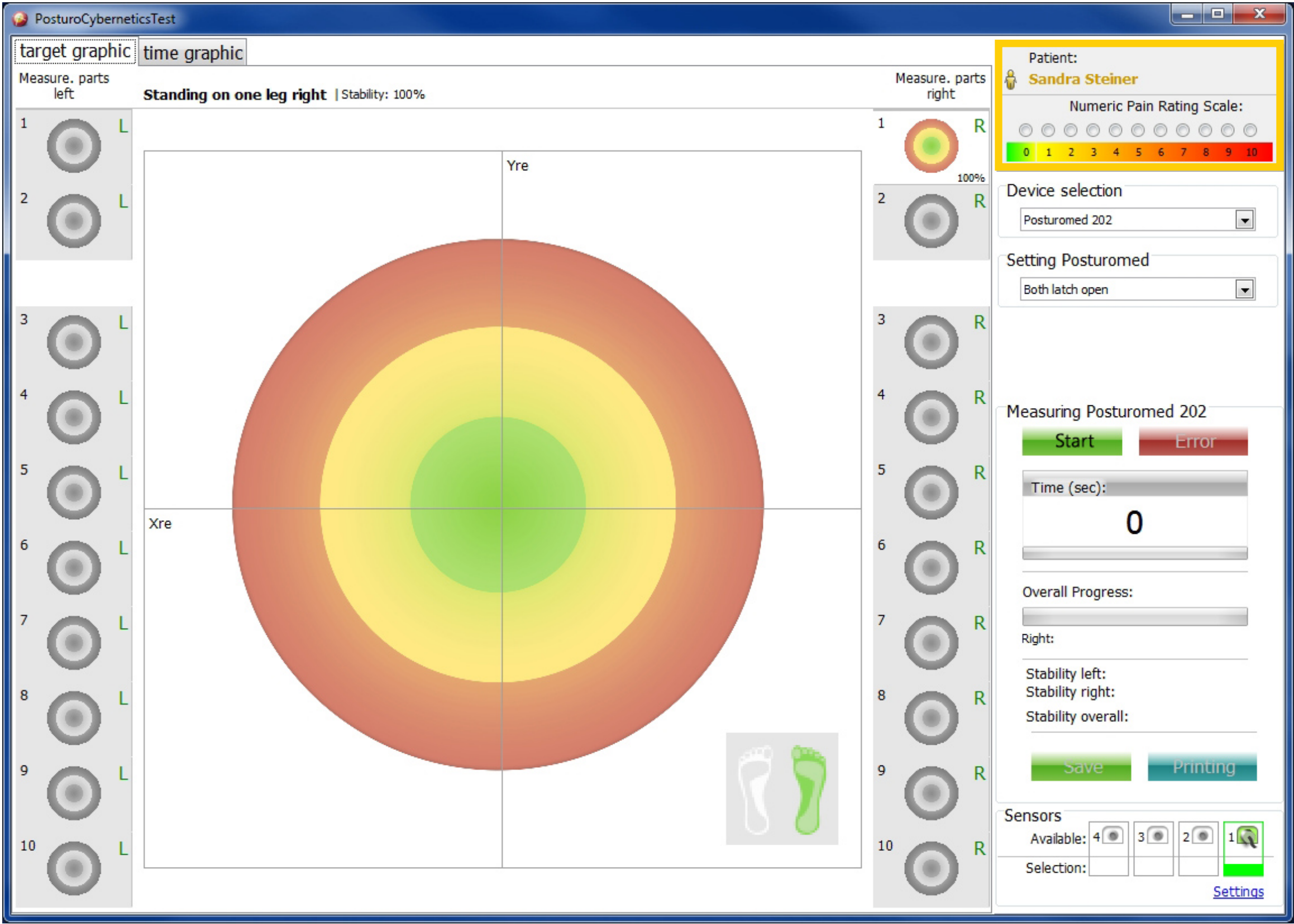
7. Measurement procedure

7.2.1 The software

Once the PCT software has been opened with a single click, the following window is displayed. An explanation of the right-hand column is given below, followed by an explanation of the graph.

## 7.2.1.1 The "Patient" section

The patient section displays the currently loaded patient. If no patient has been loaded, this field will be empty. Click on the yellow patient icon once to open the "Load patient" window. This window contains all the patients that have been saved so far, with their names and, if they have been entered, their patient numbers. Select your patient from this list and press the green "Load patient" button that is now activated to load the patient into your measurement programme. You can also use this window to change to another patient or to add a new patient. Under the patient's name, you can click on the numeric scale to enter your patient's current pain intensity. This pain entry will be displayed in the depiction of results later on and in the progress documentation for the actual measurement time. If the current pain intensity is not entered at this point, no entry for this measurement time will be included in the progress documentation.

7. Measurement procedure

7.2.1.2 The "Device selection" section

You can use the device selection section to select the device (Posturomed® 202 or Torsiomed®). This setting has no effect on the measurement or the measurement results in terms of a software change, but it is stored in the file name with an appropriate abbreviation so you can immediately tell which measurement procedure was used with which device just by looking at the file name. You can also filter the various measurements by the device used in the progress documentation, although this is only reliable if the devices have been entered correctly. The device selection is also displayed in the evaluation protocol and in the printouts.
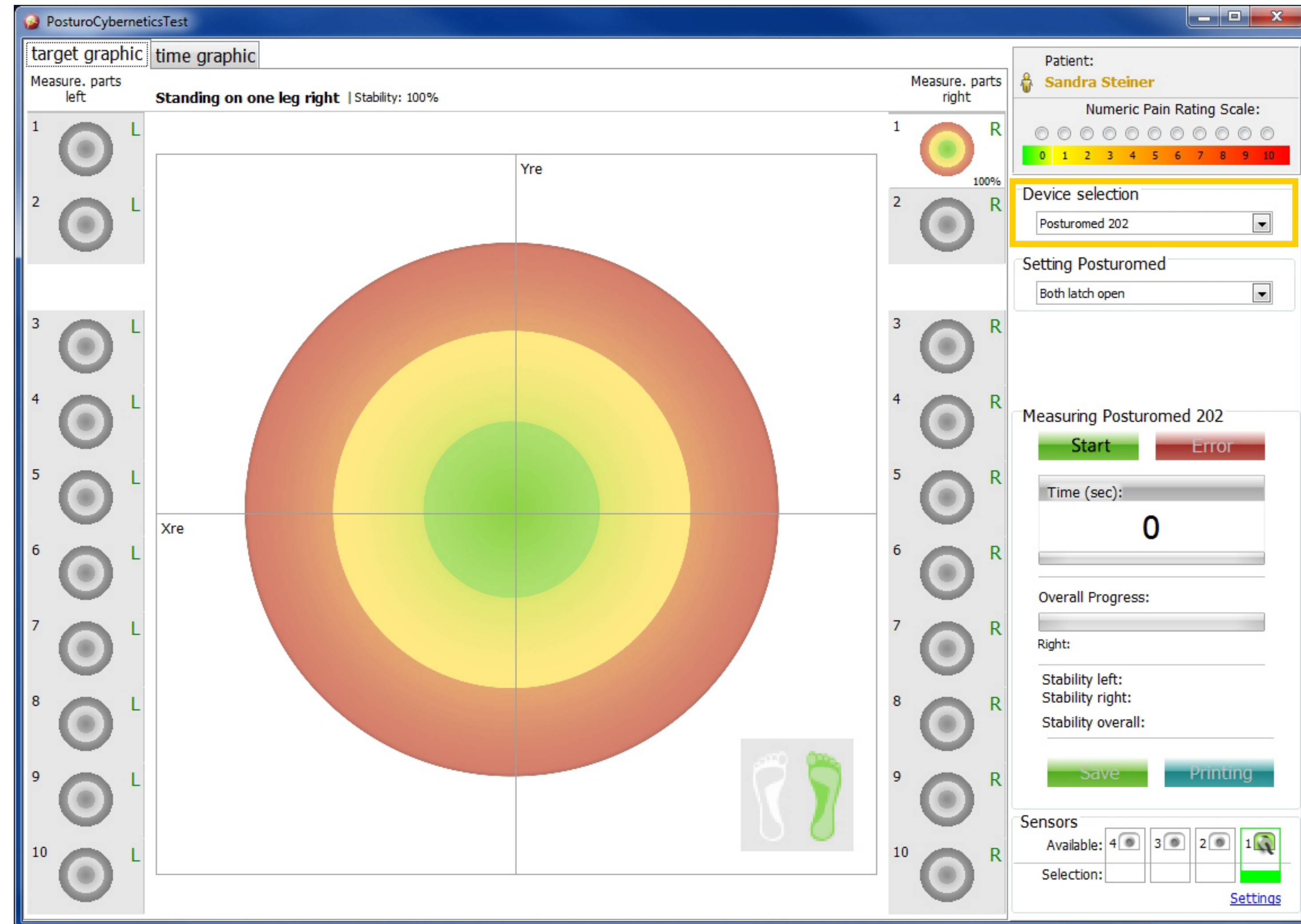
7. Measurement procedure

7.2.1.3 The "Setting Posturomed" section

In addition to the device selection section, this field is activated if you select the Posturomed® 202 as the device. You can use this field to select the setting of the two locking bars of the Posturomed® and thus the blocking or release of the second oscillating circuit. Releasing the second oscillating circuit increases the oscillating amplitude of the Posturomed® treatment surface and thus the effort required by the person standing on it. This setting does not affect the measurement software, but it is noted in the evaluation protocol and the printouts.

Please note that once you have chosen the locking bar settings for your patient, or even for your whole patient clientele, they should not be changed. The locking bar settings should not be changed in a measurement run or even throughout the entire measurements in the treatment process. It is otherwise not possible to compare single measurement results for one individual or, as applicable, between different individuals.
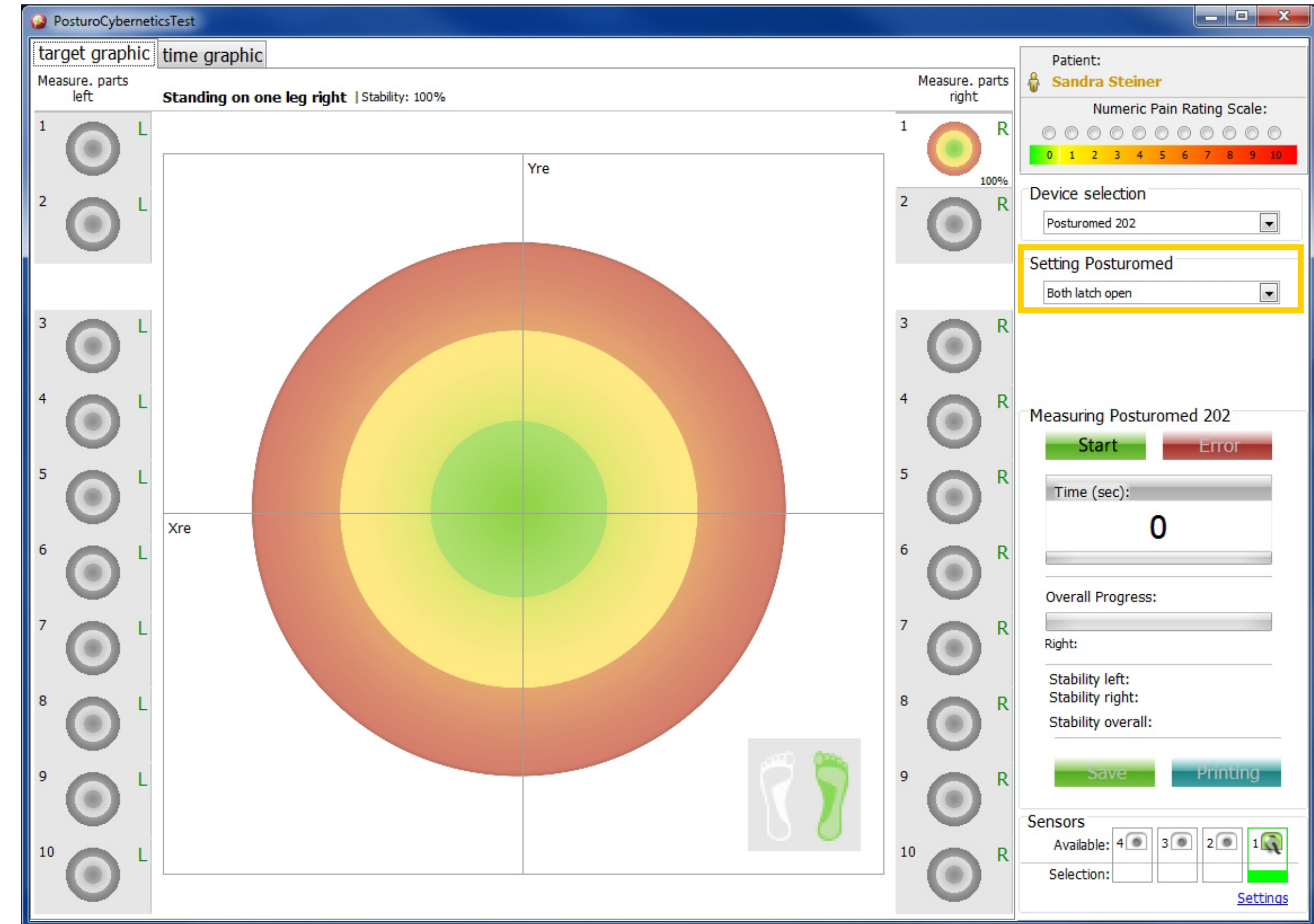
7. Measurement procedure

7.2.1.4 The "Measurement" section

The "Measurement" section contains all the buttons for controlling a measurement ("Start"/"Stop", "Error", "Save", "Printing") and for displaying the progress over time and the total progress of the Posturo-CyberneticsTest.

This section also outputs the numerical results for "Stability left", "Stability right") and "Stability overall" (see Section 8.1.1, "Stability").

The start button is used to activate the measurement. When the button has been activated, it changes into a stop button that can be used to stop the measurement manually. The start button releases the measurement but does not cause measurements to be started immediately. Measurements only start once the measurement has been released by a single audible signal followed by the sensor sensing an acceleration that exceeds the autostart threshold. You can set this threshold in the menu bar under "Settings"/"Autostart threshold" to a value between 10% and 100% by clicking or sliding the slider (see page 16). A lower threshold value makes the measurement system respond to sensor accelerations with greater sensitivity. We recommend setting the threshold value to 20%. The measurement duration is ten seconds. The end of the duration is indicated by a double audible signal. In the 10-second pause period, the forthcoming one-leg stand is announced by an automatic voice output. The first two measurements are trial runs and they are performed alternatively right and left. The sequence is automatically randomised from the fifth measurement run onwards.

If your subject makes an error during a measurement run, you can activate the error button to repeat the run. If the error button is activated during a pause, the measurement that took place before the pause is cancelled and repeated.
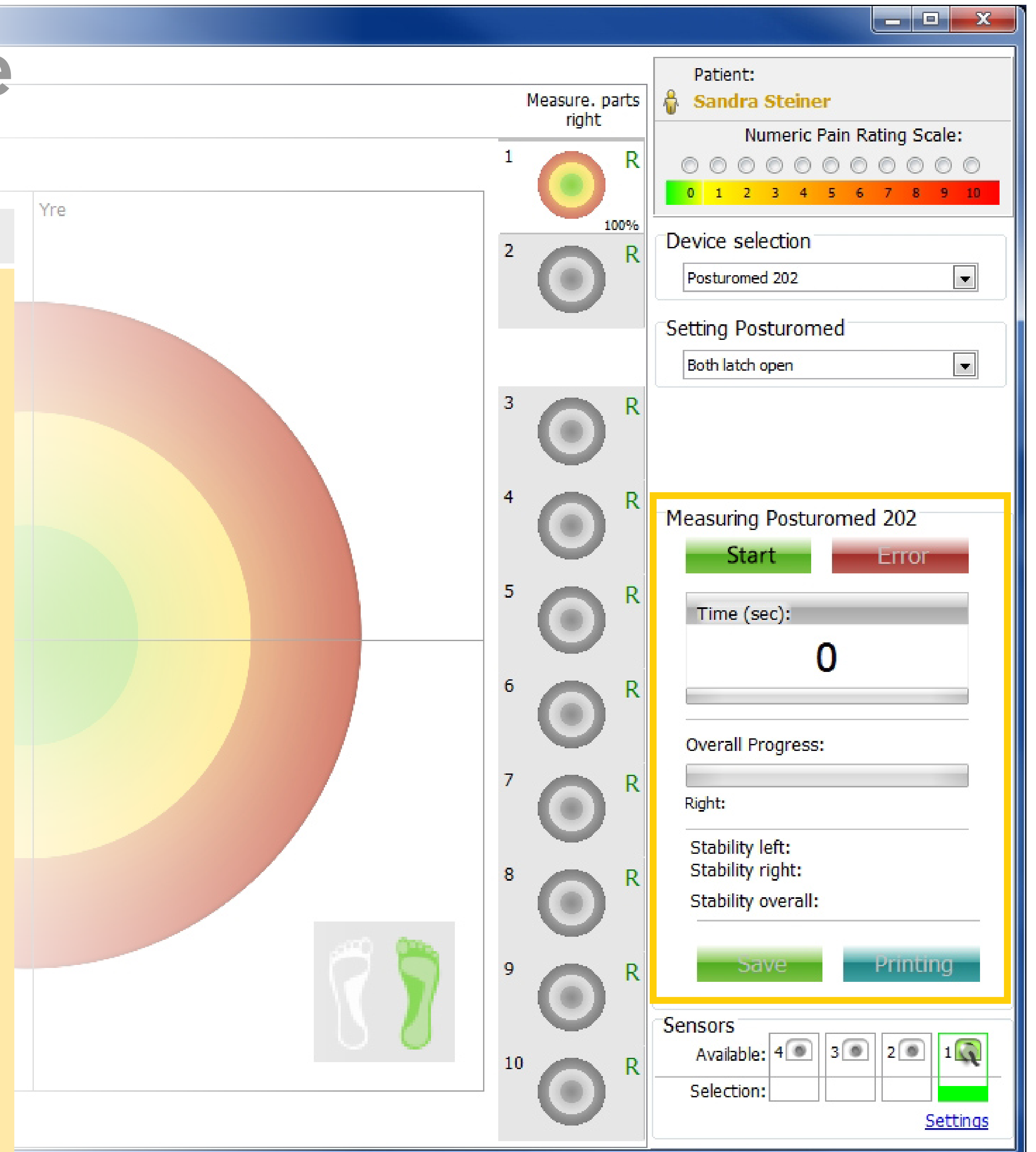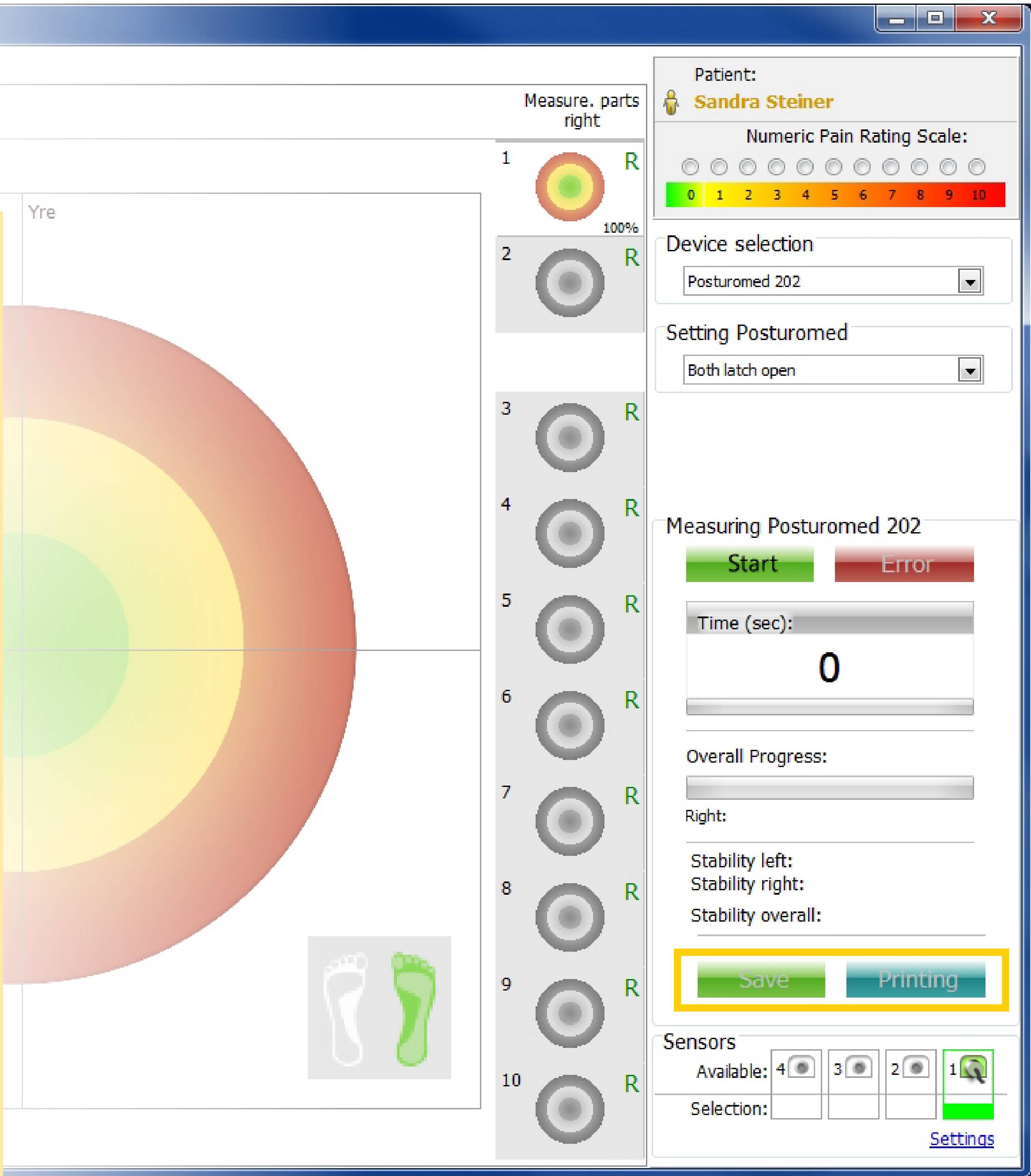
7. Measurement procedure

You can click on the "Save" button to save the measurement data. If no patient has been loaded, a window will be displayed before the data are saved, asking you to load a saved patient or to create a new patient.

Pressing the "Print" button generates a single-page PDF document containing all 20 measurement runs in time graph form and numerically. The individual averages and the overall average are calculated on the basis of the last eight measurements per one-leg stand, which is why the two test runs for each one-leg stand are graphically offset.

The numerical output results for "Stability left", "Stability right" and "Stability over-all" represent the averages of the previous eight measurement runs per one-leg stand. The first two test runs per one-leg stand are not incorporated into the output results as the learning curve at this point is still rising. Out of a total of 20 measurement runs, only the last 16 are therefore evaluated.

When the measurements have been completed, the "Start" button changes into a "New" button. You can click this button to start a new measurement straight away. If your current measurement has not yet been saved, a confirmation window will be displayed to ensure that you do not lose the most recently recorded data accidentally. If you confirm that you wish to save the data in this window, the window closes and the screen is emptied for a new measurement.
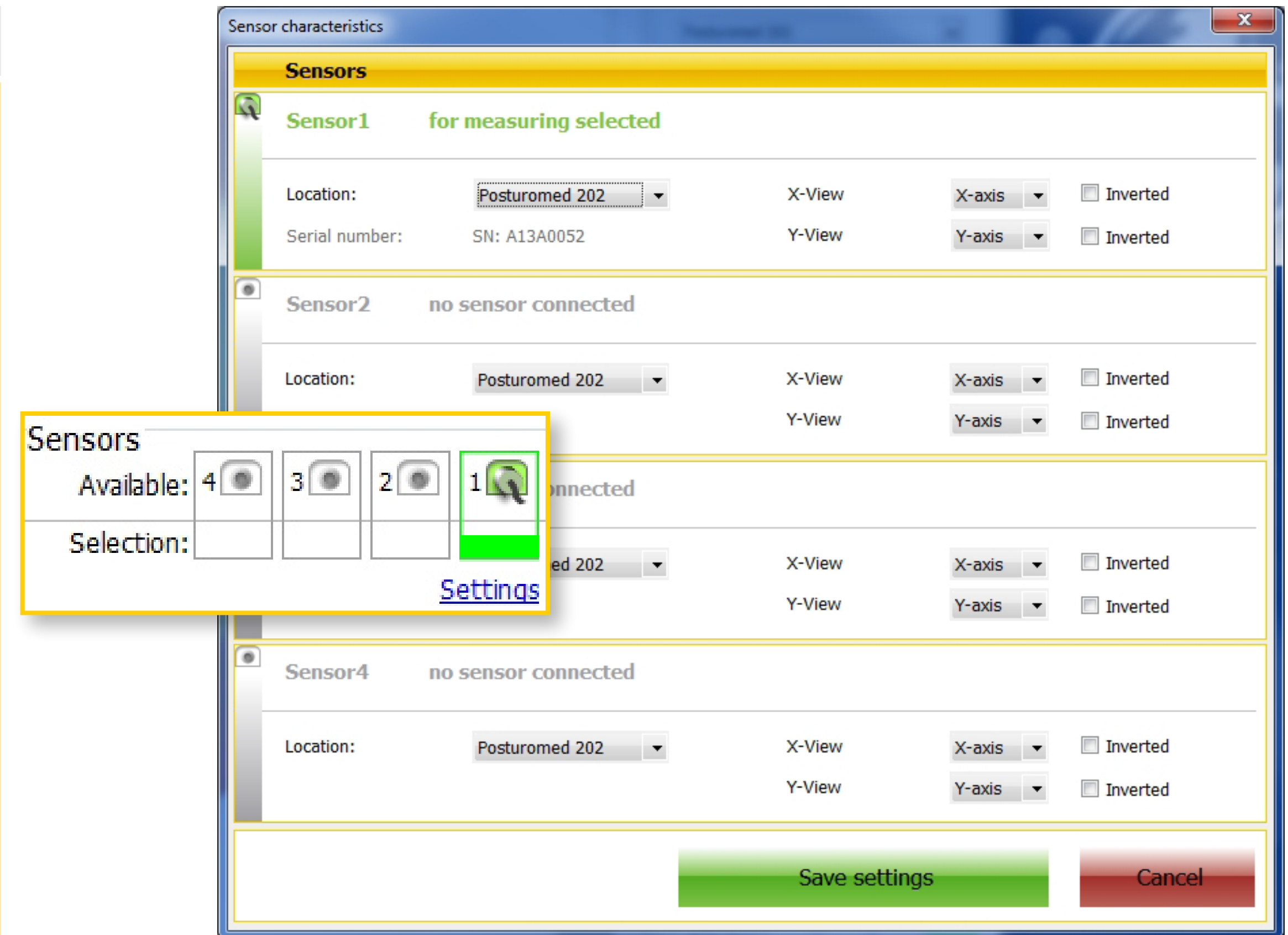
7. Measurement procedure

7.2.1.5 The "Sensors" section

The bottom right section of the dialogue window contains the "Sensors" display field. This section indicates the number of sensors currently connected to the measuring box ("Available", green outline and green plug icon) and shows which sensors are being used for the current measurements ("Selection", green outline with horizontal bar underneath, selected under "Settings"). If a sensor is connected to the computer via the measuring box, the first sensor is always shown in the dialogue window, regardless of which measuring box port the jack plug was plugged into. The numbers next to the plug icons in the dialogue window do not represent the activated plug but the number of sensors connected within the green outline.

Click on **"Settings"** to access the function field "Sensor properties". Here you can see under "Location" which devices you selected in the currently opened measurement program.

7. Measurement procedure

The **Serial number** of your attached sensor or sensors is displayed underneath "Location".

You can also specify which **sensor axis** corresponds to which actual movement axis of the device's treatment surface. The default setting here is for the axes to match, with the sensor measuring the accelerations of the device's x-axis (right to left) along its own x-axis and the device's y-axis along its y-axis. As the sensors are 3D sensors, you can also initiate the z-axis, depending on how the sensor attached to the device is orientated. The sensor axes should correspond to those of the device where possible, however, to avoid confusion later on when the results are interpreted.

You can click the **"Inverted"** check box to invert the acceleration directions. Accelerations towards the right will then be shown as being towards the left, accelerations towards the front will be shown as being towards the rear, and vice versa.

7. Measurement procedure

7.2.1.6 Graphs

The majority of the screen is taken up by the graph. Each measurement dialogue has one target graph and two time graphs (x- and y-graphs) to visualise the sensor accelerations. If the PosturoCyberneticsTest is activated, the target graph is shown first. You can use the two tabs on the left at the top ("target graphic" and "time graphic") to switch back and forth between the graph displays whenever you like before, during and after the measurement runs and during measurement pauses. Each graph contains at least one Cartesian coordinate system in which a graph is drawn. This coordinate system contains a red (outer) area, a yellow (central) area and a green (inner) area. You cannot zoom into or out of the graph as you can for the 2D measurement.

Ten small additional graphs are provided on both sides of the main graph. The additional graphs for the sub-measurements not currently in use are greyed out. The additional graphs are numbered at their top left. Once the sub-measurement has been completed, the stability percentage is shown beneath the graph on the right.

The stability information shown above the main graph always relates to the measurement that is currently active or, during a pause, to the forthcoming measurement (initially showing 100%). The continuous average stability for each one-leg stand and the continuously updated average overall stability are shown in the right-hand column in the "Measurement" section.
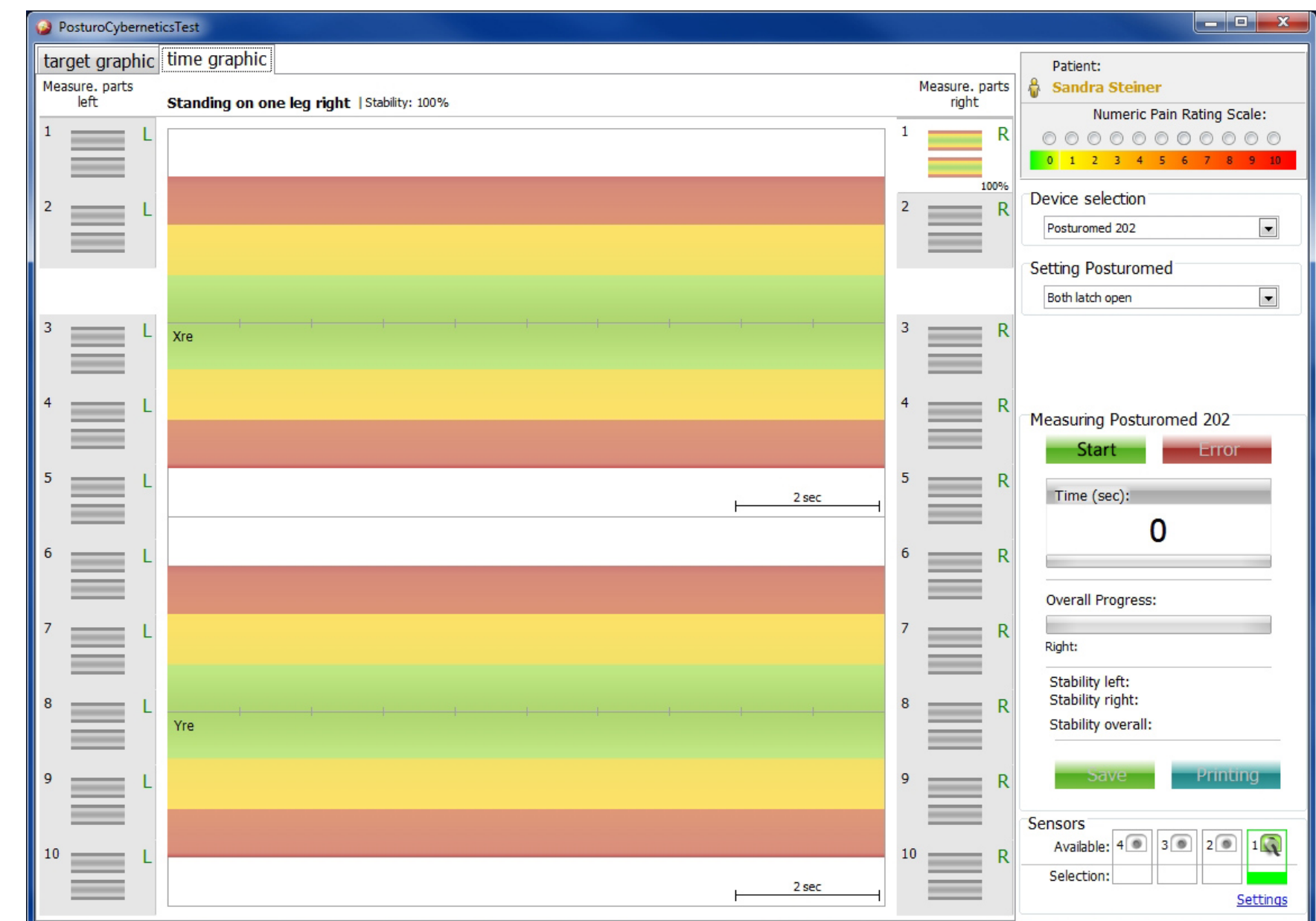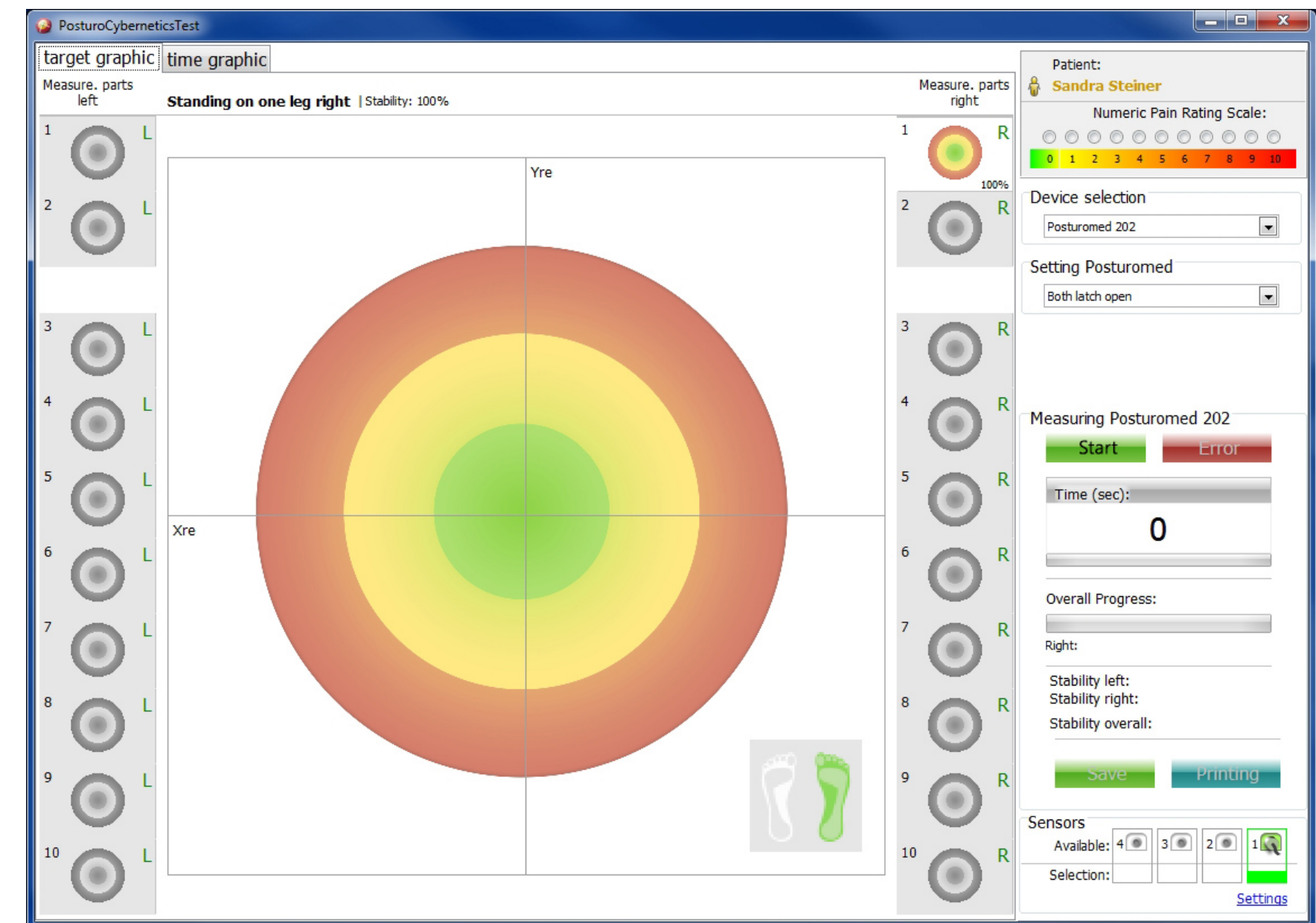
7. Measurement procedure

7.2.2 The test method

As the PCT is a standardised and scientifically evaluated measurement method, set environmental and procedural conditions are specified, and these conditions are discussed below.

7.2.2.1 The measuring station

For the PCT, both locking bars of the Posturomed® are locked by default, as the learning effects are lowest here. During the measurement procedure, the subject cannot see their own reflection in a reflective surface. The line of sight is directed straight ahead, at eye level (an optimum supplement here is the BIOSWING® titubation grid) and the patient is prevented from seeing the computer monitor to avoid any visual feedback regarding the oscillations which they trigger.

7.2.2.2 Die The subjects

The subjects must be mentally and physically relaxed. They must not have undergone intense physical exertion within the last 60 minutes. The subjects must not have lain down within the last 20 minutes. Instead, their movement apparatus must have been subjected to axial load (standing, walking, sitting upright).

The following exclusion criteria must be observed, except where they form the object of investigation:

- Flu-like infection
- Pains
- Fatigue
- Influence of drugs
- Active and passive joint-stabilising bandages, tapes, orthoses, etc.
- Acute inflammation in weight-bearing joints or their soft tissue

- Deficit/lesion of the vestibular system
- Spasticity of the muscles in weight-bearing joints
- Stiffening of weight-bearing joints
- Clothing that is too tight or constricting, or that impairs movement

7. Measurement procedure

7.2.2.3 Preparing the subject

In scientific studies, the measurement process is explained to the subjects using the following standardised text:

"This test procedure is used to assess your ability to maintain balance while standing on one leg on an unstable platform. You should position yourself behind the appropriate line for you on the stride length marking mat. When the computer emits a single audible signal, move your right foot on to the centre of the unstable platform in one swift step and move your left foot to loosely touch your right inner knee. Your arms should hang loosely by the side of your body and your line of sight should point straight ahead. Please refrain from touching the railings and do not lower your free leg unless you would otherwise fall over. If you do lower your free leg, we will repeat

the measurement run for this one-leg stand. When you perform the one-leg stand as described, please stand upright and steady for ten seconds until you hear a double audible signal indicating that the measurement is over. You can then return to the mat. This measurement process is repeated with the right or the left leg, in random order as determined by the computer. Ten measurements are performed standing on the right leg and ten on the left. Before the first measurement and in the pauses, the PC will indicate which one-leg stand is coming up.

I will now demonstrate this test procedure. After this, please perform one test run with the right leg and one with the left. If you have any questions, we should clarify them before the actual measurement run begins. Please do not talk during the one-leg stand."

The test leader will demonstrate the correct way to step onto the Posturomed® (or Torsiomed®) with arms hanging by their side, no more than once per side. The subject, wearing no shoes (in bare feet or with thin socks) then moves to the marking mat in front of the Posturomed® or in front of the first step of the Torsiomed® (without marking mat) and practises the standardised stepping movement (for the Torsiomed® stepping up as if walking up steps) onto the device surface, once right and once left, alternately.

After one test run with the right leg and one with the left, the measurement starts. The test leader clicks the **START** button on the right-hand side of the screen (this button then turns into a **STOP** button that can be used to stop the measurement). After four seconds, the forthcoming right one-legged stand is automatically announced by the PC. After a single audible signal at second ten, the subject begins to move their right foot to the centre of the platform in one swift step. The foot of the free leg (left) is moved against the inner knee of the supporting leg and held there loosely (not pressed against

the inner knee). This one-leg stand is held for 10 seconds until the measuring run is complete (indicated by a double audible signal). The subject returns to the marking mat and four seconds later is notified of the following one-leg stand. When the pause comes to an end at second ten, the single audible signal is issued again and the patient stands on their left leg, with the right leg free. Ten correct right one-leg stands and ten correct left one-leg stands are performed in random order as determined by the computer. The average of the last eight runs is used for the evaluations. While the data is being recorded, the test leader watches out for errors in the execution of the movement The subjects should not speak, should keep their gaze horizontal and fixed on a particular point, and should not be distracted by external influences.

7. Measurement procedure

7.2.2.4 Measurement duration

The measurement duration as determined by the software is ten seconds for the one-leg stand. Clinical experience has shown that this length of time is sufficient to level out the oscillations that occur on the platform and it does not result in any measurable neuronal fatigue. The total measuring time excluding pauses is 200 seconds (10 x 10 seconds on the right leg, 10 x 10 seconds on the left leg, in random order as determined by the computer).

7.2.2.5 Cancelling the recording of data

The recording of data for a one-leg stand is cancelled if the subject performs any of the following errors:

- The subject touches the railing with a body part.

- The subject changes the position of the foot of the standing leg on the device platform.

- The subject places the free leg on the ground.

- The foot of the free leg is not held loosely in the area of the inner knee of the supporting leg. Brief (max. 3 second) corrective deviations of the free leg to maintain balance are tolerable.

- The subject lowers the body's centre of gravity (knee flexion and/or hip flexion above 10° in supporting leg).

8. Measurement data, evaluation – printing – export

The data you have collected and saved are available for evaluation, printing and exporting. These three functions are available in the menu bar of the main window under "File", along with the "End" function, which you can use to close MicroSwing® 6.

8.1 Evaluating measurement data

Various options are available for evaluating or illustrating your data, depending on whether you have already loaded a patient. If no patient has been loaded, open the menu item "Evaluate" in the menu bar of the main window under "File" by left-clicking it once. A full-screen window, "Evaluation", opens with a target disc graph located in its centre.

To illustrate and evaluate your patient data, click the "Measurement loading..." button in the top right with underlined blue text in the "Measuring" function field. The "Load patient" dialogue window opens.
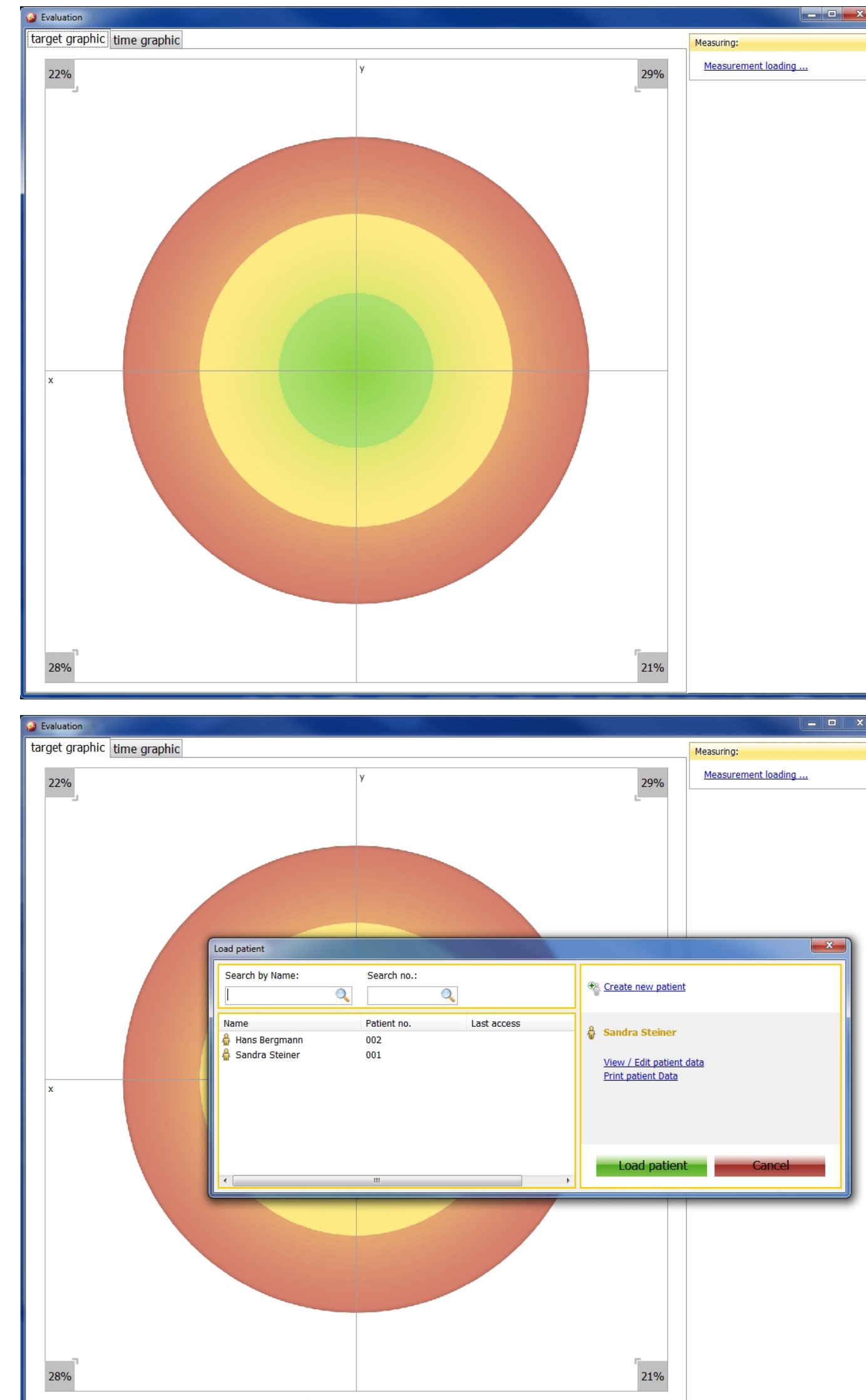
8. Measurement data, evaluation – printing – export

You can use the two search fields above the patient list in the "Load patient" dialogue window to search the patient database by name or patient number (if one is stored). The search function reacts dynamically to the information you enter, automatically removing any patients from the list displayed who do not meet the entered criterion.

Select the patient by clicking the name. You can use the "View/Edit patient data" button and the "Print patient Data" button to perform the corresponding function for the currently selected patient.

Click on the "Cancel" button to close the dialogue window without loading a patient into the main function field.

The "Load patient" dialogue window closes when you click the green "Load patient" button and a new dialogue window, "Load measurement", opens. In this dialogue window, left-click the measurement you want to evaluate and click the green "Load measurement" button to upload the measurement. If there is a long list of measurements in this dialogue window, it is advisable to use the search field above the list to search the measurement database by date.
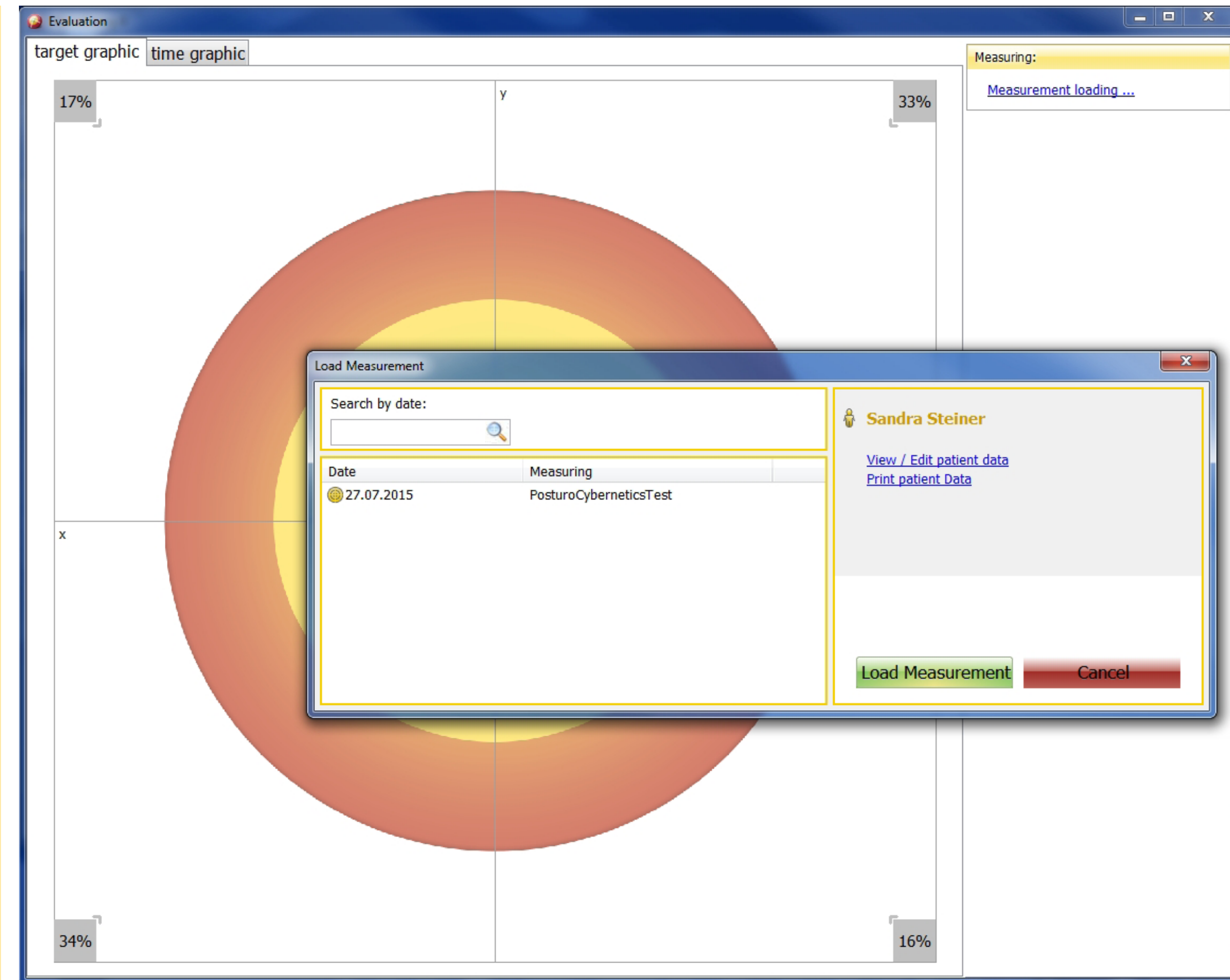
8. Measurement data, evaluation – printing – export

Once you have loaded the selected measurement for the patient, the measurement is shown as a blue graphic in the target disk graph and numerically in the fields in the right-hand half of the screen. If the patient has already been loaded in the main window, you can access the evaluation window by left-clicking the desired measurement in the top-right function field, "Most recent measurements for…", to access an illustration of the measurements directly. The name of your patient is shown under "Measurement" along with the measurement date and time and the pain intensity at the time of the measurement. You can use the "other measurement loading…" button, which is still active, to load a new measurement directly. Below this button, details of the selected device, the measurement procedure and the graphic resolution are displayed. The achieved stability of the selected measurement run and the overall stability are shown as a percentage in the results field.

You can click on the "time graphic" tab to access the time graph. The top graph depicts the displacements along the sensor's x-axis and the bottom graph depicts the displacements along the sensor's y-axis.

This separation of the two axes shows, unlike the target graph, not only how the accelerations of the platform are composed of the displacements of the individual axes but also how they compare over time.

Clicking the green "Printing" button once opens a single-page PDF document with a graphic and numerical depiction of the results. You can save the document to a data storage medium or print it out directly. Closing the document takes you back to the "Evaluation" window.
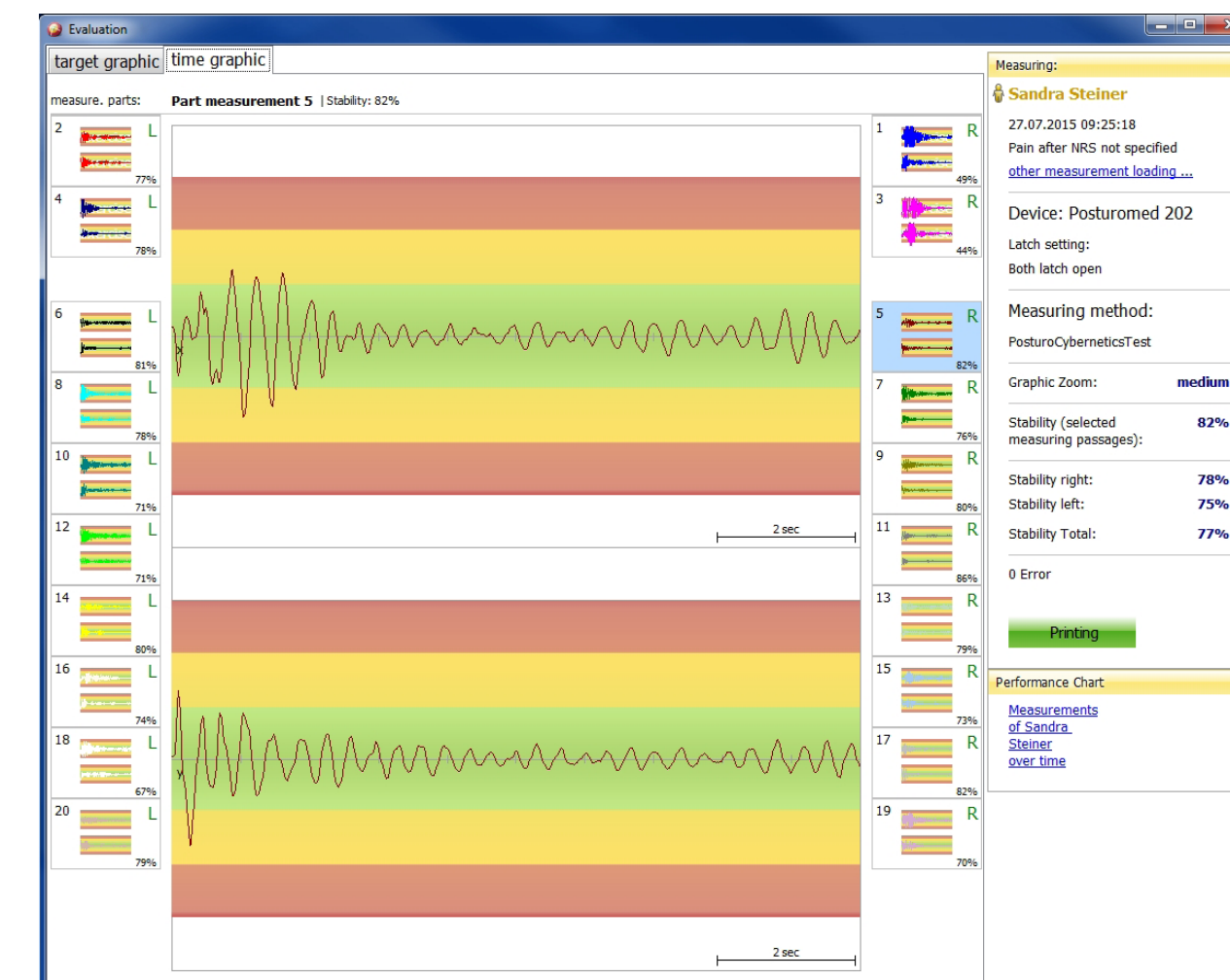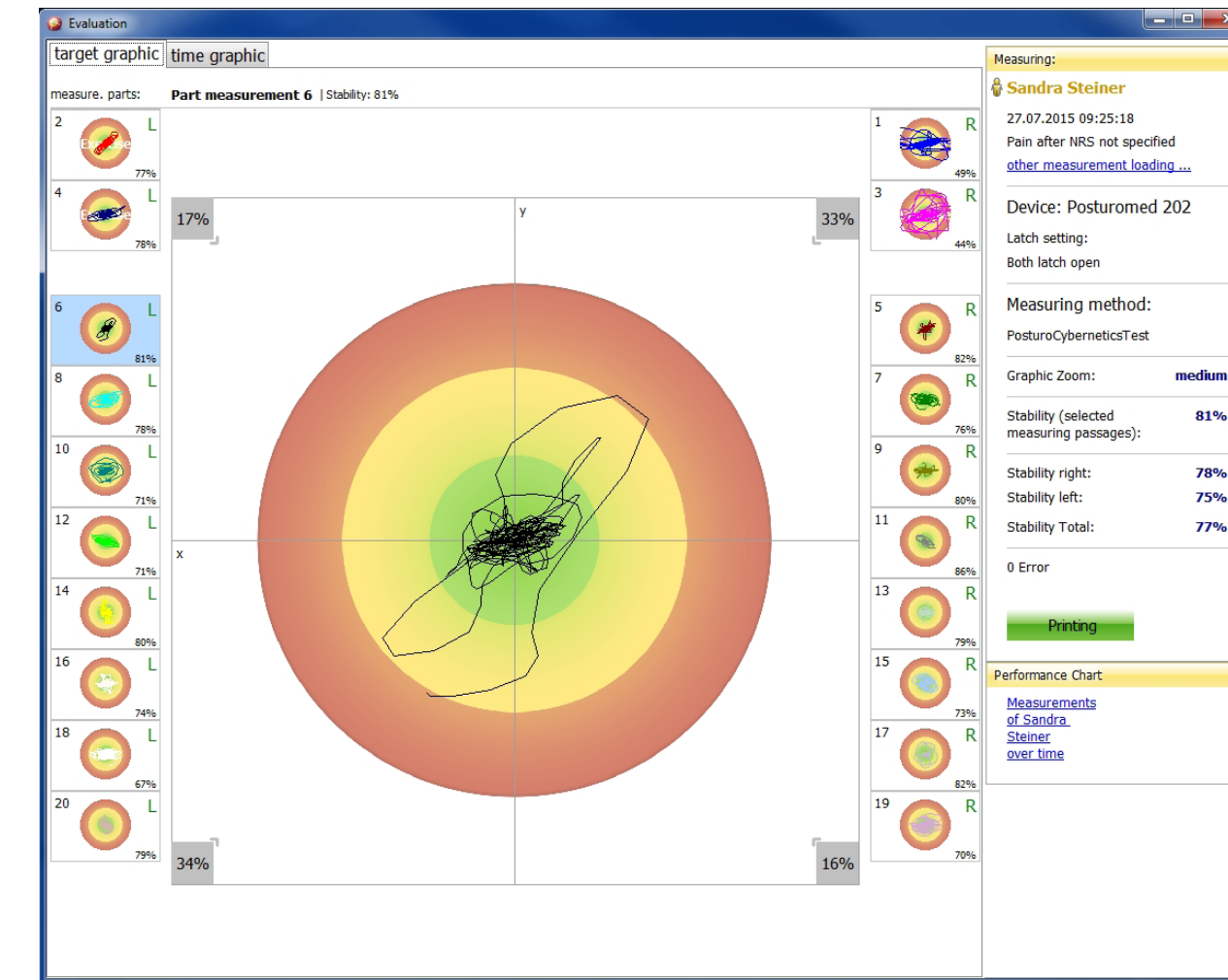
8. Measurement data, evaluation – printing – export

You can use the "Print" button to show the individual measurement results in a progress graph in a new window. This graph provides a graphic depiction of your patient's treatment progress. Please note that this graph can only be created with at least two saved measurements of the same type. Click "Measurement of … over time" to open the "Development" window.

The majority of the window is taken up by the progress graph. The graph shows three basic types of curve:

- The stability curves: one (blue) in the 2D measurement and two (blue and green) in the PCT

- The coordination factor curve (orange)

- The pain curve (red)

You can add or remove these curves by clicking on the corresponding boxes underneath the graph.

The x-coordinates represent the time axis, with the individual (at least two) measurement runs marked with their date. The y-coordinates on the left-hand side represent the stability from 0 to 100% (these values should be as large as possible – see Section 8.1.1). On the right-hand side, they represent the pain level from 0 to 10 in red numbers (these values should be as low as possible) and the coordination factor from 0 to 1,000 in orange (these numbers should be as low as possible – see Section 8.1.3). The coordination factor has no numerical limits and can theoretically be infinitely high. If you remove the pain curve or the coordination factor from the graph, its scale is also deleted and the width of the graph expands to fill the space.

The pain curve can only show a value for a particular point in time if a value was actually clicked on the numerical pain scale at the time the measurement was taken.

You can click on the green "Print" button in the footer to generate a PDF document, to which you can add notes or text highlights to using the PDF tool. You can save this document or print it out via your connected printer.
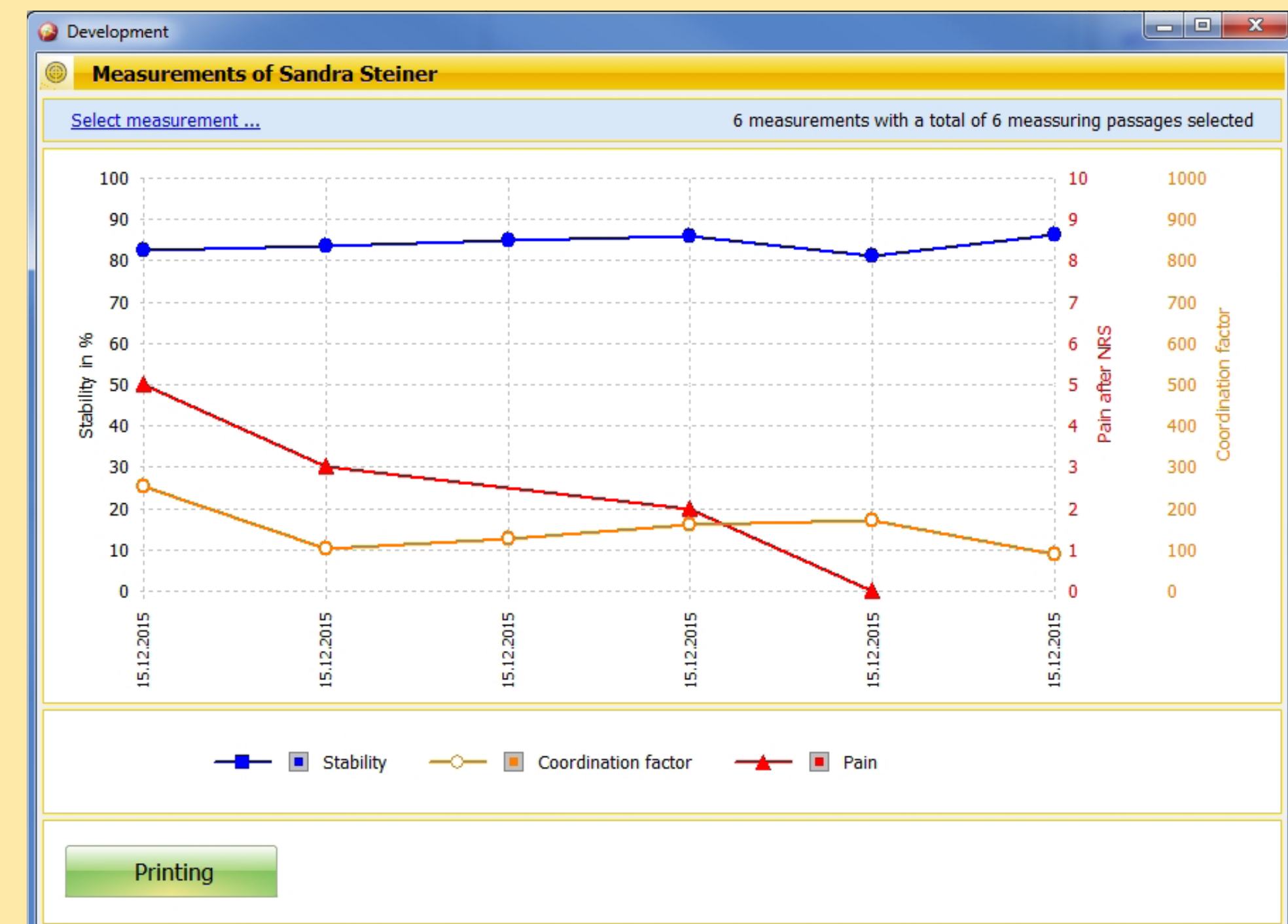
8. Measurement data, evaluation – printing – export

The name of the currently loaded patient is shown with a yellow background at the top of the header. Underneath this, in the second line of the header on the right, you can see the information relating to the measurements used for this progress graph and the related measurement runs. Please bear in mind that only 16 of the 20 measurement runs performed in the PCT are used for the evaluation (eight right one-leg stands and eight left ones). Accordingly, for two measurements there will be a total of 32 measurement runs and for three, 48 measurement runs.

Clicking the blue "Select measurement…" button on the left-hand side opens the "Measurements" window.

The name of your patient is displayed here and underneath you have the option of selecting the measurements to be shown in the progress graph by the device used and the measurement procedure. In the box underneath, select the measurements or the measurement times that you want to display in the progress graph.

Clicking the green "Choose" button closes the window and your selection will be shown in the graph.
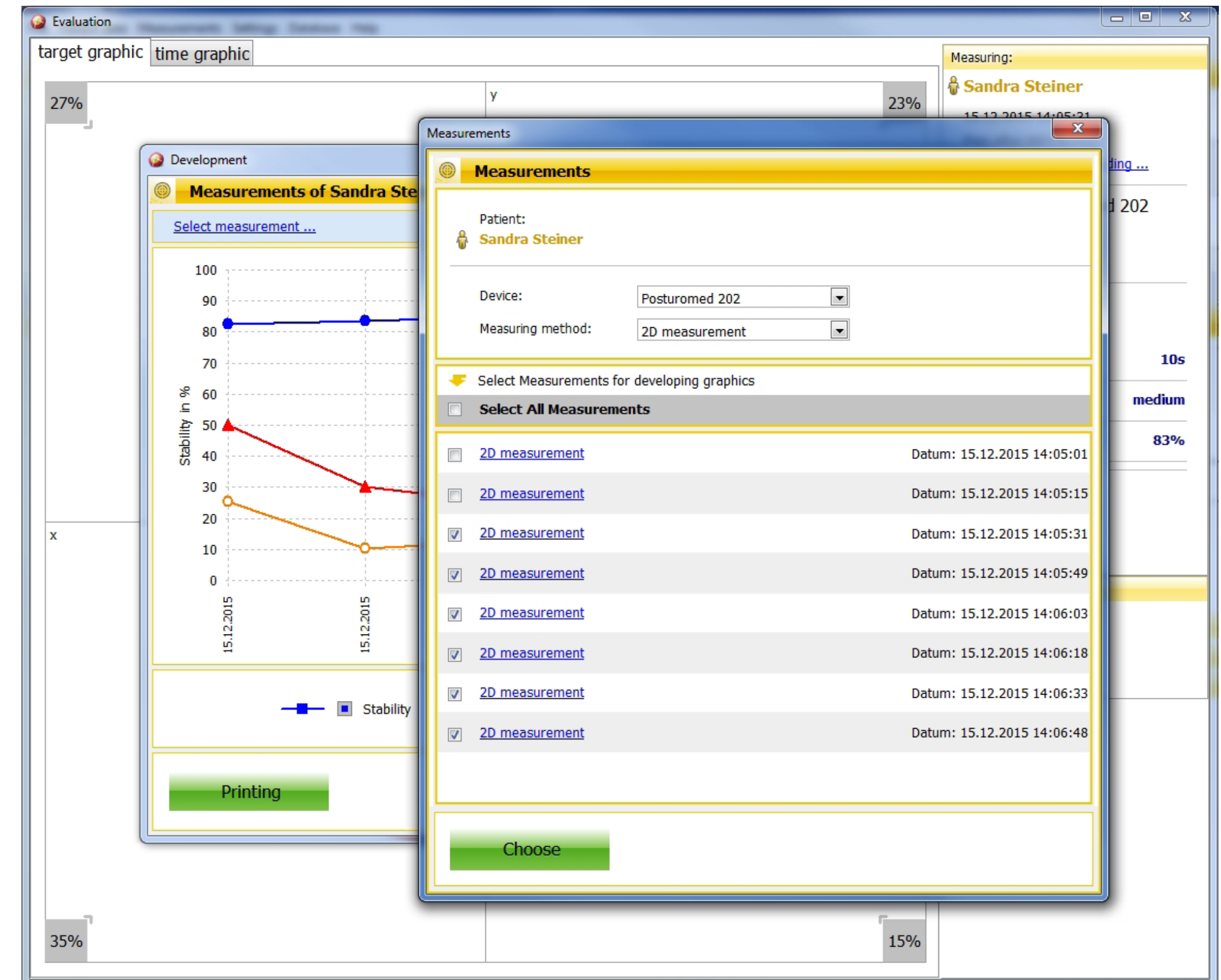
8. Measurement data, evaluation – printing – export

8.1.1 Stability

After each measurement run, the stability is output as a percentage. The stability value is based on a mathematical operation, derived from the oscillation frequency and oscillation amplitude. The highest stability of 100% corresponds to the idle sensor or idle platform. In this case, the frequency and the amplitude are equal to zero. Higher oscillation frequencies and oscillation amplitudes result in lower stability percentages.

Please note that the Stability details are always related to the measurement period. A stability comparison at different measurement times is not possible. The optimal measuring time is 10 seconds.

In the 2D measurement (but not in the PCT), two other parameters are output after each measurement in addition to the stability:

- Oscillation frequency

- Coordination factor

In MicroSwing® 6 the stability is calculated on the basis of the following equation:

$$Stability = \frac{\left(4000 - \frac{\sum\limits_{n\text{-}2}^{NumberOfValues} \left(\sqrt{(x_n - x_{n\text{-}1})^2 + (y_n - y_{n\text{-}1})^2} \right)}{NumberOfValues} \right)}{40}$$

8.1.2 Oscillation frequency

The oscillation frequency represents the number of oscillations per second in both axes (x and y) at the same time. Its SI unit (Système International d'Unités = International System of Units) is hertz (Hz). If no stimulus is sensed by the acceleration sensor, the frequency will remain zero.

In MicroSwing® 6 the oscillation frequency is calculated on the basis of the following equation:

$$Oscillation\ frequency = \frac{NumberOf Amplitudes\ X - Direction + NumberOf Amplitudes\ Y - Direction}{Time} \times Correction\ factor$$

8. Measurement data, evaluation – printing – export

8.1.3 Coordination factor

The coordination factor represents the harmony of oscillations per second in both axes (x and y) at the same time. More harmonic oscillations in the two planes result in a smaller coordination factor, which means that the patient is better able to coordinate the handling of the unstable surface. There is no numeric limit for the coordination factor. An oscillation is harmonic if its change over time can be depicted by a sine function. The coordination factor is thus a very sensitive variable. If no stimulus is sensed by the acceleration sensor, the coordination factor will remain zero. If the stimuli for the acceleration sensor are very arrhythmic (non-linear) in both axes (x and y), the acceleration sensor can reach values of over 1,000.

In MicroSwing® 6 the coordination factor is calculated on the basis of the following equation:

$$Coordination\ factor = \left(\frac{\sum_{n=1}^{AnzAmplX-1} Abs((aMaxXn - aMinXn) - (aMaxXn + 1 - aMinXn + 1))}{n} \right.$$

$$\left. + \frac{\sum_{n=1}^{AnzAmplY-1} Abs((aMaxYn - aMinYn) - (aMaxYn + 1 - aMinYn + 1))}{n} \right) k$$

8. Measurement data, evaluation – printing – export

8.2 Printing measurement data

To print your patient data and measurement results, open the menu item "Printing" in the menu bar of the main window under "File" by left-clicking it once.

The "Printing" dialogue window now opens, with the main fields "Patients" and "Measurements of…".

In the main "Patients" field, you can now left-click the patient whose data you want to release for printing. You can also use the search function to search for the patient by name or, if a number has been entered, by number. The search function reacts dynamically to the information you enter, automatically removing from the displayed listany patients who do not meet the entered criterion. Once you have selected your patient, the selected name is then displayed in the yellow header line ("Measurements of …") in the second main window. This

window lists all measurements or measurement procedures that you have so far performed on the selected patient. The date and time of the performed measurement are displayed in this field on the right-hand side. The measurements are listed in reverse date and time order. The most recent measurement is shown at the top of the list. Left-click the measurements you want to print to select them. As confirmation, a black tick is displayed in the box to the left of the selected measurement.

If you want to print all the measurements for this patient, place a tick in the field at the top under "Print all measurements".

8. Measurement data, evaluation – printing – export

At the bottom of the "Printing" dialogue window, you can choose which pages you want to print by adding tick marks before the printing job is initiated. All ticks are added as standard, with a cover sheet, the collected patient data and optional documentation included in the printout. The cover sheet and patient data only include the information that you entered when the patient was first created.

The measurement results are shown as a graph and numerically, as they are in the function area "Evaluation" (see Section 8.1). The only graph that is printed is a time graph, one for the sensor's x-axis and one for its y-axis. Left-clicking the green "Print" button in the bottom right opens the PDF document, which shows the pages that will be printed so you can check them. You can use the PDF tool to add notes or text highlights to the document,

save it or print it out directly. Please ensure that a suitable working printer is connected to your PC. A colour printer is recommended to display the graphs correctly.

Closing this document takes you back to the main MicroSwing® 6 window. You can also print your patient's data directly from the main window. To do this, load a patient in the patient field ("Load patient") and then click the activated "Printing" button. The patient data will then be displayed in the PDF document. Measurement results cannot be released for printing in this way.
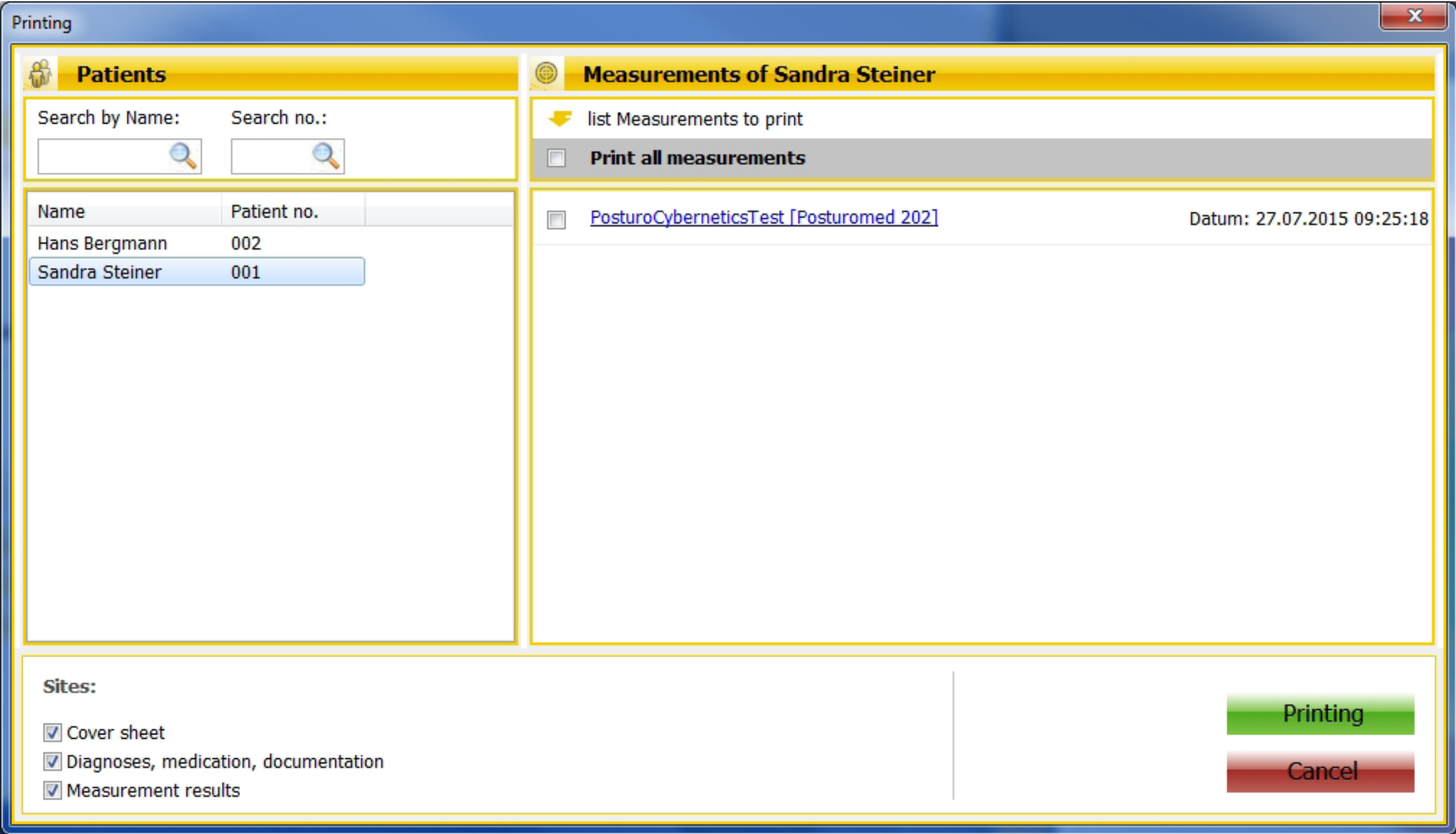
8. Measurement data, evaluation – printing – export

8.3 Exporting raw data

To export the raw data, open the menu item "Raw Data Export" in the menu bar of the main window under "File" by left-clicking it once. The "Export" dialogue window opens, with the main fields "Patients" and "Measurements of....". In the main "Patients" field, you can now left-click the patients whose data you want to release for export. You can also use the search function to search for the patient by name or, if a number has been entered, by number. The search function reacts dynamically to the information you enter, automatically removing any patients from the displayed list who do not meet the entered criterion. Alternatively, you can also select all patients for data export in the header by ticking a box. If necessary, individual patients can then be removed by removing the check mark in front of their name.

Once you have selected the patients, the selected name is then displayed in the yellow header line ("Measurements of …") in the second main window. This window lists all measurements that you have so far performed on the selected patient. The listed measurement procedures are labelled with the corresponding name. The date and time of the performed measurement are displayed in this field on the right-hand side. The measurements are listed in reverse date and time order. The most recent measurement is shown at the top of the list.

Left-click the measurements whose raw data you want to export to select them. As confirmation, a black tick is displayed in the box to the left of the selected measurement. If you want to export all the raw data for this patient, place a tick in the field at the top under "Select all measurements of the Patient".

At the bottom of the "Export" dialogue window, select the select the output format (RAW: unprocessed raw data without mathematical size, g: acceleration due to
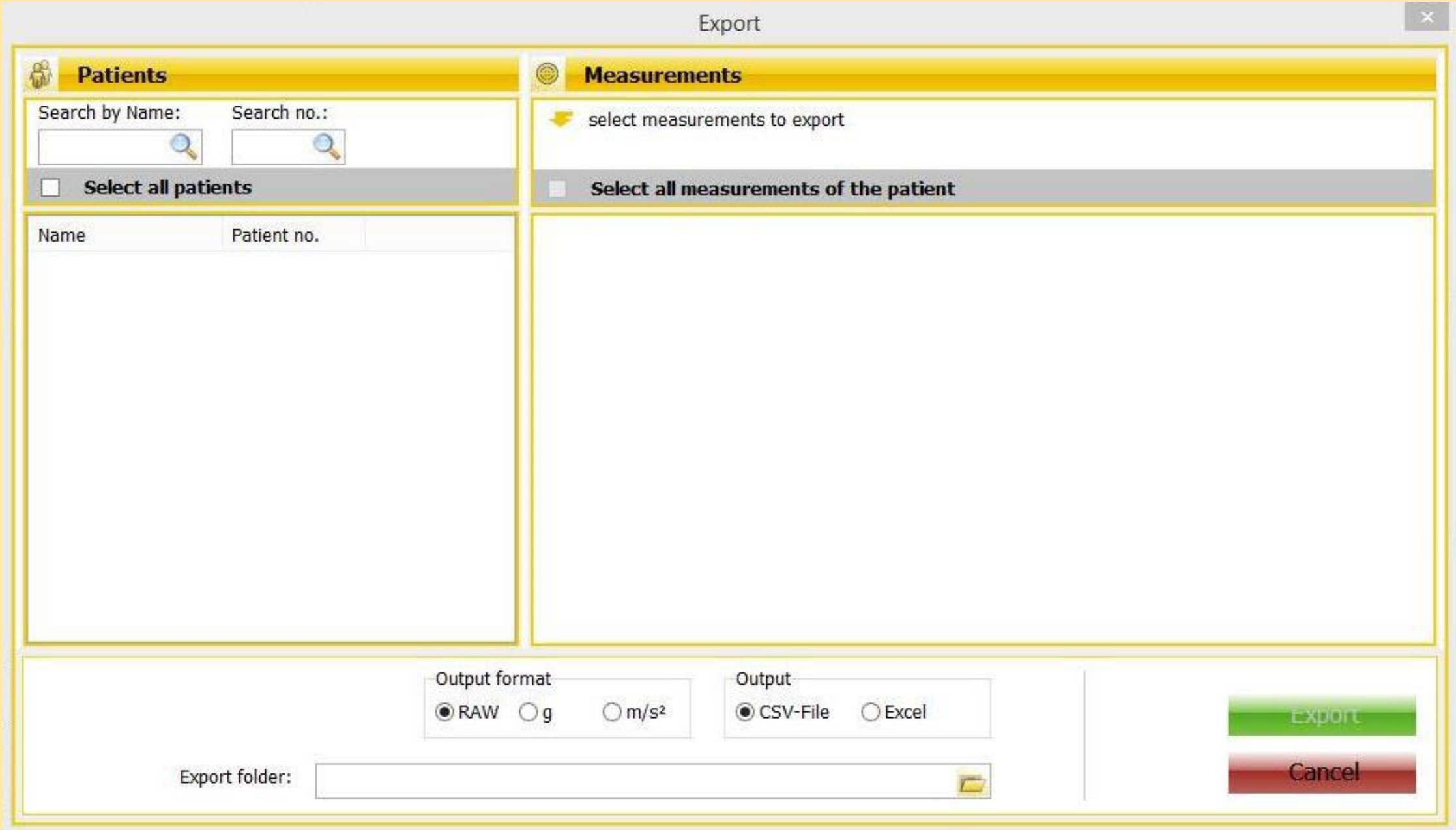
gravity, m/s2: pure acceleration), the output type (CSV file or Excel) and the export folder to which you want to export the raw data. Click the green "Export" button to export the raw data to the selected target folder. After the export has been completed, you will find the raw data in the export folder of your choice in the output type of your choice. The export window will remain open for additional exports. You can close this window by clicking the red "Cancel" button.

8. Measurement data, evaluation – printing – export

8.3.1 Exported raw data in Excel

If you have exported your raw data in Excel as described in 8.3, they will be available in the selected folder as a numeric table in Excel format if you use Microsoft Office. The raw data in this Excel table (RAW) represent the analogue signals sent from the acceleration sensor converted into digital figures by the MicroSwing measuring box's 14-bit analogue-to-digital converter (A/D converter). If you have exported the measurement data directly as acceleration, either gravitational acceleration (g = 9.81 m/s^2) or pure acceleration(m/s^2), the raw data will be given a corresponding mathematical algorithm (see section 8.3.2).

These RAW raw data do not represent mathematical quantities – they do not depict an acceleration in a particular time period or any travelled path!

The Excel table contains three folders that you can select in the bottom left: Raw data vertical in parallel, raw data vertical stacked and raw data horizontal. These three folders all contain the same raw data, arranged in a different way in each case.

The folder Raw data vertical in parallel: The first 15 rows of this folder contain information on the patient you have selected for each time of measurement, and the remaining rows contain the other times of measurement for your patient/all other selected patients. In addition to the patient's personal details, information is also provided on the selected measurement method including the device selection, the time of measurement, the desired output type (format) and in the 15 line the total distance traveled in meters. This is followed by the raw data in the output format you selected previously, either unedited (RAW) or converted into an acceleration (g or m/s^2). Column A contains the analogue signals, listed in ascending order from zero. A sensor sampling rate of 50 Hz (50 bit/second) and a measurement duration of 10 seconds (as used in the PCT), for example, results in 500 values (50 bit x 10 sec.) for each axis (columns B and C). These analogue signals are then listed in column A numbered, for a 10-second measurement duration for example, from 0 to 499 (1st check or for PCT 1st TestCheck), with the new analogue signals for the next measurement run (2nd check or for PCT 2nd TestCheck) listed underneath them. Column B contains the raw data for

8. Measurement data, evaluation – printing – export

8.3.1 Exported raw data in Excel

the x-axis of the acceleration sensor. Column C contains the raw data for the y-axis of the acceleration sensor. Each number in columns B and C corresponds to a bit, that is, a unit of information. Depending on the acceleration, these numbers may be positive (increasing acceleration) or negative (decreasing acceleration) and they may have different sizes.

The folder Raw data stacked: The first 15 rows of this folder contain information on the patient you have selected for each time of measurement, and the remaining rows contain the other times of measurement for your patient/all other selected patients. In addition to the patient's personal details, information is also provided on the selected measurement method including the device selection, the time of measurement, the desired output type (format) and in the 15 line the total distance traveled in meters. This is followed by the raw data in the out-

put format you selected previously, either unedited (RAW) or converted into an acceleration (g or m/s^2).

Column A shows the crosspoints of each axis of the coordinate system (first all x, then all y). Column B contains the analogue signals, listed in ascending order from zero. A sensor sampling rate of 50 Hz (50 bit/second) and a measurement duration of 10 seconds (as used in the PCT), for example, results in 500 values (50 bit x 10 sec.) for each axis (column C). These analogue signals are then listed in column B numbered, for a 10-second measurement duration for example, from 0 to 499 (1st check X or for PCT 1st TestCheck X), with the analogue signals for the y-axes following those for the x-axes. Column C contains the raw data for the x-axes of the acceleration sensor, followed directly by the raw data for the y-axes. Each number in column C corresponds to a bit, that is, a unit of information.

Depending on the acceleration, these numbers may be positive (increasing acceleration) or negative (decreasing acceleration) and they may have different sizes.

8. Measurement data, evaluation – printing – export

8.3.1 Exported raw data in Excel

The folder Raw data horizontal: The first 15 columns (A–O) of this folder contain information on the patient you have selected for each time of measurement, and the remaining odd-numbered rows (5, 7, 9 etc.) contain the other times of measurement for your patient/all other selected patients. In addition to the patient's personal details, information is also provided on the selected measurement method including the device selection, the time of measurement, the desired output type (format) and in the 15 line the total distance traveled in meters. This is followed by the raw data in the output format you selected previously, either unedited (RAW) or converted into an acceleration (g or m/s^2).

First the raw data are listed on a blue background for the x-axes of the acceleration sensor for each measurement run, directly followed by the raw data on a green background for each measurement run of the y-axis. Each number corresponds to a bit,

that is, a unit of information. Depending on the acceleration, these numbers may be positive (increasing acceleration) or negative (decreasing acceleration) and they may have different sizes.

Caution: As the number of columns is limited in Excel, the data from the PosturoCyberneticsTest (PCT) cannot be displayed horizontally!

These data can now be used for mathematical statistical operations or further export to other data processing programs.

8. Measurement data, evaluation – printing – export

8.3.2 Converting the raw data to an acceleration

If you do not export the raw data directly into acceleration values, you can also manually convert them to acceleration in the X or Y direction:

acceleration: $\dfrac{distance}{s^2} = \dfrac{raw\ value}{resolution} * acceleration\ of\ gravity * multiplier\ for\ unit$
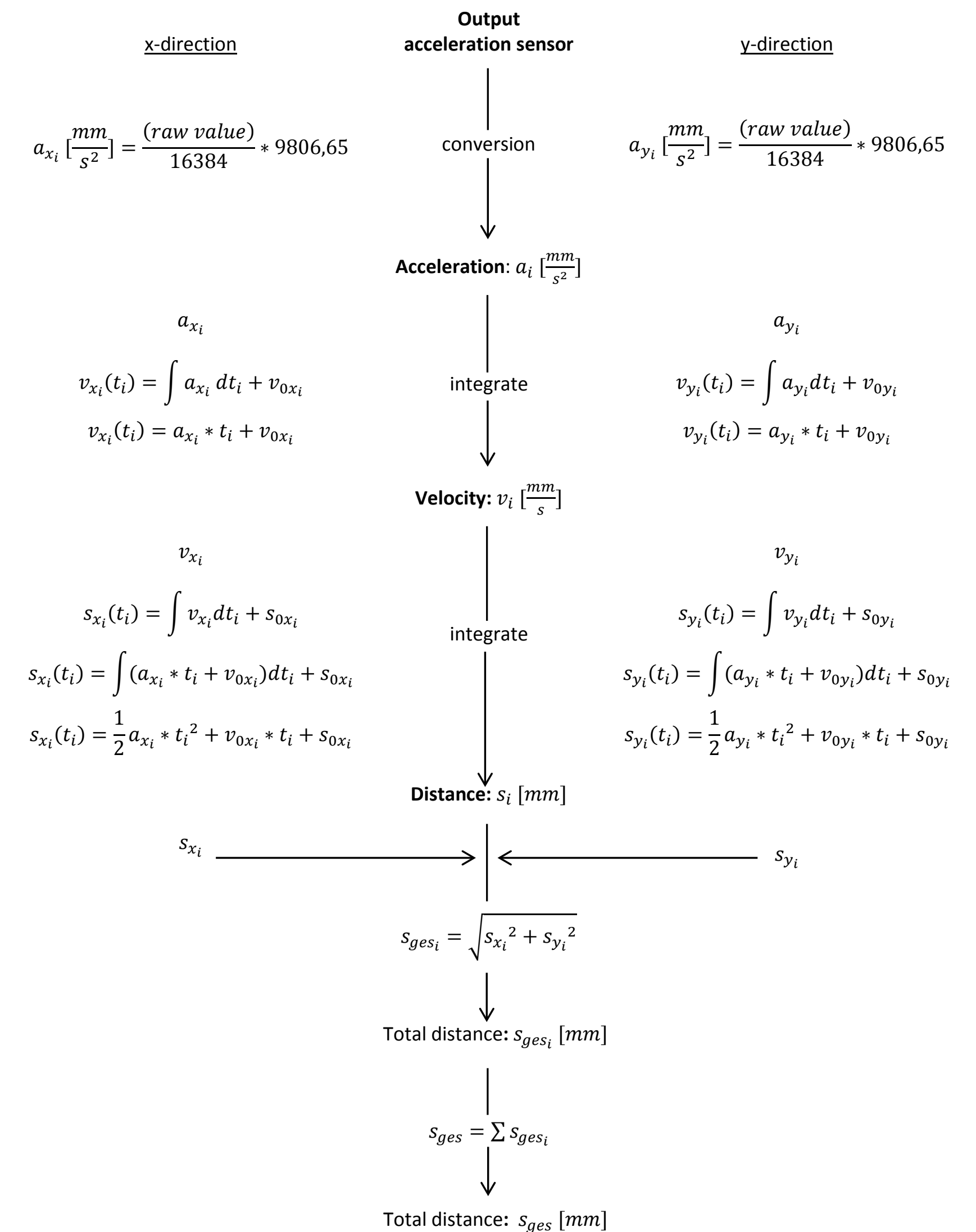
acceleration in mm per unit of time: $\dfrac{mm}{s^2} = \dfrac{(raw\ value)}{16384} * 9{,}80665 * 1000$

acceleration in cm per unit of time: $\dfrac{cm}{s^2} = \dfrac{(raw\ value)}{16384} * 9{,}80665 * 100$

acceleration in m per unit of time: $\dfrac{m}{s^2} = \dfrac{(raw\ value)}{16384} * 9{,}80665$

8.3.3 Converting the raw data to a total distance

The following mathematical operation can be used to convert the two raw data (x and y) to a total distance in millimetres:

Output acceleration sensor

x-direction

$a_{x_i}\left[\dfrac{mm}{s^2}\right] = \dfrac{(raw\ value)}{16384} * 9806{,}65$

y-direction

$a_{y_i}\left[\dfrac{mm}{s^2}\right] = \dfrac{(raw\ value)}{16384} * 9806{,}65$

conversion

Acceleration: $a_i\left[\dfrac{mm}{s^2}\right]$

a_{x_i}

$v_{x_i}(t_i) = \int a_{x_i}\,dt_i + v_{0x_i}$

$v_{x_i}(t_i) = a_{x_i} * t_i + v_{0x_i}$

integrate

a_{y_i}

$v_{y_i}(t_i) = \int a_{y_i}\,dt_i + v_{0y_i}$

$v_{y_i}(t_i) = a_{y_i} * t_i + v_{0y_i}$

Velocity: $v_i\left[\dfrac{mm}{s}\right]$

v_{x_i}

$s_{x_i}(t_i) = \int v_{x_i}\,dt_i + s_{0x_i}$

$s_{x_i}(t_i) = \int (a_{x_i} * t_i + v_{0x_i})\,dt_i + s_{0x_i}$

$s_{x_i}(t_i) = \dfrac{1}{2}a_{x_i} * t_i^2 + v_{0x_i} * t_i + s_{0x_i}$

integrate

v_{y_i}

$s_{y_i}(t_i) = \int v_{y_i}\,dt_i + s_{0y_i}$

$s_{y_i}(t_i) = \int (a_{y_i} * t_i + v_{0y_i})\,dt_i + s_{0y_i}$

$s_{y_i}(t_i) = \dfrac{1}{2}a_{y_i} * t_i^2 + v_{0y_i} * t_i + s_{0y_i}$

Distance: $s_i\ [mm]$

$s_{x_i} \longrightarrow \quad \longleftarrow s_{y_i}$

$s_{ges_i} = \sqrt{s_{x_i}^2 + s_{y_i}^2}$

Total distance: $s_{ges_i}\ [mm]$

$s_{ges} = \sum s_{ges_i}$

Total distance: $s_{ges}\ [mm]$

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9. Guarantee

The statutory guarantee period of 24 months applies to the MicroSwing® components. The guarantee does not apply to damage caused by a failure to observe the instruction manual or by accidents, misuse, modification or tampering on the part of unauthor- ised persons. No warranty is provided for accessory parts. If technical problems occur in connection with the MicroSwing® compo- nents, please contact the following hotline:

MicroSwing Technical Support, GK Computersysteme

Tel.: +49 (0) 9231 – 66 08 12

For all other enquiries, please contact the manufacturer of the treatment devices:

Or the manufacturer of the MicroSwing®components:

Software

Legal information

HAIDER BIOSWING GmbH
Dechantseeser Str. 4
95704 Pullenreuth, Germany

Tel.: +49 (0) 92 34 / 99 22 - 0
Fax: +49 (0) 92 34 / 99 22 - 166
Email: info@bioswing.de
www.bioswing.de

Your contact: Christof Otte

Haynl-Elektronik GmbH
Magdeburger Str. 117a
39218 Schönebeck, Germany

Tel.: +49 (0) 3928 / 69414
Fax: +49 (0) 3928 / 76222
Email: info@haynl.de
www.haynl.de

The latest version of the MicroSwing® 6 software is available from the download section at
www.bioswing.de/therapiesysteme

HAIDER BIOSWING GmbH
Dechantseeser Str. 4
95704 Pullenreuth, Germany

Tel.: +49 (0) 92 34 / 99 22 - 0
Fax: +49 (0) 92 34 / 99 22 - 166
Email: info@bioswing.de
www.bioswing.de