SW6000 Corneal Topographer

User's Manual

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1. MANUAL CONVENTIONS

In discussing the normal interaction between the software and those involved in a particular operation, exam or exam review, this manual uses the term *Clinician* to refer to the person operating the equipment, and *Patient* to refer to the person undergoing the exam.

2. INTENDED PURPOSE

The Suoer SW6000 Corneal Topographer is a computerized Videokeratometer using Placido rings to map the surface of the human cornea. The map is captured in three-dimensions and can be displayed subsequently using a number of representations.

The cornea map can be represented in two-dimensional surface coordinates (Cartesian or Polar) with the third dimension expressed in curvature (mm), optical power (Diopter), elevation (mm), or corneal height (mm). The map is presented as a 2D color map or a 3D perspective. It can be displayed according to different definitions of curvature or elevation. The options are axial curvature and power, tangential curvature and power, elevation, shape factor, and best-fit radius.

The clinical applications include providing measured corneal data for contact lens fitting, refractive surgery, orthokeratology and general assessment of the corneal surface.

The SW6000 shall only be used as described in this manual and only for the intended purpose.

3. IMPORTANT FACTS

The SW6000 Corneal Topographer is a highly accurate measuring instrument. It measures and maps the surface of the human cornea and represents the results in various quantities and output forms that can be applied in various medical applications. It combines these results with theoretical surface shapes to form the basis for precise contact lens fitting.

3.1. Clinical Results

This manual does not provide guidance on interpretation of clinical results.

The clinician must ensure that he or she has received appropriate medical training in such interpretation. For this reason Suoer cannot be held responsible for any misdiagnosis of results.

3.2. Radiation

The SW6000 emits radiation in the visual range for illumination in the distinct wavelength 760nm (red LED cone illumination), 530nm (green LED fixation target) and 950nm (non-visible infrared profile illumination). The levels of

intensity of this illumination are less than 50 cd/m$_2$, below any levels known to be hazardous.

3.3. Electromagnetic Emissions

This device emits no harmful or undesired electromagnetic emissions.

3.4. Interface

Strong electromagnetic interference from other unprotected devices may affect the performance or results of the SW6000. If the use of such devices with high electromagnetic emissions cannot be avoided, do not use the SW6000 and the device simultaneously.

3.5. Side effects

No undesired side effects to patient or clinician or other persons are known, when using this instrument under normal conditions and for the intended purpose.

4. INSTALLATION

Suoer staff or their authorized representatives will normally install the SW6000 hardware and software. These instructions provide guidelines on the installation process when this is not the case if, for instance, you decide to install the SW6000 on another PC. Only a qualified PC technician should perform the hardware and software installation.

The basic tasks associated with installing the SW6000 are

- · Setting up the Instrument in a suitable environment.

- · Installing the SW6000 Software.

- · Installing the Picolo frame-grabber board.

The SW6000 software can be installed without a frame-grabber to review Patient Exams.

4.1. Software Installation

It is important that you read the SW6000 user's manual for additional details on installation.

A single CD is supplied with installation software for both the SW6000 software and the Driver for the Video-Frame-Grabber.

1. Insert the installing CD that will automatically bring up the setup window (see

2. Figure i): Click the Button *Setup the SW6000 Viewer* to set up the SW6000 software for the computer.
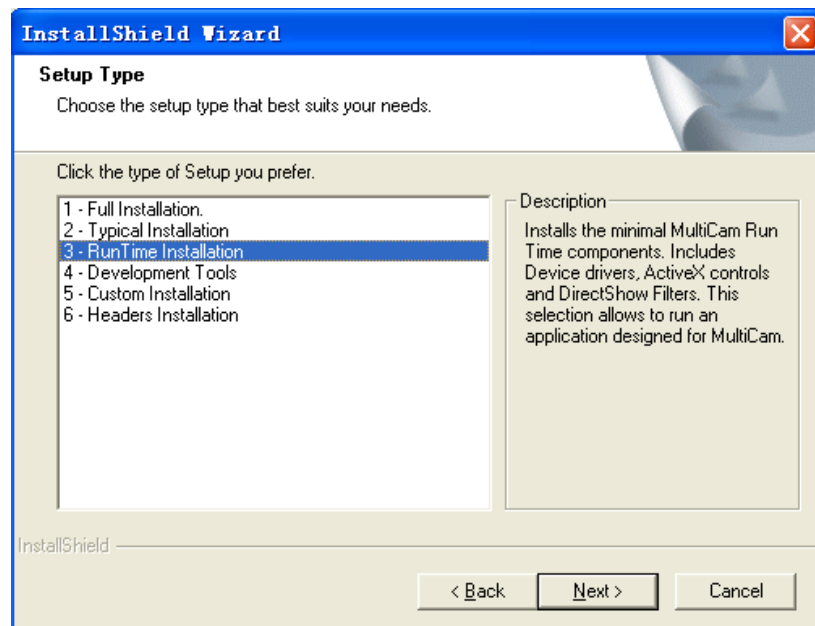
change you have to make in the dialog below:

Figure iii

Select the third option: *3-RunTime Installation.*

5. Restart the computer when the software installation is complete.

Running the Software

Select the SW6000 Viewer from the **Start > Program Files > SW6000** menu or double-click the desktop icon.

4.2. Video Frame-grabber Installation

Existing Installations

If this installation is an upgrade to an existing Suoer SW6000 system that uses a PICOLO frame-grabber, you need do nothing more. When the system restarts it will recognize the existing PICOLO device and automatically update the drivers.

New Installations

The PICOLO video frame-grabber and its supporting drivers are only compatible with Windows 2000 and subsequent.

Installing the board

1. Turn off the computer.
2. Turn off all accessories (printer, modem, monitor etc) connected to the computer.
3. Unplug the computer and all accessories.
4. Remove the cover from the computer. Refer to your computer's user manual for instructions.
5. Select an unused PCI slot and remove the cover, retaining the screw that held the cover in place.
6. Discharge any static build-up on your body by touching the metal case of the computer.
7. Remove the card from its anti-static box touching the edges of the card only.
8. Carefully insert the card into the PCI expansion slot, gently pressing down until the board is firmly seated.
9. Secure the board in place using the screw removed from the cover in step 5.
10. Replace the cover on the computer.
11. Reconnect power and accessories.
12. Restart the computer on completion of the installation. Windows will

recognize the new hardware and automatically install the new drivers.

5. TESTING A PATIENT

The following sections describe the steps to performing an examination with the SW6000 instrument

5.1. Patient Selection

The recommended practice is to have a patient selected before starting to capture and analyze an exam. (Fig 1) shows the SW6000 viewer initial display with a patient selected in the explorer pane.
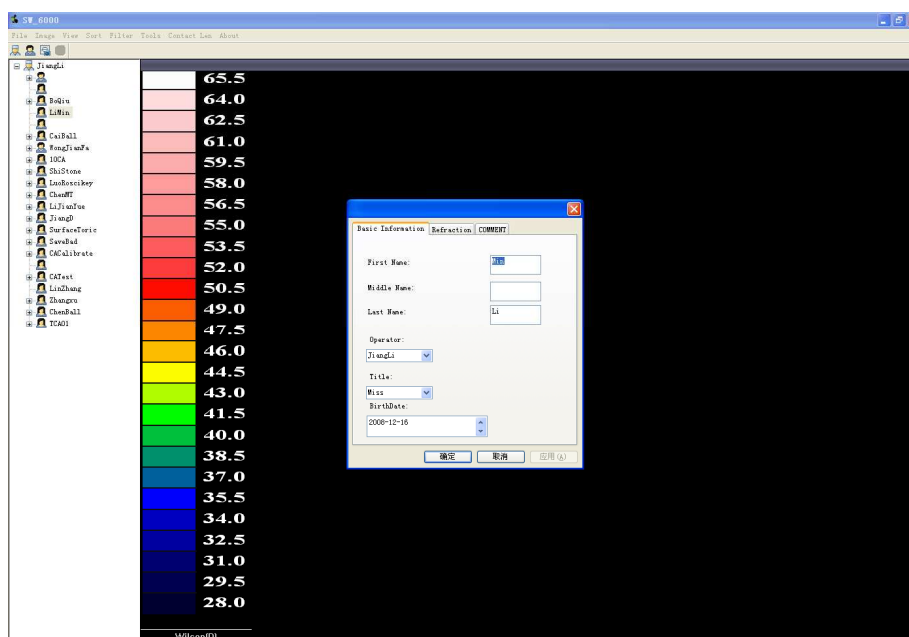

Fig 1

5.2. Position the Patient

In order to capture good quality and accurate images some precautions should be followed in positioning the patient correctly. While these are well known and

standard practice for corneal topography examinations, here we reiterate the most important points as they apply to the SW6000.

The Patient should sit comfortably in the chair. Ask the patient to put his chin onto the chinrest and put her forehead firmly against the forehead rest.

She should then push her chin forward on the chinrest. If the patient has deep-set eyes instruct her to move her head back from the headrest. This rotates the eye away from the eyebrow and eyelashes and produces better coverage and fewer interruptions of rings on the upper cornea. Adjust the eye height to the level marks on the chinrest.

Ask the patient to look into the center of the yellow fixation target and keep her gaze on this target. The target center point together with the center of the ring pattern on the eye defines the Video-Keratoscope axis (VK-axis), the reference axis to which the axial radius/power is calculated (the values for tangential radius/power are less affected by the fixation). If the patient is fixating on the target, the VK-axis is aligned with the line of sight.

When an image is taken with the patient not fixated on the target, the axial power is not referenced to the line of sight, but to an arbitrary axis which may not be reproducible in future exams and may not represent the visual refractive properties of the patient's eye. In most cases examining the position of the center of the pupil easily identifies this. For images with good fixation the pupil center is aligned with the center of the VK-axis (center of the Polar and Cartesian grids). If unsure, re-capture the image and view the difference between the two images. Axial power maps are identical for fixated eyes. The

tangential power for both images should have their center in the same position relative to the pupil center.

Ask the patient to open eyelid as much as possible and close the other eye if necessary.

5.3. Capturing Patient Exam

Click the button or the *File > New > Exam* menu to display the SW6000 Capture View (see Fig 2). The red illumination rings inside the SW6000 cone turn on.
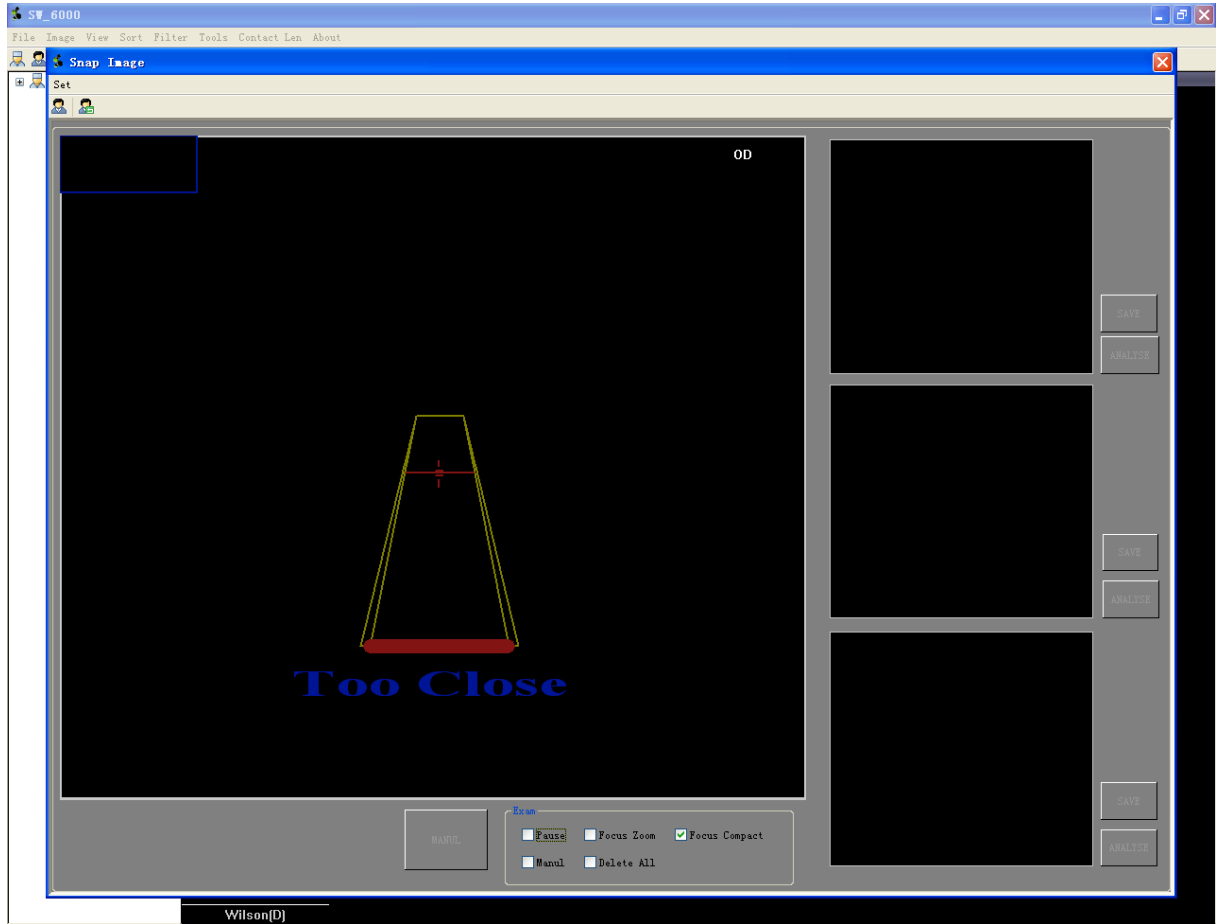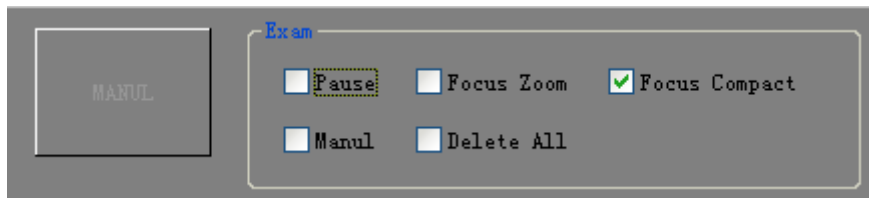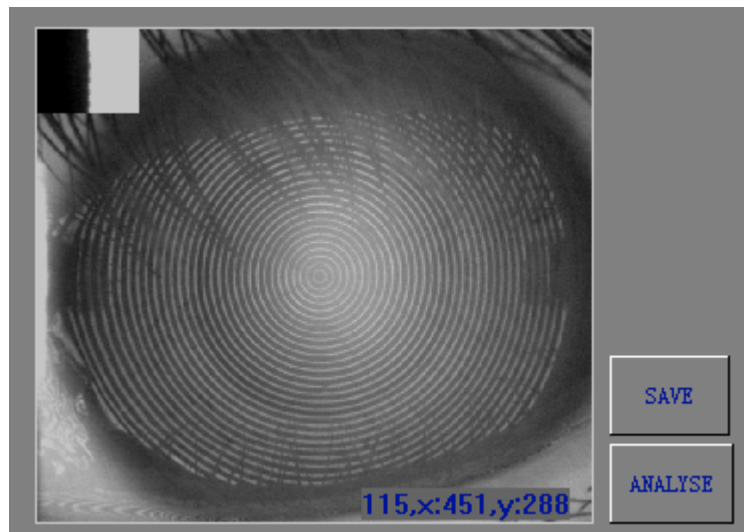
Fig 2 Capture View

Fig 3 Capture control window

Fig 4 Captured image window

Capture Control Window Features (see Capture control window):

Pause: freeze the live video from the capture card

Center Zoom: select to show the center-focusing region in a zoom mode

Focus Compact: if selected, pictures well focused will be automatically captured; otherwise, the focusing range will expand so that the not so well focused pictures could be automatically captured, which may inevitably incur errors to the calculation of the exam results, however, this option is of particular use when the patient is hard to focus.

Manual: if selected, the **button Manual** should be enabled, images can be captured manually clicking the **button Manual**. This option is of particular use if it is impossible for the patient to be well fixed or well focused.

Clear: select to clear all the images captured and shown in the **captured zone.**

The focusing window shows live video from the SW6000. The yellow and red target overlaid on the focusing window provides three-dimensional centering and focusing information. The red crosshair indicates the keratoscope axis. The red bar moving along a three-dimensional *runway* indicates the distance of the eye from the optimal focusing plane. The "**view**" is from the camera's perspective, so if the red bar is at the top or narrowest part of the runway then the patient is still too far away.

The SW6000 joystick allows positioning in three dimensions. Move the joystick in the desired direction for movement left and right and for closer to or further away. Rotate the joystick knob for movement up and down, clockwise to raise,

anti-clockwise to lower.

Using the joystick, position the SW6000 relative to the patient's eye so that the reflection of the Placido rings is centered on the red crosshair, and the red bar is over the horizontal red line. Automatic capturing is selected according to best centering, focusing and least eye movement. Figure 2 shows a typical capture screen display.

It may not be possible to align the red focusing bar over the horizontal cross bar for patients with deep set eyes, because of contact between the bridge of the nose and the instrument. In this case, The clinician should ask the Patient to turn around her head a bit to get a comfortable position with her eye fixed on the fixation target. Then try it again. If failed, the capturing process should be finished under manual capture mode: Select the radio button *Manual* in the capture control window (see Fig 3), then, center the Placido rings on the red crosshair and bring the red focusing bar as close to the horizontal red line as possible without causing patient discomfort. Provided that the red bar is somewhere within the focusing range (i.e. not at the very end), press the button *Manual* to capture the image.
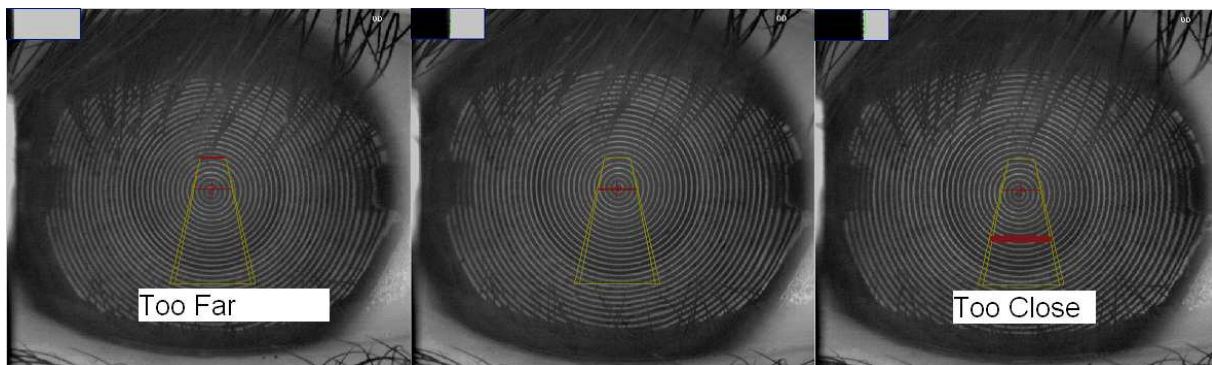

Fig 5 Focus examples showing Too Far, In Focus, and Too Near

Ask the patient to open her eyelid as much as possible and close the other eye if necessary. Images captured whose *profile window* was interrupted by eyelash should be cleared and redo the process.
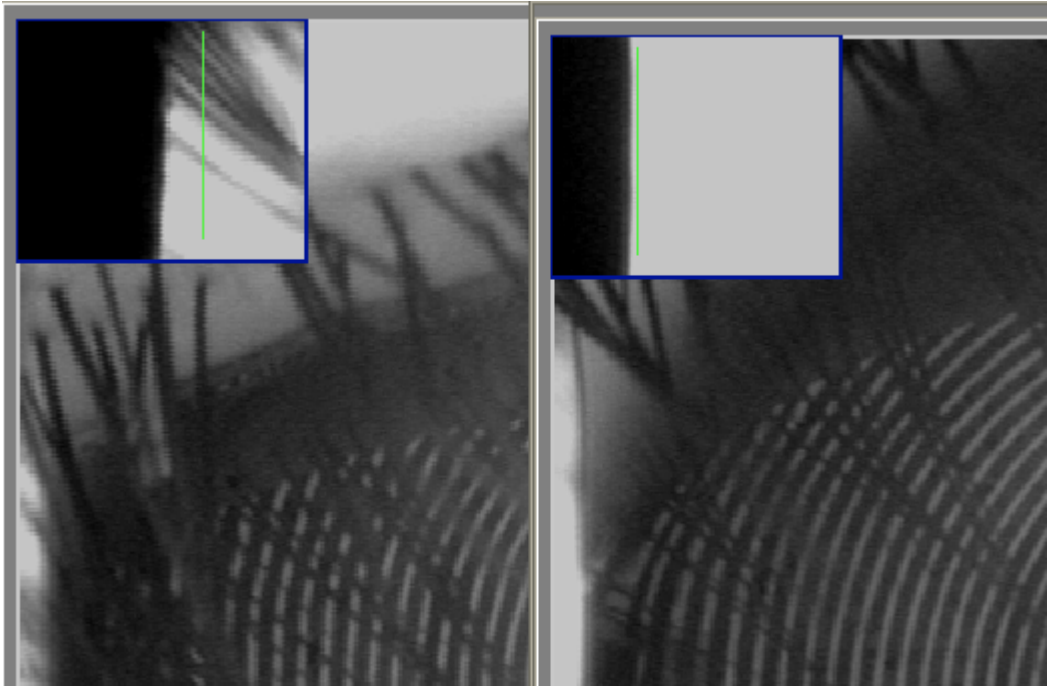

Fig 6 Focus examples showing profile window disrupted by eyelash, clean profile window

In addition, Images captured in which the first ring was abridged should be discarded, since a clear first ring of striking contrast is the solid base for the calculation.

5.4. Alternate Methods of Patient Selection

Exams cannot be saved unless a patient is selected. If a patient or a patient exam is currently selected before starting the capture window, then a new exam is created for that patient. Otherwise the exam is created without reference to a patient.

However, a patient can be selected or deselected from either the Capture or Analysis window while capturing a patient exam. Click on the button 👤or the menu **File > Clear Patient** clears the currently referenced patient for the exam. Click on the button 👤 or the File>Select Patient Menu to bring up the Find Patient dialog (see Fig 7).
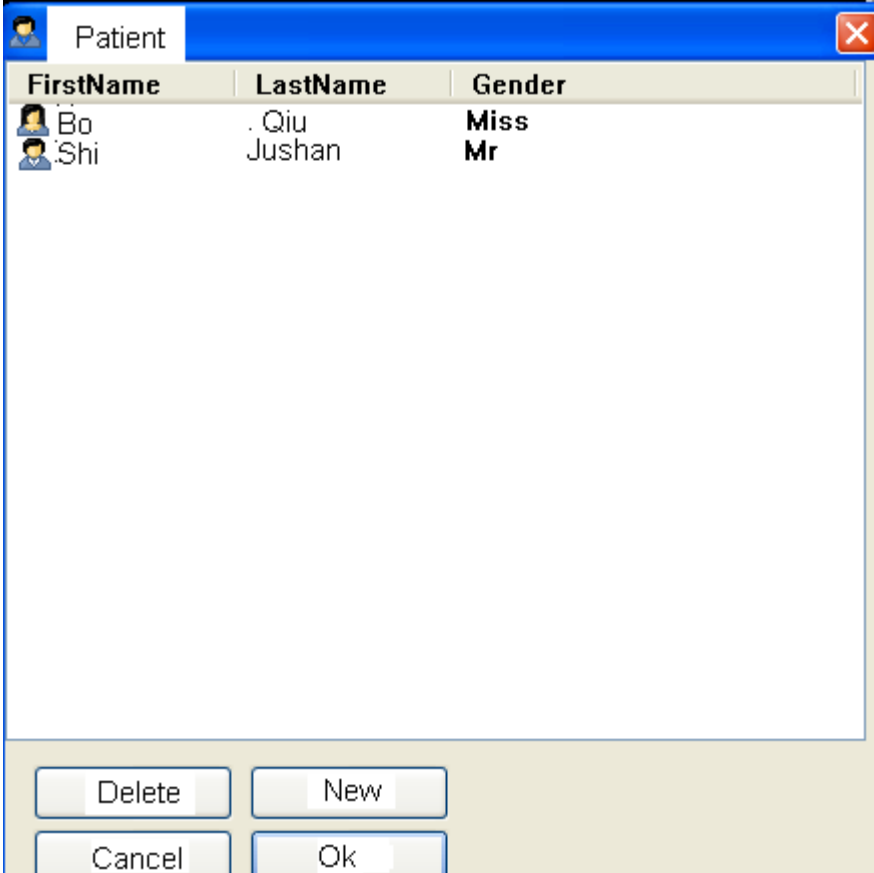

Fig 7 Find Patient Dialog

Select a patient from this list and click **OK**; you can now save an exam against this patient.

5.5. Save the exam

Click on the *Save* Button beside the *captured window,* see (Fig 4) image shown in the window can be saved and added to the SW6000 database, in addition, a Patient Exam item is added to the *Explorer pane* under the current patient.

5.6. Analyze the exam

Click on the *Analyze* Button beside the *captured window* (see Fig 4) to view the exam results. (See ANALYSING AND VIEW EXAM RESULTS)

6. ANALYSING AND VIEW EXAM RESULTS

The SW6000 software provides a variety of ways in which to view exam results. The Exam View mode controls how selected exams are displayed (see **6.2. Setting the Exam View** Mode).

For each of these modes you can set the type of data to display (See **6.3. Changing the View** Settings), and the color mapping (see **Setting up the color key**).

6.1. Selecting the Exam Result

The first step in viewing Exam Results is selecting the exam to view. To select the exam for a particular patient, click on the left or right eye exam symbol or the date of the exam in the SW6000 Explorer pane.
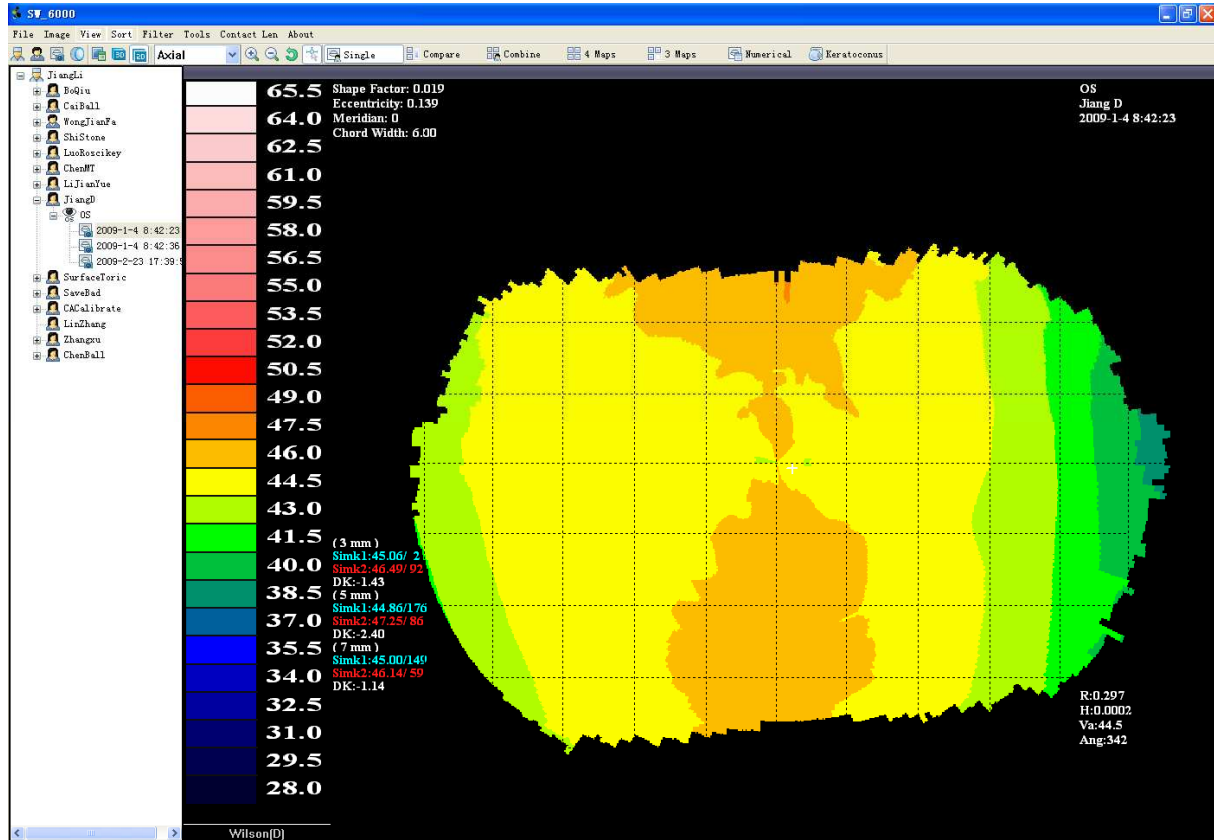
Fig 8 Select and Display an existing exam

The View pane now displays the exam result. Fig 8 shows a single right eye image. How the exams are displayed depends on the current View Mode.

6.2. Setting the Exam View Mode

The View Mode controls how the selected Patient Exams are displayed. You select the View mode from the **combo list** or the corresponding toolbar button. The combo selections and toolbar buttons for the various modes are:

Details View

Firstly, Select the Exam to view in the SW6000 Explorer pane, then right click the *Selection*, Click the item *Edit* in the popup menu to display textual information about the Selected Patient Exam (see Fig 9). It provides for the

Clinician to add comments and, where an exam has been attributed to the wrong patient, to change the owning Patient.
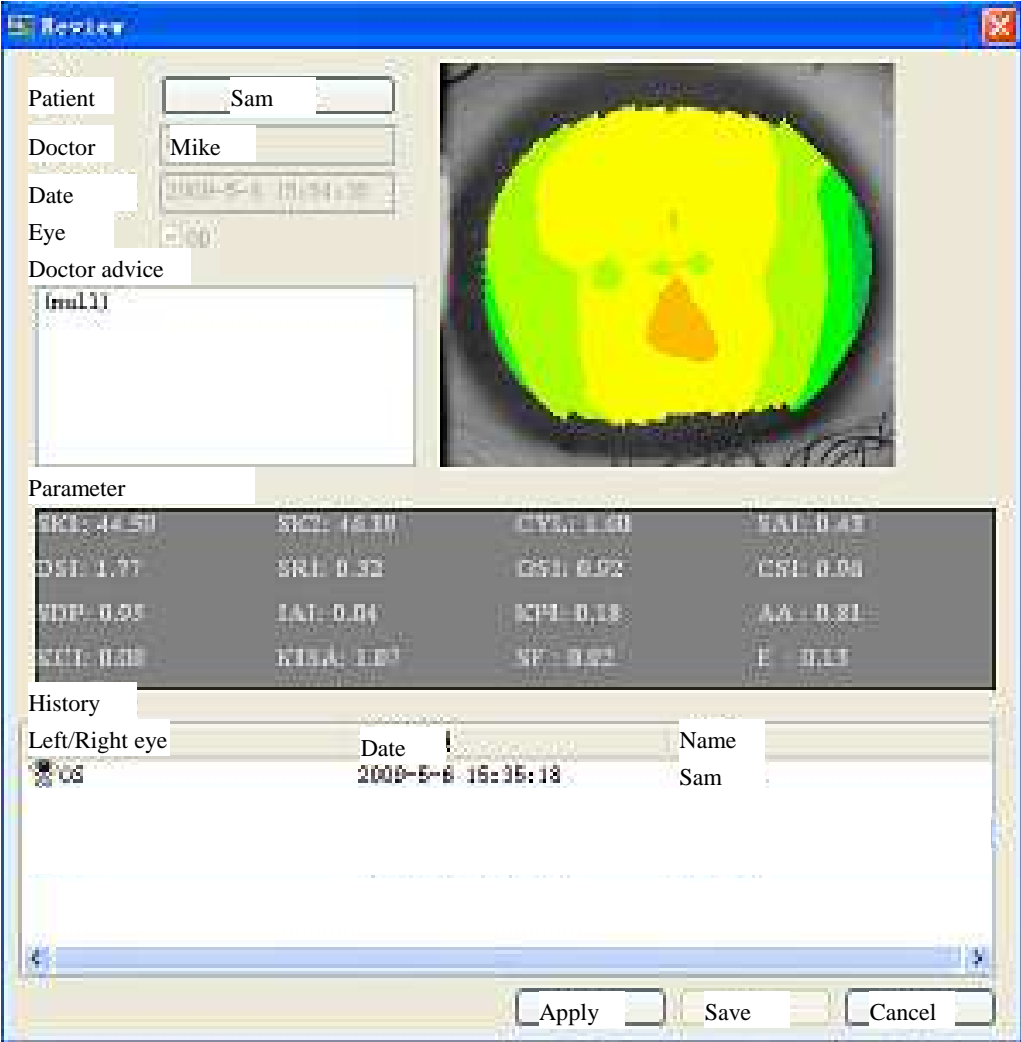

Fig 9

In the SW6000 Viewer, the windows can be switched between several modes to gain different perspective to display the Patient's Corneal Topography.
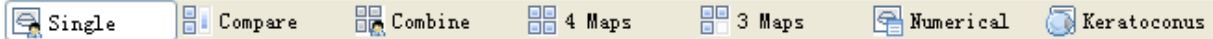

Fig 10 The Mode Switch Toolbar

Single View

Click on the button ⬛. This displays one selected Patient Exams.

Combination View

Click on the button🖳 or the **View > Combination** menu. This view displays four separate views of the selected Patient Exam (see Fig 11).

The Map Type and settings for each image can be controlled independently.
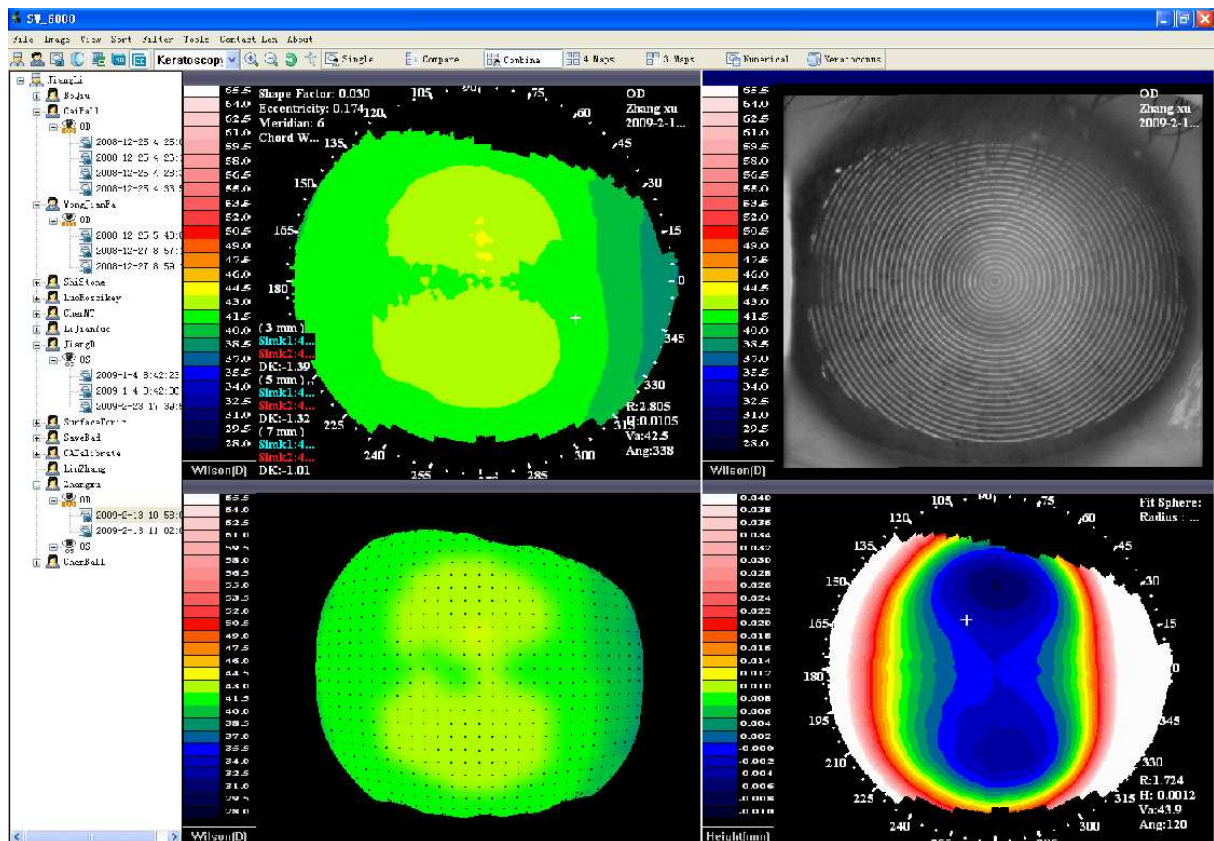
Use this view for an overview of the corneal data.

Fig 11   Combination View

Compare View

Click on the button 🖳 or the **View > Compare** menu. This view displays two selected Patient Exams and the difference between them. Use this view to observe changes over time and healing patterns.
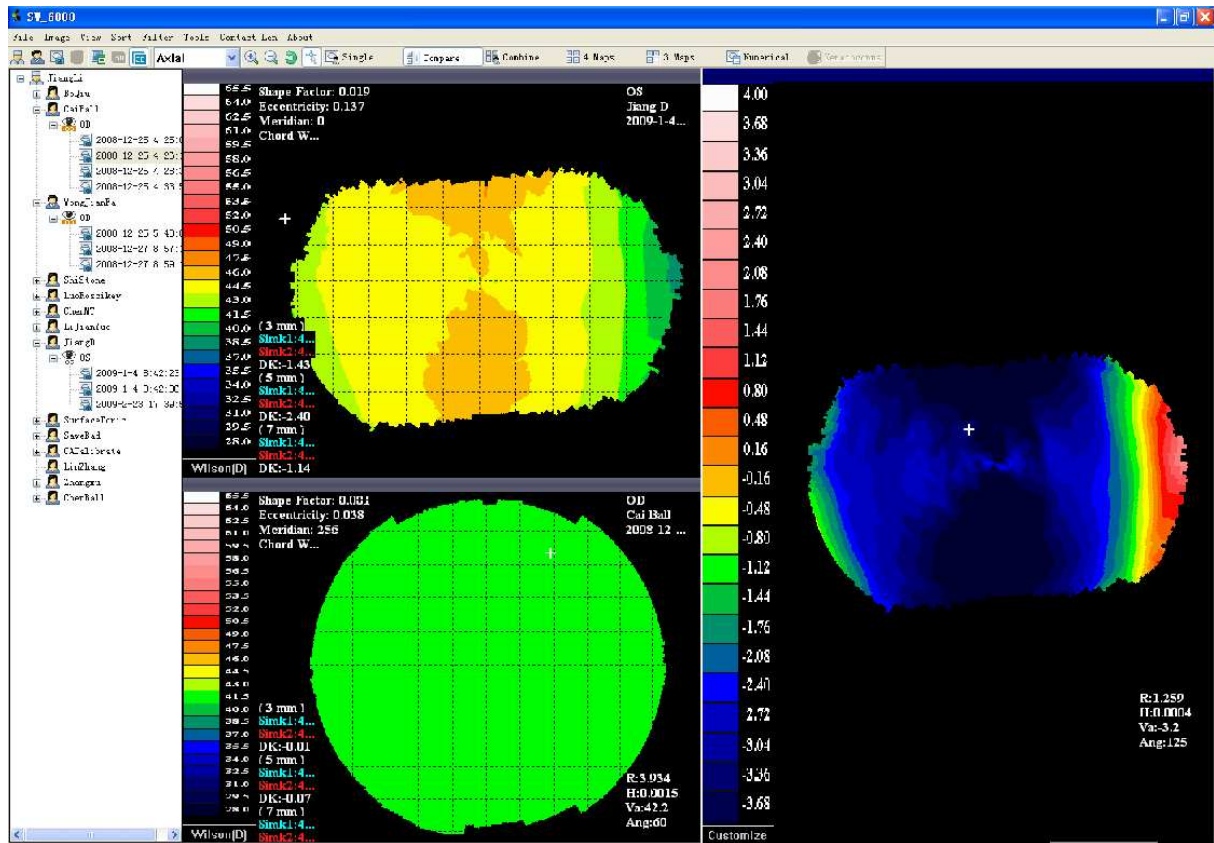
Fig 12 Compare View

Multiple View

Click on the button ⊞ or the **View >4 Tests** menu. This view displays up to four selected Patient Exams simultaneously. The Map Type and settings for each image can be controlled independently. Use this view to compare multiple images.
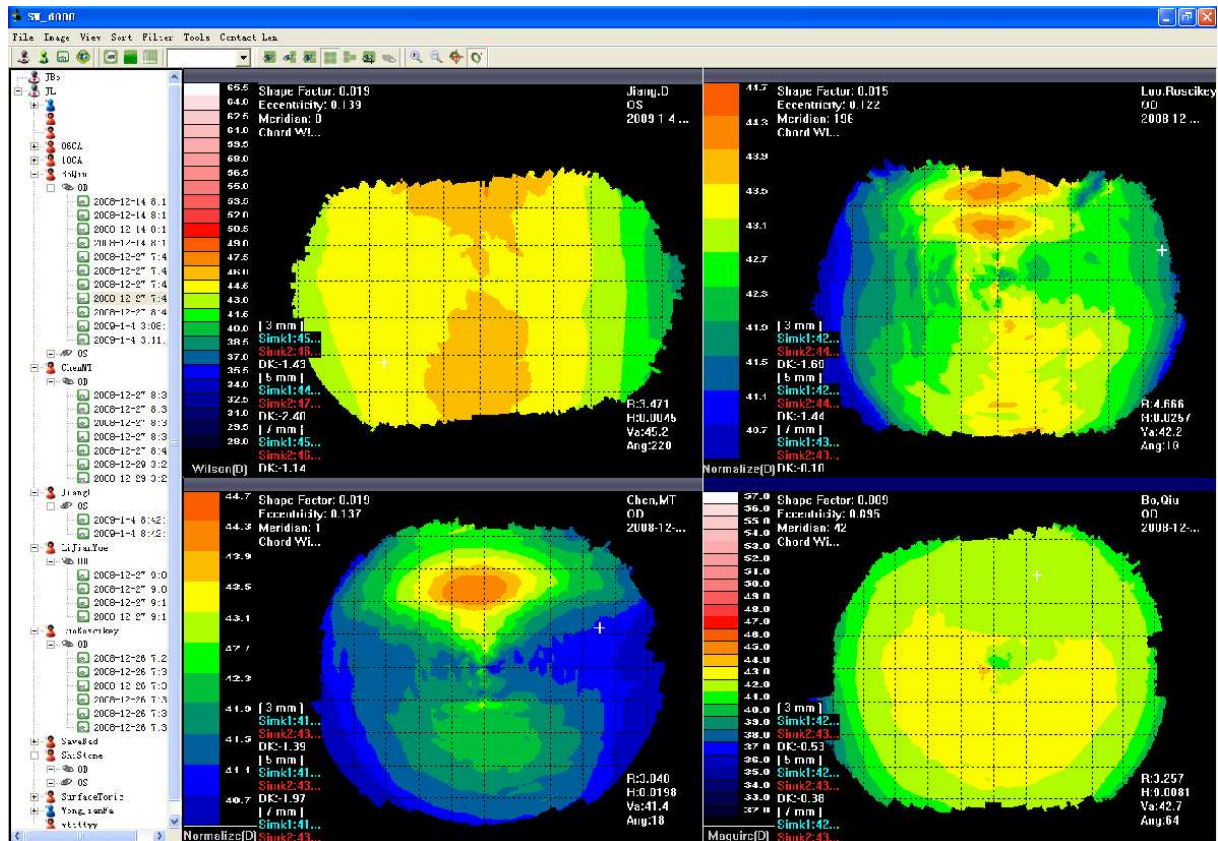
Fig 13 Multiple View

Numeric View

The Analysis Details Dialog provides numerical readouts of various analysis parameters at a specified meridian and chord for the currently selected exam. Select the button 🔲 or the **View > Details** menu to display the Analysis Details dialog (see Fig 14). This displays the corneal height, shape factor and apical curvature at the selected chord and meridian. The **Steep** and **Flat** buttons set the meridian to the steep and flat axis respectively.

Fig 14 Analysis Details Dialog

6.3. Changing the View Settings

You can customize the information displayed for a Patient Exam for each Exam View Mode (see 6.2. Setting the Exam View Mode). First display the **Map View Settings** dialog (see Fig 15) by clicking on the button ![icon]. The dialog allows you to set both the Map Type to display and for setting a considerable number of options.
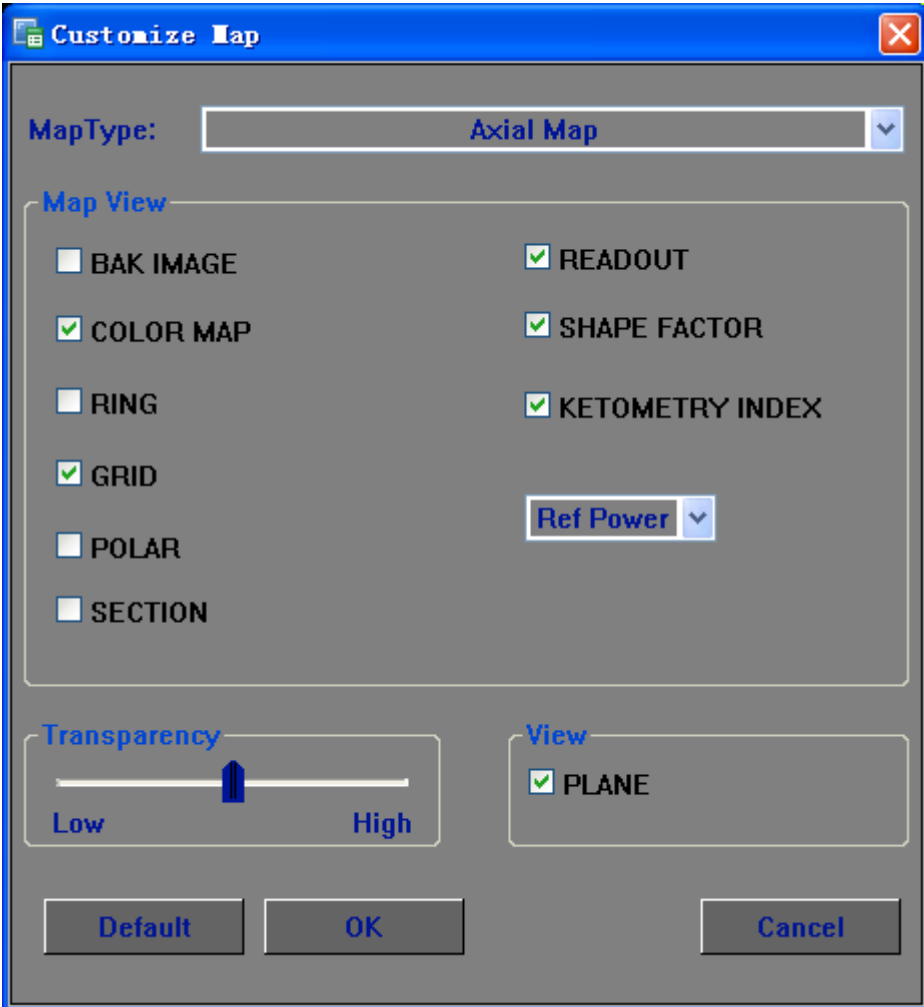

Fig 15 Map View Setting Dialog

These options are applied to the image as you change them. Once you are satisfied with your display settings, click *OK* and the changes will be saved. If for any reason you do not want to save the changes, click *Cancel* and the display

will revert to the original settings.

You can click at any time on the *Defaults* button to restore the software defaults.

Map Types

The Map Type controls the type of data displayed for a Patient Exam. The types displayed in the following list are selected from the drop-down boxes in either the Toolbar or the Map View Settings dialog (see Fig 15). In each case the images are of the same exam.

Axial Power Map

Displays the paraxial power of the surface in Diopters with respect to the keratoscope axis.
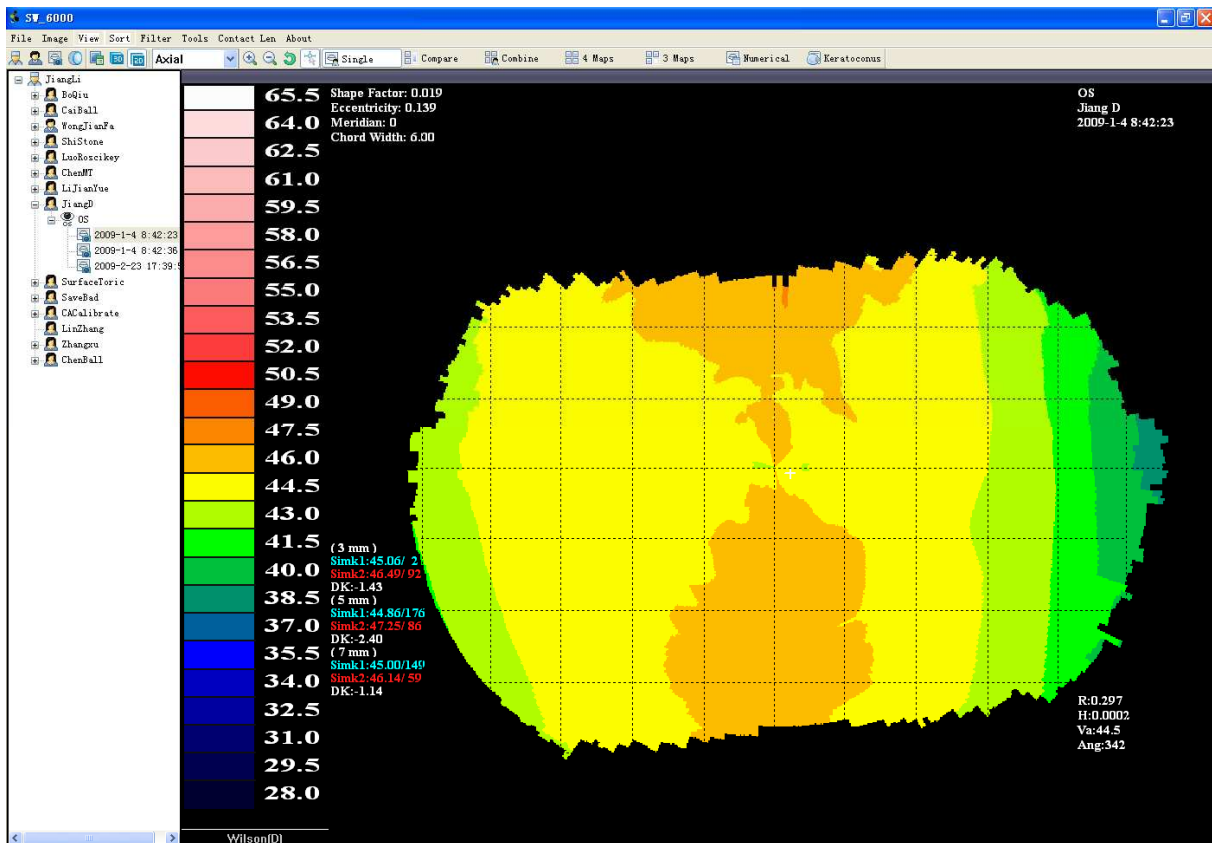
Fig 16   Axial Curvature Map

Tangential Power Map

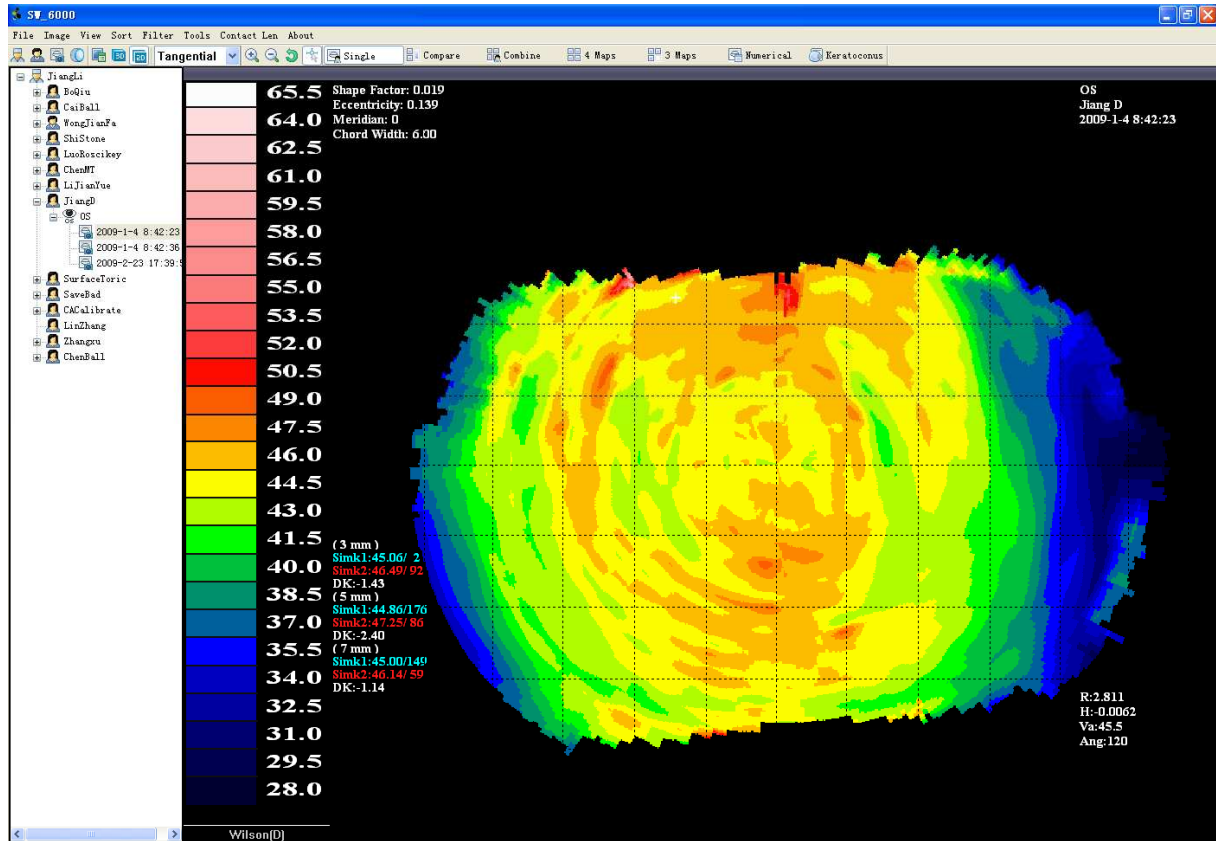Displays the local paraxial power of the surface in Diopters.

Fig 17   Tangential Power Map

Elevation Map

Displays the distance from a specified best-fit sphere to the surface in microns. Positive values indicate the surface is above the best-fit sphere. The Radius of the best-fit sphere is shown on the top right text block of the Pane (see Fig 18).
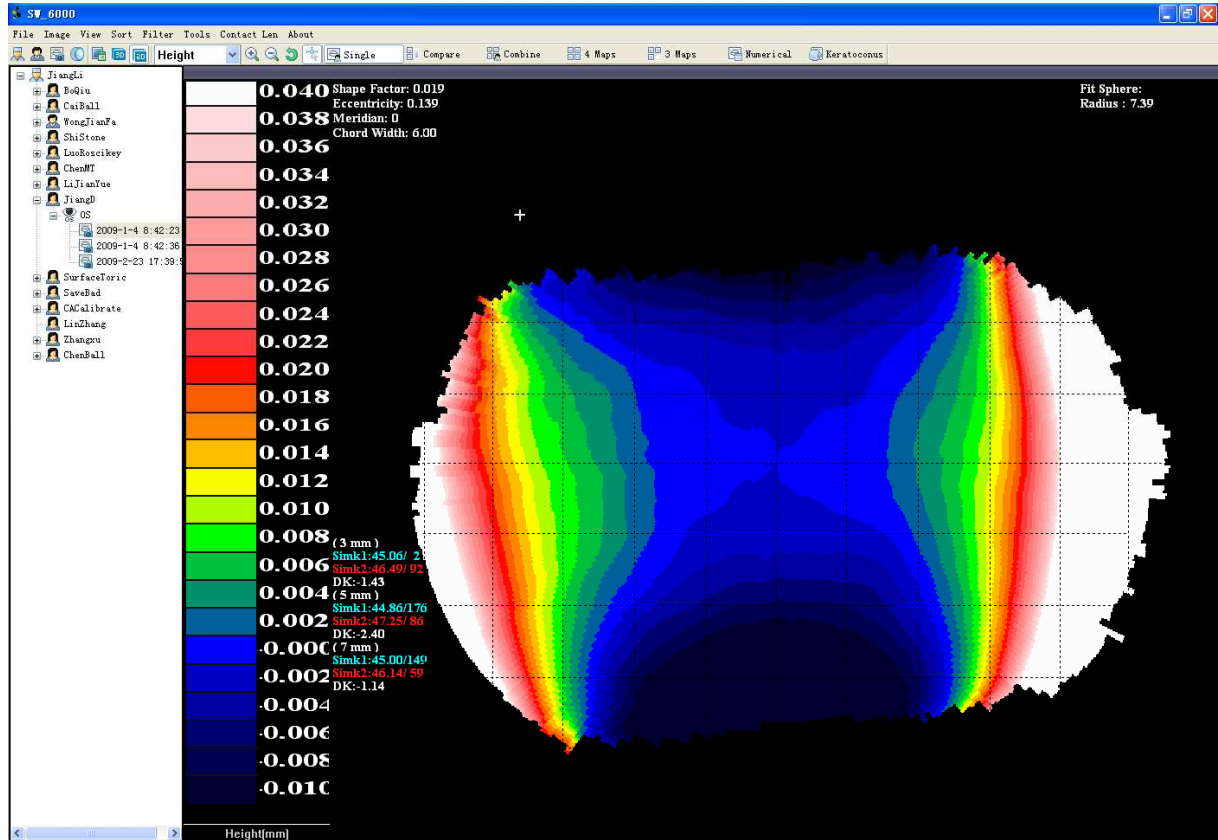

Fig 18 Text Data Block

Fig 19　Elevation Map

The data may be viewed as either a two-dimensional plan as above or as a three-dimensional image. These views are selected by clicking the appropriate button:

　　[2D] Plan – 2-dimensional

　　[3D]　Perspective – 3-dimensional

A 3-dimensional exam view is displayed without the eye image. An example for the same image used above is shown in Fig 20.
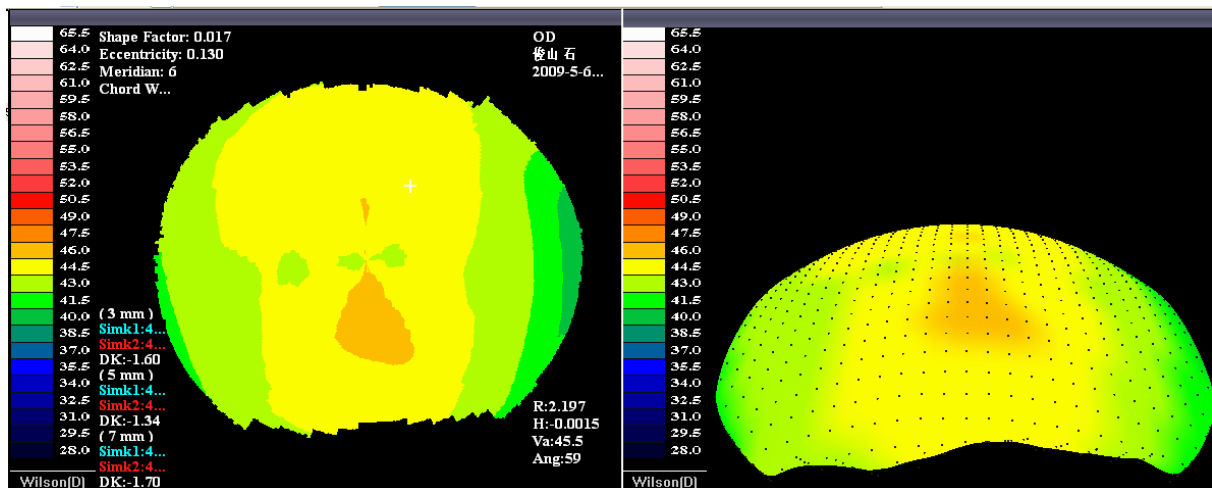
Fig 20　Plan View, Perspective View

The Options toolbar (below) provides a quick means of changing the map and display type.

Apart from the Map Type selection, the **View Settings** dialog contains a number of controls that can help in interpreting and analyzing the exam result (the button presents these dialogs).

Before Changing the View Settings of the Map, you should firstly *enable* the pane that you tend to apply the settings to, especially if in Modes such as *Combination View*, *Compare View*, *Multiple view* that are constituted with several sub-view, the settings will only be applied to the sub-pane which is enabled (See Fig 21). Simply Clicking in the pane will make it enabled.
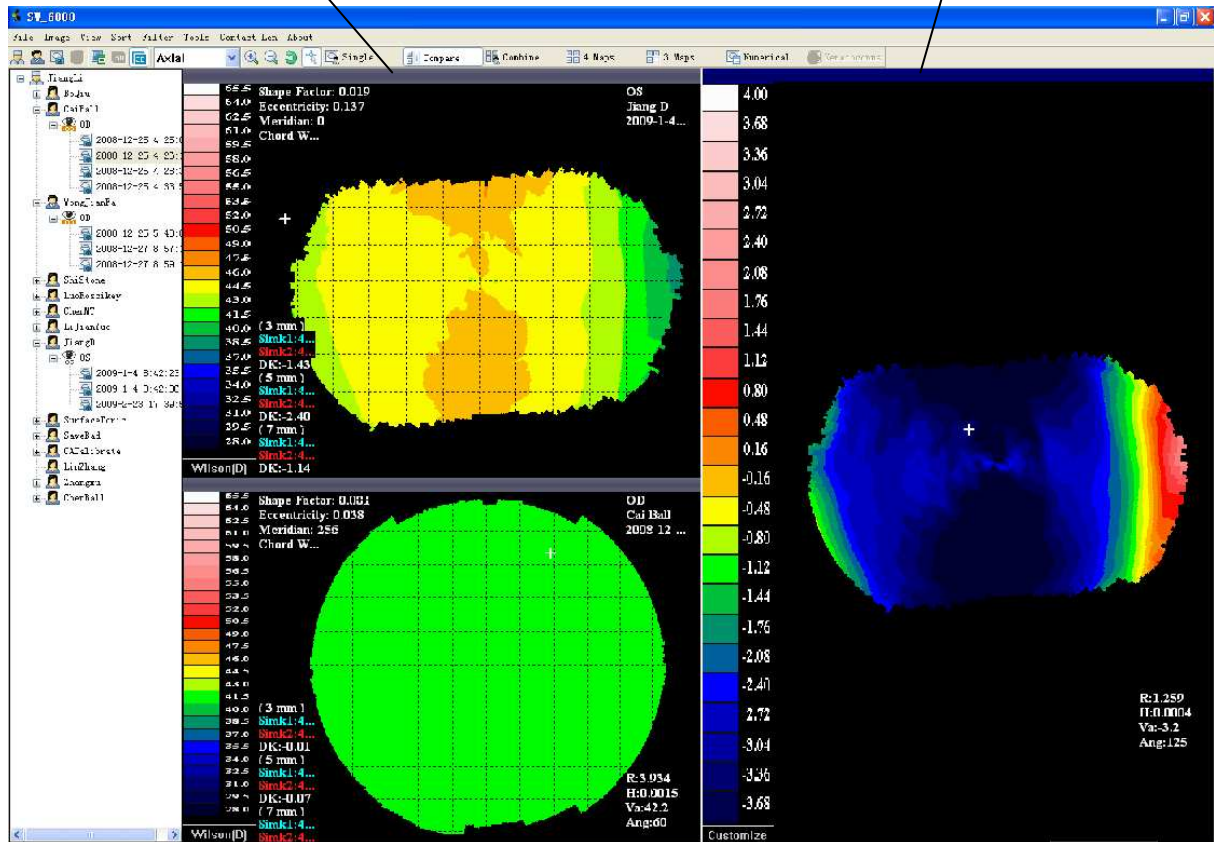
Fig 21 Sub-Panes Disabled and Enabled

The set of image option controls in the **View Settings** dialogs are summarized below.

Bak Image

Displays the raw video image. The color map is displayed transparently over the image. You can set the level of transparency with the **Transparency** spin box. Displaying Effects can be achieved as follows:
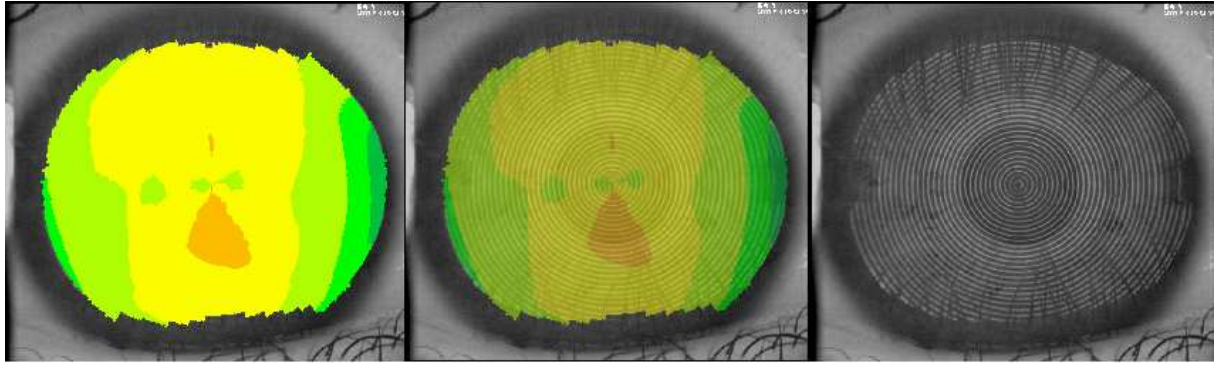
Fig 22   with absolute opacity, with half absolute opacity, with no opacity

Image

Displays the color-mapped data. Disabling the color map allows you to examine the raw video image.

Ring

Draw the outline of the Placido ring, this option is of particular use to check if there's something wrong with the Edge Find Algorithm.
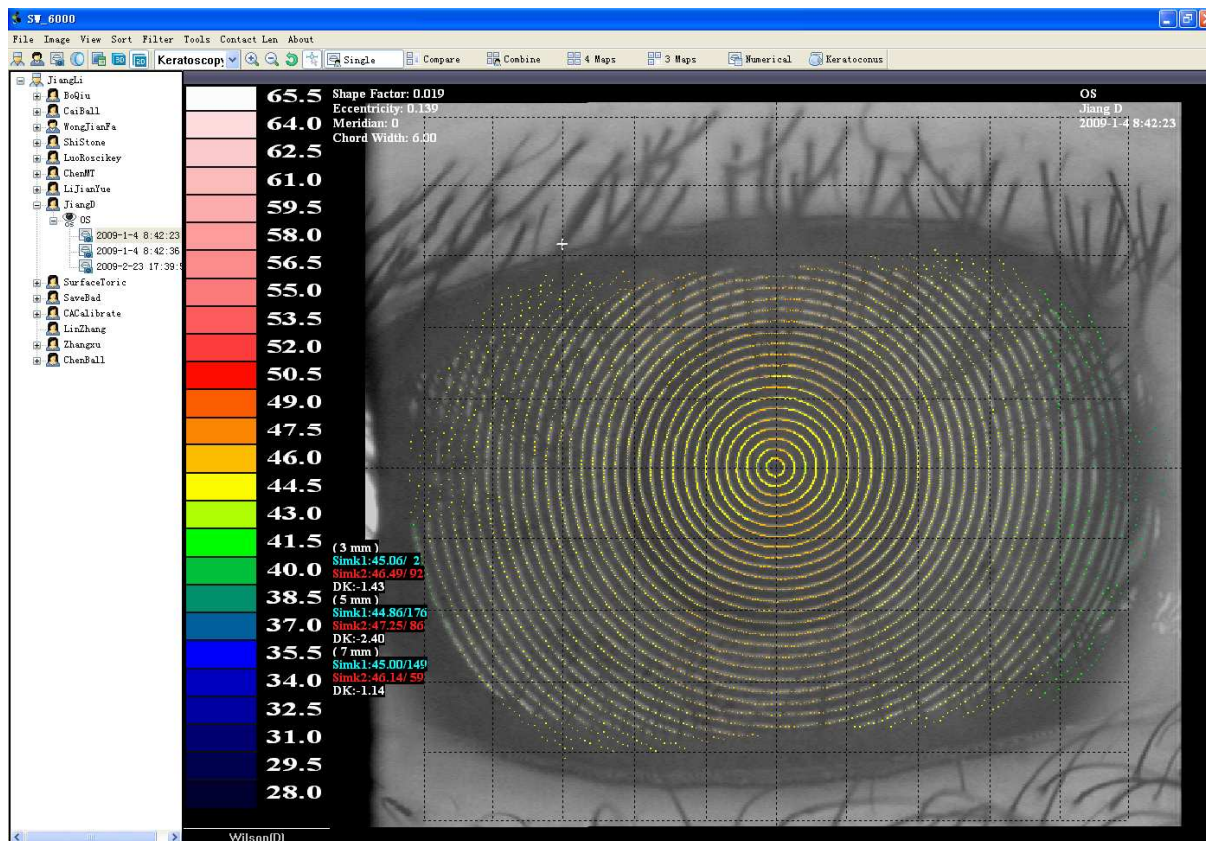
Fig 23 Displaying with ring outlined

Grid

Displays a one-millimeter rectangular grid, centered on the keratoscope axes, overlaying on the color map.

Polar

Displays a polar reference ring, centered on the keratoscope axis, overlaying the color map.

Section

Displays a cross-section of the displayed data in a window below the color map. A white Section indicator line is displayed over the color map to indicate the

source of the cross section. To show the wave data below, you should first select and Enable the Section line that will become light yellow, and allow you to rotate and translate the line (See Fig 24). The vertical axis of the Section graph covers the same range as the current color key. Note that the image may contain data that is outside the currently selected color key, resulting in parts of the section graphic being clipped at the window edge(s).
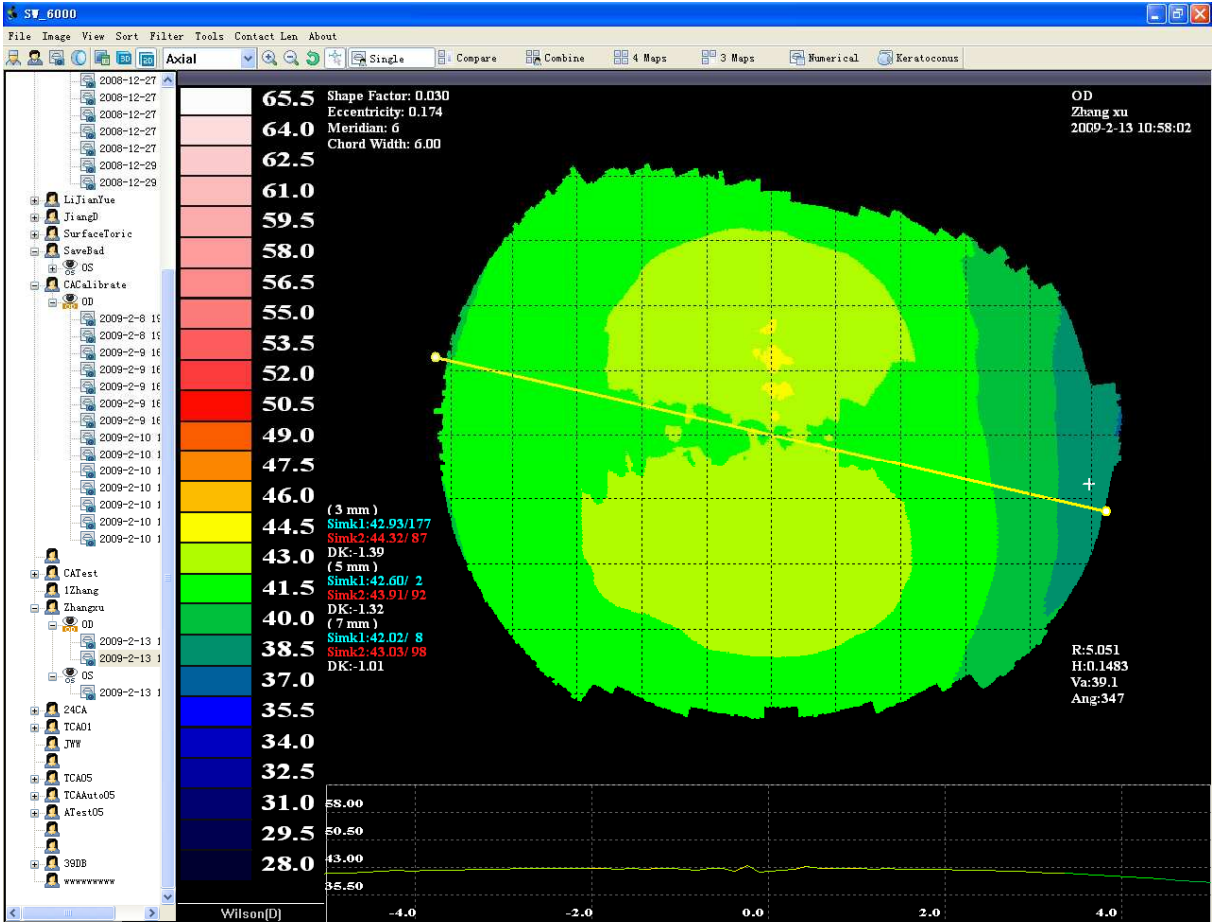
Fig 25   Section Display

Readout

Displays a readout marker (a white cross) over the color map. The location of the readout marker relative to the keratoscope axis, and the data values at that location, are displayed in the bottom right hand corner of the image. The values

presented are in terms of the currently selected Map Type. Clicking and dragging with the left mouse button moves the readout marker and updates the readout in real time.

Shape Factor

Keratometry Index

On the left-hand side of each image there is a Top and Bottom block of text data. Numerically, the Upper Block display the Corneal Shape Factor, and the Lower one the Sim k in Diopters / Sim k in mm. The Sim k values contain information in 3mm, 5mm, and 7mm zone.

Here we define the terminology Simk1 /Simk2 as the simulated keratometric

(SimK) values for the steep (in the red) and Flat (in blue) axes of eye,

DK (in white) is referred to the corneal cyl.

On the right-hand side of each image there is a bottom block of text data, click the map zone, it will display,and it contains:

R:

H

Va

Ang

Notes:

Here we define the parameters of a (prolate) ellipse as(where Line *PO* represents the visual axis):
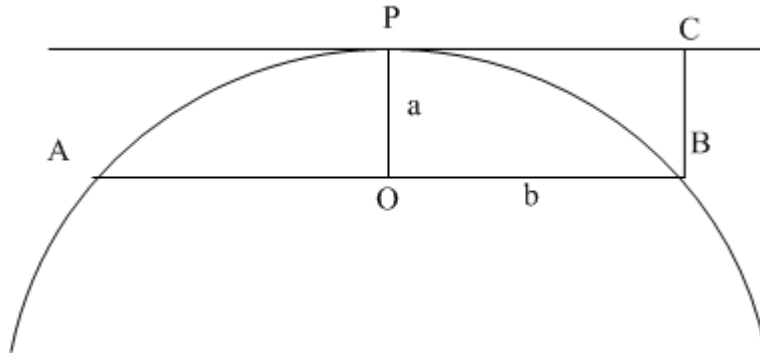
Fig 26   Ellipse

E (Eccentricity)

This is the standard mathematical eccentricity value of the ellipse defined by the

shape factors. The SW6000 computes this from

$$e = \sqrt{1 - \frac{\min(a,b)^2}{\max(a,b)^2}}$$

$$SF = 1 - \frac{b^2}{a^2}$$

Setting up the color key

Clicking the Button ![Wilson(D)] at the bottom of the **Color Key**

Pane will bring up the Color Key Customize Dialog (below) in which you can

set the appropriate Color Key, including:
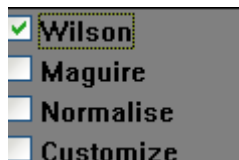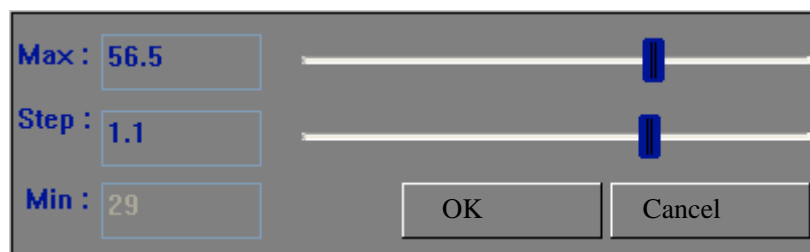
Fig 27   Fig 28

   Wilson   Range From 28.0D~65.5D, 1.5D Step

Maguire	Range From 32.0D~57.0D, 1.0D Step
Normalise	Range From 40.7D~44.7D, 0.4D Step
Customize	Customizable Color Key (See Fig 28)

Zooming and Panning

You can zoom and pan the currently displayed Patient image using the

Image > Zoom and **Image > Pan** menu items. You can use the **Image >**

Zoom > Reset menu item to reset the default image view.

Using the Mouse to Pan and Zoom

You can also use the mouse to pan or zoom within a single image. Select the

Pan, or **Zoom** option from the **Image > menu** or by clicking with the right

mouse button over the image or the toolbar

The shape of the cursor will change to reflect the current cursor mode.

You can also use Hot Keys (refer to the menu) to Operate in the Zooming and

Panning Mode.

Exam Filters

Exam filters allow you to restrict that Exams are shown in the Explorer pane.

 Filter By Patient

Only Patient who fulfills a certain criteria would their exam results shown in the

Explorer Pane.

 Filter By Clinician

Only Clinician who fulfills a certain criteria would their Patient's exam results

shown in the Explorer Pane.

    ▽ Filter By Time

Only Exam, which was taken during a certain period of time, would be shown in the Explorer Pane.

Sorting SW6000 Exams

The SW6000 Exams displayed in the Explorer pane can be sorted by any of the column headings.

      Sorting the Patients

      Sorting the Clinicians

Backing up the SW6000 Database

SW6000 exam data is stored in the SW6000 sub-directory under the directory (C:\SW6000 for a typical install).

To backup the SW6000 database:

1. Exit SW6000 Viewer.

2. Copy the SW6000 directory to a backup media.

Archiving the SW6000 Exam Data

The SW6000 software provides a mechanism for archiving SW6000 Exam Data to an external file or backup media. Archiving is used to reduce the size of the SW6000 database to prevent it completely filling the hard disk or exceeding the capacity of the backup media.

Select **[Tools->Archive…]** to display the Archive Dialog (see Fig 29).

Fig 29

Set the archive cut-off date and click on Update. All exams captured between the given date range will be displayed in the list box below.

NOTICE .

Exams have been archived would not display.

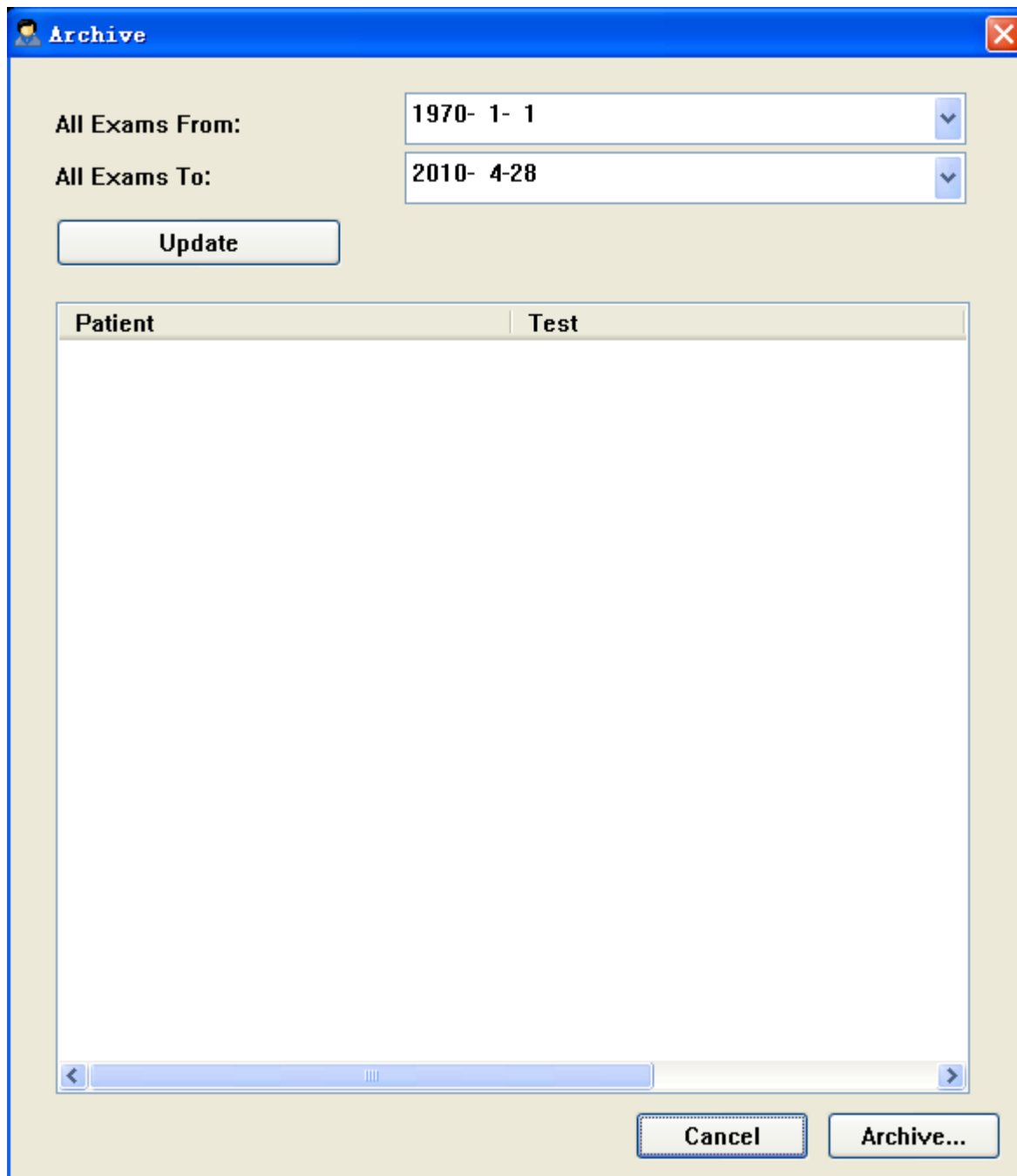Select any exams that you want to archive and click on the *Archive...* Button and enter the name and location of the archive file that will be created. This creates an archive file and an associated directory containing the data files.

Once the archive file/directory has been created it can be copied to a backup media (tape or CD-ROM) and then deleted.

NOTICE

Note that archiving does not remove the exam information from the database – only the image data. The exam information takes up very little space and is left as a placeholder for the exam. If you delete the exam placeholder for an archived exam the archived image for that exam cannot be restored.

Note that if archived files or the associated directory were lost, the exams contained in would not be able to display.

Restoring the Archived Exam Data

Archiving moves the video and analysis data for SW6000 Exams from the SW6000 data directory (Default : C:\SW6000\Database\Archive\0)to the archive. When you select an SW6000 Exam that has been archived the software attempts to get the data from the archive. If the archive has been moved, the exam would not be able to display until you recover the Archive files to the right places.

The Archive pane in the Review Views displays the name of the archive file and the date it was created (see Fig 30) for exams that have been archived.
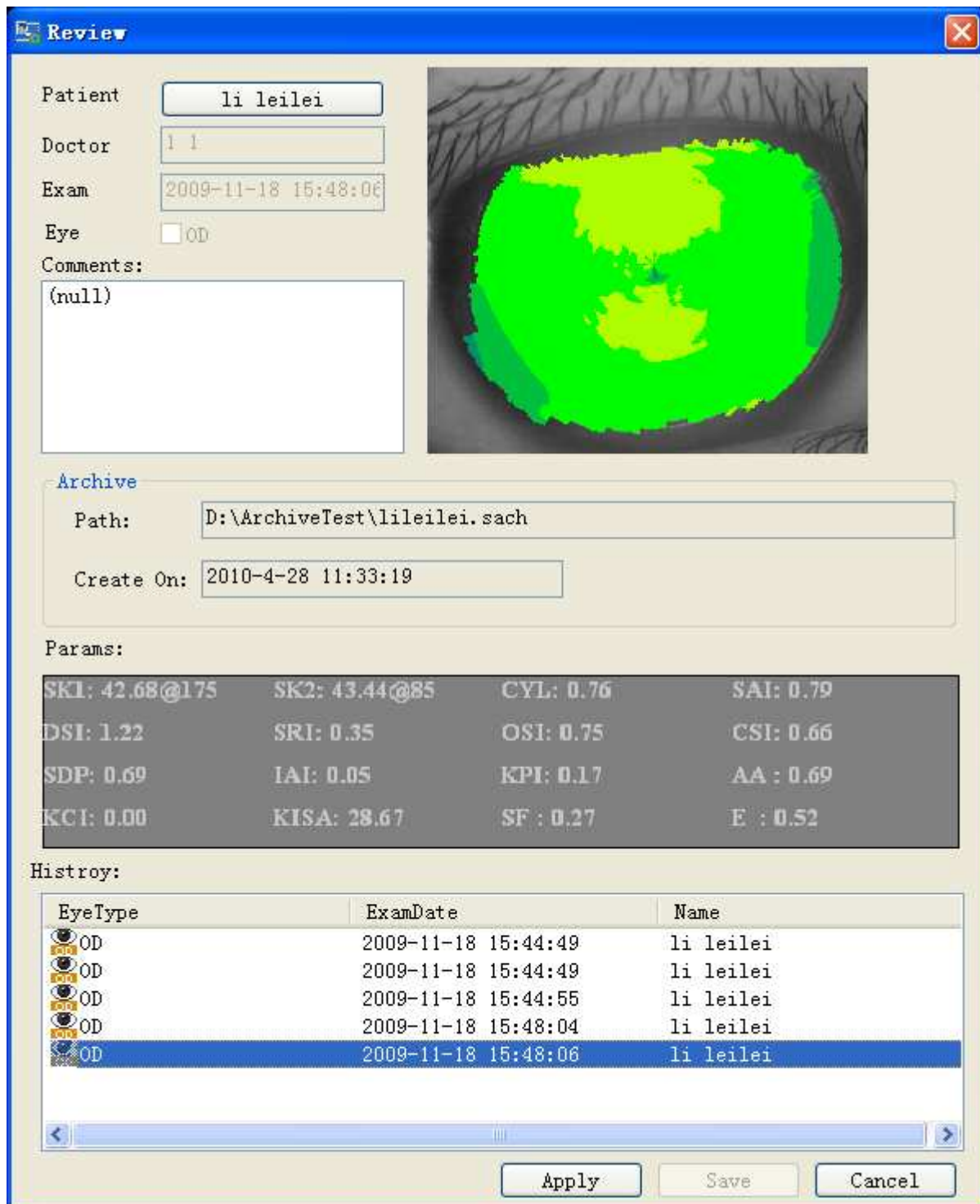
Fig 30

To restore exam data from an archive:

• Select the **[Tools->Restore…]** menu item.

• Specify the location and name of the archive file.

FITTING CONTACT LENSES

The SW6000 software provides a simulated fluorescein display for evaluating the fit of RGP contact lenses (see Fig 31). This is a simulation and should only be used as a guide to the expected fit.

Fig 31

7.1. Create a new Contact Lens

Before proceeding with contact lens fitting you should have captured exams for both eyes of the patient (see Capturing Patient Exam).

Select the Patient Exam on the Explorer pane and open it displaying in the

SW600 Viewer, then click on the button🔵. This displays the Contact Lens

Design dialog shown in Fig 32.
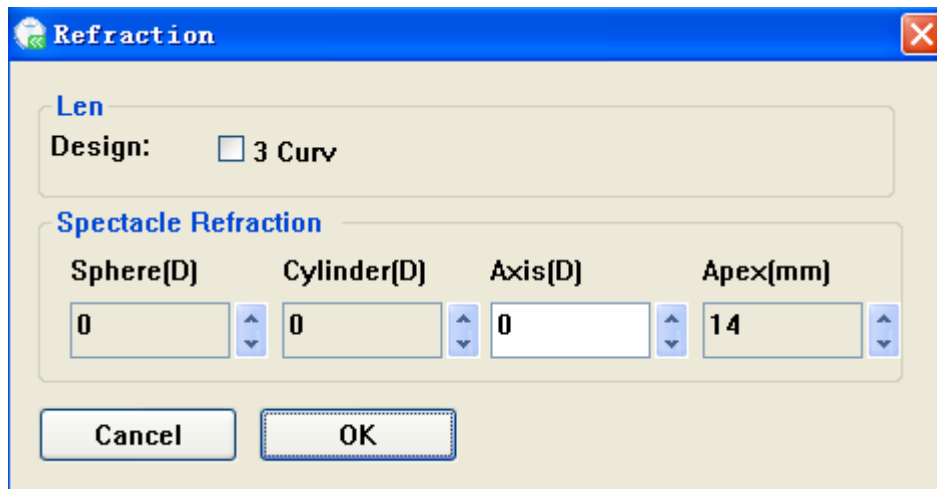
Fig 32 Setting the Refraction Info

The Contact Lens Design dialog (see Fig 32) allows you to select the lens design

to use. The recommended parameters for the design are automatically calculated

based on the eye geometry. The simulated fluorescein pattern is computed and

displayed.

The dialog also allows you to specify the manifest refraction that the software

uses to calculate the required contact lens power. The dialog is displayed when

creating a new contact lens. You can also use it to review the design or

refraction for an existing contact lens by clicking the 🔲button or the **Contact**

Lens > Ref Review menu.

7.2. Editing the Lens Design

Click on the button 🔲 to display the contact Lens Designer dialog. This is

normally displayed automatically when you create a new contact lens. The

parameters that are displayed and can be changed in this dialog depend on the

selected lens design. Typically the controls allow you to change parameters such as the lens diameter, base optic curve radius and peripheral curve parameters. Enter values in the numeric text boxes by clicking the spin-buttons or using the keyboard. For all lens designs, changing values may cause other values to be recalculated to match. For instance, when the base optic radius is changed the peripheral curve parameters are generally automatically updated. For the lens design dialogs where this occurs, the automatically generated values can be overridden by changing them manually.
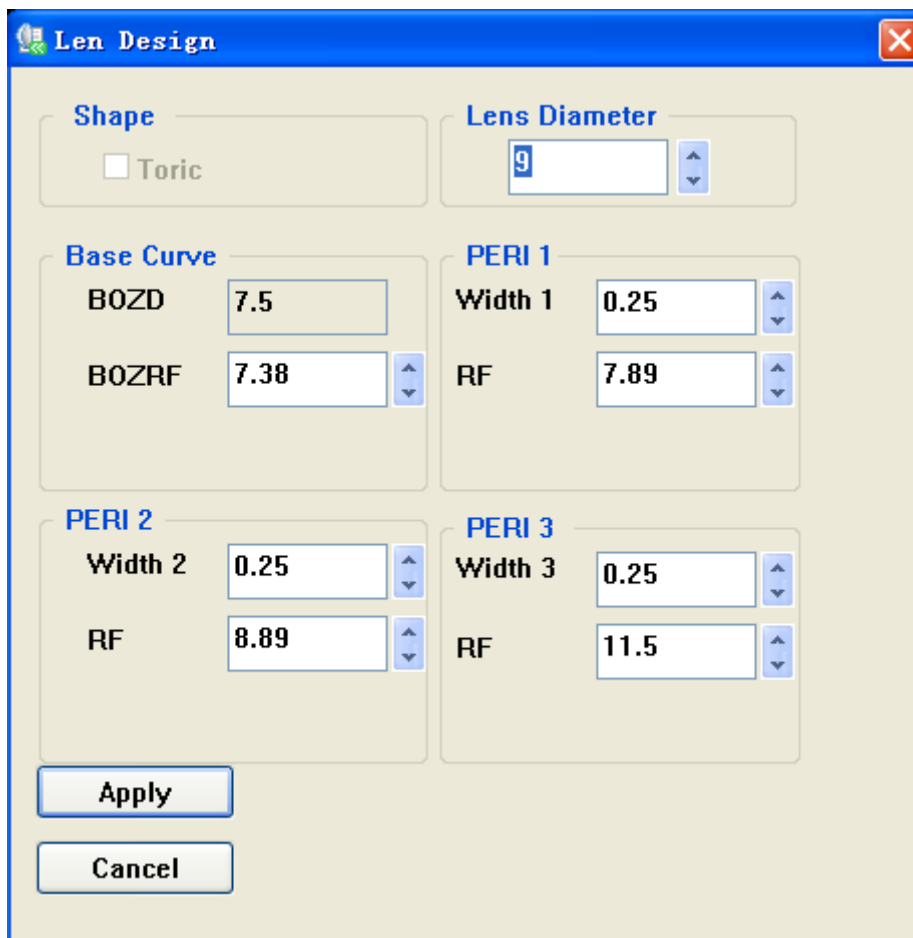
Fig 33 Contact Lens Designer Dialog

BOZRF: radius of the base curve

BOZD: diameter of the base curve zone

PERI1:   the first peripheral curve

WIDTH1:   the width of the first peripheral curve zone

RF: the radius of the peripheral curve

Click on the *Apply* button to display the simulated fluorescein pattern for the new parameters. The *Cancel* button reverts to the previous parameters.

7.3. Setting up the Color Key

Click on the Button [CL(um)] under the Color Key Pane to bring up the *CL Adjust Dialog* setting up or revising the Color Key Which mapping the clearance between the anterior corneal and the posterior lens to the simulated fluorescein pattern.
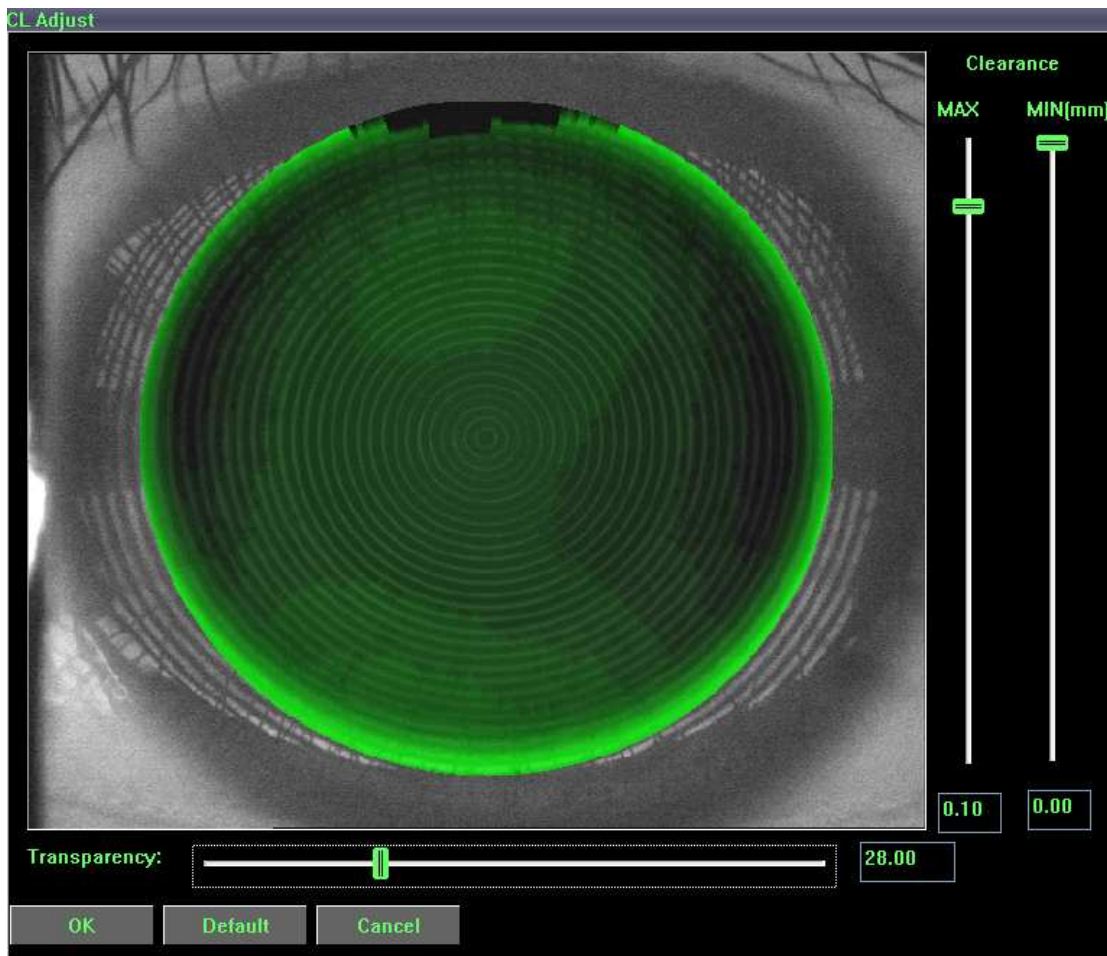
Fig 34 CL Adjust Dialog

Changes will update the displaying in real time in the dialog, Click on the Button **OK** all the setting will be applied to the Displaying window while *Cancel* undo.

7.4. Saving the Fitting Exam

Click on the Button to save the Fitting Exam, A Fitting Exam item, identified with the icon , is added to the Explorer pane under the current exam result of the current patient.

7. KERATOCONUS SCREENING

Before proceeding with Keratoconus Screening you should have captured exams for the patient (see Capturing Patient Exam). Select the Patient Exam on the Explorer pane and open it displaying in the SW600 Viewer, then click on the button. This displays the Keratoconus Screening Viewer shown in Fig 33.
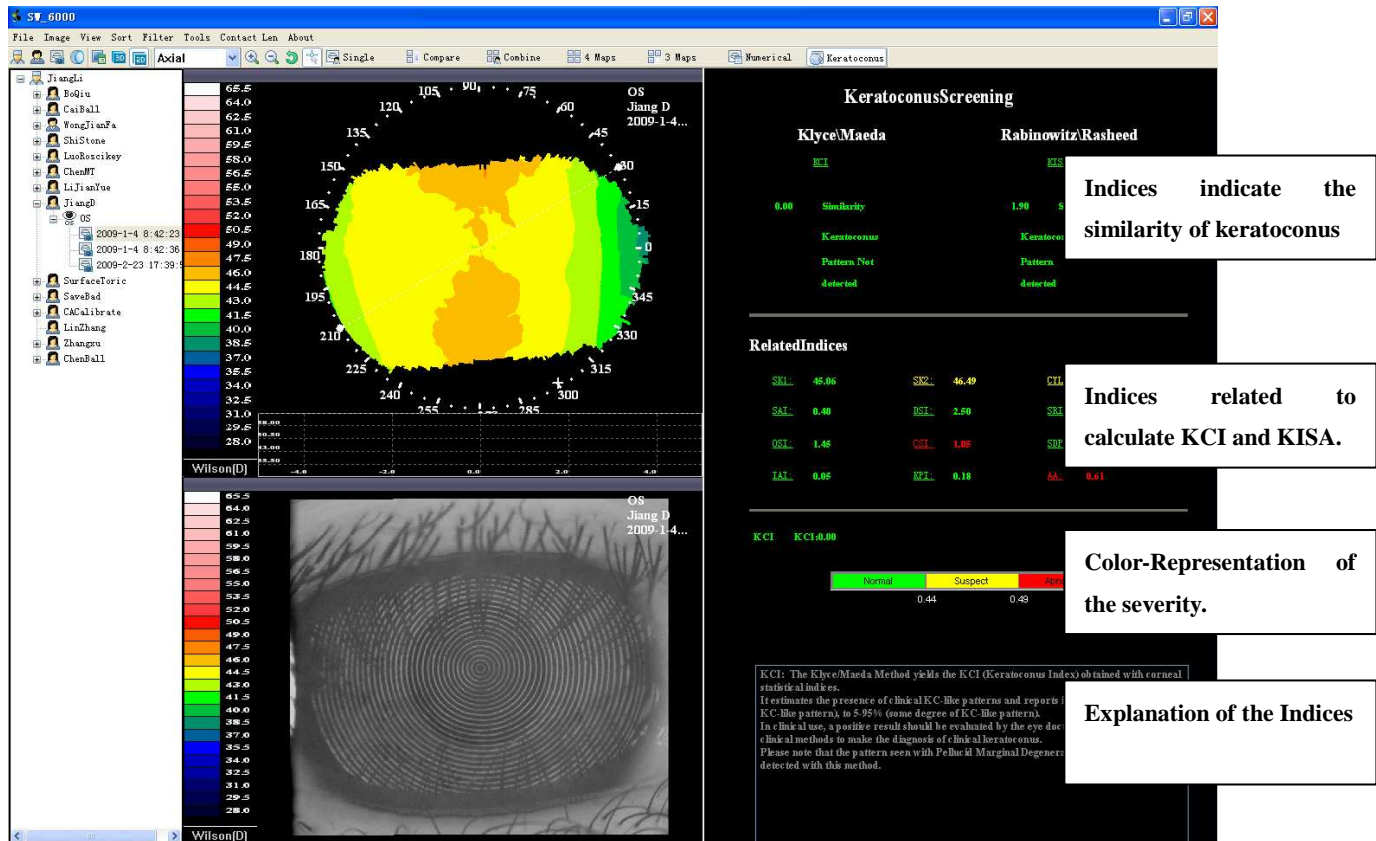
Fig 35 Keratoconus Screening

Moving the mouse over one of the Terminology (for example,KCI),the cursor indicating the mouse will change to a hand cursor automatically. Press it down, and the explanation of the terminology will be displayed in the text block. Which is at the bottom of the pane.

8. CALIBRATION

The accuracy and repeatability of exam results is dependent on ensuring that the SW6000 is correctly calibrated. The instrument is supplied with a calibration object, which is calibrated to the National Standard.

⚠ Handle and maintain this object with care! Do not touch, scratch or dent the object surface; it is a delicate optical device.

If any surface defects are identified the object must be replaced to ensure the best calibration result. You should check the calibration of the instrument:

- After installation or moving the system to another location.

- On a monthly basis the button ▦ or *Tools > Calibrate* menu runs the Calibration Wizard, which allows you to recalibrate the instrument. The following sections describe the Calibration Wizard Steps.

9.1. Mounting the Calibration Object in the chin rest

1. Plug *Rod 1* into the screw thread hole and turn the screw to tighten it.

2. Insert *Rod 2* to *Rod 1* and shift it to a certain height in which the Calibration

   Images can be conveniently obtained.

3. Tighten the bolts.

9.2. Capturing Calibration Images

The Calibration Wizard captures five separate images of the calibration object at different locations within the instrument's working range (see fig46). It analyses these images to measure the error in the current calibration.

The SW6000 joystick allows positioning in three dimensions. Move the joystick in the desired direction for movement left and right and for closer to or further away. Rotate the joystick knob for movement up and down, clockwise to raise, anti-clockwise to lower.

Position the instrument to align the center of the rings with the Central cross and the focusing bar over the central horizontal cross hair. When the instrument is properly positioned the wizard will automatically capture the image. And then the calibrate routine will update several parameters to allow you to repeat the process to capture each of the five images.

⚠ Vibration of large amplitude should be avoided to guarantee the veracity of the calibration routine.

Click on the Button 🖳 or *Tools > Calibrate* menu to bring up the *Calibration Wizard Dialog*
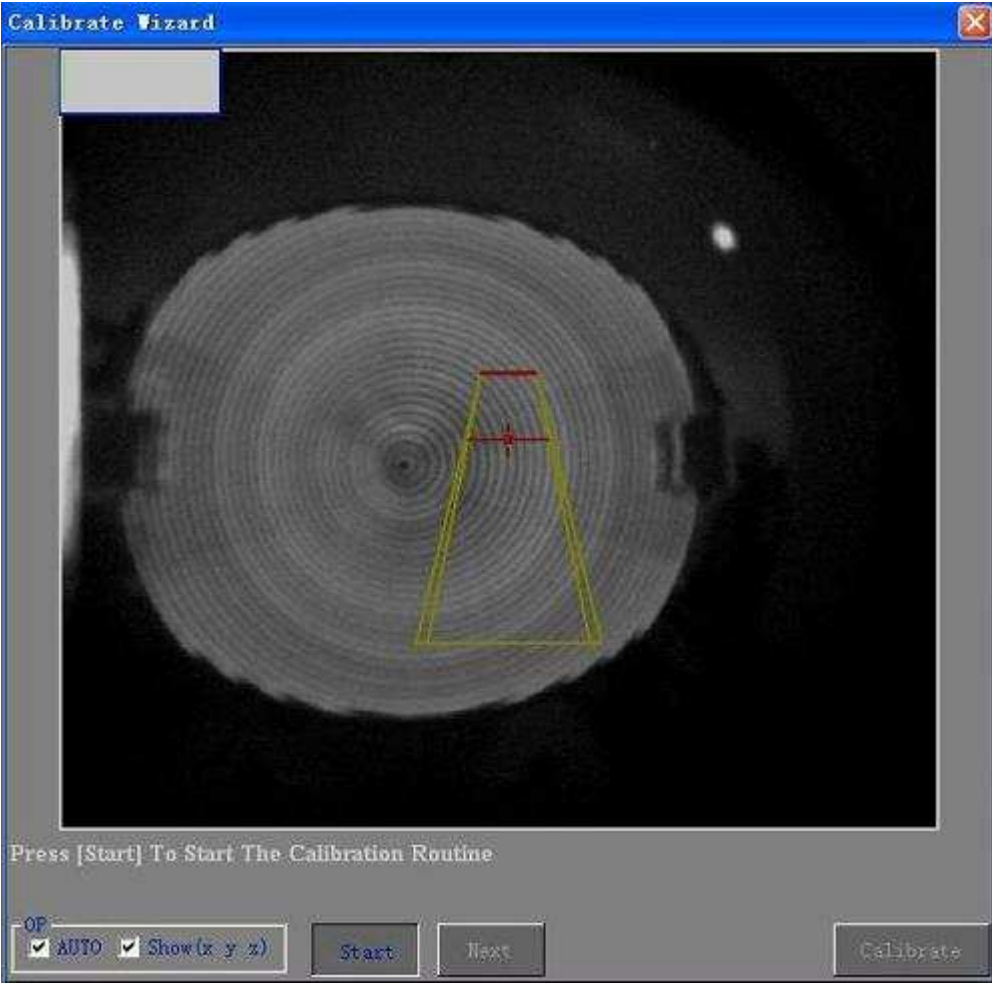
Fig 36 Calibration Wizard Dialog

Click on the *Start* button, tips about focusing precision will show up (below Fig).
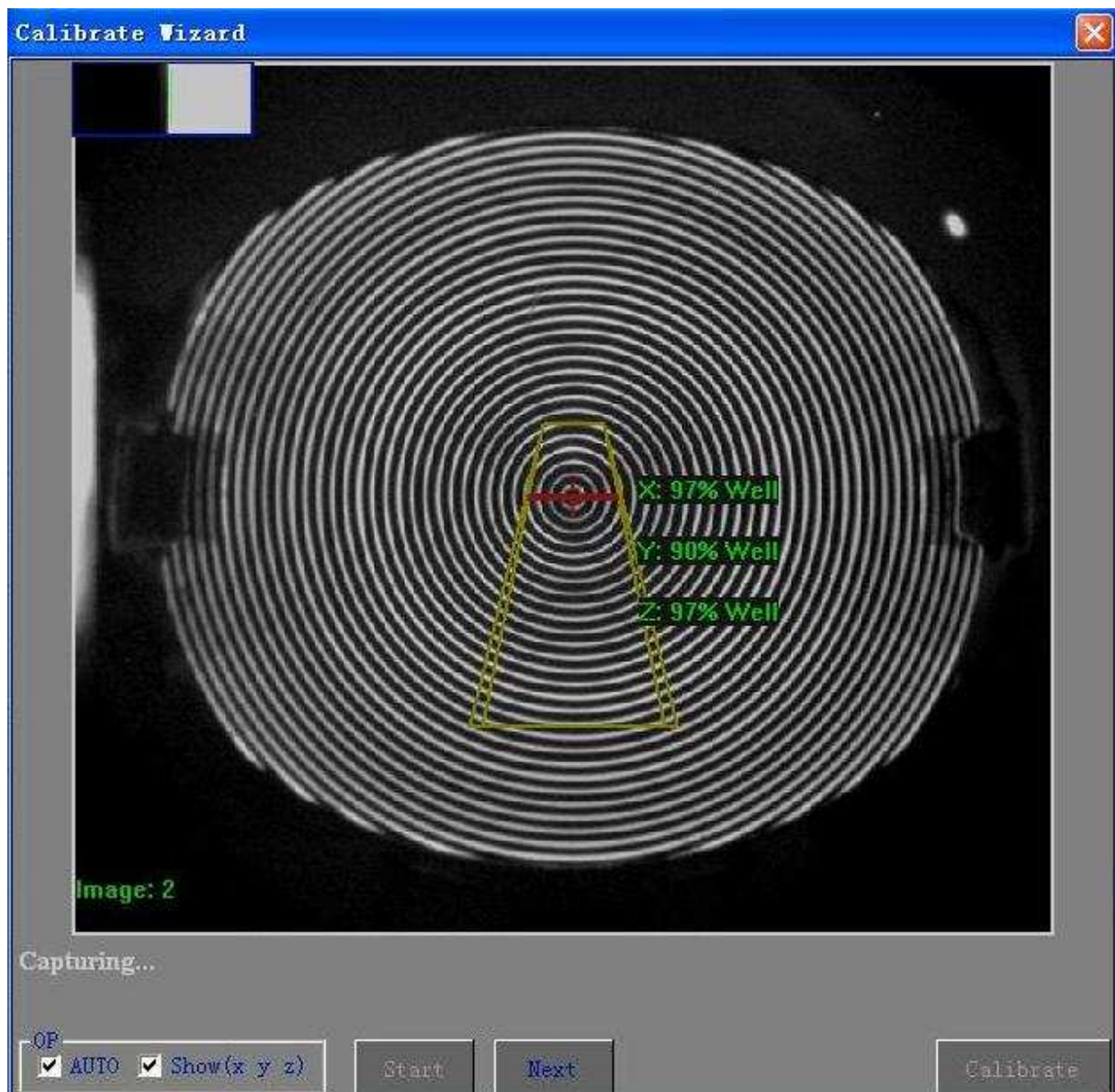
Fig 37 Capturing

Position the instrument to align the center of the rings with the Central cross and the focusing bar over the central horizontal cross hair. When the instrument is properly positioned the wizard will automatically capture the image. In addition, under the ***Auto Capturing Mode,*** only focusing precision at all x/y/z directions achieves 95% (see Fig 38) would the Calibration Image be automatically captured.
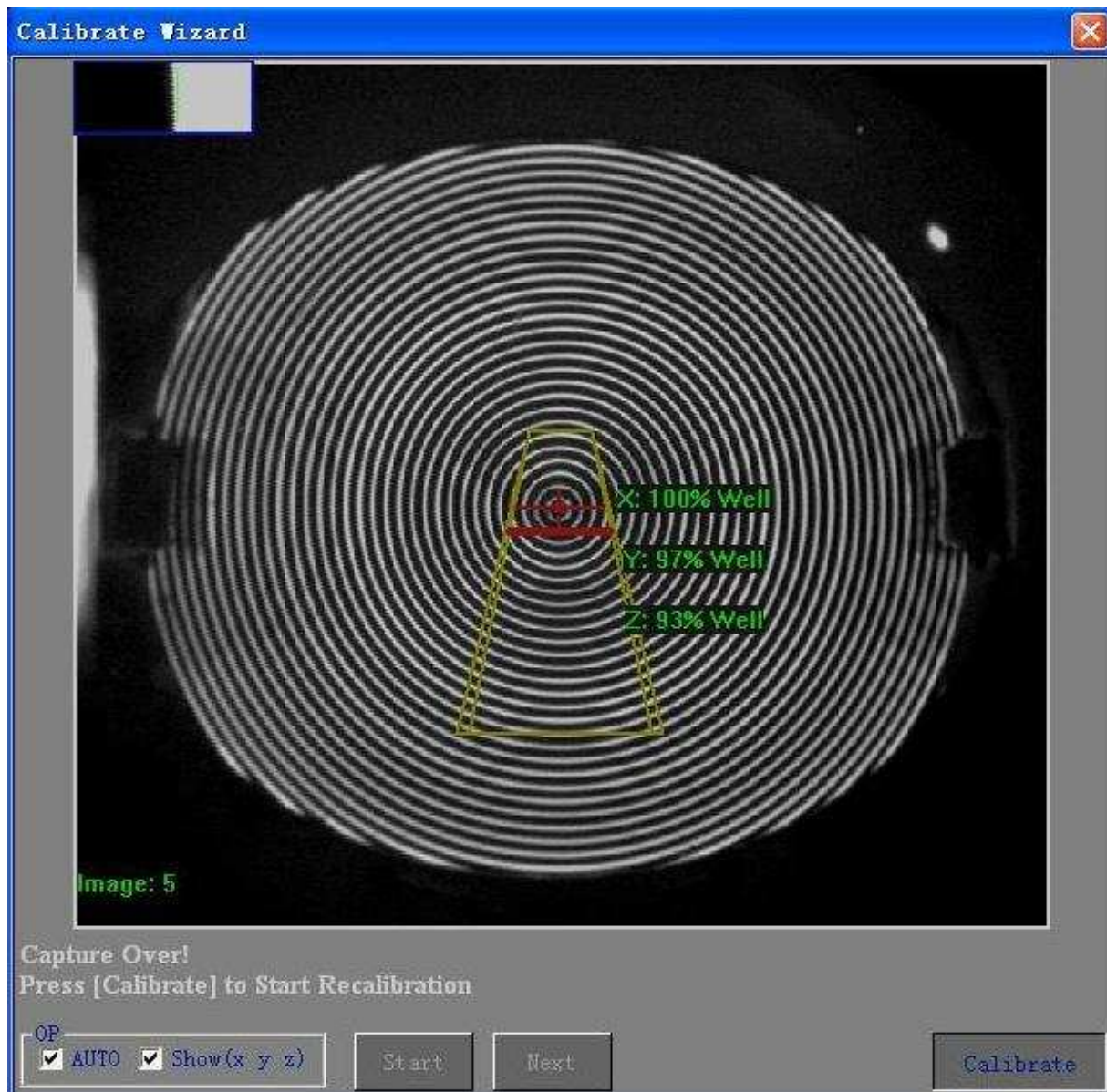
Fig 38 Focus well, Captured

Repeat the process above to capture each of the five images.

As soon as the last of the five has been captured, the button *Calibrate* will be

enabled. Press it down to run the calibration routine.
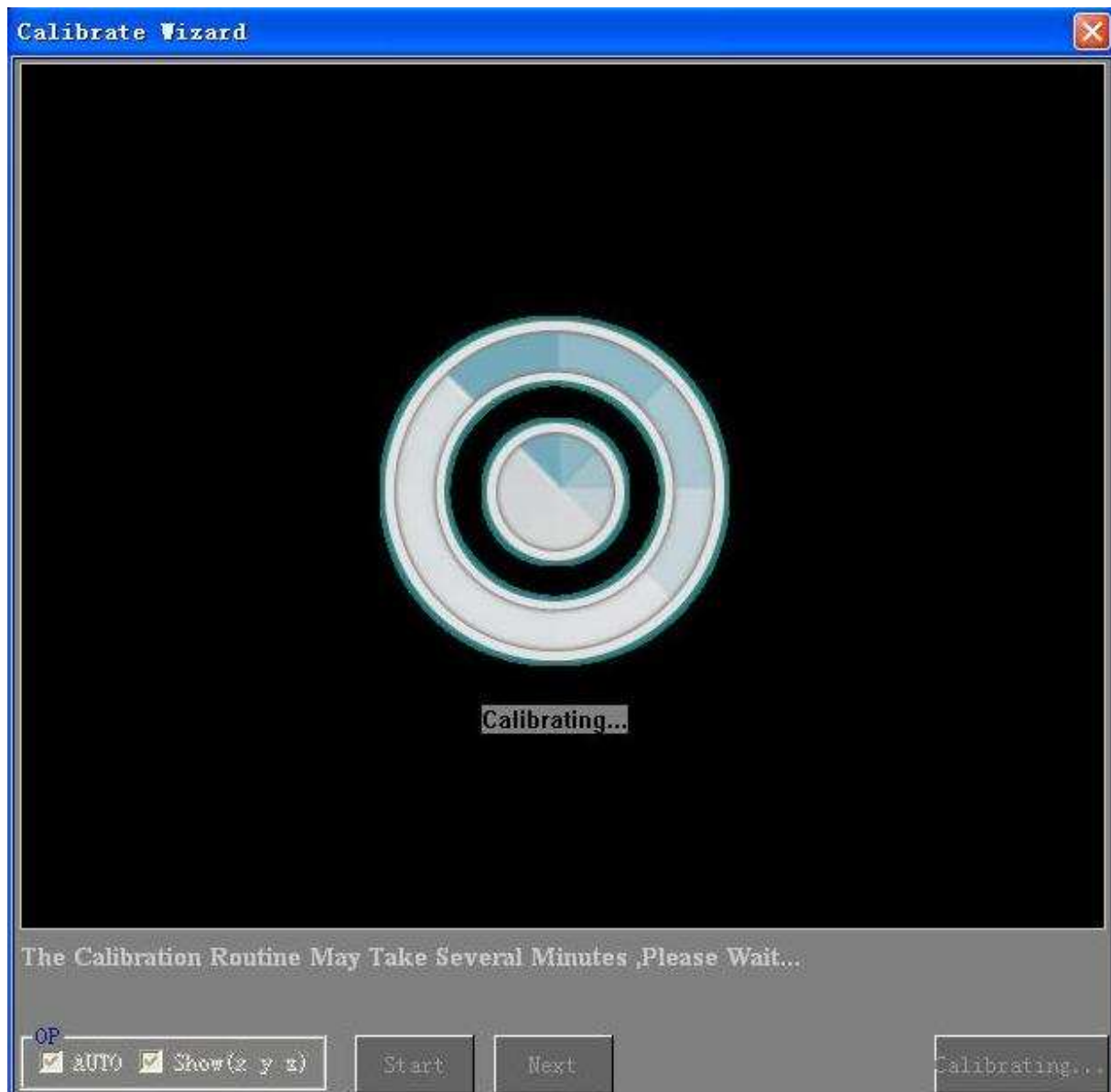
Fig 39 Calibrating

The calibration will automatically stop once the error is sufficiently low.

Calibration of the SW6000 involves analyzing and adjusting over 60 software

parameters to match the exact physical dimensions of the instrument.

Consequently, depending on the speed of the PC, calibrating a new

Instrument usually takes between 10 and 15 minutes.
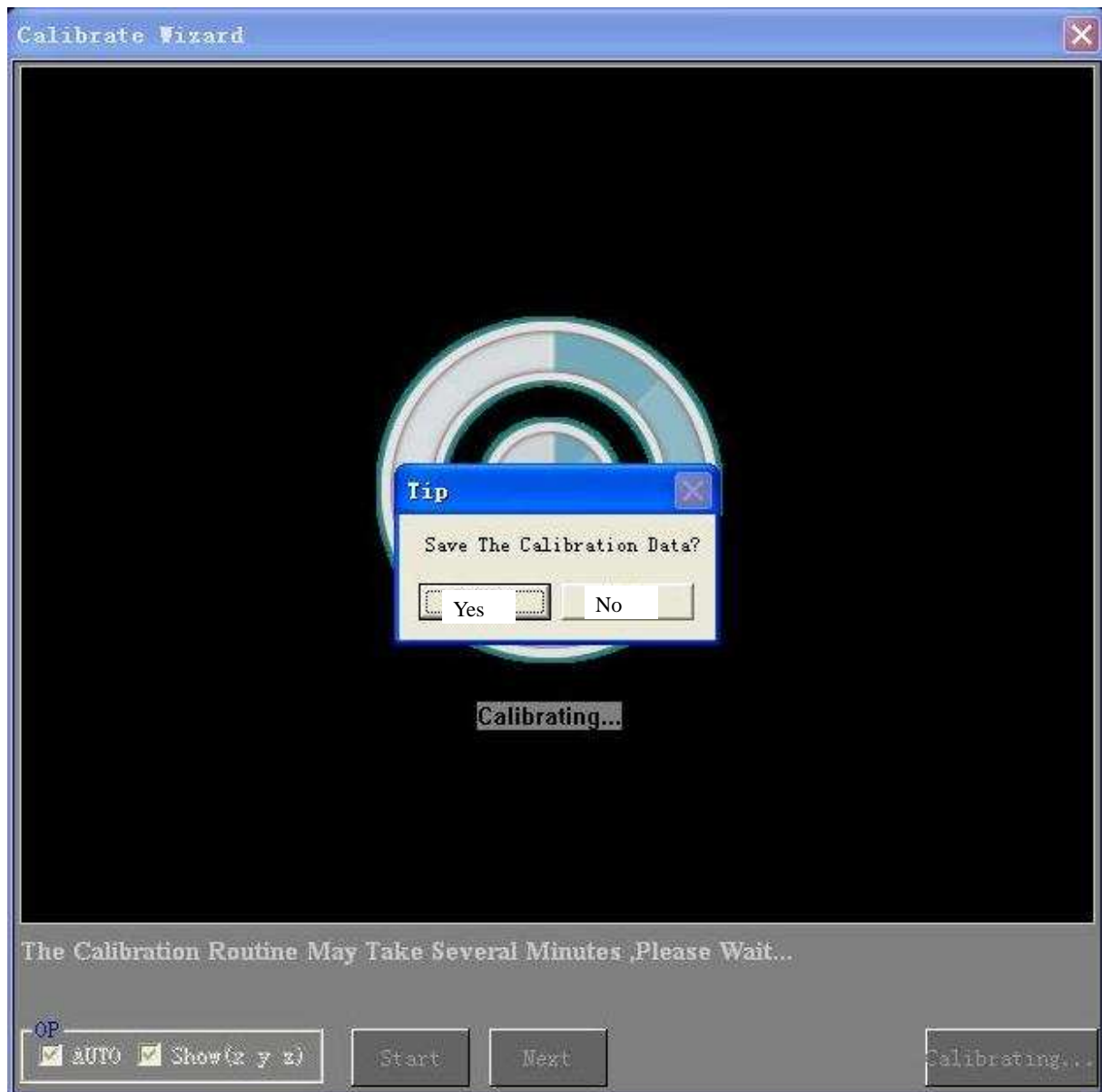
Fig 40 Calibration over

Click the corresponding Tip you want to choose to save and refresh the calibration results for the current and later exams, or simply cast it away.

9. CLEANING AND MAINTENANCE

To maintain the life of the components and the accuracy of the instrument, regular maintenance is required in the form of lubrication and cleaning.

10.1. Routine Hygiene and Cleaning

All surfaces coming in contact with patients need regular disinfecting. Standard instrument grade disinfectant diluted with 50% water may be used on all external surfaces. Wipe surfaces with a damp cloth only to avoid liquid entering delicate parts and optics. Do not use strong oxidizing agents or solvents as they could damage surface coatings. Do not use any aerosols or sprays that could contaminate the optics. Use soft non-abrasive cloth only.

Special care of the inside of the cone is required, and is described in the section below.

10.2. Cleaning of contaminated Optics

The following optics is externally accessible and subject to contamination from dust, residues from evaporated liquids, body acids and fats, and makeup.

- Cone surface

- Imaging lens front surface

- Profile illumination window (on RH channel just inside cone edge).

- Profile image window (on LH channel inside cone edge).

Internal optical surfaces are not accessible without disassembly. Do not attempt to disassemble or turn any of the sealed mounting screws, as the alignment of the optics and the calibration may be altered considerably. Do not put any objects into the cone other than those listed.

Recommended cleaning materials:

- Lint free lens paper.

- Cotton applicators.

- Grease absorbing micro fibre cleaning cloth (e.g. Luminex).

- Non-smear optics cleaner.

The cone assembly is made of polymer products. This means the cone is sensitive to mechanical surface damage (scratches, dents) and may not be chemically resistant to certain solvents.

Do not use any abrasive cloth or strong organic solvents like acetone.

The image lens is positioned near the apex of the cone and difficult to access. Unless the optical performance of the lens is noticeably affected we do not recommend approaching the lens. Dust on this surface is not visible on the image. Its effect is a lowering of image brightness and overall resolution (not local blurs) only.

The profile windows are 2 x 2 mm in size. To reach the corners of these windows form the tip of a cotton applicator with tweezers to a pointed rectangular shape and wet slightly with optics cleaner.

The narrow end of the cone can easily be reached with the cotton applicators. For the entrance area cloth or cotton gives a good result.

10.3. Calibration Object

The calibration object has a delicate optical surface. After use clean with isopropanol and a lint-free cloth to prevent acid corrosion from fingerprints.

Use the same technique to remove any contamination prior to using the object again.

Trouble shooting

Problem	Comments	Action
No video image		Instrument ON/OFF switch on? Check power adaptor to frame grabber are not loose Check frame grabber card is firmly in PCI slot Re-boot the computer to reinitialise the frame grabber
No cone illumination	Illumination only comes on for a few seconds, when computer boots up, or when in Capture mode.	Check frame grabber card is firmly in PCI slot
Distance bar in capture window not working,oversensitive or jumping		Is bright light source present, which contaminates profile signal? If yes: Remove light source, or reposition instrument. If no: *Has instrument been subjected to excessive shock, vibration or impact?* If yes: check calibration and recalibrate if necessary.
Instrument does not calibrate	Possible reasons: One or more images taken out of distance range One or more images too far off center One or more of the calibration balls not clean Profile optics misaligned Dirt on profile optics Too much stray light in image Too much movement in image Illumination defect	Identify problem, re-capture affected images if applicable and recalibrate

Standard SW6000 Accessories

Accessories	Number
Frame capture card.	1
Calibration Object R 7.9375mm with mounting screw.（Optional）	1
Standard Table Top.	1
Chinrest.	1
Instrument Cover.	1
SW6000 Software on CDROM medium.	1

Technical Specifications

Working Distance:			30mm
Coverage:			0.25mm - 11mm
Field of View:			11mmH 11mmV
Placido Rings:			32
Illumination source	Profile		Nonvisible Infrared 950nm LED
	Cone		760nm Red LED
	Fixation		530nm Green LED
Curvature	**Measurement Range**		10~100 Diopter
	Accuracy		Test Objects ±0.1D
	Repeatiability		Test Objects <0.1D
Measurement Points			11,520
Views		.Axial Curvature	
		.Tangential Curvature	
		.Elevation(Best-Fit) Sphere	
		.Videokeratoscopic(Rings,Photopic)	
		.Keratometry	
Presentation Displays		.Single View	
		.Dual View (difference)	
		.Multiple View	
		.3D View	
Astigmatism		3mm,5mm,7mm	
Keratoconus Screen		Klyce Corneal Statistics	
		Rabinowitz Statistics	
Contact Lens.		Personalized auto-fit for customized lens	
		. Adjustable Clearance Scale	
Power Requirements		12V DC Supplied Via PC	