BrienHoldenVisionInstitute

INTRODUCTION TO THE REFRACTOR HEAD

A refractor head is a device that contains all the lenses and accessories that can be found in a trial lens set. When conducting a refraction in the clinical setting, it can be a useful alternative to using a trial frame and trial lens set.

AIM

This unit will introduce you to the refractor head and outline the various dials and wheels that are present. The commonly used components are discussed so that you are familiar with the device when you encounter it in the clinic.

LEARNING OUTCOMES

When you have worked through this unit you should be able to:

- adjust the refractor head for different people
- identify and locate spheres, cylinders, prisms and accessory lenses/filters in a refractor head
- understand the abbreviations used on a refractor head
- change the spherical power on a refractor head
- change the cylinder axis and power on a refractor head.

REFRACTOR HEAD

REFRACTOR HEAD

A refractor head (also called a “refractor” or “phoropter”) is a device that houses a collection of lenses that can be used to measure a person’s refractive error. It can be seen as an alternative to using a trial lens set and trial frame for retinoscopy and measurement of best vision sphere (BVS) and sphero-cylindrical refractions.

In a similar way that different trial lens sets have different types of trial lenses (plastic vs metal, colours), refractor heads also come in different designs and colours, but they all contain a similar set of lenses. This chapter will outline the general features of the refractor head, however it is advised that you familiarise yourself with the specific model and type in your clinic before seeing people, as different refractor heads may vary in regards to the position of certain dials.

A refractor head, like a trial lens set contains:

- spherical lenses (plus and minus)
- cylindrical lenses
- prism
- accessory lenses.

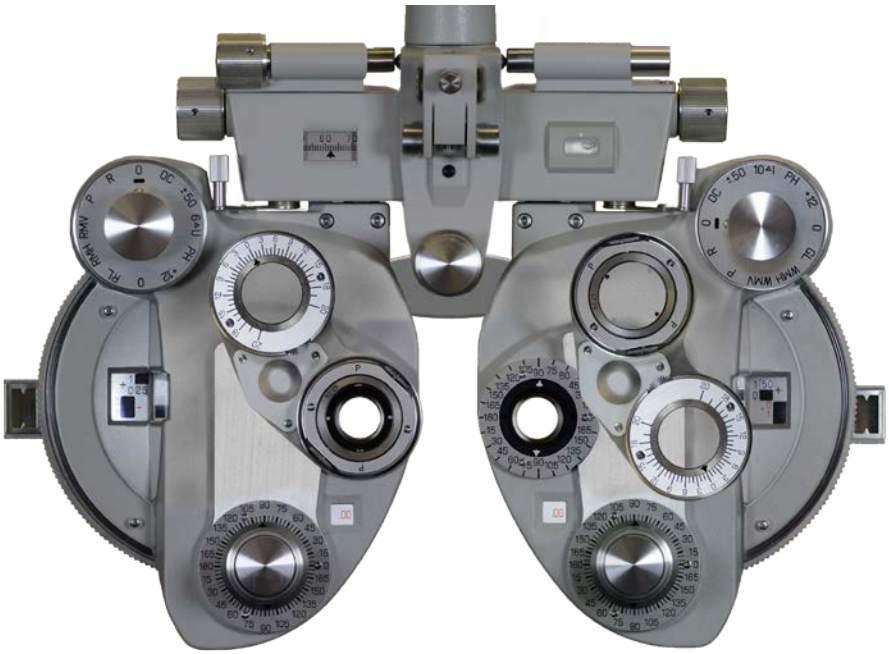


Figure 16.1: *A refractor head*

A refractor head is extremely heavy and is normally held in place by a stand. The stand is adjustable and allows for positioning of the refractor head at different heights depending on the person being examined (it is normally used in conjunction with an adjustable seat). Due to its weight and setup, a refractor head cannot easily be moved from room to room or to different locations. Therefore, a refractor head is not commonly used in the outreach setting where a trial lens set and trial frame is preferred.

As all the spherical and cylindrical lenses, prism and accessory lenses can be easily accessible in a refractor head, it can provide an efficient means of performing a refraction. However, due to its size and construction, it may not feel as comfortable or as natural as a trial frame. Some people may even become confused when a refractor head is used. Therefore, it is even more important to give the person good instructions and adequate time to make decisions when using a refractor head.

REFRACTOR HEAD CONTROLS

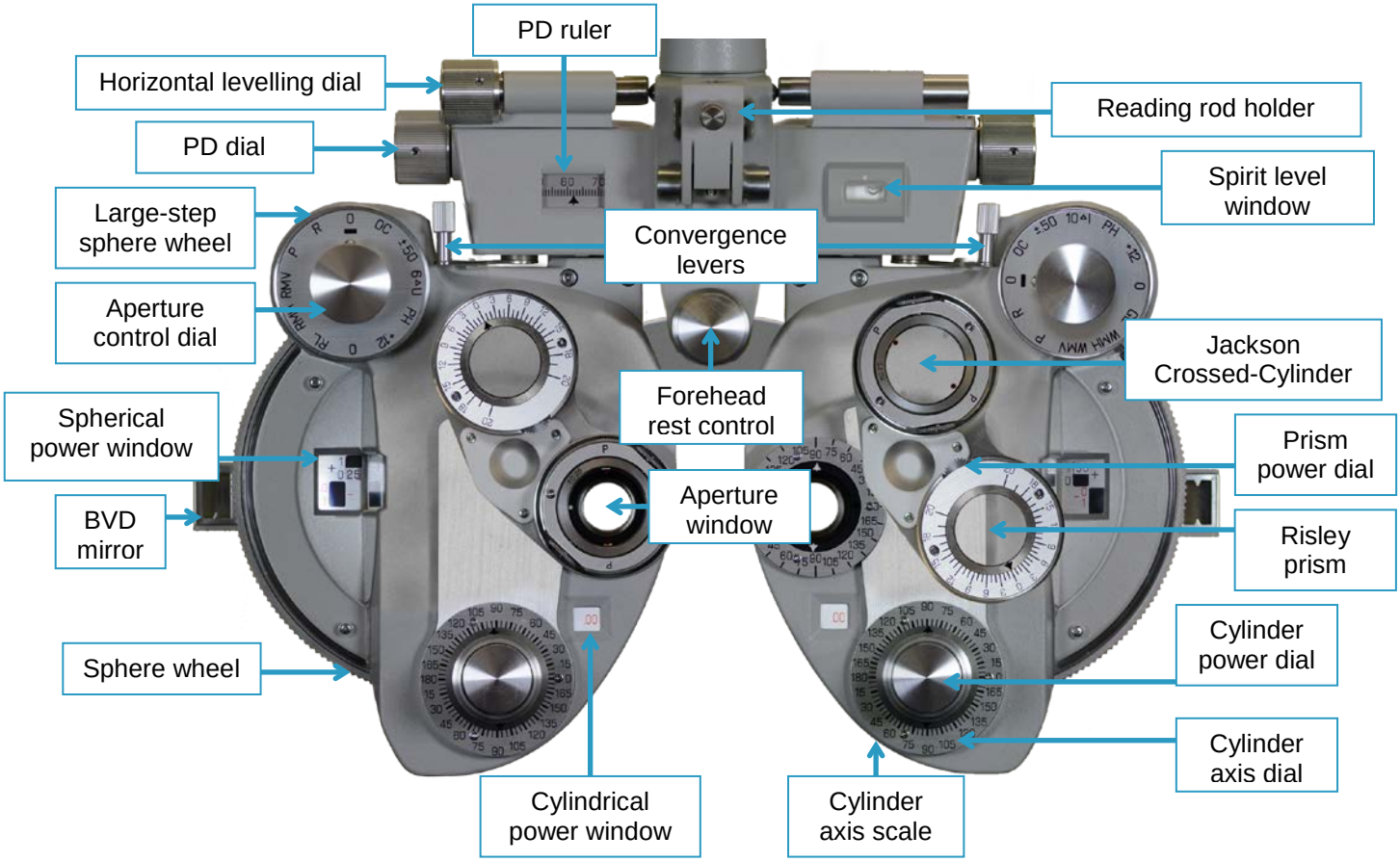


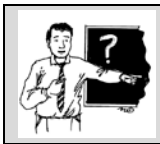
Figure 16.2: *Parts of the refractor head labelled (these parts appear in bold in the text below)*

ADJUSTING THE REFRACTOR HEAD	There are dials on a refractor head that allows the device to be adjusted so that it is more comfortable to the person being examined. This section will outline the dials and parts of the refractor head that are used to adjust the device for the person being examined. Just like when using a trial frame, it is important that the person is looking through the optical centre of the lenses otherwise errors will be introduced into your refraction due to incorrect setup. As you read through this section, locate the relevant dial/s (which appear in bold in the text below) on the refractor head in figure 16.2. Most of these dials will be present on both sides of the device. The **horizontal levelling dial** controls the horizontal tilt of the refractor head. It is normally used in conjunction with the **spirit level window** to ensure that the refractor head is straight when performing refractions. Sometimes, when a person has an asymmetrical facial structure, one eye may be higher than the other. In these cases, the spirit level window can be ignored and horizontal adjustment of the refractor head depends on observing that the eyes are central in the aperture windows. Set the spherical and cylindrical powers to plano (i.e. no power) or insert a starting prescription if you have one.

REFRACTOR HEAD CONTROLS (cont.)

ADJUSTING THE REFRACTOR HEAD (cont.)	The **PD dial** is used to adjust the PD of the refractor head so that it matches that of the person being examined. The **PD ruler** shows the distance between the aperture windows in mm. The **forehead rest control** adjusts the forehead rest (located at the rear of the refractor head) backwards and forwards. This dial should be used in conjunction with the **back vertex distance (BVD) mirror** to ensure that the person is at an appropriate distance from the rear of the refractor head. Before placing the refractor head in front of the person, ensure that all surfaces that touch the person's face is clean (preferably with an alcohol swab). If the person is too close to the refractor head, their lashes may touch the lenses. Furthermore, body heat may even cause the lenses to fog up. Check the BVD mirror during your refraction as people may move during the examination. The **aperture window** is where the person you are examining will be looking through. (It is shielded at the rear of some refractor heads with a clear lens and therefore it is important to ensure the shield is clean otherwise your refraction may be affected.) Ensure both apertures are set to open before placing the refractor head in front of the person. It is good practice to double check by observing whether the person's eyes are central in the aperture windows before commencing your refraction. The **convergence levers** are used to adjust the refractor head for distance and near testing. For distance tests they are positioned outwards. For near tests, they are positioned inwards. In the near position, the PD is reduced and the two halves of the refractor head tilt inwards slightly.
APERTURE CONTROL DIAL	The **aperture control dial** changes which accessory lens/filter is placed into the aperture window. The setting that is positioned at the top of the dial indicates which lens/filter is displayed. Although it contains many lenses/filters which you may not use during your refraction process, it is still important to have an idea of each lens/filter and what it is utilised for.

REFRACTOR HEAD CONTROLS (cont.)

APERTURE CONTROL DIAL (cont.)	**Open (O)** In this setting, the aperture window has no accessory lens/filter in place. This setting is generally used during a refraction to determine the refractive error of the eye. Most aperture control dials will have two 'open' settings. There is no difference between the two and either can be used when the examiner wishes to have no accessory lens/filter in front of the person's eye. **Occlude (OC)** This setting places an occluder into the aperture window and is generally used to allow testing of the fellow eye. Avoid occluding both eyes simultaneously as this can be alarming for the person. Remove the occluder from one eye before placing it in front of the fellow eye. **Plus 0.50D fixed cross cylinder (±.50)** This setting will place a plus 0.50 D fixed cross cylinder lens into the aperture window. It is commonly used in conjunction with a near chart (consisting of horizontal and vertical lines) to estimate a person's near addition. **6 base up prism (6BU) and 10 base in prism (10BI)** This setting will introduce a prism (of the indicated power and orientation) into the aperture window. The 6BU and 10BI settings are commonly used in conjunction with the Risley prism to measure horizontal phoria and vertical phoria, respectively. **Pinhole (PH)** This setting places a pinhole into the aperture window. It allows the examiner to determine whether a decline in vision is due to uncorrected refractive error or eye disease.  The person may need to move their head and/or eye around to be able to see the chart when the pinhole aperture is in place. **+0.12 DS lens (+.12)** This will introduce a +0.12 DS lens into the aperture window. It allows the examiner to test spherical power in a +0.12 DS step.

REFRACTOR HEAD CONTROLS (cont.)

APERTURE CONTROL DIAL (cont.)	**Red lens (RL) and green lens (GL)** This setting places a coloured filter into the aperture window. It is commonly used with appropriately coloured charts and devices to measure suppression in people with amblyopia. **Maddox Rod Horizontal (RMH or WMH)** This introduces a Maddox rod filter in front of the eye with the grating running horizontally. In this orientation, a point source of light will be seen as a **VERTICAL** line. This lens is used in conjunction with a point source of light to determine a person's horizontal phoria. RMH and WMH indicates that the Maddox rod is red and white, respectively. **Maddox Rod Vertical (RMV or WMV)** This introduces a Maddox rod filter in front of the eye with the grating running vertically. In this orientation, a point source of light will be seen as a **HORIZONTAL** line. This lens is used in conjunction with a point source of light to determine a person's vertical phoria. RMV and WMV indicates that the Maddox rod is red and white, respectively. The Maddox rod filter will result in a point source of light to be seen as a line at 90° (perpendicular) to the orientation of the grating. **Polarising lens (P)** This will introduce a polarising filter into the aperture window. The plane of polarising will be different between the right and left eyes by 90° (i.e. perpendicular). This filter dissociates the eyes when combined with a polarised chart and is used in certain binocular balance techniques and also in suppression testing in amblyopia. **Retinoscopy lens (R)** This setting places a retinoscopy working distance lens into the aperture window. In most refractor heads, this will be a +1.50 DS lens and requires retinoscopy to be performed at approximately 67cm.
SPHERICAL POWER ADJUSTMENT	Rotating the spherical power wheel will change the spherical power displayed to the person as indicated in the spherical power window. In most refractor heads, black numbers will indicate a positive spherical power while red numbers indicate negative spherical power. Every click of the sphere wheel adjusts the spherical power by 0.25 DS as indicated in the spherical power window. If you require bigger increments, then the large-step sphere wheel should be used as it changes the power by 3 to 4 dioptres (depending on refractor head design).

REFRACTOR HEAD CONTROLS (cont.)

JACKSON CROSS CYLINDER

Refractor heads have a rotating arm which contains a **Jackson Cross Cylinder (JCC)** and **Risley prism**. This rotating arm can be turned into position as required.

Jackson cross cylinder (JCC)

When the JCC lens is placed in front of the aperture window it can be turned between two positions. One position is for power refinement while the other is for axis refinement. In order to switch between the two, the JCC can be twisted within the housing until it clicks into place.

For axis refinement, the “A” on the JCC is aligned with the small arrow at the base of the cylinder axis dial. In this position, the JCC is ready to be used to refine the axis of astigmatism.

Figure 16.3: *JCC in axis refinement position*

Because the JCC is used to adjust the axis of the cylindrical lenses, a helpful feature of modern refractor heads is that when the cylinder axis dial is turned, the JCC will also turn to maintain alignment with the cylinder axis. To adjust the cylinder axis, turn the **cylinder axis dial**. The current axis is shown by the small arrow at the base of this dial.

With older refractor heads, the cylinder axis dial is not linked with the JCC. The JCC in these refractor heads must be adjusted manually.

For power refinement, the “P” on the JCC is aligned with the small arrow at the base of the cylinder axis dial. In this position, the JCC is ready to be used to refine the power of astigmatism.

Figure 16.4: *JCC in power refinement position*

REFRACTOR HEAD CONTROLS (cont.)

JACKSON CROSS CYLINDER (cont...)	To adjust the power of any cylindrical lens you would like the person to see with, adjust the **cylinder power dial**. The power of the cylindrical lens currently presented is shown in the cylindrical power window. Cylinder powers are in negative cylinder form and are shown in red.
RISLEY PRISM	**Risley prism** The Risley prism can also be rotated within its housing to give prism that is base up (BU), base down (BD), base in (BI) or base out (BO). To adjust the power of the Risley prism, turn the small prism power dial. The small arrow that moves when the prism power dial is turned indicates the current power and orientation of the **BASE** of the prism. With the Risley prism in place, the arrow indicates the position of the base of the prism. If the zero on the scale is positioned horizontally then the prism power produced is either BU or BD prism. As mentioned previously, the small arrow indicates the position of the base of the prism. For example, if the zero is horizontal, and the small arrow is positioned at the 3 above this, this indicates a 3△ BU prism. ***Figure 16.5:*** *Risley prism showing a 3△ BU prism.*

REFRACTOR HEAD CONTROLS (cont.)

RISLEY PRISM (cont...)

If the zero on the scale is positioned vertically then the prism power produced is either BI or BO prism. For example, if the zero is vertical and the small arrow is positioned nasally to the 6, this indicates a 6△ BI prism.

Figure 16.6: *Risley prism showing a 6△ BI prism (left eye).*

A common mistake is to leave the rotating arm in front of the aperture window when not in use. Always remember to remove the rotating arm once you are finished with the JCC or Risley prism.

READING ROD

The reading rod can be inserted into the **reading rod holder** and moved down so that a refractor head card can be used. The card can be used to test accommodative reserve, near addition as well as many other near testing procedures. When not required, the card can be unclipped and the rod can be positioned upwards, or unscrewed by loosening the reading rod screw.

Figure 16.7: *Reading rod in position with near point refractor head card attached*

SUMMARY: INTRODUCTION TO THE REFRACTOR HEAD

A REFRACTOR HEAD

- A refractor head is a device containing spherical, cylindrical and prism lenses, as well as some accessory lenses.
- These lenses are used to measure a person's refractive error.

SPHERICAL LENSES

- Are adjusted by both the sphere wheel and the large-step sphere wheel.
- Usually plus lenses are shown in black and minus lenses are red.

CYLINDRICAL LENSES

- Cylindrical lenses in a refractor head are only in minus powers.
- The power of the cylindrical lens is controlled by the cylinder power dial and is shown in the cylindrical power window.
- The axis of the cylindrical lens is controlled by the cylinder axis dial and is shown by the arrow at the base of this dial.

JACKSON CROSSED-CYLINDER

- A JCC can be placed into position on a rotating arm.
- It can be clicked into position to refine cylindrical axis and power like a regular JCC.

RISLEY PRISM

- A Risley prism can be placed into position to provide different strengths of BU, BD, BI or BO prism.
- The small arrow indicates the power of the prism and the location of the prism's base.

BEFORE BRINGING THE REFRACTOR HEAD CLOSE TO THE PERSON

- The back of the refractor head lightly touches the person's face, so it should be cleaned prior to use.
- Before placing the refractor head up close to the person's face, all settings on the refractor head should be checked.
- PD should be adjusted.

TEST YOURSELF QUESTIONS

1. **How do you adjust the Interpupillary Distance (PD) on a refractor head?**

2. **Does a refractor head contain cylindrical lenses of plus or minus form?**

3. **How can you tell if a refractor head is displaying a plus or a minus spherical lens?**

4. **How do you adjust the power of a cylindrical lens in a refractor head?**

5. **How can you tell whether the Risley prism has been set to base up or base down?**

6. **Complete the following table:**

Aperture Control knob abbreviation:	Lens/filter displayed
O	
OC	
PH	
R	
P	

7. **How can a refractor head be adjusted to be more comfortable for the person behind it?**

NOTES