THE NEOTIA UNIVERSITY

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ज्ञानम् आत्म प्रदीपाय

Dispensing Optics
Practical Manual
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PRACTICAL 1: DETERMINATION OF OPTICAL CENTRE BY HAND NEUTRALISATION

Introduction

Optical centre of a lens is a point with in or on the lens, any light ray passing through it will not be deviated. So power at that particular point is zero. The optical centre of the lens has to coincide the centre of the pupil to avoid prismatic effect. Hence there is significant of determining the optical centre of a lens.

Principle/ Theory

Hand neutralization is a procedure by which power of a unknown lens can be determined by neutralizing it with another lens with known power. The neutralization is based on the fact that when an object is viewed through a lens and the lens is moved, there will also be movement of the image of the object and the movement is dependent on whether the lens is convex or concave. The movement of the image is with the lens if the lens is concave and vice versa.

The image formed by the lens stops moving once the power of the lens is neutralized with a lens of equal but opposite power.

Apparatus required

1. Trial lenses
2. A white paper with a perpendicular cross drawn on it – "The Optical Cross"

Procedure

- ✧ The lens is held on the perpendicular cross in such a way that there is gap between the lens and the cross.
- ✧ The image of the cross is viewed through the lens and assessed if it is perpendicular. If the image of the cross is not perpendicular, then the lens is a cylindrical or spherocylindrical one. In this case there will be scissoring of the cross by rotation. The lens is then rotated till the cross becomes exactly perpendicular. These are the principal meridian of the lens.
- ✧ Hence the lens is moved right to left and up and down to make the cross image exactly overlapped with the line of the object cross.
- ✧ The optical centre is marked with a felt tip pen.

Results & Observations

The point at which the cross marks intersect with the lens is the optical centre of the lens.

If the image of the cross through the lens cannot be aligned with the cross object by moving the lens up-down and side wise. The lens is grounded with prism and the prism has to neutralized before determining the optical centre.

PRACTICAL 2: DETERMINATION OF POWER BY HAND NEUTRALISATION OF SPHERICAL LENS, CYLINDRICAL LENS, SPHERO-CYLINDRICAL LENS

Introduction

Depending on the surface power there are three different types of lenses

- Spherical lens: Power in this type of lens is equal in either of the meridian.
- Cylindrical lens: Cylinder lens has got power in one meridian an axis in another meridian. The axis meridian has got no power.
- Sphero-cylindrical lens: It has got power in both the meridian but the power in one meridian is not same with the other meridian.

Principle/ Theory

Hand neutralization is a procedure by which power of a unknown lens can be determined by neutralizing it with another lens with known power. The neutralization is based on the fact that when an object is viewed through a lens and the lens is moved, there will also be movement of the image of the object and the movement is dependent on whether the lens is convex or concave. The movement of the image is with the lens if the lens is concave and vice versa.

The image formed by the lens stops moving once the power of the lens is neutralized with a lens of equal but opposite power.

Apparatus required

Trial lenses and a target preferably a perpendicular cross

Procedure

- At first the principal meridian and the optical centre has to be determined as discussed in previous manual.
- Now by holding the lens at principal meridians and looking at the cross the lens is moved side wise first.
- The movement of the vertical line of the cross is noted against the movement of the lens. If movement of the lens is with the lens concave and if there is against movement of the line the lens is convex.
- The concave lens is neutralized with a convex or a plus lens where as convex lens is neutralized with a concave or minus lens.
- The power of the neutralizing lens is increased till no movement of the vertical line is observed. The no movement point is the neutralizing point and the power of the neutralizing lens with opposite sign at that point is the power of the lens in that meridian whose axis will be 90^o opposite to it.
- Once the power of vertical meridian is neutralized, the lens is then moved up and down and movement of the horizontal line is assessed.
- Power of the horizontal meridian is neutralized as it is done for vertical meridian.
- In case of sphero-cylindrical lens with oblique axis the principal meridian will be oblique. Hence the lens has to be moved obliquely while neutralizing its power.

Results & Observations

- ✧ Spherical lens: The neutralization power in both the meridian is equal
- ✧ Cylindrical lens: Power is required to neutralize one meridian where as the other meridian is already neutralized without any power.
- ✧ Sphero-cylindrical lens: The power required to neutralize either meridian is different and the difference of the neutralizing power is cylinder.

PRACTICAL 3: IDENTIFICATION OF BASE AND APEX OF PRISM

Introduction

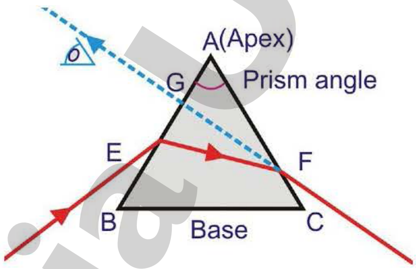
A prism can be defined as a refracting medium bounded by two refracting surfaces inclined at an angle.

The point at which two surfaces come together and meet is call apex of the prism and the wider surface opposite to the apex is called base of the prism.

When prism is prescribed it is indicated by its base. So it is important to identify of base of the prism.

Principle/ Theory

When the light rays are incident on the surface of the prism, there is deviation of the light rays towards the base of the prism after refraction. So the image formed by the prism after refraction will be deviated towards the apex of the prism. The change in the direction of the ray from its baseline is called angle of deviation.



Refraction through prism

While looking at an object through a prism, direction at which there is shifting of image is the apex and opposite to it is base of the prism.

Apparatus required

1. Loose prism
2. A distance target

Procedure

- ✧ A target, preferably a spot light is fixed at distance.
- ✧ Looking at the target the prism is placed in-front of the eye and an immediate shifting of the target is noted.
- ✧ The direction at which there is shifting of the image is apex of the prism and opposite to the direction of the shifting there is base of the prism.

Results & Observations

The orientation of the prism is denoted by its base. If the shifting of the target is toward nasal side, the apex of the prism is on nasal side and the orientation of the prism is base out. Similarly for shifting of the target temporally, downward and upward, the orientation of the prism will be base in, base up and base down respectively.

PRACTICAL 4: DETERMINATION OF OPTICAL CENTER AND POWER OF LENS BY LENSOMETER

Introduction

Lensometer is an instrument by which back vertex power and front vertex power of a lens can be measured. It measures power of the lens and determines the axis of the lens more accurately in comparison with hand neutrilisation method. The purposes of lensometry are to determine the prescription of pair of spectacles, verifying the accuracy of fabricating glasses and duplicating the lens prescription in laboratory.

Principle/ Theory

The lensometer works on Badal principle which states that if the eye is placed at the focal point of a positive lens, the virtual image of an object located between the lens and the anterior focal point will always subtend the same visual angle.

A lensometer consists of an illuminated target which is movable, a powerful convex lens and a afocal telescope as eyepiece. When a lens of unknown power is introduced, the image of the illuminated target is made out of focus. The refractive power of the unknown lens can be measured by moving the illuminated target closer to or further from the convex lens.

Apparatus required

1. Lensometer
2. Trial lenses

Procedure

- ✧ The Lensometer is fixed at a comfortable viewing positioned and the instrument is locked.

The eyepiece focusing

- ✧ The eyepiece is rotated first counter clock wise to make the reticule blur
- ✧ The eyepiece is then turned clockwise to make the reticule clear.

Power calibration

- ✧ With no power or Plano power the instrument is switched on.
- ✧ The power wheel is first turned into plus and then it is rotated in opposite direction until the sharpest focus of the mire is achieved. The power wheel should indicate zero if the instrument is properly calibrated.
- ✧ If the power wheel doesn’t indicate zero, refocusing of the eyepiece or rechecking of calibration is needed.

Determination of the Optical centre

- ✧ The spectacles are placed on the frame table in such a way that the back surface of the spectacles faces the table top and the rim of the spectacles rest on the frame table.

- ✧ The spectacles are moved side to side and up and down to bring the target mire at the centre of the reticule.
- ✧ Clamp is put on the spectacles and mark the centre with a marking pin attached to the Lensometer.

Determination of power

- ✧ With the lens positioned in its optical centre, the power wheel is rotated toward plus or minus until the target mire gets clear.
- ✧ In case of spherical lens all the mires become equally clear where as in case of cylinder or spherocylinder target mire in one direction only gets clear.
- ✧ To measure the astigmatic lens the power wheel is rotated until the mire in one direction gets clear.
- ✧ The axis wheel is then rotated until three parallel lines are straight and unbroken.
- ✧ The number on the power wheel is the power of spherical power.
- ✧ The power wheel is further is rotated until the mires on other meridian become clear and the reading on the mire is noted.
- ✧ Cylinder power is the difference between first and second reading.
- ✧ The axis of the cylinder is the direction of the second power reading. It is recorded from the axis wheel.

Results & Observations

Power of the lens: ____ Dsph ____ Dcyl @ ____

PRACTICAL 5: DETERMINATION OF POWER OF PRISM BY LENSOMETER

Introduction

Lensometer is an instrument by which back vertex power and front vertex power of a lens can be measured. It measures power of the lens and determines the axis of the lens more accurately in comparison with hand neutralization method. The purposes of measuring prism are to determine the amount of prism the spectacle lens is having, verifying if the prescription is having the desired prismatic effect.

Principle/ Theory

The Lensometer works on Badal principle which states that if the eye is placed at the focal point of a positive lens, the virtual image of an object located between the lens and the anterior focal point will always subtend the same visual angle.

A Lensometer consists of an illuminated target which is movable, a powerful convex lens and a afocal telescope as eyepiece. When a lens of unknown power is introduced, the image of the illuminated target is made out of focus. The refractive power of the unknown lens can be measured by moving the illuminated target closer to or further from the convex lens.

Apparatus required

1. Lensometer
2. Loose prisms

Procedure

- ✧ The Lensometer is fixed at a comfortable viewing positioned and the instrument is locked.

The eyepiece focusing

- ✧ The eyepiece is rotated first counter clock wise to make the reticule blur
- ✧ The eyepiece is then turned clockwise to make the reticule clear.

Power calibration

- ✧ With no power or Plano power the instrument is switched on.
- ✧ The power wheel is first turned into plus and then it is rotated in opposite direction until the sharpest focus of the mire is achieved. The power wheel should indicate zero if the instrument is properly calibrated.
- ✧ If the power wheel doesn't indicate zero, refocusing of the eyepiece or rechecking of calibration is needed.

Determination of power of the prism

- ✧ The patient is made to wear the spectacles and marking on the lenses is done on patients pupillary centre with a felt tip pen.
- ✧ The lens is then placed on the frame table in such a way that marking on the lens coincides with the reticule of the Lensometer.

- ✧ In presence of prism, the centre of the reticule doesn't coincide with the centre of the mire.
- ✧ If the deflection is along 'X' axis, there is presence of horizontal prism and in case of vertical prism the deflection is along 'Y' axis.
- ✧ Prism amount and direction is measured form the reticule.
- ✧ Total amount of prism is the sum of the prisms in either of the eye.

Results & Observations

The result is recorded with amount of prism in Δ (prism dioptre) and direction.

To calculate total amount of horizontal prism bases in the same direction are added where as bases in the opposite direction are subtracted.

e. g., BO/BO or BI/BI are additive whereas BO/BI or BI/BO are subtractive.

PRACTICAL 6: AXIS AND OPTICAL CENTRE MARKING ON UNCUT LENS

Introduction

The uncut lenses are round in shape and they are custom shaped to fit in a specific size and shape of spectacles frame. The customization also includes how to position the lenses into the frame. The specific position of the lens in the frame is in such a way that the optical centre should coincide with the pupillary centre. It also has to fit with proper axis given in prescription. It is important of marking the optical centre and the axis of the uncut lens to get the desired position of the lens inside the frame. A Lensometer is the essential instrument for marking the optical centre and axis.

Principle/ Theory

The Lensometer works on Badal principle which states that if the eye is placed at the focal point of a positive lens, the virtual image of an object located between the lens and the anterior focal point will always subtend the same visual angle.

A Lensometer consists of an illuminated target which is movable, a powerful convex lens and a afocal telescope as eyepiece. When a lens of unknown power is introduced, the image of the illuminated target is made out of focus. The refractive power of the unknown lens can be measured by moving the illuminated target closer to or further from the convex lens.

Apparatus required

1. Lensometer
2. Uncut lens
3. Marker pen
4. Ruler

Procedure

- ✧ The Lensometer is turned on and it is made on focus.
- ✧ The lens is placed on the spectacles table and fixes it against the lens stop with the lens holder.
- ✧ Now the lens is centred by moving the lens the lens right to left and up and down. When the lens is centred, the illuminated mire exactly coincides with the reticule.
- ✧ The power drum is rotated to the sphere power written on prescription.
- ✧ Axis wheel is now set at the axis written on prescription.
- ✧ The lens is rotated until the thin lines on the mire gets straight and unbroken. While rotating the lens, the lens holder should be lifted to avoid scratches on the lens.
- ✧ The power drum is further moved to make thin lines sharper to adjust the cylinder power.
- ✧ Now the lens is marked with lens marker.
- ✧ Along the marking dots a line is drawn on the back surface of the lens with ruler and the marker pen.
- ✧ With the help of marker pen ‘R’ is written on right lens.
- ✧ By similar method marking is done on left eye and letter ‘L’ is written on the lens.

PRACTICAL 7: MEASUREMENT OF CURVATURE BY SPHEROMETER

Introduction

Spherometer is a measuring instrument used to measure the radius of curvature of a spherical surface. The device contains a frame supported by three legs. A circular scale can be rotated up and down with the help of a fine screw through the centre of the frame. A vertical scale is fixed to the table which indicates the number of turns of the screw.

Spherometer

Principle/ Theory

The least count of the Spherometer = (Pitch of the Spherometer screw) / (No. Of division on the circular scale)

Where least count of the Spherometer is 0.01mm

Pitch is the distance covered by the central screw in one complete rotation which is 1mm.S

Apparatus required

1. Spherometer
2. A spherical lens
3. A large size plane mirror

Procedure

- The Spherometer is placed on a plane paper a gentle pressure is given on it to have three impression marks on the paper.
- The three points are marked as A, B, C and distance between these points is measured.
- The distances between AB, BC and CA are noted and their average is taken.
- Pitch value is measured and least count is calculated and noted.
- The central screw is rotated up and the Spherometer is placed on the lens so that all the three legs rest on it.
- Now the screw is turned down till it touches the lens.
- The reading is taken from the circular scale which is aligned with the vertical scale.
- The Spherometer is now removed and placed on a plane mirror.

- ✧ The central screw is then rotated down till the tip of it just touches the plane mirror.
- ✧ Number of complete rotation to touch the plane mirror is counted and noted.
- ✧ Again the reading of circular scale which line the vertical scale is recorded.
- ✧ From the last incomplete rotation number of circular scale division is noted.
- ✧ Three different observations are made and recorded.

Observations

1. Distance between two legs of the Spherometer (l)

AB = ____ cm

BA = ____ cm

CA = ____ cm

Average l = (AB+BC+CA)/3

2. Least count of the Spherometer

1 pitch scale division = 1mm

No. of full rotations given to screw = 5

Distance moved by the screw = 5 mm

Hence, pitch, p = 5mm/5 = 1 mm

No. of divisions on circular (disc) scale = 100

Hence, least count = 1mm/100 = 0.01 mm = 0.001 cm

3. Table for sagittas(h)

Serial. No.	**Circular Scale Reading**		**Number of Complete Rotations (n_1)**	**No. of Disc Scale divisions In incomplete rotation**	**Total Reading $h = (n_1 \times p) + x \times (L.C.)$ (mm)**
	Initial(a)	**Final(b)**			
1					h_1 =
2					h_2 =
3					h_3 =

Calculations & Result

Mean value of $h = (h_1 + h_2 + h_3)/3$ mm

Radius of curvature $R = l^2/6h + h/2$ mm

PRATICAL 8: MEASUREMENT OF BASE CURVE OF LENS GENEVA LENS MEASURE

Introduction

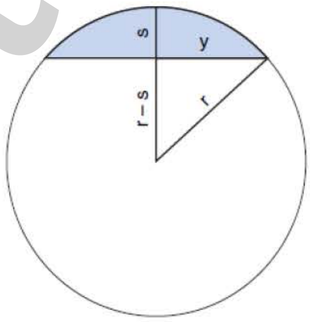
Geneva lens measure or lens clock is specialized version of spherometer. It contains two fixed pins and a spring loaded movable pin in the centre. When the device is placed on a curved surface the central pin moves inward or protrude forward. A pointer activated by a gear indicates the position of the central movable pin on a circular scale.

Geneva lens measure

Geneva lens is used to measure the power of the lens, radius of curvature, sagittal depth and lens thickness.

Principle/ Theory

In meniscus lens base curve is the curvature of front surface which is convex. Base can be measured in Dioptre directly by placing the lens clock on convex surface of the lens.



Sagittal depth of convex lens

From Pythagorean theorem applying in this diagram,

$$y^2 + (r - s)^2 = r^2$$

$$y^2 + r^2 - 2rs + s^2 = r^2$$

$$y^2 + r^2 - r^2 + s^2 = 2rs$$

$$2rs = y^2 + s^2$$

$$r = y^2/2s + s/2$$

Where r is radius of curvature, s is sagittal depth and y is half of the diameter of the lens.

Apparatus required

4. Geneva lens measure or lens clock
5. A meniscus lens

Procedure

- ✧ Calibration of the lens clock is checked by placing the lens clock on the reference curvature. In case of proper calibration the indicator of the clock dial should coincide with 'zero' mark.
- ✧ The lens clock is held in such a way that central pin of the lens clock is at the optical centre of the lens and it is perpendicular to the lens surface.
- ✧ The lens clock is now depressed against the lens until all three pins touches the lens surface.
- ✧ The base curve measure is taken from the inside number or the black number of the face of the lens measure.

Results & Observations

BC: ______ D