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The effect of the progressive lens on the computer vision syndrome

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Abstract

AIM: to know design and how the PALs works, determine the relationship between the size of PALs and visual field of addition, distance and corridor, difference between brands of PALs, make comparison between the most common lenses

METHOD: collection of lenses from different brands and measure them by (AL700 automatic lensometer) by changing the setting to PALs measure in order to determine the all information about it and how to make the fitting in many points to avoid any vision problems

RESULT: found a linear relationship between the size of PALs the field of addition. and where increaseing the sphere and cylinder the addition power decrease

* Introduction

1- Shortcuts

PALs: progressive addition lens
Sv: single vision lens
Add: addition power

2- about chapter one

PALs History, Explain the PALs how it works, design and determine each area in it for which distance use and Enumerate the features, benefit and disadvantages.

Know the different design of PALs properties, advantages and disadvantages.

Define the binocular single vision, Peripheral (Extra-Foveal) Vision and their effect on PALs.

Make comparison between the most common lenses use by patient And know some feature about each one.

*** Determine PALs marking**

In addition each subjects in this chapter is with illustrative pictures Help to understand.

3- Progressive Addition Lenses PALS

1- The concept of progressive addition lens has been around since 1907 when the first patent on progressive power lens was published by Owen Ave.

2- Varilux 1 was introduced by Essilor in France in the year 1959

3- " Progressive addition lenses are one piece lenses that vary gradually in surface curvature from a minimum value in the upper distance portion to a maximum value in the lower near portion.

4- Unlike bifocal or trifocal lenses, progressive lenses ensure that the presbyopic spectacle wearer finds the right dioptric power for every distance, guaranteeing smooth and uninterrupted vision without any visible line of demarcation

5- The power increase is achieved by constantly decreasing the radii of curvature in the vertical and horizontal directions

6- A progressive lens provides visual compensation at all distances namely Far, Distances and Near.

7- It has a lens that changes its dioptric power continuously, starting at its geometric centre and gradually progressing its dioptre value.

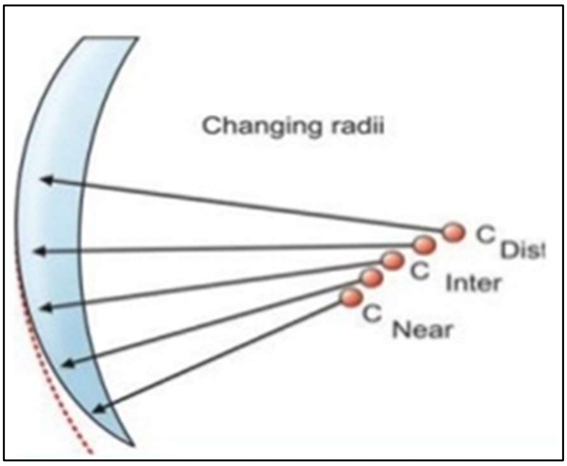


Figure (1) the areas of progressive lens

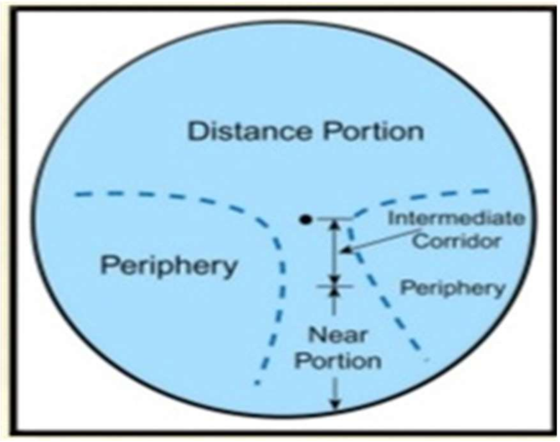


Figure (2) changing of radii

5- Based on the number of focal points, ophthalmic lenses are divided into four types

*** SINGLE VISION LENSES**

1- Corrects only one vision at a time (Single focal point)

2- Inconvenient

3-Cumbersome

*** BIFOCALS**

1- Corrects two vision, Distance and near.(Two focal points)

2- Image jump

3-Intermediate blur

TRIFOCALS - Corrects three vision, distance, near and intermediate. (Three focal points)

PROGESSIVE - Corrects different distances.(Many focal points)

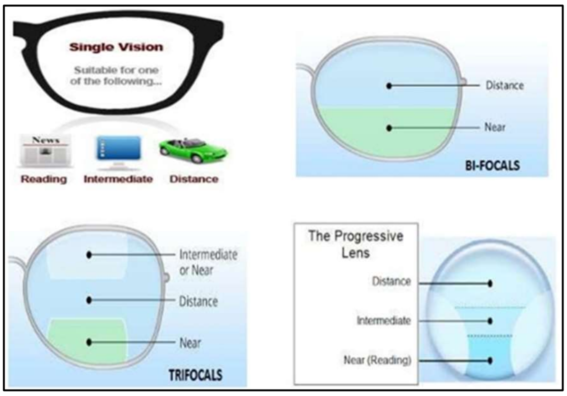


Figure (25) types of ophthalmic lens

6- The general design of PALs

1- Distance A designated zones located in the upper portion of the lens, which provides the necessary distance correction. More than 1m

2- Near A designated zone in the lower portion of the lens, which provides

3- the necessary near addition or near power. Works frequently at close range (30–60 cm)

4- Intermediate A corridor in the central portion of the lens connects these two zones, which increases progressively in plus power from the distance to near. This zone is also known as progressive zone". (60–90 cm computer work, meetings)

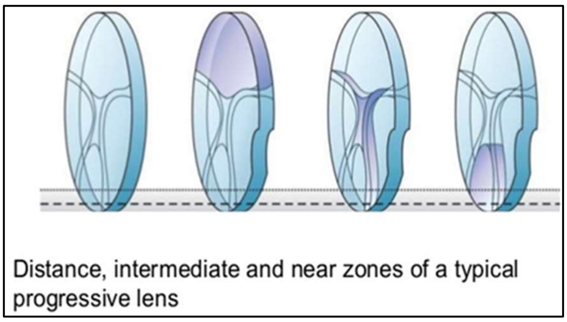


Figure (3) distance, intermediate, near zones of PAL

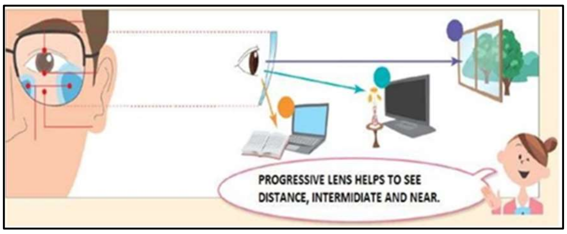


Figure (4) distance, intermediate, near vision

7- Uses of PALs

1- myopia (distance vision)

2- presbyopia (near vision)

3- use for intermediate vision (computer distance)

4- esophoria

* Presbyopia correction

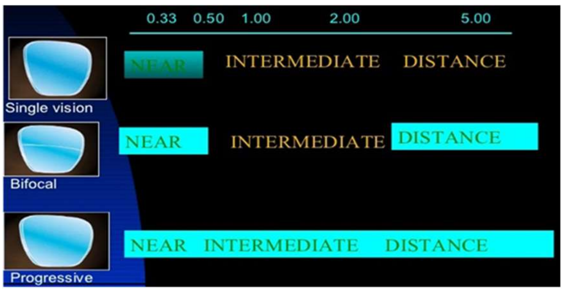
1- PALS

2- Enhanced near vision

3- Bifocals

4- Trifocals

5- SV (readers): full aperture half-eyes



Figuer (5) Range of clear vision

8- Why we Use PALs?

Feature

1- Uninterrupted vision from distance to near

2- No visible line

No line of demarcation provides more cosmetically appealing lenses with continuous vision, free from visually distracting borders. The lens looks like a single vision lens.

3- No jump in vision from distance to near

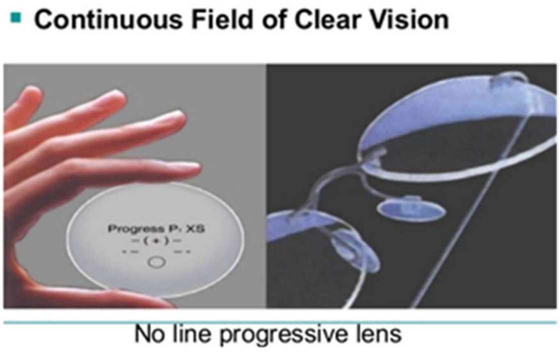


Figure (8) No visible line in PALs

*** Benefit**

1- Better vision as intermediate is clear

2- Looks like single vision

3- Lighter/thinner than SV

4- Looks better

5- More natural vision

6- More visual comfort

7- Confidence in mobility

*** Disadvantages**

1- Peripheral aberration

2- Some adaptation problems

3- More critical fitting

4- More expensive

*** Contraindication**

1- Field of view

2- Direction of gaze

3- Mobility /head movement

4- Prescription:-anisometropia / high cylinder / prisms

9- Binocular vision

As the patient's gaze is lowered for near objects, the eyes converge to maintain a single binocular image. The progressive lenses should ensure that this is maintained for different object distances from the eyes, as illustrated by the lines.

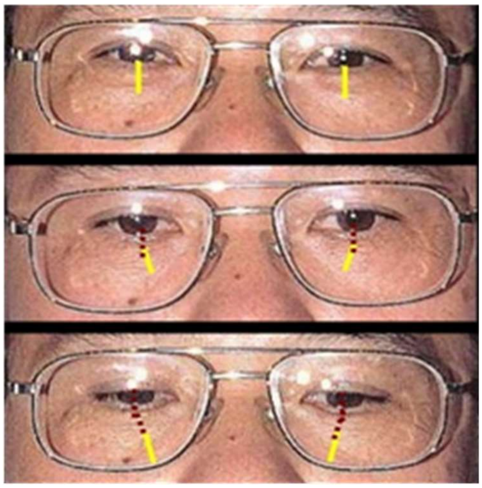


figure (6) different line of sight with PALs

10- Peripheral (Extra-Foveal) Vision

The PAL design should ensure that 'objects in the periphery of the visual field are easily fused. The distribution of prism in each lens should also be balanced for binocular viewing Corresponding areas in the two lenses should provide a similar level of vision.

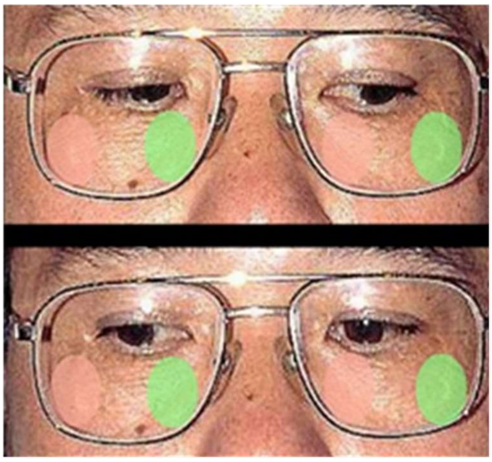


Figure (7) Peripheral (Extra-Foveal) Vision

11- Principal parameter

1- Size of distance & near area.

2- Type and intensity of aberration

3- Depth & usable width of corridor

12- Design in PAL'S

1- Hard design

2- Soft design

3- Symmetrical design

4- Asymmetrical design

5- Mono design

6- Multi design

7- Prescription based design

* Prescription base design

1- Result of years of Vision Research

2- Dedicated design for every Base and Add

3- Design by Base: different designs for Hyperopes, Emmetropes and Myopes (FOV &Magn.)

4- Design by Add: effective near zone sizes change as the add increases

5- Near inset position varies relative to level of Presbyopia / reading distance

6- Corridor length also varies relative to both Base and Add

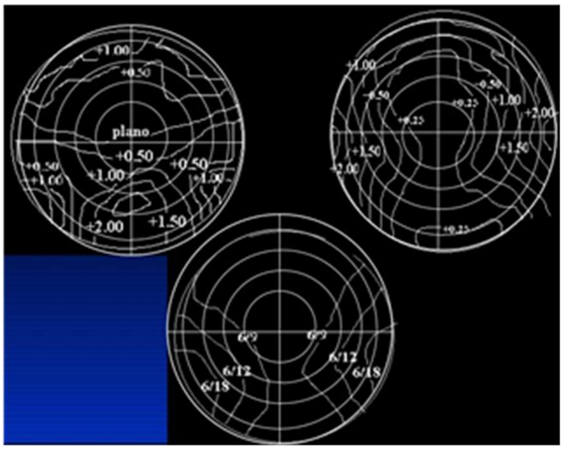


Figure (14) Prescription base design

13- Varilux readable

1- Full working field enjoy as single vision lens for intermediate and near

2- Much clearer intermediate which can't be attained by single vision lens

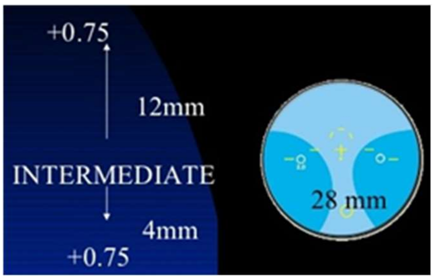
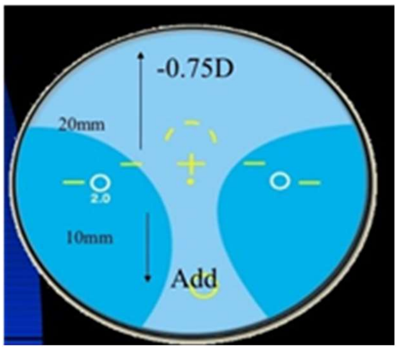


Figure (15) Varilux readable

* Cosmolit P Aspheric thin design



Figure(16) Cosmolit P

* Overview

Electricians, plumber, painter, pharmacists, librarians

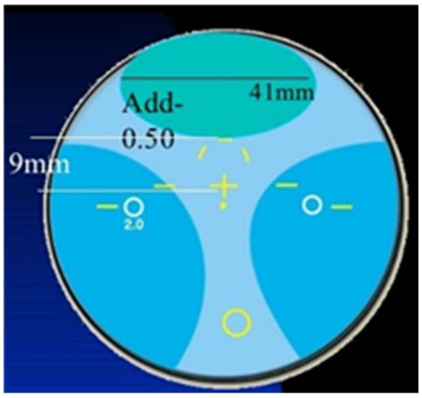


Figure (17) Overview

*** Technica Soft design of 1.00cyl max**

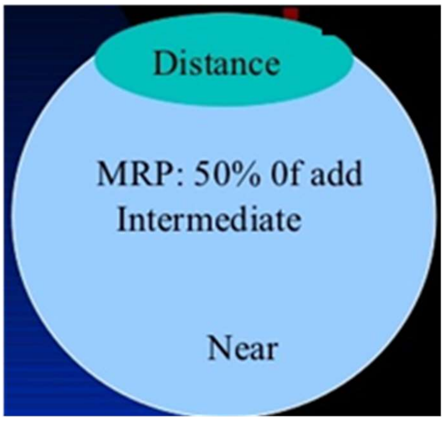


Figure (18) Technica soft design

*** Computer lens Access uses a unique aspheric surface**

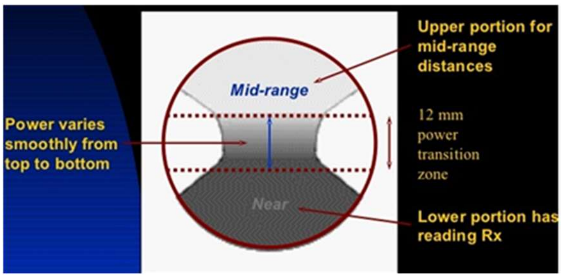


Figure (19) Computer lens

14- Access provides

1- Extended range

2- " Wider breadth of field

3- Mid-range vision is as wide as close-up vision

4- Continuous vision throughout the lens

5- Ease of use

6- Pantoscopic tilt of the frame

7- Pupil distance

8- Thickness reduction prism, and more.

9- By taking all of these parameters into consideration, Shamir's Eye-Point TechnologyTM enabled the creation of the perfect progressive lens.

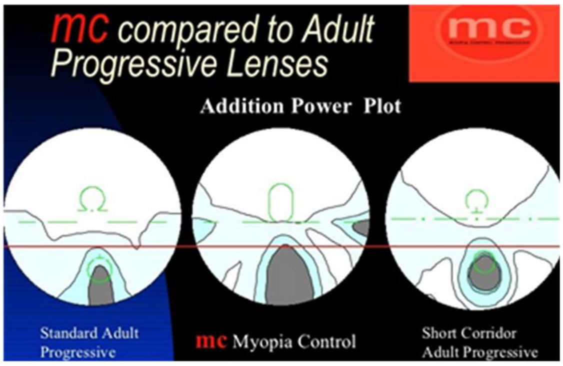


Figure (20) compares adult PALs

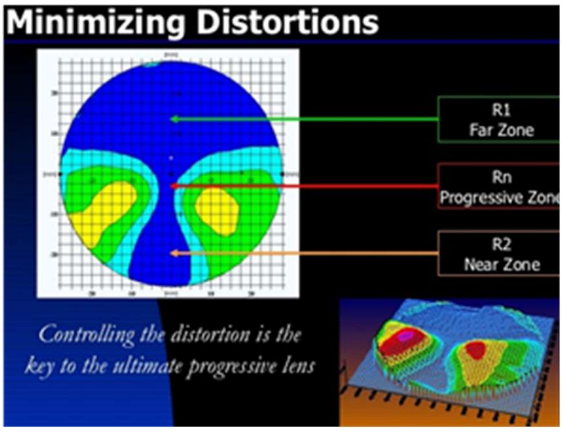


Figure (21) minimizing distortion

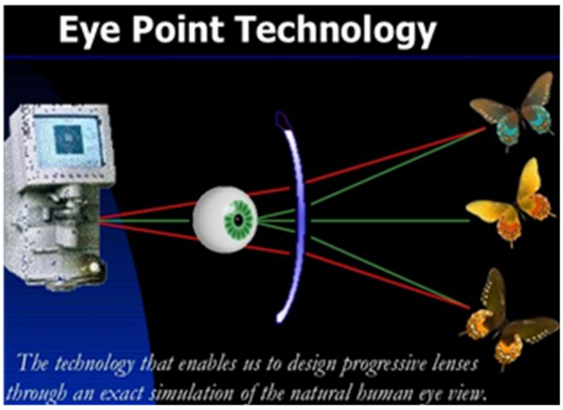


Figure (22) eye point technology

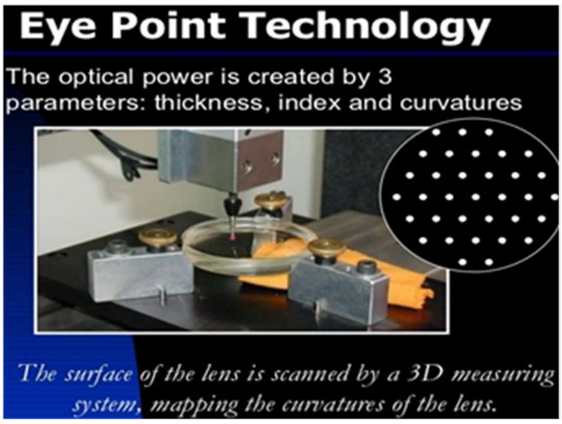


Figure (23) eye point technology

15- Eye Point Technology

The surface data & a highly advanced mathematical algorithm are the basis to Shamir's Eye-Point Technology, which takes into account numerous parameters: -

1- Lens index refraction
2- Lens prescription
3- Lens center thickness
4- Distance from the eye to the back vertex of the lens
5- Distance from the lens to the object
6- Object's angular position in the eye's field of vision

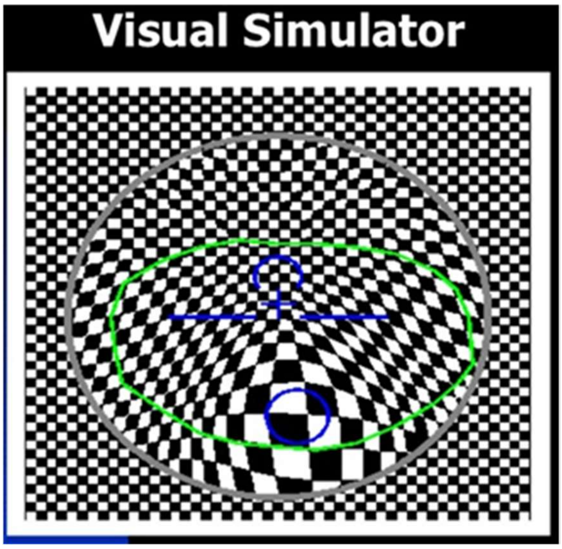


Figure (24) visual simulater

* Method and method

1- about chapter 2

collection of lens from many brand and measured by (AL700 automatic lensometer) after change the sitting of (al700) to PALs measure to determine all information about the lens.

Enumerate the parts of automatic lensometer and how to use.

Enumerate the icons measurement and progressive screen and know the meaning of each parts.

How can measure the progressive lens.

How can fitting the lens in right points to avoid vision problem by use correct PD, BVD, pantoscopic angle.

Enumerate the problem occurs with if the fitting worse and how can treated by refit the lens, frame adjustment, repeat refraction.

In addition each parts in this chapter is with illustrative pictures help to understand.

In the whole measurements done to the different lenses.

Alensometer AL700 has been used to specify the values of px, py

All the tables next pages illustrate these measurement

Figure (29) Automatic lensometer Al700

2- Icons – measurement and progressive screens

1- Left eye icon: indicates that al700 is ready to measure the left lens.

2- Abbe number icon: display the current abbe number setting for the al700.

3- Cylinder icon: display the current cylinder measurement mode for the al700("-" for minus, "+" for plus and "+ / -" for plus/minus).

4- Step icon: display the current measurement step setting for the al700 (0.25D for 1/4 diopter, 0.12D for 1/8 diopter).

5- Lens icon: display N (normal) for non-contact lens, H for hard contacts, and S for soft contacts.

6- Single lens icon: indicates that the al700 is ready to measure a single lens.

7- Right eye icon: indicate that the al700 is ready to measure the right lens.

8- Pd left lens: when feature is enabled, it indicate that the al700 is ready to measure the pupillary distance for the left lens.

9- Pd right lens: when feature is enabled, it indicate that the al700 is ready to measure the pupillary distance for the right lens.

10- S: spherical measurement.

11- C: cylindrical measurement.

12- A: axis measurement.

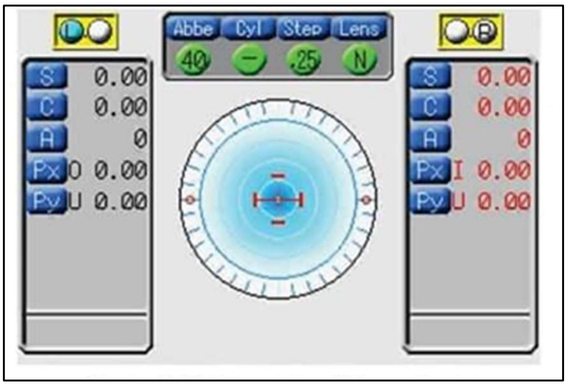


Figure (31) measurement screen icons

13- Px: prism x measurement.

14- Py: prism y measurement.

15- Pd: pupillary distance (PD) measurement.

16- Ad1: the first near point measurement.

17- Ad2: the second near point measurement.

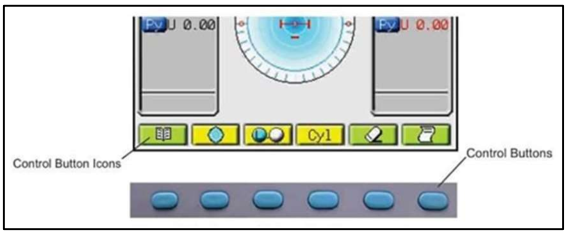


Figure (32) control buttons for measurement screen

18- Progressive icon: press this button to open the progressive screen and measure progressive lenses.

19- Single/multifocal icon: press this button to reopen the measurement screen and measure single, bifocal, or multifocal lenses.

20- Erase icon: press this button to delete saved lens measurement from the screen.

21- Menu icon: press this button to open the set-up screen.

22- Printer icon: press this button to send your patient data to the al700 printer.

4- Measurement mode

Progressive lens: -

1- Placing lens on the lens stand.

2- If the al700 detects a progressive lens, the progressive measurement screen opens.

3- Finding the progressive section of lens. Slowly moving the lens right and left on the lens stand. When the progressive section found, the progressive screen displays a red arrow icon and irregular blue cross icon.

4- Measuring the far point of the lens. your objective is to move the lens around the lens stand until the blue cross aligns along the vertical line in the clear area and becomes symmetrical. use red arrow icons to direct your movements.

5- When you find the far point, the symmetrical blue cross turns green. When you hear the beep, the message "marking ok"appears and the data turns red, your far point measurement is automatically saved.

6- Find the near point of the lens.

7- When you find the near point, the near point cross turns yellow-green (the far point cross remains solid green).

8- If you need to measure a second add segment, press the memory/add switch.

9- Press the print button.

Press the erase button to clear the measurement data and measure the next lens.

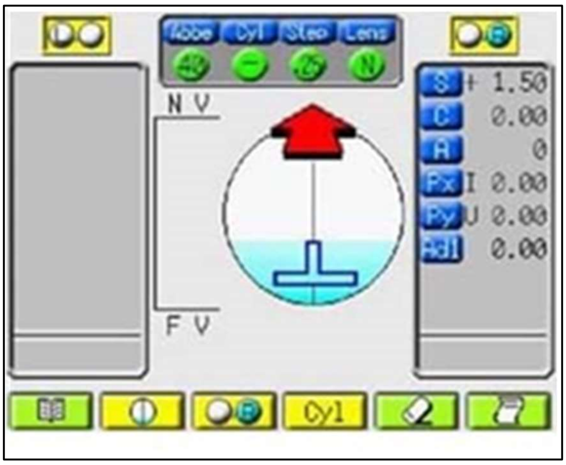


Figure (35) progressive lens detection on screen

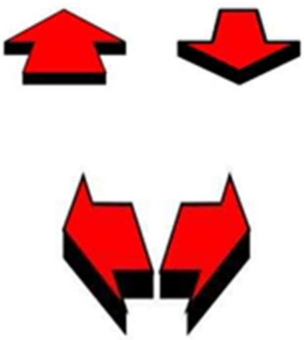
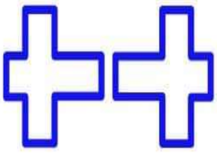


Figure (33) progressive lens detection on screen

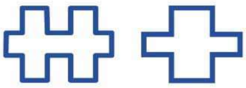
Straight red arrows indicate you are following the correct path to the far point.

Slanted red arrows indicate you have moved past the progressive section. When you return to progressive section, the arrows become straight again.



Irregular blue crosses on their sides also indicate that you are outside the progressive section of the lens

A symmetrical blue cross indicates you have located the far point.



An irregular blue cross indicates that you have moved outside the progressive section of lens.

5- Printing patient data

The al700 allows you to print out your patient data by pressing the printer control button.

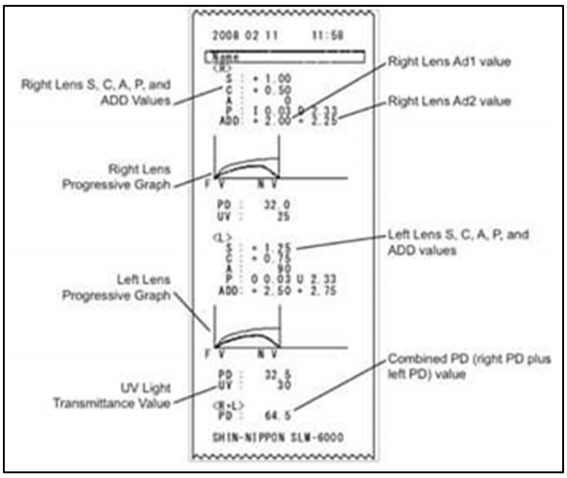


Figure (34) sample patient data printout

7- Fitting of progressive lens:

*** Centeration**

Vertical and horizontyal centration The fitting crosses has to be positioned in front of the pupil´s centers when your customer is looking straight ahead with a natural head and body posture.

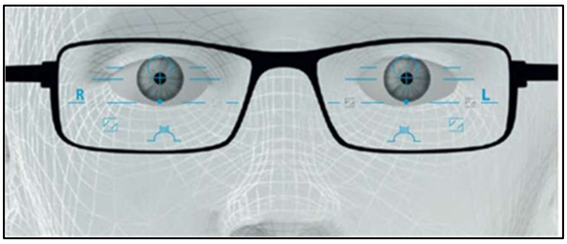


Figure (35) vertical and horizontal centration for progressive lenses.

*** Centering prismatic prescriptions**

During centering, taking into account the horizontal and vertical ray deflection caused by the prism if the lens features a prescribed prismatic power. Decanter the fitting crosses by 0.25 mm per 1 cm / m in the opposite direction to the prism base. This applies regardless of the lens design.

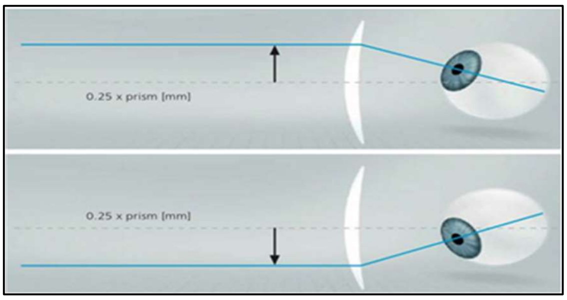


Figure (36) centration of prismatic prescription.

2- wear parameters

Physiological position of wear parameters To guarantee a large distance zone, the distance between the pupil center and the upper frame rim should measure at least 8 –10mm for progressive lenses.

* Frame dimensions

Measure the vertical (h) and horizontal (l) boxed lens sizes in the lens plane using the internal dimension and add the groove depth. Alternatively, the dimensions can be determined using the original lenses if the frame was glazed with these with sufficient accuracy. Determine the distance between the lenses (DBL) as usual, taking the groove depth into account.

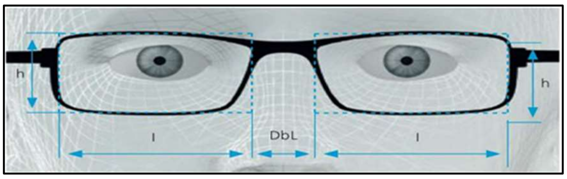


Figure (37) frame dimensions

* Pupillary distance (PD/z)

Make sure that the eyes do not converge when determining the monocular pupillary distance. If no pupillary distance is specified 32 mm will be applied as default value.

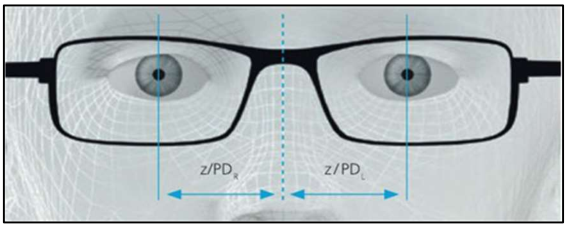


Figure (38) centration distance (z).

* Pantoscopic angle (PA)

If no pantoscopic angle is specified 9° will be applied as default value.

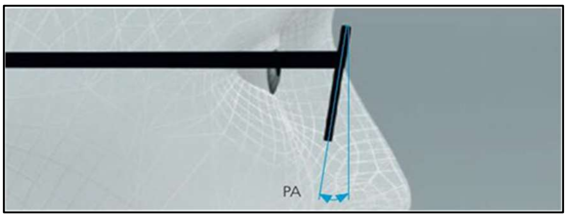


Figure (39) pantoscopic angle (PA).

* Back vertex distance (BVD)

If no back vertex distance is specified 12 mm will be applied as default value.

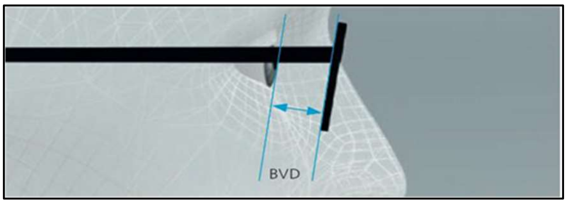


Figure (40) back vertex distance (BVD).

* Fitting height (y)

The fitting height (y) is measured with the customer looking straight ahead, with his or her head and body in a natural posture. Please use the diameter template to check the final position of the near measuring area.

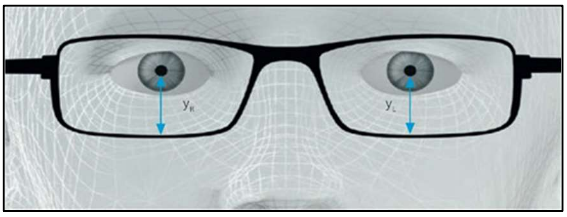


Figure (41) fitting height (Y).

4- lens inspection and glazing

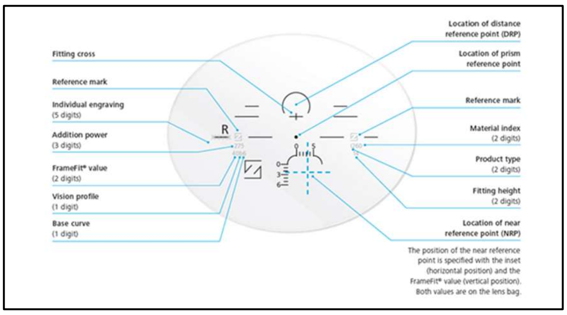


Figure (50) lens inspection and glazing.

* Measured power/ wearing power

We calculate the progressive lenses so that every consumer experiences exactly the power determined during refraction with the trial frame. The measured powers therefore differ from the powers ordered. The measured powers are solely intended for checking the lenses in the focimeter and are specified on the lens bag

1- Distance measurement: The measurement is performed in the distance measuring circle. The measured power is calculated for this point of the lens. This inevitably results in deviations from the ordered power: this is adapted to the fitting cross, i.e. for the point on the lens at which the wearer looks into the distance.

2- Near measurement: The focimeter measures the back vertex power length for an infinitely distant object. In the focimeter a parallel, object-side ray path is therefore assumed. The support on the focimeter locks the lens in position so that the measuring ray leaves the lens at 90°. In near vision during wear, the ray path follows a different path. A divergent ray bundle emerges from the near object, and the rays exit the back surface ofthe lens at an oblique angle. The measurement is performed in the near measuring area.

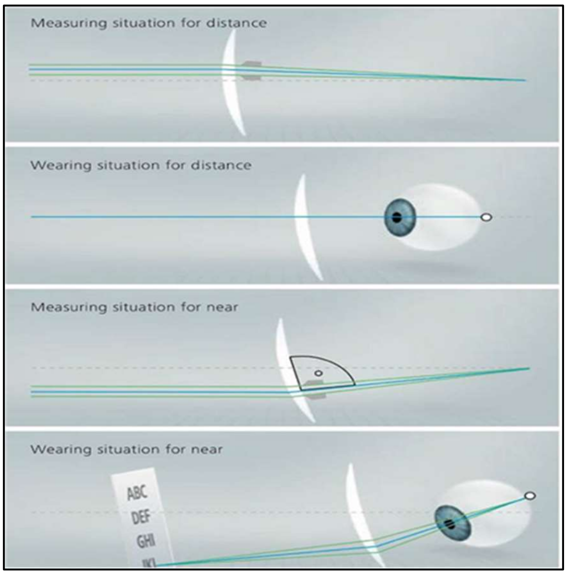


Figure (51) measured power/wearing power.

* Results And Discussion

* About this chapter

Draw the two symbol size of PALs which use in the research. Graph of ideal base curve with visual acuity for distance and near before and after cutting the lens. diagrams of PALs comparison between two PALs different in power.

And the table for each lens which get all information about it

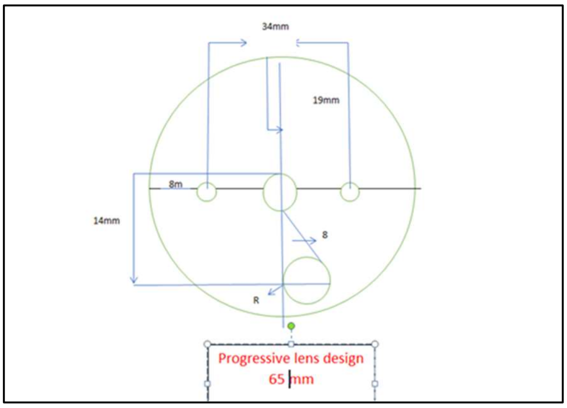


Figure (55)

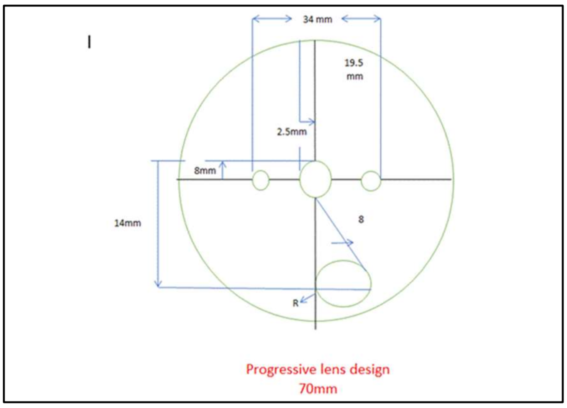


Figure (56)

Add1(addition): first reading of addition power (near point)

Add2(addition): second reading of addition power (near point)

Px: prismatic effect on x axis

Py: prismatic effect on y axis

Axis: the axis of power

Cyl (cylinder); cylinder reading

Sph (sphere): sphere reading

Progressive Lens 1 (progressive 156)			Size=70mm		
Add	Py	Px	Axis	Cyl	Sph
2	1.75	0.25	0	0	0
1	0.25	1.25	145	0.75	0.25
1.5	1	1	2	0.25	0.5
1.25	1	0.5	87	0.5	0.75
0.75	1.75	0.75	9	1	1
0.75	2	1	176	0.75	1.25
0.75	3.5	1.5	56	0.75	1.5
0.5	1.75	1.75	74	0.5	1.75
0.25	1.5	2.5	82	0.5	2

Table (1) best vision in this lens

Progressive Lens 2 (ziess)			Size=70mm		
Add	Py	Px	Axis	Cyl	Sph
1.25	0	0	0	0	0
1	2	1.25	169	0.25	0.25
0.75	2.25	0.75	80	0.25	0.5
0.5	1.75	0.5	69	0.75	0.75
0.25	1.25	1	50	0.25	1

Table (2)

Progressive Lens 3 (ziess)			Size=65mm		
Add	Py	Px	Axis	Cyl	Sph
2.5	0	0	0	0	0
1.5	5	1.25	28	2	1.75
0.5	1.75	1.5	161	2.25	2
0.25	0.5	0.25	9	1.5	2.25
1.25	2.5	2.5	87	1.25	2.5
1	2.5	3	8	1.25	2.75
0.5	2	0.75	0	1.25	3
0.5	2.75	1	1	1.25	3.25
0.5	1.25	1.25	171	0.5	3.5
0.5	1.5	1.75	70	0.25	3.75
0.25	0.5	6.25	51	0.25	4

Table (3)

Progressive Lens 4 (ziess)			Size=65mm			
Add2	Add1	Py	Px	Axis	Cyl	Sph
	0.75	2	2	89	1.75	3.25
	1	3	2	91	1.5	3.5
	0.75	0.75	0.5	81	1.75	3.75
	2.25	3.75	7	92	1.75	4
1.25	1	0.75	0	85	2	4.25
	1.5	1.5	0.25	79	2	4.5
	1.25	1.25	2.75	94	2	4.75
1.25	1	0.5	2.75	75	1.75	5
	0.75	2.25	2.75	76	1.75	5.25
0.25	0.5	7.75	4.25	66	2	5.5
	0.25	4	2.75	82	1.75	5.75
	0.25	7.25	0	83	1.5	6

Table (4)

Progressive Lens 5 (ziess)			Size=70mm			
Add2	Add1	Py	\Px	Axis	Cyl	Sph
0.25	0	0.25	2	9	0.25	0
0	0.25	1.75	1	90	0.25	0.25
	0.25	2	0.75	167	-0.5	0.5
0.75	0.5	0.25	0.25	80	-1.5	0.75
	0	0.75	0.5	82	-1	1

Table (5)

Progressive Lens 6 (ziess)			Size=70mm			
Add2	Add1	Py	Px	Axis	Cyl	Sph
	1.75	0.75	1	136	2	0
2	2.25	1.25	0.25	126	0.5	0.25
	1.75	0	1.25	150	2	0.5
	1.25	1	0	46	0.25	0.75
	1.5	1	0.25	118	0.25	1
	1.25	0.75	0.5	125	0.75	1.25
	1	0.5	0.25	96	0.25	1.5
1	1	0.5	0.25	91	0.25	1.75
	0.5	0.25	0.5	117	0.25	2
	0.5	0	0.25	54	0.25	2.25
	0	1.5	0.25	19	0.25	2.5
	0	1	0.25	0	0	2.75

Table (6)

Progressive Lens 7(ziess)			Size=70mm			
Add2	Add1	Py	Px	Axis	Cyl	Sph
0	0	3.25	1.5	139	-0.25	-0.75
	0.25	2.25	0.75	120	-0.25	-1
0.25	0.5	4.25	1.75	39	-0.5	-1.25
	1.25	0.5	2.5	156	-1.5	-1.5
	1.5	4.75	0.5	132	-1.5	-1.75
	1.5	2.75	0.25	133	-0.75	-2
	1.25	0.5	0.5	148	-0.25	-2.25
1.5	1	0.25	1.25	0	0	-2.5
	1.25	2.25	1	0	0	-2.75

Table (7)

Progressive Lens 8 (easylux)			Size=70mm			
Add2	Add1	Py	Px	Axis	Cyl	Sph
1.25	1	1	0.5	156	1.5	0
1.25	1	1.5	0	117	0.25	0.25
	1	1.25	0.25	40	0.5	0.5
1	1	1.25	0.25	145	0.25	0.75
	0.75	0.75	0.5	54	0.75	1
0.5	0.5	0.25	0.5	143	0.75	1.25
	0.25	0.25	0.25	140	0.5	1.5
	0	0.25	0.25	111	0.25	1.75
1	0.5	1	0.25	44	-2	2

Table (8)

Progressive Lens 9 (synchrony)			size=70mm		
Add	Py	Px	Axis	Cyl	Sph
1	1.25	0.25	150	0.75	0
1.75	1.25	0	121	0.25	0.25
1.25	1	0	132	0.5	0.5
1.25	1	0.25	121	0.25	0.75
0.5	0.25	0.25	138	1.25	1
0.5	0	0.25	136	1	1.25
0.5	2.75	0.75	24	0.75	1.5
0	0.75	0.25	128	0.5	1.75
0	2.25	0.25	105	0.25	2

Table (9)

Progressive Lens 10 (privo advance)			Size=70mm		
Add	Py	Px	Axis	Cyl	Sph
1	1	0.25	0	0	0
1	1	0	0	0	0.25
1	0.75	0.25	50	0.25	0.5
1	0.75	0	0	0	0.75
0.5	0.25	0.25	136	0.75	1
0.5	0.25	0	128	0.25	1.25
0.25	0.25	0	134	0.25	1.5
0	0.25	0.25	109	0.25	1.75

Table (10)

Progressive Lens 11 (synchrony)			Size=70mm			
Add2	Add 1	Py	Px	Axis	Cyl	Sph
	1.25	0.75	0.5	175	0.25	0
1	0.75	0.25	0.5	162	1.25	0.25
	1	0.5	0.75	162	1.25	0.5
	1	2	0.5	39	0.5	0.75
	0.75	2	0.25	73	0.5	1
0.5	0.25	2	0	87	0.5	1.25
	0.25	1.5	0.25	114	0.25	1.5
0	0	0.5	0	125	0.25	1.75

Table (11)