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Spectacle technology II

Protocols for practical education

MASARYK UNIVERSITY

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1 Calculation of visual field change in different spectacle lenses

1.1 Introduction

Appropriate visual field is one of three basic demands for spectacle lens centration. This demand is realized if the both visual field of right and left eye cover each other in distance of fixation point (Rutrle, 2001). Size of the visual field is indirectly proportional to spectacle lens vertex distance and spectacle lens power. In general we can say that spectacle lens with optical power 1 D changes visual field with 2.5 % monocularly.

1.2 Goals

- Calculate size of real visual field in meters
- Calculate objective distance of eye's virtual rotation centre
- Calculate size of virtual field in meters
- Calculate and check ratio between visual field size and power of the lens

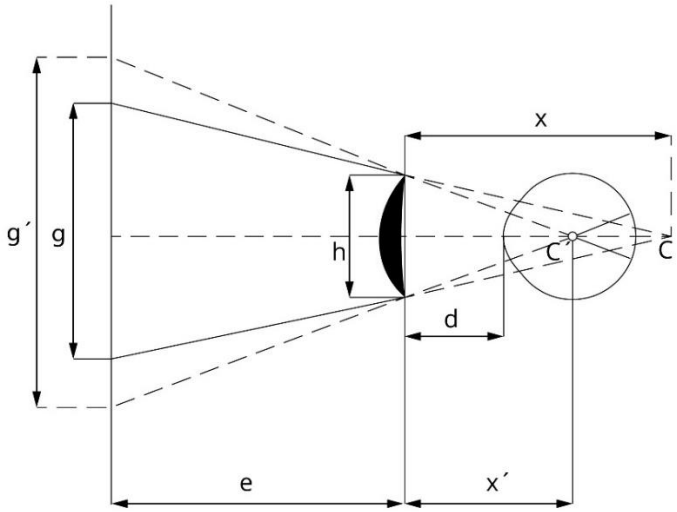
1.3 Equipment

Spectacle frame, spectacle lens, writing equipment, PD rule, calculator.

1.4 Methods

Calculate size of real visual field in meters

Calculate the virtual visual field size g according to bellow listed formula. Use the power of the lens (S), vertex distance (d = 12 mm), image distance of the real eye's centre of rotation (x'= 25 mm), distance of the fixation plane and spectacle lens (e = 1000 mm) and spectacle lens diameter (h).



Picture 1.1: Change of the visual field if corrected by spectacle lens (g = real visual field size, g' = virtual visual field size, x = distance of the virtual eye's rotation centre, x'= distance of the real eye's rotation centre, d = vertex distance, h = spectacle lens diameter, e = distance between fixation plane and spectacle lens, C = virtual eye's rotation centre, C'= real eye's rotation centre, Rutrle, 2001).

$\frac{g}{h} = \frac{e+x}{x}$ g, h, e, x [m] (1)

Calculate object distance of eye's virtual rotation centre

In next phase we use modification of Gauss's formula for calculation parameter x.

$\frac{1}{x'} = \frac{1}{x} + S'_B$ S'_B [D], x [m] (2)

Calculate size of virtual field in meters

Now is possible calculate size of virtual eye's visual field g' according to bellow listed formula.

$\frac{g'}{h} = \frac{e+x'}{x'}$ g', h, e, x' [m] (3)

Calculate and check ratio between visual field size and power of the lens

Ratio between sizes of the visual fields express in percent. Check the visual field change on spectacle lens' optical power 1 D.

1.5 Results

Calculate size of real visual field in meters

g =

Calculate object distance of eye's virtual rotation centre

x =

Calculate size of virtual field in meters

g'=

Calculate and check ratio between visual field size and power of the lens

Visual field with lens powered S = …….. was changed by ……..%

The change comes with optical power 1 D is ……. %

1.6 Discussion

Change of visual field is greater if we have higher lens optical power. Concave lenses decrease object size and increase visual field size. Convex spectacle lenses increase object size and decrease visual field.

1.7 Conclusion, notes, comments

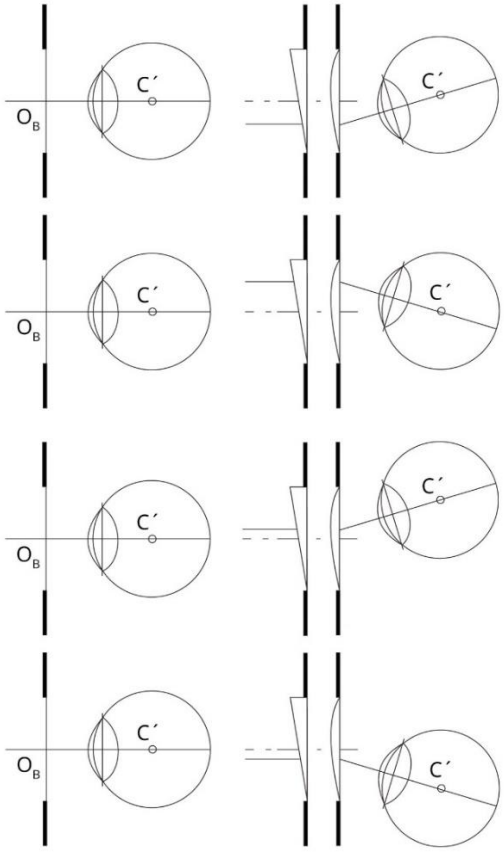
When we can find increasing and decreasing of visual field?

How is changes object observed by concave and convex spectacle lens?

2 Calculation of important point moving in prismatic lenses

2.1 Introduction

Prismatic lens bends the light beam to its base which is the thickest part of the lens. Oppositely the eye moves against the base. That is the reason why we have to adapt position of the lens main point of the prismatic lens. In practice we have to move the main point with few millimeters opposite the base. The size of the moving is related to prismatic value and vertex distance.



Picture 2.1: Moving of the main point in prismatic lens (C'= real eye's rotation center, O = optical center of the eye, Rutrle 2001).

2.2 Goals

- Measure spectacle vertex distance
- Calculate size of the prismatic effect if we move the lens 10 mm from the center
- Calculate the final decentration of the main point for correct eye pair position if we have manufactured prismatic lens

2.3 Equipment

Spectacle frame, writing equipment, PD meter or millimeter rule, calculator.

2.4 Methods

Measure spectacle vertex distance

Put on the frame to patient's head and measure vertex distance (distance from the back side of the lens to the front side of the cornea).

Calculate size of the prismatic effect if we move the lens 10 mm from the center

Calculate the size of the prismatic effect. From lens meter you will know the vertex power of the lens and decentration is 10 mm temporally. Use the Prentice formula.

$$P = \frac{S'_B \,.d\,[mm]}{10} \qquad \text{P [pD], d [mm], } S'_B \text{ [D]} \qquad (4)$$

Calculate the final decentration of the main point for correct eye pair position if we have manufactured prismatic lens

On the base of knowledge of the vertex distance (d) and given prismatic effect calculate the decentration (x).

$$x = \frac{(d+13).P}{100} \qquad \text{P [pD], d, x [mm]} \qquad (5)$$

2.5 Results

Measure spectacle vertex distance

d =

Calculate size of the prismatic effect if we move the lens 10 mm from the center

P =

Calculate the final decentration of the main point for correct eye pair position if we have manufactured prismatic lens

x =

2.6 Discussion

Prismatic effect can be made by spectacle lens decentration of can be manufactured. During the manufacturing we use special prismatic circle or we can tilt the axis of the grinding machine. Prismatic lenses are used for heterophoria resp. strabismus correction. Some prismatic lenses with high prismatic effect have aberrations like distortion or color aberration.

2.7 Conclusion, notes, comments

Which is the value and direction of the main point moving of the prismatic lens in up listed case?

Which is the rule of the prismatic lens decentration in standard vertex distance 12 mm?

3 Calculation of relationship among accommodation and convergence

3.1 Introduction

Convergence is driven by third cranial nerve. Convergence is connected with accommodation and miosis. According the theoretical calculation convergence on 1 meter is equal to pupillary distance in centimeters. Calculation is derived from definition of 1 prismatic diopter which is defined as light beam 1 cm deviation on 1 m.

Picture 3.1: Convergence and accommodation on near point (Livestrong 2013)

3.2 Goals

- Measure pupillary distance on far
- Calculate theoretical size of convergence on given distance
- Calculate theoretical value of accommodation convergence to accommodation

3.3 Equipment

Digital or manual PD meter, writing equipment, calculator.

3.4 Methods

Measure pupillary distance on far

Choose one method for distance PD measurement – direct method, infinity method or digital PD meter and measure distance PD

Calculate theoretical size of convergence on given distance

Calculate needed convergence (K) on distance 1 meter and standard reading distance (a = 40 cm).

$K = \frac{PD}{a}$ PD [cm], K [pD], a [m] (6)

Calculate theoretical value of accommodation convergence to accommodation

For calculation we need to know the size of the convergence K_1 in accommodation 1 D (1 meter) and size of the convergence K_2 in accommodation A = 2 D (distance a = 0.5 m).

$\frac{AC}{A} = \frac{K_2 - K_1}{A_2 - A_1} = \frac{K_2 - K_1}{2 - 1} = \frac{K_2 - K_1}{1}$ AC/A [pD/D], K [pD], a [m] (7)

3.5 Results

Measure pupillary distance on far

PD_P = ……. cm

Calculate theoretical size of convergence on given distance

K = ……cm.m^{-1} [pD]

Calculate theoretical value of accommodation convergence to accommodation

AC/A = …….. pD/D

3.6 Discussion

Cooperation of the accommodation and convergence is important for appropriate function of accommodative process. In case of inadequate values there are used compensation mechanisms, which is for example fusion vergence. Ocular muscles working with low energy, so in practice real convergence values are lower than theoretical. Particular values of accommodation and convergence established the line of direct proportionality which is called Donder's line.

3.7 Conclusion, notes, comments

Who will have higher needs on convergence? Patient with lower or higher PD? Patient working on 1 meter or 30 cm?

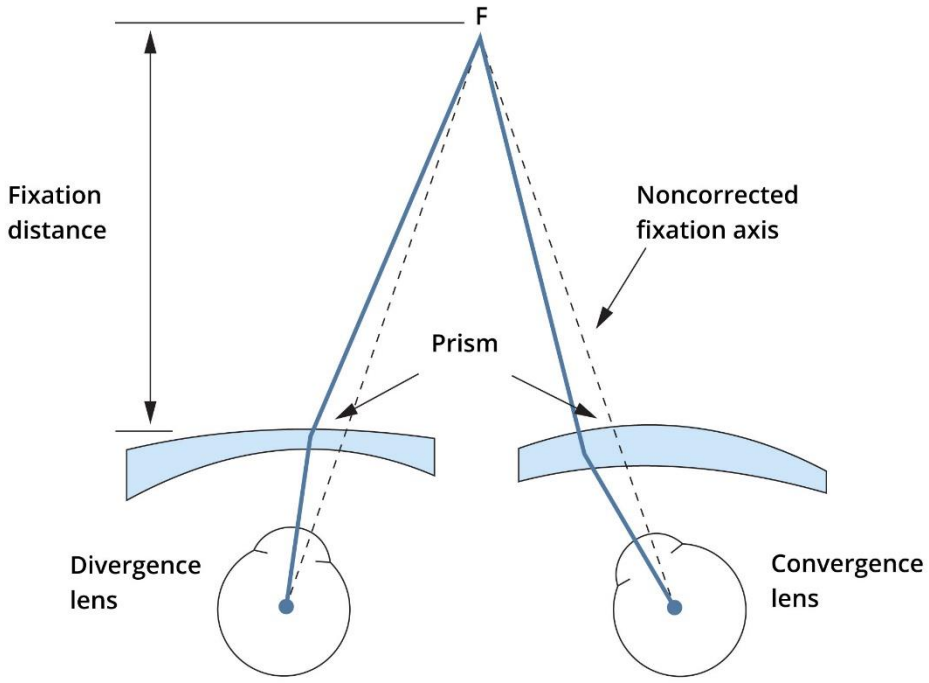
Do the spectacles influence convergence of the patient?

What is the average values for AC/A?

4 Calculation of convergence task in spectacle correction

4.1 Introduction

Spectacles can influence convergence value of the patient due to spectacle lens prismatic effect. Convex spectacle lens contains base turned out from the lens and concave spectacle lens base turned in the lens. This added prismatic effect can support the patient's convergence. For near vision glasses is recommended to center the lens whit its optical centre right on the pupil. This way we do not influence near convergence.



Picture 4.1: Near convergence demands in convex and concave lens (Opticampus 2013).

4.2 Goals

- Measure pupillary distance for far and near (40 cm)
- Measure vertex power of the lens for right and left eye
- Calculate theoretical value of convergence for near (40 cm) during the centration of spectacle lens according to near PD (40 cm)
- Calculate convergence value if the lenses are used for near (40 cm) but centered on far

4.3 Equipment

Digital or manual PD meter, writing equipment, calculator, spectacle lens

4.4 Methods

Measure pupillary distance for far and near (40 cm)

Choose one technique for measurement of near PD and measure distance PD and near PD on 40 cm. Note values for each eye separately.

Measure vertex power of the lens for right and left eye

With lensmeter measure right and left spectacle lens.

Calculate theoretical value of convergence for near (40 cm) during the centration of spectacle lens according to near PD (40 cm)

Use the far PD value and calculate theoretical value of convergence for each eye separately.

Calculate convergence value if the lenses are used for near (40 cm) but centered on far

Firstly, we calculate added prismatic effect if the patients look out of the lens' optical center. In convex lens there is prismatic effect with base out and in concave lens we have base in prismatic. Total convergence will be higher in convex lens and lower in concave lens.

$$P_P = \frac{S'_{BP} . \Delta d_p \, [mm]}{10} \qquad \text{P [pD], d [mm], } S'_B \text{ [D]} \qquad (8)$$

$$K_{CP} = K_P \pm P_P \qquad \text{K [pD], P [pD]} \qquad (9)$$

In case of concave lens we subtract P from K, in case of convex lens we add P to K.

$$P_L = \frac{S'_{BL} . \Delta d_L \, [mm]}{10} \qquad \text{P [pD], d [mm], } S'_B \text{ [D]} \qquad (10)$$

$$K_{CL} = K_L \pm P_L \qquad \text{K [pD], P [pD]} \qquad (11)$$

In case of concave lens we subtract P from K, in case of convex lens we add P to K.

4.5 Results

Measure pupillary distance for far and near (40 cm)

PD_{DP} = mm

PD_{DL} = mm

PD_{40P} = mm

PD_{40L} = mm

ΔPD_P = mm

ΔPD_L = mm

Measure vertex power of the lens for right and left eye

S'_{BP} = D

S'_{BL} = D

Calculate theoretical value of convergence for near (40 cm) during the centration of spectacle lens according to near PD (40 cm)

K_{40P} = pD

K_{40L} = pD

Calculate convergence value if the lenses are used for near (40 cm) but centered on far

$P_P =$ $[pD]$

$K_{CP} =$ $[pD]$

In case of concave lens we subtract P from K, in case of convex lens we add P to K.

$P_L =$ $[pD]$

$K_{CL} =$ $[pD]$

In case of concave lens we subtract P from K, in case of convex lens we add P to K.

4.6 Discussion

Centration of the spectacle lens on far PD is recommended for aspheric lenses for near. The reason is to respect real eye's rotation centre and maintain point imaging. On the other side we induce prismatic effect which influences patient's convergence. Mostly we generate prismatic effect with base out which leads to increase of convergence which is uncomfortable.

4.7 Conclusion, notes, comments

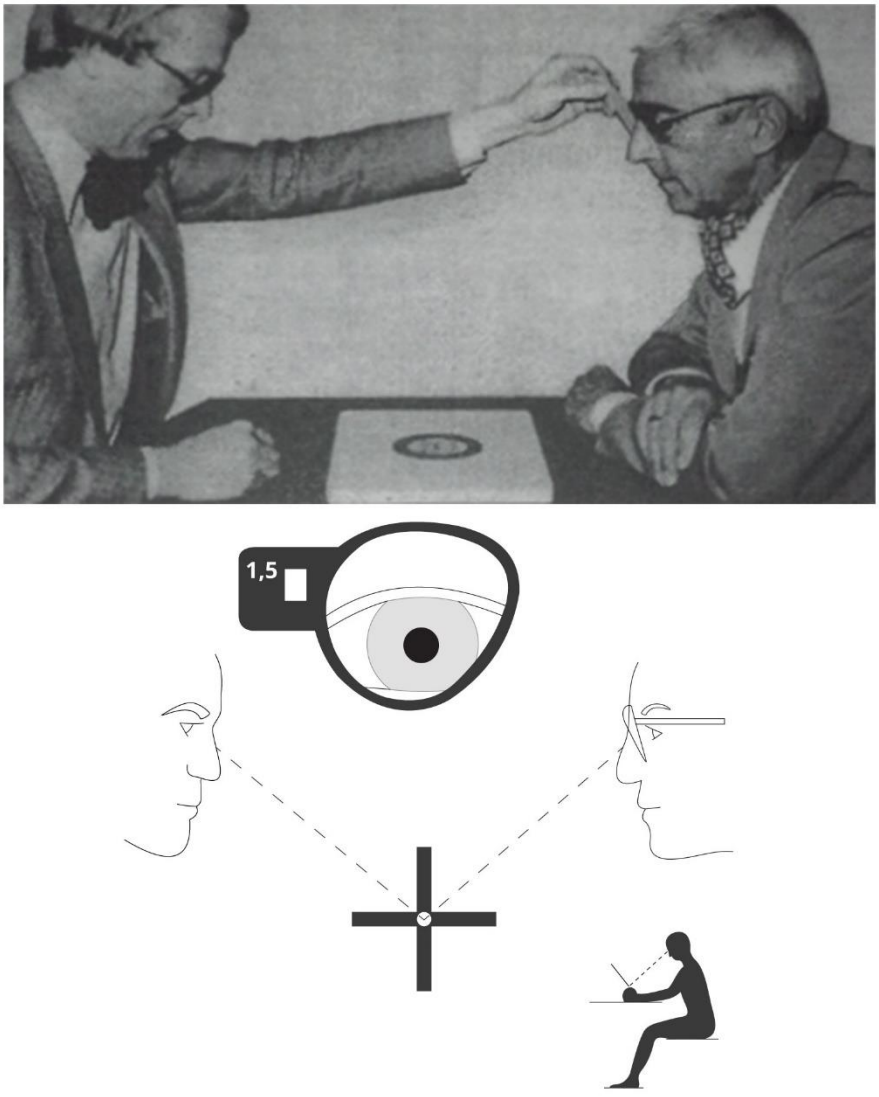
Which is the critical direction if we center the lenses for near?

What is the effect of the increased convergence in patient?

5 Mirror method in progressive addition lens centration

5.1 Introduction

Progressive spectacle lens corrects ametropia and presbyopia. Design of the progressive lens follows patient's convergence. We can say in general that higher PD leads to higher convergence. In case of manufacturing of conventional progressives we have to offer patient's convergence. If the eye's visual axis meets in fixation point and simultaneously goes through lens' optical center. If this centration is not correct it decreases quality of visual imaging. Currently we have many centration methods and video camera systems which can check position of the pupil in near vision conditions. This practice shows us simply method how to check the position of the pupil in near vision conditions.



Picture 5.1: Mirror method in progressive lens centration (Rutrle 2001).

5.2 Goals

- Put the frame to patient and adapt it
- Put the marks on demo-foils in pupils for far
- Choose the template for progressive lens and draw the near point on demo-foils
- Check the pupils' position in relationship to near points on demo-foils

5.3 Equipment

Spectacle frame, digital or handy PD meter, writing equipment, calculator, mirror.

5.4 Methods

Put the frame to patient and adapt it

Choose the correct type of frame. Pupils should be placed up to middle of the eye frame and a little bit nasally. Measure frame size (OR) and height of the eye frame (b).

Put the marks on demo-foils in pupils for far

With the permanent fix put the marks on demo-foils right to the pupils.

Choose the template for progressive lens and draw the near point on demo-foils

According to chosen template mark the near point on demo-foils.

Check the pupils' position in relationship to near points on demo-foils

With the mirror in 40 cm check the position of the pupils in comparison with marks on demo-foils.

5.5 Results

Put the frame to patient and adapt it

OR =

b =

Put the marks on demo-foils in pupils for far

PD_P =

PD_L =

Choose the template for progressive lens and draw the near point on demo-foils

y_B =

Check the pupils' position in relationship to near points on demo-foils

YES pupils are in circles / NO pupils are out of circles

5.6 Discussion

In case that pupils are out of the main points for near it means that chosen type of progressive lens is not recommended for patient. We can choose some other type of progressive lens with possibility to define position of the near main point. In case of asymmetrical convergence, we should order individually produced lenses.

5.7 Conclusion, notes, comments

How many millimeters is usual inset decentration in progressive lenses?

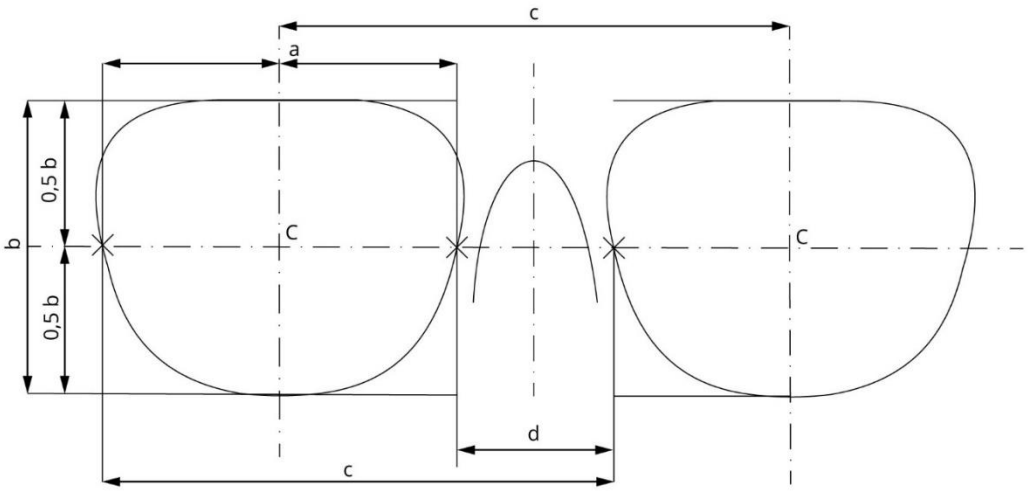
Which types of progressive design according to progressive corridor length we have on the market?

Which test enables to find if the convergence is adequate or inadequate?

6 Basic spectacle frame parameters – axis system

6.1 Introduction

Spectacle frame has some important parameters which are important for spectacle lens centration. Mainly it is spectacle frame size which contains bridge size and eye frame size. Next important parameter is eye frame height which is important mainly for bifocal and progressive lenses. There are two types of frame measurement system – axis system and boxing system. In this exercise we will work with axis system.



Picture 6.1: Measurement of the frame size with axis system (C = eye frame centre, d = size of the bridge, c – size of the eye frame, b – height of the eye frame, a – width of the eye frame, Rutrle 2001).

6.2 Goals

- Draw the frame schematically
- Draw horizontal and vertical axis of the frame
- Do the measurement of basic spectacle parameters and mark them in the scheme

6.3 Equipment

Spectacle frame, rule or millimeter rule, writing equipment, calculator, mirror.

6.4 Methods

Draw the frame schematically

Draw the spectacle frame with the front side put on the paper. Draw the inner shape of both eye frames.

Draw horizontal and vertical axis of the frame

Height of the eye frames divide in two half and middle point use for construction of the horizontal axis. Width of the eye frames divide in to half too and construct vertical axis.

Do the measurement of basic spectacle parameters and mark them in the scheme

Measure particular parameters of the spectacle frame. Measurement is related to horizontal axis not to boxes of the eye frames.

6.5 Results

Draw the frame schematically

Draw horizontal and vertical axis of the frame

Do the measurement of basic spectacle parameters and mark them in the scheme

OR =

d =

a =

b =

6.6 Discussion

All measured parameters related to horizontal axes. It means that there is difference in some spectacle parameters. Eye frame height should be the same for both systems. Exact measurement of the spectacle parameters is important for grinding the lenses. Currently these parameters are measured automatically with special readers (tracers) which send measured parameters right into the grinding machine.

6.7 Conclusion, notes, comments

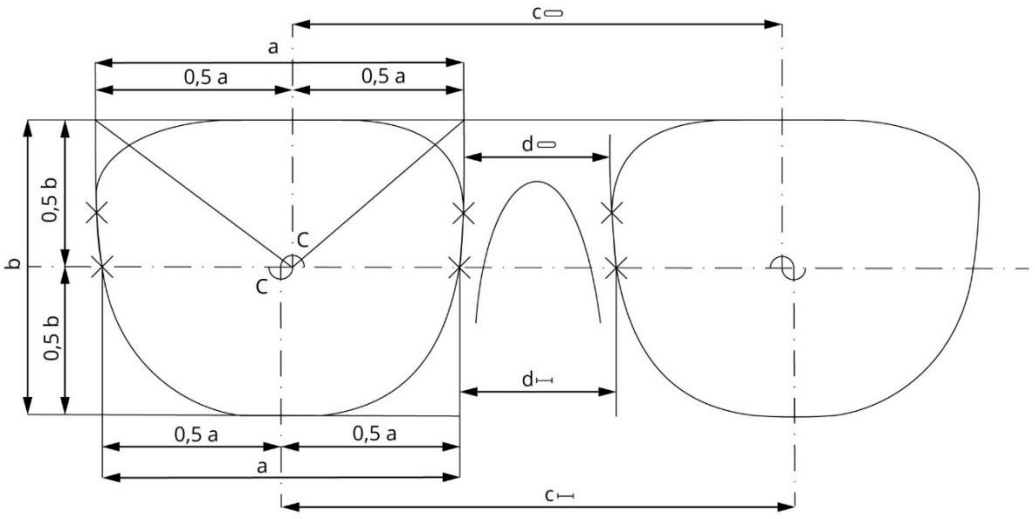
Which spectacle parameters are written on the spectacle side or spectacle bridge?

Which are average values for eye frame width and bridge size for standard spectacles?

7 Basic spectacle frame parameters – boxing system

7.1 Introduction

Spectacle frame measurement called boxing system is used especially in central Europe. We measure and calculate spectacle frame parameters related to the box. These boxes copy inner shape of the spectacle eye frame. Centre of the eye frame is defined as the crossing of the two diagonals. Position of the eye frame center will differ from axis measurement. The difference increases with the eye frame asymmetricity.



Picture 7.1: Difference in boxing and axis system (C – middle of the eye frame, d – bridge width, c – distance of the eye frames, b – height of the eye frame, a – eye frame width).

7.2 Goals

- Draw spectacle frame schematically
- Draw boxes into the eye frames
- Measure basic frame parameters and note it in the scheme

7.3 Equipment

Spectacle frame, ruler or millimeter ruler, writing equipment, calculator.

7.4 Methods

Draw spectacle frame schematically

Put the frame with the front side on the paper and draw the outer and inner shape of the frame.

Draw boxes into the eye frames

In both eye frames draw the boxes. Diagonals of the boxes creates eye frame centers. Distance of these centers defines frame size (OR).

Measure basic frame parameters and note it in the scheme

7.5 Results

Draw spectacle frame schematically

Draw boxes into the eye frames

Measure basic frame parameters and note it in the scheme

OR =

d =

a =

b =

7.6 Discussion

All measured parameters in boxing system are related to the box. These boxes are drawn into the eye frames. For example, bridge size is the nearest distance between eye frames. Eye frame height is the longest distance from lower to upper inner side of the eye frame. This system is more reliable than axis system.

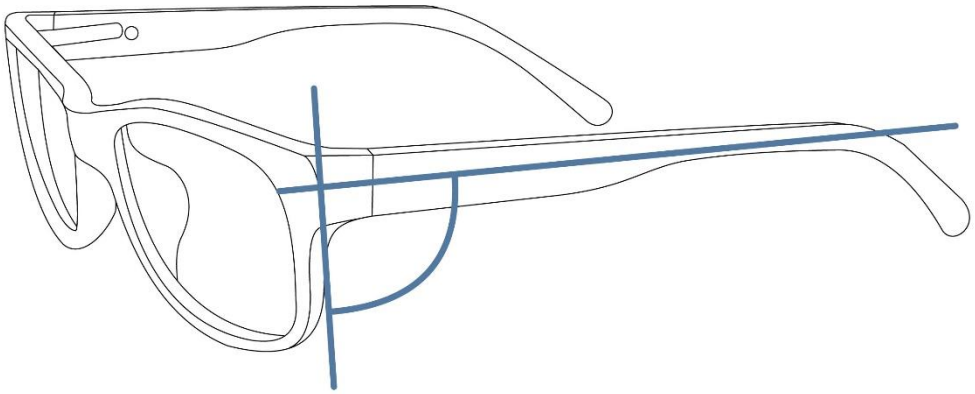
7.7 Conclusion, notes, comments

Which symbol on the frame or frame side notes the boxing system?

8 Measurement of spectacle side inclination

8.1 Introduction

Standard spectacle frame is in comparison with vertical level skewed with so called pantoscopic angle or angle of inclination. This angle enables usage of frame for distance and near too. Pantoscopic angle is important for spectacle lens centration. In professional view optician have to decide if the lenses will be centered on pupil with natural head position (inclination is not 0 degrees, usually 10 degrees) or on pupil with so called perpendicular view (inclination is 0 degrees). In practice we have to difference to types of inclination – inclination of the frame and inclination of the frame side.



Picture 8.1: Inclination angle of the frame side.

8.2 Goals

- Measure angle of inclination for frame side with angle meter
- Measure pantoscopic angle

8.3 Equipment

Spectacle frame, ruler or millimeter ruler, writing equipment, calculator.

8.4 Methods

Measure angle of inclination for frame side with angle meter

Put the frame with its side on the paper and draw the shape to clearly see the angle between the frame and the frame side. The same procedure repeats for the other side of the frame.

Measure pantoscopic angle

Put the frame on patient´s head and instruct the patient to look in infinity and move the head into natural position. This time you can measure pantoscopic angle with an angle meter.

8.5 Results

Measure angle of inclination for frame side with angle meter

α_P =

α_L =

Measure pantoscopic angle

α_I =

8.6 Discussion

Frame side inclination is usually between 70 to 85 degrees. The lower this angle is, the higher is pantoscopic angle. With higher pantoscopic angle we have to adapt vertical centration of the spectacle lens to maintain point imaging.

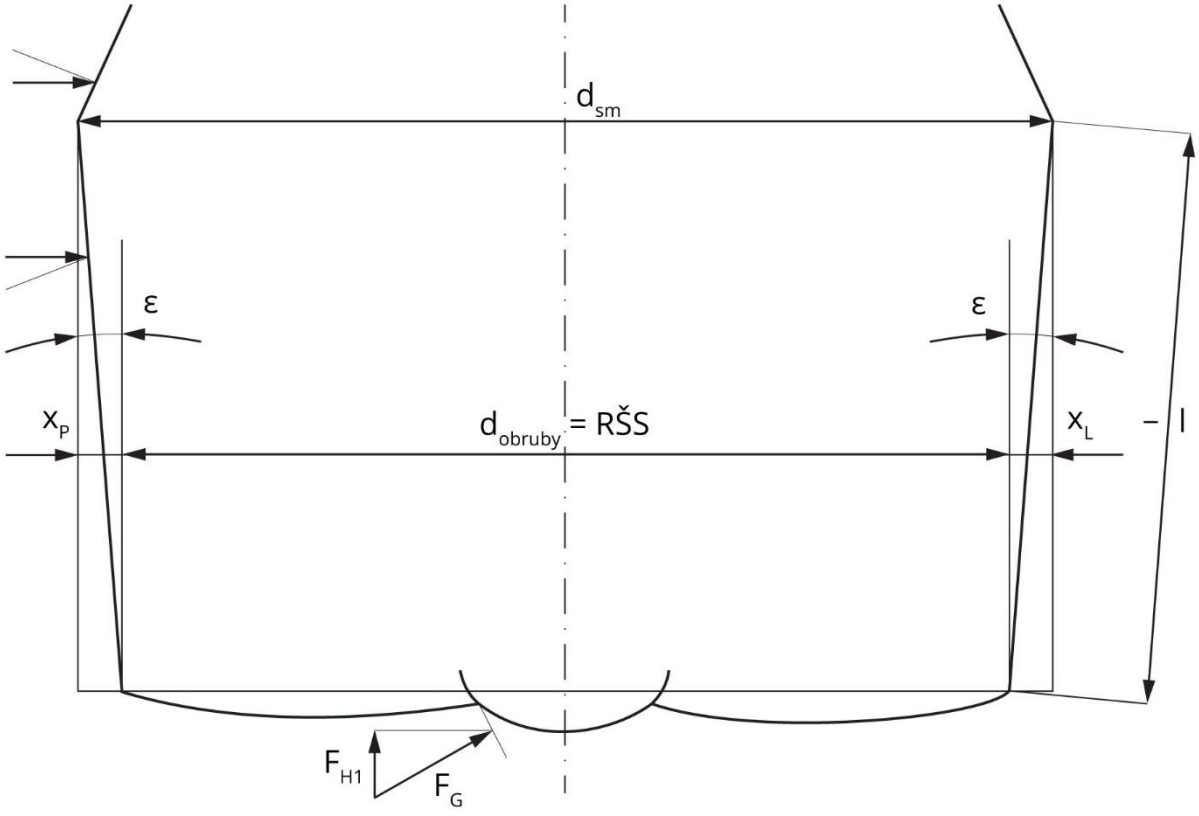
8.7 Conclusion, notes, comments

What difference have you measured between frame and side frame inclination?

9 Measurement of spectacle side opening angle

9.1 Introduction

Spectacle frame stability is provided not only with side endings behind the ears, but also with the power which push the skin around the temporal area (above the ear). Optimal frame side opening should be from 5 to 10 degrees. Recommended size of the spectacle frame is derived from so called temporal size (dsm, Rutrle 2001). Temporal size is influenced by the head size.



Picture 9.1: Angle of the frame opening (dsm – temporal size, d – size of the spectacle frame, ϵ – angle o angle opening, F_H – horizontal power, F_G – gravity power, x – side opening, l – length of the side, Rutrle 2001).

9.2 Goals

- Measure size of the spectacle frame d_S
- Measure angle of frame side opening ϵ
- Calculate size of d_{SM}
- Measure size of your head periphery d_H
- Check suitability of the selected spectacle frame

9.3 Equipment

Spectacle frame, ruler or millimeter ruler, writing equipment, calculator.

9.4 Methods

Measure size of the spectacle frame d_S

Put the frame with front side on the paper and draw the frame shape. Measure size of the center of the spectacle frame. This distance is from peripheral part of one eye frame to another in horizontal direction.

Measure angle of frame side opening ϵ

Draw the shape of the frame like from upper view in the protocol. Measure angle of the frame side opening (ϵ). This angle should be very similar on both sides (See the picture 9.1)

Calculate size of d_{SM}

The value of the temporal size you can calculate if you add value x_P and x_L to value d. Value x_P and x_L you can calculate with trigonometric function. You should know the angle of the side opening and length of the side (l).

$$\sin\epsilon = \frac{x_{PL}}{l}$$

$$x_{PL} = \sin\epsilon \,.\, l$$

$$d_{SM} = 2.x_{PL} + d_S \tag{11}$$

Measure size of your head periphery d_H

With help of elastic ruler measure periphery size of your head (O). From the object periphery formula calculate diameter of the virtual circle.

$$O_H = \boldsymbol{\pi}.d_H \tag{12}$$

Check suitability of the selected spectacle frame

Compare temporal size of the frame d_{SM} with the d_H which shows the head diameter.

9.5 Results

Measure size of the spectacle frame d_S

d_S =

Measure angle of frame side opening ϵ

ϵ =

Calculate size of d_{SM}

d_{SM} =

Measure size of your head periphery d_H

d_H =

Check suitability of the selected spectacle frame

$d_H < d_{SM}$

$d_H > d_{SM}$

$d_H = d_{SM}$

9.6 Discussion

In optimal situation is the size of the d_H equal or higher than d_{SM} of the frame. In case of d_{SM} is higher than d_H we have to push the side to the head. Other way is to replace the frame with the frame with smaller d_S value. In every case the opening angle of side should be not higher than 5 to 10 degrees.

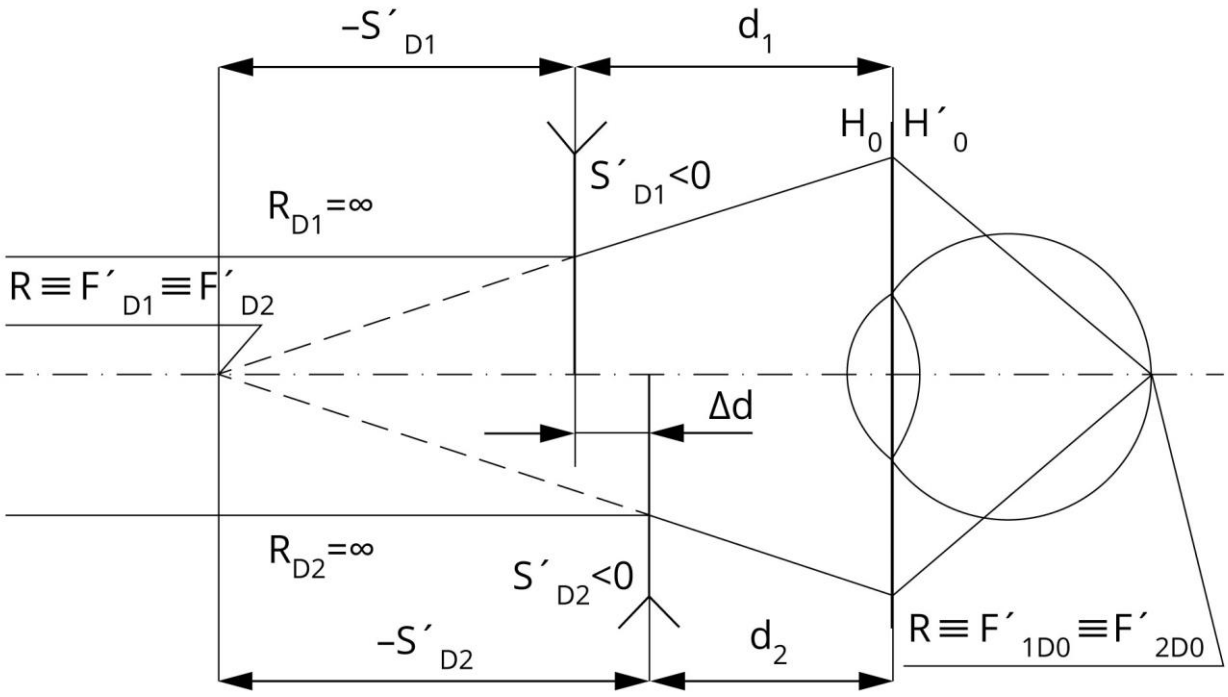
9.7 Conclusion, notes, comments

How is the way to adapt the frame sides in plastic and metal frames?

10 Calculation of spectacle lens optical power if vertex distance is changed

10.1 Introduction

Change of vertex distance of the spectacle frame influences lens vertex power (S_B). The most often we meet this problem in contact lens application. In this case is difference about 12 mm in vertex distance. Next example is recalculation of the new vertex power from trial frame to target frame. In this case the change is from 3 to 6 mm in vertex distance.



Picture 10.1: The change of vertex distance in concave spectacle lens (R – far point, F – focus of the eye, S – vertex power of the lens, d – vertex distance, H – principal plane, Rutrle 2001).

10.2 Goals

- Measure vertex distance in trial frame (d_Z)
- Measure vertex power of the trial frame (S_{BZ})
- Measure vertex distance of the individual spectacle frame (d_I)
- Calculate vertex power for individual lens (S_{BI})

10.3 Equipment

Spectacle frame, spectacle lens, ruler, millimeter ruler, writing equipment, calculator, angle meter.

10.4 Methods

Measure vertex distance in trial frame (d_Z)

With help of handy PD meter measure vertex distance – distance between back side of the lens and front side of the cornea.

Measure vertex power of the trial frame (S_{BZ})

Measure vertex power of the lens in lensmeter.

Measure vertex distance of the individual spectacle frame (d_I)

With help of handy PD meter measure vertex distance – distance between back side of the lens and front side of the cornea.

Calculate vertex power for individual lens (S_{BI})

Use the below listed formula to calculate vertex distance of the individual adapted lens.

$$S_{BI} = \frac{S'_{BZ}}{1 - \Delta d . S'_{BZ}} \qquad (13)$$

10.5 Results

Measure vertex distance in trial frame (d_Z)

d_Z =

Measure vertex power of the trial frame (S_{BZ})

S'_{BZ} =

Measure vertex distance of the individual spectacle frame (d_I)

d_I =

Calculate vertex power for individual lens (S_{BI})

S'_{BI}=

10.6 Discussion

Change of vertical power should be done above 4 D. Below this power the change is smaller than 0.25 D (in case of standard vertex distance 12 mm). In case of usage of concave spectacle lens stronger more than 4 D we decrease the power of the applied contact lens.

10.7 Conclusion, notes, comments

In the trial frame we have spectacle lens -3,5 D. We will apply contact lens. What vertex power will contact lens have?

11 Fixing of spectacle frame with glue

11.1 Introduction

We can repair plastic spectacles with the glue. As glue we can use acetone which is used for melting frames from acetate cellulose. Acetone is melting material to long molecular chains. After acetone evaporation we have solid connection of two frame parts. It is recommended to use silone to fasten the frame. Often we have to glue the eye frame with the grinded lens in it (Benes and col. 2010). Gluing the frame bridge has short endurance thanks to high stress put on frame bridge.

Picture 11.1: Gluing the frame with the acetone (Youtube 2013).

11.2 Goals

- Drill two holes into the frame, one on one side
- Put the acetone on both frame sides
- Use the silicone to bind both frame sides
- Glued connection support with the acetone mush

11.3 Equipment

Spectacle frame, silone, acetone, acetone mush, handy drilling machine, protective glasses

11.4 Methods

Drill two holes into the frame, one on each side of the frame

With handy driller make two holes on both frame sides. Holes should not influence the eye frame groove

Put the acetone on both frame sides

Both side put into the acetone to melt

Use the silicone to bind both frame sides

Use approximately 10 cm of silicone to put into the hole. Use the special knot to fasten the connection

Glued connection support with the acetone mush

Acetone mush is contains small parts of acetate and acetone. This mush put on the connection to fasten the connection

11.5 Results

Drill two holes into the frame, one on each side of the frame

Drilling hole should be placed 2 mm from the frame edge. Hole diameter should be twice wider than silone

Put the acetone on both frame sides

Melting of the acetate frame with the acetone last approximately 2 minutes

Use the silicone to bind both frame sides

Use special knot to fasten the connection

Glued connection support with the acetone mush

Glasses can be again used next day

11.6 Discussion

Plastic frame repair with the glue and silone should be enable in every optical store. Currently some patients still want this service. Spectacles with this repair are still ready to use but repair is visible. Important thing is to preserve the eye frame groove for spectacle frame.

11.7 Conclusion, notes, comments

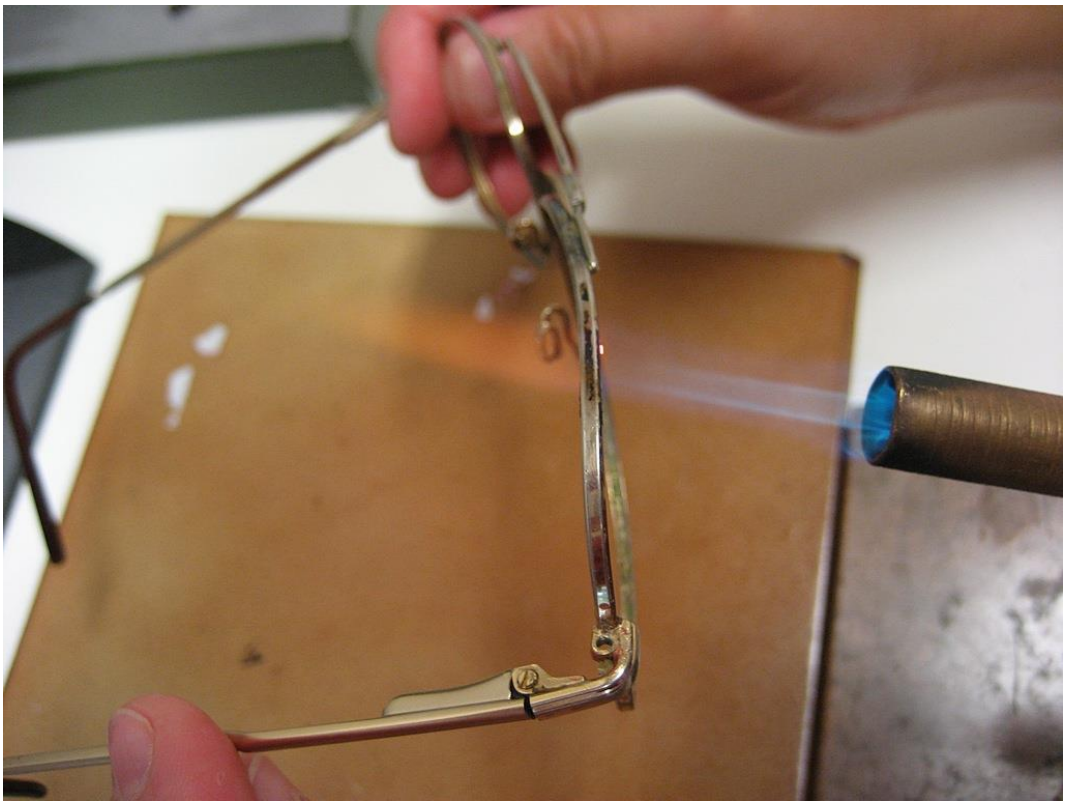
What is the cost of this repair in the market?

What is the insurance for this repair?

12 Soldering of spectacle frame

12.1 Introduction

In the optical store we use hard soldering if the temperature is more than 450°C. Soldering with hard solder wire is solid. Soldering machine is usually propane-butane, helium or electric. For better soldering is used borax (sodium tetraborate decahydrate).



Picture 12.1: Soldering of metal spectacle frame (Benes et al. 2010).

12.2 Goals

- Solder spectacle pad holder
- Solder the broken eye frame
- Solder so called triple connection

12.3 Equipment

Metal spectacle frame, propan-butan soldering machine, binding wire, soldering wire, melting substance borax, drilling machine, polishing instrument, protective glasses, dish with water.

12.4 Methods

Solder spectacle pad holder

Put the borax on the frame and use the propan-butan soldering machine to heat the metal frame to red color. Put the pad holder on the frame into the top of the flame. In short time the solder will melt and flew into the connection. After that put the soldering frame out of the flame to cool the connection.

Solder the broken eye frame

Put the borax and silver solder on the broken part. Put this part of the frame into the flame and wait for silver solder melting.

Solder so called triple connection

In case of broken connection eye frame-opening connection-side holder you have to use connection wire or continue in this sequence. Firstly solder half of the opening to the side holder. Further put the eye frame to previous connection to solder it.

12.5 Results

Solder spectacle pad holder

Pad holder should be perfectly adapted. Solder should not be in the eye frame

Solder the broken eye frame

If the solder is in the eye frame groove use the drilling machine to remove the solder

Solder so called triple connection

If you solder eye frame connection you should pay attention to its correct adaptation

12.6 Discussion

We do soldering often in optical store. After the soldering the frame should be polished with polishing disk connected to the drilling machine. Sometimes is used color on the frame surface.

12.7 Conclusion, notes, comments

What is the cost of soldering in optical store?

What is insurance for soldering?

13 Change of melting hinge of the frame

13.1 Introduction

Plastic frame sometimes contains melted side connection (hinge). This connection connect frame center with the frame side. Melted side connection should resist powering more than rivet side connection. The most of the defect of the side connection is break of one circle. Further we have to replace all side connection.

Picture 13.1: Replacement of the melted side connection (Benes et al. 2010).

13.2 Goals

- Replace melted side connection on both sides of the frame

13.3 Equipment

Electric or propan-butan soldering machine, tweeze, new side connection, dish with the water.

13.4 Methods

Replace melted side connection on both sides of the frame

Heat the broken melted side connection. With help of tweeze remove the broken part and replace it with new one. New side connection is heat with the electric soldering machine.

13.5 Results

Replace melted side connection on both sides of the frame

Replaced side connection should be stable in the frame. Check the frame side opening angle.

13.6 Discussion

Side connection replacement is quick service. If we want to do it more quickly we can heat the metal side connection right in the flame.

13.7 Conclusion, notes, comments

What is the cast of side connection replacement?

What is the insurance period on this replacement?

14 Change of rivet hinge of the frame

14.1 Introduction

Rivet hinge contains two rivets. Stability of rivet hinge is better than melted hinge.

Picture 14.1: Rivet hinge (author's source).

14.2 Goals

- Replace rivet hinge

14.3 Equipment

Hammer, push-full instrument, header instrument, protective glasses, wooden pad, new hinge.

14.4 Methods

Replace rivet hinge

Firstly we have to remove end of the rivets. Further with help of push-full instrument remove rivets. Now is possible to replace broken hinge. Put the new rivets into the hinge and use hammer.

14.5 Results

Replace rivet hinge

Use only small amount of hammer hits.

14.6 Discussion

Rivet hinge is esthetic addition to the frame.

14.7 Conclusion, notes, comments

What is the price of the rivet hinge?

What is the insurance of this replacement?

15 Literature

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