HAPTIC (SCLERAL) LENS FITTING

Gerald E. Lowther, O.D., Ph.D.

I. Preformed versus molded

A. Preformed lenses are fitted from a diagnostic set of lenses with a set range of parameters available.

B. Molded lenses are made from a mold of the eye the lens is to be fitted on.

II. Molded Lenses

A. Uses: usually gives best fit and is often necessary on deformed eyes such as after an injury, keratoconus, etc.

B. Impression taking (insertion procedure):

1. Impression material: irreversible alginates-made from marine kelp and used extensively in dental work. The material comes as a powder and when mixed with water is a thick (whipped cream consistency) material which in 1-2 minutes sets up into a soft rubber consistency. Moldite is one of the tradenames.

2. Preparing the patient for molding: Place the patient in a supine position and locate a fixation point that has the eye to be molded fixating slightly nasally. Cover the eye to be molded when determining the fixation point. If the patient has a high refractive error have the patient hold a spectacle trial lens before the fixating eye.

3. Place a band-aid on the patient's lower lid just under the lashes with only a small portion of the adhesive area attached. This will make it easier to pull the lower lid from under the molding shell.

4. Determine the largest molding shell that can easily be inserted under the lids. The molding shells are about the size of a scleral lens. It has a hollow handle and multiple holes drilled in it so that the mold will adhere to the shell when it is being removed from the eye.

5. Go over the procedure to be used with the patient so they know what they will be asked to do.

6. Place a drop of corneal anesthetic on the eye (although many patients have been molded without it-some indicate that the anesthetic stings more than the molding procedure). Dry the patient's lids.

7. Mixing the material: Place the powder from the vial into a rubber mixing bowl and add the appropriate amount of water (at room temperature) as indicated on the vial. Spatula the material against the side of the bowl being careful not to mix bubbles into the mixture. You have 1-2 minutes to mix the material, get it in the shell, and place it on the eye.

8. Fill the molding shell with molding material and tap the handle on the table surface to remove any bubbles or air pockets. Hold the shell so the mark (usually a red line for the right shell and green for the left) will be on the temporal side when inserted.

9. Have the patient look down. With the index finger of the left hand at the lid margin, over the lashes pull the patient's upper lid up and out of the way. With the right hand put the molding shell under the upper lid keeping the shell up against the back of the lid-do not push it down against the eye as this will make the mold too thin. It can be placed under the upper lid by slightly rotating the shell as it is inserted. Once it is under the upper lid, hold the shell with the left hand and using the band-aid, pull the lower lid out from under the shell. Have the patient fixate the pre-determined fixation point.

10. There will be excess material on the outside of the lids. When this material no longer sticks to you finger when touched the mold is ready to remove-this usually takes 1-2 minutes.

11. Removal: Remove the excess molding material from the patient's lids. Pull the lids away from the mold to loosen them from the molding material. Have the patient look up. Holding the handle of the molding shell with your left hand, work the lower lid under the molding material using the index finger of your right hand. You may have to rotate the top of the shell handle upward and the bottom of the shell out away from the eye to break the suction. Do not try to pull the shell straight out from the eye. Once the suction is broken, the mold can be removed from the eye with the bottom coming out first.

12. As soon as the mold is removed from the eye place it in a cup of water to prevent it from dehydrating.

13. Irrigate to remove any excess molding material that might have been left in the cul-de-sac. If there are significant sized pieces left in place they can be removed with a moistened cotton tipped applicator. Usually there is very little left in place.

14. Inspect the eye with fluorescein and the biomicroscope. Usually there will be mild, superficial stippling which will clear in an hour or so.

C. Impression Taking (injection procedure):

The injection procedure is similar to the insertion technique except after mixing the molding material it is put into a syringe. The molding shell is placed under the lids, being held away from the eyeball, and then the molding material is injected through the handle of the shell onto the eye.

It is easier if one person put the molding shell in place while a second person mixes and injects the molding material. One must be careful not to use too much pressure when injecting the material as this can distort the cornea giving an incorrect impression. Removal of the mold and follow-up are the same as described above.

D. Fabricating the Eye Model

1. A dental stone copy of the mold must be made. The dental stone comes as a powder and is mixed in a rubber bowl with water to a thick toothpaste consistency. It should be spatulated against the side of the bowl to prevent bubbles forming. It is then placed in the mold and will harden to at stone consistency. If too much water is added it will be soft and crumble.

2. Once the stone is mixed up, remove the mold from the water, blot the surface to remove excess water. If a dental vibrator is available, hold the mold handle on the vibrator and spatulate the dental stone into the mold. The vibrator will get rid of any bubbles that form. If a vibrator is not present tap the handle of the impression shell on the table surface to force any bubbles out. Be care when putting the impression material in the mold not to trap bubbles against the impression surface.

3. Place the impression shell with the mold up right in the vial that the impression material came in to allow the dental stone to harden.

4. The dental stone will harden enough to handle in an hour or two. Before it is completely hardened mark on the back of the eye model using a sharp object the horizontal line (using the temporal mark on the shell), nasal and temporal positions, which eye, and patient's name on the back of the shell. Allow the dental stone at least 24 hours to completely harden.

5. If there are any sharp edges on the eye model they can be smoothed with a file to prevent chipping of the eye model.

6. Often during molding there will be folds in the conjunctiva that show up as ridges on the eye model. These can be smoothed or scraped off using a razor blade.

E. Copying the Eye Model

1. The eye model should be copied so that if an eye model is fractured or broken during the pressure process you will not have to take another eye impression and start over.

2. With one method of copying the eye model you must do the following steps:

   a. First soak the eye model in water for a few minutes and make sure that it is hydrated.

   b. Coat the eye model with a separating agent such as Kerr Super-Sep. Spread the fluid generously and evenly over the eye model and allow it to dry.

   c. Take modeling clay and build up a bowl around the eye model so that the eye model sits upright in the bottom of the modeling clay bow. Make sure the eye model is pressed into the clay so that dental stone cannot get under the eye model as this will make it difficult to separate the two pieces of dental stone.

   d. Mix dental stone according to the previous directions and pour the dental stone into the bowl cavity over the eye model.

   e. Place the eye model, modeling clay bowl and the poured dental stone on a stone on a dental vibrator and vibrate the bubbles out of the mixture.

   f. After the dental stone has hardened, remove the clay and separate the eye model from the newly formed negative of the model.

   g. Soak the negative in water for a few minutes.

   h. Coat the surface of the negative with the dental separator and allow to dry.

   i. Mix dental stone according to the previous directions and pour the dental stone mix into the cavity of the negative. Place the negative on a dental vibrator and drive the air bubbles out of the mix and allow it to "set". Then separate the eye model from the negative. Now you have a second eye model which is an exact duplicate of the first eye model.

   j. With each negative and additional eye models that are made be sure to transfer the marking (horizontal line, temporal and nasal, name, right or left eye, and date) accurately so that this information will be on all eye models.

3. Another technique of copying the eye model is by the use of silicone elastic

impression materials. This technique requires the following steps:

a. Soak the eye model in water so that it is hydrated.

b. Mix the silicone elastic impression material (a type is the Kerr Syringe Elasticon) according to the directions supplied. Spatulate the material into a small cylinger which is closed at one end (one and one-half inches in diameter and _ inch deep).

c. Press the eye model gently into the impression material until the back of the eye model is flesh with the impression material. Allow the material to "set". This takes only several minutes.

d. Transfer the markings from the eye model to the impression material.

e. Remove the eye model from the rubbery impression material. This will leave a very accurate and stable negative of the eye model.

f. Next mix the dental stone according to the previous directions and pour into the negative. Vibrate it on the dental vibrator to remove the bubbles. Allow it to harden and then remove the eye model after marking it. The negative can be used repeatedly and will remain useful indefinitely.

F. The corrections and modifications of the eye model to obtain the proper clearances and a suitable fit.

1. Obtaining proper corneal and transitional (limbal) clearances.

   a. Clearances desired.
      Normally a clearance of about 0.20 mm is desired over the corneal area (between the cornea and the back of the lens). This clearance must extend out over the limbus by 1 – 2 mm. The junction between the area of clearance and the haptic portion should be tapered. There are several ways to do this.

   b. Cornea-transition-scleral shim technique

      1. A very satisfactory method to obtain corneal and transition clearances with any shaped eye is to use shims on the eye model. These shims are usually thin sheets of plastic of known thickness. The thickness and shape can be varied depending on the amount of corneal and transition clearance desired.
      2. Using a pencil to mark the limbus on the eye model.

3. The shim material for the proper corneal-transition clearance is usually about 0.20 mm thick. Flexible plastic sheeting available at hardware stores can be used. The shim material is cut into a two inch square and lubricated on one side by silicone or other grease to prevent it from sticking to the plastic sheets and placed against a two inch square of plastic 1.0 mm thick for support (the technique of forming and pressing the plastic will be covered in greater detail later). The two pieces of plastic are held over a heating unit. An infra-red frame warmer or a small electric hot plate are suitable. The material is heated to the point that it is soft and pliable and then is placed on the base of the press with the thin sheet on top. The eye model is forced down into the plastic sheets by means of the press and the pressure is held until the plastic cools and sets

4. The eye model and sheet is removed. The remaining shim material is left on the eye model. The shim is trimmed with a razor blade 1 –2 mm beyond the limbus. The corneal shim is then glued in place on the eye model.

5. When a lens is placed on an eye which has been fabricated from an impression of the eye, it will often be noted that there is an excessive negative pressure holding the lens against the eye. This excessive clinging action will result in poor pumping or exchange of fluid under the haptic section and there will be resultant irritation and redness of the eye.

6. To eliminate this tightness use a shim over the whole eye model and the corneal-transition shim. This cover shim should be 0.08 mm to 0.14 mm thick. It is pressed over the whole eye model in the same manner as the corneal shim was pressed on. This will result in a smooth transition between the transition and sclera section. This additional increase in flattening of the haptic radius will result in a decrease in the clinging of the lens on the eye, a decrease in the relative negative pressure under the haptic and a minimizing of the physiological insult to the eye.

G. Forming the final shell.

1. Take two squares of plastic (PMMA) two inches square, about 1.0 mm thick. Place the silicone lubricant on one piece of plastic and then place them together. Next, place a thin coat of silicone lubricant on the front surface of the shim on the eye model. Heat the two sheets of plastic and then form the plastic over the

eye model with a press. Remove the outer plastic and the remaining plastic forms the shell with a known corneal, transition, and scleral clearance.

2. The shell must be cut down to the proper size and shape. This is done by grinding away the excess plastic with a fairly rough grinding wheel or hand grinder. A rough stone is used so that excess heat is not generated. The final lens is usually about 22 to 23 mm in diameter. The lenses are usually round or horizontally oval with more haptic portion on the temporal side.

3. Once the approximate size and shape is roughed out with the grinder, a hand file is used to finish shaping the lens and to get the approximate edge contour. Next emery paper is used to further contour the edge and eliminate the larger grooves of the file. Finally the edge is polished using a buffing wheel with jeweler's rouge or using a felt pad and silvo. The edge contour is important and the edge should be rounded and contoured similar to that of a corneal lens but on a larger scale of course. The edge contour and polish should be examined under a stereomicroscope.

4. At this point the lens can be placed in the eye. The lens should be inserted and allowed to settle for several minutes. A felt marking pen should be used to dot the front of the shell where the center of the optic should be placed. Normally this is over the center of the pupil unless the pupil is decentered due to trauma, cataract surgery, etc. In the case of a decentered pupil the optic should be centered with respect to the optics of the eye which would be at the center of the cornea.

5. The point where the fenestration is to be located should also be marked. The fenestration is usually placed over the limbus on the temporal side of the cornea in the shadow of the upper lid and lashes. It may be placed in other locations for functional or cosmetic reasons.

6. Fenestrating the lens.

   The fenestration is usually 0.8 to 1.0 mm in diameter. The fenestration is placed in the lens by a small frill bit mounted in a handle. Slowly turn the drill bit by hand applying a constant, gentle pressure. So not force or hurry this procedure since it could cause chipping at the edge of the hole. The openings of the hole should be tapered giving a slight funnel shaped opening and then should be polished with a felt point and silvo being careful not to create too much heat during polishing which could cause crazing of the plastic.

7. Fabricating the back optic.

   The back of the shell is marked with a felt marking pen. The lens is placed on a radius lap to determine which radius approximates the back of the shell. If the radius is too steep the markings in the center will be removed. If it is too flat the center will not be touched and a peripheral band of ink will be polished away. Usually a radius 0.4 to 0.6 mm flatter than the flattest K reading is used. An optical zone in the range of 7.0 to 8.0 mm in diameter is fabricated on the lens. The radius tool can be a diamond impregnated abrasive lap or tape covered metal tool used with grit to grind out the optical zone. The surface is polished with wax or pitch laps or a pad covered lap with Silvo, Lustrex, or other suitable polish. The back surface formed should be read easily with the radiuscope without a distorted image.

8. The shell is now complete except for the front optic. Before the front optic is fabricated the fit should be examined and any initial modifications should be made. The fabrication of the front optic will be discussed later.

H. Presses Used to Form the Shells

1. One of the simplest presses is a cylinder of plastic or metal which has an inside diameter of 1 _ to 2 inches and has one end closed. The eye model is placed on a block about 1/8 to _ " high so that the eye model is slightly off the table top. The plastic sheet to be pressed is heated until it is very flexible. It is then placed over the eye model and the cylinder (open end) is forced down over the eye model and plastic. The air pressure in the tube causes the plastic to conform to the eye model. When the plastic has cooled (a few minutes), it can be removed and is ready to be ground down to size. (See Brit. J. Of Physiological Optics, Vol. 25, no. 1, 1966 for further details.)

2. A second type of simple press is a bottle capper type press. This type of press has a piston which is used to force the eye model down into the heated plastic. One of these small presses can be obtained in many department stores. The base must be modified by placing a cylinder of fairly hard rubber (held in a metal cylinder for support) on the base. The rubber should have a depression of about on inch in diameter for the eye model to be pressed into. Also the arm holding the pisten may have to be shortened on these presses.

I. Prescription and Front Radius Fabrication

The prescription to be ground into the lens must be determined. This can be accomplished by one of the following methods:

1. Use of a Corneal or Preformed Lens

Since the haptic shell which you are fitting does not have good optics, the patient cannot be refracted with it on the eye. A suitable corneal lens or preformed haptic lens with optics can be used when doing the refraction to determine the prescription needed. If the base curve is different than the molded lens you are fitting this must be taken into account.

Example:

Corneal lens: B.C. 7.50 mm
Power -3.00
Refraction over corneal lens: -1.00
B.C. of molded haptic: 7.80 mm
What power is needed in haptic lens?
With a 7.50 mm B.C., -4.00D. is needed.

7.50 to 7.80 B.C. is a change of –1.75 D. in the lacrimal lens.

Thus the haptic lens needs –2.25 D.

2. Use of corneal readings and spectacle prescription.

The base curve of the haptic lens is known and if the K readings and spectacle Rx are known the power required can be calculated.

Example:

Spectacle Rx: -8.00 (vertex dist. 12 mm)
K readings: 45.00 D sph.
B.C. of haptic lens: 7.80 mm

What power is needed in the haptic lens:

7.80 mm = 43.25 D
Difference between K and B.C. is 1.75 D.
-8.00 @12 mm = -7.25 @ the cornea
-1.75 D from tear layer so you need –5.50 D. in the lens

This method is usually not as accurate as refracting over a diagnostic contact lens and cannot be used with a distorted cornea.

3. Determination of the Front Radius

To determine the front radius the base curve must be converted to diopters using the index of plastic. The prescription to be ground into the lens is then taken into account to determine the power of the front surface (considering center thickness to be zero). Then the front surface power is converted to millimeters of radius. Since the radii are short the lens must be treated as a thick lens. The center thickness (usually 0.40 to

0.80 mm depending on the prescription) in mm is divided by 3 to obtain a correction factor which must be added onto the front radius (the thickness effectively adds plus power which must be compensated for by a longer front radius).

Example: Want a PMMA lens with –2.00 D., 0.60 mm c.t., 8.20 mm B.C. and index of 1.49.

8.20 mm = -59.76 D.
    2,00 D. prescription
    +57.76 D. front power if c.t. = 0

+57.76 D. = 8.48 mm
    0.20 mm c.f. for c.t. of 0.60
    8.68 mm is desired c.t.

4. Cutting and Polishing on Front Surface

   a. Cutting the front optic

   The lens is mounted on a convex lap by means of a mounting wax. It is then placed on the spindle of the lathe and the desired radius and c.t. is cut.

   b. Eliminating the groove on the front surface

   After the front optic is cut on the lens there is a ledge or groove left at the junction of the front optic and haptic sections.

   This can be eliminated by either changing the radius setting of the lathe gradually from that used to cut the front optic and gradually cutting this ledge away or by placing a razor blade against this ledge as the lens spins and cuts the ledge away. After the above is done there will be groove marks that can be polished away by using a cotton-tipped applicator with Silvo on it and holding it in this region to polish the junction (similar to what is done on lenticular corneal lenses).

   c. Polishing the front optic

   When the front optic is cut on the lens with the lathe, there are lathe marks left on the surface. These must be polished out by using either small concave buttons covered with tape or concave wax tools of the proper radius. A standard polishing compound is used. This is the same procedure used when making corneal lenses.

J. Modifications

1. Appearance of a well fitted lens.

   a. Using a pen light, the haptic area should be examined for tight areas. If the lens is too tight in a given area, the sclera will look white or "blanched" in this area due to the blood vessels being compressed and the blood forced out of them. The tight areas become more prominent if slight pressure is applied to the front of the lens. Also having the patient fixate in different directions helps one to detect tight areas. The haptic area should fit uniformly with no blanched areas.

   b. The fit of the lens should be examined using fluorescein. It is best to place the fluorescein in the solution in the lens before it is inserted. The patient should be allowed to wear the lens several minutes before the fit is evaluated. The fluorescein pattern should show an even clearance over the corneal area and from 1 to 2 mm peripheral to the limbus. The limbus must be cleared completely if the lens is to be comfortable.

   c. A bubble may be present, however, it is not necessary to have a bubble for a good fit. If there is a bubble, it should be 1/4 inch by 1/8 inch sausage shaped and should be located over the corneo-scleral junction. The best location of the bubble is temporal or superiorly but should not be in the lower nasal or inferior positions since this will interfere with vision during reading and close work. The bubble must be mobile with different gazes but should not break across the pupil. It will enlarge with versions.

   d. Under the haptic portion of the lens, there should be practically no fluorescein. If the haptic has loose areas, fluorescein will be pooled in these areas. If there is edge stand-off fluorescein will be seen under the haptic edge and must be corrected.

   e. The fit should be examined for "cling" (the relative negative pressure under the lens due to a "glove" or perfect fit of the haptic). If a suction cup is applied to the front of the lens, one should be able to lift the lens easily away from the eye. If there is "cling" this will be difficult and the eyeball will even move forward as one tries to pull the lens straight forward from the eye.

2. Haptic Tight Areas

   If a tight area occurs, with resultant scleral injection and discomfort as the lens is worn for a period of time, this tightness must be relieved. First the tight area is marked on the lens with a felt marking pen as the patient wears the lens. The lens is then removed and the area on the ocular surface, where the plastic is to be removed, is

coated with ink using a felt marking pen. The plastic is ground away by 1) holding the lens against a diamond impregnated radius lap and selectively ground at the desired position, 2) using an emery grinding ball, 3) an abrasive rubber grinding point, or 4) a dental burr. After the desired amount of plastic is removed (only remove 0.05 to 0.10 mm at a time depending on the harshness of the tight area or the clearance desired), the area is polished using Silvo, Lustrox, or similar polish on a small felt polishing wheel. The lens is then inserted and the fit is again examined. If the tight area still remains the above procedure must be repeated.

3. Central Corneal Touch

   If the fluorescein pattern shows a central corneal touch, this must be eliminated by increasing the corneal clearance. The clearance is increased by doing a corneal grind-out using a radius lap (same procedure as was used to fabricate the back optic). The same radius may be used as was used to fabricate the back optic, which results in a uniform increase in corneal clearance when first fitted may eventually need one or more corneal grind-outs and limbal grind-outs (to be discussed later) to obtain a comfortable and satisfactory fit.

4. Excessive Corneal Clearance

   If the corneal clearance is too great there will be a large bubble over most of the corneal area. To correct this one must perform a "haptic let-down". The same procedure is used in this case as is done for a tight haptic area except plastic is uniformly removed over the whole haptic area allowing the lens to settle back towards the eye eliminating the excessive corneal clearance.

5. Limbal Tightness

   On fitting a lens or after a period of lens wear, if the fluorescein pattern shows that there is no limbal clearance, a limbal grind-out must be done. the procedure is again similar to eliminating a haptic tight area. The area to be worked on is marked with a felt pen as the patient wears the lens. The tight area and area of desired clearance must be marked as accurately as possible. After removing the lens, the back optic should be protected from possible scratching or distortion during the grinding, pumice, and polishing stages by covering it with a small piece of tape. The area to be removed should be coated with the felt pen, allowing one to know where he is removing plastic during the grinding. Again plastic should be removed in small steps since the procedure can be repeated to remove more plastic but it cannot be replaced if too much is removed.

6. Lens Correction

a. If after fenestration the bubble is large the lens may not be centered correctly. Opposite the bubble there may be a peripheral corneal touch.

1. First check for a tight area peripheral to the bubble in the haptic area. A tight area in this region will not allow the lens to center correctly. It is the first area that should be corrected.

2. If the bubble is temporal and the corneal touch is on the Nasal side, check the nasal flange width to determine if it is too wide causing the lens to be pushed temporally. If this is the case, the flange width must be reduced.

3. If no tight area is found, treat the lens as if there is a tight area in the region of the haptic peripheral to the bubble. Ease this area and usually this allows proper centration.

7. Large, Immobile Bubble with Proper Lens Centration

This is due to excessive clearance on one side of the corneal-transition section. This may be corrected by doing a haptic "let-down" on the haptic area peripheral to the bubble. Usually an area on one-third to one-half the circumference of the haptic must be let down.

Recommended reading material:

Bier N, Lowther GE. Contact Lens Correction. Butterworth, London 1997. chapters 7-11.

Ruben M, Guillon M. Contact Lens Practice. Chapman & Hall Medical, London 1994. chapter 31.

Phillips A, Stone J. Contact Lenses, 3rd edition. Butterworths, London 1989. chapter 18.