

Surgical Manual for the administration of LUXTURNA®

IMPORTANT

The purpose of this Surgical Manual is to provide information to surgical personnel on the administration of LUXTURNA® (voretigene neparvovec) in accordance with the Singapore package insert.

If you have questions about the administration procedure and materials used for the administration of voretigene neparvovec, please contact your Novartis representative.

LUXTURNA® (voretigene neparvovec) is indicated for the treatment of adult and paediatric patients with inherited retinal dystrophy caused by confirmed biallelic RPE65 mutations and who have sufficient viable retinal cells as determined by the treating physician(s).

Disease-causing biallelic RPE65 mutations should be confirmed by an accredited laboratory using validated assay methods.

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Purpose of the Surgical Manual

This Surgical Manual describes the materials and procedures necessary to perform subretinal injection of LUXTURNA® (voretigene neparvovec). This manual does not describe procedures for performing standard 3-port Pars Plana Vitrectomy (PPV). Only surgeons experienced in performing macular surgery who undergo the Surgical Education Program in subretinal injection procedures should administer voretigene neparvovec.

This manual does not describe pharmacy procedures for preparing voretigene neparvovec for administration. Please consult the voretigene neparvovec Pharmacy Manual for more information about pharmacy procedures for preparing voretigene neparvovec.

Voretigene neparvovec is delivered via subretinal injection using a commercially available subretinal injection cannula. Subretinal injection is performed after a PPV. Voretigene neparvovec must only be administered by subretinal injection.

Required Materials

The treatment center should have standard equipment and supplies used in vitreoretinal surgery available in the operating room on the day of the procedure. All materials required for a standard PPV are to be provided by the treatment center. In addition to these standard materials, the treatment center must also supply the items listed below and described further in following sections:

- Subretinal injection cannula (with a polyamide micro tip with an inner diameter of 41 gauge)
- Extension tube (made of polyvinyl chloride no longer than 6" (15.2cm) in length and with an inner diameter no greater than 1.4mm).
- Two sterile syringes containing diluted voretigene neparvovec (1 primary syringe and a second back-up syringe to be provided by the pharmacy).

Subretinal injection cannula

Table 1 lists subretinal injection cannulas that have been tested in biocompatibility experiments for use with voretigene neparvovec. Each of these cannulas were commercially available as of the date of this manual.

Figure 1 shows a representative subretinal injection cannula.

Table 1. Biocompatible subretinal injection cannulas

Product description	Manufacturer	Reference number
PolyTip® cannula 25 g/38 g* 25 g x 28 mm cannula with 38 g (0.12 mm) x 5 mm tip	MedOne Surgical, Inc. Sarasota, FL	3219
De Juan/Awh subretinal injection cannula 25 g/41 g 41 g (0.10 mm) tip	Synergetics, Inc. USA - Bausch & Lomb, Inc. O'Fallon, MO	12.03.25

* Inner diameter 41g (gauge).

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A back-up subretinal injection cannula should be available for each administration of voretigene neparvovec.

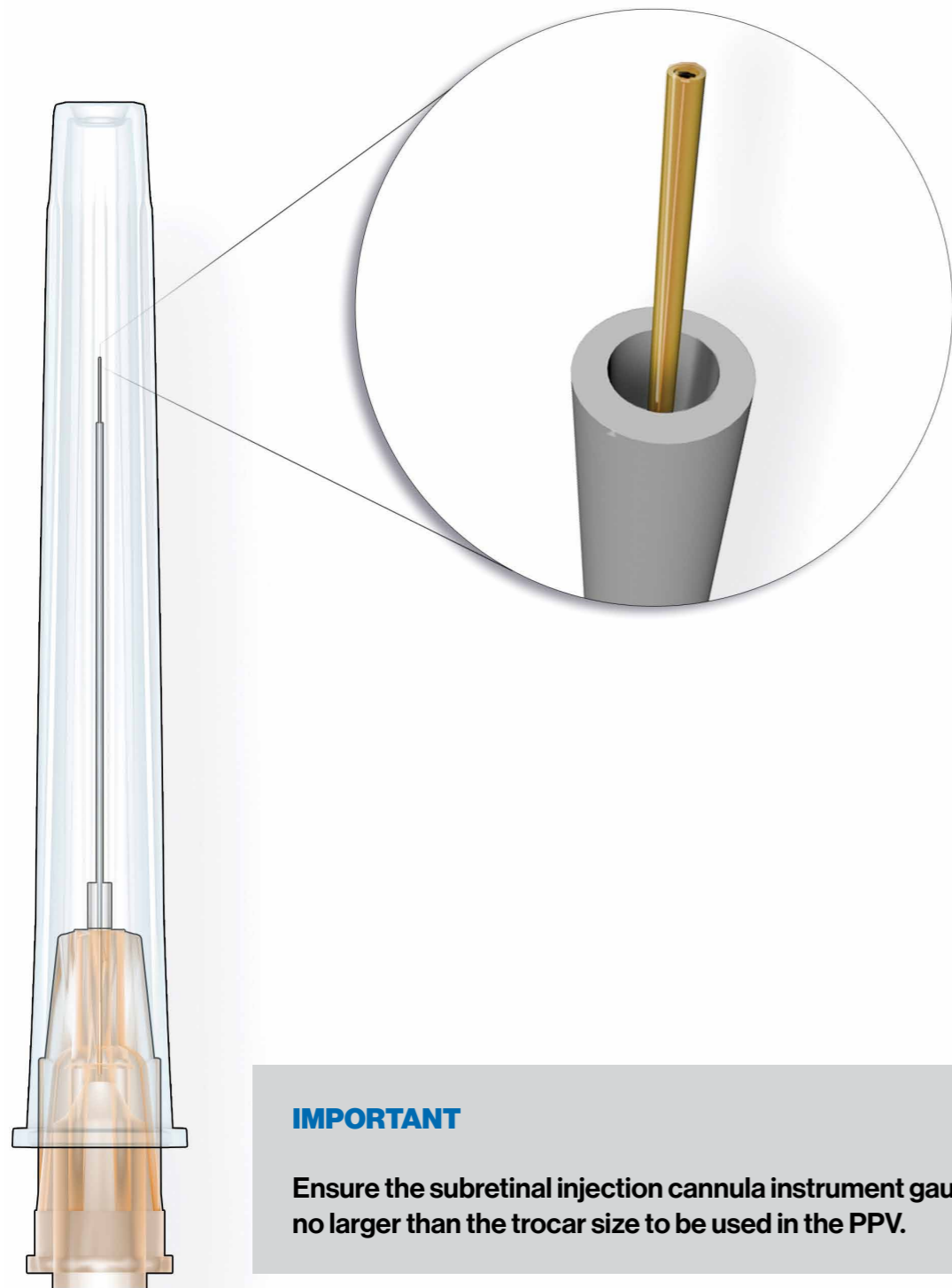


Figure 1. Representative subretinal injection cannula (model shown: PolyTip® cannula 25 g/38 g by MedOne Surgical, Inc., Sarasota FL; reference number 3219). Image copyrights Spark Therapeutics.

Extension tube

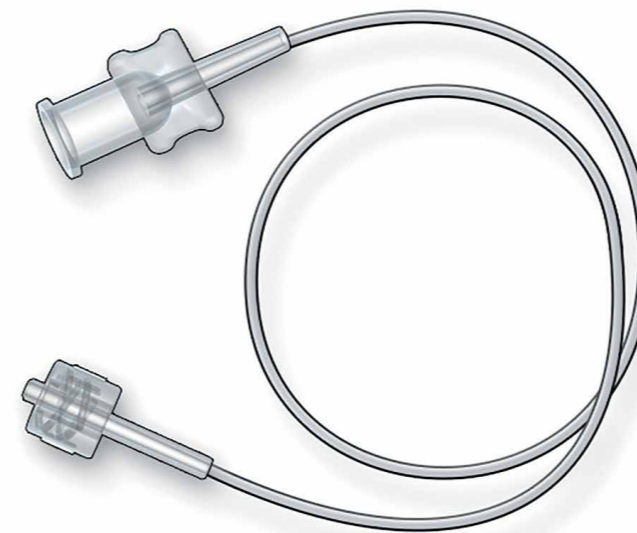
Table 2 lists extension tubes that have been tested in biocompatibility experiments for use with voretigene neparvovec. Each of the listed extension tubes was commercially available as of the date of this manual.

Figure 2 shows a representative extension tube.

Table 2. Biocompatible extension tubes

Product description	Manufacturer	Reference number
Ocular irrigation tube 15.2 cm (6"), ID 0.8 mm, OD 1.6 mm male/female Luer lock connections	Eagle Labs Rancho Cucamonga, CA	169-30L-6
High pressure extension tube 15.2 cm (6"), ID 1.4 mm, OD 2.29 mm, PVC tube with male and female Luer lock connections	MedOne Surgical, Inc. Sarasota FL	3243

ID= inner diameter; OD= outer diameter.



IMPORTANT

Use one of the recommended extension tubes. To avoid excess priming volume, do not use a tube longer than 6" (15.2 cm) or with an ID greater than 1.4 mm.

Figure 2. Representative extension tube (model shown: ocular irrigation tube by Eagle Labs, Rancho Cucamonga CA; reference number 169-30L-6).

Syringe

IMPORTANT

- The pharmacy will prepare 2 syringes of voretigene neparvovec.
- The first syringe will be used to administer the product and the second syringe will serve as a back-up supply.
- Each 1-mL syringe will contain 0.8 mL of voretigene neparvovec.
- Maintain voretigene neparvovec at room temperature until administration.
- Begin administration procedure within 4 hours from the preparation of voretigene neparvovec by the pharmacy.
- Following administration, all materials (including the back-up syringe) should be discarded into a biohazard container.
- Refer to local biosafety guidelines for the handling and disposal of the product.

Table 3 lists a commercially available syringe that has been tested in biocompatibility experiments for use with voretigene neparvovec. This syringe was commercially available as of the date of this manual.

Figure 3 shows this syringe.

Table 3. Biocompatible syringe

Product description	Manufacturer	Reference number
BD Luer-Lok™ 1-mL disposable syringe Has 1/100 mL graduations	Beckton, Dickinson & Company Franklin Lakes NJ	309628

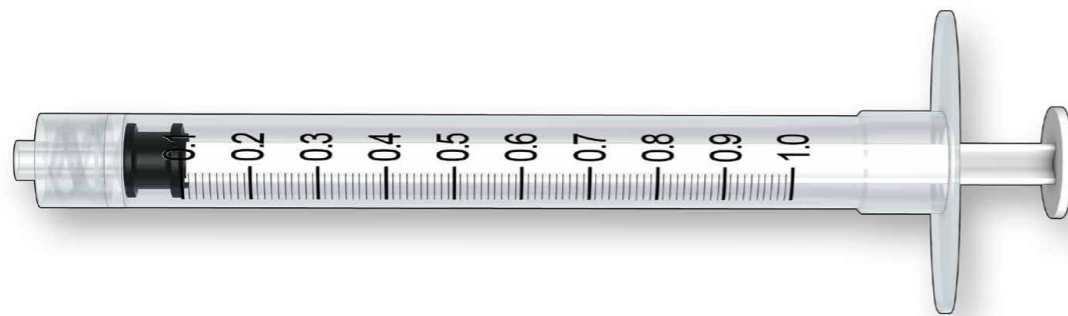


Figure 3. Representative syringe (model shown: BD Luer-Lok™ 1-mL disposable syringe, Franklin Lakes NJ; reference number 309628). Image copyrights Spark Therapeutics.

Procedure

Preoperative procedures

Immunomodulatory regimen

In addition to standard preoperative and postoperative procedures, subretinal injection of voretigene neparvovec requires administration of an immunomodulatory regimen of prednisone.

Prior to initiation of the immunomodulatory regimen and prior to administration of voretigene neparvovec, the patient must be evaluated for symptoms of active infectious disease of any nature. In case of such infection, the start of the immunomodulatory regimen and subsequent voretigene neparvovec treatment must be postponed until after the patient has recovered.

Starting 3 days prior to the administration of voretigene neparvovec to the first eye, it is recommended that an immunomodulatory regimen is initiated following the schedule outlined in Table 4. Initiation of the immunomodulatory regimen for the second eye should follow the same schedule and supercede completion of the immunomodulatory regimen of the first eye. Patients will be on a systemic immunomodulatory regimen for a minimum of 18 days up to a maximum of 30 days, depending on the timing of the administration of voretigene neparvovec to the second eye.

Table 4. Preoperative and postoperative immunomodulatory regimen for each eye

Preoperative	3 days prior to administration	Prednisone (or equivalent) 1 mg/kg/day (maximum of 40 mg/day)
	4 days (including the day of administration)	Prednisone (or equivalent) 1 mg/kg/day (maximum of 40 mg/day)
Postoperative	Followed by up to 5 days	Prednisone (or equivalent) 0.5 mg/kg/day (maximum of 20 mg/day)
	Followed by 5 days of one dose every other day	Prednisone (or equivalent) 0.5 mg/kg every other day (maximum of 20 mg/day)

Surgery logistics

The logistics and processes of scheduling surgery, preoperative care, and transportation of the product from the pharmacy to the operating room, is dependent on timely, efficient and concise communication between all parties.

Once the surgery date and time have been determined, confirm that the surgeon, assistant, operating room staff and pharmacy staff have been informed and are expecting to be available at the designated surgical date and time.

Confirm availability of the product with the pharmacy at least one day prior to surgery and specify the mode or person transporting the product from pharmacy to the operating room.

The patient will undergo the preoperative evaluation and assessment by nursing staff and anesthesiology in the fashion customary for outpatient eye surgery.

IMPORTANT

After the patient has been cleared for surgery by the anesthesiologist, operating room staff calls pharmacy to release the order for product preparation. Do not induce anesthesia before the product has been prepared and delivered to the operating room.

IMPORTANT

Two syringes (a primary syringe and a second back-up syringe) must be delivered from the pharmacy.

IMPORTANT

Once voretigene neparvovec has been delivered to the operating room, dilate the eye and give adequate anesthesia to the patient.

Surgical procedure overview

Method of administration

Voretigene neparovec must not be administered by intravitreal injection. The product is administered as a subretinal injection after vitrectomy in each eye. Following subretinal injection, patients should be instructed to report any symptoms suggestive of endophthalmitis or retinal detachment without delay and should be managed appropriately.

The administration of voretigene neparovec should be carried out in the surgical suite under controlled aseptic conditions. Once availability of the product from the pharmacy is confirmed, adequate anaesthesia should be given to the patient prior to the procedure. The eye to be injected must be dilated, and a broad-spectrum microbiocide should be topically administered prior to the surgery according to standard medical practice.

Intraocular pressure should be monitored prior to, and following administration of the product, and managed appropriately.

Special precautions for disposal and other handling

Avoid accidental exposure and follow universal biohazard precautions for preparation, administration and handling of voretigene neparovec.

- Wear personal protective equipment (e.g. laboratory coat, safety glasses, and gloves) while preparing or administering voretigene neparovec.
- Avoid accidental exposure to voretigene neparovec, including contact with skin, eyes, and mucous membranes. Cover any exposed wounds before handling.
- Treat all voretigene neparovec spills with a virucidal agent such as 1% sodium hypochlorite and blot using absorbent materials.
- Dispose of all materials that may have come in contact with voretigene neparovec (e.g. vial, syringe, needle, cotton gauze, gloves, masks, or dressings) in accordance with universal biohazard precautions.

Accidental exposure

- In the event of an accidental occupational exposure (e.g. through a splash to the eyes or mucous membranes), flush with clean water for at least 5 minutes.
- In the event of exposure to broken skin or needle stick injury, clean the affected area thoroughly with soap and water and/or a disinfectant.

IMPORTANT

This medicine contains genetically modified organisms. Unused medicine and waste products must be disposed of in compliance with the institutional guidelines for genetically modified organisms or biohazardous waste, as appropriate.

Surgical team

Subretinal injection of voretigene neparovec requires coordination between a lead surgeon and an assistant (Figure 4). Effective communication between the surgical team members during the surgical procedure is required to ensure the appropriate administration of voretigene neparovec. The lead surgeon and the assistant should agree upon communication signals for when to start injecting and when to stop.

The lead surgeon will have primary responsibility for the procedure, including the following tasks:

- Inspection of materials
- Injection apparatus assembly and preparation
- PPV
- Preparation of injection site
- Insertion of the subretinal injection cannula into the retina during the subretinal injection procedure
- Post-injection procedures

The assistant will handle the syringe containing voretigene neparovec during the subretinal injection procedure and control the speed of injection of the drug while the lead surgeon maintains the subretinal injection cannula in the proper position.

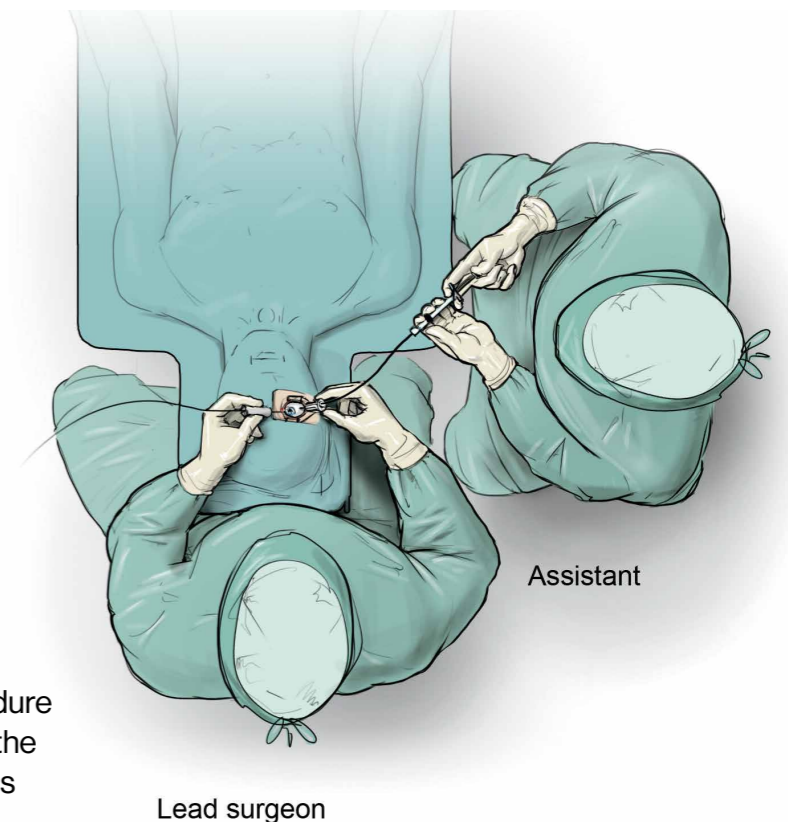


Figure 4. Lead surgeon and assistant positions in relation to patient (view without surgical microscope). Image copyrights Spark Therapeutics.

Surgical procedure components

Subretinal injection of voretigene neparovec requires that a PPV be performed prior to subretinal injection. The PPV should be carried out using standard surgical and medical procedures and is not described in detail in this manual.

Inspection of materials

- 1 In the operating room and prior to use, the lead surgeon should inspect the packaging of the subretinal injection cannula and the extension tube to ensure that sterility has not been compromised and the contents have not been damaged. If the tip of the cannula has been deformed, a new subretinal injection cannula must be used.
- 2 Prior to administration, the lead surgeon should inspect the voretigene neparvovec contained within both syringes (primary syringe and second back-up syringe). If particulates, cloudiness, or discoloration are visible, do not use the product.

CAUTION

In the event that the subretinal injection cannula is damaged or compromised, DO NOT use the damaged cannula. Instead, inspect the back-up subretinal injection cannula and, if not damaged or compromised, use the back-up subretinal injection cannula for the procedure.

Injection apparatus assembly and preparation

Within the sterile field, connect the syringe containing the diluted voretigene neparvovec to the extension tube and subretinal injection cannula (Figure 5). Then inject the product slowly through the extension tube and subretinal injection cannula to eliminate any air bubbles.

Preparation of materials in the sterile field

- 1 On the sterile field, remove the subretinal injection cannula from its packaging and place on the sterile drape, leaving the clear plastic sheath covering the cannula tip in place.
- 2 Remove the extension tube from its packaging and place on the sterile drape.
- 3 Remove both syringes containing voretigene neparvovec from the sterile plastic bag and place them on the sterile drape.

Assembly of the components

- 1 Attach the male Luer-Lok™ end of the extension tube to the subretinal injection cannula, leaving the clear plastic sheath covering the cannula in place (Figure 5).
- 2 Attach primary syringe containing voretigene neparvovec to the female Luer-Lok™ hub of the extension tube.

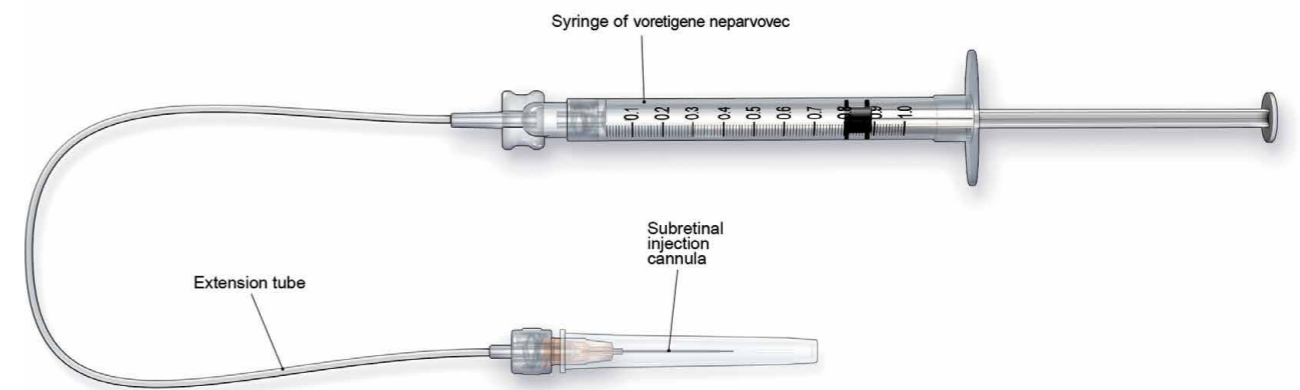


Figure 5. Injection apparatus assembly. Image copyrights Spark Therapeutics.

Filling of the subretinal injection cannula

in the sterile field over the sterile drape

- 1 Remove the plastic sheath from the tip of the subretinal injection cannula. Take care to avoid excess manipulation of the unsheathed cannula tip to avoid cannula deformation or damage.
- 2 Position the cannula tip over a sterile biosafety waste container.
- 3 Hold the syringe vertically with the Luer-Lok™ hub positioned upward, and inject the product slowly through the extension tube and the subretinal injection cannula to eliminate air bubbles. Continue injecting until 0.3 mL of voretigene neparvovec remains in the syringe, and the extension tube and the subretinal injection cannula are completely void of air. Local biosafety guidelines for preparation, administration and handling of voretigene neparvovec should be followed (Figure 6).
- 4 Confirm the volume of product available in the syringe for injection, by aligning the plunger tip with the line that marks 0.3 mL.
- 5 Store the filled subretinal injection cannula in a sterile location until the time of subretinal injection.

IMPORTANT

Begin administration procedure within 4 hours from the preparation of voretigene neparvovec by the pharmacy.

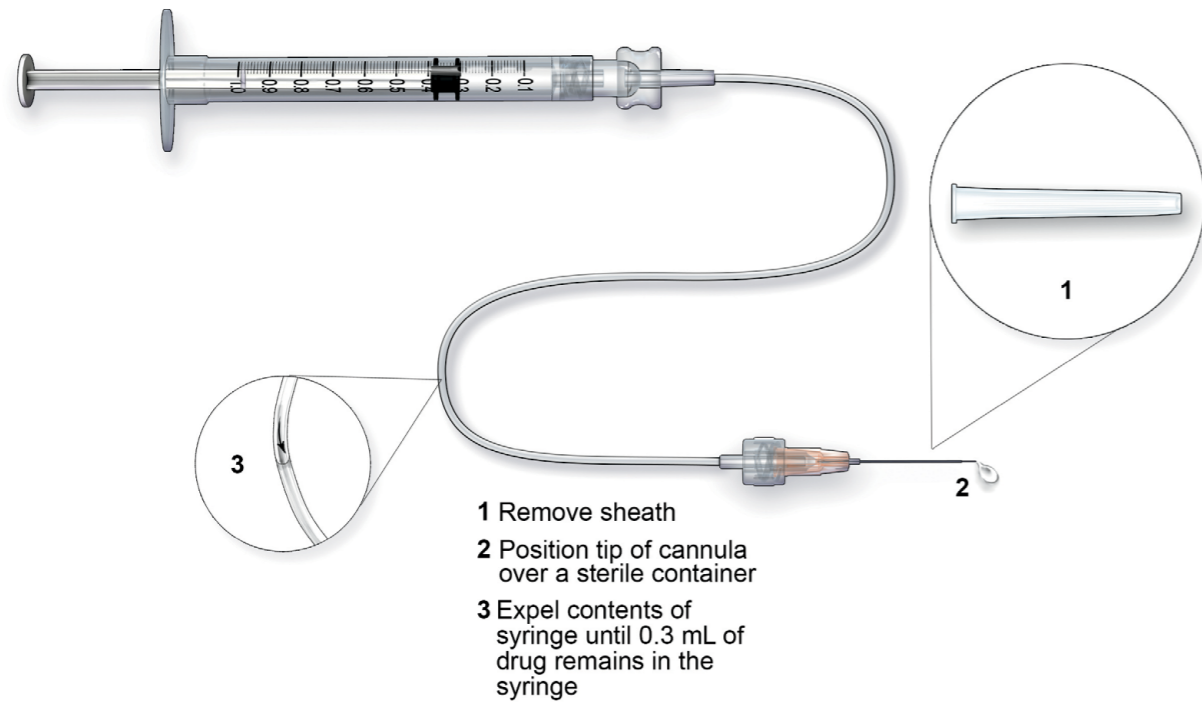


Figure 6. Filling of the subretinal injection cannula.
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Pars Plana Vitrectomy (PPV)

IMPORTANT

Avoid use of valved trocars to prevent damage to the subretinal injection cannula tip and to help prevent an increase in intraocular pressure (IOP) during the subretinal injection. If valved trocars are used, consider removing the valve cap of the trocar before insertion of the subretinal injection cannula.

- 1 Perform a 3-port PPV per the standard of care.
- 2 Trocar placement is standard of care for macular surgeries.

IMPORTANT

Ensure that the vitreous is removed as completely as possible, particularly in the area of superior sclerotomy sites. Vitreous base removal with scleral depression is not necessary.

- 3 Induce a posterior vitreous detachment and assure that the posterior cortical vitreous is removed by standard means.

Preparation of injection site

Injection site inspection and preparation

- 1 Inspect the macular region and intended injection site.
- 2 Using a Tano Diamond Dusted Membrane Scraper (DDMS™; Synergetics USA, O'Fallon MO) or similar instrument, ensure that no vitreous remains over the macula or at the injection site.
- 3 If a visible epiretinal membrane (ERM) is present, the ERM should be removed according to standard procedures prior to subretinal injection.

IMPORTANT

No dyes or triamcinolone were used to aid vitreous visualization or ERM removal during clinical trials of voretigene neparvovec.

Injection site selection

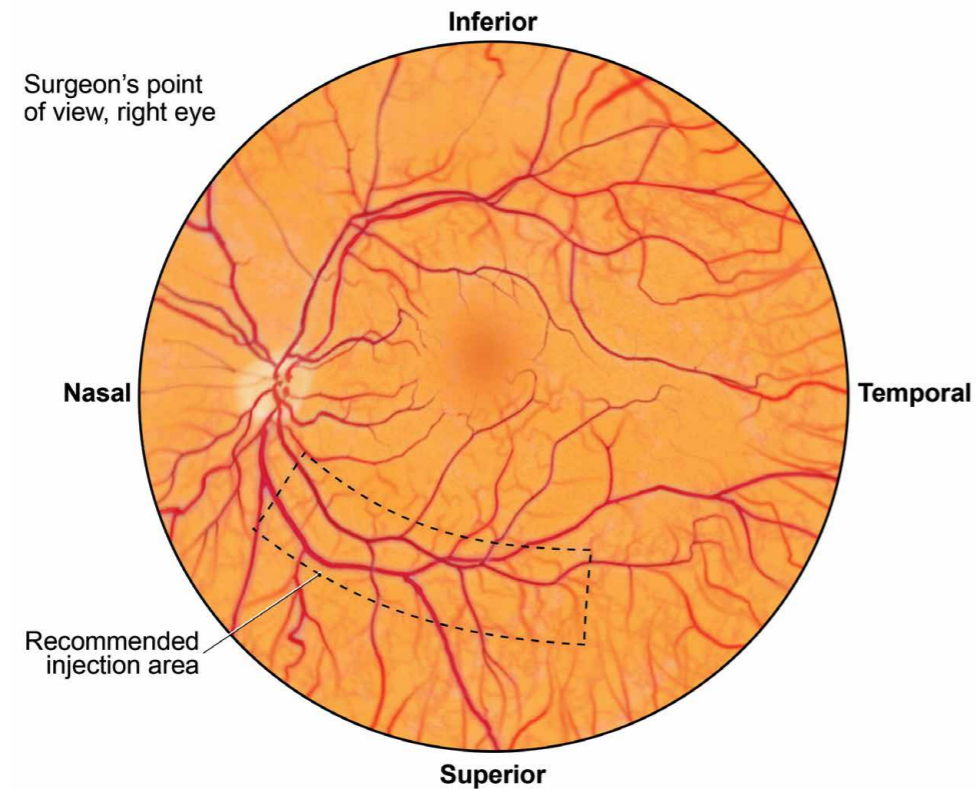


Figure 7. Injection area.
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IMPORTANT

The injection site should be located along the superior vascular arcade, at least 2 mm distal to the centre of the fovea (Figure 7).

- 1 To determine the subretinal injection site location, consider the patient's retinal pathology and anatomy, and the ease of injection site accessibility.
- 2 The injection site should not be located within areas of pathologic or anatomic features, such as:
 - Intraretinal pigment migration
 - Dense atrophy.
- 3 Avoid direct contact with the retinal vasculature to limit risk of injury to retinal arteries/arterioles and to prevent bleeding complications.

Subretinal injection procedure

- 1 Reduce the IOP to 10 mmHg to accommodate the additional intraocular volume (0.3 mL) of voretigene neparovec.
- 2 The assistant should retrieve the injection assembly from the sterile drape and, retaining hold of the syringe, hand the subretinal injection cannula to the lead surgeon.
- 3 Ensure that the subretinal injection cannula and the syringe containing voretigene neparovec are each properly locked to the extension tube.
- 4 Confirm that the tip of the plunger in the syringe is set at 0.3 mL.
- 5 The lead surgeon should insert the tip of the subretinal injection cannula through the vitrectomy trocar (Figure 8).
- 6 Under direct visualization, place the tip of the subretinal injection cannula in contact with the retinal surface (Figure 9).

IMPORTANT

Effective and ongoing communication between the lead surgeon and assistant is important to procedural success.

IMPORTANT

Take care not to bend the tip of the cannula during insertion.

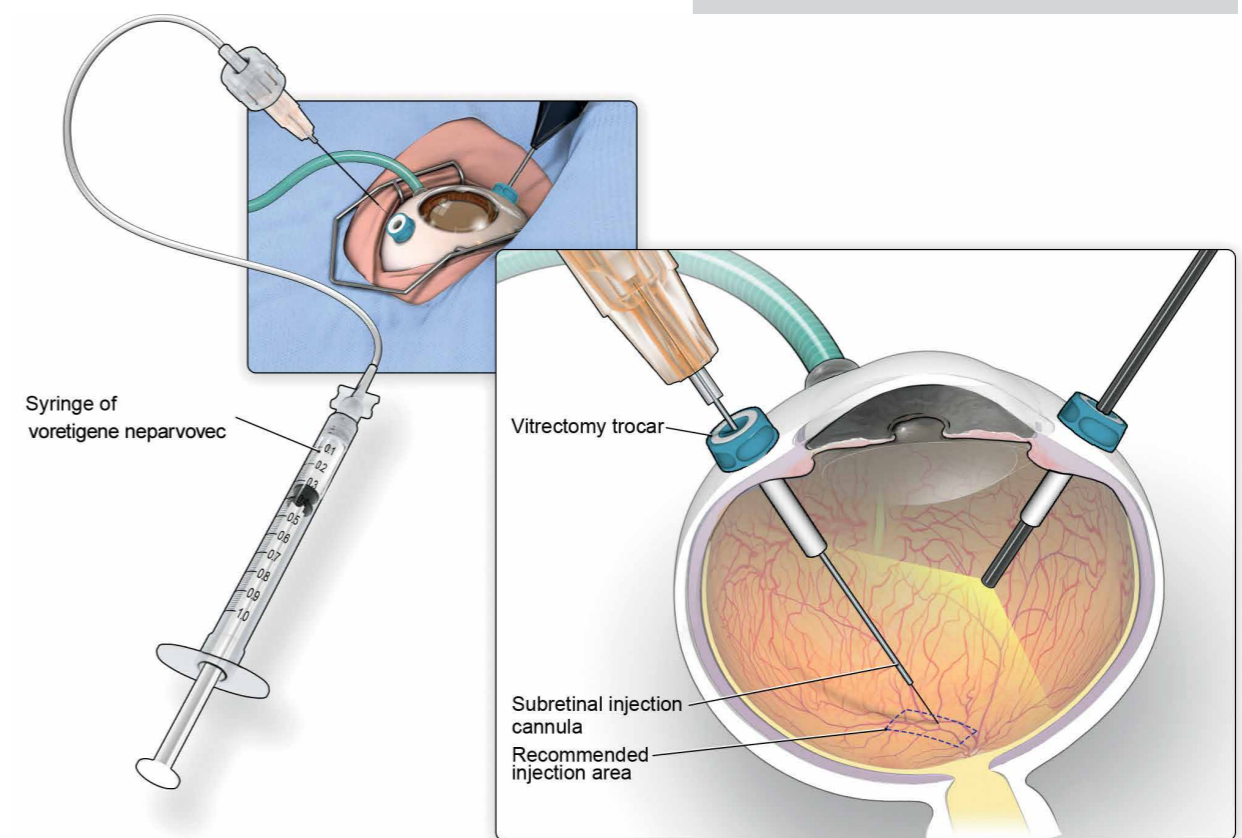


Figure 8. Insertion of subretinal injection cannula into the vitrectomy trocar.
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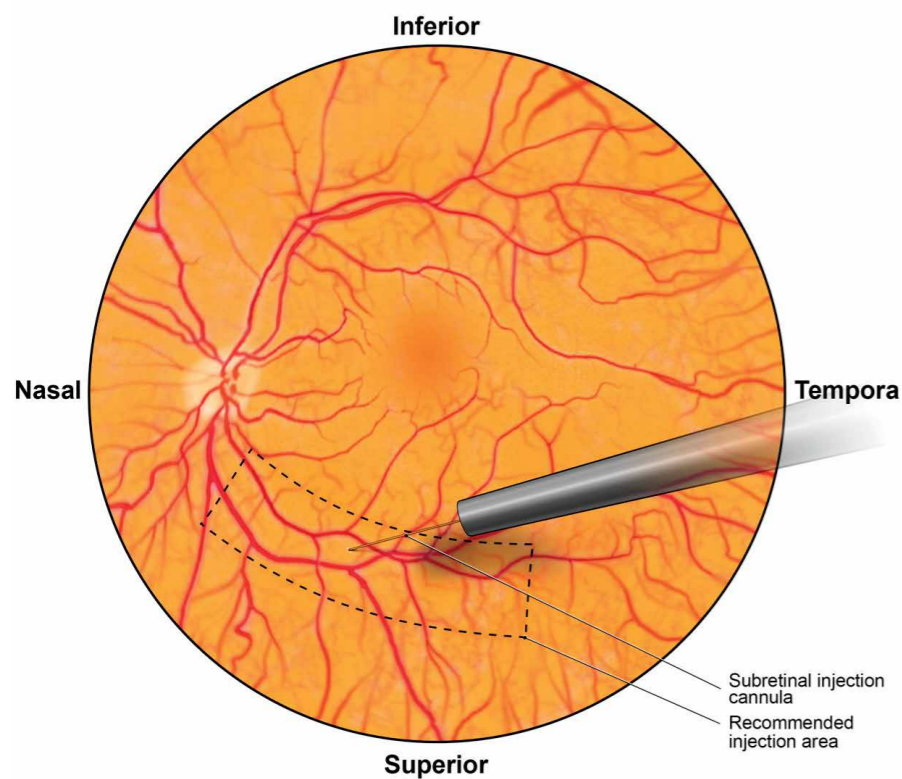


Figure 9. Subretinal injection cannula approaching injection site.
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IMPORTANT

The assistant must wait for verbal communication from the lead surgeon before depressing the plunger to initiate the injection.

- 7 Carefully position the tip of the subretinal injection cannula so as to indent the neural retina and drape the retina over the tip of the cannula, taking care not to perforate the retina (Figure 10).
- 8 The lead surgeon should instruct the assistant to inject a small amount of the product slowly, until the lead surgeon observes an initial subretinal bleb (Figure 11).

IMPORTANT

Any resistance detected by the assistant while pushing the plunger should be communicated to the lead surgeon. Resistance may indicate a blockage in the injection apparatus assembly or misplacement of the cannula tip.

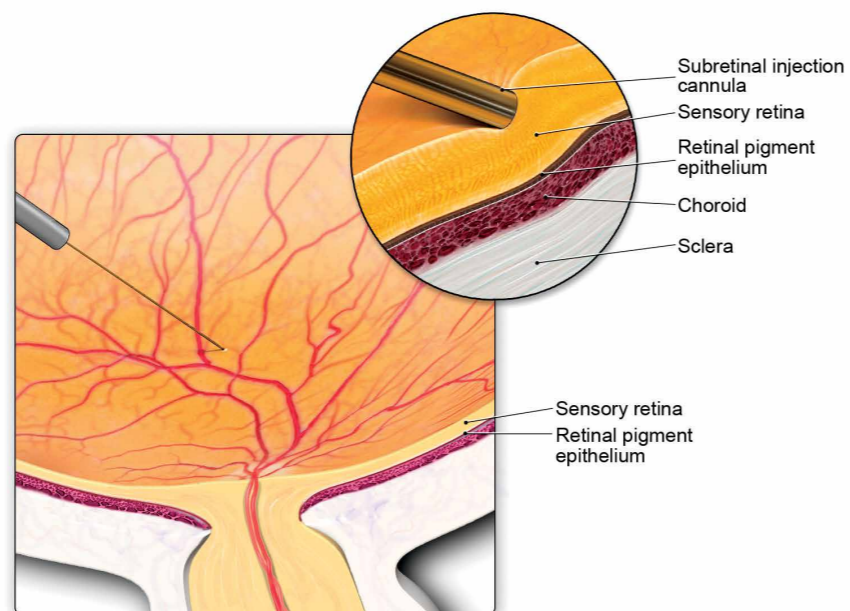


Figure 10. Placement of subretinal injection cannula for injection.
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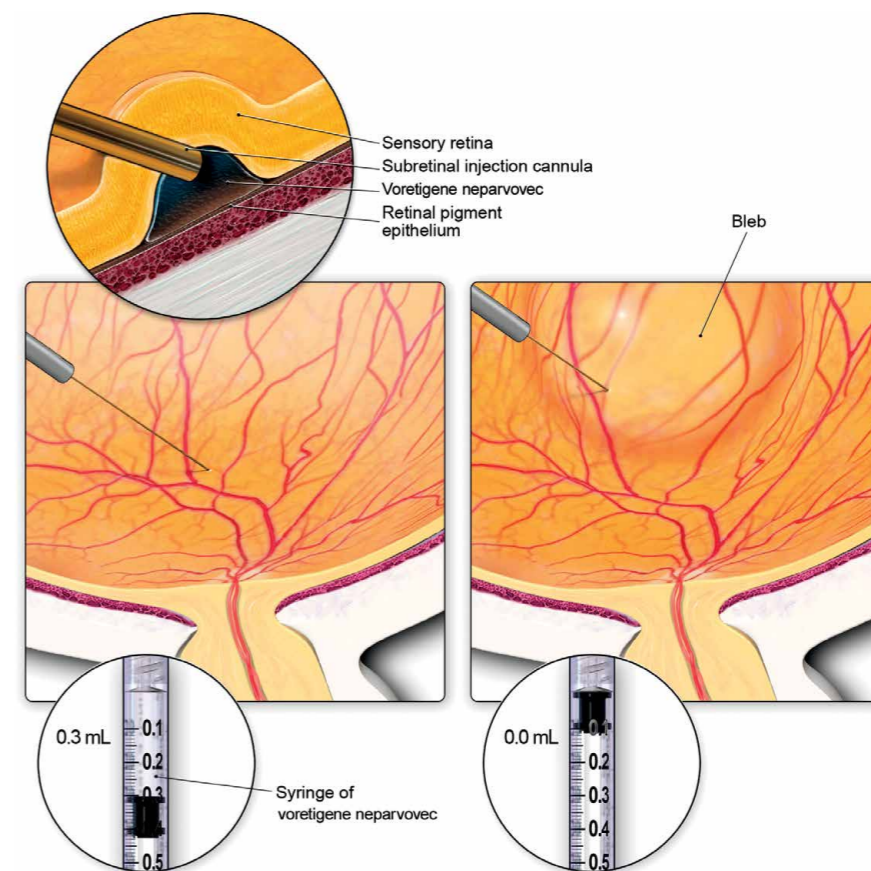


Figure 11. Subretinal injection and bleb formation.
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- 9 If a bleb does not begin to form:
 - Stop injection and confirm patency of the subretinal injection cannula.
 - If patency is confirmed, redirect the cannula tip to a different injection site within the recommended area.
 - Attempt subretinal injection of the remaining drug into the new site.
- 10 If a bleb begins to form, continue slowly injecting the full 0.3 mL of voretigene neparvovec. The assistant should hold the plunger down for approximately 5 seconds after completing the injection to ensure that the product has exited the subretinal injection cannula.

IMPORTANT

In the event of unsuccessful attempts to raise a bleb with the first syringe, the back-up syringe may be required in order to ensure subretinal delivery of the product.

IMPORTANT

The shape of the bleb and the duration of time required for bleb formation will vary among patients.

- 11 Upon completion of administration, remove the subretinal injection cannula from the eye.
 - Following administration, all materials (including the back-up syringe) should be discarded into a biohazard container.

Post-injection procedures

- 1 Increase IOP to 30 mmHg.
- 2 Perform a comprehensive retinal examination using indirect ophthalmoscopy, and scleral indentation to evaluate for any retinal abnormalities. Treat any noted abnormalities as per standard of medical care.
- 3 Perform a fluid-air exchange in the vitreous cavity in order to remove any voretigene neparovec that may have refluxed from the subretinal injection site (retinotomy) and to provide tamponade. Carefully avoid fluid drainage near the retinotomy created for the subretinal injection.

IMPORTANT

Do not position the tip of the aspiration cannula in the immediate vicinity of the injection site, in order to prevent removal of the drug from the subretinal space.

- 4 Withdraw all instruments and vitrectomy trocars.
- 5 Supine head positioning is initiated immediately in the postoperative period and, upon discharge, the patient should be advised to rest in a supine position as much as possible for 24 hours.

References

For Healthcare Professionals Only.



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