

## SYNOPSIS

### Indications for Surgical Procedures with VisionGraft®

- Corneal patch graft
- Anterior lamellar keratoplasty
- Boston Type 1 keratoprosthesis
- Glaucoma tube patch graft<sup>17</sup>

### VisionGraft® Characteristics

- Gamma-irradiated corneal tissue, sterile
- Stable shelf-life at room temperature for two years
- No rehydration required / ready to use
- Clear when transplanted
- Durable, maintains shape with manipulation

### Benefits of Irradiation

- Reduces the likelihood of graft rejection
- No antigen-presenting cells transferred with donor tissue
- Eliminates risk of bacterial or fungal disease
- Does not change the tensile strength of corneal tissue

### Similar to Fresh Corneas

- Histopathology demonstrates normal collagen structure
- Similar mean interfibrillar distance and fibril diameter
- Thickness and handling (whole corneas)
- Comparable suture pull-through strength

### Surgeon Perspective of VisionGraft®

- Good re-epithelialization
- Reduces or eliminates erosion
- Reduces re-operations
- Provides a diagnostic window to the valve

### Patient Perspective of VisionGraft®

- Provides translucent outcome
- Reduces or eliminates the need for repeated surgeries to replace eroded tissue

### Alternative Solutions

- Sclera
- Glycerine-preserved cornea
- Pericardium
- Amnion

## CONCLUSION

In summary, the findings of the studies mentioned in this paper indicate that VisionGraft® sterile, gamma-irradiated corneal allografts provide a safe and effective alternative to conventionally prepared corneal tissue in non-endothelial surgical applications.

## REFERENCES

1. Daoud YJ, Smith R, Smith T, Akpek EK, Ward DE, Stark WJ. The intraoperative impression and postoperative outcomes of gamma-irradiated corneas in corneal and glaucoma patch surgery. *Cornea*. 2011 Dec;30(12):1387-91.
2. Chae JJ, Choi JS, Stark WJ, Elisseff JH. Extracellular Matrix Characterization of the Acellular Gamma-Irradiated Cornea.
3. Eye Bank Association of America. Statistical Report (2008). 2009. Available at: [http://www.restoreight.org/wp-content/uploads/2013/04/2012\\_Statistical\\_Report\\_FINAL-reduced-size-4-10.pdf](http://www.restoreight.org/wp-content/uploads/2013/04/2012_Statistical_Report_FINAL-reduced-size-4-10.pdf). Accessed July 15, 2013.
4. Weiss JL, Williams P, Lindrom RL, Doughman DJ. The use of tissue adhesive in corneal perforations. *Ophthalmology*. 1983; 90(6):610-616.
5. Izaguirre Roncal LB, Gonzalvo Ibanez FJ, Perez Olivan S, Sanchez Perez A, Brito Suarez C, Honrubia Lopez FM. [Conjunctival flaps in corneal perforations]. *Arch Soc Esp Oftalmol*. 2000; 75(12):825-829.
6. Rodriguez-Ares MT, Tourino R, Lopez-Valladares MJ, Gude F. Multilayer amniotic membrane transplantation in the treatment of corneal perforations. *Cornea*. 2004; 23(6):577-583.
7. Larsson S. Treatment of perforated corneal ulcer by autoplasmic scleral transplantation. *Br J Ophthalmol*. 1948; 32(1):54-57.
8. Parmar P, Salman A, Jesudasan CA. Visual outcome and corneal topography after eccentric "shaped" corneal grafts. *Cornea*. 2009; 28(4):379-384.
9. Shi W, Liu M, Gao H, Li S, Want T, Xie L. Penetrating keratoplasty with small-diameter and glycerin-cryopreserved grafts for eccentric corneal perforations. *Cornea*. 2009; 28(6):631-637.
10. King JH Jr, Townsend WM. The prolonged storage of donor corneas by glycerine dehydration. *Trans Am Ophthalmol Soc*. 1984; 82:106-110.
11. Utine CA, Tzu, JH, Akpek EK. Lamellar keratoplasty using gamma-irradiated corneal lenticules. *Am J Ophthalmol*. 2011; 151(1):170-174.
12. Heflin TH, Yoshida J, Zambrano A, Jun A, Meng H, Pan Q, Stark W, Daoud Y. Gamma-irradiated Sterile Cornea for use in Penetrating Keratoplasty: A Novel Approach.
13. Lawrence SD, Netland PA. Gamma-irradiated cornea allograft for glaucoma surgery. *J Glaucoma*. 2013 Jun-Jul; 22(5): 355-7.
14. Stevenson W, Cheng SF, Emami-Naeini P, Hua J, Paschalis EI, Dana R, Saban DR. Gamma-irradiation reduces the allogenicity of donor corneas. *Invest Ophthalmol Vis Sci*. 2012 Oct 1;53(11):7151-8.
15. Corrales G. Using VisionGraft® for Emergency Penetrating Keratoplasty. 2012; retrieved from <http://www.visiongraft.org/content/using-visiongraft%C2%AE-emergency-penetrating-keratoplasty>.
16. Sikder S, McCally RL, Engler C, Ward D, Jun AS. Evaluation of irradiated corneas using scatterometry and light and electron microscopy. *Cornea*. 2011; 30(5):503-507.
17. Akpek EK, Aldave AJ, Aquavella JV. The use of pre-cut, γ-irradiated corneal lenticules in Boston type 1 keratoprosthesis implantation. *Am J Ophthalmol*. 2012 Sep;154(3):495-498.e1.

# ADVANCES IN TREATMENT OF CORNEAL DISEASE: Gamma-Irradiated Sterile Cornea (VisionGraft®) Provides Safe, Effective Alternative for Non-Endothelial Cornea Surgery

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# ADVANCES IN TREATMENT OF CORNEAL DISEASE: Gamma-Irradiated Sterile Cornea (VisionGraft®) Provides Safe, Effective Alternative for Non-Endothelial Cornea Surgery

## INTRODUCTION

Worldwide, corneal disease is responsible for almost one-fifth of all blindness.<sup>1,2</sup> Among the approximately eight million people who suffer from corneal disease annually, an estimated 100,000 receive corneal transplants.<sup>1,2</sup> Corneal transplantation is one of the most common and most successful solid tissue transplantation surgeries performed today.<sup>3</sup> In the U.S., more than 46,000 cornea transplantations were completed in 2012 alone.<sup>3</sup>

Despite the general success of corneal surgical procedures, conventional corneal transplantation still faces a number of challenges. One of the greatest challenges is a supply issue due to donor shortages. In the U.S., less than 60 percent of donated corneas are deemed suitable for transplant.<sup>1</sup> Additionally, donated corneas can be of low quality or have short distribution periods.<sup>2</sup> This further complicates transplantations in remote areas. In high-risk populations, corneal transplants often have a high failure rate subsequent to immune rejection of donor tissue.<sup>2</sup> Recent studies have indicated that gamma-irradiated corneal tissue could address several of these issues by increasing the supply of donor cornea tissue, making it stable over longer periods of time, and reducing donor immunogenicity.<sup>1,2</sup>

Traditionally, treatment of corneal defects has been managed through utilization of tissue adhesives,<sup>4</sup> conjunctival flaps,<sup>5</sup> amniotic membrane grafting,<sup>6</sup> patching with scleral tissue,<sup>7</sup> or patching with fresh corneal tissue,<sup>8</sup> or patching with glycerin

or cryopreserved corneal tissue.<sup>9</sup> Although commonly used, glycerin-cryopreserved corneal tissue, poses several challenges for surgeons. Glycerin-cryopreserved corneas must be rehydrated and repeatedly rinsed of residual glycerin prior to use in any procedure. Additionally, manipulation and handling by surgeons can change the cornea's thickness and clarity. Once implanted, the glycerin-treated corneas may take several weeks before complete stromal clearing, potentially leading to more complications and medical management.<sup>10</sup>

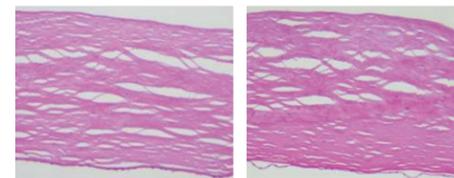
## A CLEAR ALTERNATIVE



VisionGraft® Patch Sclera Patch

Several studies show that using VisionGraft®, a sterile, gamma-irradiated cornea allograft made available by TBI/Tissue Banks International, may provide a safe and effective alternative for non-endothelial corneal procedures. A recent study documenting clinical outcomes for lamellar keratoplasty found that gamma-irradiated corneal tissue not only was clear out of the package, but remained clear through epithelialization and a follow-up period of 7 to 36 months.<sup>11</sup> A similar study of sterile, gamma-irradiated cornea in penetrating keratoplasty reported that VisionGraft® remained clearer and thinner than fresh corneal grafts without endothelium up to one week postoperatively.<sup>12</sup>

Figure 1.



Irradiated Cornea Fresh Cornea

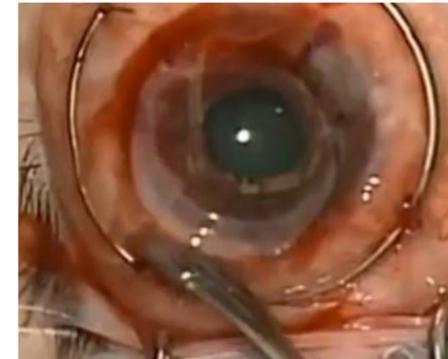
In a study that tested the optical properties of 20 donor corneas, researchers found that tissue sterilized with irradiation had pachymetry, deeper stromal histology (see Figure 1.), and ultrastructural characteristics comparable with non-irradiated tissues and should be suitable for such clinical applications as tectonic keratoplasty and keratoprosthesis implementation.

Gamma-irradiated corneal allografts also convey other benefits that can alleviate the shortage of donor corneal tissue. The process of gamma-irradiation virtually eliminates the risk of infection while also enhancing the allograft's stability and shelf-life.<sup>1</sup> Within 24 hours of initial harvest, grafts are sterilized by a validated gamma-irradiation procedure (AAMI American National Standard: Sterilization of health care products-radiation, ANSI/AAMI/ISO 11137, Parts 1-3:2009).<sup>13</sup> Sterility is verified via two-week microbiological testing, and lots are released subsequent to receipt of testing results.<sup>14</sup>

Another benefit of gamma-irradiation is its ability to destroy antigen-presenting cells, thereby reducing the likelihood of allograft rejection. Researchers found that, in gamma-irradiated corneas, viable corneal cells were universally absent; all

were positive for ethidium homodimer-1, indicating cell membrane disruption and widespread cell death.<sup>14</sup> The use of VisionGraft® tissue could be especially advantageous in cases with underlying inflammation or where the graft needs to be placed close to the limbus.<sup>11</sup> In one case, in which a fungal infection resulted in corneal perforation, the use of VisionGraft® improved the patient's chances for a successful second graft by using a sterile corneal graft with reduced immunogenicity (see Figure 2.).<sup>15</sup>

Figure 2.



In addition, gamma-irradiated corneas convey storage advantages over the standard glycerin and optisol methods. Gamma-irradiated allografts offer sterility as well as a long shelf life – at least one year of surgical quality when conveniently stored in albumin at room temperature.<sup>11,12</sup> This makes VisionGraft® ideal for both emergencies and scheduled surgeries, as well as for use in remote areas.<sup>11,12</sup>

Moreover, sterile gamma-irradiated corneal tissue is ready to use and easy to handle. According to a study of gamma-irradiated corneal grafts in lamellar keratoplasty, VisionGraft® tissue appeared clear in the storage bottle and did not require rinsing in saline prior to surgical use.<sup>11</sup> VisionGraft® corneas were reported to handle identically to fresh corneas, due to similar thickness and tensile strength.<sup>11</sup> One study reporting 150 patient outcomes using irradiated corneas in non-endothelial surgical applications found that VisionGraft® was "suitable for any use where a clear human tissue is needed."<sup>11</sup> The 19 surgeons surveyed in the study used 198 irradiated donor corneas and reported positive impressions of VisionGraft® regarding its ease of use, clarity, thickness, tensile strength, and suturing, as well as epithelialization and biological incorporation.<sup>1</sup>

## COMPARABLE TO FRESH CORNEAS

VisionGraft® sterile corneas are comparable to, and offer a number of advantages over, fresh corneas:

- Sterile gamma-irradiated corneas have the same thickness as fresh corneas and handling is identical.<sup>11</sup>
- The tissue does not require rehydration prior to surgery and is clear when implanted.
- Gamma-irradiation offers additional patient safety, compared to fresh corneas, and virtually eliminates the risk of bacterial or fungal disease.<sup>1</sup>
- A key benefit of VisionGraft® is its demonstrated ability to deplete antigen-presenting cells transferred within the donor tissue; due to gamma-irradiation processing, this reduces the likelihood of graft rejection by "preventing...direct sensitization".<sup>11</sup>
- VisionGraft® offers a shelf life of two years at room temperature, a low 2.5% erosion rate, and demonstrated positive clinical outcomes for up to 24 months.

Studies have also demonstrated that VisionGraft® is easier to work with than other patch graft materials, provides better durability and tensile strength, and reduces or eliminates erosions.<sup>11,12</sup> Moreover, there was no incidence of immune rejection, infection, significant opacification, or neovascularization of donor tissues during the follow-up period.<sup>14</sup>

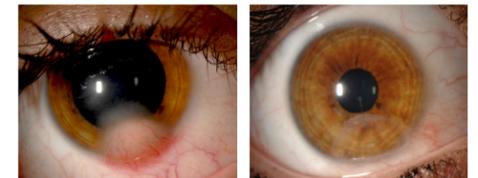
Lab testing on the VisionGraft® tissue included suture pull-through testing, which demonstrated comparable strength with that of fresh corneal tissue, histopathology studies that demonstrated normal collagen structure, and electron

microscopy testing, which demonstrated similar mean interfibrillar distance and fibril diameter to that of non-irradiated fresh corneas.<sup>16</sup>

## A SOLUTION FOR NON-ENDOTHELIAL SURGICAL APPLICATIONS

Despite the success of corneal transplants, a shortage of donor tissue remains one of the most serious hurdles. Gamma-irradiation provides a sterile graft for non-endothelial surgical procedures. Recent studies have demonstrated that sterile, gamma-irradiated corneal tissue is suitable for use in patch grafts – both corneal and glaucoma – as well as in keratoprosthesis and lamellar corneal procedures.<sup>1,11,17</sup> Using VisionGraft® corneal tissue for non-endothelial applications can increase the supply of corneal tissue suitable for transplantation in situations that require viable endothelium.

Figure 3.



Before After

VisionGraft® tissue also maintains its shape, strength, and optical clarity.<sup>1</sup> Thus, sterile gamma-irradiated tissue can serve as an effective alternative in non-endothelial surgical applications, can be immediately accessed in remote areas or emergency situations, and can increase the supply of corneal tissue suitable for transplantation in situations that require viable endothelium (see Figure 3.).

## COMPARISON: GAMMA-IRRADIATION VS. OTHER CURRENT STORAGE METHODS FOR CORNEA TISSUE

Properties	Irradiated Cornea	Glycerin Cornea	Cryopreservation
<b>Sterile (yes or no)</b>	Yes	No	No
<b>Surgeon preparation</b>	None required	Yes	Yes
<b>Tissue quality</b>	Very Good	Thicker, rubbery	Thinner
<b>Storage - Duration Condition</b>	2 years	5 years	2 weeks
	Room temp.	Room temp.	Refrigerated
<b>Clarity</b>	Clear	Inconsistent	Clear