

## CASE REPORT

# Penetrating Keratoplasty Following Superficial Keratectomy, Amniotic Membrane Patch and Bandage Soft Contact Lenses in Band and Pseudophakic Bullous Keratopathy

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## ABSTRACT

**Introduction:** Band keratopathy is usually associated with chronic ocular inflammatory conditions. Recent use of combination treatments such as chelation, excimer laser, and amniotic membrane transplantation in band keratopathy management. Bullous keratopathy (BK) is a main complication of cataract surgery. The purpose of treatment are to reduce pain and improve vision when possible. Treatment depending on the severity of symptoms, cause of BK and potential for visual improvement. BK is a leading indication for keratoplasty and improvement of vision is possible only with keratoplasty.

**Objective:** To report a case of a 64-year-old man with penetrating keratoplasty (PK) following superficial keratectomy (SK), amniotic membrane patch (AMP) and bandage soft contact lenses (BSCL) in band and pseudophakic bullous keratopathy.

**Case presentation:** A 64-year-old man with band and pseudophakic bullous keratopathy reported with reduced vision in both the eyes (1/300 and 6/48 BCVA in the right and left eye, respectively) for past few years. SK, AMP and BSCL was performed for ocular surface reconstruction in his right eye. One month later, he underwent a PK and 3 months following surgery, the corneal graft remained transparent. Six months after the surgery, BCVA of the right eye was 6/30 with S - 3,00 refractive correction.

**Conclusion:** Patients with band and pseudophakic bullous keratopathy can achieve visual outcomes and realise a significant improvement in corneal transparency by undergoing SK, AMP, BSCL and PK.

**Keyword:** Penetrating keratoplasty, Superficial keratectomy, Amniotic membrane patch, Bandage soft contact lenses, Band and pseudophakic bullous keratopathy.

## INTRODUCTION

**B**and keratopathy is characterized by the appearance of a band across the central cornea, formed by the precipitation of calcium salts on the corneal surface (directly under the epithelium). This form of corneal degeneration can result from a variety of causes, either systemic or

local, with visual acuity decreasing in proportion to the density of the deposition.

The term band keratopathy describes the precipitation of calcium salts in Bowman's layer in a band-like distribution across the central cornea. There are several local and systemic causes of band keratopathy, the most common ocular

condition being intraocular inflammation and the most common systemic condition being hypercalcemia (Najjar et al 2004) Treatment of symptomatic band keratopathy is typically surgical; treatment of the underlying cause can prevent further calcium deposition but does not usually reverse the corneal findings. We herein report a case of band keratopathy associated with ocular inflammation and systemic hypercalcemia, which markedly improved after treatment of the underlying facto

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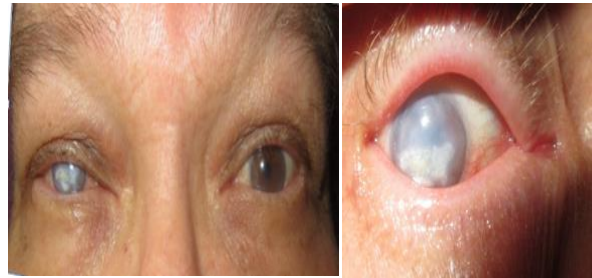
### CASE REPORT

A 64-year-old man after surgery keratoplasty with penetration techniques. With the history of Bullous Keratopathy right eye. Come with chief complaint white spots on the right eye black eye. Experienced since 2009, slowly. Decreased vision exists. History of cataract surgery on the left eye (phacoemulsification). Red eye exists, eye droppings are minimal, excessive tears exist, no glare, no itching. There is no history of trauma, no history of hypertension, history of DM, regular treatment.

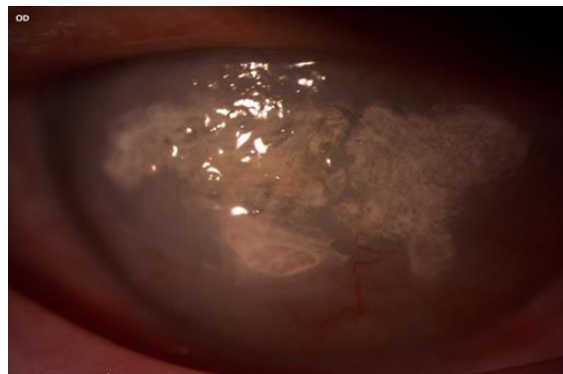
Examination revealed visual acuity of right eye was 1/300, left eye 6/120. There was minimal secretion on right eye. Conjunctival hyperemia in both eyes. Cornea cloudy in right and in the left eyes looks bullous in the corneal epithelium. Front chamber, iris, pupil, and lens in right

eyes is difficult to evaluate, then in the left eyes within normal. Fundoscopy and Ultrasonography did not evaluate and diagnosed as right eye keratopathy bullosa, planned for right eye anterosclerotomy.

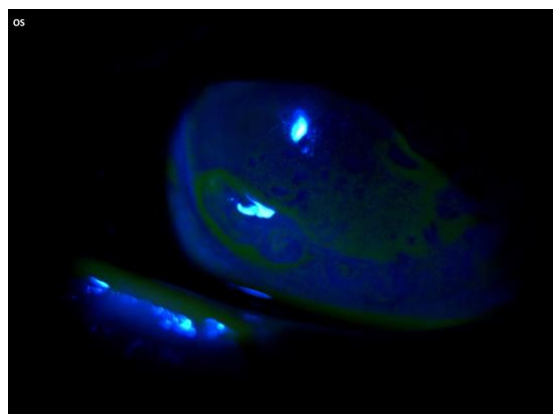
One month later, he underwent a PK and 3 months following surgery, the corneal graft remained transparent. Six months after the surgery, BCVA of the right eye was 6/30 with S - 3,00 refractive correction.



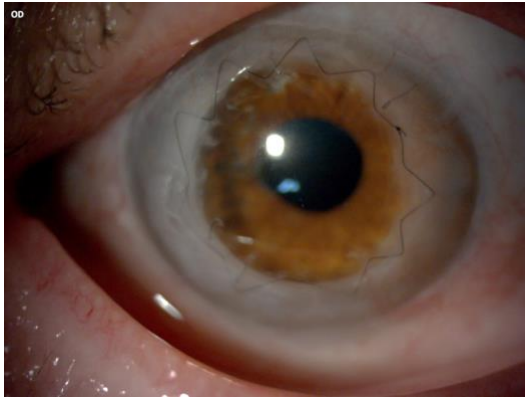
**Figure 1.** Photograph of patient



**Figure 2.** Band keratopathy in the setting of intraocular inflammation



**Figure 3.** Fluoresen (+) in kornea paracentral



**Figure 4.** Photograph of patient post op

## DISCUSSION

Corneal edema from inadequate endothelial pump function is one of the most common complications of cataract surgery. Various causes for this endothelial dysfunction can be divided into four categories including : (a) mechanical injury, (b) inflammation/infection, (c) chemical injury, and (d) concurrent eye disease. This review serves as a basis for the diagnosis and treatment of this complication<sup>1</sup>.

The cornea is a complex structure that is responsible for most of the refraction of the eye and, because of its highly exposed position, has a protective role, acting as a physical barrier to trauma and infection<sup>2,3</sup>. One of the most important property of the cornea is its transparency, which is a result of a number of factors: the absence of blood vessels, the regularity and smoothness of the covering epithelium, the regular arrangement of the extracellular and cellular components in the stroma, which is dependent on the state of hydration and metabolism of the stromal elements<sup>4</sup>.

The cornea consists of five layers from anterior to posterior: epithelium, Bowman's layer, stroma, Descemet's membrane, and endothelium. The composition of the stroma is not uniform; the anterior stroma contains a higher ratio of dermatansulfate to keratansulfate, making the posterior stroma more likely to swell with excess water in states of endothelial dysfunction<sup>4</sup>.

Immunohistochemical studies showed deposits of a specific extracellular matrix component, such as fibrilin-1 which belongs to the family of extracellular matrix proteins associated with elastic microfibrils and tenascin-C, which is a glycoprotein that has great importance in healing and is found in the posterior collagen layer or in the subepithelial fibrotic areas of corneas with bullous keratopathy<sup>5</sup>.

Pseudophakic Bullous Keratopathy is irreversible corneal edema secondary to cataract extraction. The edema occurs from damage to the corneal endothelial cells, which normally act to maintain the dehydrated state of the cornea by controlling the Na<sup>+</sup>/K<sup>+</sup> ATPase pumps<sup>6</sup>. The main cause of bullous keratopathy is the loss of endothelial cells due to surgical trauma, especially in cataract surgery at sixth decade patients, with or without lens implantation<sup>5,7</sup>.

The localized increase of temperature associated with the phacoemulsification probe can lead to thermal damage to adjacent corneal tissue. Damage to the endothelium can be caused by high irrigation or aspiration rates that can result in turbulent flow with lens particles connected with it<sup>8</sup>.

Also, the duration of phacoemulsification used during the surgery is very important because the ultrasound energy is associated with the production of free radicals, which are reactive species with one or more unpaired electrons in their outer orbits and can damage the corneal endothelium by oxidative stress<sup>8</sup>.

Other etiologies include endothelial dystrophies such as Fuchs dystrophy, tumors of the anterior chamber such as myxoma, congenital abnormalities, like microcornea, acute and neovascular glaucoma, herpetic endotheliitis or surgeries that can lead to endothelial cell loss like trabeculectomy, intraocular lens scleral fixation, anterior chamber lens implants for aphakic correction and high ametropia, after argon laser, radial keratotomy<sup>5</sup>.

Bullous keratopathy may occur in around 1 to 2% of the patients undergoing cataract surgery, which is about two to four million patients worldwide<sup>5</sup>.

The clinical treatment for corneal edema should be based on topical hypertonic agents such as sodium chloride (5%), anti-inflammatory drugs, topical and/or systemic anti glaucoma medications, because increased IOP can compromise endothelial cell function, corticosteroids, lubricants and sometimes, due to the pain experienced by the patients, therapeutic contact lenses to improve symptoms<sup>8</sup>.

According to a study conducted in 2015, systemic L-cysteine facilitated corneal edema remission when administered in the postoperative period in patients after cataract surgery, thus advocating its concurrent use in patients developing bullous keratopathy.

An increased expression of several pro inflammatory mediators at the protein level in the corneal epithelium was demonstrated in patients with pseudophakic corneal edema. These cytokines and MMP, which are a family of extracellular proteinases that degrade the extracellular matrix proteins, participate in the pathologic processes in the pseudophakic corneal edema and specifically contribute to the continuous degradation of Bowman's layer and recurrent erosions of the corneal epithelium.

Based on the presumption that high L-cysteine levels may act as regulatory substrate for MMPs, more studies should be conducted in order to establish the adjuvant role of systemic L-cysteine in pseudophakic bullous keratopathies<sup>7</sup>.

The use of conjunctival flaps is effective but has been limited by its unacceptable cosmetic outcome<sup>5</sup>.

Corneal transplantation is still the gold-standard treatment for bullous keratopathy patients, as it provides symptomatic relief and visual rehabilitation<sup>9</sup>. Some limitations such as visual acuity recovery occur because of the high astigmatism and, although the cornea is the

most commonly transplanted tissue in the body and corneal grafts high success rate, there is also the risk of rejection<sup>5,10</sup>. Corneal transplantation refers to surgical replacement of a full-thickness or lamellar portion of the host cornea with that of a donor eye. If the donor is another person, the procedure is called an allograft; use of donor tissue from the same or fellow eye is called an autograft<sup>11</sup>.

**Suture techniques.** The donor button is initially secured with at least 4 interrupted cardinal sutures. The second cardinal suture is the most important because the potential for induction of astigmatism is greatest if the suture 180° from the first suture is not aligned accurately. Complete wound closure is achieved with interrupted sutures, 1 or 2 continuous sutures, or a combination. The suture knots may be positioned in either donor or host tissue and are buried in the corneal stroma. Most cornea surgeons prefer deep partial thickness corneal suture bites incorporating 95% of the donor's and host's relative corneal thickness to avoid posterior wound gape and facilitate wound stabilization and healing<sup>11</sup>.

A variety of techniques are used to complete the suturing, depending on the clinical situation and surgeon preference. Vascularized, inflamed, or thinned corneas tend to heal unevenly and unpredictably. Interrupted sutures, usually 16–24 in number, are the technique of choice in such corneas, as well as in pediatric keratoplasties, in which wound healing is rapid. If they attract blood vessels or loosen because of wound contraction, sutures maybe removed selectively after sufficient healing of the donor–recipient interface. Astigmatism may be reduced postoperatively by selective removal of sutures in the steep corneal meridian, although premature removal risks wound dehiscence or slippage. In the absence of vascularization, inflammation, or thinning, single or double continuous sutures or combined interrupted and continuous sutures can be used to secure the PK. If properly placed, continuous sutures may allow more even distribution of tension and

healing around the wound. The advantages of continuous sutures include the ability to adjust the suture intraoperatively or postoperatively using a keratometer and their ease of removal postoperatively. Disadvantages include sectoral loosening, or cheese wiring, which may compromise the entire closure<sup>11</sup>.

Corneal collagen cross linking (CXL) with Riboflavin and ultraviolet A (UVA) radiations is a photochemical process that was introduced by Seiler and Spoerl at the University of Dresden for the treatment of corneal ectatic disorders such as keratoconus and post LASIK ectasias<sup>12</sup>.

Corneal CXL is considered a new tool in the struggle for the temporary reduction in corneal edema in patients with bullous keratopathy. It has been found to improve corneal transparency, corneal thickness, and ocular pain after surgery<sup>13</sup>.

The proposed mechanism of action is that riboflavin absorbs UVA light, which results in the production of free oxygen radicals. These highly reactive oxygen radicals then induce the cross-linking of corneal stromal collagen and strengthen the cornea<sup>12</sup>.

Amniotic membrane (AM) facilitates re-epithelialization by providing a suitable substrate and a normal basement membrane, by promoting epithelial cell migration and adhesion. AM is also believed to produce several growth factors that support epithelial cells. When the amniotic membrane is applied to the cornea, keratocyte derived fibroblasts and myofibroblasts are known to migrate from the corneal stroma into the amniotic stroma. This contributes to the subepithelial fibrosis and also anchors the amnion epithelial sheet to the corneal surface<sup>14</sup>.

Amniotic membrane transplant is effective in controlling pain in patients with pseudophakic bullous keratopathy and does not induce neovascularization, but is not the first treatment option because of the cost and needed time<sup>5,15</sup>.

Phototherapeutic keratectomy (PTK) can improve pain by reducing corneal thickness and this would help the

remaining endothelial cells maintain corneal hydration<sup>5</sup>. Several studies reported PTK to be elective in the management of patients with bullous keratopathy from a variety of etiologies; they reported that the bullae resolve and pain is abolished in a large proportion of patients treated with a superficial ablation<sup>15,16</sup>.

The main sensory nerve plexus in the cornea, which is derived from the nasociliary branch of the ophthalmic division of the trigeminal nerve, is located in the stroma, in the immediately subepithelial region, with a lower density plexus deeper in the stroma<sup>15</sup>. The rationale for this treatment is the ablation of these nerve plexuses thereby reducing corneal sensation and, in addition, corneal scarring induces an increase of extracellular proteins such as laminin, fibronectin, type IV collagen and hemidesmosomes which promote a greater adhesion between the epithelium and stroma<sup>5,15</sup>.

Deep PTK appears to be more successful in comparison with superficial PTK because of the increased scarring associated may also result in an increased stability of the epithelium and a deep ablation has a superior effect on decreasing pain by the ablation of the neural plexus in the cornea<sup>15</sup>.

## CONCLUSION

Patients with band and pseudophakic bullous keratopathy can achieve visual outcomes and realise a significant improvement in corneal transparency by undergoing SK, AMP, BSCL and PK.

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