



Review article

Complications and fitting challenges associated with scleral contact lenses: A review



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ABSTRACT

Introduction: The modern scleral contact lens (ScCL) has evolved from the very first contact lens fitted 128 years ago. Originally manufactured in glass and oxygen impermeable plastics, these lenses are available today in high Dk gas permeable materials that allow permeation of oxygen, reducing many of the complications that were seen with older generation ScCL. However, as with any new contact lens modality, the modern ScCL brings with it a new set of complications and fitting limitations.

Methods: Pubmed searches under different keywords were conducted.

Results: Existing literature provides some reports of infection with the scleral devices, although these are often seen in severely compromised corneas, while hypoxic and inflammatory complications are rarely reported in the literature. Furthermore, the somewhat complex relationship of a scleral lens on the eye can create fitting and removal challenges. Anomalies such as conjunctival prolapse, epithelial bogging, midday fogging, and limbal bearing have been reported, and appear to be unique sequelae to scleral lens wear.

Conclusion: Although this revolutionary technology broadens the scope in which practitioners can treat patients with irregular ocular surfaces, reports of these complications indicate that there is still a need for continued research to further enhance the clinical outcomes of this promising contact lens modality.

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1. Introduction

1.1. Resurgence of Scleral Contact Lenses

The first device resembling a scleral contact lens (ScCL) was fitted in 1887 by the firm of F. Ad. Müller & Söhne of Wiesbaden, Germany for a patient with lagophthalmic keratitis in the right eye due to cancerous destruction of the lower eyelid [1]. This therapeutic, blown glass shell was worn on an extended wear basis and probably had a total diameter of about 25.00 × 30.00 mm [2]. In 1888, Adolf Fick designed a ground shell with a total diameter of 20.00 mm in a series of five patients with corneal scarring and one with keratoconus, only one of them achieving visual improvement [3]. In the same year, Photinos Panas reported that his junior colleague, Eugène Kalt, had obtained a significant increase in visual acuity with a shell in a case of keratoconus [4]. Examination of Kalt's shells revealed that they had a mono-curve back surface construction with a total diameter of 16.00–22.00 mm [5]. In 1889, August Müller was the first clinician to correct refractive error with a contact lens, when he neutralized his own high myopia using a ground scleral lens having a total diameter of 20.00 mm [6].

The practice of fitting lenses using a trial set was originated by the German firm of Carl Zeiss, which in the 1920s offered a choice of four alternative specifications of ground lenses to correct keratoconus [7]. Within a decade the fitting set expanded to 39 lenses to allow correction of refractive errors [8]. While there was a range of base curve radii and back surface scleral radii, each lens had the same primary optic diameter of 12.00 mm and the same overall diameter of 20.00 mm. Successful eye impressions were first made by István Csapody in 1929 [9] and the manufacture and

fitting of molded scleral lenses using this approach was developed by József Dallos [10].

The earliest report of the successful clinical use of poly(methyl methacrylate) (PMMA) ScCL was made by Petrus Thier in 1939 [11]. The major limitation of both glass and PMMA contact lenses is their negligible gas transmissibility, which has been associated with hypoxic complications for patients wearing them from the late 19th until the latter part of the 20th century.

The first rigid gas permeable (GP) contact lens material was cellulose acetate butyrate which came into use in the mid-1970s [12]. Subsequently, siloxymethacrylate and fluoromethacrylate materials were developed with greatly increased oxygen permeability, which reduced hypoxic complications with corneal lenses. Even with the development of newer GP materials, the re-emergence of scleral contact lenses did not gain momentum until the late 1990's and early 2000's. Modern day ScCL pioneers include Donald Ezekiel of Perth, Australia, who was the first to describe fitting gas permeable scleral contact lenses – on 43 patients – in 1983 [13], Perry Rosenthal of the United States, Ken Pullum of the United Kingdom, and Rients Visser of The Netherlands, who have all led the advancement of ScCL for refractive correction in post-surgical and keratoconic eyes [14–16]. These innovative practitioners realized the potential of the scleral lens modality, and have led practitioners to embrace this new application of a historical concept.

1.2. Literature search

The goal of this review article was to examine the literature and compile a list of documented complications and fitting challenges associated with ScCL use. The literature reviewed in this article was

Table 1
Case reports of infectious events amongst scleral contact lens wearers.

Author (year)	ScCL Indication(s) ^a	Infectious Organism(s)	Outcome	Taking steroids (y/n)	Taking prophylactic antibiotics (y/n)	Comments	Study Design ^b
Rosenthal et.al. [16] (2000)	PED post-PK	Mycobacterium abscessus	Failed graft	Y	Y	Known epi defect at time of infection	CS/R
Rosenthal et.al. [16] (2000)	PED post-PK	Streptococcus pneumonia	Failed graft	Y	Y		CS/R
Rosenthal et.al. [16] (2000)	PED post-PK	Alpha-hamolytic streptococcus, Staphylococcus epidermidis (x2)	Failed graft x3	Y	Y	Known epi defect at time of infection	CS/R
Rosenthal et.al. [16] (2000)	PED post-PK	Staphylococcus epidermidis	Failed graft	Y	Y	Known epi defect at time of infection	CS/R
Kalwerisky et.al. [17] (2012)	Exposure keratopathy related to acute thermal keratitis	MRSA	Resolved with fortified antibiotics	N	Y		CS/R
Kalwerisky et.al. [17] (2012)	Exposure keratopathy related to acute thermal keratitis	Pseudomonas aeruginosa	Resolved with fortified antibiotics	N	Y		CS/R
Severinsky et.al. [18] (2014)	Irregular astigmatism post-PK	Not cultured	Unknown	Unknown	Unknown	Authors report poor lens compliance	CS/R
Severinsky et.al. [18] (2014)	Irregular astigmatism post-PK	Not cultured	Unknown	Unknown	Unknown	Authors report poor lens compliance	CS/R
Fernandes et.al. [19] (2013)	OCP & SS	Staph. epidermidis, Corynebacterium accolens, & Microsporidia	Failed graft	Y	N	Known epi defect at time of infection	CR/R
Farhat & Sutphin [20] (2014)	GVHD	Acanthamoeba	DALK performed	Y	Y		CR/R
Zimmerman & Marks [21] (2014)	Neurotrophic keratitis 2 [^] HSK	Unable to determine on culture	Resolved with antibiotic treatment	N	Y	Authors report poor compliance	CR/R

^a PED: persistent epithelial defect; PK: penetrating keratoplasty; OCP: ocular cicatricial pemphigoid; SS: sjogren's synrome; HSK: herpes simplex keratitis GVHD: graft vs. host disease; DALK: Decemet's anterior lamellar keratoplasty.

^b CR: single case report; CS: case series; R: retrospective.

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