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Editorial

The rigid lens renaissance: A surge in sclerals

Throughout the 1990′s and 2000′s, debate amongst academics and clinicians surrounding the demise of rigid contact lenses took place across numerous forums, spanning professional, industry, and scientific publications including *Contact Lens and Anterior Eye* [1]. The original prediction of the demise of rigid contact lenses by the year 2010 [2], later revised to the *virtual* demise of rigid lenses (accounting for only ~1% of all contact lenses fitted) [3], was based on contact lens prescribing patterns in the United Kingdom derived from annual practitioner surveys that indicated a significant decline in rigid lens fits, particularly in the first two years of the survey. While 2010 has come and gone, rigid lenses still remain.

Twenty years have now passed since the original prediction of the ultimate demise of rigid lenses, and the profession has witnessed the birth and widespread uptake of daily disposables, silicone hydrogels for extended and continuous wear, and most recently silicone hydrogel daily disposables. However, while rigid contact lens prescribing has no doubt declined over the last half century, international survey data collected in 2017 suggests that, on average, rigid lenses (excluding orthokeratology) still comprise around 10% of all contact lens fits, with orthokeratology accounting for an additional 1% [4]. These data obtained from almost 20,000 lens fits display considerable regional variation in prescribing trends across the thirty markets examined. In 2017, rigid lenses (excluding orthokeratology) accounted for between 0% (Czech Republic, Lithuania, Moldova) to 72% (Denmark) of all contact lens fits. However, data from the same international consortium collated between 2005 and 2017 suggests a relatively stable pattern of rigid lens prescribing globally when averaged across all markets; a mean of 9.2% (range 7–12%) for rigid lenses (excluding orthokeratology) and 1.2% (range 1–2%) for orthokeratology over this period. Therefore, on average, over the past decade, rigid lenses have maintained slightly over 10% of the global market share.

As 2010 approached, contact lens enthusiasts opposing the prediction of the virtual demise of rigid lenses also hinted at the potential for growth in the rigid lens market (a rigid lens resurgence or renaissance) due to the apparent increasing popularity of smaller diameter scleral contact lenses and orthokeratology [5,6]. Fig. 1 displays the PubMed database search results for the terms "*orthokeratology*" and "*scleral contact lens*" between 2000 and 2017 after excluding references unrelated to these contact lens modalities. From 2010–2011 onwards there is a marked increase in the number of publications per year (including laboratory research, clinical trials, and case reports) related to orthokeratology and in particular scleral contact lenses. However, has this recent surge in publications related to these specialist contact lens modalities translated to, or coincided with, an observable change in rigid lens prescribing?

The orthokeratology and scleral contact lens overall prescribing patterns as a percentage of all contact lens fits (soft and rigid), obtained from international surveys of ~14,000–25,000 contact lens fits performed annually between 2003 and 2016 are shown in Fig. 2 [7]. These data suggest a gradual increase in specialty lens prescribing over the last decade, with a current market share of ~2% for orthokeratology and ~1% for scleral lenses. Fig. 3 displays the overall prescribing patterns for orthokeratology and scleral contact lenses as a percentage of all contact lens fits (soft and rigid) obtained from Contact Lens Spectrum annual market research surveys (e.g. [8]) of contact lens practitioners (~500 respondents annually, primarily optometrists) performed between 2008 and 2016. These data highlight a very stable pattern of orthokeratology prescribing over the past decade (1% of all lens fits), but steady growth in scleral contact lens prescribing from ~1% in 2014 to more than 5% in 2017. Data from the Contact Lens Spectrum annual market research surveys also show a similar increase in overall rigid lens prescribing from 6% in 2014 to 11% in 2017 which suggests that patients are primarily being fitted with scleral lenses as a first lens option rather than a simple refitting of existing corneal rigid lens wearers into sclerals. While the orthokeratology data presented in Figs. 2 and 3 are fairly consistent (1–2% of all lens fits), the more rapid increase in scleral lens prescribing in recent years, observed in the Contact Lens Spectrum surveys, may be a result of the specific practitioners surveyed. The International Contact Lens Consortium data (Fig. 2) is obtained from a wide range of practitioners, often facilitated through a professional organisation, while the Contact Lens Spectrum data (Fig. 3) is collated through a readership survey which would include practitioners subscribed to "*Scleral Lens Monthly*", an editorial concerning all things scleral.

Why is there an increase in scleral lens prescribing? Over the past decade, numerous contact lens manufacturers have expanded their portfolio to include scleral lens designs and precision lathing techniques now allow complex lenses to be generated in a highly reproducible manner. Preformed scleral lens diagnostic fitting sets, manufactured in highly oxygen permeable materials, have simplified in-office fitting procedures for practitioners. However, impression techniques can still be utilised to obtain a true representation of an abnormal ocular surface (www.eyeprintpro.com), and a range of customisations are available to practitioners including back surface haptic toric, quadrant specific, and multifocal designs.

Advances in ophthalmic instrumentation have also simplified the scleral lens fitting process and have advanced our understanding of the peripheral corneal shape, the limbal junction and scleral morphology. Corneal topographers with composite map pasting [9] (Fig. 4) and simulated post-lens tear layer functions are now considered essential for the modern rigid contact lens practitioner, and recently corneo-scleral topographers provide reliable estimates of scleral curvature and sagittal depth at the anticipated landing zone of scleral lenses (Fig. 5) [10,11]. Quite possibly the

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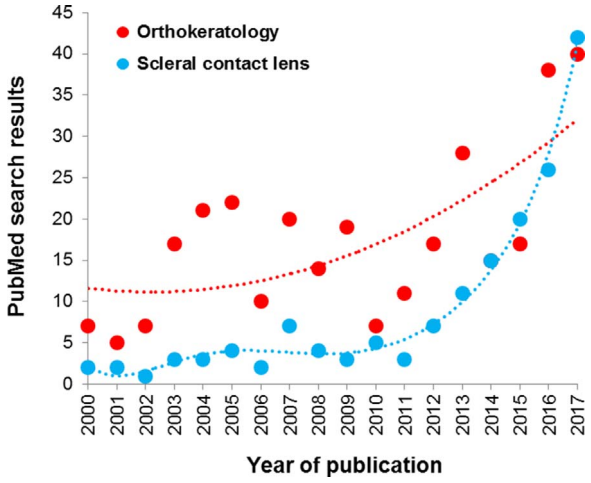

Fig. 1. PubMed database search results between 2000 and 2017 for "*orthokeratology*" and "*scleral contact lens*" after excluding unrelated references.

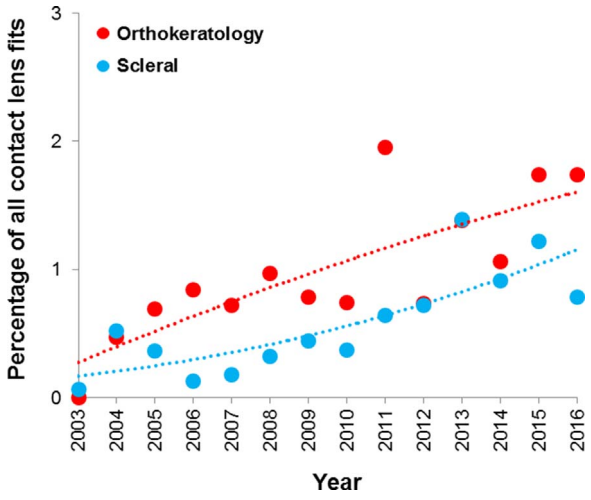

Fig. 2. Orthokeratology and scleral contact lens overall global prescribing patterns as a percentage of all contact lens fits (soft and rigid) obtained from international surveys of ~14,000 to 25,000 contact lens fits performed annually between 2003 and 2016 (adapted from [7]).

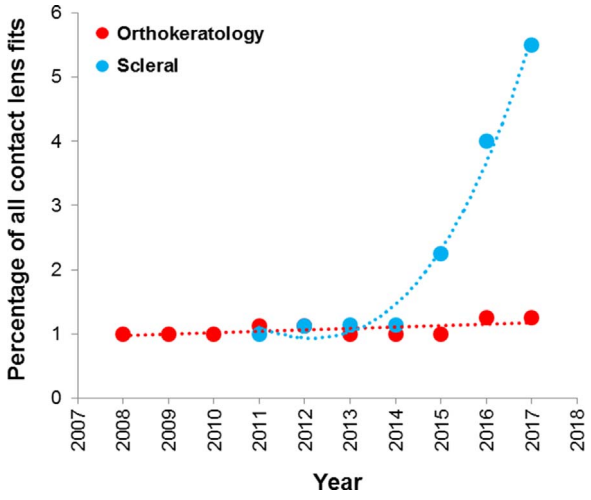

Fig. 3. Orthokeratology and scleral contact lens overall prescribing patterns as a percentage of all contact lens fits (soft and rigid) obtained from Contact Lens Spectrum annual market research surveys (e.g. [8]) of contact lens practitioners (~500 respondents annually, primarily optometrists) performed between 2008 and 2016.

most significant technological advance that may underlie the current and future surge in scleral lens prescribing is the advent of ocular optical coherence tomography (OCT). OCT imaging not only allows a non-invasive in-vivo examination of the relationship between a scleral lens and the cornea (central and limbal clearance), and the effect of lens wear upon the conjunctiva and sclera [12], but has improved our knowledge of the anatomy and physiological variations in the conjunctiva and sclera which are relevant to scleral contact lens practice and research [13,14].