Contact Lens and Anterior Eye 40 (2017) 15–24

Contents lists available at ScienceDirect

Contact Lens and Anterior Eye

journal homepage: www.elsevier.com/locate/clae

Factors in the success of new contact lens wearers

Anna Sulley, BSc, MCOptom, FAOO[a,*], Graeme Young, MPhil, PhD, FCOptom, DCLP, FAAO[b], Chris Hunt, MSc[b]

[a] Johnson Vision Care Companies, Johnson & Johnson Medical Ltd., Pinewood Campus, Nine Mile Ride, Wokingham, RG40 3EW, UK
[b] Visioncare Research Ltd, UK

ARTICLE INFO

Article history:
Received 13 April 2015
Received in revised form 1 September 2016
Accepted 19 October 2016

Keywords:
Contact lenses
New contact lens wearer
Discontinuation
Dropout
Lapsed

ABSTRACT

Purpose: To determine the first-year retention rate for patients fitted with contact lenses (CLs) and identify factors associated with retention and dropout.
Methods: This multi-site study was a retrospective chart review of the status of neophyte CL wearers fitted in representative UK eye care practices.
Results: Consecutive records for 524 patients at 29 sites were reviewed. Mean age at dispensing was 34 years (range 8–79), 68% were under 45 years and 61% female. Soft CLs were fitted to 98% of patients. After 12 months, 388 were still CL wearers, a retention rate of 74% (95% CI: 70.1–77.6). Of the 136 lapsed, 25% discontinued during the first month and 47% within 60 days. The main reasons cited for discontinuation included poor distance vision (26%; of whom, 37% were toric and 51% multifocal), poor near vision (16%), discomfort (14%) and handling problems (15%). In 32% of cases, the reasons for discontinuation were unknown. For 71% of dropouts, no alternative lens or management strategy had been tried. Significant factors associated with retention in univariate analysis were: age (younger), sphere power (higher), lens type (sphere vs multifocal) and purchase frequency (regular). Multivariate analysis showed lens sphere power, purchase frequency and lens material to be significant factors. There was a wide variation in retention rates between sites (40–100%).
Conclusions: During the first year of CL wear, the overall retention rate for neophyte CL wearers was 74% (spherical CLs 79%, torics 73%, multifocals 57%), with many lapsing during the first 2 months. Factors associated with retention and dropout in these patients include: lens power, material and type, and purchase frequency. While handling and comfort are the most commonly cited performance-related reasons for discontinuing in new spherical lens wearers, visual problems are the most common among new wearers of toric and, in particular, multifocal CLs.

1. Introduction

Although many studies have investigated the level of contact lens discontinuation, the true rate of dropout from lens wear remains unclear [1–8]. Recent estimates have varied from 12% to 43% for permanent discontinuations [1,3–8]. This variation is likely to be due to differences in the location, methodology and timing of the various studies (Table 1). Those undertaken in universities [1,4,6] or through websites [7,8], for instance, may suffer from selection bias. Another complicating factor is the definition of dropout; most commonly, studies have estimated the proportion of any patients who have tried contact lenses and subsequently discontinued. However, dropout rates estimated by Rumpakis [7] related to those contact lens wearers who discontinued in the first year [9].

Historical dropout rates are also influenced by the products available at the time. Since few of the products available in the 1990s are still used, estimates from that period are of limited interest. A better approach, therefore, is to estimate the current rate of discontinuations, either as a proportion of all current wearers or for those patients recently fitted with contact lenses. The present study has taken the latter approach, investigating the one-year retention rate for new wearers.

Various studies have examined factors relating to contact lens discontinuation [10–15]. Previous studies have identified discomfort as a prime reason for discontinuation, with vision and handling among other factors involved (Table 1). In the UK, a 2002 study of lapsed wearers found that 51% cited discomfort as the principal reason for having given up contact lens wear [10]. Among the more recent studies, Dumbleton et al. [8] reported the primary reasons

* Corresponding author.
E-mail address: asulley1@its.jnj.com (A. Sulley).

http://dx.doi.org/10.1016/j.clae.2016.10.002
1367-0484/

Table 1
Previous publications reporting contact lens discontinuation rates.

Reference	n	Age range (years)	Country	Methodology	Results	Reasons for Discontinuation
Dumbleton et al. (2013) [8]	4207	17–77	Canada	Web-based survey	Discontinuations: 40% Permanent discontinuations: 23%	Discomfort: 44.3% Vision: 6.3% Handling: 6.3%
Rumpakis (2010) [7,9]	372 eye care practitioners	–	US (138), Taiwan, Korea + others	Web-based survey	'Dropout rates': US—16%, Asia-PR—31%, EMA—30%	Discomfort: 45.6% Vision: 17.5% Handling: 7.0%
Richdale et al. (2007) [6]	453	18–88	US (University)	Self-administered questionnaire	Discontinuations: 24% Dissatisfied CL wearers: 26%	Discomfort: 64% Vision: 14% Handling: 0%
Jutai et al. (2003) [5]	418	15–82	Canada	Self-administered questionnaire	Discontinuations: 43%	–
Young et al. (2002) [10]	236	18–74	UK	Self-administered questionnaire	–	Discomfort: 51% Vision: 13%
Harknett et al. (2001) [4]	115	14–72	UK (University clinic)	5-year chart review	Discontinuations: 29%	–
Pritchard et al. (1999) [3]	1444	–	Canada (Quebec)	Mailshot questionnaire	Discontinuations: 34% Permanent discontinuations: 12%	Discomfort: 50% Vision: 3% Handling: 3%
Weed et al. (1993) [1]	568	–	Canada (University)	Self-administered questionnaire	Discontinuations: 51% Permanent discontinuations: 40%	Discomfort: 41% Vision: 0% Handling: 0%

for discontinuation with contemporary lenses were discomfort (24%) and dryness (20%).

Several factors relating to lens parameters, material and modality have been associated with discontinuation, including lower sphere power [3], and use of silicone hydrogel (SiH) and daily disposable lenses [8]. A previous study suggested that the skill of the eye care practitioner is a key factor in many cases [12]. This was supported by the fact that a high proportion of lapsed wearers (77%) could be successfully refitted [10]. A further study found that many astigmats (74%) who had previously dropped out of contact lens wear could be successfully fitted with current toric soft lenses [16]. Dropout rates may therefore relate to differences in procedures between individual contact lens practices and practitioners, as well as differences between patients and between contact lens types.

Previous studies have also attempted to suggest methods for minimising contact lens dropouts [18–22].

The most common remedies include using a wide selection of products [11,18,19], careful prescribing for presbyopes [17,18], switching care system [17], and close follow-up of new wearers [21].

Since these studies were conducted, new contact lens designs, materials and care systems have been introduced. Practice procedures may also have changed. The purpose of this study was therefore to determine the first-year retention rate for new wearers fitted with current contact lenses and identify patient, lens and practice-related factors associated with retention and dropout.

2. Materials and methods

This multi-site, sponsor-masked study was a retrospective chart review of the current status of new contact lens wearers fitted in eye care practices in the UK. The protocol was approved by the West of Scotland NRES Ethics Committee prior to undertaking the study. Neophyte wearers were defined as those with no habitual contact lens wear in the previous 3 years. Habitual wear did not include short contact lens trials ($\leq$2 weeks). Patients were required to be at least 8 years old on the date contact lenses were first dispensed and to have been dispensed lenses for the first time during an 18-month period between September 2011 and March 2013. Those eligible for contact lenses under the National Health Service for medical or other reasons were excluded from the study.

Investigational sites were recruited using various methods, including via mailshots, journals and social media. Practices were expected to be fitting more than two new contact lens patients a week, easily able to review patient data and willing to follow the study protocol. Practices were chosen to be broadly representative of the UK market. The 29 sites recruited were categorised according to practice type and location. Independents were considered to have 1–9 practices (52% of sites), regional groups 10–49 practices (7%) and national groups 50 or more practices (41%). Sites recorded their locations as town (45%), city centre (28%), suburban (24%) or village (3%). Locations were spread around the UK, including Scotland, Wales and Northern Ireland.

At each site, a nominated member of practice staff conducted the retrospective review of practice records. All staff were trained in the study procedures via an interactive, self-administered web presentation with a series of multiple-choice questions at the end.

Records of contact lens fittings were reviewed in a chronological manner from September 2011 in order to identify up to 25 neophyte patients dispensed lenses within the specified period. Practitioners used a variety of methods to identify those eligible, such as reviewing consecutive entries in the appointment book, order records or register of new patients. The anonymity of patients was protected. Detailed information from each record on contact lens type, powers, replacement frequency (daily, two-weekly or monthly) and purchasing habits (quarterly, yearly or other specified frequency) was recorded on a patient-specific questionnaire.

Investigators were required to state whether the patient was still wearing contact lenses (Yes/No), together with any change of lens type, with details taken from the patient and practice records. While no specific guidance was given, practices used various strategies for determining whether patients had discontinued and why, such as reviewing the records in discussion with the patient or during subsequent contact with the practice. The date of dropout and main reasons were recorded, along with any alternative lens or lens care strategies tried. Investigators were also required to complete a site-specific questionnaire relating to their type and mode of practice, procedures and staff.

2.1. Statistical analysis

All statistical analyses were performed using SAS software Version 9.4 (SAS Institute, Cary, NC). Missing data were excluded from the analysis.

Where data were collected by eye, these were converted to the subject level as follows:

- Lens type—if right and left eyes were different types, the more advanced design lens was used; e.g. a patient with a toric lens in one eye and a spherical lens in the other was placed in the toric group.
- Lens sphere power—the average of right and left eyes was used.
- Lens cylinder power—the highest lens power was used.

Estimates of retention rates were calculated for the total sample and for selected sub-groups. Retention rate was calculated as:

$$\frac{\text{No. of curent wearers}}{\text{No. of lapsed} + \text{current wearers}} \times 100$$

Two-sided 95% confidence intervals of retention rate were also calculated.

Univariate generalised linear mixed models (GLMM) with a binary distribution were used to evaluate potential factors associated with retention rates (Table 2). Where appropriate, least-squares mean differences were used to test for differences between groups. Following the univariate analysis a multivariate logistic regression model was fitted. The model included the potential factors that showed a *P*-value of 0.20 or less in the univariate analysis. Due to the small number of RGP (11) and prosthetic (1) wearers, only those patients who were dispensed soft contact lenses were included in the univariate and multivariate analyses (n = 512). In each case, a GLMM was used with a binary distribution and logit link function with the following random effects: site and patient (nested in site). This type of mixed effects model was used to account for the variation between sites and patients while exploring the effects of both categorical and continuous variables on retention rates.

Separate analyses using GLMMs were used to look for interactions between subject age and lens type. A similar model was used as with the univariate model with the inclusion of subject age, lens type, and their interaction as effects.

The univariate analysis of sphere power was also completed on a subset of the patients, namely those that were dispensed spherical or toric soft contact lenses (n = 432).

The potential practice-factors associated with retention rates (Table 3) were analysed from the site-specific questionnaire using univariate generalised linear models. The site-specific retention rate was used as the dependent variables and the question as the independent variable. One site did not complete this questionnaire and was therefore excluded from the site-specific questionnaire analysis.

3. Results

Patient status is summarised in Table 4. In total, records for 524 patients were reviewed, where the outcome was known, of whom almost all (98%) were fitted with soft lenses. Eleven RGP wearers (2%) and one prosthetic lens wearer (0.2%) are only included in the overall retention rate calculation (for comparison with previous discontinuation studies) but are excluded from all subsequent analyses.

3.1. Patient characteristics

Patients ranged in age from 8 to 79 years (mean 34 years). The proportion of patients in each age group was 15% <16 years, 23% aged 16–24, 20% aged 25–34, 10% aged 35–44, 23% aged 45–59 and 8% aged 60+. Sixty percent (316/524) were female.

3.2. Overall retention rates

Of the 524 neophyte patients, 74% (95% CI: 70.1–77.6%, 388/524) were still wearing contact lenses 12 months after fitting (Fig. 1). Of those that discontinued, the time of discontinuation was unknown in 10% of patients (14/136). Of those with known date of discontinuation, one quarter (31/122) discontinued during the first 30 days, nearly half (47%, 57/122) within 60 days, and three-quarters within 180 days. The retention rate for the 512 soft lens wearers was 73.4% (95% CI: 69.4–77.1).

A summary of the retention rates is shown in Table 5.

3.3. Retention factor analysis

3.3.1. Lenses dispensed

The following analysis is for soft lens wearers only, given the small number of patients wearing other lens types. Lens powers were collected rather than refraction. In some cases, such as those wearing monovision correction, the lens power may not have accurately reflected the true spherical refraction. However, based

Table 2
Univariate generalised linear mixed models with a binary distribution—Soft contact lens wearers only (n = 512). Contact lens wearing status was used as the dependent variable. The following variables (one model per variable) were included as fixed effects and site and patient (nested in site) were included as random effects.

Effect	*P*-value	F-value	Numerator DF	Denominator DF
Age Group (6 groups)	**0.0088**	**3.12**	**5**	**506**
Age Group (≤45 vs. >45)	**0.0008**	**11.35**	**1**	**510**
Gender	0.15	2.11	1	510
Lens Type	**0.0042**	**5.53**	**2**	**509**
Lens Material	0.072	3.25	1	510
Lens Material (Spheres only [n = 261])	0.070	3.31	1	259
Lens Material (Torics only [n = 169])	0.11	2.61	1	167
Lens Sphere Power	**0.0036**	**3.28**	**6**	**505**
Lens Sphere Power (Spheres and Torics only [n = 430])	**0.014**	**2.69**	**6**	**423**
CL Cylinder Power	0.11	2.03	3	165
Lens Replacement Frequency	0.57	0.57	2	509
Practice Type	0.71	0.14	1	23
Practice Location	0.33	1.17	2	21
Purchase Frequency	**0.0020**	**6.29**	**2**	**509**

DF = Degrees of Freedom. Statistically significant differences are shown in bold.

Table 3
Univariate generalised linear models with a binomial distribution (n = 28 sites)—Site-specific retention rate was used as the dependent variable. The following variables (one model per variable) were included as fixed effects.

Effect	*P*-value	F-value	Numerator DF	Denominator DF
Clinic Time for CL	1.00	0.00	1	26
CL Turnover	0.71	0.14	1	26
New CL Fittings	0.60	0.28	1	26
No. of Optometrists	0.56	0.35	1	26
No. of CL Optician	0.94	0.01	1	26
Experience	0.97	0.00	1	26
Length of CL Fitting	0.95	0.11	3	24
Free Trial Fittings	0.78	0.08	1	26
Proactively Suggest CLs	0.93	0.07	2	25
Phone New Wearers	0.99	0.08	4	23
Follow-up those that Fail to Return	0.99	0.09	4	23

DF = Degrees of Freedom. Statistically significant differences are shown in bold.

Table 4
Patient Status.

Total no. of patient records reviewed (known outcome) 524	
Soft CL wearers	512 (98%)
RGP wearers	11 (2%)
Prosthetic lens wearer	1 (0.2%)

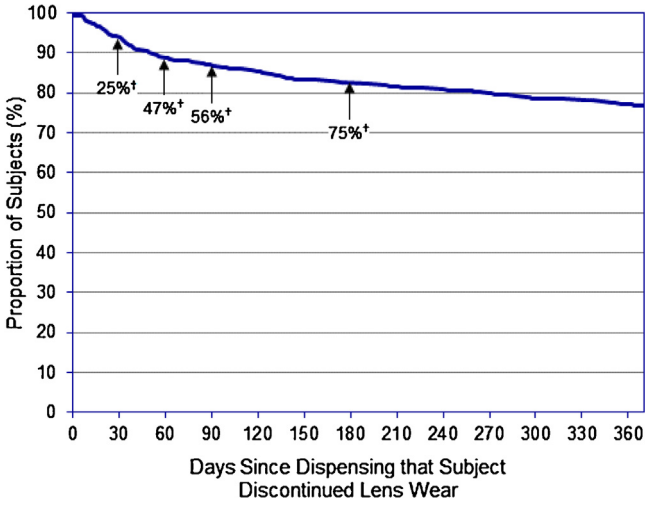

Fig. 1. Proportion of patients who discontinued lens wear by number of days since dispensing (n = 510 [122 with known date of discontinuation plus 388 still wearing contact lenses after 12-months]).

on soft lens spherical powers, 66% (338/512) were myopic corrections.

Soft lenses dispensed comprised single-vision spherical (51%), toric (33%), and multifocal (16%) designs. Of the toric lenses, the median cylinder power dispensed was −1.29D. Nearly half (46%) were with-the-rule (180 ± 20°), 44% against-the-rule (90 ± 20°) and 10% had oblique axes. Of those dispensed with multifocal soft lenses, 48% were relatively high adds (>+2.00/'high').

Thirteen soft lens wearers (3%) had a plano power dispensed in at least one eye (11 torics with plano sphere and two multifocals with plano for distance) and 14 subjects (3%) only required contact lenses in one eye.

A majority of soft lens wearers used daily disposable lenses (56%, 285/512) with 44% (227/512) wearing re-usable (2-weekly or monthly replacement) lenses. Of the daily disposable users, 60% wore spherical lenses; with reusable lenses, the proportion of spheres was 39%. Almost all patients (99%, 507/512) wore their soft contact lenses on a daily wear basis rather than for extended wear.

3.3.2. Summary of univariate and multivariate analyses

Univariate analysis was first used to look for factors influencing retention rate. Significant factors found, summarised in Table 2, were: patient age ($P = 0.0088$), lens type ($P = 0.0042$), lens sphere power group ($P = 0.0036$), and purchase frequency ($P = 0.0020$). Univariate analysis of site-specific factors showed no significant differences in retention rates (Table 5).

The multivariate logistic regression analysis was completed using all variables that showed a *P*-value of 0.20 or less in the univariate analysis (Table 3). As with the univariate analysis, lens sphere power group ($P = 0.021$) and purchase frequency ($P = 0.0006$) were both found to be significant factors. Lens material was also found to be a significant factor ($P = 0.032$). Lens type was not found to make a significant contribution to the multivariate model.

The obvious correlation between age and multifocals may account for the absence of lens type as a significant factor in the multi-variant analysis.

3.4. Patient factors

3.4.1. Age and gender

Patient age was found to be a significant factor influencing retention rate by the univariate analysis ($P = 0.0088$). However, this was not shown in the multivariate analysis ($P = 0.31$,). The highest retention rate (83%, 64/77) was noted with the under-16 age group and the lowest with the 60+ age group (54%, 22/41, Fig. 2). When comparing patients under 45 years (i.e. approximately pre-presbyopic age) to those aged 45 years or over, retention rates were significantly different; these were 78% (274/350) and 63% (102/162) respectively ($P = 0.0008$). Although retention rates were lower in those aged 60+ than in the 45–59 age group, this difference was not statistically significant.

3.5. Lens factors

3.5.1. Lens type and material

The univariate analysis showed a significant effect of lens type on retention rate ($P = 0.0042$, Fig. 3). The retention rate for spherical lenses (excluding torics, multifocals and other lens types) was 79%. For torics the rate was 73% and for multifocals 57%. For single-vision lenses (spheres and torics combined, excluding multifocals) the rate was 76%. However, this difference was not shown by the multivariate analysis ($P = 0.39$).

Soft lens material showed a trend towards a significant effect on retention rate ($P = 0.072$, Fig. 3) with the univariate analysis and a

Table 5
Summary of retention rates at 12-months.

Variable			Retention Rate	95% Confidence Interval	No. of Current Wearers	Total (Current + Discontinued)
Total	–		74.0	70.1–77.6	388	524
Patient Factors:						
Age	<16		83.1	73.2–89.9	64	77
	16–24		78.0	69.7–84.5	92	118
	25–34		72.8	63.5–80.5	75	103
	35–44		82.7	70.3–90.6	43	52
	45–59		66.1	57.3–73.9	80	121
	60+		53.7	38.7–67.9	22	41
	<45		78.3	73.7–82.3	274	350
	≥45		63.0	55.3–70.0	102	162
Gender	Male		77.1	70.8–82.4	155	201
	Female		71.1	65.8–75.8	221	311
Lens Factors:						
Lens Type	Sphere		78.9	73.6–83.4	206	261
	Toric		72.8	65.6–78.9	123	169
	Multifocal		57.3	46.5–67.5	47	82
	Prosthetic Lens[a]		100.0	20.7–100.0	1	1
	RGP[a]		100.0	74.1–100.0	11	11
Soft Total			73.4	69.4–77.1	376	512
Soft Lens Factors:						
Lens Material	Silicone Hydrogel (SiH)		69.0	63.4–74.0	200	290
	Hydrogel		79.3	73.5–84.1	176	222
Lens Material by Type	Sphere	SiH	74.1	66.4–80.6	106	143
		Hydrogel	84.7	77.2–90.1	100	118
	Toric	SiH	66.7	56.1–75.8	56	84
		Hydrogel	78.8	69.0–86.2	67	85
	Multifocal	SiH	60.3	48.0–71.5	38	63
		Hydrogel	47.4	27.3–68.3	9	19
Power—Sphere	>+4.00		88.0	70.0–95.8	22	25
	+2.25 to +4.00		83.7	70.0–91.9	36	43
	+2.00 to Pl		56.6	47.1–65.6	60	106
	−0.25 to −2.00		73.0	66.5–78.7	146	200
	−2.25 to −4.00		81.4	72.6–87.9	79	97
	−4.25 to −6.00		80.0	64.1–90.0	28	35
	>−6.00		83.3	43.6–97.0	5	6
Power—Cylinder	−0.75 to −1.00		61.5	49.4–72.4	40	65
	−1.25 to −1.50		80.8	68.1–89.2	42	52
	−1.75 to −2.00		76.9	57.9–89.0	20	26
	>−2.00		80.8	62.1–91.5	21	26
Lens Replacement Frequency	Daily Disposable		75.4	70.1–80.1	215	70
	2-weekly Replacement		75.5	61.9–85.4	37	12
	Monthly Replacement		69.7	62.6–75.9	124	54
Practice Factors:						
Practice Type	Independent		74.6	68.3–80.1	156	209
	National/Regional		72.6	67.3–77.3	220	303
Practice Location	City Centre		70.6	63.3–76.9	120	170
	Town Centre		78.9	72.6–84.1	150	190
	Suburban/Village		69.7	62.0–76.5	106	152
Purchase Frequency	Quarterly		78.7	73.3–83.2	203	258
	Yearly		90.5	71.1–97.3	19	21
	Other		66.1	59.8–71.9	154	233

[a] The 11 RGP and one prosthetic lens wearers were excluded from statistical analysis other than for overall retention rate.

significant effect in the multivariate analysis ($P = 0.032$, Table 6). A higher retention rate was seen with the hydrogel lenses (79%, 176/222) compared with silicone hydrogel [SiH] lenses (69% 200/290).

When looking at spheres and torics separately, SiH lenses had retention rates of 74% and 67% respectively, and hydrogel lenses 85% and 79% respectively. These differences between materials by lens type were not significant.

There was no significant difference in retention rate by lens replacement frequency ($P = 0.57$).

3.5.2. Lens power

Significant differences in retention rates were seen across the range of spherical contact lens powers ($P = 0.0036$, Fig. 4). This difference remained significant in the multivariate analysis. Pairwise *post-hoc* comparisons were completed after the univariate analysis which showed that, for patients with a sphere power in the range +2.00D to plano, the retention rate was significantly lower (57%, $P < 0.05$) when compared to five of the other six groups: >+4.00, +2.25 to +4.00, −0.25 to −2.00, −2.25 to −4.00, and −4.25 to −6.00. A similar pattern was seen when the multifocal wearers were removed from the statistical analysis. Significant differences in retention rates were found when looking at spherical power across spherical lens wearers and toric lens wearers ($P = 0.014$). The retention rate was also significantly lower for patients with a sphere power in the range +2.00D to plano (56%, $P < 0.05$) when compared to the same five of the other six groups.

With the toric lens wearers, the retention rate ranged from 62% for low cylinder powers (−0.75 to −1.00) to 81% for higher cylinder

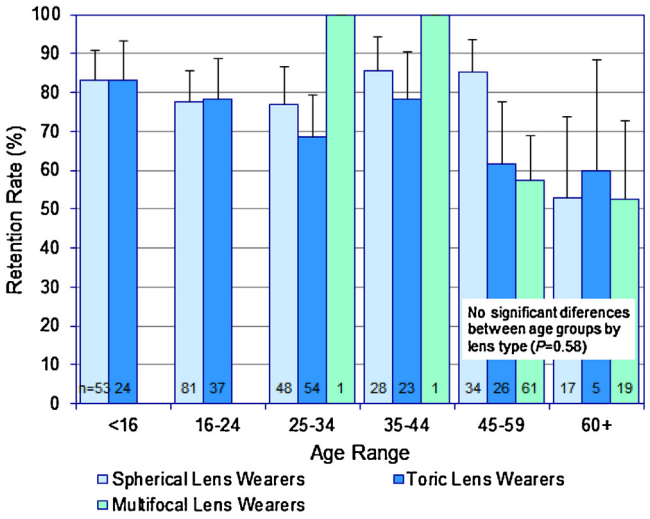

Fig. 2. Retention rates by age group and lens type. Error bars show upper 95% confidence intervals.

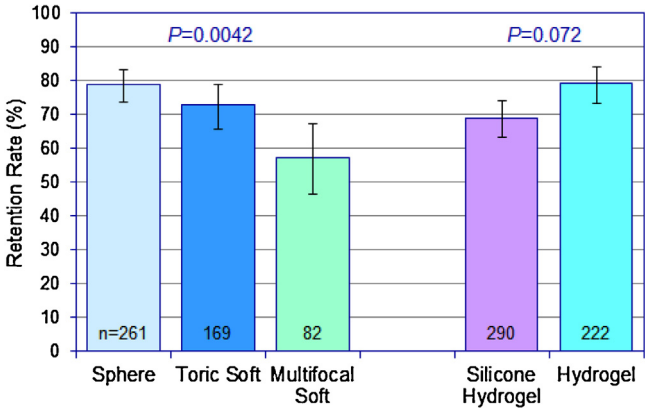

Fig. 3. Retention rates by lens type. Error bars show 95% confidence intervals. P-values from the univariate analysis (Table 2).

Table 6
Multivariate generalised linear mixed models with a binary distribution—Soft contact lens wearers only (n = 512). Contact lens wearing status was used as the dependent variable. The following variables were included as fixed effects and site and patient (nested in site) were included as random effects.

Effect	*P*-value	F-value	Numerator DF	Denominator DF
Age Group (6 groups)	0.31	1.20	5	488
Gender	0.19	1.76	1	492
Lens Type	0.39	0.94	2	442
Lens Material	**0.032**	**4.61**	**1**	**494**
Lens Sphere Power	**0.021**	**2.51**	**6**	**494**
Purchase Frequency	**0.0006**	**7.62**	**2**	**494**

DF = Degrees of Freedom. Statistically significant differences are shown in bold.

powers (−1.25 to −1.50 and >−2.00). However, retention rates did not differ significantly (P = 0.11) and the number of patients with high cylinder powers was small.

3.6. Practice factors

3.6.1. Type and location of practice

The retention rates for individual sites ranged from 40% to 100% (Fig. 5), with a median of 75%. A majority of the patient records reviewed were at national group practices (53%, 271/512), with 41% (209/512) being at independent practices and 6% (32/512) at regional groups. The number of records per practice ranged from 17 to 25 (mean: 22.6) at national groups, 7–23 (mean: 13.9) for independents and 15–17 (mean: 16.0) at regional groups.

Comparing types of practice, there were no significant differences (P = 0.71) between retention rates for independents (75%, 156/209) and national/regionals (73%, 220/303). The national and regional groups were combined as only two were regional practices. For practice locations, retention rates did not differ significantly (P = 0.33). Retention rates were 79% (150/190) for town centre sites, 71% (120/170) for city centre sites and 70% (106/152) for suburban/village locations.

3.6.2. Purchase frequency

Some basic information was collected regarding purchasing frequency. The multivariate analysis showed a significant effect of purchasing frequency on retention rate (P = 0.0006). A majority (54%) of those continuing with lens wear had arranged to be supplied with lenses on a regular (i.e. quarterly) basis compared with 40% of the wearers who had discontinued. Also, those wearers purchasing lenses on a regular basis were significantly less likely to drop out than those whose purchasing intention was described as 'other', most of whom bought their lenses on an *ad hoc* basis as and when required (P = 0.0012, pairwise *post-hoc* comparison). Only a small proportion of patients (5%) purchased their lenses yearly.

3.6.3. Other practice-specific factors

The site-specific questionnaire enabled the study to evaluate the effect of different modes of practice and procedures on retention rate (Table 3). None of the factors proved to be statistically significant.

However, it was notable that only 29% of wearers who discontinued (40/136) had been offered an alternative lens or strategy to try. Of those offered an alternative, 63% (25/40) were issued different lenses, 38% (15/40) were offered a further trial fitting, 28% (11/40) were given additional instruction/advice, 23% (9/40) had their lens power modified and 10% (4/40) changed their wearing pattern. None had recorded giving the patient a change of care product. Of the toric and multifocal soft lens lapsed wearers, only 35% (28/80) were offered an alternative lens. For the multifocal lapsed wearers, 43% (15/35) were offered an alternative lens, while for the toric group the figure was 29% (13/45).

3.7. Reasons for discontinuing

For 32% of wearers who discontinued (44/136), the reasons for dropout were unknown. Reasons for discontinuation are therefore reported for 68% (92/136) of those who discontinued lens wear. The reasons recorded are summarised in Fig. 6. In 55% (51/92) of cases, more than one reason was reported. The main reported reasons included: discomfort (21%, 19/92), poor distance vision (38%, 35/92), poor near vision (24%, 22/92), handling problems (23%, 21/92) and loss of interest (16%, 15/92). Discomfort was more likely to be reported than dryness or soreness as a reason for discontinuing.

When the vision reasons are combined (distance and near), poor vision is a reason for discontinuation in 47% of cases compared with 25% for the combined reasons related to comfort (discomfort, dryness and soreness) and 18% for motivation reasons (inconvenience and lost interest). Fig. 7 shows a breakdown of reasons for discontinuation by lens type.

Of the wearers who discontinued with known reason, 48% (44/92) wore daily disposable lenses compared to 52% (48/92) who wore reusable lenses (2-weekly or monthly replacement). There were no significant differences between these two groups when looking at discomfort, handling, cost and inconvenience. Lens

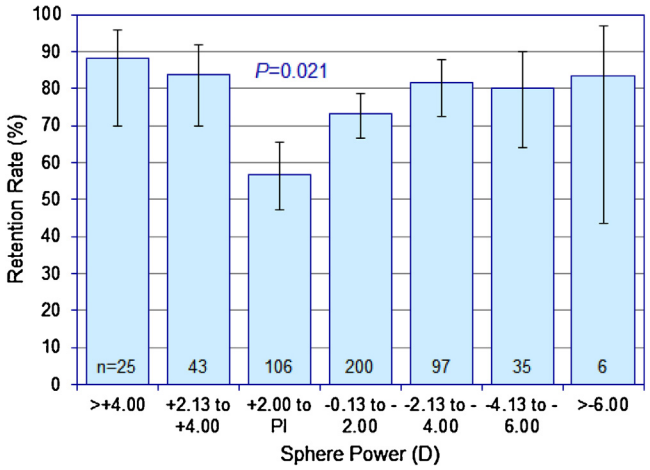

Fig. 4. Retention rates by sphere power–soft lens wearers (n = 512). Error bars show 95% confidence intervals. P-value from the multivariate analysis (Table 6).

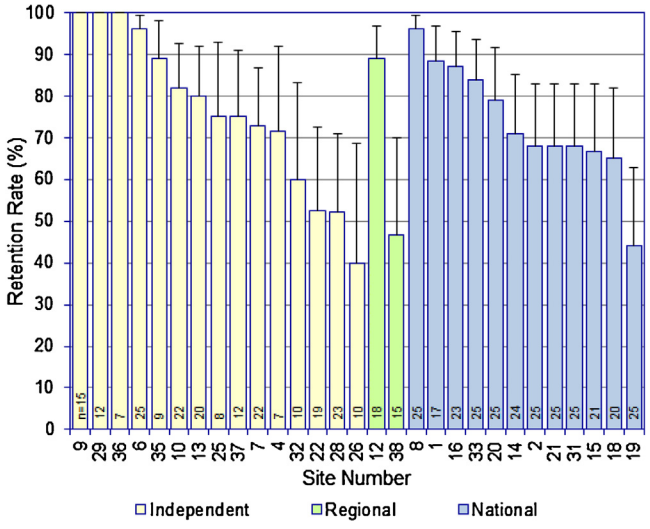

Fig. 5. Retention rates by site (n = 29 sites). Error bars show upper 95% confidence intervals.

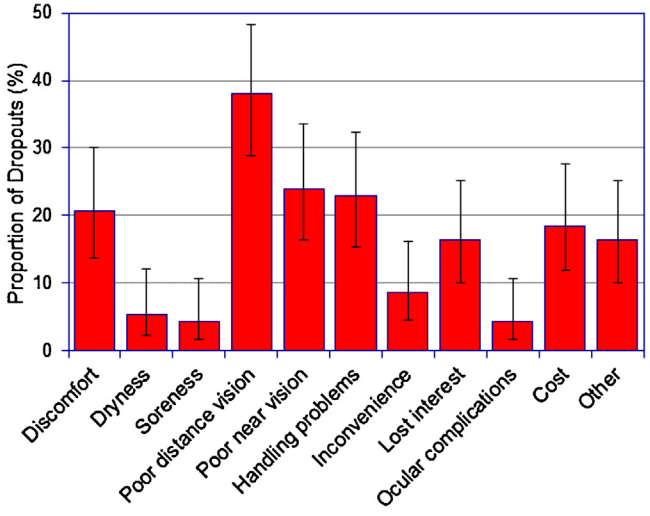

Fig. 6. Reasons for discontinuing lens wear (n = 92). Error bars show 95% confidence intervals.

material (SiH vs. hydrogel) did not appear to have a significant effect on the reason for discontinuing.

During the first 6 months the main reason for discontinuing was distance vision (39–50%); however, this dropped to 21% in the final 6 months (Fig. 8). Discomfort peaked as a reason at 1–3 months (29%) then fell to 16% in the final 6 months. Dropouts due to handling problems decreased as experience increased and those dropping out due to cost increased with time.

4. Discussion

This study has revealed new findings on the first-year retention rate among patients new to contact lenses and identified factors involved in retention and dropout. Previous studies used various methodologies and patient populations to investigate dropout rates. [1–8]. Of the more recent studies, Dumbleton *et al*[8] surveyed those who had discontinued in a previous 2-year period having worn lenses for longer than 6 months and found that 23% had dropped out of contact lens wear permanently. Rumpakis[7] has confirmed that his estimates, as in the present study, related to those wearers who discontinued in the first year [9]. Dropout rates in this international study varied from region to region, with a rate of 30% in Europe/Middle East/Africa [7].

The present study identifies a dropout rate in the first year of 26% and a potential opportunity for UK eye care practices to improve their success in retaining new wearers in contact lenses. Although the overall first-year, new wearer retention rate was relatively low (74%), the rate for single-vision soft lenses (spheres and torics combined, excluding multifocals) was slightly higher, at 76%, and for spherical soft lenses the rate was 79%. The range of lenses fitted in the present study was comparable with data from Morgan's UK contact lens prescribing trends [23].

Nearly a half of new wearers who discontinued did so within the first 2 months of using contact lenses. Practices should pay particular attention to new wearers during this early period and develop strategies to support and manage patients through the initial stages of lens wear. Contacting patients in the first few days to check on their progress is among potential strategies. As might be expected, handling problems tended to be less likely to be a reason for dropout after the initial 1–3 months, whereas cost tended to be more likely a reason 3 months or more after fitting.

4.1. Patient factors

The study included a wider age range than other contact lens discontinuation studies that specified age [4,6,8,10]. A substantial proportion of these new lens wearers were in the older age groups (≥45 years) which perhaps suggests a shift in the contact lens wearer demographic. In a survey conducted 10 years ago, of 3.2 million contact lens wearers in the UK, only 10% were ≥45 years [24]. Nearly a third of the patients in the present study were in the older age groups; however, this proportion is likely to be lower than that for the total contact lens wearing population as the average age of new wearers is lower than that of existing wearers.

Age was one of the most notable factors influencing retention rate, with the older age groups (>45 years) showing a lower rate in the univariate analysis. In the case of the 60+ group, the retention rates were lower with all lens types. However, with the age group 45–59 years, the retention rate for spherical lenses was comparable to that of the younger groups. In this group, the reduced retention rate was, therefore, driven by the multifocal fittings. The study also included younger patients than previous discontinuation studies where age was specified. Retention in the youngest age group (<16 years) was relatively high, at 83%, suggesting that these patients are well motivated to wear contact lenses.

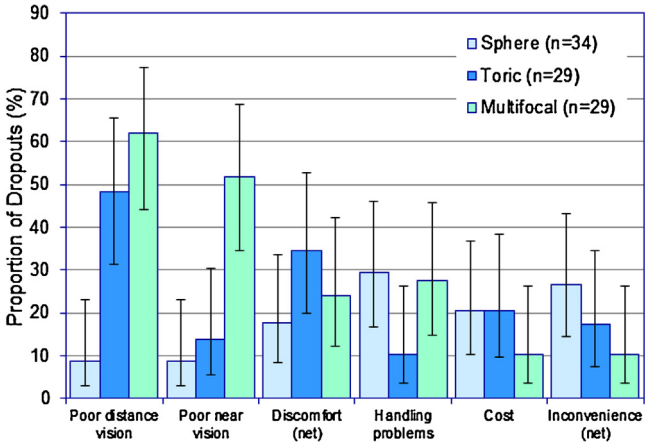

Fig. 7. Reasons for discontinuing lens wear by lens type (n = 92). Error bars show 95% confidence intervals.

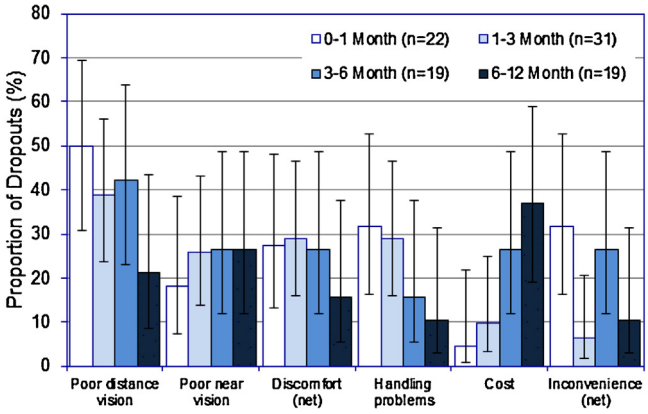

Fig. 8. Reasons for discontinuing lens wear by time after dispensing (n = 92). Error bars show 95% confidence intervals.

4.2. Lens factors

As expected, there was a difference in success between lens types, with multifocals showing a poorer retention rate. This reflects the fact that current multifocal designs have limitations; historically, clinical studies tend to report success rates comparable to the retention rate noted in this study (57%) [25]. The presbyopic age group is more likely to be prone to dryness-related comfort problems [26]. However, the predominant reason reported for discontinuing multifocal wear was vision-related problems, suggesting that either better designs are needed or better fitting procedures to optimise vision with current multifocals. Differences in findings between univariate and multivariate analyses indicate that confounding factors may be present.

Toric lenses are generally expected to have a poorer success rate than spherical lenses. It was surprising, therefore, that the study did not find a significant difference in retention rates. This probably reflects a general improvement in toric designs over recent years and practitioners' growing confidence in fitting them. A recent study refitting lapsed astigmatic contact lens wearers with toric soft lenses noted an improved success rate compared with previous estimates (94% vs 69%) [16,10]. Morgan has reported an increase in prescribing of toric soft lenses to new patients from 19% of soft lens fits in 1996 to 36% in 2013 [27,23]. In the present study, a third of patients fitted with soft lenses wore toric designs, which is close to the proportion expected from the prevalence of astigmatism ≥0.75DC (the level at which a toric lens is normally considered) [28].

Comparing material types, the retention rate was lower with SiHs than hydrogels and this difference was significant in the multivariate analysis. If this reflects a true difference, it was not due to differences in the lens types used as this finding was noted when only spherical lenses were considered. This suggests that switching wearers from hydrogels to SiHs may not necessarily help retain new wearers who are considering dropping out. Individual patient and lens factors may also play a part. A recent study attempted to predict success in new contact lens wearers by evaluating changes in tear metrics and ocular signs induced by 6 months of SiH wear [29]. These authors found that wettability of the ocular surface was the main factor affecting contact lens dropout.

Similarly, fitting wearers with daily disposables rather than reusable lenses would seem to have little effect on new wearer retention. Dumbleton *et al*[8] found that a higher proportion of lapsed wearers than current wearers were using daily disposables and hydrogel lenses, but more non-lapsed wearers than lapsed wearers wore SiH contact lenses.

Lens sphere power influenced retention rate, with plano and low plus lenses achieving poorer success. The lower success with low plus lenses was not driven by a greater usage of multifocals as the difference in retention rates was still evident when only spheres were considered. The lower retention rate may be due to poorer motivation in these patients.

High cylinder toric prescriptions are more susceptible to rotation-induced blurred vision, therefore higher cylinders are generally expected to be less successful. The number of patients in this study with high cylinders was small; however, it was encouraging to find no significant difference in retention rate between levels of cylinder power. This perhaps reflects recent improvements in toric lens design providing better stability, and growing practitioner experience in fitting higher astigmats and in toric soft prescribing in general.

4.3. Practice factors

One of the surprising findings was the wide range in retention rates between practices. This variation was not explained by the most obvious differences: practice type and location. National groups, on average, achieved a similar overall retention rate to independent practices and there was no significant difference for location. A recent UK study found that independent practices fit contact lenses to older patients, undertake a higher proportion of multifocal lens fittings and fit a lower proportion of daily disposable and toric soft lenses (but a higher proportion of rigid lenses) than national groups [30]. Despite these differences in fitting behaviour, retention rates do not appear to be influenced by practice setting.

Purchase frequency was shown to have a significant effect on retention rate; a higher rate was associated with arrangement for a regular supply, highlighting that convenience for patients is a factor that may help keep them in lenses.

4.4. Reasons for discontinuation

Previous studies have found comfort-related problems to be the main reason for contact lens dropout [1,3–8,10–12]. In the present study with new wearers, the most commonly reported reason for discontinuation was vision-related problems but reasons varied with lens type. For those wearing spherical lenses, handling problems and comfort were the principal performance-related

reasons. Toric and, in particular, multifocal wearers, were more likely to discontinue due to poor vision. That said, nearly twice as many wearers overall reported vision being a reason for discontinuation than comfort. In a previous UK study, half of lapsed wearers (51%) gave discomfort as the main reason, although this study was among lapsed wearers who had last discontinued contact lens wear an average of 5 years earlier, rather than new wearers [10]. The present study also included a wider age range (8–79 years vs 18–74 years).

Possible explanations for an apparent shift in reasons for discontinuation are: (i) that soft lenses have improved to the extent that discomfort is less of a problem than was previously the case, or (ii) that a high proportion of the unknown reasons for discontinuation in the present study were poor comfort and, therefore, not captured. Subjects with poor comfort may be less likely to return, whereas those with poor vision may be more likely to return such that the reasons for their discontinuation are discovered.

However, it should also be noted that patients in this study were new wearers, in contrast to most previous lapsed wearer studies. New wearers may have a lower expectation of contact lens comfort than established wearers and be more likely to notice differences in vision between spectacles and contact lenses. It may also be relevant that in the present study information was provided by the practitioner rather than directly from the patient. The high proportion of lapsed wearers that were wearing toric and, in particular, multifocal lenses may also have increased the proportion dropping out for vision reasons in comparison with previous studies. That said, even allowing for missing data and other limitations, poor vision appears to be a more predominant factor than previously reported.

Poor vision was a more critical factor with multifocal wearers. It might be expected that a proportion of multifocal wearers will fail to achieve satisfactory vision with the first lenses dispensed and some may find that other contact lens options prove more successful. Yet only a minority of multifocal dropouts were tried with alternative lenses. It is possible that some of these could have continued in lens wear if another lens or strategy had been tried. Other authors have observed that a systematic approach to multifocal fitting can help to improve success rates [31].

Similarly with the toric dropouts, only a small proportion of patients were tried with alternative lenses. Astigmatic patients may need to try more than one toric lens if vision is to be optimised, although a recent study found most astigmats (88%) can be successfully fitted at the first attempt with current toric soft lens designs [16].

Notably, for nearly one in three wearers who discontinued, the reasons for dropout were unknown. This suggests that practitioners should endeavour to identify dropouts and determine the retention rate for their own practices to benchmark their performance. Accordingly, practice procedures should be in place to closely follow new wearers, probe the reasons for lapsing, get them back in to the practice and try alternative strategies as appropriate.

4.5. Potential strategies for retention

One of the most surprising findings from this study overall is that, in most cases, no alternatives had been tried before the patient dropped out and in only a minority had a further trial fitting, modified power or different lens type been tried. None had recorded giving the patient a change of care product despite evidence that symptoms in soft lens wearers can be perceptibly improved by switching to an alternative lens/care product combination [32].

The wide variation in retention rates between sites indicates that differences in how practices run their contact lens service have an influence on success. The univariate analyses attempted to identify those factors that might be important; for instance, practitioners' years of experience, length of time allocated to fitting, etc. The fact that none of these proved to be significant may be due to the large number of factors exerting an influence on contact lens success.

Supplying lenses on a quarterly basis was significantly associated with better retention compared to non-regular *ad hoc* purchasing. Regular purchasing may be associated with retention without influencing it and those who sign up for quarterly supply at the outset may be more motivated to continue lens wear. That said, once lens wear is established, maintaining regular contact with the practice does provide opportunities for intervention if issues arise. Regular purchasing may also encourage compliance with lens replacement frequency, although other authors have found that compliance is not a major factor driving dropout from contact lens wear [8].

This is not the first study to attempt to determine first-year retention rates in contact lens wearers; however, the only other study to examine discontinuation in the first year was an online survey conducted in 2010 [7,9]. To our knowledge the present study is the first to do so in a consecutive group of patients fitted in a range of eye care practices. The main limitation of the study was that it relied on the cooperation of busy eye care practitioners to extract and provide the data. This time-consuming task, especially for those without electronic patient record systems, was an obstacle to recruitment of sites but also meant that the study relied on practitioners' interpretations of the outcomes.

A further, prospective, patient survey has therefore been conducted to determine the current contact lens-wearing status of neophyte patients at 1-, 3- and 12-months post-fitting to evaluate their overall satisfaction, factors influencing their success and reasons for discontinuation [33]. This study also found that the main reason cited for new wearer discontinuation was poor vision (41% overall), with discomfort (36%) and handling problems (25%) also key.

5. Conclusions

During the first year of contact lens wear, the retention rate for neophyte wearers in the UK was 74% (spherical lenses 79%, torics 73%, multifocals 57%), with a high proportion of discontinuation occurring during the first two months. Factors associated with retention and dropout in these patients were in univariate analysis: age, lens type (sphere/multifocal), spherical refraction and purchase frequency. Multivariate analysis showed lens material, sphere power and purchase frequency to be significant factors. Retention rates are not related to gender, cylinder power (torics), lens replacement frequency, or type of practice or location However, retention rates vary widely between individual practices.

While this study confirms that handling and comfort are the most commonly cited performance-related reasons for discontinuing among new wearers overall, the findings suggest that visual problems are the most commonly cited reason among new wearers of toric and, in particular, multifocal contact lenses. Strategies aimed at addressing factors associated with dropout rates should help to improve retention among new contact lens wearers.

Disclosure

One author is an employee of Johnson & Johnson Vision Care Companies, and the two authors from Visioncare Research Ltd. conduct clinical trials and provide consultancy services for a range of companies including Johnson & Johnson Vision Care Companies.

Acknowledgements

This study was supported by Johnson & Johnson Vision Care Companies. We thank the practitioners who took part in the study and Alison Ewbank for help in the preparation of this manuscript.

References

[1] K.H. Weed, D. Fonn, R. Potvin, Discontinuation of contact lens wear, Optom. Vis. Sci. 70 (12s) (1993) 140.
[2] J.L. Schlanger, A study of contact lens failures, J. Am. Optom. Assoc. 64 (1993) 220–224.
[3] N. Pritchard, D. Fonn, D. Brazeau, Discontinuation of contact lens wear: a survey, Int. Contact Lens Clin. 26 (1999) 157–162.
[4] T. Harknett, T. Bowden, H. Shadbolt, S. Mian, Five years after dispensing –are contact lenses a success? Cont. Lens Anterior Eye 24 (2001) 127–128.
[5] J. Jutai, W. Woolrich, G. Strong, The predictability of retention and discontinuation of contact lenses, J. Am. Optom. Assoc. 74 (5) (2003) 299.
[6] K. Richdale, L.T. Sinnott, E. Skadahl, J.J. Nichols, Frequency of and factors associated with contact lens dissatisfaction and discontinuation, Cornea 26 (2) (2007) 168–174.
[7] J. Rumpakis, New data on contact lens dropouts: an international perspective, Rev. Optom. 147 (1) (2010) 37–40.
[8] K. Dumbleton, C.A. Woods, L.W. Jones, D. Fonn, The impact of contemporary contact lenses on contact lens discontinuation, Eye Contact Lens 39 (2013) 93–99.
[9] Anon, Contact lens dropout, Cont. Lens Spectrum 28 (Suppl. 10) (2013) 3–9.
[10] G. Young, J. Veys, S. Coleman, A multicentre study of lapsed contact lens wearers, Ophthal. Physiol. Opt. 22 (2002) 516–527.
[11] S.T. Briggs, Profile of contact lens failures in Saudi Arabia, Clin. Exp. Optom. 79 (1996) 255–259.
[12] G. Young, Why one million contact lens wearers dropped out, Cont. Lens Anterior Eye 27 (2004) 83–85.
[13] R.L. Chalmers, C.G. Begley, Dryness symptoms among an unselected clinical population with and without contact lens wear, Cont. Lens Anterior Eye 29 (2006) 25–30.
[14] J. Schafer, G.L. Mitchell, R.L. Chalmers, B. Long, S. Dillehay, J. Barr, P. Bergenske, P. Donshik, G. Secor, J. Yoakum, The stability of dryness symptoms after refitting with silicone hydrogel contact lenses over 3 years, Eye Contact Lens 33 (2007) 247–252.
[15] V.E. Evans, N.A. Carnt, T.J. Naduvilath, B.A. Holden, Factors associated with drop out from silicone hydrogel contact lens daily wear, Invest. Ophthalmol. Vis. Sci. 49 (2008) (E-abstract 4839).
[16] A. Sulley, G. Young, K.O. Lorenz, C. Hunt, Clinical evaluation of fitting toric soft lenses to current non-users, Ophthal. Physiol. Opt. 33 (2) (2013) 94–103.
[17] E.B. Papas, J.B. Ciolino, D. Jacobs, W.L. Miller, H. Pult, A. Sahin, S. Srinivasan, J. Tauber, J.S. Wolffsohn, J.D. Nelson, The TFOS International Workshop on Contact Lens Discomfort: report of the management and therapy subcommittee, Invest. Ophthalmol. Vis. Sci. 54 (2013) 183–203 (11 TFOS).
[18] T.G. Quinn, Turning drop-outs into success stories, Cont. Lens Spectrum. 10 (11) (1995) 43–47.
[19] P.L. Rakow, Where have all the drop-outs gone? J. Ophthal. Nurs. Technol. 9 (5) (1990) 223–224.
[20] N. Pritchard, How can I avoid CL drop-outs? Optician 222 (5825) (2001) 14–18.
[21] J. Veys, A. Sulley, Give drop-outs another chance, Optician 224 (5871) (2002) 40–44.
[22] D. Fonn, Preventing contact lens dropouts, Cont. Lens Spectrum 17 (2002) 8.
[23] P. Morgan, Trends in UK contact lensprescribing 2013, Optician 246 (6418) (2013) 16–17.
[24] College of Optometrists/Optician Consumer Research. NOP for Reed Business Insight, 2005.
[25] J.E. Key, J.L. Yee, Prospective clinical evaluation of the ACUVUE bifocal contact lens, CLAO J. 25 (1999) 218–221.
[26] S. Patel, K.E. Boyd, J. Burns, Age, stability of the pre-corneal tear film and the refractive index of tear, Cont. Lens Anterior Eye 23 (2) (2000) 44–47.
[27] C. Ramsdale, P. Morgan, Trends in UK contact lens prescribing 1996, Optician 213 (5583) (1997) 35–36.
[28] G. Young, A. Sulley, C. Hunt, Prevalence of astigmatism in relation to soft contact lens usage, Eye Cont. Lens 37 (2011) 20–25.
[29] N. Best, L. Drury, J.S. Wolffsohn, Predicting success with silicone-hydrogel lenses in new wearers, Cont. Lens Anterior Eye 36 (2013) 232–237.
[30] P.B. Morgan, N. Efron, Influence of practice setting on contact lens prescribing in the UK, Cont. Lens Anterior Eye 38 (2015) 1 70–72.
[31] J. Woods, C.A. Woods, D. Fonn, Fitting soft center-near design multifocal lenses, Cont. Lens Spectrum 24 (2010) 3 44–46.
[32] D. Tilia, P. Lazon de la Jara, N. Peng, E.B. Papas, B.A. Holden, Effect of lens and solution choice on the comfort of contact lens wearers, Optom. Vis. Sci. 90 (5) (2013) 411–418.
[33] A. Sulley, G. Young, C. Hunt, et al., Prospective Evaluation of New Contact Lens Wearer Retention Rates, Scientific paper presentation at BCLA/NCC conference, March, 2016.