Comparison of the Ocular Surface in Adult and Pediatric Contact Lens Wearers

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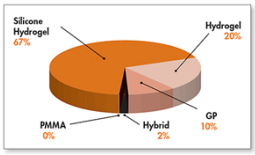
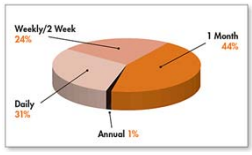
Contact Lens Market

- 40.9 million CL wearers in the US
- $2.5 billion market in the US
- $7.2 billion market worldwide



2016 Fits and refits by material

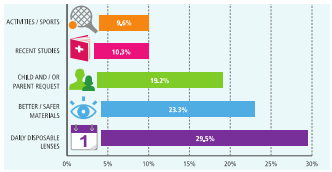


2016 Soft contact lens fit replacement schedules

Nichols, 2017

Children in Contact Lenses

- Proportion of pediatric CL wearers
- Reasons for fitting
  - Sports, other activities
  - Patient's request
  - CL material options
  - Cosmetic
  - Myopia control
  - Medically necessary



AOA Children & Contact Lenses Study

Children in Contact Lenses

- Benefits to practice
  - Patient and parent satisfaction
  - Children may come back for visits more frequently
  - CL's and spectacle purchases
  - Referrals

2016 CL Spectrum Survey	
Patients Seen Each Week	105
% CL-Wearing Patients	33
# CL Fits/Refits Per Week	26
Estimated % Gross Practice Revenue from CLs	32
Estimated % Net Practice Revenue from CLs	27

Nichols, 2017

Long-term Consequences of Fitting Children in Contact Lenses

- Risk of microbial keratitis
- Ocular surface changes
- Dryness and discomfort leading to contact lens intolerance

Contact Lens Dropout

Annual Contact Lens Dropout Rates

- Rumpakis: 15.9%
- Richdale: 24.1%
- Pritchard: 34.0%

Reasons for Contact Lens Dropout:

1. Discomfort and/or dryness (most common)
2. Poor vision
2. Cost
3. Handling and care

Dry Eye Disease: Background

- Prevalence
  - Wide range reported in studies (5-35% of the population)
- Symptoms vs. signs
  - Lack of correlation of signs and symptoms (Nichols et al, 2004)
- Diagnostic testing
- Etiology
  - Evaporative (86% of dry eye patients, Lemp et al, 2012)
  - Aqueous deficient
  - Combination

Factors Associated with Dry Eye

- Contact lens use
- Medications (hypertensive, antidepressants, oral contraceptives, antihistamines, glaucoma)
- Systemic conditions
- Acne rosacea
- Ocular surgeries (refractive)
- Environmental conditions (humidity levels, wind)
- Computer use
- Smoking status
- Age

Pediatric vs. Adult Contact Lens Wearers

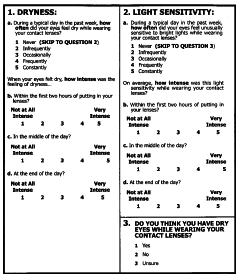
- Extensive literature on adult lens wearers while data on children is limited
- Ability of children to understand and cooperate while performing measurements
- Systemic diseases

Systemic Diseases in Children

- Cystic fibrosis
- Ectodermal dysplasia syndromes
- Juvenile rheumatoid arthritis
- Graft-versus-host disease
- Sjogren syndrome
- Diabetes
- Vernal keratconjunctivitis

Subjective Comparisons

- Based upon symptoms, the prevalence of dry eye in CL wearers is 2-3x that of non-CL wearers of the same age
- Contact Lens Dry Eye Questionnaire (CLDEQ)
  - Pediatric: 4.3% considered to have dry eye
  - Adult: 56.2% considered to have dry eye



1. DRYNESS:

a. During a typical day in the past week, how often did your eyes feel dry while wearing your contact lenses?
1 Never (SKIP TO QUESTION 2)
2 Infrequently
3 Occasionally
4 Frequently
5 Constantly

When your eyes felt dry, how intense was the feeling of dryness...

b. Within the first two hours of putting in your lenses?
Not at All Intense 1 2 3 4 5 Very Intense

c. In the middle of the day?
Not at All Intense 1 2 3 4 5 Very Intense

d. At the end of the day?
Not at All Intense 1 2 3 4 5 Very Intense

2. LIGHT SENSITIVITY:

a. During a typical day in the past week, how often did your eyes feel unusually sensitive to bright lights while wearing your contact lenses?
1 Never (SKIP TO QUESTION 3)
2 Infrequently
3 Occasionally
4 Frequently
5 Constantly

On average, how intense was this light sensitivity while wearing your contact lenses?

b. Within the first two hours of putting in your lenses?
Not at All Intense 1 2 3 4 5 Very Intense

c. In the middle of the day?
Not at All Intense 1 2 3 4 5 Very Intense

d. At the end of the day?
Not at All Intense 1 2 3 4 5 Very Intense

3. DO YOU THINK YOU HAVE DRY EYES WHILE WEARING YOUR CONTACT LENSES?
1 Yes
2 No
3 Unsure

Subjective Comparisons

- Contact Lenses in Pediatrics (CLIP) Study
  - 84.6% of those ages 8-12 reported their eyes never or rarely felt dry

Question	n	Never		Rarely		Sometimes		Often		Always		p-value
		Children	Teens	Children	Teens	Children	Teens	Children	Teens	Children	Teens	
Itch?	116	44.2	34.4	46.2	48.4	7.7	17.2	1.9	0	0	0	0.24
Get red?	115	56.9	64.1	35.3	25.0	3.9	10.9	3.9	0	0	0	0.13
Burn?	115	63.5	55.6	30.8	36.5	5.8	7.9	0	0	0	0	0.72
Tear?	116	42.3	34.4	40.4	51.6	13.5	10.9	1.9	3.1	1.9	0	0.62
Feel light sensitive?	116	61.5	62.5	26.9	23.4	5.8	10.9	3.9	1.6	1.9	1.6	0.81
Feel dry?	116	50.0	35.9	34.6	31.3	11.5	26.7	1.9	3.1	1.9	0	0.08

Subjective Comparisons

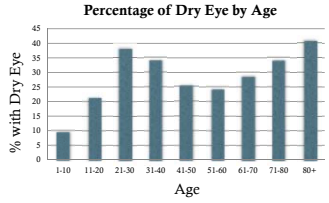
Ocular Surface Disease Index

Variables	Pediatric group (n=45)	Adult group (n=45)
OSDI®	12.82±12.82	35.61±24.85
1. Eyes that are sensitive to light?	1.12±1.23	1.21±1.10
2. Eyes that feel gritty?	0.47±0.70	1.53±1.24
3. Painful or sore eyes?	0.33±0.61	1.57±1.11
4. Blurred vision?	0.21±0.72	1.50±1.23
5. Poor vision?	0.77±1.29	1.58±1.18
6. Reading?	0.08±0.28	1.60±1.16
7. Driving at night?	N/A	1.37±1.20
8. Working with a computer or bank machine (ATM)?	0.62±.92	1.40±1.03
9. Watching TV?	0.37±0.71	1.48±1.22
10. Windy conditions?	0.58±0.76	1.55±1.19
11. Places or areas with low humidity (very dry)?	0.59±0.86	1.49±1.24
12. Areas that are air conditioned?	0.37±0.69	1.39±1.22

Han et al, 2013

Subjective Comparisons

- Canada Dry Eye Epidemiology Study



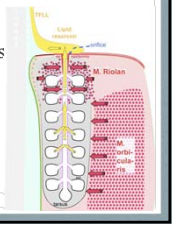
- Limited number of surveys appropriate for both age groups

Blink rates

- Adults: 12 blinks/minute
- Children (4-6 years old): 8 blinks/minute
- Infants: (36-53 weeks): ~5 blinks/minute
- Infants (0-17 weeks): 2 blinks/minute

Meibomian Glands

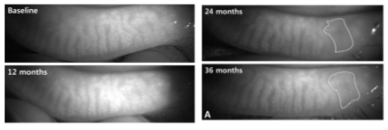
- Sebaceous glands that secrete the lipid layer of the tear film
- Total number
  - Number in upper eyelid: 25-40
  - Number in lower eyelid: 20-30
- Delivery of meibum through blinking forces



Images: International Workshop on MGD

Meibomian Gland Atrophy

Pediatric group fit in corneal reshaping lenses



	Baseline	6 Months	12 Months	24 Months	36 Months
Meiboscore	0.10±0.11	0.11±0.19	0.11±0.31	0.11±0.50	0.19±0.10

Meibomian Gland Atrophy

Adult CL and Non CL wearers

Table 1. Mean Meiboscores in Contact Lens Wearers and Nonwearers

	Mean Meiboscore (95% Confidence Interval)		
	Contact Lens Wearers	Nonwearers	P Value
Total	1.72 (1.47–1.96)	0.96 (0.73–1.19)	<0.0001
Upper eyelid	0.96 (0.71–1.01)	0.32 (0.24–0.40)	<0.0001
Lower eyelid	0.87 (0.68–1.05)	0.62 (0.48–0.76)	0.036

Table 2. Average Meiboscores in Rigid Gas Permeable Lens Wearers and Hydrogel Lens Wearers

	Mean Meiboscore (95% Confidence Interval)		
	Rigid Gas Permeable Lens Wearers	Hydrogel Lens Wearers	P Value
Total	2.04 (1.54–2.55)	1.52 (1.17–1.86)	0.092
Upper eyelid	0.98 (0.72–1.25)	0.77 (0.60–0.94)	0.193
Lower eyelid	1.06 (0.64–1.43)	0.75 (0.54–0.95)	0.145

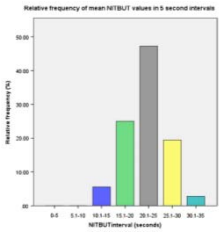
Table 3. Results from Multiple Regression Analyses for Meiboscores in Contact Lens Wearers

Variables	Coefficient	Standard Error	P Value
Duration of contact lens wear (yrs)	0.066	0.028	0.020
Spherical component of refraction (D)	0.064	0.054	0.240
Cylindrical component of refraction (D)	0.177	0.231	0.446
Lid margin score	−0.071	0.285	0.802
Superficial punctuate keratopathy score	0.440	0.238	0.065
Tear breakup time (seconds)	−0.064	0.055	0.130
Schirmer value (mm)	−0.007	0.014	0.602

Arita et al. 2009

Tear Film Break-Up Time

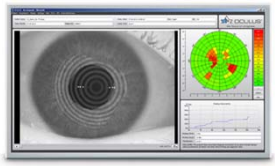
- Pediatric population
  - 36 subjects
  - Mean age: 7.64 years (2.16-15.83)
  - Mean NITBUT: 21.76±4.06 seconds



Jones and Nischal, 2013

Non-invasive tear break-up time

- Advantages
  - Non-invasive (no disruption to the tear film)
  - No reflex tearing after dye instillation
  - Data obtained from equipment
- Equipment
  - Oculus Keratograph 5M
  - Tearscope



Tear Film Break-Up Time

Pediatric Population

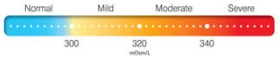
	Baseline	6 Months	12 Months	24 Months	36 Months
TBUT (sec)	13.21±3.58	12.68±6.15	12.90±5.45	12.76±5.17	12.10±5.08

Adult Population

	NIBUT (sec)	TBUT (sec)
Nichols et al.	11.2±6.8	7.6±10.4
Sengor et al.		7.57 ± 2.67
Maruyama et al.	9.5±1.5	

Tear Osmolarity

- Normal values
- Inter-eye difference
- Measurements should be performed no sooner than 2 hours after therapeutic eye drops



Tear Osmolarity

Pediatric Population

	Baseline	6 Months	12 Months	24 Months	36 Months
Tosm (mm Hg)	301.85±6.03	302.90±3.53	302.24±8.99	303.41±7.72	304.90±7.39

Adult Population

	Osmolarity (mOsm/L)
Lemp et al.	300.8± 7.8
Muselier-Mathieu et al.	294.0
Miller et al.	319 ± 30

Summary

- There are several indications for contact lens wear in children and children prefer contact lenses compared to spectacles
- Limited knowledge of the ocular surface on pediatric soft contact lens wearers
- Pediatric contact lens wearers appear to have less dry eye symptoms than adult contact lens wearers

Thank you!

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