CONTACT LENS SOLUTIONS
SORTING OUT THE CONFUSION

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EVOLUTION OF CARE SYSTEMS

- Heat
- Multi-step chemical
- Hydrogen peroxide
- One-bottle Multipurpose

FDA CLASSIFICATION

- Group I  Low-water-content Non-ionic
- Group II  High-water-content Non-ionic
- Group III  Low-water-content Ionic
- Group IV  High-water-content ionic
- New Group for silicone hydrogels

PURPOSE OF LENS CARE SOLUTIONS

- Remove surface contaminants
- Maintain healthy eyes
- Maintain comfort
- Maintain good VA

FUNCTIONS OF CL SOLUTIONS

- Cleaning
- Rinsing
- Disinfection
- Rewetting
- Storage

SOLUTION TYPES

- Saline solutions
- Cleaners
  - Surfactant
  - Enzymatic
- Chemical disinfecting products
- MPS
- In-eye contact solutions (rewetting)
SURFACE CONTAMINATION

- Environmental Debris
- Tear film components
- Microorganisms

NATURAL PROTECTION OF EYE

- Antimicrobial components in tears
- Relatively impenetrable epithelium
- Mechanical flushing by lids

COMPLICATIONS OF LENS CONTAMINATION

- GPC
- SLK
- Infiltrative keratitis
- Decreased comfort
- Decreased VA

DEVIAITION FROM PRESCRIBED REGIMEN

- Reduced efficacy
- Potential ocular complications

ISSUES IN SOLUTION DEVELOPMENT

- Safety vs. microbial growth
- Efficacy in cleaning & disinfection
- Safety vs. toxic or hypersensitive reactions
- Complexity vs. compliance
  - Simplicity minimizes confusion
  - Fosters compliance

SOFT LENS PRESERVATIVES

- Thimerosal
- Sorbate
- PHMB (polyhexamethylene biguanide)
- PAPB (polyaminopropyl biguanide)
- Polyhexanide (PHMB)
- Alexidine (biguanide)
- Hydrogen peroxide
- Polyquad (quaternary ammonium compound)
**PRESERVATIVES**

- Reduce bacterial & fungal loads from normal use
- Most do not bind to lens surfaces as readily as older preservatives
- Most not absorbed into lens matrix
- Most effective up to 30 days
- Most not effective vs. acanthamoeba

**ADVERSE REACTIONS**

- Sensitive patients
  - Allergic & toxic responses to preservatives
  - May need preservative-free regimen
- Poor lens care habits

**CLINICAL TESTING**

**Chemistry**

- Uptake & release of preservatives by lens materials
- Cleaning effectiveness
- Solution compatibility with lens materials

**NON-COMPLIANCE ISSUES**

- 40% to 90% of contact lens wearers are non-compliant in some aspect

- Solution-related compliance issues
  - 62% “Top off” solution
  - Re-use of contact lens solution
  - Under-filled lens case wells
  - Failure to secure contact lens case during soaking
  - 40% never clean contact lens case

**SHELF LIFE**

- Considerations
  - Solution stability
  - Microorganism growth
- Life of opened bottles
  - Preservatives used
  - Storage temperature
  - Use environment

**STERILIZATION vs. DISINFECTION**

- Lenses are *disinfected, not sterilized*
- Misuse of system may reduce efficacy
  - Modification
    - Shortening minimum soak time
  - Omission of steps
THIMEROSAL

- Gray discoloration of lenses and case
- High rate of sensitivity
- Reactions mimic infection, allergy, hypoxia

SORBATE

- Yellow discoloration of ionic lenses
- ? Efficacy
- Still some sensitivities

PAPB (DYMED)

- Long-chain molecule
- Does not penetrate lens matrix
- No lens discoloration
- Still some sensitivities
- ? Compatibility with SiHy lenses

POLYQUAD

- Quaternary ammonium compound
- Long-chain molecule
- Does not penetrate lens matrix

DUAL DISINFECTION SYSTEMS

- PHMB & PQ-1
- Alexidine & PQ-1

HYDROGEN PEROXIDE
SALINE SOLUTIONS

- Isotonic salt solutions
  - Rinsing
  - Storage for heat-disinfected lenses
- Preserved
- Non-preserved
- Tested for microorganism stasis capability

NON-PRESERVED SOLUTIONS

- Squeeze bottles
- Aerosols

NON-PRESERVED SQUEEZE BOTTLES

- Limited shelf life after opening
- Not good for P/T or EW
- Must show patient how to pierce tip
- Possible contamination of tip

AEROSOLS

- Can’t instill in eye
- Good for P/T or EW
- Keep can at school or work

UNIT DOSE
(INHALATION SALINE)

MULTI-PURPOSE SOLUTIONS

- Single bottle for cleaning, disinfection, & storage
- Regimen now includes
  - Digital rubbing
  - Rinsing
MPS FORMULATIONS

• Contain low-level of surfactant to facilitate removal of loose surface debris
• Sensitive patients may have slight stinging or dryness
• Heavy depositors should use separate surfactant

ADVANTAGES & DISADVANTAGES

• ? Efficacy vs. viruses & fungi
• Easy-to-follow directions
• ? Better compliance
• Better than oxidizing systems for long-term storage
• Will patients just “top-off” solution?

MULTIPURPOSE CARE SYSTEMS

• Alcon Opti-Free Express, RepleniSH, & Pure Moist
• B+L ReNu Fresh (Multiplus)
• B+L ReNu Sensitive (Multipurpose)
• B+L BioTrue
• AMO-Arbort Complete Easy Rub Formula
• AMO-Arbort RevitaLens OcuTec
• Generic solutions

GENERIC SOLUTIONS

• Many are ReNu Fresh (Multiplus) formulation
  – Target
  – Walmart Equate
  – CVS
  – Walgreens
• Problems with SPK
  – Silicone Hydrogels
  – FDA Group II
• May change in formulation when contract runs out & new supplier makes product

ReNu Fresh

• Stand alone efficacy (MPDS)
• Two cleaning agents
  – Hydranate
  – Poloxamine
• ? Compatibility with some FDA Group II & silicone hydrogel lenses

ReNu Sensitive

• ? Confusion with sensitive eyes saline
• Older formulation
• No protein remover
• ? Compatibility with FDA Group 2 & Silicone hydrogels
Bausch & Lomb BioTrue

- Dual disinfection
- PHMB/Polyquaternium 1
- pH = to tears
  - Sodium Borate & Boric acid
- Hyaluronan
  - Body’s natural lubricant
  - Helps CLs retain moisture

COMPLETE EASY RUB

- Rub & Rinse
- 6 hour soak
- MPS - not stand alone
- Surfactant cleaner
- 4 beneficial electrolytes
- FDA Group 2 & SiHy compatibility

RevitaLens OcuTec

- ✓ Broad-spectrum dual disinfection system
- ✓ Sustains antimicrobial activity even under non-compliant conditions
- ✓ Effective against Acanthamoeba
- ✓ Low rates of corneal staining and adverse events
- ✓ Highly effective protein removal
- ✓ Conditions the lenses
- ✓ Increases ocular comfort

OPTI-FREE® Express®

- Contains Polyquad & Aldox (fungicide & amoebacide)
- Acanthamoeba disinfection of both cysts and trophs

OPTI-FREE RepleniSH

- Polyquad & Aldox for enhanced disinfection
- Amoebacide & fungicide
- Citrate for cleaning
- TEARGLYDE for long-term wetting & reconditioning
  - Works synergistically with patient’s own tears

OPTI-FREE pure moist

- Polyquad & Aldox for enhanced disinfection
- Amoebacide & fungicide
- Hydraglyde - EO/BO
  - EO Poly(oxyethylene) attracts moisture
  - BO Poly(oxybutylene) targets silicone
  - Anchors solution from lens case into lens matrix
HYDROGEN PEROXIDE DISINFECTION

- Bleaches as it disinfects
- Has cleaning action
  - Lenses swell and then shrink during disinfection & neutralization
  - Deposits are sloughed off surface
  - Safe on all soft lenses

CLEAR CARE

- No-rub peroxide
- Built-in cleaner for protein removal - Pluronic 17R4 (surfactant)
- Peroxide-based cleaning activity
- Residual peroxide issue may require rinsing
  - 5 second rinse; 6 hour soak

CLEAR CARE

- 3% hydrogen peroxide diluted in saline
- Must remember to change case regularly
- Not good for long-term storage

OXYSEPT ULTRACARE

- 3% peroxide diluted in water
- Timed-release neutralizing tablet
- Neutralizer contains catalase & salt
- Vitamin B-12 color indicator confirms neutralizer tab was added
- HPMC lubricant increases viscosity

OXYSEPT ULTRACARE

- Lenses disinfected & neutralized in 6 hours
- Possible confusion between neutralizing & enzyme tablets
- Not good for long-term storage
BAUSCH & LOMB PeroxiClear

- 3% H₂O₂ diluted in potassium chloride solution
- Poloxamer surfactant
- Platinum disc
- 4 hour neutralization
- Optional saline rinse

PRIVATE LABEL PEROXIDE SYSTEMS

PROBLEMS OF HYDROGEN PEROXIDE

- Different directions for each system cause confusion
- Different neutralizers are incompatible
- Substitution of generic peroxide
  - Stability
  - Discoloration

SURFACTANTS

- Reduce surface tension of solutions
- Facilitate debris removal from lens surfaces
  - Loosely bound oils
  - Mucus
  - Cosmetic residues

SURFACTANT CLEANERS

- Clean off tear film debris, cosmetic residues
- Wash away micro-organisms
- Allow better penetration of disinfectant into lens matrix
- Enhance efficacy of disinfectant

PROTEIN REMOVAL

Problems of Accumulated Protein

- Decreased comfort
- Decreased wear time
- Decreased vision
- Corneal staining
- Papillary hypertrophy
ENZYMATIC CLEANERS

• Break down (digest) proteins, muco-proteins, lipoproteins
• Keep pores open so maximum oxygen can reach eyes
• Prevent shrinking & tightening
• Allow lenses to hydrate fully
• Minimize occurrence of GPC

TYPES OF ENZYMATIC CLEANERS

• Subtilisin
  – Made by genetically-engineering bacteria
  – Used in laundry detergents
  – OK for simultaneous enzyming & disinfection

ReNu Liquid Daily Protein Remover

• Sterile, preservative-free solution
• Proteolytic enzyme (subtilisin)
• Dissolve in ReNu MPS
• 1 Drop in each side of case
• Shake gently to mix
• Do not let lenses soak more than 12 hours
• Rinse thoroughly before wearing

DAILY PROTEIN REMOVER

• Alcon Supra-Clens
  (Pancreatin)

WETTING AGENTS & LUBRICANTS

• Enhance lens wettability
• Maintain lens comfort
• Reduce friction between lens, cornea, & lids
  – Decrease irritation
  – Decrease adverse responses
• Common wetting agents
  – Povidone
  – Hydroxypropyl methylcellulose
  – Polyethylene glycol
  – Dextran
  – Hyaluronate

LENSES LUBRICANTS

• Dry, windy weather
• Dry work environment & airplane cabins
• Car & home heating & A/C ducts
• Late hours
• Prolonged close work (computer or reading)
• Rewetting lenses before removal from eyes
LENS LUBRICANTS

Medications

• Antihistamines
• Decongestants
• Oral contraceptives
• GI meds with belladonna
• Accutane
• Psychotropic drugs

REWETTING DROPS

• 30 ml limit (risk of contamination)
• Instruct patients on proper use
• Contain:
  – Saline
  – Wetting agents
  – Cleaning components

LENS LUBRICANTS

Health Problems

• Arthritis
• Other collagen diseases
• Thyroid disease
• Menopause

CARE OF LENS CASES

• Rinse cases nightly
• Clean with a new toothbrush and surfactant cleaner as needed
• Replace cases every 1-3 months

FUNGAL KERATITIS

• Fusarium organism
• Initially in Asia
• ? Climate
• ? Hygiene
• ? Patient compliance
• ? Viscosity

FUNGAL KERATITIS

• Initial presentation
  – Pain
  – Photophobia
  – Injection
  – Discharge
  – Tearing
• More painful than peripheral ulcer
**FUNGAL KERATITIS**

- Hx of trauma – particularly vegetative matter
- Hx of prior corneal surgery
- Hx of ocular surface disorder
- May develop slowly or rapidly
- Suspect if no response to antibiotics

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**FUNGAL GROWTH**

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**COMPLETE® MOISTURE PLUS**

- No-Rub
- MPS - not stand alone
- Uses artificial tear lubricant
  - HPMC (hydroxylpropyl methylcellulose)
- Thicker, heavier fluid layer
- Surfactant cleaner
- 5 second rinse; 4 hour soak

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**COMPLETE® MOISTURE PLUS**

- 138 cases of culture positive acanthamoeba
- 56% used Complete Moisture Plus
- Does increasing lubricant concentration compromise antimicrobial efficacy?

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**COMPLETE® MOISTURE PLUS**

- Acanthamoeba feed on bacteria & fungi
- Swimming, showering, hot tubs
- ? Association between lowering of chlorine levels in water supply by EPA & risk of AK
- Lack of proper lens care & hygiene
  - “No-rub” labeling
  - -Topping off

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**COMPLETE® MOISTURE PLUS**

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COMPLETE®
Easy Rub Formula

• 2002 Formulation
• No added viscosity
• Requires rubbing

PSEUDOMONAS

HOT TUBS, SWIMMING POOLS, & TAP WATER RINSES

PREVENTING MICROBIAL KERATITIS

• Wash hands before handling CLs
• Rub & rinse lenses before disinfection
• Rinse case nightly
• Use fresh solution nightly
  – *Never top-off!!!*

PREVENTING MICROBIAL KERATITIS

• Make sure lenses are stored in disinfecting solution *NOT* saline
• Never use expired solutions
• Don’t stretch life of lenses

PREVENTING MICROBIAL KERATITIS

• Change solution daily
• No tap water
• Keep case open & dry when not in use
• Replace cases monthly
SOLUTION INCOMPATIBILITIES

PATIENT SYMPTOMS

- Dryness
- Burning
- Itching
- Cloudy lenses
- Fuzzy vision
- Lens awareness

OBJECTIVE SIGNS

TOXIC KERATOPATHY

LIMBAL ENGORGEMENT

SUPERIOR LIMBIC KERATITIS
SUPERIOR LIMBIC KERATITIS

CORNEAL INFILTRATES

SOLUTION-RELATED PSEUDO-DENDRITE

TARSAL PLATE CHANGES

Example of a Grade 7 Tarsal Plate Score


CORNEAL STAINING

SOLUTION SENSITIVITY

DIFFUSE SPK

Example of typical diffuse punctate staining

Figure 2.32: Diffuse punctate staining due to a hypersensitivity reaction to a contact lens care system. (Picture courtesy of Ian Cox.)
PHMB REACTIONS
Watch for SPK in some FDA GROUP 2 & Silicone Hydrogels

STAINING GRID

SILICONE-HYDROGEL LENSES
• New lens frontier
• Has different solution needs
  – Occasional disinfection
  – Daily rewetting & protein removal

LENS DISCOLORATION
Always start with new CLs when changing care systems
• Precipitates may cloud lenses if patient changes care systems with old lenses
• Lenses may discolor when switching from MPS to $H_2O_2$

LENS DISCOLORATION
SORBATE DISCOLORATION
FLUORESCEIN DISCOLORATION

USE OF GENERIC $\text{H}_2\text{O}_2$

$\text{H}_2\text{O}_2$ CORNEAL BURN

REACTIONS INVOLVING HYDROGEN PEROXIDE CARE SYSTEMS

PROBLEMS RELATED TO CATALASE NEUTRALIZERS

- Changes in sag depth may occur in silicone hydrogel lenses
- If the Oxysept Ultracare neutralizer is used in a case with a disc, it will gum up the disc
RIGID LENS SOLUTIONS

- **Boston**
  - Original
  - Advance
  - Simplus (MPS)
- **Lobob**
  - Optimum
- **Menicon**
  - Menicon GP
  - Unique pH

RGP PRESERVATIVES & DISINFECTANTS

- Chlorhexidine (ChG)
- Polyaminopropyl biguanide (PAPB)
- Polyquad
- Benzyl Alcohol

RGP CLEANERS

Remove accumulated secretions & contaminants

- Abrasive
  - Boston Cleaner (original formula)
- Mildly Abrasive
  - Boston Advance
- Non-Abrasive
  - Optimum by Lobob Extra Strength Cleaner

CLEANING/SOAKING SOLUTIONS

- Serve as antimicrobial storage media
- Prevent dehydration & warpage of lenses
- Contain benzyl alcohol
  - Meni-Care
  - Optimum by Lobob

RGP CONDITIONING SOLUTIONS

- Create thin, hydrophilic layer on lens surface
  - Increase comfort on insertion
  - Allow tear film to form stable layer on lens surface
  - Reduce dry spots
  - Meet antimicrobial requirements for disinfection
    - Most require rubbing or separate daily cleaner

WETTING/SOAKING SOLUTIONS

- Boston Conditioning ChG
- Boston Advance Comfort Formula (ChG & PAPB)
ALL-IN-ONE SOLUTIONS

• Boston Simplus
• Menicon Unique pH

WETTING SOLUTIONS

• Convert hydrophobic surface of rigid lens to one that is temporarily hydrophilic
• Help keep lenses clean during insertion
• Help keep lens on fingertip during insertion
• Act as mechanical buffer (cushion) between lens & cornea

WETTING/REWETTING SOLUTIONS

• Allergan Refresh Contacts
• AMO/Abbott blinkContacts
• Boston Rewetting Drops (ChG)
• Meni-Care GP (Benzyl Alcohol)
• Optimum by Lobob Wetting/Rewetting (Benzyl Alcohol)

ENZYMATIC CLEANERS

PROTEIN REMOVERS

• Boston One-Step Liquid Enzymatic Cleaner (subtilisin)
• Alcon SupraClens (pancreatin)
• Ultrazyme tablets (subtilisin)

PLASMA TREATED MATERIALS

• Electrical charge is applied to chamber containing CLs & O₂
• CL surface is chemically oxidized
• Surface becomes more hydrophilic

PLASMA TREATED MATERIALS

• Wetting angle is reduced
• Patient comfort is increased
• New wearers adapt more readily
• Lenses cannot be cleaned with abrasive cleaners
CLEANING NEW GP MATERIALS

- **NEVER** use abrasives on:
  - Menicon-Z
  - Onsi-56
  - Hydro-2
- Lens surfaces will be permanently damaged

PIGGYBACK CARE

- Clean GP lenses each night with GP or soft lens cleaner & rinse with saline
- Store GP lenses in soft lens MPS or in H₂O₂
- Rub, rinse & store soft lenses separately in MPS or in H₂O₂ systems
- Try to use daily disposables so only GPs need to be cleaned & disinfected nightly

PIGGYBACK CARE

- In morning, rinse soft & GP lenses & insert in eyes
- If using H₂O₂, use soft lens rewetting drops to wet GP prior to insertion
- Never use GP rewetting drops with piggyback systems

RGP LAB CLEANERS

- Remove manufacturing residues
  - Pitch
  - Solvents
  - Adhesive
- Remove cosmetic residues & lipids

DIAGNOSTIC GP LENS CLEANING & STORAGE

- Clean well after each use
- Disinfect with hydrogen peroxide for 10 minutes
- Wet vs. dry storage
- Must redisinfect lenses stored wet every 30 days
- Use dry storage for infrequently used trials
- Clean, rinse, & rewet prior to reuse

FOR SUPER GP CLEANING

- Progent
  - Protein remover, disinfectant, & intensive cleaner
FOR SUPER GP CLEANING

Progent

- Soaking over 30 minutes may discolor lenses
  - Rinse lenses & vial with sterile saline or other appropriate rinsing solution for about 30 seconds
  - Clean with daily cleaner, rinse, and insert in eyes
  - Effective in 5 minutes against bacteria, fungi, viruses, & acanthamoeba
- Effective in 30 minutes against prions

RGP Cleaning & Handling Rules

- Use only solutions formulated for RGPs
- Re-educate former PMMA wearers
- NEVER USE SALIVA TO WET LENSES!
- Clean nightly, immediately after removal
- Clean in palm of hand
  - Cleaning between fingers may cause warpage, cracking, eversion
- Do not rinse in hot water

RGP CLEANING & HANDLING RULES

- Do not mix solutions from different manufacturers
- Fill case before storing lenses
- Use case with ridges
- Use screw-top case, if possible
- Resoak lenses at least 4 hours if they dry out

GP SOLUTION PROBLEMS

SOLUTION INCOMPATIBILITIES

Objective Signs
- Conjunctival Injection
- SPK
- Mild Epithelial Edema
- Hydrophobic Surface Spotting
- Lens Deposits

TOXIC REACTION TO GP CLEANER INSTILLED IN EYE
GP SOLUTION SENSITIVITY

Repeated use of alcohol-based cleaner on GP lenses will cause parameter changes, brittleness, & cracking

GP INCOMPATIBILITIES

GP SOLUTION INCOMPATIBILITIES

• Use of borate buffered GP solutions in conjunction with products containing PVA may cause a sticky gel to form on CLs

AVOID SOLUTION-RELATED PROBLEMS BY:

• Educating staff
• Instructing patients thoroughly
• Telling patients to check with office before buying new products
• Emphasizing importance of
  – Immediate care for solution-related emergencies
  – Regular contact lens check-ups