Drooling: Assessment and Management for Children with Medical Complexity

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Disclosures

No conflicts of interest
Learning Objectives

• To describe the types of sialorrhea and common etiologies
• To assess and evaluate the severity and impact of sialorrhea
• To understand common sialorrhea treatment options
Outline

- Case Presentation
- Etiology
- Assessment
  - Physical Exam
  - Tools
- Management Options
  - Observation
  - Rehabilitation
  - Pharmacologic
  - Surgical
Definitions

- Hypersalivation
- Drooling
- Sialorrhea
Drooling

Anterior Drooling

Posterior Drooling
Saliva

- Three major pairs of salivary glands\(^3\)
  - Submandibular gland
  - Parotid gland
  - Sublingual gland

- Functions of saliva\(^3\)
  - Lubricates food, tongue, lips
  - Oral hygiene
  - Bacteriostatic/bactericidal effects
  - Initiates carbohydrate digestion
  - Regulated esophageal acidity
3 year old boy presenting for routine follow up. Mother notes significant drooling.

PMHx:
• Cerebral Palsy GMFCS V
• Hypertonia
• Fed via G-Tube
• Seizures disorder
• Suspected asthma
• Scoliosis
• Constipation

Medications
• Baclofen
• Keppra
• Clobazam
• PEG-3370
• Ventolin PRN
Drooling

Rarely due to overproduction of saliva

Inefficient control of salivary secretions

- Sensory issues
- Motor issues
<table>
<thead>
<tr>
<th>Sequence of Swallowing\textsuperscript{5}</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oral preparatory (voluntary)</td>
</tr>
<tr>
<td>Oral (voluntary)</td>
</tr>
<tr>
<td>Pharyngeal (involuntary)</td>
</tr>
<tr>
<td>Esophageal (involuntary)</td>
</tr>
</tbody>
</table>
Impact of Drooling

Clinical Implications
- Aspiration pneumonia
- Perioral dermatological issues
- Dentition problems

Social Implications
- Impact on self-esteem
- Unpleasant odor
- Embarrassment
- Reduced social inclusion
Etiology

Increase saliva production
- Anticonvulsants (clobazam/ clonazepam)
- Antipsychotic medications
- Toxicity (selenium, mercury...)

Nasal blockage (mouth breathing)
- Adenoid/tonsillar hypertrophy
- Allergic rhinitis

Oral cavity
- Dental malocclusion
- Poor lip closure
- Caries, gum disease, ulcers
Etiology

• Inefficient or deficient swallowing
  • Anatomic
  • Neurologic
    • Cerebral Palsy
    • Bell’s Palsy
  • Developmental
• Hypotonia, poor head control, poor posture
• Neurodevelopmental concerns
  • Autism
  • Severe cognitive/awareness difficulties (sensory deficiency)
Assessment

**Medical Assessment**
- Medical history
- Medication
- Neurologic assessment
- Respiratory status
- Gastroesophageal reflux (GER)
- Allergies
- Dental examination
- Orofacial examination

**Social Evaluation**
- Intrinsic motivation
- Child’s self-management skills
- Impact of sialorrhea
- Importance of saliva control to family

**Oromotor Assessment**
- Head control
- Positioning
- Mouth closure
- Occlusion
- Lip seal
- Sensorimotor examination
- Swallow examination
- Swallow on demand
• No universally accepted measurement tool
• Few pediatricians use standardised methods to measure
  • Sialorrhea
  • Effectiveness of medications
  • Adverse effects
• Most commonly used measures
  • Count the number of bib changes per day (80%)
  • Degree of parental satisfaction (85%)
Focused Physical Exam

- Head and body posture
- Oral cavity examination
- HEENT exam
  - Oral cavity
  - Facial exam
  - Tonsils size
- Neurological evaluation
- Pulmonary and cardiac auscultation
- Nutritional status
Assessment

Identify Risk for Aspiration
- Aspiration may present with the following:
  - Repeated episodes of pneumonia
  - Repeated courses of antibiotics
  - Wet breath sounds
  - Need for frequent suctioning
  - Obvious pooling of secretions in the posterior oropharynx

Anterior Drooling
- Visible spillage of saliva from mouth.
- Consider quantitative assessment:
  - Drooling severity (subjective scales):
    - Teacher Drool Scale (TDS)
    - Drooling Severity and Frequency Scale (DSFS)
    - Visual Analogue Scale (VAS)
    - Number of bibs
  - Drooling frequency (objective scale):
    - Drooling Quotient (DQ)
  - Impact on Child and Family:
    - Drooling Impact Scale (DIS)

Posterior Drooling
- Generally no quantitative assessment is available, consider:
  - Salivagram
  - Flexible Endoscopic Evaluation of Swallowing (FEES)
Do you use a formal assessment tool when diagnosis or monitoring sialorrhea?
## Assessment Tools

### Table 1 Measures of sialorrhea

<table>
<thead>
<tr>
<th>Type of measure</th>
<th>Name of measure</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Quantitative/semiquantitative outcome methods</strong></td>
<td>Bib count [20]</td>
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<tr>
<td></td>
<td>Bib weight [21]</td>
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<tr>
<td></td>
<td>Sochaniwskyj’s technique [22]</td>
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<tr>
<td></td>
<td>Drooling Quotient [23]</td>
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<td></td>
<td>5-min Drooling Quotient (DQ5) [24]</td>
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<tr>
<td><strong>Scales and questionnaires measuring severity</strong></td>
<td>Drooling Infants and Preschoolers Scale (DRIPS) [25]</td>
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<td>Drooling Severity and Frequency Scale (DSFS) [26]</td>
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<td></td>
<td>Blasco Index for the assessment of drooling [1]</td>
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<tr>
<td></td>
<td>Teacher Drool Scale (TDS) [27]</td>
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<tr>
<td></td>
<td>Modified Teacher Drool Scale (mTDS) [28]</td>
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<tr>
<td></td>
<td>Visual Analogue Scale (VAS) [29]</td>
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<tr>
<td><strong>Scales and questionnaires measuring severity, impact on quality of life and daily life</strong></td>
<td>Modified drooling questionnaire [30]</td>
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<tr>
<td></td>
<td>Drooling Impact Scale (DIS) [31]</td>
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<tr>
<td></td>
<td>French version of Drooling Impact Scale (DIS-F) [32]</td>
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<tr>
<td></td>
<td>Brazilian Portuguese language version of DIS [33]</td>
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<td></td>
<td>Drooling impact questionnaire (short version) [6]</td>
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<tr>
<td></td>
<td>Questionnaire to evaluate impact of drooling on daily living (questionnaire 1; questionnaire 2) [8]</td>
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<tr>
<td></td>
<td>Daniel Drooling Impact Score Questionnaire (DDISQ) [34]</td>
</tr>
<tr>
<td></td>
<td>Drool rating scale [35]</td>
</tr>
</tbody>
</table>
Drooling Impact Scale

- Measures impact of drooling
- Evaluates longitudinal changes

### The Drooling Impact Scale

*Over the past week:*

1. **How frequently did your child dribble?**
   - Not at all
   - 1
   - 2
   - 3
   - 4
   - 5
   - 6
   - 7
   - 8
   - 9
   - 10
   - Frequently

2. **How severe was the drooling?**
   - Not at all
   - 1
   - 2
   - 3
   - 4
   - 5
   - 6
   - 7
   - 8
   - 9
   - 10
   - Very severe

3. **How many times a day did you have to change bibs or clothing due to drooling?**
   - Not at all
   - 1
   - 2
   - 3
   - 4
   - 5
   - 6
   - 7
   - 8
   - 9
   - 10
   - More than 10

4. **How offensive was the smell of the saliva on your child?**
   - Not offensive
   - 1
   - 2
   - 3
   - 4
   - 5
   - 6
   - 7
   - 8
   - 9
   - 10
   - Very offensive

5. **How much skin irritation has your child had due to drooling?**
   - None
   - 1
   - 2
   - 3
   - 4
   - 5
   - 6
   - 7
   - 8
   - 9
   - 10
   - Severe rash

6. **How frequently did your child’s mouth need wiping?**
   - Not at all
   - 1
   - 2
   - 3
   - 4
   - 5
   - 6
   - 7
   - 8
   - 9
   - 10
   - All the time

7. **How embarrassed did your child seem to be about his/her dribbling?**
   - Not at all
   - 1
   - 2
   - 3
   - 4
   - 5
   - 6
   - 7
   - 8
   - 9
   - 10
   - Very embarrassed

8. **How much do you have to wipe or clean saliva from household items eg toys, furniture, computers etc?**
   - Not at all
   - 1
   - 2
   - 3
   - 4
   - 5
   - 6
   - 7
   - 8
   - 9
   - 10
   - All the time

9. **To what extent did your child’s drooling affect his or her life?**
   - Not at all
   - 1
   - 2
   - 3
   - 4
   - 5
   - 6
   - 7
   - 8
   - 9
   - 10
   - Greatly

10. **To what extent did your child’s dribbling affect you and your family’s life?**
    - Not at all
    - 1
    - 2
    - 3
    - 4
    - 5
    - 6
    - 7
    - 8
    - 9
    - 10
    - Greatly
Assessment

Drooling Quotient 5 (DQ5)

- Assesses severity of drooling
- Observed during two trials of 5 minutes
  - Activity
  - Rest

<table>
<thead>
<tr>
<th>Interaction/singing/playing</th>
<th>Observation Intervals 15 sec</th>
<th>Score 1 of 0</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.00-0.15</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>0.15-0.30</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>0.30-0.45</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>0.45-1.00</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>1.00-1.15</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>1.15-1.30</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>1.30-1.45</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>1.45-2.00</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>2.00-2.15</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>2.15-2.30</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>2.30-2.45</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>2.45-3.00</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>3.00-3.15</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>3.15-3.30</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>3.30-3.45</td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>3.45-4.00</td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>4.00-4.15</td>
<td></td>
</tr>
<tr>
<td>18</td>
<td>4.15-4.30</td>
<td></td>
</tr>
<tr>
<td>19</td>
<td>4.30-4.45</td>
<td></td>
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<tr>
<td>20</td>
<td>4.45-5.00</td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Watching television/listening to music</th>
<th>Observation Intervals 15 sec</th>
<th>Score 1 of 0</th>
</tr>
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<tbody>
<tr>
<td>1</td>
<td>0.00-0.15</td>
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</tr>
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<tr>
<td>3</td>
<td>0.30-0.45</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>0.45-1.00</td>
<td></td>
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<tr>
<td>5</td>
<td>1.00-1.15</td>
<td></td>
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<tr>
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<td>1.45-2.00</td>
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<td></td>
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<td>4.30-4.45</td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>4.45-5.00</td>
<td></td>
</tr>
</tbody>
</table>

Score: Total amount of intervals with new saliva × 100 = 20
### Table 1. Thomas-Stonell and Greenberg scale

<table>
<thead>
<tr>
<th>Drooling severity score</th>
<th>Drooling frequency score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dry</td>
<td>1) Never</td>
</tr>
<tr>
<td>Mild-wet lips</td>
<td>2) Occasionally</td>
</tr>
<tr>
<td>Moderate-wet lips and chin</td>
<td>3) Frequently</td>
</tr>
<tr>
<td>Severe-drool extends to clothes wet</td>
<td>4) Constantly</td>
</tr>
<tr>
<td>Profuse-clothing, hands and objects wet</td>
<td></td>
</tr>
</tbody>
</table>
Assessment Tools

• Tools to quantify drooling
  • Drooling Impact Scale
  • Drooling Quotient
  • Drooling Severity and Frequency Scale
  • Daniel Drooling Impact Score Questionnaire – DDISQ
  • Modified Teacher’s Drooling Scale
  • Weighing oral cotton rolls or bibs
  • Visual Analogue Scale
• Drooling since an infant, but now worsening.
• He is coughing every day now and has noisy breathing when he lies down
• Wiping saliva off his face all day, because of this, kids play with him less
• Doing less physiotherapy, as having to spend time cleaning drool throughout sessions
What therapies can we offer?
Treatment Options

- Observation
- Rehabilitative / Non-Pharmacologic Measures
- Pharmacologic Measures
- Botulinum Toxin Injection
- Surgical
Consider Alternative Diagnoses
Observations

1. When symptoms were mild to moderate
2. <4 years old with:
   • Anticipation of normal swallowing development and
   • Without pulmonary complications
3. Minimal impact on the quality of life
4. Not a concern for the caregivers
Rehabilitative Options

1. Oral motor and oral sensory therapy
2. Behavior therapy
3. Positioning and posture adjustments
4. Oral appliances

**Fig. 1.** Rehabilitative options offered for drooling at surveyed IPOG institutions.
Rehabilitative Options

• Intraoral Devices
  • Not recommended in CMC
Pharmacologic Options

- Glycopyrrolate
- Scopolamine patch
- Benztropine
- Atropine
- Benzhexol Hydrochloride (Artane)
- Ipatropium Bromide – not yet studied in children
Medications adverse effects

- Behavioural changes
- Constipation
- Flushing
- Pupillary dilation/visual disturbance
- Urinary retention
- Other less common side effects included
  - Xerostomia
  - Sleep disturbance
  - Vomiting

- In RCTS and prospective trials:
  - 35% to 83% for glycopyrrolate (14–16, 20, 22), 46% to 76% for scopolamine (14, 18, 22), 25% to 33% for benztropine (12, 31), 10% to 88% for benzhexol/trihexyphenidyl (18, 22, 23), and 12% to 42% for atropine
Glycopyrrolate

Pharmacokinetics
- Time to peak effect: 2.5hrs
- Half-life: 3hrs
- Duration of action: 8-12hrs

Dosing Regime
- 0.02mg/kg/dose BID (morning and lunchtime)
- Max dose: 0.04mg/kg/dose TID or 3mg/dose TID

Side Effects
- Behaviour changes
- Constipation
- Urinary retention
- Flushing

![Graph showing incidence of side effects:]
- Dry mouth
- Constipation
- Vomiting
- Nasal congestion
- Flushing
- Urinary retention

Glycopyrrolate (n = 20) vs Placebo (n = 18)
Scopolamine

- **Used in nausea/vomiting and sialorrhea**

**Pharmacokinetics**
- Time to peak effect: 24hrs

**Dosing Regime**
- $\frac{1}{4}$ patch q3 days
- Increasing by $\frac{1}{4}$ patch every 7 days as tolerated.
- Maximum dose: 1 patch applied every 3 days

**Side Effects:**
- Skin irritation
- Xerostomia
- Drowsiness
Benzhexol Hydrochloride (Artane)

- Used for dystonia and sialorrhea

**Pharmacokinetics**
- Begins action within 1hr
- Peak action at 1-3hrs
- Duration of action 6-12hrs

**Dosing Regime**
- 1mg twice daily (morning and lunch/ after school);
- 2mg twice daily
- 3mg TID

**Side Effects**
- Behaviour changes
- Constipation
- Urinary retention
Benzotropine

Used for dystonia and sialorrhea

Pharmacokinetics
- Begins action within 1hr
- Peak action at 7hrs
- Duration of action 6-12hrs

Dosing Regime
- 0.02 to 0.05 mg/kg/dose 1 to 2 times daily
- Max dose 4mg/dose

Side Effects
- Anticholinergic effects
- Hyperthermia
- Psychiatric effects (confusion, depression, psychosis)
Atropine

1% solution drops

Pharmacokinetics
- Begins action within 30min
- Peak action at 3hrs
- Duration 5hrs

Dosing Regime
- 0.5mg per drop
- Up to q4hrs
- Max dose 3mg/day

Side Effects
- Anticholinergic effects
- Tachycardia
No consensus in most effective medication(s) nor optimal dosing

Little is known about tolerance

Side effect profiles should be considered

Glycopyrrolate, scopolamine/hyoscine, trihexyphenidyl/benzhexol, benztropine, and atropine all effective
Botulinum Neurotoxin

Toxin A and Toxin B

No consensus on:

• Infection strategy
• Dosing
• Time interval between doses

Side Effects

• Dysphagia
• Dysarthria
• Increased salivary viscosity
• Indications
  (1) Not tolerate/ contraindications to medical management
  (2) Persistent symptoms post medical and rehabilitation management
  (3) Pulmonary complications despite other medical management
  (4) Failed ductal ligation (recanalization)
  (5) If systemic medication or surgery not desired (parental choice or anesthesia contraindication).

• 50-80% experience reduction in drooling
### Table 2
Important conditions to check prior to drooling surgery.

<table>
<thead>
<tr>
<th>Associated neurological condition and its future progression</th>
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</thead>
<tbody>
<tr>
<td>Presence of a muscular disorder</td>
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<tr>
<td>Metabolic disorders</td>
</tr>
<tr>
<td>Swallowing status</td>
</tr>
<tr>
<td>Pulmonary status</td>
</tr>
<tr>
<td>Coagulation status</td>
</tr>
<tr>
<td>Presence of sleep apnea</td>
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<tr>
<td>Tonsillar and adenoidal hypertrophy</td>
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<tr>
<td>Macroglossia</td>
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<tr>
<td>Occlusion issues, Dental health, oral hygiene</td>
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<td>Number of aspiration pneumonias/respiratory complications</td>
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<td>Presence of laryngo-pharyngeal or gastric reflux</td>
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<td>Current list of medication</td>
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<tr>
<td>Presence of a gastrostomy tube</td>
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<td>Presence of a nasogastric tube</td>
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<tr>
<td>Previous treatment for drooling</td>
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<td>Family situation and caregiver</td>
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<td>Mental status and ability to consent</td>
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### Table 3
Surgical options for drooling performed by IPOG members (an institution can perform more than one type of intervention).

<table>
<thead>
<tr>
<th>Option</th>
<th>Percentage</th>
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<tbody>
<tr>
<td>Submandibular glands excision only</td>
<td>68%</td>
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<tr>
<td>Submandibular glands excision + ligation of parotid ducts</td>
<td>50%</td>
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<tr>
<td>Submandibular duct relocation ± sublingual gland excision</td>
<td>40%</td>
</tr>
<tr>
<td>Submandibular and/or parotid ductal ligation</td>
<td>33%</td>
</tr>
<tr>
<td>Submandibular and/or parotid duct ligation + sublingual gland excision</td>
<td>12%</td>
</tr>
<tr>
<td>Tympanic neurectomy</td>
<td>12%</td>
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</table>
Surgical Options

Table 2. Results Summary

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>No. of Studies</th>
<th>Subjective Success Rate (95% Confidence Interval), %</th>
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<tbody>
<tr>
<td>Overall</td>
<td>59</td>
<td>81.6 (77.5-85.7)</td>
</tr>
<tr>
<td>Mean follow-up duration</td>
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<tr>
<td>≥1 year</td>
<td>42</td>
<td>83.9 (78.6-89.1)</td>
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<tr>
<td>&lt;1 year</td>
<td>17</td>
<td>76.6 (68.9-84.4)</td>
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<td>Surgical procedure</td>
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<tr>
<td>BSM duct rerouting</td>
<td>21</td>
<td>84.4 (77.7-91.1)</td>
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<td>BSMG excision and bilateral parotid duct rerouting</td>
<td>8</td>
<td>87.8 (80.5-95.1)</td>
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<tr>
<td>BSMG duct rerouting and BSLG excision</td>
<td>8</td>
<td>71.5 (63.6-79.4)</td>
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<td>BSMG excision and bilateral parotid duct ligation</td>
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<td>85.2 (78.6-91.7)</td>
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<tr>
<td>4-Duct ligation</td>
<td>4</td>
<td>64.1 (27.6-100)</td>
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</tbody>
</table>

Abbreviations: BSLG, bilateral sublingual gland; BSM, bilateral submandibular; BSMG, bilateral submandibular gland.
### Table 4
Potential drooling surgery complications.

<table>
<thead>
<tr>
<th>Submandibular gland excision</th>
<th>Submandibular duct relocation</th>
<th>Duct ligation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Risk of anesthesia</td>
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</tr>
<tr>
<td>Bleeding/hematoma</td>
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</tr>
<tr>
<td>Infection</td>
<td>Infection</td>
<td>Infection</td>
</tr>
<tr>
<td>Pain (less)</td>
<td>Pain</td>
<td>Pain</td>
</tr>
<tr>
<td>Xerostomia</td>
<td>Less risk of Xerostomia</td>
<td>Xerostomia</td>
</tr>
<tr>
<td>Dental caries</td>
<td>Less risk of dental caries</td>
<td>Dental caries</td>
</tr>
<tr>
<td>Halitosis</td>
<td>Less risk of halitosis</td>
<td>Halitosis</td>
</tr>
<tr>
<td>Failure to achieve desired effect</td>
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</tr>
<tr>
<td>Lingual nerve injury, rarely hypoglossal facial nerve injury</td>
<td>Lingual nerve injury</td>
<td>Ranula, ductocele, sialocele</td>
</tr>
<tr>
<td>Marginal mandibular</td>
<td>Risk of aspiration, to be prevented through careful patient selection</td>
<td>Dysphagia secondary to xerostomia</td>
</tr>
<tr>
<td>Dysphagia secondary to xerostomia</td>
<td>Ranula (some remove the sublingual glands to reduce this risk)</td>
<td>Gland swelling, pain, or infection</td>
</tr>
<tr>
<td>Hypertrophic scar, keloid</td>
<td>Floor of mouth swelling, gland swelling/pain/infection in case of ductal injury or stenosis</td>
<td>Intraoral wound dehiscence</td>
</tr>
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<td></td>
<td>Intraoral wound dehiscence</td>
<td>Recanalization leading to relapse</td>
</tr>
</tbody>
</table>
Treatment Options Summary

- **Optimize Conditions**
  - Medication review
  - Dental care and hygiene
  - Posture

- **Behavioral and Non-medical Interventions**
  - Consider developmental age, motivation and learning abilities

- **Oral Sensory/motor intervention**

- **Behavioral intervention**

- **Oral appliances**

- **Pharmacological Interventions**
  - Anticholinergic medication
    - Glycopyrrlate
    - Scopolamine
    - Benztropine
    - Benchezine
    - Botulinum toxin A or B
    - Submandibular
    - Parotid
    - Submandibular & Parotid

- **Surgical Management**
  - (usually > 4 years of age)
    - Duct ligation (submandibular, parotid or both)
    - Bilateral submandibular gland excision
    - Submandibular duct relocation

- **Follow-up assessment & monitor for side effects**

**Color Legend for Level of Treatment Evidence**

- **Effective**
- **Probably or Possibly Effective**
- **Recommended by clinical expert opinion**
- **Contraindicated for posterior drooling**
• Clarify goals
• Treatment indicated
• Consider rehabilitation therapies and medications
• Consider botulinum injections/ surgery in the future
• Counsel on side effects
Sialorrhea can have significant physical, mental, and social implications.

Therapies include rehabilitative means, pharmacologic, and surgical options.

Assessment tools exist to formally monitor sialorrhea and treatment response.

Consider side effect profile and alternative indications when selecting medical management.


