

# Drooling: Assessment and Management for Children with Medical Complexity

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# Disclosures

No conflicts of interest

# Learning Objectives

- To describes 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<sup>1</sup>
- Drooling<sup>1</sup>
- Sialorrhea<sup>1</sup>

# Drooling



Anterior Drooling<sup>2</sup>

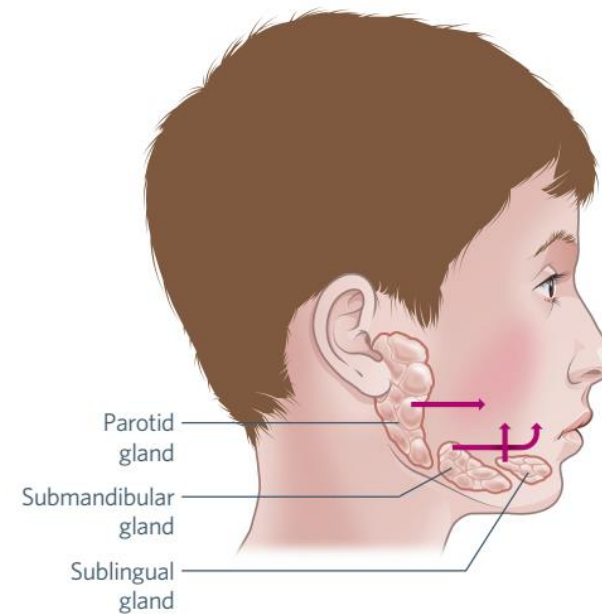


Posterior Drooling<sup>2</sup>

# Saliva

- Three major pairs of salivary glands<sup>3</sup>
  - Submandibular gland
  - Parotid gland
  - Sublingual gland
- Functions of saliva<sup>3</sup>
  - Lubricates food, tongue, lips
  - Oral hygiene
  - Bacteriostatic/ bactericidal effects
  - Initiates carbohydrate digestion
  - Regulated esophageal acidity

**Figure 1.** Location of the major salivary glands with ducts shown as arrows



# Case Presentation

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<sup>1</sup>

Inefficient control of salivary secretions<sup>1</sup>

- Sensory issues
- Motor issues

## Sequence of Swallowing<sup>5</sup>

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Oral preparatory (voluntary)

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Oral (voluntary)

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Pharyngeal (involuntary)

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Esophageal (involuntary)

# Impact of Drooling

## Clinical Implications<sup>5</sup>

- Aspiration pneumonia
- Perioral dermatological issues
- Dentition problems

## Social Implications<sup>5</sup>

- Impact on self-esteem
- Unpleasant odor
- Embarrassment
- Reduced social inclusion

# Etiology<sup>6</sup>

## 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<sup>6</sup>

- 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<sup>4</sup>

## 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

# Assessment

- No universally accepted measurement tool<sup>7</sup>
- Few pediatricians use standardised methods to measure<sup>7</sup>
  - Sialorrhea
  - Effectiveness of medications
  - Adverse effects
- Most commonly used measures
  - Count the number of bib changes per day (80%)<sup>7</sup>
  - Degree of parental satisfaction (85%)<sup>7</sup>

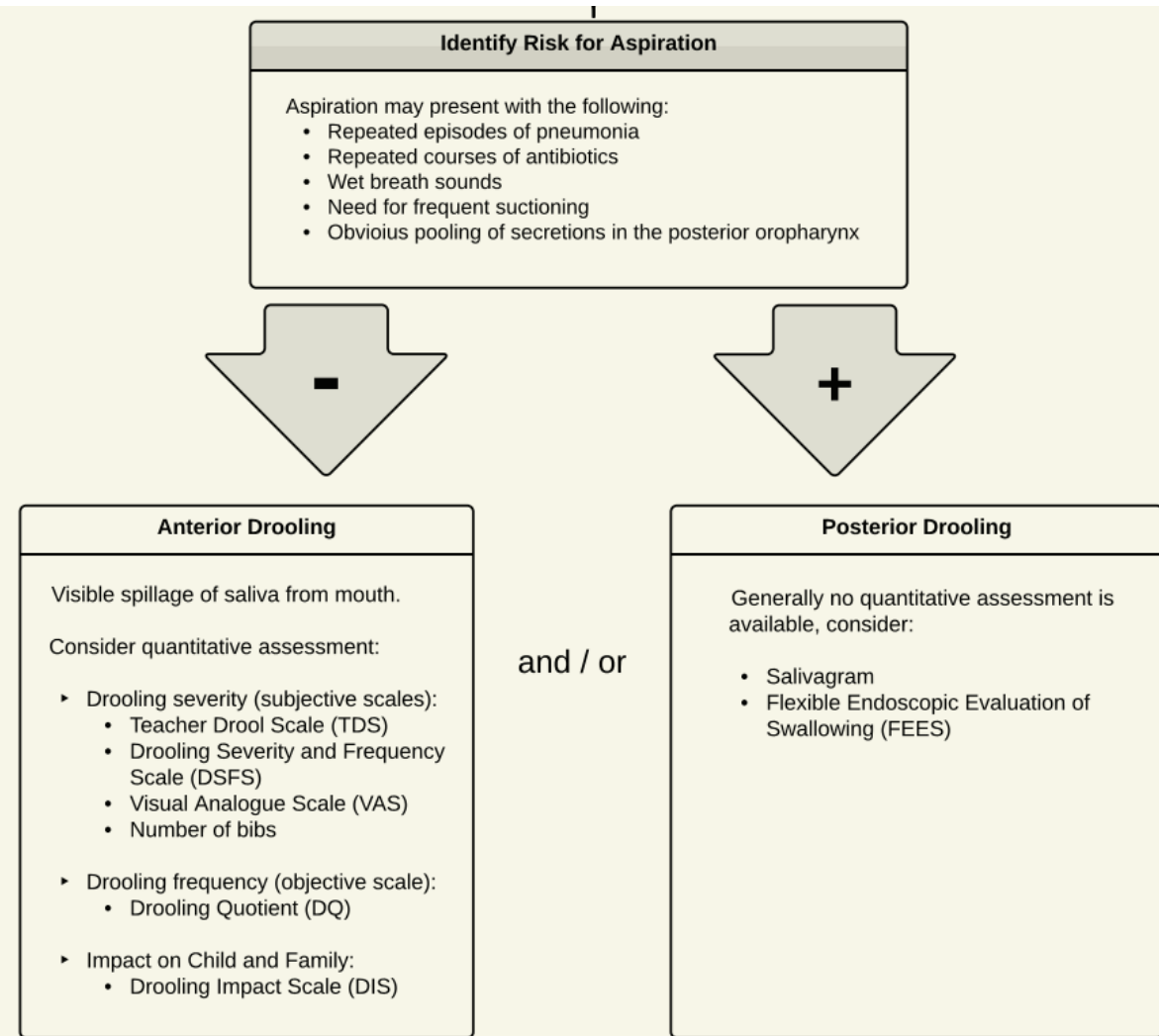
# Focused Physical Exam<sup>7</sup>

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



# Assessment<sup>4</sup>

## ASSESSMENT (multi-disciplinary when possible)



Do you use a formal  
assessment tool when  
diagnosis or monitoring  
sialorrhea?

# Assessment Tools<sup>7</sup>

**Table 1** Measures of sialorrhea

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

# Assessment Tools

## Drooling Impact Scale<sup>8</sup>

- 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
---	---	---	---	---	---	---	---	---	----

 Constantly
2. How severe was the drooling?  
Remained dry 

1	2	3	4	5	6	7	8	9	10
---	---	---	---	---	---	---	---	---	----

 Profuse
3. How many times a day did you have to change bibs or clothing due to drooling?  
Once or not at all 

1	2	3	4	5	6	7	8	9	10
---	---	---	---	---	---	---	---	---	----

 10 or more
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
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 Greatly

# Assessment

## Drooling Quotient 5 (DQ5)<sup>9</sup>

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

### DQ5 Activity

*Interaction/singing/playing*

	Observation intervals 15 sec	Score 1 of 0
1	0.00-0.15	
2	0.15-0.30	
3	0.30-0.45	
4	0.45-1.00	
5	1.00-1.15	
6	1.15-1.30	
7	1.30-1.45	
8	1.45-2.00	
9	2.00-2.15	
10	2.15-2.30	
11	2.30-2.45	
12	2.45-3.00	
13	3.00-3.15	
14	3.15-3.30	
15	3.30-3.45	
16	3.45-4.00	
17	4.00-4.15	
18	4.15-4.30	
19	4.30-4.45	
20	4.45-5.00	

### DQ5 Rest

*Watching television/listening to music*

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

**Score:**  $\frac{\text{Total amount of intervals with new saliva}}{20} \times 100 =$

20

# Assessment<sup>10</sup>

**Table 1.** Thomas-Stonell and Greenberg scale<sup>8</sup>

Drooling severity score	Drooling frequency score
Dry	1) Never
Mild-wet lips	2) Occasionally
Moderate-wet lips and chin	3) Frequently
Severe-drool extends to clothes wet	4) Constantly
Profuse-clothing, hands and objects wet	

# Assessment Tools

- Tools to quantify drooling<sup>8</sup>
  - 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

# Case

- 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<sup>11</sup>

Observation

Rehabilitative /  
Non-Pharmacologic  
Measures

Pharmacologic  
Measures

Botulinum Toxin  
Injection

Surgical

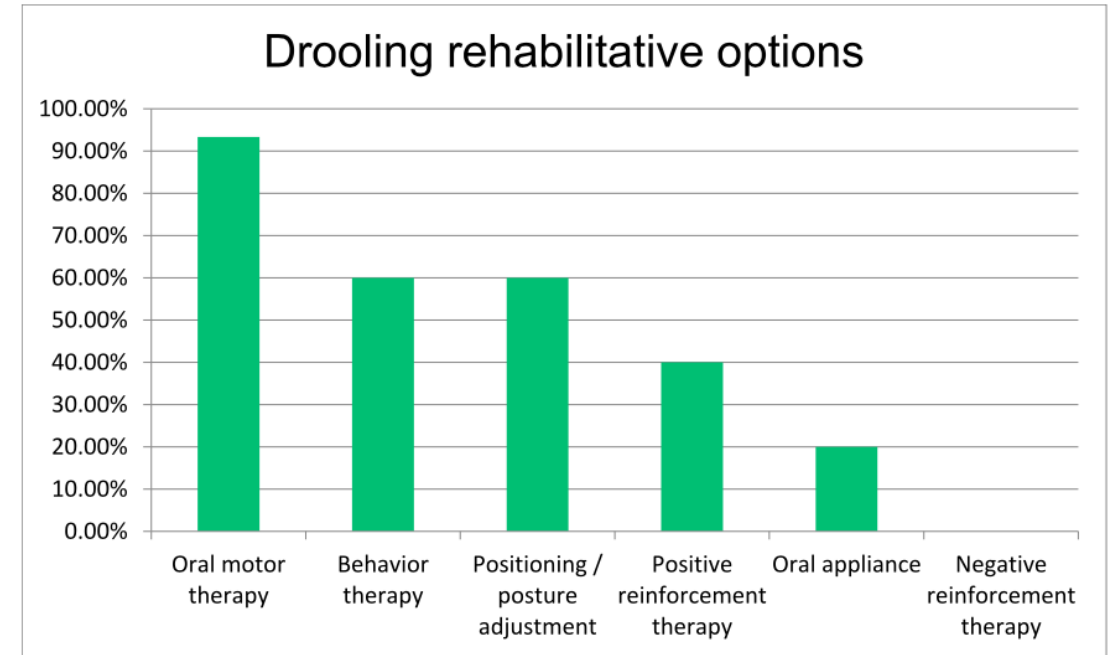
Consider Alternative Diagnoses

# 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

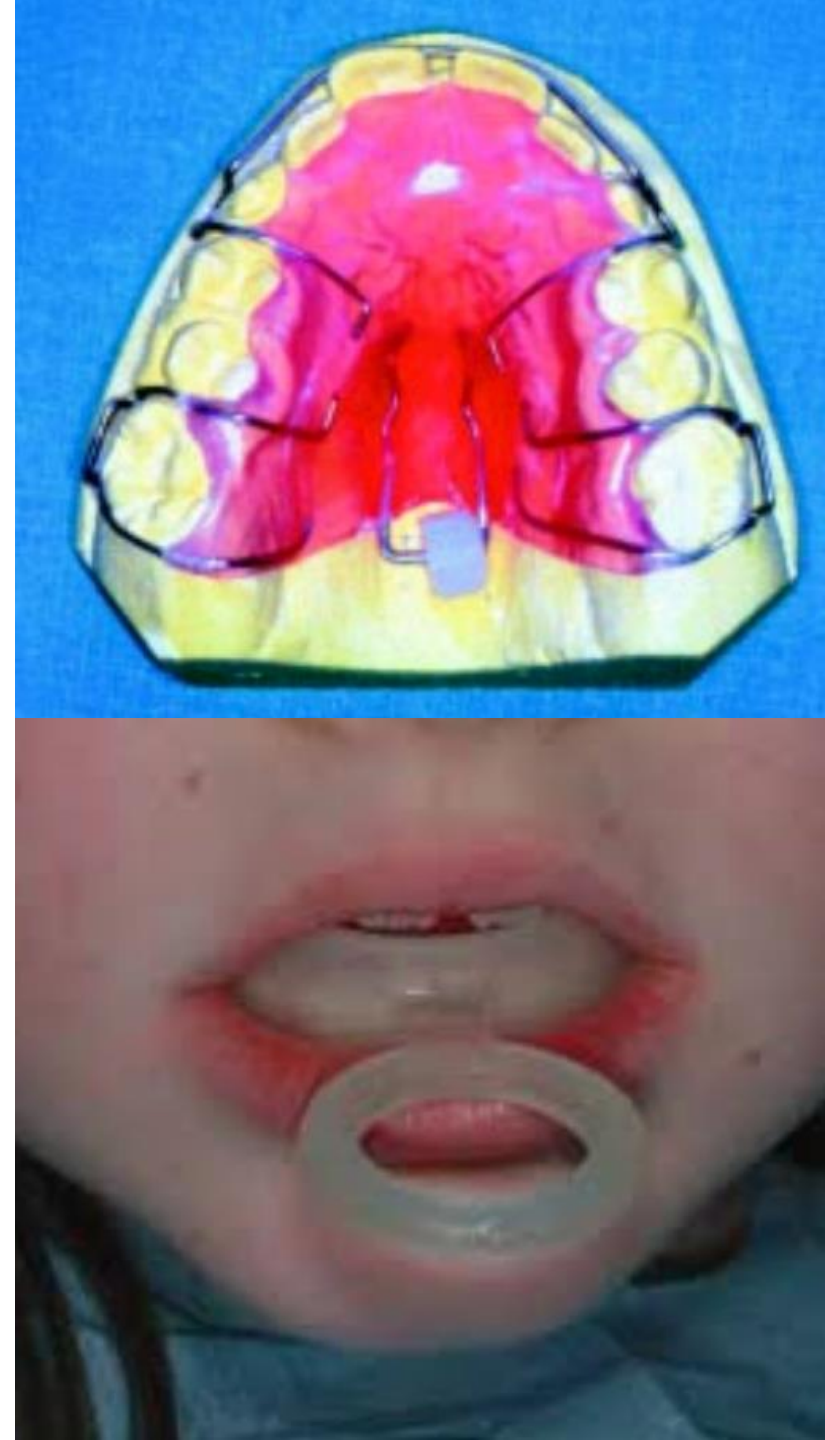
1. Oral motor and oral sensory therapy
2. Behavior therapy
3. Positioning and posture adjustments
4. Oral appliances



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

# Rehabilitative Options

- Intraoral Devices
  - Not recommended in CMC



# Pharmacologic Options

Glycopyrrolate

Scopolamine  
patch

Benzhexol  
Hydrochloride  
(Artane)

Benztropine

Atropine

Ipratropium  
Bromide – not yet  
studied in children

# Medications adverse effects<sup>11</sup>

- 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<sup>12</sup>

## Pharmacokinetics

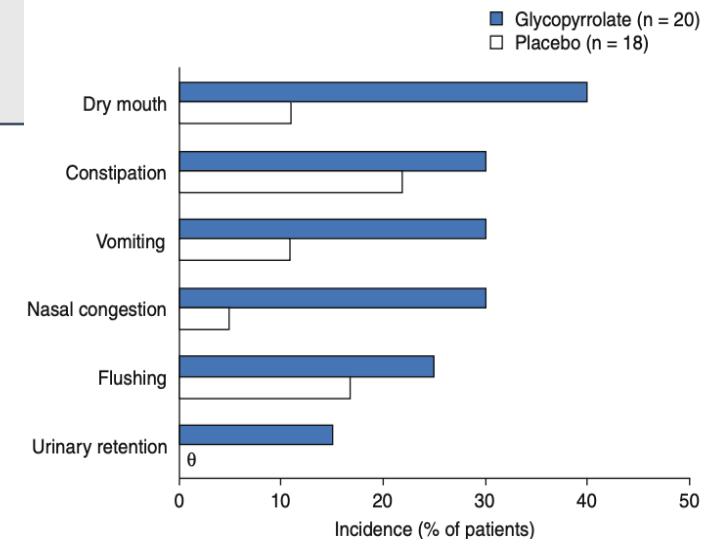
- Time to peak effect 2.5hrs
- Half-life: 3hrs
- Duration of action 8-12hrs

## 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



# Scopolamine<sup>11</sup>

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)<sup>13</sup>

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<sup>14</sup>

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<sup>15</sup>

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

## Medication summary

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No consensus in most effective medication(s)  
nor optimal dosing

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Little is known about tolerance

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Side effect profiles should be considered

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

# Botulinum Neurotoxin<sup>16</sup>

## Toxin A and Toxin B

### No consensus on:

- Infection strategy
- Dosing
- Time interval between doses

### Side Effects

- Dysphagia
- Dysarthria
- increased salivary viscosity

# Botulinum Neurotoxin<sup>16</sup>

- 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



# Assessment for Surgery<sup>17</sup>

**Table 2**

Important conditions to check prior to drooling surgery.

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Associated neurological condition and its future progression
Presence of a muscular disorder
Metabolic disorders
Swallowing status
Pulmonary status
Coagulation status
Presence of sleep apnea
Tonsillar and adenoidal hypertrophy
Macroglossia
Occlusion issues, Dental health, oral hygiene
Number of aspiration pneumonias/respiratory complications
Presence of laryngo-pharyngeal or gastric reflux
Current list of medication
Presence of a gastrostomy tube
Presence of a nasogastric tube
Previous treatment for drooling
Family situation and caregiver
Mental status and ability to consent

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# Surgical Options<sup>17</sup>

**Table 3**

Surgical options for drooling performed by IPOG members (an institution can perform more than one type of intervention).

Submandibular glands excision only	68%
Submandibular glands excision + ligation of parotid ducts	50%
Submandibular duct relocation ± sublingual gland excision	40%
Submandibular and/or parotid ductal ligation	33%
Submandibular and/or parotid duct ligation + sublingual gland excision	12%
Tympanic neurectomy	12%

# Surgical Options<sup>17</sup>

**Table 2. Results Summary**

<b>Characteristic</b>	<b>No. of Studies</b>	<b>Subjective Success Rate (95% Confidence Interval), %</b>
Overall	59	81.6 (77.5-85.7)
Mean follow-up duration		
$\geq 1$ year	42	83.9 (78.6-89.1)
<1 year	17	76.6 (68.9-84.4)
Surgical procedure		
BSM duct rerouting	21	84.4 (77.7-91.1)
BSMG excision and bilateral parotid duct rerouting	8	87.8 (80.5-95.1)
BSMG duct rerouting and BSLG excision	8	71.5 (63.6-79.4)
BSMG excision and bilateral parotid duct ligation	9	85.2 (78.6-91.7)
4-Duct ligation	4	64.1 (27.6-100)

Abbreviations: BSLG, bilateral sublingual gland; BSM, bilateral submandibular; BSMG, bilateral submandibular gland.

# Surgical Complications

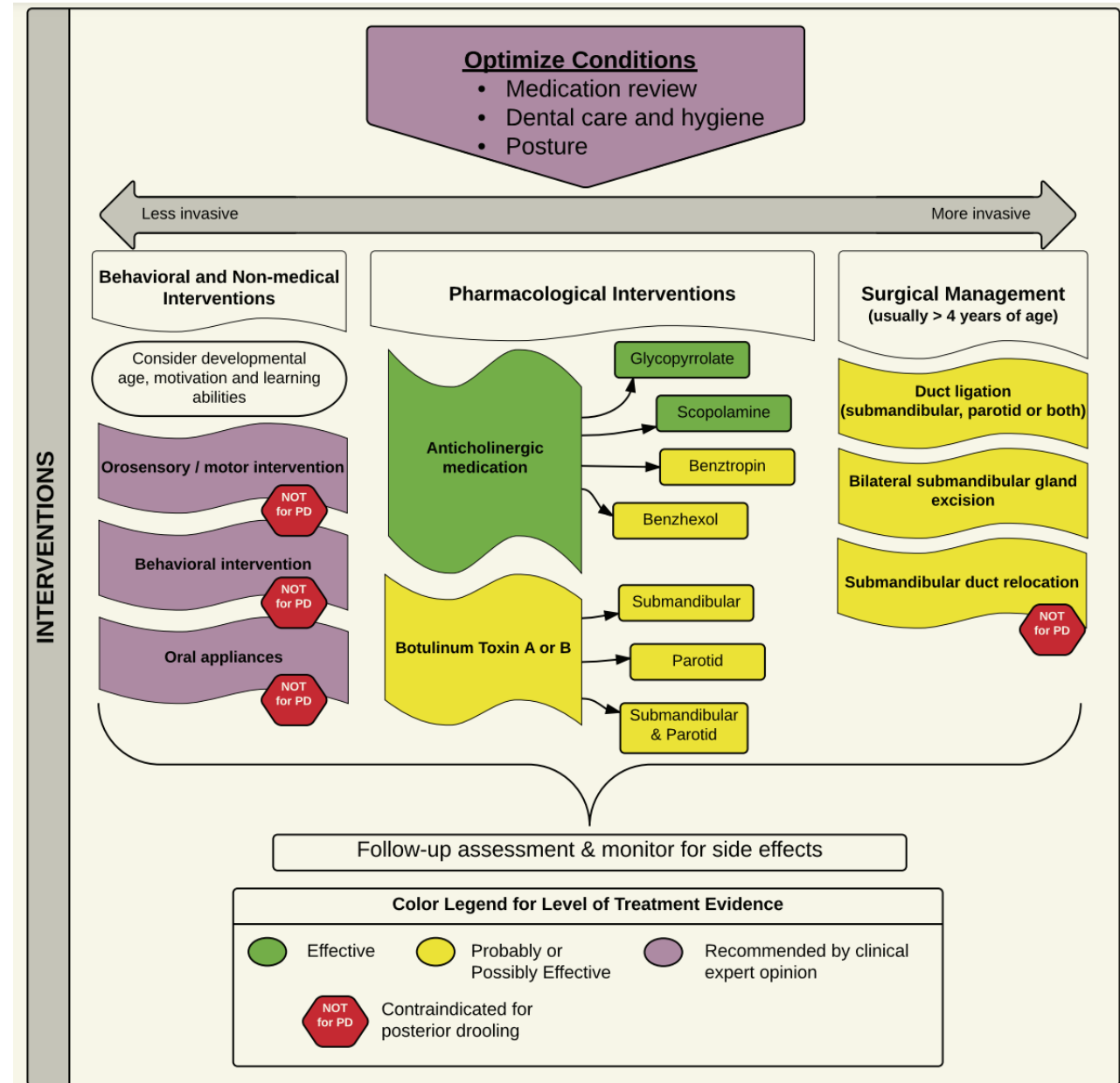
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**Table 4**

Potential drooling surgery complications.

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

# Treatment Options Summary<sup>4</sup>



# Case

- Clarify goals
- Treatment indicated
- Consider rehabilitation therapies and medications
- Consider botulinum injections/ surgery in the future
- Counsel on side effects



## Take Home Message

- 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

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