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REVIEW ARTICLE

Management of Drooling: A review

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ABSTRACT
Drooling, also known as sialorrhea, refers to the unintentional loss of oral fluids from the mouth, such as saliva. In healthy infants and toddlers, isolated drooling is common and may be connected to teething. The autonomic parasympathetic nervous system regulates saliva production from the paired glands. Children with impaired motor control and oral sensibility is more likely to experience chronic sialorrhea; excessive salivation is less common. Physical complication includes dry lips, dehydration, unpleasant Odor, and subsequent bacterial infection. The goal of anticholinergic medication is to alter the neuroglandular regulation of saliva. Various approaches to manage this condition for moderate and severe drooling include conservation interventions, physical therapy, drug therapy, radiotherapy, pharmacotherapy, oral motor training and surgery. These background, assessment, and management topics are covered in great detail in this article.
Keyword: *- Drooling, Hypersalivation, neurological disorder, sialorrhea.*

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INTRODUCTION

Drooling refers to an inability to regulate mouth secretions. Drooling not caused by overproduction of saliva; rather, it is the result of an issue with the mechanism of coordinated control of the palatolingual or orofacial muscles. Drooling can occur in patients even in those who produced less salivary flow, such as those with Parkinson's disease [1, 2]. Salivary "continence" occurs generally by 15-19 months, many kids will still have over salivation until they are three years old, especially when they are eating It is classified as pathogenic after the age of four[3]. The overall frequency of severe sialorrhea in children is 0.6% [3]. In chronic neurological disorders, sialorrhea is highly prevalent and has an effect on mental health and a mark on life quality [4]. There are two types sialorrhea anterior and posterior [5]. Both can happen either concurrently or independently. In addition, posterior drooling can cause social embarrassment, isolation, and low self-esteem [6]. The sublingual and submandibular glands release 70% saliva within unstimulated state. On the other hand, most saliva is produced by the parotid glands when the body is prompted. In the stimulated condition compared to the resting state, saliva flow is five times

Causes of Drooling [7]

Disorder	NEEDED
systemic diseases	nasal blockage Heavy metal toxicity. Overhydration: gastrointestinal disorders
Dental conditions	Planus Mucosal ulcers Teething and Ulcerative Lichen. herpes simplex ulcers painful ulceration Oral pain: stomatitis, periodontitis, and pulpitis
Neurological disorder	myasthenia gravis cerebral palsy a paralyzed face symptoms of Guillain-Barré

Some medicines are known to cause drooling or sialorrhea: -

Indirect muscarinic stimulants are to block the acetylcholinesterase enzyme. By raising acetylcholine levels, they activate muscarinic or nicotinic receptors, which causes an increase in salivary flow. The three primary clinical acetylcholinesterase inhibitors were used. donepezil, galantamine, and rivastigmine is used to treat Alzheimer's disease. Drooling is rarely -seen as a clinical issue with this family of medicines, despite its unique mechanism [7-9]. Neostigmine, physostigmine, and edrophonium are further acetylcholinesterase inhibitors that are primarily used in the diagnosis and management of myasthenia gravis. All anti-dopamine medications have the potential to induce drooling as a result in dysfunctional bradykinesia, a condition which swallowing occurs infrequently. Patients typically exhibit extrapyramidal side effects, which makes this clinically extremely obvious. Therefore, sialorrhea may result with antipsychotic medications due to the following factors:

1. Induced Parkinson's disease symptoms.
2. A reduction in noradrenaline or blockade of α2-adrenergic receptors.
3. The muscarinic receptors M3 and M4 are directly affected.

Common first-generation antipsychotic drugs including fluphenazine and haloperidol, cause more extrapyramidal symptoms than atypical antipsychotics, which belong to the second generation, include clozapine, risperidone, and olanzapine. Excessive sedation is a mechanism that hinders swallowing and is a negative effect of several antipsychotic medications [10]. Clozapine is the prototype of an atypical antipsychotic. Due to its antagonism with the sympathetic nervous system's α2-adrenergic receptors with its agonistic action on glandular muscarinic receptors M3 and M4, which activates the parasympathetic nervous system to promote salivary production it can cause sialorrhea [11, 12]. When benzodiazepines are taken in excess or at high doses, it can sometimes result in drooling this indicates that the swallowing process has changed [13]. Non-steroidal anti-inflammatory drugs, quinidine, potassium, iron preparations, doxycycline, and tetracycline may cause oesophageal mucosal inflammation, leading to drooling due to functional or pain impairment [14,15]. Toxins including organophosphate insecticides and nerve agents can cause drooling by blocking the acetylcholinesterase enzyme, resulting in the muscarinic and nicotinic receptors being overstimulated. Drooling can also be caused by mercury, thallium, manganese, and arsenic poisoning [16-25], Moreover, it is a clinical indicator of some illegal substances such as phencyclidine [26]. Herbal medicines, such as jaborandi (containing pilocarpine) and yohimbine (alkaloids) that act as peripheral adrenergic α2 antagonists, can increase salivary production [38,39]. Furthermore, the medication betel nut, it contains arecoline, a direct muscarinic agonist that can cause "betel nut drooling," and is ingested by millions of people in Southeast Asia." Saliva flow can also be stimulated by red pepper and citric acid [24].

Management of Drooling: - The control of drooling remains difficult Despite an availability of the numerous successful therapeutic in nature as to reduce saliva production. Saliva flow from the oesophagus to the mouth is regulated by cognitive abilities, swallowing, lip closure, head posture, and oral sensitivity [26]. Primary care physicians can provide a complete history and physical examination of their patients, as well as evaluate the effect of drooling on their standard of living and identify areas of improvement [27]. There are several different treatment options, but it's unclear which ones are the safest and most efficient. Improving a child's capacity to behaviourally control their secretions and improving their Oro motor control are the primary objectives of treating sialorrhea, reduction of the adverse effects of sialorrhea on social-affective and health outcomes[43] Saliva drooling is a difficult problem that is best treated by a multifunctional team. The team consists of the otolaryngologist, dentist, orthodontist, neurologist, occupational therapist, speech therapist, and primary care physician Together with the patient's consent, a management strategy might be created. The aim of managing Drooling is a way to lessen excessive saliva production. while keeping the oral cavity moist and healthy. Preventing xerostomia, or Mouth dryness is essential. basically, two primary methods are present [28].

1.**Non-invasive treatments**: - positioning, improving eating and drinking abilities, Oral prosthetic devices, oral therapy, biofeedback therapy, both positive and negative reinforcement, medication treatment, and botulinum toxin treatment.

2. **Invasive Treatment: - Radio** therapy or surgery.

Non-Invasive Treatment: -

Positioning: It is crucial to consider the patient's position before initiating any therapy. A human being must feel fully supported and at comfortable while sitting. Mouth control of saliva and swallowing is enhanced by proper alignment, which includes the trunk and head control [29].

Eating and drinking skills: - Unhealthy consuming habits might make drooling worse. Some progress may be made if eating and drinking, mouth movement, and lips closures procedures receive more focus

and are improved. Avoiding alcohol and acidic fruits will help reduce drooling because they increase saliva production [30].

Oral facial facilitation: this method will help in increasing the frequency of swallowing, oral motor control, and sensory awareness. Patients with both hyper and hypotonic muscles showed improvement in their drooling with this technique, according to Scott and Staios et al. This comprises many methods that speech therapists typically use to enhance salivary control and muscular tone. The majority of research indicate quick benefits with negligible long-term gains. This method is simple to use, has no negative adverse effects, and possibly stopped if no changes are shown [31].

a) frosting- The result normally lasts between 5 and 30 minutes. enhances swallow reflex and tone.

b) Brushing: It is advised to do this before meals because the effects possibly noticed for up to 20 to 30 minutes.

c) Vibration: enhances the tone of muscles with high tones.

d) Manipulation: techniques such tapping, stroking, patting, and applying strong pressure with fingertips directly on muscles are reported to increase oral awareness.

e) Oral motor sensory activities: such as tongue and lip exercises.

Speech therapy: For best results, speech It is best to start speech treatment as quickly as feasible. The objectives are to enhance lip closure (particularly while swallowing), boost tongue mobility, strength, and posture, and lessen nasal regurgitation while swallowing [32].

Rehabilitation- Sialorrhea management may be greatly aided by programs that target posture, body alignment, and oral motor skills. While most trials demonstrate short-term improvement with limited long-term benefit [33], there is not any agreement on the efficacy of these treatment [34]. Oromotor and Oro sensory methods include active and passive exercises to enhance tongue mobility, strength, and location as well as lip sealing [35]. Sensory applications include using various oral textures, vibration, tapping, palpation, and biofeedback systems. This strategy is only appropriate for kids with moderate to severe dental issues, adequate mental abilities. Its success rate is most when initiated early. These methods have no adverse effects and are simple to use in daily life [36].

Behavioural therapy: Children with normal cognitive function and only moderate sialorrhea may benefit from behavioural therapy [37]. includes overcorrection, signals, and both positive and negative reinforcement. This can be done by family members and adults, and repeated therapy is frequently necessary. There is little proof for it, and no negative effects have been noted [38].

Oral prosthetic device: To improve lip closure, tongue position, mandibular stability, and swallowing, a range of prosthetic devices, such as chin cups and dental appliances, can be helpful. Better outcomes depend on the patient's cooperation and comfort [39-42].

Pharmacological therapy

Drooling can be treated with muscarinic receptor antagonists such atropine, glycopyrronium bromide, and scopolamine (hyoscine), which reduce salivary secretion. Patients with glaucoma, paralytic ileus, prostatic hypertrophy, cardiac issues, or pyloric obstruction should not take these medications [43]. There are significant individual variations and incomplete results that sometimes result in the use of large dosages and appearance of extreme side effects like constipation, impaired vision, agitation, disorientation, retention of urine, and possibly toxic psychosis. These adverse reactions provide a higher risk to the more patient than sialorrhea itself [44]. As the parasympathetic nervous system regulates saliva secretion, and as the particular neurotransmitter involved is analogue (Ach), a decrease in Ach levels would result in a decrease in salivary secretion [45].

Glycopyronnium bromide oral: In 2010, the FDA approved this solution formulation for children with severe sialorrhea and neurologic problems aged 3 to 16 [46]. The remedy is recommended for the intermittent, short-term therapy of severe sialorrhea symptoms [47].Studies have different dosage recommendations for oral usage. An initial dosage of 12.8µg/kg/ dose of glycopyrronium should be administered three times a day, according to the product's list of characteristics. The effects start quickly (15-30 minutes) and peak between one and four hours, lasting up to six to eight hours [43]. Compared to transdermal scopolamine, it is usually more well-tolerated and has a similar but less common side effect profile. While either drug can be utilized, glycopyrronium needs to be taken first [48].

Atropine: -Drooling can be minimized when atropine is taken sublingually [49]. Comparing sublingual release to parenteral delivery, there are numerous benefits. Atropine has a reversible effect, is inexpensive, and does not require specialized training to administer. Patients with dementia, cognitive decline, or hallucinations should not use it [50, 51].

Transdermal patches (Scopolamine®): - scopolamine are used for treat motion sickness-related nausea. Dry mouth is the most frequent adverse effect. Those who drool have tested for both scopolamine and clozapine reactions., brain lesions, Parkinson's disease or significant oropharyngeal resection [52,

53]. Nebulization is a preferable way to administer scopolamine since it improves medication absorption. It has been observed that an 800μg dose given twice or three times a day is both effective and free of side effects [54].

Benzhexol (trihexyphenidyl): This medication is mostly used to treat dyskinetic cerebral palsy and disorders of dystonic movement. Benzhexol was generally well tolerated and successful in an investigation that was without a prescription, medication in the management of kids with cerebral palsy's dystonia or sialorrhea [56]. For sialorrhea, the starting dose should be 0.5 mg for newborns and 1 mg for kids once a day. Dosage should be titrated every two weeks up to a maximum of two milligrams per day.

Oral Benztropine: - - Some research suggests that benztropine also reduces excessive salivation.17 3-3.8 mg/day dose ranges have been reported. Sedation, dysphoria, and restlessness are serious central side effects that are reported [55].

Intra-oral botulinum toxin (BTX) injections: Although BTX has a wide range of therapeutic applications, its efficacy in treating excessive drooling has just recently been established [57]. This neurotoxin inhibits the cholinergic nerve terminals' ability to release Ach [58]. As new nerve terminals emerge to form new brain connections, the blocking is only temporary [59]. When anticholinergic therapy does not produce the desired results, these injections are frequently taken into consideration [43]. Reports indicate that the effect is maximal four to six weeks after injection, extending durations of one to six months [60]. the submandibular and parotid gland infusion is often administered under ultrasonography supervision. The most common adverse effects are thickening of secretions, dysphagia, and injection site irritation. At the moment, the FDA has approved BTX types A and B for the treatment of adult chronic sialorrhea [61, 62] in young people, in spite of the Although BTX injections have a beneficial overall effect, there is insufficient evidence to verify its efficacy [63, 64].

INVASIVE TREATMENT

Radiation therapy

Scholars like Borg al et. have examined the application of ionizing radiation as a treatment for sialorrhea in an attempt to lessen the production of saliva[74] Because it can result in delayed development, xerostomia, stomatis, tooth decay, malignancy, and Radiation osteitis, they suggested avoid radiotherapy for children [65].

Surgical Treatment [66]

The final therapeutic option for sialorrhea is surgery, which is advised:

• When conservative treatments have failed in moderate-to-persistent instances.

• In extreme situations if there are signs of past treatment failure or minimal benefit from conventional therapy.

• In moderate cases where cognitive development is delayed or conservative therapy have failed due to lack of cooperation.

Neurectomy: -. Saliva flow is decreased when the parasympathetic nerve is sectioned. The tympanic cord and plexus nerve can be sectioned unilaterally or bilaterally by themselves and conjunction in addition to other treatments a submandibular gland like that exegesis [67, 68]. The sublingual and submaxillary glands secrete less when the tympanic chord is removed; However, the side effects of this surgery alone have been demonstrated to be insignificant [69]. Therefore, it is not advised for people who have hearing issues. Controversial are the long-term outcomes of isolated neurectomies [70].

Surgical procedure of gland and salivary duct: - The aim of duct blockage is to achieve atrophy of the gland. There are several distinct methods. which consist of the submandibular glands' exegesis or the bilateral the ducts of parotid glands. Based on data from three investigations involving 96 patients, the simplest strategy has shown to be effective (85-86% success rate) [71]. With a success rate of 75%–89%, repositioning the submandibular duct, either alone or in combination, is a routine treatment. Benefits consist its physiologic features and it's a minimally invasive [72]. Various research has reported on the methods and outcomes of ductal repositioning.

CONCLUSION

Drooling is major issue in certain kids, particularly those suffering from neurological issues. Monitoring sialorrhea is crucial since it can cause children's potentially dangerous chronic pneumonias with silent micro-aspirations. The multidisciplinary expert team more effectively organizes the diagnosis and treatment of children's chronic sialorrhea. Treatment choices for children vary based on age, severity, and cognitive function. Non-invasive and reversible treatments should be prioritized first, with surgical operations as last resort. Future extensive research in this area is necessary because this issue affects so many children and their families.

REFERENCES

1. Proulx, M., De Courval, F. P., Wiseman, M. A., & Panisset, M. (2005). Salivary production in Parkinson's disease. *Movement disorders: official journal of the Movement Disorder Society*, *20*(2), 204-207
2. Bagheri, H., Damase-Michel, C., Lapeyre-Mestre, M., Cismondo, S., O'Connell, D., Senard, J. M., ... & Montastruc, J. L. (1999). A study of salivary secretion in Parkinson's disease. *Clinical neuropharmacology*, *22*(4), 213-215.
3. Fairhurst CB, Cockerill H. (2010). Management of drooling in children. Archives of Disease in Childhood-Education and Practice. 1.321–32
4. Dias BL, Fernandes AR, Maia Filho HS.(2016). Sialorrhea in children with cerebral palsy. J Pediatr (Rio J). 92:549-558.
5. Glader L, Delsing S, Hughes A, Parr J, Pennington L, Reddi Hough D et al. (2016). Sialorrhea. Bottom Line 'Evidence Informed' Recommendations for Children/Youth with Cerebral who have sialorrhea. (Assessed October 23, 2020). Available at: https://www. aacpdm.org/).
6. Scully, C.; LaMere's, J.; Gleeson, M.; Tomas, I.; Diz, P. (2009). Drooling. J. Oral Pathol. Med. 209,
7. Holsinger, F.C.; Bui, D.T. (2007). Anatomy, function, and evaluation of the salivary glands. Salivary Glands Disorders 1, 1–16.
8. Dodds WJ. (1989). The physiology of swallowing. Dysphagia. 3:171-8.
9. Lipkin P. Epidemiology of the development disabilities. In: Capute AJ, Accardo PJ (eds) Development Disabilities in Infancy and Childhood. Baltimore: Paul Brookes Publications, 199 of the devel Lipkin P. Epidemiology of the development disabilities. In: Capute AJ, Accardo PJ (eds) Development Disabilities in Infancy and Childhood. Baltimore: Paul Brookes Publications, 199
10. Lipkin P. Epidemiology of the development disabilities. In: Capute AJ, Accardo PJ (eds) Development Disabilities in Infancy and Childhood. Baltimore: Paul Brookes Publications,
11. Myer CM, 3rd. Sialorrhea. Pediatr Clin North Am. 1989; 36:1495-1500.
12. Hockstein NG, Samadi DS, Gendron K, Handler SD. Crysdale WS. (1989). Management options for the drooling patients. Ear Nose Throat J; 68:820-30.
13. Sullivan PB, Lambert B, Rose M, Ford-Adams M, Johnson A, Griffiths P. (2000). Prevalence and severity of feeding and nutritional problems in children with neurological impairment: Oxford Feeding Study. Dev Med Child Neurol ; 42:674-80
14. Tahmassebi JF, Curzon ME. (2003). Prevalence of drooling in children with cerebral palsy attending special schools. Dev Med Child Neurol; 45:613-7.
15. Hyson HC, Johnson A, Jog MS. (2001). Survey of sialorrhea in parkinsonian patients in southwestern Ontario. Can J Neurol Sci 28: S46-7
16. Steele LS, Glazier RH. (1999). Is donepezil effective for treating Alzheimer's disease? *Can Fam Physician.* 45:917-919
17. Scott LJ, Goa KL. (2000). Galantamine a review of its use in Alzheimer's disease. *Drugs.* 60:1095-1122
18. Finkel SI. (2004). Effects of rivastigmine on behavioural and psychological symptoms of dementia in Alzheimer's disease. *Clin Ther.* 26:980-990
19. Freudenreich O. (2005). Drug induced sialorrhea. *Drugs of Today (Barc).* 41:411-418.
20. Szabadi E. (1997). Clozapine-induced hypersalivation. *Br J Psychiatry.* 171:89
21. Corrigan FM, McDonald S, Reynolds GP. (1995). Clozapine-induced hypersalivation and the alpha 2 adrenoceptor. *Br J Psychiatry.* 167:412.
22. Freudenreich O. (2005). Drug induced sialorrhea. Drugs of Today (Barc). 41: 411-418.
23. Guggenheimer J, Moore PA. (2003). Xerostomia. Etiology, recognition and treatment. J Am Dent Assoc. 134: 61-69. 16.
24. Steele LS, Glazier RH. (1999). Is donepezil effective for treating Alzheimer's disease? Can Fam Physician. 45: 917-919.
25. Finkel SI. (2004). Effects of rivastigmine on behavioural and psychological symptoms of dementia in Alzheimer's disease. Clin Ther. 26: 980-990.
26. Drachman DB. (1994). Myasthenia gravis. N Engl J Med. 330: 1797-1810.
27. Kales SN, Christiani DC. (2004). Acute chemical emergencies. N Engl J Med. 350: 800-808.
28. Brown JS Jr. (2002). Environmental and chemical toxins and psychiatric illness. Washington DC: American Psychiatric Publishing, Inc.
29. Doherty MJ. (2004). The quicksilver price. Mercury vapor poisoning aboard HMS Triumph and HMS Phipps. Neurology. 62: 963-966.
30. Solis MT, Yuen E, Cortez PS, Goebel PJ. (2000). Family poisoned by mercury vapor inhalation. Am J Emerg Med. 2 18: 599-602.
31. Bagheri H, Schmitt L, Berlan M, Montastruc JL. (1992). Effect of 3 weeks treatment with yohimbine on salivary secretion in healthy volunteers and in depressed patients treated with tricyclic antidepressants. Br J Clin Pharmacol. 34: 555-558.
32. Palmer JB, Drennan JC, Baba M. (2000). Evaluation and treatment of swallowing impairments. Am Fam Physician. 61: 2453-2462
33. Clarkson TW, Magos L, Myers GJ. (2003). The toxicology of mercury – Current exposures and clinical manifestations. N Eng J Med. 349: 1731-1737. 60.
34. Vashishta R, Nguyen SA, White DR, Gillespie MB. (2013). Botulinum toxin for the treatment of sialorrhea: A meta-analysis. Otolaryngology and Head and Neck Surgery. 148(2):191-196

35. Hockstein NG, Samadi DS, Gendron K, Handler SD. (2004). Sialorrhea: A management challenge. American Family Physician. 69(11):2628-2634.
36. Glader L, Delsing S, Hughes A, Parr J, Pennington L, Reddihough D et al. (2016). Sialorrhea. Bottom Line 'Evidence Informed' Recommendations for Children/Youth with Cerebral Palsy who have sialorrhea.(Assessed October 23, 2020). Available at: https://www. aacpdm.org/
37. Louise Cummings, (2008). Text book of Clinical Linguistics, edin univ press, page 95-99.
38. Johnson H, Scott A. (1993); Book on practical approach to saliva control and communication.
39. Scott, A., & Staios, G. (1993). Oral-facial facilitation. In J. Hilary & A. Scott (Eds.), A practical approach to saliva control (pp. 32-42). San Antonio, TX: Communication Skill Builders.
40. Costanzo, L. (2000). Text book of Physiology, 3rd edition. Saunders Elsevier. ISBN 10:1-4160-2320-8.
41. Bavikatte G, Sit PL, Hassoon A. (2012). Management of drooling of saliva. Br J Med Pract. 5: a507.
42. Leung AK, Kao CP. (1999). Drooling in children. Paediatr Child Health. 4:406-411.
43. Fairhurst CB, Cockerill H. (2011). Management of drooling in children. Arch Dis Child Educ Pract Ed. 96:25-30.
44. Van Hulst K, Lindeboom R, van der Burg J, Jongerius P. (2012). Accurate assessment of drooling severity with the 5-minute drooling quotient in children with developmental disabilities. Dev Med Child Neurol. 54:1121-1126.
45. Mier RJ, Bachrach SJ, Lakin RC, Barker T, Childs J, Moran M. (2000). Treatment of sialorrhea with glycopyrrolate: A double-blind, dose-ranging study. Arch Pediatr Adolesc Med. 154(12):1214-8.
46. Daniels TE, Criswell LA, Shiboski C, Shiboski S, Lanfranchi H, Dong Y, et al. (2009). An early view of the International Sjögren's Syndrome Registry. Arthritis Rheum. 61: 711-714.
47. Parr JR, Todhunter E, P (2017). Glycopyrronium for severe drooling in children. Drug Ther Bull. 55:93-96. 15.
48. Parr JR, Todhunter E, Pennington L, Stocken D, Cadwgan J, O'Hare AE, et al. (2018). Drooling Reduction Intervention randomised trial (DRI): comparing the efficacy and acceptability of hyoscine patches and glycopyrronium liquid on drooling in children with neutralizability. Arch Dis Child. 103:371-376.
49. Hyson CH, Johnson AM, Jog MS. (2002). Sublingual atropine for sialorrhea secondary to Parkinsonism: a pilot study. Mov Disord. 17: 1318-1320.
50. Gaftanyuk O, Trestman RL. (2004). Scopolamine patch for clozapine induced sialorrhea. Psychiatr Serv. 55: 318.
51. Dreyfuss P, Vogel D, Walsh N. (1991). The use of transdermal scopolamine to control drooling. A case reports. Am J Phys Med Rehabil. 70: 220-222.
52. Zeppetella G. (1999). Nebulized scopolamine in the management of oral dribbling: three case reports. J Pain Symptom Manage. 17: 293-295.
53. Jongerius PH, vanTiel P, van Limbeek J, Gabreëls FJ, Rotteveel JJ. (2003). A systematic review for evidence of efficacy of anticholinergic drugs to treat drooling. Arch Dis Child. 88: 911-914.
54. Carranza-del Rio J, Clegg NJ, Moore A, Delgado MR. (2011). Use of trihexyphenidyl in children with cerebral palsy. Pediatr Neurol. 44:202-206.
55. Camp-Bruno JA, Winsberg BG, Green-Parsons AR, Abrams JP. (1989). Efficacy of benztropine therapy for drooling. Dev Med Child Neurol. 31:309-319.
56. Little SA, Kubba H, Hussain SS. (2009). An evidence-based approach to the child who drools saliva. Clin Otolaryngol. 34:236-239.
57. Ondo W, Isaacson S, Lew M, Dashtipour K, Chary D, Clinch T, et al. (2019). RimabotulinumtoxinB (MYOBLOC) in the treatment of adult sialorrhea (P4.8-024). Neurology.92(15 Supplement): P4.8-024.
58. Blitzer A, Friedman A, Michel O, Flatau-Beque B, Csikós J, Jost W. (2018). SIAXI: IncobotulinumtoxinA for sialorrhea in Parkinson's disease, stroke, and other etiologies-Phase 3 Results (S30.007). Neurology. 90(15 Supplement): S30.007.
59. Porte M, Chaleat-Valayer E, Patte K, D'Anjou MC, Boulay C, Laffont I. (2014). Relevance of intraglandular injections of Botulinum toxin for the treatment of sialorrhea in children with cerebral palsy: a review. Eur J Paediatr Neurol. 18:649-657.
60. Walshe M, Smith M, Pennington L. (2012). Interventions for drooling in children with cerebral palsy. Cochrane Database Syst Rev. CD008624.
61. Borg M, Hirst F. (1998). The role of radiation therapy in the management of sialorrhea. Int J Radiation Oncol Biol Phys. 41: 1113-1119.
62. Assouline A, Levy A, Abdelnour-Mallet M, Gonzalez-Bermejo J, Lenglet T, Le Forestier N, et al. (2014). Radiation therapy for hypersalivation: a prospective study in 50 amyotrophic lateral sclerosis patients. Int J Radiat Oncol Biol Phys. 88: 589-595.
63. Arnold HG, Gross CW. (1977). Trans tympanic neurectomy: a solution to drooling problems. Dev Med Child Neurol. 19: 509-513.
64. Mullins WM, Gross CW, Moore JM. (1979). Long-term follow-up of tympanic neurectomy for sialorrhea. Laryngoscope. 89: 1219-1223.
65. Sellars SL. (1985). Surgery of sialorrhea. J Laryngol Otol. 99: 1107-1109
66. Grewal DS, Hiranandani NL, Rangwalla ZA, Sheode JH. (1984). Trans tympanic neurectomies for control of drooling. Auris Nasus Larynx. 11: 109-114.
67. Grant R, Miller S, Simpson D, Lamey PJ, Bone I. (1989). The effect of chorda tympani section on ipsilateral and contralateral salivary secretion and taste in man. J Neurol Neurosurg Psychiatry. 52: 1058-1062.
68. Dundas DF, Peterson RA. (1979). Surgical treatment of drooling by bilateral parotid duct ligation and submandibular gland resection. Plast Reconstr Surg. 64: 47-51.

69. Shott SR, Myer CM, Cotton RT. (1989). Surgical management of sialorrhea. Otolaryngol Head Neck Surg. 101: 47-50.
70. Brundage SR, Moore WD. (1989). Submandibular gland resection and bilateral parotid duct ligation as a management of chronic drooling in cerebral palsy. Plast Reconstr Surg. 83: 443-446.
71. Wilkie TF. (1967). The problem of drooling in cerebral palsy: a surgical approach. Can J Surg. 10: 60-67.
72. Meningaud JP, Pitak-Arnnop P, Chikhani L, Bertrand JC. (2006). Drooling of saliva: A review of the etiology and management options. Oral Surg Oral Med Oral Pathol Oral Radial Endod. 101: 48-57. 15.