



## Speech Outcomes after Tonsillectomy (For Tonsillitis) in Patients with Submucous Cleft Palate

Sherif M. Askar<sup>1\*</sup>, Hazem S. Amer<sup>1</sup>, Amal S. Quriba<sup>2</sup>, Mostafa H. Hassaan<sup>1</sup>, Ahmad M. Anany<sup>1</sup> and Ashraf Al- Malt<sup>1</sup>

<sup>1</sup>Department of Otorhinolaryngology, Head and Neck Surgery, Zagazig University, Egypt

<sup>2</sup>Department of Otorhinolaryngology, Head and Neck Surgery, phoniatic unit, Zagazig University, Egypt

### Abstract

**Objectives:** Otolaryngologists often face a problem when they have a patient with inflammatory indications for tonsillectomy particularly in developing countries where infection is endemic and its complications are dangerous. This work aims at presenting our experience in tonsillectomy (due to inflammatory indications) in patients with submucous cleft palate and to assess its effects on speech.

**Materials and Methods:** Thirteen patients with submucous cleft palate complaining of inflammatory indications for tonsillectomy were subjected to the protocol of speech assessment including video-nasopharyngoscopy and nasometric assessment.

**Results:** Comparison between preoperative and postoperative results of speech assessment, endoscopic velopharyngeal closure as well as nasometric assessment all revealed non-significant differences.

**Conclusion:** Tonsillectomy due to inflammatory indications could be performed in patients with SCP, and gives no or little effects on the performance of velopharyngeal sphincter.

**Keywords:** Speech; Tonsillectomy; Submucous cleft palate

### Introduction

The otolaryngologist often faces a decision-making problem when he has a patient with submucous cleft palate (SCP) who has an indication to undergo tonsillectomy. Surgeons are often reluctant to operate in the oropharynx to avoid hazardous effects on the velopharyngeal sphincter (VPS) and speech difficulties, but the situation differs when surgical intervention is strongly indicated. Controversy often exists over whether tonsillectomy will affect speech in patients with known velopharyngeal insufficiency (VPI), particularly in those with SCP [1,2]. Recent studies have challenged the old assumption that tonsillectomy is contraindicated in patients with or at risk for VPI [1,3,4].

For a long time infection had been the most common indication for tonsillectomy up until the 1980s; however recently, obstruction is now more commonly reported as a primary indication [5]. Researchers mainly described tonsillectomy in cases of sleep disturbance or obstructive sleep apnea while inflammatory indications were not widely discussed [1,3,4]. This may be the situation in the western developed communities, but in the less developed countries (where infection is endemic) inflammatory indications might still lead the indications [5,6].

This work aims at presenting our experience in tonsillectomy (due to inflammatory indications) in patients with SCP and to assess its effects on speech.

### Patients and Methods

This prospective study was carried out on patients with SCP who were referred to pediatrics unit, ORL-HN Department, Zagazig university hospitals in the period between January 2010 and June 2015. Patients were referred to our unit complaining of different forms of inflammatory tonsillitis (Table 1). Patients with high grades of hypertrophied adenoidal tissues (Grade 3-4) and/or sleep-disordered breathing were excluded from the study. Other exclusion criteria included syndromic cleft palate and neurologic-mental disorders. Patients who did not attend regular follow up sessions of speech assessment were also excluded from the study. The study was approved by the International Review Board of our institution.

### OPEN ACCESS

#### \*Correspondence:

Sherif Mohammad Askar, Department of Otorhinolaryngology, Head and Neck Surgery, Zagazig University, Egypt, Tel: 00201000471589; Fax: 0020552307830;

E-mail: askr\_sh@yahoo.com

Received Date: 23 Sep 2016

Accepted Date: 24 Oct 2016

Published Date: 08 Nov 2016

#### Citation:

Askar SM, Amer HS, Quriba AS, Hassaan MH, Anany AM, Al- Malt A. Speech Outcomes after Tonsillectomy (For Tonsillitis) in Patients with Submucous Cleft Palate. Clin Surg. 2016; 1: 1174.

Copyright © 2016 Askar SM. This is an open access article distributed under the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

**Table 1:** Patient's data: Ch T: chronic tonsillitis; EC: electrocautery; CI: cold instruments.

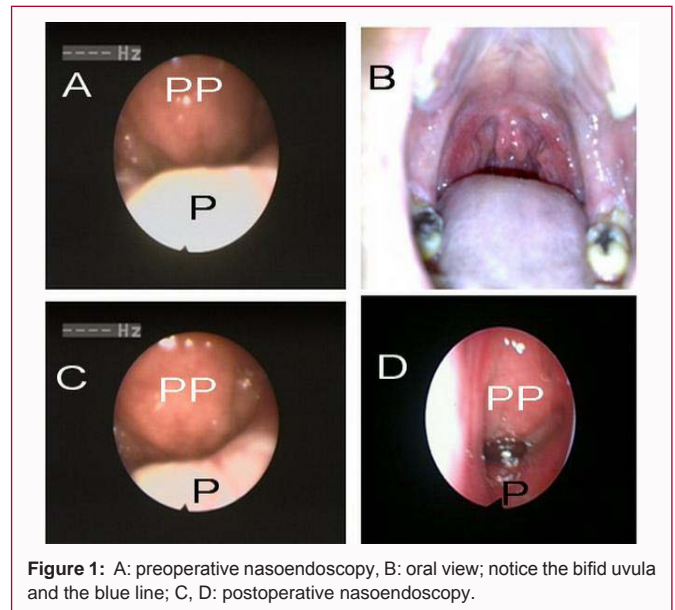
Patient	Sex	Age	Indication	Procedure
1	m	6	Ch. T	EC
2	m	8	Recurrent	CI
3	m	10	Halitosis	EC
4	f	6	Ch. T	CI
5	f	7	Recurrent	CI
6	m	5	Ch. T	CI
7	m	8	Recurrent	EC
8	f	7	Recurrent	CI
9	f	10	Recurrent	CI
10	f	6	Ch. T	CI
11	f	9	Recurrent	EC
12	f	16	Quinsy	EC
13	m	19	Halitosis	EC

Thorough history taking was the first step stressing upon details of recurrent attacks of tonsillitis (for each attack as regard its period, presence of fever, effects on performance and school absence, needs of antibiotics, etc...), mouth breathing and bad breath. Personal or family history of rheumatic fever was a point of detailed discussion. Complete general and head and neck examination was the following step, and Antistreptolysin O titer [ASOT] was requested for all of them. Then, patients were subjected to speech assessment in the Phoniatic unit of our department; all patients were assessed blindly by 3 Phoniaticians.

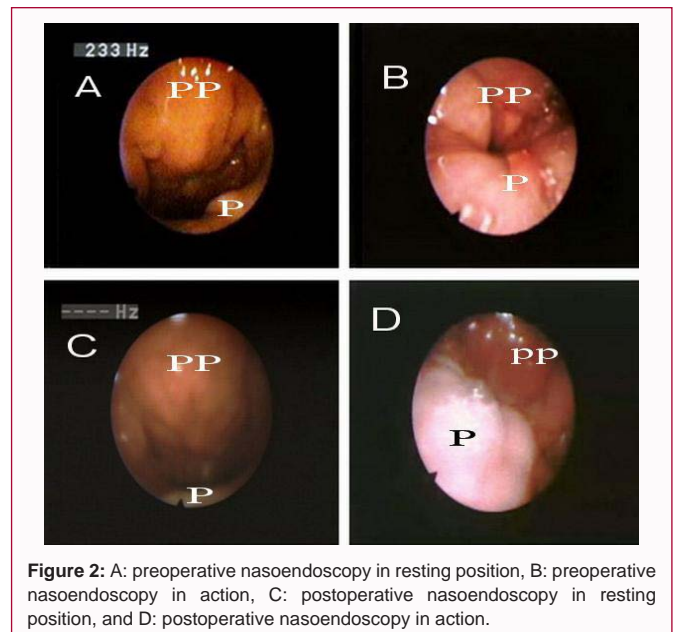
Patients' and parents' interview and detailed history were obtained. Then auditory perceptual assessment (APA) of the patient's speech was done: The subjective evaluation of patients' speech in a free conversation included type (hyponasality or hypernasality) and degree of nasality, consonant precision, the compensatory articulatory mechanisms (glottal and pharyngeal articulation), facial grimace, audible nasal emission of air, and the overall intelligibility of speech. All these elements are graded along a 5-point scale in which 0=normal and 4=severe affection.

Video-nasoendoscopy (VNE) was performed for all patients using a flexible fiberoptic nasopharyngeal endoscope from (Xion medicals) Figure 1(a-c-d); and Figure 2(a-d). The velopharyngeal valve movement was recorded while the patient was repeating the speech samples following recommendation given by an International Working Group [16]. The movement of the velum and lateral pharyngeal walls was traced on the monitor and given a score from 0 to 4 as follows: (0=the resting (breathing) position or no movement; 2=half the distance to the corresponding wall; 4=the maximum movement reaching and touching the opposite wall). Pattern of closure of the VPI was specified whether circular, coronal, sagittal, or other.

Nasometer II 6400 from (Kay Pentax Corporation, Montvale, NJ, USA) was used for the analysis of speech samples of all patients. The Picture-Cued Subtest from the Egyptian SNAP test was applied to assess nasometric changes. All subjects were asked to read or repeat six sentences separately containing the following phonemes (bilabial plosives, lingual-alveolar plosives, velar plosives, velar fricatives, sibilant fricatives and nasals), guided with their corresponding pictures [7].



**Figure 1:** A: preoperative nasoendoscopy, B: oral view; notice the bifid uvula and the blue line; C, D: postoperative nasoendoscopy.



**Figure 2:** A: preoperative nasoendoscopy in resting position, B: preoperative nasoendoscopy in action, C: postoperative nasoendoscopy in resting position, and D: postoperative nasoendoscopy in action.

A written informative consent was obtained from each patient after clarification of the procedure in details to patients and/or parents. Tonsillectomy was performed (after routine preoperative laboratory and radiological evaluations). Patients were sent to the Phoniatics unit after 1 month of surgery (after the complete healing).

The VPS function and speech were assessed on regular sessions (every 4-6 months) till the end of the follow up period. The study focused on the Phoniatics results after tonsillectomy (for inflammatory indications) in patients with SCP.

The data were collected; tabulated and analyzed using SPSS statistical package Version 20 for windows. Comparison between preoperative and postoperative speech evaluations was done. Qualitative data were presented as numbers and corresponding percentages. Non parametric tests were used when appropriate (Wilcoxon matched pairs test for quantitative data; and chi square test for qualitative data).  $P < 0.05$  is considered significant and  $P < 0.001$  is considered highly significant. A literature review was performed, to

**Table 2:** Comparison between preoperative and early (1 month) postoperative assessment of speech (n = 13).

Variable	Grade of nasality	Preoperative	Postoperative	X <sup>2</sup>	P
Type of nasality	Hypernasality	5 (38%)	7 (54%)	0.67	0.72
	Hyponasality	1 (8%)	1(8%)		
	Normal	7 (54%)	5 (38%)		
Audible nasal emission of air	Present	3 (23%)	5 (38%)	0.72	0.4
	Absent	10 (77%)	8 (62%)		
Imprecision of consonants	0	9 (69%)	9 (69%)	1.33	0.72
	1	2 (15%)	2 (15%)		
	2	1(8%)	2 (15%)		
	3	1 (8%)	0 (0%)		
	4	0 (0%)	0 (0%)		
Compensatory mechanisms	0	9 (69%)	9 (69%)	1.2	0.75
	1	3 (23%)	2 (15%)		
	2	1 (8%)	1 (8%)		
	3	0 (0%)	1 (8%)		
	4	0 (0%)	0 (0%)		
Speech intelligibility	0	0 (0%)	0 (0%)	1.06	0.59
	1	0 (0%)	1 (8%)		
	2	0 (0%)	0(0%)		
	3	4 (31%)	4 (31%)		
	4	9 (69%)	8 (62%)		
Overall velopharyngeal closure	0	0 (0%)	0 (0%)	0.27	0.88
	1	0 (0%)	0 (0%)		
	2	2 (15%)	3(23%)		
	3	3 (23%)	3 (23%)		
	4	8 (62%)	7(54%)		
Results of nasometry	Bilabial Plosives				
	Lingual-Alveolar Plosives		W		p
	Velar Plosives		19		0.17
	Velar fricatives		18		0.09
	Sibilant Fricatives		21		0.29
	Nasals		18		0.13
			23		0.61
		21		0.25	

compare results with other reports.

## Results

### General characteristics

A total of 21 patients with SCP underwent tonsillectomy for inflammatory indications over the time period. Of these, 8 patients were excluded and 13 patients were enrolled in the study. The excluded eight patients included two patients with high grades of hypertrophied adenoidal tissues and sleep-disordered breathing; two patients with syndromic cleft palate; and one patient with neurologic-mental disorders. Patients who did not attend scheduled follow up sessions of speech assessment were also excluded from the study (3 patients).

The studied patients (13) were six males (46.2%) and seven females (53.8%) and their age ranged from 5 to 19 years (mean=8 years and 6 months). Bifid uvula was seen preoperatively in all cases

but zona pellucida and notching of hard palate were identified in 10 patients. Transnasal nasopharyngoscopy revealed loss of the midline convexity of the nasal surface of the soft palate with flattening (8 patients) and a clear midline groove (5 patients).

Six patients presented with seven or more attacks of acute bacterial tonsillitis (documented by a physician) per year for two years or more that was associated with fever and absence from school. Four patients presented with chronic tonsillitis, associated with chronic cervical lymphadenitis. One patient had two attacks of left peritonsillar abscess, documented with drainage of pus. High ASOT was obtained from the eleven patients, and was reported to be 1300 IU/mL in recurrent tonsillitis; 975 IU/mL in chronic tonsillitis; and 660 IU/mL in peritonsillar abscess. Two patients had a chief complaint of halitosis, with wide tonsillar crypts and their ASOT was 530 and 570 IU/mL. Recovery period passed smoothly with no reports of postoperative complications. The follow up was extended

**Table 3:** Comparison between preoperative and late postoperative assessment of speech (n = 13).

Variable	Grade of nasality	Preoperative	Postoperative	X <sup>2</sup>	P
Type of nasality	Hypernasality	5 (38%)	6 (46%)	0.16	0.69
	Hyponasality	1 (8%)	1(8%)		
	Normal	7 (54%)	6 (46%)		
Audible nasal emission of air	Present	3 (23%)	4 (31%)	0.2	0.66
	Absent	10 (77%)	9 (69%)		
Imprecision of consonants	0	9 (69%)	8 (62%)	2.06	0.5
	1	2 (15%)	2 (15%)		
	2	1(8%)	3 (23%)		
	3	1 (8%)	0 (0%)		
	4	0 (0%)	0 (0%)		
Compensatory mechanisms	0	9 (69%)	8 (62%)	1.06	0.79
	1	3 (23%)	3 (23%)		
	2	1 (8%)	1 (8%)		
	3	0 (0%)	1 (8%)		
	4	0 (0%)	0 (0%)		
Speech intelligibility	0	0 (0%)	0 (0%)	1.06	0.59
	1	0 (0%)	0 (0%)		
	2	0 (0%)	1(8%)		
	3	4 (31%)	4 (31%)		
	4	9 (69%)	8 (62%)		
Overall velopharyngeal closure	0	0 (0%)	0 (0%)	0.21	0.9
	1	0 (0%)	0 (0%)		
	2	2 (15%)	2 (15%)		
	3	3 (23%)	4 (31%)		
	4	8 (62%)	7(54%)		
Results of nasometry	Bilabial Plosives		w		p
	Lingual-Alveolar Plosives		23		0.33
	Velar Plosives		22		0.24
	Velar fricatives		30		0.51
	Sibilant Fricatives		32		0.41
	Nasals		19		0.15
			22		0.63

to 15-18 months after surgery.

**Speech assessment**

**Pre-operative assessment speech:** Assessment of APA of patients revealed that among 13 patients, 5 patients (38%) had hypernasality and 2 (18%) had hyponasality. Audible nasal air emission was detected in 3 patients (23%). Compensatory mechanisms were detected in 4 patients (31%) in the form of pharyngealized fricatives and facial grimace. Speech intelligibility was affected mildly in 4 patients (31%). Endoscopic velopharyngeal closure revealed that 5 (38%) had incompetent closure (Tables 2,3).

**Early (1 month) postoperative assessment:** Assessment of APA revealed the presence of 7 patients (54%) with hypernasal speech and 1 (8%) with hyponasal speech. 5 patients (38%) had nasal emission of air. 4 patients (31%) suffered imprecision of consonant. While 5(38%) had un-intelligible speech. Endoscopic velopharyngeal closure revealed that 6 (46%) had incompetent closure (Tables 2,3).

**Late postoperative speech (at the end of the follow up):**

Postoperative APA of patients’ speech revealed that among 13 patients of the study 6 patients (46%) suffered hypernasality and 1 patient (8%) suffered hyponasality, the same as preoperative assessment. Among participants of the study there were 4 patients (31%) suffered postoperative audible nasal air emission Imprecision of consonants and compensatory speech mechanisms were detected in 5 patients (38%) with different grades of severity. While 5(38%) had un-intelligible speech. Endoscopic velopharyngeal closure revealed that 6(46%) had incompetent closure (Table 3).

**Statistical comparisons:** Comparisons between preoperative results once with early postoperative and then with late postoperative results revealed non-significant difference. Comparisons between Endoscopic velopharyngeal assessments also revealed non-significant differences (Tables 2,3). Also comparisons between preoperative and postoperative nasometric results revealed that there was non-significant difference for all sentence of the substest (Tables 2,3).

## Discussion

The role of tonsils on velum position and function is poorly characterized. The velum position during speech depends on the complex balance of vector forces created by palatal elevators, depressors, and constrictors [8]. Elevation is primarily achieved by the levator veli palatini, and transverse closure is mediated primarily by the superior constrictor. The palatopharyngeal and palatoglossal muscles, between which the palatine tonsils reside, serve to depress the palate. The position of these arches can vary based on the size and shape of the tonsils, and, theoretically, the forces exerted on the palate may be affected [1]. A SCP indicates a muscular dehiscence in the soft palate despite an overlying intact mucosal envelope, and can often go undetected. Bifid uvula, zona pellucida and notching of the hard palate are the usual triad. On transnasal nasopharyngoscopy there is loss of the usual midline convexity of the superior surface of the soft palate, with either flattening or a midline groove, consistent with the absence of muscular is uvulae. Different grades of dehiscence were mentioned [9].

Although several studies have reported change in voice and speech after removal of palatine tonsils, the effects of tonsillectomy on speech remain unclear [10,11]. Moreover many theories and practices exist, but the effect of tonsillectomy in patients with VPI is largely unknown, yet there remains hesitancy among few surgeons to perform tonsillectomy in these patients [1,12]. Cosman and Falk, 1975 [13] mentioned that few cases of VPI may be expected to worsen with tonsillectomy, as the tonsils are thought to act as lateral obturators. In these cases tonsillectomy would not be recommended or may necessitate simultaneous or staged flap augmentation. They stated that careful endoscopy should be done for proper identification of these cases. In the recent time, this assumption could be considered historical, and recent data have challenged the old notion that tonsillectomy is contraindicated in patients with or at risk for VPI [25]. Moreover, Paulson et al., [1] 2012 argued that tonsillectomy may play a role in improving VPI in such cases.

In our study, (VNE) was performed for all patients and represented an important item in the pre and postoperative sessions. Its significance in diagnosing, documenting and follow up of patients with speech concerns was mentioned [15-16]. VNE demonstrated no or minimal change as regard VPS closure patterns, VP gap and other VP functions. This was evident from the non significant difference in the comparison between preoperative and postoperative endoscopic assessments.

Given the potential long-term sequelae of untreated chronic tonsillitis and/ or recurrent acute tonsillitis, especially in endemic areas tonsillectomy may be unavoidable, even in cases with dysfunction of the palate. Moreover some patients with weak palate might develop VPI later on in middle or late adolescence due to changes of cephalometric parameters; hence surgeries to correct VPI could probably not be avoided [12-16].

Although acute rheumatic fever (ARF) is relatively rare in developed economies, it is much more common in the developing world and among aboriginal populations [17]. The prevalence of rheumatic heart disease (RHD) was reported to be 5.1 per 1000 in school children in Egypt [18]. In addition, the course of ARF was found to be severe and aggressive in different parts of the country where rheumatic fever is still one of Egypt's major public health problems [18-20]. Laboratory tests including ASOT play an important

role in confirming a diagnosis and in the follow-up of rheumatic diseases in the pediatric age group [21]. In a recent study, the upper limit of normal (ULN) values of ASOT in normal Egyptian children is quite high, reaching up to 400 IU/mL. This value differs in different countries, but does not exceed 340 IU/mL (18). ASOT values of our patients met with the Egyptian criteria.

The American Academy of Otolaryngology-Head and Neck Surgery offers guidelines of 3 or more infections of tonsils per year despite adequate medical therapy; the Scottish Intercollegiate Tonsillectomy Guidelines Network recommends 5 or more episodes per year of tonsillitis with disabling symptoms and lasting for longer than 1 year [24,25]. In this work, patients had seven or more documented attacks of acute tonsillitis for 2 years or more.

Gysin, 2013 [22] stated that peritonsillar abscess tends to be an indication for (and treated with) tonsillectomy; in this work, we reported one patient with a documented history of two attacks of homolateral quinsy.

In the present study (at the end of follow up period) patients with SCP who underwent tonsillectomy had very little overall change in speech parameters which was evident in all comparisons between preoperative and late postoperative APA of speech: Type of nasality, audible nasal air emission, Imprecision of consonants, compensatory speech mechanisms and intelligibility of speech. Among thirteen patients with SMC, there were 5(38%) presented with preoperative mild to moderate VPI according to VNE assessment. This number increased postoperatively to become 6(46%). This change showed non-significant statistical difference. Moreover there were non-significant differences between preoperative and post operative nasometric assessment. The Picture-Cued Subtest from the Egyptian SNAP test was applied to assess nasometric changes due to its suitability for the age range of this study, variability of speech tasks that assess different phonemes and availability of normal results. Abou-Elsaad et al., [7] 2012 studied 92 Egyptian Arabic speakers and mentioned standardization of nasometry among Egyptians. Non-significant differences in nasometric assessment confirmed the results of other lines of speech assessment, as it is an objective test giving automatically tested nasalance score which do not depend on examiner's opinion. This means that non complicated tonsillectomy has no or minimal effect on speech and velopharyngeal functions even in patients with risk of VPI.

Our speech findings are consistent with several studies. D'Antonio et al. [23] in 1996 demonstrated improved or unchanged speech parameters in 15 patients at risk for VPI after tonsillectomy. Similar results have been demonstrated in other researches. In a recent study, Paulson et al., [1] 2012 demonstrated improved or unchanged speech parameters in 23 patients at risk for VPI after tonsillectomy. Also, a Taiwanese study by Hu et al. [11] comparing management of VPI in the presence of tonsillar hypertrophy, a subset of patients who underwent an isolated tonsillectomy had similar speech outcomes to our study. In their study, 19 of the patients underwent tonsillectomy; 14 patients had no change in function, three patients improved, and two patients worsened after tonsillectomy.

The results of this study can conclude that tonsillectomy (due to inflammatory indications) could be done in patients with SCP, and gives no or little effect on the VPS.

It should be mentioned that the reported few cases of post-tonsillectomy VPI (including our cases) might release the question

whether this incident occurred as a natural pathway of the weak palate or as a result from surgery. In other words, could VPI (in this incident) have happened whether surgical procedure was performed or not.

At the end of this work, the authors might recommend tonsillectomy (if indicated) in patients with SCP, after good preoperative preparation including nasoendoscopy and speech evaluation.

## Conclusion

The results of this work can conclude that tonsillectomy due to inflammatory indications could be performed in patients with SCP, and gives no or little effects on the VPS and its function. Preoperative adequate clinical assessment including proper speech evaluation and video-nasoendoscopy plays an important role and can help to anticipate postoperative outcomes particularly in cases of SCP. Further studies are still needed to elucidate the impact of tonsillectomy on patients with or at risk for velopharyngeal insufficiency, particularly given the high prevalence of streptococcal infection in our population.

## References

- Paulson LM, MacArthur CJ, Beaulieu KB, Brockman JH, Milczuk HA. Speech outcomes after tonsillectomy in patients with known velopharyngeal insufficiency. *Int J Otolaryngol*. 2012; 2012: 912767.
- Haapanen ML, Gnatus JJ, Rihkanen H, Ertama L. Velopharyngeal insufficiency following palatine tonsillectomy. *Eur Arch Otorhinolaryngol*. 1994; 251: 186-189.
- Muntz H, Wilson M, Park A, Smith M, Grimmer JF. Sleep disordered breathing and obstructive sleep apnea in the cleft population. *Laryngoscope*. 2008; 118: 348-353.
- Robison JG, Otteson TD. Increased prevalence of obstructive sleep apnea in patients with cleft palate. *Arch Otolaryngol*. 2011; 137: 269-274.
- Ahmed AO, Aliyu I, Kolo ES. Indications for tonsillectomy and adenoidectomy: Our experience. *Niger J Clin Pract*. 2014; 17: 90-94.
- Adoga AA, Okeke. Hemostasis during cold dissection tonsillectomy: Comparing the use of adrenaline and normal saline. *J Clin Med Res*. 2011; 3: 105-108.
- Abou-Elsaad T, Quriba A, Baz H, Elkassaby R. Standardization of nasometry for normal Egyptian Arabic speakers. *Folia Phoniatr Logop*. 2012; 64: 271-277.
- Kuehn DP, Folkins JW, Cutting CB. Relationships between muscle activity and velar position. *Cleft Palate J*. 1982; 19: 25-35.
- Reiter R, Brosch S, Wefel H, Schlömer G, Haase S. The submucous cleft palate: Diagnosis and therapy. *Int J Pediatr Otorhinolaryngol*. 2011; 75: 85-88.
- Svancara P, Horaček J, Vokrál J, Cerný L. Computational modelling of effect of tonsillectomy on voice production. *Logoped Phoniatr Vocol*. 2006; 31: 117-125.
- Hu TL, Yun C, Wang R, Chen PK, Lo LJ. Management of velopharyngeal insufficiency in the presence of enlarged tonsils: comparing a one-stage versus two-stage treatment result. *J Plast Reconstr Aesthet Surg*. 2008; 61: 883-888.
- Salami A, Jankowska B, Dellepiane M, Crippa B, Mora R. The impact of tonsillectomy with or without adenoidectomy on speech and voice. *Int J Pediatr Otorhinolaryngol*. 2008; 72: 1377-1384.
- Cosman B, Falk AS. Pharyngeal flap augmentation. *Plast Reconstr Surg*. 1975; 55: 149-155.
- Tweedie DJ, Skilbeck CJ, Wyatt ME, Cochrane LA. Partial adenoidectomy by suction diathermy in children with cleft palate to avoid velopharyngeal insufficiency. *Int J Pediatr Otorhinolaryngol*. 2009; 73: 1594-1597.
- Askar SM, Quriba AS. Powered instrumentation for transnasal endoscopic partial adenoidectomy in children with submucosal cleft palate. *Int J Pediatr Otorhinolaryngol*. 2014; 78: 317-322.
- Askar SM, Abou-El Saad TS. A speech nasoendoscopy-based surgeon's decision for correction of velopharyngeal insufficiency following adenotonsillectomy. *Eur Arch Otorhinolaryngol*. 2014; 271: 391-398.
- Madden S, Kelly L. Update on acute rheumatic fever. It still exists in remote communities. *Can Fam Physician*. 2009; 55: 475-478.
- Abdel-Moula AM, Sherif AA, Sallam SA, Mandil AM, Kassem AS, Zaher SR. Prevalence of rheumatic heart disease among school children in Alexandria, Egypt: a prospective epidemiological study. *J Egypt Public Health Assoc*. 1998; 73: 233-254.
- Kassem AS, Madkour AA, Massoud BZ, Zaher SR. Benzathine Penicillin G for Rheumatic Fever Prophylaxis: 2-Weekly versus 4-Weekly Regimens. *Indian J Pediatr*. 1992; 59: 741-748.
- Kotby AA, Habeeb NM, Ezz El Elarab S. Antistreptolysin O titer in health and disease: levels and significance. *Pediatr Rep*. 2012; 4: e8.
- Breda L, Nozzi M, De Sanctis S, Chiarelli F. Laboratory tests in the diagnosis and follow-up of pediatric rheumatic diseases: an update. *Semin Arthritis Rheum*. 2010; 40: 53-72.
- Gysin C. Indications of pediatric tonsillectomy. *ORL J Otorhinolaryngol Relat Spec*. 2013; 75: 193-202.
- D'Antonio LL, Snyder LS, Samadani S. Tonsillectomy in children with or at risk for velopharyngeal insufficiency: effects on speech. *Otolaryngol Head Neck Surg*. 1996; 115: 319-323.
- Baugh RF, Archer SM, Mitchell RB, Rosenfeld RM, Amin R, Burns JJ, et al. Clinical Practice Guideline: Tonsillectomy in Children. *Otolaryngol Head Neck Surg*. 2011; 144: 1-30.
- Munir N, Clarke R. Indications for tonsillectomy: the evidence base and current UK practice, Review. *Br J Hosp Med*. 2009; 70: 344-347.