Correlation between Clinical and Radiographic Findings in the Assessment of Adenoid Hypertrophy

Aseel Abdu Aljahdali[1], Azza Sami Reda[2], Rani Ghazi Ahmad[3], Rashid A. Barnawi[4], Ahmad Haitham Abduljabbar[5], Mohammad Abdulrahim Wazzan[6]

[1]Department of Radiology, Ministry of National Guard Health Affairs, King Abdulaziz Medical City, Jeddah, Saudi Arabia. [2]Department of Radiology, King Abdulaziz University Hospital, Jeddah, Saudi Arabia. [3]Department of Radiology, King Abdulaziz University, Jeddah, Saudi Arabia. [4]Department of Radiology, King Abdulaziz University Hospital, Jeddah, Saudi Arabia. [5]Department of Radiology, King Abdulaziz University Hospital, Jeddah, Saudi Arabia. [6]Department of Radiology, King Abdulaziz University Hospital, Jeddah, Saudi Arabia.

ABSTRACT

BACKGROUND

The significance of radiological assessment in the treatment plan of patients with adenoid hypertrophy cannot be undermined. This study evaluated the correlation between clinical symptoms and radiological findings in the clinical assessment of patients with adenoid hypertrophy.

METHODS

A cross-sectional study was conducted by recruiting 147 individuals aged between 1 to 27 years from September 2017 to February 2018. Clinical assessment was performed through questionnaires prepared for primary caregivers. Radiographic findings were obtained through lateral nasopharyngeal radiographs. Frequencies, percentages, cross-tabulation, chi-square analysis, and Pearson correlation test were used to analyse the collected data via Statistical Package for Social Sciences (SPSS).

RESULTS

A positive correlation was observed between clinical presentations of snoring and adenoid thickness. No significant correlations were observed between mouth breathing, obstructive breathing during sleep, and the total clinical score obtained with the nasopharyngeal diameter. A significant correlation of nasopharyngeal diameter with mouth breathing and soft palate thickness was noted. The ratio of soft-palate tissue was also significantly correlated with nasopharyngeal diameter.

CONCLUSIONS

Findings revealed a significant correlation between mouth breathing with all the radiological findings at 5% level of significance. It also suggests that suspected adenoid hypertrophy in children can be treated with lateral radiograph of the nasopharynx for better treatment outcomes.

KEY WORDS

Adenoids, Hypertrophy, Child, Nasal Obstruction

Corresponding Author:
Dr. Azza Rani Ahmad,
Department of Radiology,
King Abdulaziz University Hospital,
Jeddah, Saudi Arabia.
E-mail: rahmad@kau.edu.sa

DOI: 10.14260/jemds/2020/87

Financial or Other Competing Interests: None.

How to Cite This Article:
Aljahdali AA, Reda AS, Ahmad RG, et al. Correlation between clinical and radiographic findings in the assessment of adenoid hypertrophy. J. Evolution Med. Dent. Sci. 2020;9(07):378-382, DOI: 10.14260/jemds/2020/87

Submission 11-12-2019,
Peer Review 22-01-2020,
Acceptance 28-01-2020,
Published 17-02-2020.

BACKGROUND

Chronic nasal obstruction is among the leading causes of adenoidal hypertrophy. Enlarged adenoids account for a relatively small volume of nasopharynx and an increased frequency of upper respiratory infections. This condition is commonly observed in children who present with varying clinical signs and symptoms, including mouth breathing, snoring, hypo-nasal speech, and resultant infections such as recurrent otitis, rhinosinusitis, and adenoiditis. [1-5] Severe cases of adenoidal hypertrophy present with obstructive sleep apnea, poor performance at school, and impairment of cognitive functions. [1, 2, 5] In comparison to the bony structure of the nasopharynx, adenoids grow more rapidly in children, which predispose them to obstructive symptoms. [5] Adenoidectomy is considered the best surgical intervention for treating symptomatic patients with adenoid hypertrophy, particularly in the paediatric population. [6] The decision for surgical intervention should be carefully evaluated based on disease severity. This involves reviewing the medical history of the patient, identifying the symptoms, and conducting a thorough examination using Fibro-nasoendoscopy and a lateral nasopharyngeal radiograph. [7]

Owing to its easy accessibility, availability, and non-invasiveness, radiographic imaging has been the gold standard to assess obstruction of the nasopharyngeal airway by enlarged adenoids. [4] Several radiological parameters are assessed on the radiographic image of the lateral nasopharyngeal soft tissue that assesses the size of the adenoid and the degree of nasopharyngeal airway obstruction. [8] Illustrates the Cohen & Konak method, which compares the thickness of the soft palate. Various methods have been used for the diagnosis of adenoid hypertrophy. For instance, a lateral radiograph of the nasopharynx may be useful to assess the adenoid size and its association with the size of the nasopharynx, as the clinical examination can be notoriously unreliable in young children. The emergence of flexible fiberoptic nasopharyngoscopy has aided in better evaluation of adenoid hypertrophy. [9, 10] It provides valuable information regarding correct patient selection for adenoidectomy, thus eliminating the possibility of unnecessary surgical intervention.

The present study hereby aims to assess the correlation between clinical symptoms and radiological findings in the assessment of adenoid hypertrophy. This study also compares the scoring of radiological findings in patients suspected to have adenoid hypertrophy and undergoing a radiographic assessment for the same. These findings will be contributory to recognizing the significance of radiological assessment and to devise an effective treatment plan for patients with adenoid hypertrophy. Moreover, this study is the first to assess the correlation between the parameters in patients with adenoid hypertrophy, among patients in Saudi Arabia.

METHODS

This analytical cross-sectional study was conducted in King Abdul Aziz University Hospital, Saudi Arabia, from September 2017 to February 2018. 147 individuals aged between 1 and 27 years, experiencing adenoidal hypertrophy were recruited through a consecutive purposive sampling method. Symptomatic patients above 1 year of age, with severity of adenoid hypertrophy necessitating adenoidectomy, were included in the study.

The study was approved by the Institutional Review Board (IRB) of King Abdul Aziz University Hospital under IRB reference number 853-18. The confidentiality of the participants was maintained. In case of minors, consent was obtained from their guardians prior to recruitment. Demographic details of the individuals, including age and sex. Clinical assessment was performed through questionnaires prepared for the primary caregiver of the patients and patients themselves, whereby the degree of indicated symptoms prevailing in the patients was assessed based on a clinical scoring system.

The symptoms assessed included snoring, mouth-breathing, and obstructive breathing during sleep. These symptoms were scored as; absent (0), mild (1), moderate (2), and severe (3). The final clinical score was calculated by adding the scores of snoring, mouth-breathing, and obstructive breathing during sleep. The final scores thus obtained from clinical assessment determined the severity of clinical symptoms and were categorized as a. Mild: <1 b. Moderate: Between -1 and 4 c. Severe: >4.

The scoring system relied on the most common symptoms observed in patients with adenoid hypertrophy. To assess radiographic parameters, left lateral open and closed mouth radiographs were taken with a mild neck extension for better visualization of the structures of interest. The radiographic image was analysed to calculate the thickness of the adenoids, nasopharyngeal diameter, and the thickness of the soft palate. The radiological findings were reviewed and confirmed by a senior attending consultant at King Abdul Aziz University Hospital before including the data into the study. The data thus collected through clinical and radiological assessments were documented on a data collection sheet and analysed using the Statistical Package of Social Sciences (SPSS) version 20.0. Descriptive statistics were used to present demographic characteristics in the form of frequencies and percentages. Cross-tabulation, Chi-square analysis and Pearson correlation test were used to compute the collected data, with a significance value of (>0.05).

RESULTS

Of the 147 patients who underwent a clinical examination and radiological investigations, 61 (64. 9%) were males, and 29 (34. 5%) were females. Most patients were aged between 1 and 7 years (69. 9%) ; while, 25%, 3. 4%, and 1. 4% were aged between 8-14 years, 15-21 years, and 22-28 years, respectively. Table 1a presents the correlation between the total clinical score and each clinical presentation (snoring, mouth breathing, and obstructive breathing during sleep), with the adenoid thickness. The results showed a positive correlation between the clinical presentation of snoring and adenoid thickness (r= 0.199, p-value= 0.018), depicting the need for adenoidectomy. There was no significant association of mouth breathing (r= 0.144, p-value= 0.091), obstructive

breathing during sleep (r= 0.040, p-value= 0.639), and the total clinical score (r= 0.160, p-value= 0.059) with the thickness of adenoids (Table 1a).

Correlation between the calculated total clinical score and each clinical presentation (Snoring, mouth breathing, and obstructive breathing during sleep) with nasopharyngeal diameter is depicted in Table 1b. A negative correlation was observed between the clinical presentation of snoring and nasopharyngeal diameter (r= 0.016, p-value= 0.851), thus suggesting a need for adenoidectomy. There was no significant association of mouth breathing (r= -0.046, p-value= 0.592), obstructive breathing during sleep (r= -0.098, p-value= 0.251), and total clinical score (r= -0.053, p-value= 0.533) with the nasopharyngeal diameter (Table 1b).

Adenoid Thickness		
	R	**p-Value**
Snoring	0.199	0.018
Mouth breathing	0.144	0.091
Obstructive breathing during sleep	0.040	0.639
Total clinical score	0.160	0.059
Nasopharyngeal Diameter		
	R	**p-Value**
Snoring	0.016	0.851
Mouth breathing	-0.046	0.592
Obstructive breathing during sleep	-0.098	0.251
Total clinical score	-0.053	0.533

Table 1. Correlation between total clinical score (and each clinical presentation; snoring, mouth breathing and obstructive breathing during sleep) with adenoid thickness and nasopharyngeal diameter

The association of the different ranges of nasopharyngeal diameter with the documented patient symptoms and the soft palate thickness is illustrated in Table 2a. The findings showed a positive correlation between soft palate thickness, nasopharyngeal diameter, and clinical factors (Table 2a). A significant correlation of nasopharyngeal diameter with mouth breathing (p= 0.023), and soft palate thickness (p= 0.003) was also observed. Table 2b illustrates the association of different ranges of adenoid thickness with patient's symptoms and soft palate thickness. There was no significant correlation between snoring, mouth breathing, obstructive breathing, and that of soft palate thickness with the thickness of the adenoids (Table 2b).

Nasopharyngeal Diameter					**p-Value**
	19-21	22-24	25-27	28-30	
Snoring					
Absent	3 (20%)	4 (21. 1%)	2 (5. 9%)	3 (10.7%)	0.428
Mild	4 (26. 7%)	1 (5. 3%)	10 (29. 4%)	6 (21. 4%)	
Moderate	4 (26. 7%)	5 (26. 3%)	13 (38. 2%)	10 (35. 7%)	
Severe	4 (26. 7%)	9 (47. 4%)	9 (26. 5%)	9 (32. 1%)	
Mouth Breathing					
Absent	3 (12%)	1 (5. 6%)	2 (5. 7%)	6 (33. 3%)	0.023
Mild	8 (32%)	1 (5. 6%)	10 (28. 6%)	2 (11. 1%)	
Moderate	7 (28%)	6 (33. 3%)	15 (42. 9%)	4 (22. 2%)	
Severe	7 (28%)	10 (55. 6%)	8 (22. 9%)	6 (33. 3%)	
Obstructive Breath					
Absent	6 (10.2%)	4 (33. 3%)	0 (0%)	2 (25%)	0.349
Mild	13 (22%)	3 (25%)	3 (17. 6%)	2 (25%)	
Moderate	20 (33. 9%)	3 (25%)	7 (41. 2%)	2 (25%)	
Severe	20 (33. 9%)	2 (16. 7%)	7 (41. 2%)	2 (25%)	
Soft Palate Thickness					
6 – 7 mm	5 (38. 5%)	4 (33. 3%)	3 (13%)	0 (0%)	0.003
7 – 8 mm	5 (38. 5%)	4 (33. 3%)	8 (34. 8%)	3 (11. 5%)	
8 – 9 mm	1 (7. 7%)	2 (16. 7%)	8 (34. 8%)	9 (34. 6%)	
9 – 10 mm	2 (15. 4%)	2 (16. 7%)	4 (17. 4%)	14 (53. 8%)	
Adenoid Thickness					**p-Value**
	19-21	22-24	25-27	28-30	
Snoring					
Absent	4 (28. 6%)	2 (11. 1%)	5 (13. 9%)	2 (9. 1%)	0.239
Mild	4 (28. 6%)	2 (11. 1%)	3 (8. 3%)	7 (31. 8%)	
Moderate	3 (21. 4%)	5 (27. 8%)	14 (38. 9%)	5 (22. 7%)	
Severe	3 (21. 4%)	9 (50.0%)	14 (38. 9%)	8 (36. 4%)	
Mouth Breathing					
Absent	6 (27. 3%)	1 (6. 7%)	3 (8. 8%)	3 (15. 8%)	0.149
Mild	3 (13. 6%)	2 (13. 3%)	6 (17. 6%)	5 (26. 3%)	
Moderate	9 (40.9%)	2 (13. 3%)	11 (32. 9%)	5 (26. 3%)	
Severe	4 (18. 2%)	10 (66. 7%)	14 (41. 9%)	6 (31. 6%)	
Obstructive Breath					
Absent	10 (18. 2%)	2 (20.0%)	0 (0%)	1 (11. 1%)	0.252
Mild	9 (16. 4%)	1 (10%)	5 (31. 2%)	1 (11. 1%)	
Moderate	13 (23. 6%)	5 (50%)	4 (25%)	5 (55. 6%)	
Severe	23 (41. 8%)	2 (20%)	7 (43. 8%)	2 (22. 2%)	
Soft Palate Thickness					
6–7 mm	5 (38. 5%)	4 (33. 3%)	3 (13%)	0 (0%)	0.174
7–8 mm	5 (38. 5%)	4 (33. 3%)	8 (34. 8%)	3 (11. 5%)	
8–9 mm	1 (7. 7%)	2 (16. 7%)	8 (34. 8%)	9 (34. 6%)	
9–10 mm	2 (15. 4%)	2 (16. 7%)	4 (17. 4%)	14 (53. 8%)	

Table 2. Correlation between different nasopharyngeal diameter ranges and different adenoid thickness to patient's, symptoms, and soft palate thickness

Correlation between nasopharyngeal diameter, soft palate thickness, and adenoid thickness was calculated and is shown in Table 3a. The findings showed a statistically significant positive correlation of adenoid thickness with nasopharyngeal diameter (p= 0.000), and with the thickness of soft palate (p= 0.000). The latter also showed a significant correlation with nasopharyngeal diameter (p= 0.000).

Table 3b shows the correlation between the ratio of soft palate thickness to nasopharyngeal diameter and the calculated clinical scores. A significant and positive correlation was observed between the ratio of soft palate thickness to nasopharyngeal diameter and the clinical scores recorded (r=. 138, p= 0.004). The average percentage of this ratio with the clinical scores was derived by numerical computation of ratio of soft palate thickness to nasopharyngeal diameter, which is observed to be 28. 9%.

The correlation between the ratio of soft palate thickness to adenoid thickness and the clinical scores is shown in Table 3c. There was a negative correlation detected in this regard. However, this finding was not statistically significant. (r= -. 114, p= 0.180). The average percentage of the ratio with the clinical scores was derived by numerical computation of ratio of soft palate thickness to nasopharyngeal diameter, which observed to be 43. 8%.

Table 3d depicts the correlation between the ratio of nasopharyngeal diameter to adenoid thickness and the clinical scores. There was a significant and positive correlation observed between the parameters (r=. 272, p= 0.001). The average percentage of the ratio with the clinical scores was derived by numerical computation of ratio of soft palate thickness to nasopharyngeal diameter, which calculated as 68. 0%.

Correlation between Nasopharyngeal Diameter, Soft Palate Thickness, and Adenoid Thickness				
		Adenoid Thickness	**Nasopharyngeal Diameter**	**Soft Palate Thickness**
Adenoid thickness	Pearson Correlation	1	. 694**	. 406**
	Sig. (2-tailed)		. 000	. 000
	N	140	140	140
Nasopharyngeal diameter	Pearson Correlation	. 694**	1	. 426**
	Sig. (2-tailed)	. 000		. 000
	N	140	147	140
Soft palate thickness	Pearson Correlation	. 406**	. 426**	1
	Sig. (2-tailed)	. 000	. 000	
	N	140	140	140
Correlation between Soft Palate/Nasopharyngeal Ratio and Clinical Score				

		Soft Palate/ Nasopharyngeal Ratio	Clinical Score
Soft Palate/ Nasopharyngeal Ratio	Pearson Correlation	1	. 138
	Sig. (2-tailed)		. 004
	N	140	140
Clinical Score	Pearson Correlation	. 138	1
	Sig. (2-tailed)	. 004	
	N	140	149
Correlation between Clinical Score and Soft Palate/Adenoid Thickness Ratio			
		Clinical Score	**Soft Palate/Adenoid Thickness**
Clinical Score	Pearson Correlation	1	-. 114
	Sig. (2-tailed)		. 180
	N	149	140
Soft Palate/Adenoid Thickness	Pearson Correlation	-. 114	1
	Sig. (2-tailed)	. 180	
	N	140	140
Correlation between Nasopharyngeal Diameter/Adenoid Ratio Thickness and Clinical Scores			
		Clinical Scores	**Nasopharyngeal Diameter/ Adenoid Thickness Ratio**
Clinical Scores	Pearson Correlation	1	. 272**
	Sig. (2-tailed)		. 001
	N	149	140
Nasopharyngeal/ Adenoid	Pearson Correlation	. 272**	1
	Sig. (2-tailed)	. 001	
	N	140	140
**. Correlation is significant at the 0.01 level (2-tailed).			

Table 3. Correlational Statistics

Cross tabulation between the percentages of each ratio and the clinical scores is presented in Table 4 (for three categories, i.e., <2, 2-3 and >3). When the ratio of the soft palate thickness to nasopharyngeal diameter fell within the 26-35% category or higher, 78.21% of the patients were observed to have a clinical score more than 3.76% of the patients with a clinical score of less than 2 were seen at or below this category. Interestingly, there was a statistically significant association of the parameters (p= 0.032).

Considering the ratio between the thickness of the soft palate and that of the adenoid, 86.4% of the patients with a clinical score of more than 3 fell within the category of 34-46% or higher. However, only 29. 6% of the patients with a clinical score of less than 2 belonged to this or the lower category. There was no statistically significant association between the parameters (p= 0.154). When the percentage of adenoid thickness to nasopharyngeal ratio was cross tabulated with the clinical scores, 71.2% of the patients with a clinical score of more than 3 belonged to the category of 66-75% or higher, while 60.6% of the patients with a clinical score of less than 2 belonged to this category or the lower category. There was no significant association between the variables (p= 0.541).

		Clinical Scores			p-Value
		<2	2-3	>3	
Soft Palate to Nasopharyngeal ratio	<15	1	1	0	0.032
		4. 0%	7. 1%	0.0%	
	15-25	13	6	22	
		52. 0%	42. 9%	21. 8%	
	26-35	5	4	69	
		20.0%	28. 6%	68. 31%	
	36-45	6	2	10	
		24%	14. 3%	9. 90%	
	46-55	0	1	0	
		0.0%	7. 1%	0.0%	
Soft Palate Thickness to Adenoid Thickness ratio	<20	0	1	1	0.154
		0.0%	7. 1%	1. 0%	
	20-33	8	3	13	
		29. 6%	21. 4%	13. 1%	
	34-46	2	6	63	
		7. 4%	42. 9%	63. 4%	
	47-60	12	1	18	
		44. 4%	7. 1%	18. 9%	
	61-73	3	3	2	
		11. 1%	21. 4%	2. 1%	
	74-87	2	0	1	
		7. 4%	0.0%	1. 0%	
	>88	0	0	1	
		0.0%	0.0%	1. 0%	
Adenoid thickness to nasopharyngeal diameter ratio	<35	0	0	1	0.541
		0.0%	0.0%	1. 4%	
	36-45	2	1	1	
		4. 7%	7. 7%	1. 4%	
	46-55	6	1	4	
		14. 0%	7. 7%	5. 5%	
	56-65	8	4	15	
		18. 6%	30.8%	20.5%	
	66-75	10	3	29	
		23. 3%	23. 1%	39. 7%	
	>76	17	4	23	
		39. 5%	30.8%	31. 5%	

Table 4. Cross tabulation between clinical scores, nasopharyngeal diameter, adenoid thickness, and soft palate thickness percentages

DISCUSSION

The structure of the adenoid comprises a mass of lymphoid tissue that is embedded in the mucosal membrane of the nasopharynx. Hypertrophic adenoids may block the posterior choanae, which interferes with nasal airflow and the drainage of secretions. Following viral infections, hypertrophic adenoids tend to harbour pathogenic bacteria that multiply rapidly. [11] Although adenoids and tonsils are present since birth, they become visible at six months of age. Their growth is rapid until the age of six, and later involute through adulthood. Encroachment of the nasopharyngeal airway owing to pathological enlargement of adenoids does not occur until the age of 1 or 2. [12]

Assessment of adenoidal obstruction in children (clinical signs versus roentgenographic findings) was studied by Wood[13] at the Children's Hospital of Pittsburgh. This study showed a correlation between clinical ratings and roentgenographic ratings of nasal/nasopharyngeal obstruction in individuals. The predictive value of the clinical ratings was calculated based on roentgenographic parameters as the gold standard. The results demonstrated that clinical assessment alone is insufficient for establishing the presence of adenoidal obstruction. However, clinical assessment can rule out adenoidal obstruction with a high degree of confidence when findings are unequivocally negative. [13] Likewise, Cynthia[14] investigated the correlation between clinical and radiological findings in adenoid hypertrophy. The results depicted that radiological assessment was reproducible in most of the cases and demonstrated better accuracy in cases diagnosed with mild adenoid hypertrophy. [2]

Adedeji et al. [5] conducted a cross-sectional hospital-based study at Lautech Teaching Hospital that correlated adenoidal nasopharyngeal ratio (ANR) with symptoms of enlarged adenoids in children. The present study findings are in concordance with their study, which demonstrated that adenoid thickness, could be assessed using the patient's clinical and radiological findings. Another study conducted by Bitar et al. [15] also revealed a significant correlation of the narrowing of the nasopharyngeal airway with clinical presentation of snoring. Their study showed a significant correlation of the ratio of soft palate thickness to nasopharyngeal diameter with the clinical score. The present study showed that most of the patients with a higher clinical score were within a percentage range of 26-35% (Table 4),

and patients below this range were found to be mildly symptomatic.

Although similar findings were observed when studying the percentage of adenoid thickness to nasopharyngeal ratio for patients in the category of 66-75%, the statistical insignificance of this correlation could be owing to a small sample size. However, the importance of this ratio to predict clinical scores cannot be ignored. Most of patients with higher clinical scores belonged to the percentage range of 34-46% when the soft palate thickness to adenoid thickness ratio was tabulated with the clinical scores. However, similar findings were not observed in patients with a low clinical score.

CONCLUSIONS

The present study has demonstrated that a lateral radiograph of the nasopharynx is effective in evaluating children suspected to have adenoid hypertrophy in accordance with their clinical symptoms and thus provides an objective measure of the pathology.[5] A limitation of the present study is that it fails to assess certain symptoms essential in the diagnosis of adenoid hypertrophy, including nasal obstruction and recurrent otitis. The present study highlights that a single finding is not enough to determine disease severity, and that the ratio of various anatomical structures adds predictive value to clinical scores. There is a need for more comprehensive studies in future on larger samples, with the inclusion of a greater number of clinical symptoms in patients suffering from adenoid hypertrophy.

REFERENCES

[1] Feres MF, Hermann JS, Cappellette M Jr, et al. Lateral X-ray view of the skull for the diagnosis of adenoid hypertrophy: a systematic review. International Journal of Pediatric Otorhinolaryngology 2011;75 (1) :1-11.
[2] Feres MF, Hermann JS, Sallum AC, et al. Radiographic adenoid evaluation: proposal of an objective parameter. Brazilian Radiology 2014;47 (2) :79-83.
[3] Orji FT, Ezeanolue BC. Evaluation of adenoidal obstruction in children: clinical symptoms compared with roentgenographic assessment. The Journal of Laryngology & Otology 2008;122 (11) :1201-5.
[4] Paradise JL, Bernard BS, Colborn DK, et al. Assessment of adenoidal obstruction in children: clinical signs versus roentgenographic findings. Pediatrics 1998;101 (6) :979-86.
[5] Adedeji TO, Amusa YB, Aremu AA. Correlation between adenoidal nasopharyngeal ratio and symptoms of enlarged adenoids in children with adenoidal hypertrophy. African Journal of Paediatric Surgery: AJPS 2016;13 (1) :14-9.
[6] Bagwell K, Wu X, Baum ED, et al. Cost-effectiveness analysis of intracapsular tonsillectomy and total tonsillectomy for pediatric obstructive sleep apnea. Applied Health Economics and Health Policy 2018;16 (4) :527-35.
[7] Dixit Y, Tripathi PS. Community level evaluation of adenoid hypertrophy on the basis of symptom scoring and its X-ray correlation. Journal of Family Medicine and Primary Care 2016;5 (4) :789-91.
[8] Feres MFN, Muniz TS, De Andrade SH, et al. Craniofacial skeletal pattern: is it really correlated with the degree of adenoid obstruction? Dental Press Journal of Orthodontics 2015;20 (4) :68-75.
[9] Kurien M, Lepcha A, Mathew J, et al. X-rays in the evaluation of adenoid hypertrophy: it's role in the endoscopic era. Indian Journal of Otolaryngology and Head and Neck Surgery 2005;57 (1) :45-7.
[10] Dawood MR, Khammas AH. Diagnostic accuracy of radiology and endoscopy in the assessment of adenoid hypertrophy. Int J Otorhinolaryngol Clin 2017;9 (1) :6-9.
[11] Lieser JD, Derkay CS. Pediatric sinusitis: when do we operate? Current Opinion in Otolaryngology & Head and Neck Surgery 2005;13 (1) :60-6.
[12] Mohammed W, Di Muzio B. Adenoidal hypertrophy. Radiopedia. org 2015 [cited 2015 Jul 7]. http://radiopaedia. org/articles/adenoidal-hypertrophy
[13] Wood RA. Assessment of adenoidal obstruction in children: clinical signs versus roentgenographic findings. Pediatrics 1999;104 (Suppl 2) :370.
[14] Sempele CY. Correlation between clinical and radiological findings in pediatric adenoid hypertrophy at the Kenyatta National Hospital. Master of Medicine in Diagnostic Radiology. University of Nairobi. 2016:1-62.
[15] Bitar MA, Rahi A, Khalifeh M, et al. A suggested clinical score to predict the severity of adenoid obstruction in children. European Archives of Oto-Rhino-Laryngology and Head & Neck 2006;263 (10) :924-8.