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Effects of adenoidectomy and adenotonsillectomy on the components of Waldeyer ring

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ABSTRACT

Background: The consolidated effects of adenoidectomy alone and adenotonsillectomy on the Waldeyer ring need to be studied in children.
Methods: This was a clinical trial with a sample size of 100 in each of the two arms [Group A: adenoidectomy alone, Group B: adenotonsillectomy].
Results: It was found that the association between adenoid recurrence (Risk 3 times) and palatine tonsil hypertrophy (Risk 11 times) in Group A patients at 3 and 6 months was extremely significant. Whereas lingual tonsil hypertrophy was found to be highly associated with Group B.
Conclusions: If adenoidectomy alone is performed, there are high chances of hypertrophy of palatine tonsils, lateral pharyngeal bands and a high risk of adenoid recurrence. If adenoidectomy and tonsillectomy are performed together there is some chance of lingual tonsil hypertrophy. Hence it would be prudent to perform both the surgeries simultaneously in most children for better control of chronic infections and obstructive sleep apnoea symptoms.

Keywords: Adenoidectomy, Adenotonsillectomy, Waldeyer ring

INTRODUCTION

Running nose is a common problem of children mostly of the rural and urban slum areas of the developing countries. It is directly associated with chronic adenoiditis in most cases and sinusitis in a few cases. The chronically infected members of the Waldeyer ring can act as a reservoir of infection that can spread to the other regions in the vicinity like the ear and the lungs. They can also lead to stunted growth of the child. These infections contribute significantly to sickness absenteeism in school. Communicable viral infections of the upper respiratory tract are soon followed by persistent bacterial infections in the pockets of the Waldeyer ring leading to considerable morbidity and mortality in children. Hence it is important to study the precarious relationship that exists between the members of Waldeyer ring in the event of an infection. Much controversy exists, even today regarding the diagnostic and therapeutic approach to recurrent and chronic inflammatory conditions in Waldeyer ring. Adenoidectomy and tonsillectomy are one of the commonest surgeries performed on children. It is believed that adenoidectomy as a stand alone operation can reduce obstructive symptoms and recurrent upper respiratory tract infections. However, a few patients clinically display significant and indeed persistent nasal symptoms even after surgery. The presence of residual or recurrent adenoid is a possible cause. Also there is a likelihood of hypertrophy of remaining lymphoid tissues of Waldeyer ring, especially of tubal tonsils and lateral pharyngeal bands. Addition of tonsillectomy along with adenoidectomy in order to relieve the upper airway obstruction is performed by many surgeons, but in general has a higher morbidity and mortality rate than

adenoidectomy alone. A study comparing adenoidectomy alone with adenotonsillectomy and their effects on other components of Waldeyer ring like adenoid recurrence, hypertrophy of tubal tonsils, lingual tonsils, palatine tonsils and lateral pharyngeal bands is hence needed.

METHODS

Figure 1: Flow chart showing study details.

This clinical trial was conducted at Karnataka Institute of Medical Sciences, Hubli in a span of 24 months after obtaining clearance from the institutional ethical review board. Hundred consecutive eligible patients undergoing adenoidectomy alone were included in group A and another 100 undergoing adenotonsillectomy simultaneously in group B (Figure 1). Detailed history of the patients was taken and clinical examination with diagnostic nasal endoscopy was performed. All children above the age of 5 years and below 15 years with adenoid hypertrophy, with or without hypertrophy of other components of Waldeyer ring, who consented, were included in the study. Adenoidectomy was performed by the conventional blind curettage method with and without guard and tonsillectomy by dissection and snare method. Post operative assessment during follow up was based on the symptoms [snoring, mouth breathing, recurrent cold, throat pain, difficulty in swallowing] and the nasal endoscopic findings. Chi-square test, Odd's ratio and Logistic Regression were used for statistical analysis.

RESULTS

The strength of the association between group A and group B with respect to the other components of Waldeyer ring when considered individually was observed at 3 months [Table 1] and at 6 months postoperatively [Table 2]. At 3 months it was found that adenoid recurrence, palatine tonsillar hypertrophy were significantly associated with group A and lingual tonsillar hypertrophy was significantly associated with group B. Among the components of the Waldeyer ring, palatine tonsil carried the maximum risk of hypertrophy following adenoidectomy. At 6 months lateral pharyngeal band hypertrophy was found to be significant in addition to adenoid recurrence, palatine tonsillar hypertrophy in group A and lingual tonsillar hypertrophy in group B. Likewise, both adenoid recurrence and palatine tonsil hypertrophy carried almost the same high risk at 6 months in group A (Figure 2).

Figure 2: Hypertrophy of palatine tonsils, lingual tonsils and lateral pharyngeal bands and adenoid recurrence after surgery.

Table 1: Consolidated table showing status of Waldeyer ring at 3 months post-surgery.

Statistical test	Adenoid Recurrence	Palatine Tonsillar Hypertrophy	Tubal tonsillar hypertrophy	Lingual tonsillar hypertrophy	Lateral band hypertrophy
Chi-square:	14.245	10.865	2.4460	8.6650	3.0922
P value:	0.0001	0.001	0.1180	0.003	0.0787
Odds Ratio	3.2727	8.647	2.3483	0.2553	2.022
Positive Likelihood Ratio	1.70	1.90	1.42	0.43	1.36
Negative Likelihood Ratio	0.52	0.22	0.61	1.67	0.67

Table 2: Analysis of status of Waldeyer ring at 6 months post-surgery.

Statistical test	Adenoid Recurrence	Palatine Tonsillar Hypertrophy	Tubal tonsillar hypertrophy	Lingual tonsillar hypertrophy	Lateral band hypertrophy
Chi-square:	15.2530	15.3760	3.1500	8.14	7.4460
P value:	0.0001	0.0001	0.0760	0.004	0.0240
Odds Ratio	3.209	11.4938	2.591	0.2831	2.2121
Positive Likelihood Ratio	1.73	2.00	1.47	0.46	1.45
Negative Likelihood Ratio	0.54	0.17	0.57	1.63	0.66

Table 3: Multinominal logistic regression analysis of the hypertrophy of all the components of Waldeyer ring at 3 months post-surgery.

	Odds ratio	Standard Error	P value	Lower Confidence Interval	Upper Confidence Interval
Tubal Tonsillar Hypertrophy	1.126	0.724	0.869	0.273	4.653
Adenoid Recurrence	2.702	0.389	0.011	1.261	5.789
Palatine tonsillar Hypertrophy	11.006	0.904	0.008	1.871	64.754
Lateral Pharyngeal Band Hypertrophy	1.265	0.608	0.699	0.385	4.162
Lingual Tonsillar Hypertrophy	0.110	0.705	0.002	0.028	0.439
JD Node Enlargement	0.775	0.849	0.775	0.149	4.140

Table 4: Multinominal logistic regression analysis of hypertrophy of all the components of Waldeyer ring at 6 months post-surgery.

	Odds Ratio	Standard Error	P value	Lower Confidence Interval	Upper Confidence Interval
Tubal Tonsillar Hypertrophy	1.753	0.757	0.458	0.397	7.730
Adenoid Recurrence	8.316	0.687	0.002	2.163	31.970
Palatine tonsillar Hypertrophy	27.901	0.958	0.001	4.269	182.354
Lateral Pharyngeal Band Hypertrophy	0.231	0.730	0.045	0.055	0.967
Lingual Tonsillar Hypertrophy	0.102	0.727	0.002	0.025	0.424
JD Node Enlargement	0.650	1.114	0.699	0.073	5.763

Table 3 shows a logistic regression analysis of hypertrophy of the components [When considered together] at 3 months with group B as reference, and it was observed that the recurrence of adenoids, hypertrophy of palatine tonsils were significantly associated with group A and lingual tonsils hypertrophy with group B. It was also observed that the risk of palatine tonsillar hypertrophy was 11 times more and risk of adenoid recurrence was 2 times more in group A patients at 3 months post-surgery.

Table 4 shows logistic regression analysis at 6 months [When considered together] with group B as reference and it shows again that the recurrence of adenoids and hypertrophy of palatine tonsils were significantly associated with group A and lingual tonsil with group B. It was also observed that the risk of palatine tonsillar hypertrophy increased greatly to about 27 times and adenoid recurrence by 8 times in group A patients 6 months following surgery.

DISCUSSION

The members of the Waldeyer ring along with the Eustachian tube, middle ear and paranasal sinuses share a complex relationship in children. Various factors affecting the Waldeyer ring include: genetics, level of personal hygiene, nutritional status, immunity, repeated upper respiratory tract viral infections, secondary bacterial infections, low school hygiene, low socio-economic conditions, overcrowding in schools, buses and home etc. The burden of focal disease inflicted in the Waldeyer ring by the air borne aerosol route continues to be high in the developing countries. The secondary effects of infection in the Waldeyer ring like otitis media and sinusitis are also high in these countries.

The number of children undergoing adenoidectomy and adenotonsillectomy is still on the rise in the developing countries as compared to the developed countries. Persistence of the disease and recurrence of the disease are not uncommon following surgery. Hence the improvement in the health care status of these children in the school going age requires adequate control of infection and hypertrophy in the Waldeyer ring and prevention of its secondary effects. This study attempted to analyse the after effects of the most commonly performed surgeries in Otolaryngology- adenoidectomy and adenotonsillectomy. To the best of our knowledge, this is the first study of this kind reported in literature studying the effects of adenoidectomy and adenotonsillectomy on many components of Waldeyer ring when considered together. Most other studies performed (Table 5) reported the effects on one or two components of the ring only, ignoring the others. In our study we felt a follow up of 6 months was adequate, as these after effects are not exclusively due to the surgery and are in fact multifactorial in nature especially in the long run.

A cross-sectional follow-up study by Farrel J et al done in a randomly selected group of 175 children who had undergone adenoidectomy 2 to 5 years earlier showed 46 patients (26%) with nasal airway obstruction symptoms at follow-up.[9] Thirty five of them showed adenoid recurrence with size not more than 40% of choanae and most were found to have either no or only trace amounts of adenoidal tissue (usually in the pharyngeal recess).

Borys Tolczynski, et al studied 108 patients who had had their adenoids out, showed that of those operated on or before puberty, adenoid recurrence were found in 57 patients (38%) and of those operated on after puberty, recurrence were found in 16.6%.[10] They concluded that recurrences are more common in children operated on at an early age. In our study too, we have found that more recurrences of adenoid occurring at younger age.

Lesinskas E et al carried out a prospective study in the period of 2005-2007 where 150 children who had undergone an adenoidectomy were followed up for 12-24 months post-surgery.[4] Transnasal fibroscopy examinations identified some regrowth of adenoidal tissue in 13 cases (19.1%), with only 3 cases demonstrating adenoidal regrowth to grade 1. Adenoidal regrowth was correlative with the age of the patients (P = 0.048).

The observation made in the present study is comparable with these studies. The probable reason for adenoid recurrence following surgery may be the regrowth of the remnants left over during the primary surgery. The persistence of infection in the remnants could lead to continued antigenic stimulation of the lymphoid tissue of the remnant adenoids leading to its hypertrophy. The recurrence was more in those undergoing adenoidectomy alone as compared to ones undergoing adenotonsillectomy, the probable reason being the persistence of infection in the palatine tonsillar tissue thereby stimulating hypertrophy of the remnant adenoids.

Also, in the present study, the hypertrophy of tubal tonsils was seen more in the group A as compared to the group B but was statistically found to be insignificant.

A study done by Monroy et al on 13,005 adenoidectomies over a period of 11 years, 72 of them underwent revision adenoidectomy, in which at least 15 (21%) were reported to have symptoms consistent with adenoid re-growth but were found to be caused by tubal tonsil hyperplasia.[5]

In yet another study by Emerick K et al, where 24 symptomatic patients scheduled to undergo revision adenoidectomy/nasopharyngeal examination under general anaesthesia, 10 of them (42%) were identified as having tubal tonsillar hypertrophy and 54% of them were identified as due to recurrent or residual adenoids.[7]

The tubal tonsils are often not seen as a distinct entity on nasopharyngeal examination when adenoids are grossly hypertrophied. The increased incidence of tubal tonsillar hypertrophy diagnosed during post adenoidectomy follow up may be secondary to the above reason in a few cases. Examination of nasopharynx under general anaesthesia prior to adenoidectomy might be useful in its early diagnosis and treatment.

In the present study, the patients under group A showed a high chance of tonsillar hypertrophy post-operatively when compared to those under group B. The observations were statistically extremely significant.

Table 5: Similar studies of the past reported in literature.

Sl. No.	Author	Year	Place	Design of study	Component of Ring studied	Sampling	Observation	Remarks
1.	Guttmann D[1]	2014	Israel	Prospective controlled study	Lingual tonsils& palatine tonsils	48 patients with history of tonsillectomy compared with age and sex matched controls with no tonsillectomy.	Hypertrophic lingual tonsils are more common in patients with a history of palatine tonsillectomy and early diagnosis is possible with a simple base of tongue laryngoscopic examination.	In agreement with our study.
2.	Duval M[2]	2013	East Ontario	Retrospective nested case control study	Adenoids	10,948 adenoidectomies done between 1990-2010 were followed up with 1:1 matched case control subjects.	Younger age and adenoidectomy without tonsillectomy are identified as important risk factors for repeat adenoidectomy in children.	Findings agree with our study.
3.	Ozmen S[3]	2012	Turkey	Prospective study	Adenoids	58 males and 42 females between 1-13 yrs of age undergoing adenoidectomy were followed up for 3 months.	Adenoidectomy alone is an effective treatment for nasal obstruction and obstructive sleep apnoea in children.	Descriptive study, inadequate follow up, findings not in agreement with our study.
4.	Lesinkas E[4]	2008	Lithuania	Prospective study	Adenoids	150 children undergoing adenoidectomy were followed up for 12-24months.	Adenoids rarely regrow after surgery and where there were traces of tissue, it did not manifest clinically.	Recurrence less than our study.
5.	Brietzke S[5]	2006	Boston	Retrospective cohort	Adenoids & Palatine tonsils	100 children randomly selected undergoing adenoidectomy alone with 1 yr follow up	Children undergoing adenoidectomy with obstructive symptoms are more likely to require an eventual tonsillectomy and/or a second adenoidectomy.	In agreement with our study.

6.	Joshua B[6]	2006	Israel	Prospective study	Adenoids	Adenoidectomy alone performed between 1990-2000 were followed for 3-5yrs. 206 patients were compiled.	Adenoidectomy alone is a satisfactory treatment for nasal obstruction. Though some adenoid regrowth is not rare, clinically significant adenoid regrowth is insignificant.	Inadequate subjects for follow up.
7.	Emerick K[7]	2006	Boston	Retrospective case series	Tubal tonsils & adenoids	42 patients who underwent adenoidectomies were followed up for 5 yrs	Tubal tonsillar hypertrophy is a significant entity as a cause of recurrent symptoms following adenoidectomy with signs and symptoms similar to adenoid hypertrophy.	In agreement with our study.
8.	Kay D[8]	2005	Pittsburg	Retrospective cohort	Palatine tonsils & adenoids	2462 cases between 5m-18yrs undergoing adenoidectomy without tonsillectomy were followed up	There is an increased risk of subsequent tonsillar enlargement leading to tonsillectomy if adenoidectomy alone is performed.	In agreement with our study.
9.	Farrel J[9]	2000	Philadelphia	Randomised cross-sectional.	Adenoids	A randomly selected group of 175 children who had undergone adenoidectomy 2 to 5 years earlier were followed up. Nasopharyngoscopy was performed in those children who still had symptoms of nasal obstruction.	Adenoids rarely, if ever, regrow enough to cause symptoms of nasal obstruction after adenoidectomy that includes visualization and electrocautery of the adenoid bed.	No comparison group. Electrocautery was performed after adenoidectomy in all cases.

In a study by David J Kay et al, a total of 2462 patients aged 5 months to 18 years undergoing adenoidectomy without concurrent tonsillectomy were followed up. Within 5.4 years, 108 patients underwent subsequent tonsillectomy.[8] He observed that the relative risk of subsequent tonsillectomy decreased by 0.83 for each increasing year of age at adenoidectomy. He also noted that the odds of undergoing a future tonsillectomy significantly increased with increasing tonsil size at the time of adenoidectomy.

The occurrence of tonsillar hypertrophy following adenoidectomy alone might be due to a compensatory process. The removal of adenoids helps in eradicating the focus of infection in the nasopharynx but continued exposure of children to the repeated viral upper respiratory tract infection and secondary bacterial infection, especially in those operated at a younger age, probably makes the palatine tonsils more prone for infection and hypertrophy.

Another observation made in the study was that the lingual tonsillar hypertrophy in patients of group B was significantly higher than those of group A ($p<0.001$).

Dan Guttman et al in their study observed 48 patients with history of palatine tonsillectomy sex/age matched controls without history of palatine tonsillectomy. They were examined by indirect mirror or rigid and flexible laryngoscopy.[1] The groups were compared for the size of the lingual tonsils. They noted that the hypertrophy of the lingual tonsil was significantly more common in the patients with a history of palatine tonsillectomy (73%) than individuals with intact palatine tonsils (34%) ($p<0.001$).

The proximity of the palatine tonsils and lingual tonsils in the oropharyngeal inlet and sharing of function in antigen trapping might be the cause for lingual tonsillar hypertrophy following palatine tonsillectomy. The local immunity of the oral cavity and oropharynx controlled by the palatine tonsils is probably taken over by the lingual tonsils following tonsillectomy.

The present study shows a greater propensity for lateral pharyngeal band to hypertrophy following adenoidectomy alone when compared to adenotonsillectomy. The observations were significantly higher after a 6 months follow up post-surgery ($p<0.05$). On the contrary, the regression of the pharyngeal bands was observed more in those undergoing adenotonsillectomy as compared to adenoidectomy alone when followed up for 6 months.

The Waldeyer ring functions as a unit with predominant function being carried out by the adenoids in the nasopharynx and palatine tonsils in oropharynx. When these components themselves form a nidus for infection, patients become symptomatic. The persistence of the nidus of infection in the palatine tonsils or shift of infection from adenoids to palatine tonsils can explain the hypertrophy in the lateral bands in patients in whom tonsils are left behind as compared to those in whom they were removed. The better clearance of the foci of infection following adenotonsillectomy explains better regression of the lateral pharyngeal bands post-operatively as compared to those in whom tonsils were left behind.

In our study the observations made with the lateral pharyngeal band hypertrophy were insignificant at 3 months but were significant at 6 months post operatively in group A. This could probably be due to new infections which the patients might have acquired during the postoperative period rather than the prior infection for which they underwent the prescribed surgery.

CONCLUSION

The components of Waldeyer ring play a major role in childhood by acting as a ‘sieve’ for the infectious agents gaining entry via the respiratory and alimentary orifices, thereby producing immunity against those agents. Hence removal of one in childhood could lead to compensatory hyper-functioning of the other components. However, this hypertrophy could lead to symptoms of obstruction and frequent infection.

If adenoidectomy alone is performed, there are high chances of hypertrophy of palatine tonsils (11 times) and lateral pharyngeal bands (2 times). If adenoidectomy and tonsillectomy are performed together, there is some chance of hypertrophy of lingual tonsils. If adenoidectomy alone is performed, the risk of adenoid recurrence is 3 times especially in the young age.

In the light of all these evidence based findings, it would be prudent to consider adenoidectomy and tonsillectomy together in most paediatric patients for better control of chronic infections and obstructive sleep apnoea symptoms.

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