

## THE ROLE OF POLYSOMNOGRAPHY (HOME SLEEP STUDY LEVEL III DEVICE) IN EVALUATION OF LEVELS OF UPPER AIRWAY OBSTRUCTION IN CASES OF OBSTRUCTIVE SLEEP APNOEA HYPOPNOEA SYNDROME: A STUDY

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### ABSTRACT

#### OBJECTIVE

Polysomnography is a gold standard in diagnostic workup of obstructive sleep apnoea. Anatomical sites of obstruction in an OSA patient are known by anterior rhinoscopy, FLP scopy with Muller's manoeuvre and end expiratory tongue position to know the levels of obstructions at nose and nasopharynx (Level 1), velopharyngeal sphincter and oropharynx (Level 2), tongue base and superior hypopharynx (Level 3), larynx and inferior hypopharynx (level 4) and guides the making of a tailor made surgical plan in individual cases. This prospective study aimed at the comparison of levels of block with polysomnography parameters.

#### STUDY DESIGN

This is a prospective single center observational study, enrolled 50 consecutive patients between 2012 and 2014.

#### METHODS

All 50 patients diagnosed as snoring with a possibility of OSA underwent level 3 PSG study. Levels of obstructions noted by clinical examination and FLP scopy with Muller's manoeuvre and end expiratory tongue position. Variability in PSG parameters with single level and multilevel blocks were analysed.

#### KEYWORDS

Polysomnography, Sleep Study, Level III Device.

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#### INTRODUCTION

Obstructive Sleep Apnoea (OSA) is a sleep-related breathing disorder that involves a decreased or complete halt in airflow despite an ongoing effort to breathe. Daytime symptoms such as excessive sleepiness are thought to be related to sleep disruption (repetitive arousals) and possibly to recurrent hypoxemia.<sup>1</sup>

OSA affects millions of people across the world. This affects not only the patient, but also their bed partner and associated family members.<sup>2</sup> Effects of OSA include daytime hypersomnolence, decreased productivity at work and with long-term untreated OSA, cor pulmonale, heart failure and cerebrovascular accident. Obesity is believed to predispose to OSAS, because of mass loading of the upper airway.<sup>3</sup>

There are many sites in the upper airway that may cause the airway obstruction of OSA. Diagnosing the exact site and pattern of obstruction is pertinent to aid in the diagnosis. Magnetic resonance suggests that patients with OSAS have smaller calibre upper-airway lumen than healthy controls, mainly due to lateral narrowing of the pharyngeal walls.<sup>4</sup>

Despite the relationship between OSAS and obesity, it is important to remember that many slender people have sleep apnoea.<sup>5</sup> Smoking is related to sleep apnoea in a dose-response relationship.<sup>6</sup> Several surveys have reported a higher prevalence of snoring among smokers and passive smokers than non-smokers.<sup>7-9</sup> Other risk factors are endocrinological disorders, such as hypothyroidism<sup>10</sup> and acromegaly.<sup>11</sup> Patients with sleep apnoea are more likely to fall asleep at inappropriate times and have a higher rate of automobile crashes<sup>12</sup> and work-related accidents.<sup>13</sup> Systemic hypertension has been reported in up to 50 percent of patients with sleep apnoea.<sup>14</sup> Usually bradyarrhythmias are observed,<sup>15</sup> although ventricular tachycardia is noted occasionally in cases of severe hypoxemia. Sleep apnoea contributes to myocardial ischaemia, and even myocardial infarction in patients with coronary artery disease.<sup>16</sup>

The treatment of OSA can be purely medical, surgical or a combination of both which is determined by the level of obstruction and the anatomical sites involved leading to OSA.<sup>17</sup>

Continuous Positive Airway Pressure (CPAP) is the gold standard therapy. Polysomnography (PSG), a type of sleep study is a multi-parametric test used in the study of sleep and as a diagnostic tool in sleep medicine. Polysomnography is a comprehensive recording of the biophysiological changes that occur during sleep.

After the identification of the sleep disorder sleep apnoea in the 1970s, the breathing functions respiratory airflow and respiratory effort indicators were added along with peripheral pulse oximetry.<sup>18,19</sup>

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Assessment of sleep stages requires 3 studies: Electroencephalography (EEG), Electrooculography (EOG) and surface electromyography (EMG).<sup>20,21,22</sup>

This study is aimed to compare the levels of obstruction by clinical evaluation and Fiberoptic Laryngopharyngoscopy (FLP scopy) with Muller’s manoeuvre and end expiratory tongue position and comparing it with severity of OSA with PSG results. To determine the role of home sleep study using level III device in diagnosing the levels of upper airway obstruction in cases of obstructive sleep apnoea hypopnea syndrome and confirming the levels of blocks with the help of FLP scopy with Muller’s manoeuvre and end expiratory tongue position.

**MATERIAL AND METHODS**

The study duration of this prospective study was for two years from May 2012 to May 2014.

The study included patients who came to our OPD with history of mouth breathing and snoring, disturbed sleep, day time somnolence. Informed consent was taken from all subjects and the study was approved by Ethical Committee of our institute. A thorough history of the patients included in the study was taken and were thoroughly examined in the OPD. FLP scopy was to be done and the level of obstruction found. Patient underwent home sleep study level III device as a confirmatory diagnosis for OSA and Snoring. A questionnaire of OSA and Snoring was also given to patients for subjective evaluation in form of Epworth sleepiness score (ESS).

A total of 50 symptomatic, clinically suspected patients having obstructive sleep apnoea confirmed by sleep study level III and Fiberoptic laryngopharyngoscopy (FLP scopy) with Muller’s Manoeuvre were included.

**Inclusion Criteria**

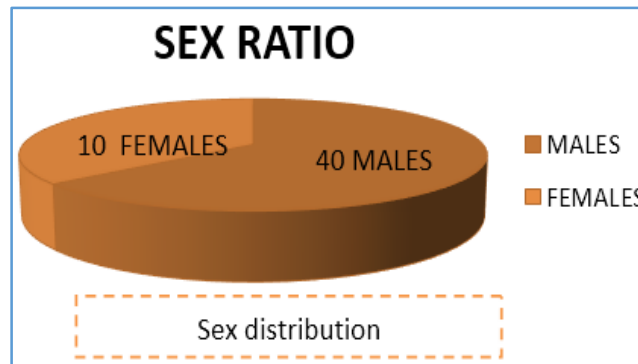
- Patients complaining of snoring and disturbed sleep due to it.
- Patients screened by Epworth sleepiness scale and having risk of OSA. Patients diagnosed as case of OSA on basis of fiberoptic laryngoscopy (FLP scopy) with Muller’s manoeuvre and end expiratory tongue position.
- Spouse complaining about the patient. Patient’s age above 18 years.

**Exclusion Criteria**

Patients below 18 years of age. All the patients who came to our OPD with complaint of history of mouth breathing and snoring, disturbed sleep, day time somnolence fulfilling all inclusion and exclusion criterions were considered. A thorough history of the patients included in the study was taken and were thoroughly examined in the OPD. FLP was done and the level of obstruction found. Patient underwent home sleep study level III device as a confirmatory diagnosis for OSA and Snoring. A questionnaire of OSA and Snoring was also given to patients for subjective evaluation in form of Epworth Sleepiness Score (ESS). Student t – test is used to analyse results.

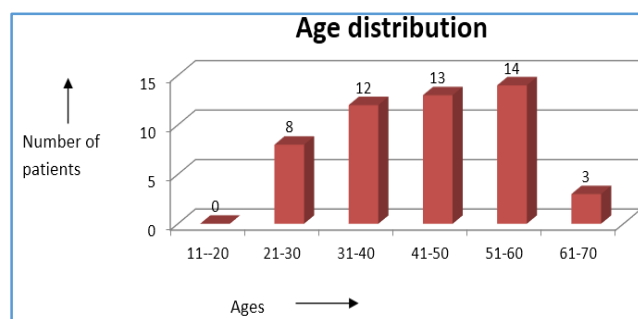
**RESULTS**

Out of 50 patients selected for the study, 40 were males and 10 were females (Male:Female ratio = 4:1).



**Fig. 1: Sex Ratio**

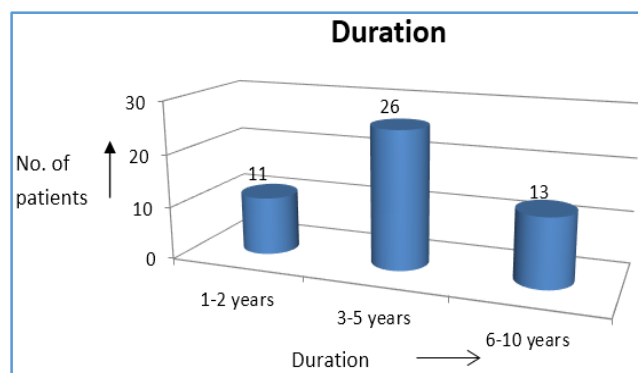
The age range was between 23 and 69 years with a mean age of 44.1 years. Maximum patients were in the age range of 31 to 60 years.



**Fig. 2: Age Distribution**

All the patients presented with chief complaint of snoring, nose blocks and day time sleepiness. Most patients had associated symptoms such as nose blocks, dryness of throat, choking spells, awakening spells, etc.

Of all the cases, maximum cases presented with complaints since 3-5 years.



**Fig. 3: Duration of Symptoms**

9 patients were hypertensive (18%), 5 patients (10%) were hypertensive and diabetic, 2 patients (4%) were diabetic, 2 patients (4%) were hypothyroid and 1 (2%) patient was both diabetic and hypothyroid. Patients presented with snoring, nose blocks, had BMI between 22.7 to 41.5 kg/m<sup>2</sup>.

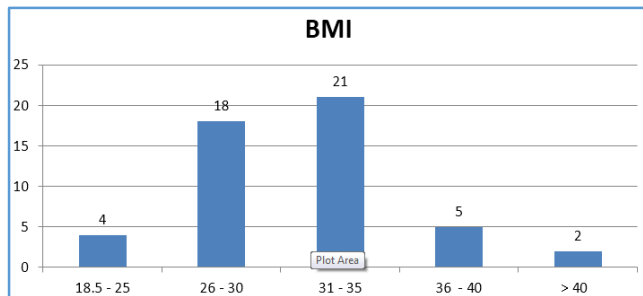


Fig. 4: BMI Distribution

28 male patients had a neck circumference > 16 inches and 5 female patients had a neck circumference > 14 inches. Maximum neck circumference is 19.5 inches in a male patient.

Neck Circumference	Males	Neck Circumference	Females
<16 Inches	12	<14 Inches	5
>16 Inches	28	>14 Inches	5

Table 1: Neck Circumference

24 patients (48%) had severe OSA. Minimum AHI was 0 and maximum AHI was 102.

Patients with normal AHI had social snoring, blocks at the level of nose.

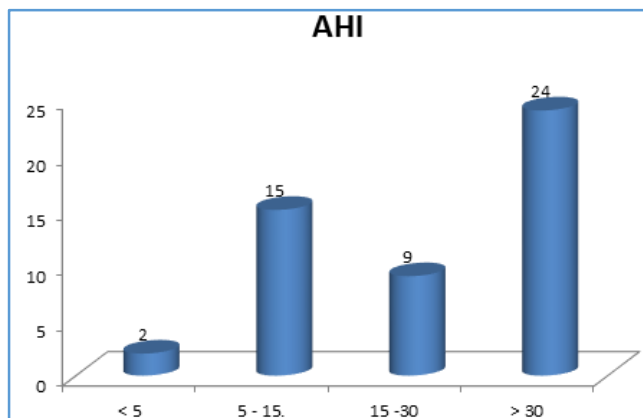


Fig. 5: Apnoea Hypoxia Index

28 patients had obstructive sleep apnoeas about 100.

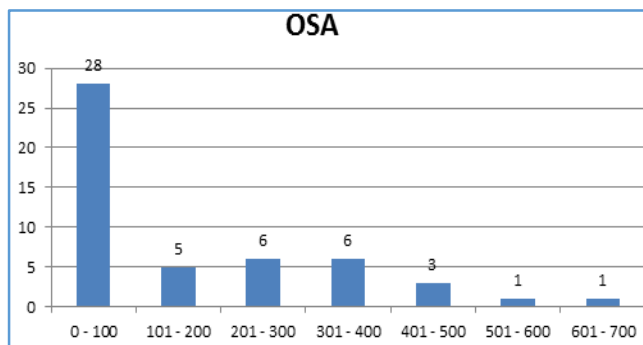


Fig. 6: Obstructive Sleep Apnoeas

35 cases had hypopneas upto 100

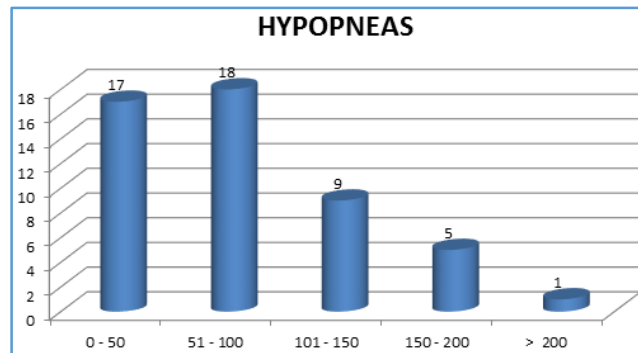


Fig. 7: Hypopneas

38 patients had central apnoeas less than 5.

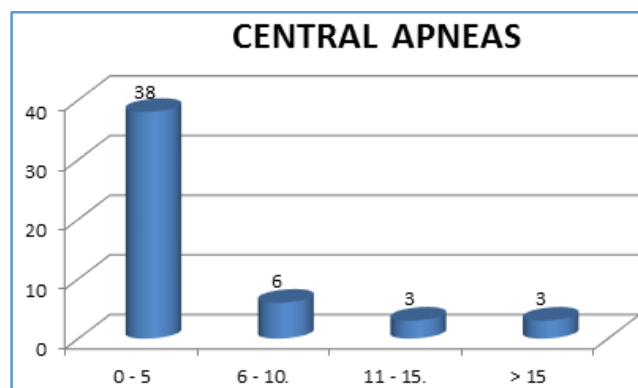


Fig. 8: Central Apnoeas

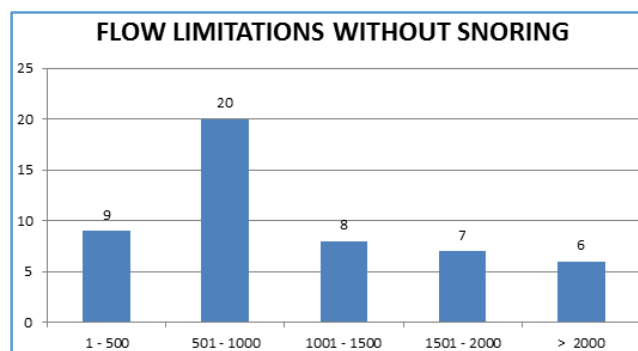


Fig. 9: Flow Limitations without Snoring

27 patients had flow limitations with snoring less than 500 and 18 patients had between 50 and 1000.

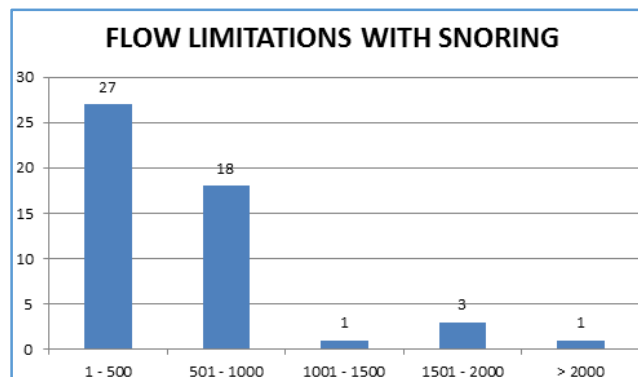


Fig. 10: Flow Limitations with Snoring

48 patients had oxygen saturation less than 90 percent.

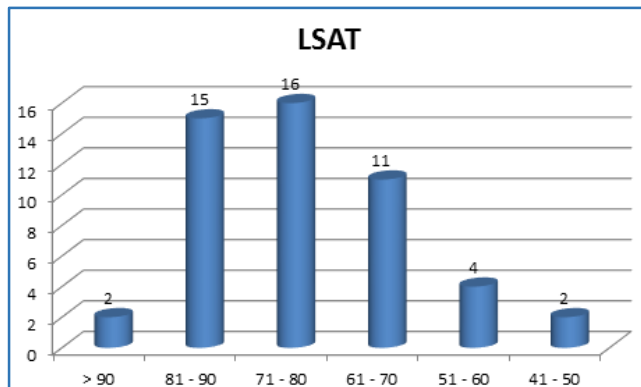


Fig. 11: 42 Members had Snoring Events between 1000 and 5000

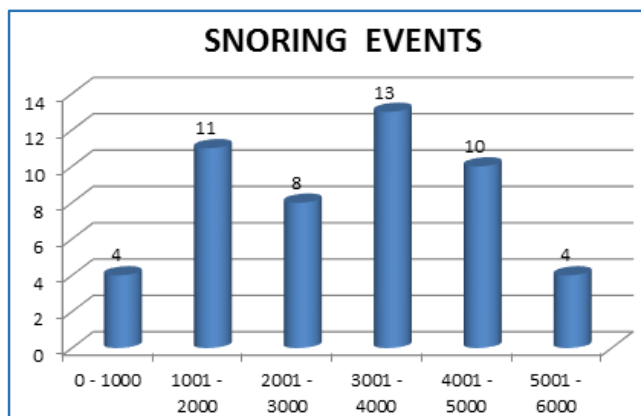


Fig. 12: Snoring Events

**FLP Scopy Findings**

With anterior rhinoscopy and FLP scopy, the Levels of Blocks were identified. Single level block cases were few, most of the cases were multilevel blocks. Level I block were 3, there were no single level blocks at Level II, III and IV.

Multilevel blocks were 33 at Levels I, II and III. There were 11 cases with Level I and III blocks. There were 3 cases with Level I and II blocks.

**Epworth Sleepiness Scale**

The ESS score was below 9 in 8 cases, mild-to-moderate in 24 cases and severe in 18 cases.

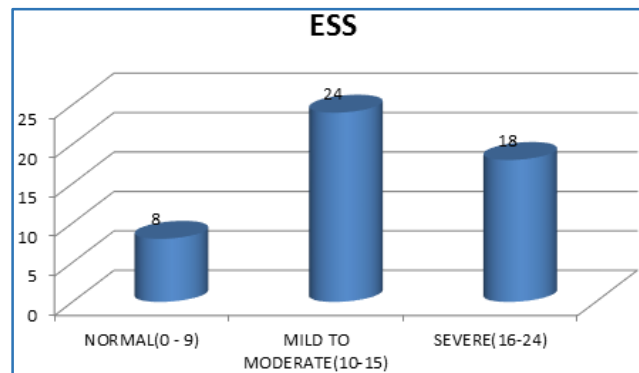


Fig. 13: Epworth Sleepiness Scale

The Minimum, Maximum and Mean values in each Group of Single and Multi-Level blocks are mentioned in the table below.

The Minimum, Maximum and Mean values in each Group of Single and Multi-level blocks are mentioned in the table below.

	Group 1			Group 2			Group 3			Group 4		
	Level 1			Level 1,2			Level 1,3			Level 1,2,3		
	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean
AHI	0	8	4.7	12	27	18	7	94	41	0	102	39.3
OSA	1	31	20.6	3	88	42.3	1	469	176.7	1	738	176
CA	0	5	2	2	4	2.6	0	28	6.6	0	68	5
H	0	25	13.6	43	64	52.6	9	193	83.6	2	338	87.8
FL -0	2003	3035	2526	646	2079	1570.3	294	2312	845	163	2204	921
FL +	49	437	198	134	456	297.6	15	944	467	30	2703	694
SNORE	394	1922	1062	1735	2762	2119	1160	5178	3192	745	5285	3249
LSAT	80	94	85	69	89	81.6	47	90	70.7	40	94	74

Table 2

There are no level 2, level 3 and level 4 blocks separately. There are no multiple blocks like levels 1, 2, 3, 4 and levels 1, 4, levels 2, 3, levels 2, 4 and levels 3, 4.

**DISCUSSION**

Polysomnography is the gold standard for assessment of OSA cases. The levels of block are assessed clinically by anterior rhinoscopy and FLP scopy with Muller’s manoeuvre for assessment of levels of obstructions.

The severity of OSA depends on the number of levels of obstruction, less in level 1 and more in combined levels of obstruction and so the values of variables detected in PSG.

We have analysed the changes in variables of PSG with levels of obstruction. In this exercise, 50 cases were taken into study who were diagnosed with OSA clinically and we have done PSG (home sleep study with level III device in

them and compared the variables in each of the case. Out of 50 cases who were clinically diagnosed with various levels of obstruction, 33 cases had multiple levels of obstructions; 3 cases with level 1 obstruction; 3 cases with level 1, 2 obstructions; 11 cases with level 1, 3 obstructions.

**They were Grouped into 4 Main Groups as**

- Group 1 –level 1 obstruction.
- Group 2—level 1, 2 obstructions.
- Group 3 – level 1, 3 obstructions.
- Group 4 – level 1, 2, 3 obstructions.

The values of PSG variables AHI, OSA, hypopneas, central apnoeas, flow limitations without snoring, flow limitations with snoring, snoring events, LSAT were compared and analyses done.

The variables are shown in the table. The mean AHI in Group 1 is about 4.7, whereas in Group 2 it is 18. Most of AHI's were mild and moderate.

The mean of AHI in Group 3 and Group 4 were 41 and 39.7, where level 3 obstruction were commonly involved.

The mean of OSA episodes in Group 1 were 20.6, in Group 2 were 42.3 and in Group 3 and 4 were 176.7 and 176. There was not much variation in central apnoeas in all groups.

The mean of Hypopneas in Group 1 is 13.6, Group 2 is 52.6, Group 3 is 83.6 and Group 4 is 87.8. The number of hypopneas in Group 1 was less than Group 2. Group 3 and 4 were similar.

The mean of flow limitations without snoring in Group 1 were more (2526) than Group 2 (1570) and Group 3 and 4 were 845 and 921. Here, again Group 3 and 4 had similar values. Group 1 had more Flow limitations without snoring than rest of the groups.

There was no difference in the Flow limitations with snoring in Group 1 and 2, i.e. 198 and 297.6, whereas it was 467 and 694 in Group 3 and 4. Hence, in Group 3 and 4 where tongue base involvement was present. Flow limitations with snoring were more than Groups 1 and 2 where the Tongue base is not involved.

The snoring episodes in Group 1 were less than Group 2, i.e. 1062 and 2119, but the snoring episodes were more in Group 3 and 4 where the mean of the snoring episodes were 3192 and 3249.

The LSAT was 85% in Group 1 and 81.6% in Group 2, 70.7% in Group 3 and 74% in Group 4. LSAT was reduced more in Group 3 and 4 where Tongue base was involved.

In Group 1 cases with Level I obstruction the mean AHI was 4.7, in Group 2 where the levels of obstructions was at nose and soft palate the mean AHI was 18 indicating moderate OSA and where the levels of obstructions was at Level I, II and III (Group IV) and Level I and III (Group III) the AHI was severe. Then Tongue base involved groups had severe AHI.

The flow limitations without snoring were high in Group 1 (2526) followed by Group 2 (1570), Group 3 and 4 had less flow limitations without snoring, i.e. 845 and 921. Here again flow limitations without snoring was low in Groups 3 and 4, where Tongue base involvement is present.

Similarly, the Flow limitations with snoring were low in Group 1 (198) and Group 2 (297.6) than compared with Group 3 and 4 which were 467 and 694.

Snoring episodes in Group 1 were 1062, Group 2 were 2119, Group 3 3192 and Group 4 were 3249. The snoring events are more in Group 3 and 4 where Tongue base involvement is present along with other levels of obstructions. In Level I, block snoring events are less.

The LSAT in Group 1 is 85%, Group 2 is 81.6%, Group 3 and 4 are 70.7% and 74%. The saturations fell to low in multilevel groups with Tongue base involvement.

The Group 1 where nose blocks was the only level of obstruction, the AHI was normal (4.5). The flow limitations without snoring was high (2526) and less flow limitations without snoring (198) and snoring episodes were 1062 and LSAT being 85% and all the mean values are correlating with each other.

The Group 2 where nose and soft palate blocks were identified the AHI (18) was mild-to-moderate, flow limitations without snoring (1570) were lower than mean of

Group 1 (2526). The mean of flow limitations with snoring (297.6) was more than Group 1 (198) and less compared to Group 3 (467) and 4 (694). Snoring episodes were 2119 more compared to Group 1 and less compared to Groups 3 and 4. LSAT was reduced 81.6 % when compared to Group 1 (85%).

In Group 3 (nose and tongue base level) and Group 4 (nose, soft palate, tongue base), the AHI was severe 41 and 39.3. Flow limitations without snoring were lesser compared to Group 1 and 2 and flow limitations with snoring are more. Snoring events were high when compared to Group 1 and 2 and LSAT fell to low 70%.

The values of AHI, flow limitations with snoring and without snoring, snoring events and LSAT were correlating to the levels of block in the four groups.

## CONCLUSION

The variables in a PSG like AHI, flow limitations without snoring, flow limitations with snoring, snoring episodes and LSAT have a good correlation with levels of obstruction in OSA cases. These variables can direct us to identify the levels of obstruction.

Identifying the correct levels of obstruction by clinical and PSG value is of great help in planning out a correct surgical treatment or medical management in cases of OSA in this particular field of evolving practice of surgeries for snoring and sleep apnoea for a good positive outcome to the patients.

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