Dysarthria is a collective name for a group of speech disorders resulting from disturbances in muscular control over the speech mechanism due to damage of the central or peripheral nervous system. Dysarthrophonia, denotes "neurological dysphonia that presents one aspect of dysarthria." In dysarthria one or all speech sub-system may be affected. The power generator of speech is the respiratory system, which plays an important system of speech mechanism. One of the assessment parameter of respiratory system is the assessment of subglottal air pressure. This can be measured by Voice Function Analyzer (Aerophone II®).

The authors undertook the study to find there is difference of the aerodynamic characteristics in normophonics and in dysarthric population.

ABSTRACT

Introduction
Dysarthria is a motor speech disorder. It occurs due to paralysis, weakness, or incoordination of the speech musculature. The authors with this study want to enrich clinical understanding of the difference of the aerodynamic characteristics in normophonic and dysarthric population.

Materials and methods
The aerodynamic characteristics in normophonics and in dysarthric population were compared and documented using Voice Function Analyzer (Aerophone II®). Forty male individuals within the age range of thirty five to fifty five years participated in this study. The control group had twenty normophonic cases with no history of neurological disorder. The second group had twenty cases with dysarthria.

Results
Significant difference was found between the two groups in peak flow, forced volume and duration, vital capacity and fast adduction-abduction measurements.

Discussion
The difference in results from both the groups and their implications are discussed based on these findings.

Conclusion
The present study has assessed the parameters of speech and voice disorder in male dysarthric individuals. It suggests inclusion of aerodynamic measurement in test protocol and for evidence based research and prognosis documentation. Measurement of laryngeal or vocal tract resistance may be useful in documenting a variety of the perceptual voice characteristics.

Keywords
Speech Disorders; Dysarthria; Dysphonia; Documentation.
The aim of the present study was to compare the aerodynamic measurement of males with dysarthria with their age matched normophonic peers. The study may help to reflect the varying physiological symptoms associated with dysarthria. The study further highlights the importance of aerodynamic measurement of dysarthric speech.

Materials and Methods

Subjects

Forty male cases within the age range of thirty five to fifty five years (Mean age- 42.8 years, SD- 4.1; Mean height-5’4”, SD-2.7”) were included in this study. They were divided into two groups. The control group constituted of twenty normophonic cases (Mean age-
39.6 years, SD-2.9; Mean height-5’35”, SD-3.2”) with no history of neurological disorder. The second group (experimental group) had twenty cases (Mean age-44.6 year, SD-2.9; Mean height-5’3”, SD-3.8”) with dysarthria. The neurological assessment was done by neurologists through imaging tests, electrophysiological evaluation and serological tests. Dysarthria was diagnosed by Speech Language Pathologists using Frenchay Dysartrhia Assessment (FDA), cranial nerve evaluation. Western Aphasia Battery (WAB) was used to evaluate associated language deficits. Mayo Clinic Protocol was used to assess the dysarthria.

**Tools**

Aerophone II®, by F.J. Electronics, Ellebuen 21, DK-2950 Vedbaek, Denmark a voice function analyzer was used in this study. It has a circumferentially vented mask to identify and record the inspiratory and expiratory airflow direction.

**Procedure**

The cases were asked to do tasks on peak flow, sustained phonation, vital capacity and fast AD/ ABD. For the measurement of vital capacity, the subjects were instructed to take a deep breath and blow slowly as long as possible into the mouth piece connected to the Aerophone II®, as shown in Fig.2.

For the measurement of mean airflow rate, the subjects were instructed to take a deep breath and phonate /ae/ as long as possible in the mouth piece connected to the Aerophone. The data was collected while placing a circumferentially placed mask. Three trials were done for each case for the above mentioned parameters to attain test retest reliability and an average was obtained of all the values. Statistical analysis was done to find the difference of the aerodynamic measurements between these two groups. Then the statistical analysis was done to find the mean value for each of the difference between the normophonic and dysarthric population. One sided t-test was measured to identify the significant difference between the two groups.

**Results**

Significant difference was found between the two groups in aerodynamic measurement (Table II). There
was a significant difference at the level of 95% CI in the result of one sided t-test. In peak flow measurement there was significant difference in mean values of peak flow (control group mean- 6.37, SD- 2.50, experimental group - 2.50, SD- 2.64), forced volume (control group mean- 1.21, SD-0.83, experimental group–6.62, SD- 7.46) and duration(control group mean- 3.43, SD- 1.28, experimental group – 5.00, SD- 2.94). In vital capacity, significant difference was found in mean values of maximum flow rate (control group mean-2.33, SD- 1.48, experimental group – 2.78, SD- 1.72), vital capacity (control group mean- 5.49, SD- 2.66, experimental group – 4.13, SD- 2.93) and duration (control group mean- 8.82, SD-3.74, experimental group–9.19, SD-3.76). In sustained phonation, a significant difference was also found in all the parameters. Fast adduction (AD)/ abduction (ABD) measurements also show a significant difference in all the mean values between the two groups.

Discussion

The present study aimed to document the dysarthrophonic characteristics of individuals with dysarthria. A variety of laryngeal impairments were noted in the study. Low peak flow and reduced duration in airflow measurement may be because of the reduced pliability in laryngeal muscle kinematics. The laryngeal resistance was found to be more which may emphasize on excessive muscle tension either at the level of the glottis or supraglottis.

The study documented reduced vital capacity which is manifested as short utterances and reduced loudness in dysarthric speakers. Dysarthric patients show weak respiratory support, low volume, incoordination of the respiratory stream. The change of aerodynamic characteristics can be due to the neurological impairments, which is common in dysarthric population. Since the vital capacity (VC) reflects mainly lung function, it was expected that there will be statistical difference between the two groups. The most frequent speech deviations observed were impaired loudness control and harshness; less frequently occurring deviations were defective articulation, restricted use of vocal variations for emphasis, poor pitch control, hyper-nasality, inappropriate pitch level, and breathiness. The pathological explanation lies with the fact that the Dopamine deficiency induces a dysfunction of the respiratory muscles that is partly responsible for dysarthria.8

The overall poor control of expiratory airflow, an alteration of the air quantity needed for the vibration of vocal cords.9,10 The fast abduction and adduction rate might be due to inadequate closure of the vocal cords. Pressure and flow information can aid in identifying
laryngeal manifestations of pathophysiology affecting phonatory characteristics and glottal efficiency\textsuperscript{11}

Conclusion

The present study may help to document the parameters of speech and voice disorder in male dysarthric individuals. The study may be helpful to include aerodynamic measurement in test protocol and for evidence based research and prognosis documentation. Further elaborated study is needed with more number of subjects and inclusion of females with dysarthria.

Table II: Statistical analysis of laryngeal aerodynamics between normal and dysarthrophonic subjects

<table>
<thead>
<tr>
<th></th>
<th>NORMAL</th>
<th></th>
<th></th>
<th>DYSARTHROPHONIC</th>
<th></th>
<th></th>
<th>RESULT 95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>MEAN</td>
<td>SD</td>
<td>DF</td>
<td>MEAN</td>
<td>SD</td>
<td>DF</td>
<td></td>
</tr>
<tr>
<td>PEAK FLOW</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Peak flow</td>
<td>6.37</td>
<td>2.50</td>
<td>29</td>
<td>2.50</td>
<td>2.64</td>
<td>9</td>
<td>t= 4.1827; p=0.0002</td>
</tr>
<tr>
<td>Forced vol.</td>
<td>1.21</td>
<td>0.83</td>
<td>29</td>
<td>6.62</td>
<td>7.46</td>
<td>9</td>
<td>t= -3.9905; p=0.0003</td>
</tr>
<tr>
<td>Duration</td>
<td>3.43</td>
<td>1.28</td>
<td>29</td>
<td>5.00</td>
<td>2.94</td>
<td>9</td>
<td>t= -2.3678; p=0.0231</td>
</tr>
<tr>
<td>VITAL CAPACITY</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Max. flow rate</td>
<td>2.33</td>
<td>1.48</td>
<td>29</td>
<td>2.78</td>
<td>1.72</td>
<td>9</td>
<td>t= -0.8001; p=0.0286</td>
</tr>
<tr>
<td>Vital capacity</td>
<td>5.49</td>
<td>2.66</td>
<td>29</td>
<td>4.13</td>
<td>2.93</td>
<td>9</td>
<td>t= 1.3661; p=0.00799</td>
</tr>
<tr>
<td>Duration</td>
<td>8.82</td>
<td>3.74</td>
<td>29</td>
<td>9.19</td>
<td>3.76</td>
<td>9</td>
<td>t= -0.2706; p=0.003882</td>
</tr>
<tr>
<td>FAST AD/ABD</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Max. flow rate</td>
<td>0.9</td>
<td>0.31</td>
<td>29</td>
<td>0.67</td>
<td>0.15</td>
<td>9</td>
<td>t= 0.2457; p=0.0306</td>
</tr>
<tr>
<td>Volume</td>
<td>1.4</td>
<td>1.05</td>
<td>28</td>
<td>0.69</td>
<td>0.57</td>
<td>9</td>
<td>t= 2.029; p=0.0495</td>
</tr>
<tr>
<td>Duration</td>
<td>13.0</td>
<td>7.33</td>
<td>29</td>
<td>6.94</td>
<td>4.04</td>
<td>9</td>
<td>t= 2.4776; p=0.0178</td>
</tr>
<tr>
<td>Mean airflow</td>
<td>0.4</td>
<td>0.23</td>
<td>28</td>
<td>0.13</td>
<td>0.12</td>
<td>9</td>
<td>t= 3.5339; p=0.0011</td>
</tr>
<tr>
<td>Ad/Abd rate</td>
<td>6.8</td>
<td>2.72</td>
<td>29</td>
<td>11.74</td>
<td>2.53</td>
<td>9</td>
<td>t= -5.0552; p&lt;0.0001</td>
</tr>
</tbody>
</table>
to study the commotion of quality of life in these individuals. This will aid in further enrichment of clinical understanding and formulate appropriate intervention plan. From this limited sample it is possible to suggest but not to confirm that laryngeal or vocal tract resistance measures may be useful in documenting a variety of the perceptual voice characteristics

Conflict of Interest

The authors declare no conflict of interest and certify that the project was not funded by outside agency or company.

References