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# EFFECTIVENESS OF VOLUME INCENTIVE SPIROMETRY ON THE STRENGTH OF ORAL MOTOR MUSCLES IN POST STROKE PATIENTS

**[1]Prerna Saude 1st Author, [2]Dr. Gargi Bhalekar 2nd Author.**

[1]BPTH, [2]Assistant Professor of Neuro Physiotherapy department, Late Shree Fakirbhai Pansare Education Foundation's College of Physiotherapy, Nigdi, Pune.

[1]Late Shree Fakirbhai Pansare Education Foundation's College of Physiotherapy, Nigdi, Pune, Maharashtra, India.

***Abstract:***

Facial and oral motor muscle weakness is a common sequela of stroke, leading to impaired speech, swallowing, and facial expression. Rehabilitation strategies targeting these muscles are limited, and the potential role of volume incentive spirometry (VIS) in oral motor strengthening remains underexplored. To assess the effectiveness of volume incentive spirometry on the strength of oral motor muscles in post-stroke patients, a quasi-experimental study was conducted on 37 post-stroke patients with facial muscle involvement using purposive sampling. Participants underwent VIS training for 4 weeks. Oral motor strength was assessed pre and post-intervention using Manual Muscle Testing and the Oral Motor Assessment Scale (OMAS). The mean OMAS score improved significantly from 10.9 ± 2.0 to 13.5 ± 1.9 ($p < 0.001$). Volume incentive spirometry is effective in improving oral motor muscle strength in post-stroke patients.

## I. INTRODUCTION

Weakness of the facial muscles can arise from a variety of neurological and muscular conditions, but stroke remains one of the most common and clinically significant causes. A stroke can disrupt the neural pathways responsible for voluntary facial movement, leading to reduced strength, impaired coordination, and noticeable asymmetry of facial expressions. In many cases, the lower half of the face is primarily affected, resulting in drooping of the mouth, difficulty with oral control, and challenges in performing everyday functions such as speaking, smiling, and eating. These changes occur because the facial regions controlling lower-face movement are more vulnerable to central nervous system damage, particularly when a stroke involves the middle cerebral artery. The middle cerebral artery supplies large areas of the motor cortex, including the regions responsible for contralateral facial movement and sensation. When compromised, patients may experience hemiparesis of the facial muscles along with varying degrees of sensory loss. This not only alters appearance but also significantly affects quality of life and communication. Several key muscles contribute to movement in the lower facial region, including the zygomaticus major and minor, buccinator, orbicularis oris, risorius, and mentalis. These muscles play essential roles in elevating the lips, controlling oral competence, shaping speech sounds, and generating emotional expressions. Because these muscles govern movements of the maxilla and mandible, any reduction in their strength or coordination can have a pronounced impact on facial function. The zygomaticus major elevates the corner of the mouth upward and outward, creating the primary movement involved in smiling, while the zygomaticus minor raises the upper lip to expose the upper teeth and assist with subtle emotional expressions. The buccinator compresses the cheek against the teeth, allowing efficient chewing, food control, blowing, and whistling. Surrounding the mouth, the orbicularis oris enables lip closure, protrusion, and shaping, making it vital for speech articulation, kissing, sipping, and maintaining an effective lip seal. The risorius draws the corners of the mouth laterally, contributing to wide smiles and expressions of tension or grimacing. The mentalis assists in elevating and protruding the lower lip and produces the characteristic wrinkling of the chin, helping stabilize the lower lip during speech and contributing to expressions such as pouting. Together, these muscles support coordinated movements of the maxilla and mandible, allowing for functional eating, speaking, and expressive communication, and their impairment such as after a stroke can significantly affect facial symmetry and overall facial function.[1] Because of the unique insertions of facial muscles, tests of these muscles differ from other manual muscle tests. Grading the strength of muscles is essentially a subjective estimate by the examiner of how well the muscle functions on a scale of zero, trace, poor, fair, good and normal.[4] The Oral Motor Assessment Scale (OMAS) is a standardized clinical tool used to evaluate an individual's oral motor skills, particularly those involved in feeding and swallowing.

Volume-oriented incentive spirometry:

Measure the volume of air you inhale with a scale marked on the device. You don't work as hard to breathe with a VIS, which helps improve the diaphragm's movement and activity.

It has following parts:

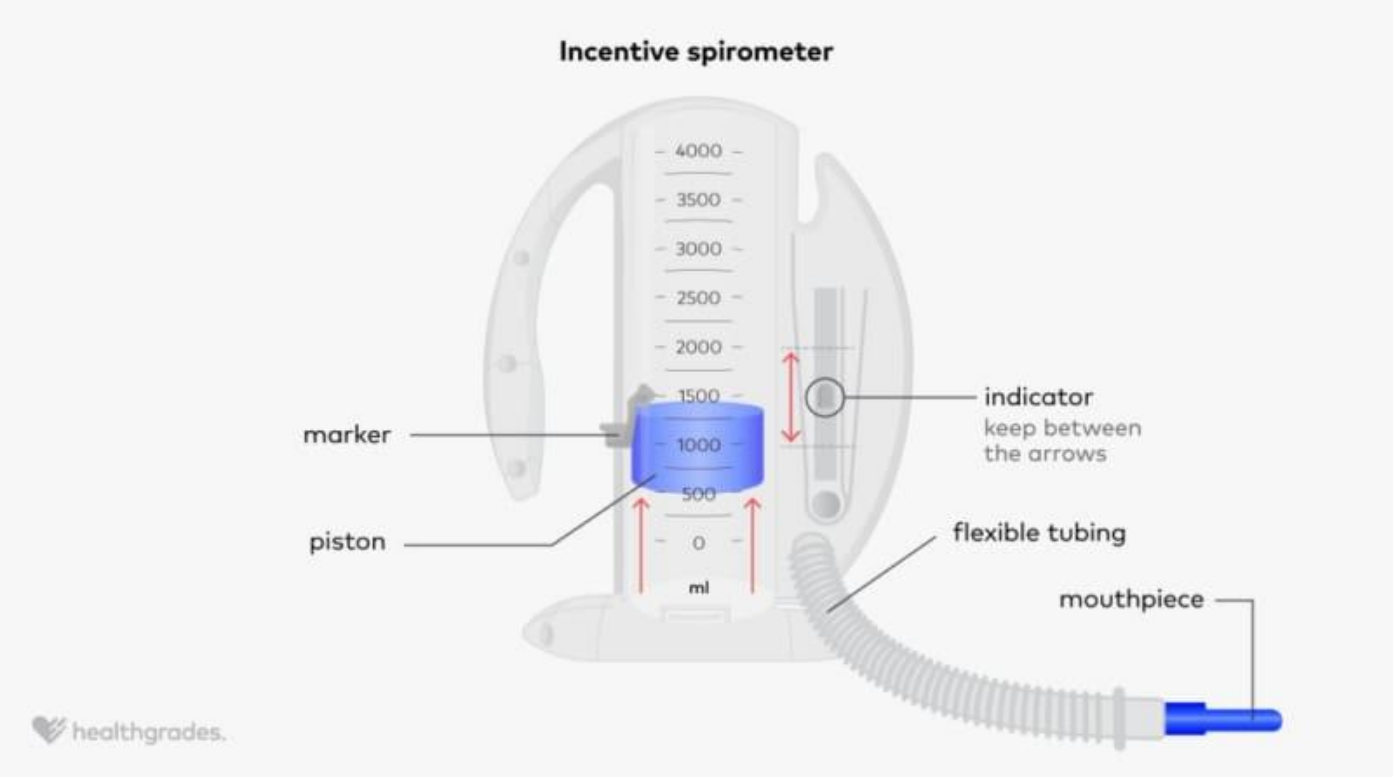
Chamber: A plastic chamber that contains a piston that rises when the patient inhales.

Mouthpiece: A vacuum tube-like mouthpiece that the patient inhales through.

Indicator: A device that shows the volume of air displaced when the patient inhales.

Slider: A slider that allows a medical provider to set a target breath volume for the patient.

Smaller chamber: A chamber that measures the speed of the patient's breath.[9]




METHODS

Study Design – Quasi experimental
Sample Size – 37 participants
Sampling Method – Convenient sampling
Study Duration – Six months
Study Area – Pune
The study employed specific criteria for participant selection.
Inclusion Criteria required subjects to be within the age group of 21–80 years, diagnosed with stroke, willing to participate, and having oromotor weakness. Participants were required to be medically stable and able to follow instructions.
Exclusion Criteria eliminated participants with severe cognitive impairment, unstable medical conditions, other neurological or respiratory disorders, or those who were unconscious or disoriented to time, place, and person.
Data collection included baseline assessment using the Oral Motor Assessment Scale (OMAS), followed by Volume Incentive Spirometry (VIS) training. Post-assessment was conducted using OMAS to evaluate improvement in oromotor muscle strength.

## II. STATISTICAL ANALYSIS AND RESULT

Graph 1-

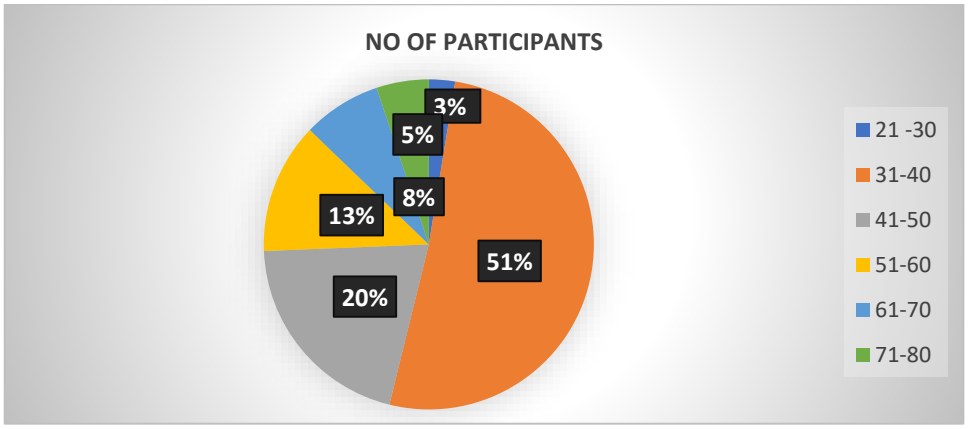



Table 1-

| AGE WISE DISTRIBUTION | NO OF PARTICIPANTS | PERCENTAGE |
|---|---|---|
| 21 -30 | 2 | 8% |
| 31-40 | 16 | 43% |
| 41-50 | 9 | 24% |
| 51-60 | 5 | 14% |
| 61-70 | 3 | 6% |
| 71-80 | 2 | 5% |

Out of total 37 participants 20 participants belonged to the age group 31-40, 8 participants belonged to the age group 41-50, 5 participants belonged to the age group 51-60, 3 participants belonged to the age group 61-70, 2 participants belonged to the age group 71-80, 1 participant belonged to the age group 21-30.

Graph 2-

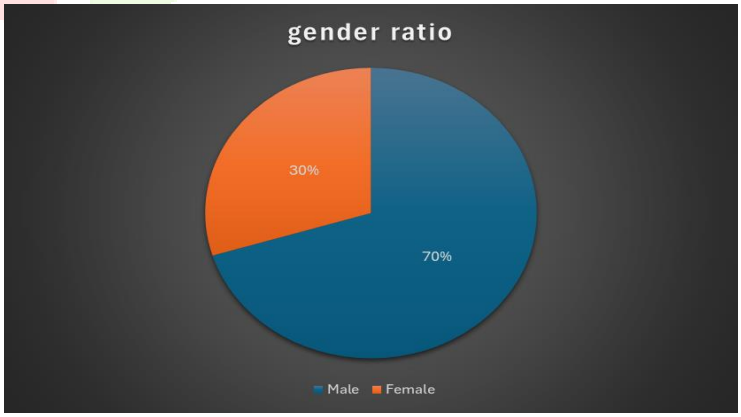



Table 2 –

| GENDER | COUNT | PERCENTAGE |
|---|---|---|
| Male | 26 | 70% |
| Female | 11 | 30% |

Out of total 37 participants 30% (11) are female and 70% (26) are male.

Graph 3-

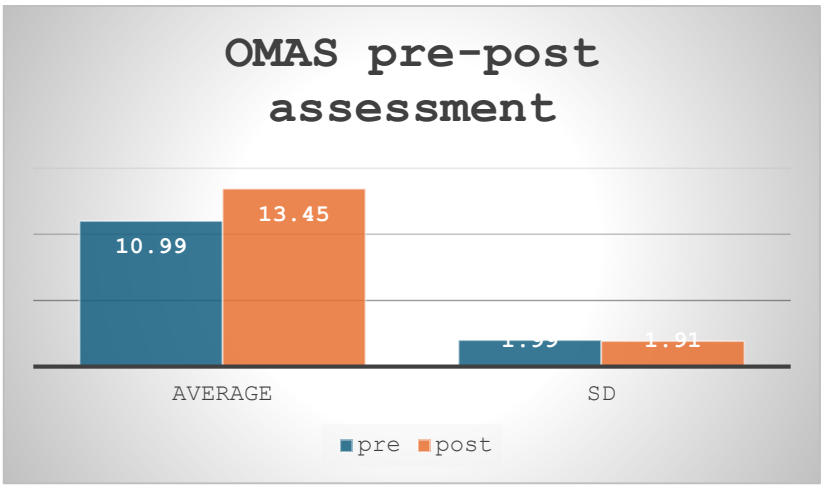



Table 3-

| SCORE | AVERAGE | STANDARD DEVIATION |
|---|---|---|
| PRE | 10.99 | 1.99 |
| POST | 13.45 | 1.91 |

Among total 37 participants the average mean score for the OMAS scale was13.52 ±1.92 SD.

Table 4 –

| Parameter | Value |
|---|---|
| P-value | *3.115e-11* |
| t | 9.4052 |
| Sample size (n) | 37 |
| Average of differences ($\bar{x}_d$) | 2.5405 |
| SD of differences ($S_d$) | 1.6431 |
| Normality p-value | 0.001084 |

RESULTS OF THE PAIRED-T TEST INDICATED THAT THERE IS A SIGNIFICANT LARGE DIFFERENCE BETWEEN BEFORE (M = 10.9 ,SD = 2) AND AFTER (M = 13.5 ,SD = 1.9), T(36) = 9.4, P < .001.

## III. DISCUSSION

The findings of the present study indicate that Volume Incentive Spirometry (VIS) produced a highly significant improvement in oromotor muscle strength among post-stroke patients ($p < 0.001$). The measured increase of 3.11 demonstrates not only statistical significance but also functional relevance, suggesting that respiratory based interventions can influence neuromuscular performance beyond the thoracic region. These outcomes align with the physiologic principles underlying VIS, in which repeated, sustained maximal inhalation enhances diaphragmatic activation, respiratory muscle recruitment, and neuromuscular coordination. Improved respiratory effort can indirectly strengthen muscles involved in lip seal, tongue mobility, and orofacial control. Support for this relationship is found in the study by Fiz et al. (1993), who demonstrated that patients with facial paralysis exhibit notable improvements in maximal respiratory pressures (Pimax and PEmax) when the orofacial muscles were better supported or strengthened. Further support is provided by neuroplasticity research. Avivi-Arber, Martin, Lee, and Sessle (2011) emphasized that the face sensorimotor cortex exhibits robust neuroplastic changes. hey note that orofacial motor functions including lip closure, tongue coordination, and swallowing are highly adaptive and capable of functional reorganization after injury.

Additionally, the present findings are supported by Konecny et al. (2011), who showed that targeted orofacial therapy in post-stroke patients with central facial paresis resulted in significant improvements in facial movement, symmetry, and functional performance compared to controls receiving standard rehabilitation. The improvements observed in both the studies suggest that combining respiratory and orofacial training may enhance facial motor outcomes more effectively than traditional therapy alone. The relevance of oral motor function assessment is further reinforced by Ortega et al. (2009), who validated the Oral Motor Assessment Scale

(OMAS) for evaluating oral motor performance in individuals with neurological impairment. They highlighted that deficits in oral motor coordination—such as lip sealing, tongue control, and mastication—are common in neurological populations and require structured intervention.

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## IV. CONCLUSION

The study demonstrates that Volume Incentive Spirometry (VIS) produces a statistically significant improvement in oromotor muscle strength among post-stroke patients, as reflected by enhanced OMAS scores. These outcomes confirm that the intervention is effective in strengthening the oral motor musculature.

## V. FUTURE SCOPE OF THE STUDY

Future research can examine gender-specific study based on the facial deviation, as males and females may respond differently.

Future researcher should examine longitudinal effects, compare VIS with other respiratory or oromotor training methods, and explore whether combining VIS with conventional therapy produces superior outcomes.

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## VII. REFERENCES

**[1]** 1. Petr Konecny, Milan Elfmark, Karel Urbanek. Facial paresis after stroke and its impact on patient's facial movement and mental status. Journal of rehabilitation medicine. 2010 [1]

2. O'Sullivan, Susan B, Schmitz, Thomas. J, Fulk, George D. Physical Rehabilitation. Seventh edition. 2019 [2]
3. Chaurasia, B.D., 2013. Human anatomy. 6th ed. Vol. 3. New Delhi: CBS Publishers & Distributors.[3]
4. Kendall FP, McCreary EK, Provance PG. Muscles: Testing and function with posture and pain. 5th ed. Philadelphia: Lippincott Williams & Wilkins; 2005.[4]
5. Hao Zhang, Li Li, Daozhen Jiao, Yanjie Yang, Chungong Pan, Ling Ye, Sulan Wei, and Meiling Jin. An interrater reliability study of pulmonary function assessment with a portable spirometer. Respiratory care. 2020 [5]
6. Fiz JA, Haro M, Aguilar J, Alvarez J, Abad J, Monso E, Morera J. Spirometry and maximal respiratory pressures in patients with facial paralysis. Chest. 1993 Jan;103(1):170-3. doi: 10.1378/chest.103.1.170. [6]
7. Lista-Paz, A., Kuisma, R., Canosa, J. L. S., Sebio García, R., & González Doniz, L. (2022). Pulmonary function in patients with chronic stroke compared with a control group of healthy people matched by age and sex. Physiotherapy Theory and Practice, 39(5), 918-926 [7]
8. Margaret Kelly-Hayes. Influence of age and health behaviours on stroke risk: lessons from longitudinal studies. J Am Geriatric Soc. 2010. October; 58(Suppl 2): S325-S328. Pg. 2 [8]

9. Kumar AS, Alaparthi GK, Augustine AJ, Pazhyaottayil ZC, Ramakrishna A, Krishnakumar SK. Comparison of Flow and Volume Incentive Spirometry on Pulmonary Function and Exercise Tolerance in Open Abdominal Surgery: A Randomized Clinical Trial. J Clin Diagn Res. 2016 Jan;10(1): KC01-6. doi: 10.7860/JCDR/2016/16164.7064. Epub 2016 Jan 1. PMID: 26894090; PMCID: PMC4740618 [9]
10. Amira F Ibrahim 1, Elham E Salem 1, Nada E Gomaa 2, Faten H Abdelazeim 1 The effect of incentive spirometer training on oromotor and pulmonary functions in children with Down's syndrome PMID: 31728137 PMCID: PMC6838806 DOI: 10.1016/j.jtumed.2019.09.004 [10]
11. Ahrens A, Skarada D, Wallace M, Cheung JY, Neely JG. Rapid simultaneous comparison system for subjective grading scales grading scales for facial paralysis. Am J Otol. 1999 Sep;20(5):667-71. PMID: 10503592 [11]
12. Beurskens CH, Heymans PG. Positive effects of mime therapy on sequelae of facial paralysis: stiffness, lip mobility, and social and physical disability. Otol Neurotol. 2003;24(4):677-681.[12]
13. Bakke M, Bergendal B, McAllister A, Sjögreen L, Asten P. Development and evaluation of a screening for orofacial dysfunction. Swed Dent J. 2007; 31:75-84.[13]
14. Groves J. Facial palsies: a selection of cases for treatment. Proc R Soc Med 1972; 66:545-49. [14]
15. Earl CJ. Disorders of cranial nerves V, VI, IX, X, XI and XII. In: Asbury AK, ed. Diseases of the nervous system: clinical neurobiology. Philadelphia: WB Saunders Co, 1986; 577-84. [15]
16. Koulouris N, Mulvey DA, Larroche CM, Green M, Moxhan J. Comparison of two different mouthpieces for the measurement of Plmax and PEmax in normal and weak subjects. Eur Respir J 1988; 1:863-67. [16]
17. Vaughan CW, Neilson PD, O'Dwyer NJ. Motor control deficits of orofacial muscles in CP. J Neurol Neurosurg Psychiatr. 1998; 51:534–539.[17]
18. Nilsson H, Ekberg O, Olsson R, Hindfelt B. Dysphagia in stroke: a prospective study of quantitative aspects of swallowing in dysphagic patients. Dysphagia. 1998; 13:32 38. [18]
19. Murray KA, Larson CR, Logemann JA. Electromyographic response of the labial muscles during normal liquid swallows using a spoon, a straw, and a cup. Dysphagia. 1998; 13:160 166.[19]
20. Pitcher JB, Ogston KM, Miles TS. Age and sex differences in human motor cortex input–output characteristics. J Physiol. 2003;546(Pt 2):605-613.[20]
21. Sapienza CM, Troche M, Pitts T, Davenport P. Respiratory strength training: concept and intervention outcomes. Semin Speech Lang. 2011;32(1):21-30.[21]
22. Park JS, Oh DH, Chang MY. The effect of expiratory muscle strength training on swallowing function in acute stroke patients. J Korean Acad Rehabil Med. 2012;36(4):440-446.[22]
23. Perry L. Screening swallowing function after acute stroke: a systematic review. Dysphagia. 2001;16(1):7-18. [23]
24. Nishio M, Niimi S. Relationship between lip closing force and respiratory function. Folia Phoniatr Logop. 2001;53(5):217-225.[24]
25. Sutt AL, Fraser JF. Respiratory muscle training improves outcomes for patients with weakness: a review. Respir Care. 2015;60(9):1342-1350.[25]