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ORIGINAL RESEARCH

Oral Sensory Perception in Adults Who Stutter: A Preliminary Study

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ABSTRACT

This preliminary study aimed to investigate oral sensory perception abilities, focusing on tactile perception and proprioception, in adults who stutter (AWS) compared to those with normal fluency. The study included 60 participants aged 18 to 35 years, comprising two groups: 30 healthy adults with normal fluency and 30 adults diagnosed with moderate to severe stuttering Participants were matched for gender, educational level, handedness, and language competencies. Oral sensory perception was assessed through two-point discrimination, the gag reflex, and oral stereognosis tasks.Results showed significant differences between the groups in various measures. Two-point discrimination scores were notably lower for the experimental group on the upper lip, tongue dorsum, and hard palate, suggesting reduced somatosensory perception despite scores remaining within normal limits. The gag reflex was found to be hypoactive in the stuttering group, indicating diminished tactile sensitivity in the velar region. Oral stereognosis revealed that the control group outperformed the experimental group in recognizing and identifying shapes, with significant differences in identification of square, triangle, oval, and crescent shapes.These findings indicate that AWS have reduced oral sensory perception, with impaired tactile and proprioceptive processing. This highlights the need for detailed oral sensory perception assessments and suggests that incorporating oral sensory feedback enhancement techniques may be beneficial in stuttering management protocols.

Keywords: Stuttering, Oral sensory perception, Proprioception, Oral stereognosis, SSI

INTRODUCTION

Stuttering is essentially a neuromuscular disorder whose core behaviour consists of tiny lags and disruptions in the timing of the complicated movements required for speech [1].Stuttering is characterized by disruptions in speech motor behaviour that result in sound and syllable repetitions, audible and inaudible sound prolongations and broken words. Individual moments of stuttering can be associated with disruptions in motor behaviour. Onset of stuttering during childhood might be related to the use of inaccurate, or incorrectly updated, internal models of the dynamics of the efferent system which evaluate generated motor commands prior to execution. In adults who stutter the speech motor control is weak link in the chain of events that lead to the production of the speech. This weak link is in term of limited skill or ability to prepare and perform the motor action required to implement various demands imposed by cognitive, linguistics, emotional and motor aspect of speech [2] Persons with stuttering are less skilled in speech production and are inclined to use a less automated strategy that is more dependent on sensory information for control of speech movement. [3] [4].The resulting mismatch between predicted and actual sensory consequences may lead to repetitive attempts at completing the planned movements or re-setting the system. [5] Sensory feedback from various perceptual systems (visual, auditory, kinaesthetic and proprioceptive) is required in order to coordinate the flow of speech effectively and any deficit in these systems can lead to the non-fluent speech. [6] [7]

Oral sensory perception is a phenomenon by which the movements of the oral cavity are fed back to the central nervous system through various neurophysiological processes. The perception of these movements during the production and after the production is important in the monitoring of speech.Sensory nerves that supply mechanoreceptors in the mucosal lining of the oral cavity, pharynx, and larynx provide the substrate for a variety of

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sensations. They are essential for the perception of complex or composite sensory experiences including oral kinaesthesia and oral stereognosis. This sensory information contributes to initiation of reflexes and coordination of timing in patterned motor behaviours.[8] Any disturbance in these sensory mechanisms canprovide asynchronous feedback information and ultimately can lead to non-fluent speech.

The oral sensory perception abilities can be assessed by the measurement of tactile perception and proprioception. Oral proprioceptive information is processed during speech production and is generally considered necessary for speech movement control. It is evident from the literature that adults who stutter (AWS) have shown significant anomalies in oral proprioception. [9] [10] [11] [12].Furthermore,literature in stuttering has demonstrated that Disturbed sensory feedback is known to be one of the contributing factors to the stuttering. Present study aimsto investigate oral sensory perception abilities in terms of tactile and proprioception in adultswith stuttering and normal fluency.

MATERIALS & METHODS

The study included 30 healthy adults with normal fluency, aged 18-35 years (mean age = 26 years), and 30 adults who stutter, also aged 18-35 years (mean age = 26 years). Participants were matched based on gender, educational level, handedness, and language competencies. Individuals with stuttering associated with neurological disorders, hearing loss, articulation/phonological disorders, or language deficits were excluded from the study.

Stuttering components and severity were assessed using the Stuttering Severity Instrument (SSI). [13] The experimental group consisted of individuals diagnosed with moderate to severe stuttering based on their SSI scores. Informed written consent was obtained from all participants.

Oral sensory perception abilities were assessed using a checklist that included measures for tactile perception and proprioception. Tactile perception was evaluated through (a) 2-point discrimination and (b) the gag reflex. Proprioception was assessed using an oral stereognosis checklist.

2-point discrimination

Two-point discrimination was evaluated by placing both points of a divider on the surface being tested. Initially, the points were positioned very close together, almost touching, and the subject was instructed to indicate when they could feel two distinct points on the surface. The distance between the points was then gradually increased until the subject reported perceiving them as separate points while their eyes were closed.

The two-point discrimination score was measured in millimetres, representing the minimum distance between two points that the subject could perceive as distinct on the skin. A sterilized blunt steel divider was used for this assessment. The two-point discrimination was measured on various oral areas, including the upper and lower lips, upper and lower gums, the dorsum and tip of the tongue, hard palate, and the inner sides of both cheeks.

Gag reflex

Gag reflex was assessed using sterile disposable cotton buds by stimulation to the posterior section of tongue and soft palate. It was scored in three-point rating scale where 0 indicated absence of reflex, 1-diminished gag reflex, 2- adequate/normal reflex.

Oral stereognosis

Oral stereognosis was evaluated by placing toffees of six different shapes in the subject's mouth and asking them to identify the shapes with their eyes closed. The shapes used included oval, circular, square, sphere, triangular, and crescent. Responses for oral stereognosis were scored on a two-point scale: 0 for inability to identify and 1 for successful identification. To assess size discrimination, a toffee of the same shape but different size (small or big) was used.

After data collection, independent sample t-tests were conducted to analyze the results and determine significant differences between the two groups for the parameters mentioned

RESULTS

Tactile Perception

Tactile perception included assessment for the sensitivity of two-point discrimination and gag reflex.

Two-point Discrimination

The two-point discrimination score was obtained on the lips (upper & lower) gums (upper & lower), tongue (dorsum & lip), hard palate, cheeks inner side (left & right). The results are presented in Table 1, which displays the t-test outcomes for the scores obtained from the 2-point discrimination task.

The analyses were carried out by using independent sample t-test to study the significance difference in score between the two groups for two-point discrimination.

Table 1. t-test results of scores obtained from 2-point discrimination.

	T	Df	Sig.(2-tailed)	Sig.(1-tailed)
2 Point Discrimination Upper Lip (mm)	3.132	58	0.003	0.0015
2 Point Discrimination Lower Lip (mm)	3.251	58	0.002	0.001
2 Point Discrimination Upper Gum (mm)	1.787	53.883	0.08	0.04

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2 Point Discrimination Lower Gum (mm)	0.452	58	0.653	0.3265
2 Point Discrimination Left Cheek (mm)	0.366	50.095	0.716	0.358
2 Point Discrimination Right Cheek (mm)	0.37	58	0.713	0.3565
2 Point Discrimination Tongue Tip (mm)	1.306	58	0.197	0.0985
2 Point Discrimination Tongue Dorsum (mm)	3.745	50.812	0	0
2 Point Discrimination Hard Palate (mm)	2.068	58	0.043	0.0215

Gag Reflex

The sensitivity of the gag reflex was assessed. The mean scores and t-test results are presented in Table 2.

Table 2. Mean standard deviation and t-test results of sensitivity for gag reflex

	Group	Mean	S.D.	t	Df	Sig. (1 & 2-tailed)
Gag. Reflex	Person with Stuttering	1.07	0.691	5.668	42.047	0
	Control Group	1.87	0.346			

Proprioception

Proprioception included oral stereognosis, lip movements, tongue movement, strength of cheeks, soft palate movement and jaw movement.

Oral stereognosis

Oral stereognosis is the ability to recognise and discriminate forms. Receptors mainly involved in oral stereognostic ability are located in various oral structures and form perception results from an association of more than one group of receptors (tactile and proprioception). The mean of scores of oral stereognosis shape identification task shows better scores for control group in identification of square, circle, sphere, triangle, oval, and crescent shapes. The Table 3depicts the finding on t-test for oral shape identification.

Table 3: t-test results for oral stereognosis shape identification task for different shapes.

	T	df	Sig.(2-tailed)	Sig.(1-tailed)
Oral stereognosis shape Square	2.408	44.798	0.02	0.01
Oral stereognosis shape Circle	1.00	29	0.326	0.163
Oral stereognosis shape Sphere	1.795	29	0.083	0.0415
Oral stereognosis shape Triangle	4.731	36.353	0	0.00
Oral stereognosis shape Oval	3.808	29	0.001	0.0005
Oral stereognosis shape Crescent	4.853	42.81	0.00	0.00

The analyses were carried out using independent sample t-test to study the significance of difference in the scores between the two groups**.**Table 4 depicts overall t-test results for oral stereognosis task all together.

Table 4. t-test results for oral stereognosis task all together.

	t- test for equality of means			
	T	Df	Sig.(2-tailed)	Sig.(1-tailed)
Oral stereognosis shape identification	7.383	38.133	0.00	0.00

DISCUSSIONS

The present study aimed at investigating the oral sensory perception abilities in terms of tactile and proprioception in two groups of adults, those with stuttering and normal fluency. The data was subjected to t-test to evaluate the t and p-value. Two-point discrimination measures the degree of innervation in a specific area of the skin**.** The smallest and most dense sensory units are located in those areas that have the greatest somatosensory cortical representation. Normally, a person should be able to recognize two points separated by as little as 2-4 mm on the lips and finger pads, 8-15 mm on the palms and 30-40 mm on the chin or back. Lesions of the sensory cortex will increase the distance. The mean scores for 2-point discrimination in the experimental group were measured on the upper lip, left cheek, right cheek, hard palate, upper gum, lower gum, tongue tip, and dorsum. However, both groups demonstrated 2-point discrimination scores within 4 mm. Significant difference in scores between the groups for 2-point discrimination was seen on upper lip, upper gum, tongue dorsum and hard palate. Hence the results suggest that even though findings are within normal range for 2-point discrimination, yet the experimental group has hyposensitive somatosensory perceptionthan that the control group.

The gag reflex functions are considered a normal occurrence when elicited by the tactile stimulation of the posterior section of the tongue or soft palate. It is considered hyperactive and abnormal when it can be elicited by the stimulation of areas other than the

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posterior half of the tongue and soft palate. Generally, a hyperactive gag condition will interfere with interfere with the eating process. On the other hand, gag reflex is considered hypoactive and abnormal when it can't be elicited by stimulation to any section of the mouth cavity. The control group achieved better scores than the experimental group. The difference between the groups in terms of gag reflex sensitivity was found to be statistically significant.The hypoactive gag reflex observed in individuals with stuttering suggests reduced tactile sensitivity in the velar region.

Oral stereognosis is the ability to recognise and discriminate forms. Receptors mainly involved in oral stereognostic ability are located in various oral structures and form perception results from an association of more than one group of receptors (tactile and proprioception). The mean of scores of oral stereognosis shape identification task shows better scores for control group in identification of square, circle, sphere, triangle, oval, and crescent shapes. Significant difference in scores was found for the shape identification task for the square, sphere, triangle, oval and crescent shapes. This indicates that individuals who stutter may exhibit a reduced proprioceptive sense and made significantly more oral form errors compared to those with typical fluency. This idea is supported by studies that utilized the NIDR-20 forms and form pair discrimination task. [14].The findings of this investigation align with previous research, which reported poorer oral form perception skills in individuals with stuttering compared to those with normal fluency.[15] [16] The findings suggest that individuals who stutter have reduced velar coordination with other oral structures, potentially reflecting diminished proprioceptive reception in the velar region. These results are further supported by previous research investigating the relationship between oral kinaesthesia and stuttering severity. [17]

CONCLUSION

The findings of this study indicate that individuals who stutter differ from fluent speakers in oral sensory perception tasks and oral sensory feedback during speech production. Specifically, individuals who stutter exhibit reduced sensitivity to texture and tactile stimuli on the hard palate and upper gum, as well as diminished somatosensory and proprioceptive awareness compared to fluent speakers. These results emphasize the importance of comprehensive oral sensory perception assessments for individuals with stuttering and suggest incorporating techniques to enhance oral sensory feedback as part of stuttering management protocols.

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