EFFICACY OF HEAD TURN TECHNIQUE IN TREATMENT OF UNILATERAL VOCAL CORD PARALYSIS: AN ATTEMPT AT EVIDENCE BASED PRACTICE

Registration No. L0480010

A Dissertation submitted in part fulfillment of
Master's Degree (Speech Language Pathology)
University of Mysore,
Mysore.

ALL INDIA INSTITUTE OF SPEECH AND HEARING
MANASAGANGOTHRI,
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MAY - 2006

Dedicated to

Four pillars of my life

Nanna, Amma, Rani and Chinni

Certificate

This is to certify that the Dissertation entitled **"Efficacy of Head turn technique in treatment of unilateral vocal cord paralysis: An attempt at Evidence Based Practice"** is a bonafide work in part fulfillment for the degree of Master of Science (Speech Language Pathology) of the student with Register No. L0480010.

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Certificate

This is to certify that the Dissertation entitled **"Efficacy of Head turn technique in treatment of unilateral vocal cord paralysis: An attempt at Evidence Based Practice"** is a bonafide work in part fulfillment for the degree of Master of Science (Speech Language Pathology) of the student (Register No. L0480010). This has been carried out under my supervision and guidance and has not been submitted earlier to any other University for the award of any other Diploma or Degree.

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Declaration

The Dissertation entitled **"Efficacy of Head turn technique in treatment of unilateral vocal cord paralysis: An attempt at Evidence Based Practice"** is the result of my own study under the guidance of Miss. K.Yeshoda, Lecturer, Department of Speech-Language Sciences, All India Institute of Speech and Hearing, Mysore, and has not been submitted earlier in any other University for the award of any Diploma or Degree.

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Table of contents

Serial No.	Title	Page no.
I	Introduction	
II	Review of L iterature	
III	Method	10
IV	Results	18
V	Discussion	**33**
VI	Summary and Conclusions	**35**
VII	Reference	38
IX	Appendixes	**43**

List of tables

Table No.	Title	Page no.
1.	Comparison of participants on clinically significant factors	11
2.	Mean and SD of acoustic parameters across baselines for the participant 1	19
3.	Mean and SD of mean MAFR for participant 1 across baselines	21
4.	Mean and Standard deviation (SD) of acoustic parameters across baselines for the participant 2	24
5.	Mean and SD of mean MAFR for participant 2 across baselines	26
6.	Mean and Standard deviation (SD) of acoustic parameters across baselines for the participant 3	28
7.	Mean and SD of mean MAFR for participant 3 across baselines	31
8.	Comparative summary of the overall changes in acoustic and aerodynamic parameters for three participants	32

List of graphs

Graph No.	Title	Page No.
1.	Effect of treatment on six acoustic parameters across baselines in Participant 1	**18**
2.	Effect of treatment on mean MAFR values across baselines for participant 1	21
3.	Effect of treatment on six acoustic parameters across baselines in Participant 2.	23
4.	Effect of treatment on mean MAFR values across baselines in participant 2	25
5.	Effect of treatment on six acoustic parameters across baselines in Participant 3	27
6.	Effect of treatment on mean MAFR values across baselines in participant 3.	30

INRODUCTION

"In science the credit goes to the one who convinces the world, not to whom the idea first occurs"

Sir Francis Darwin's above statement is important in a sense it is hard to convince scientific world. It requires sincere efforts to garner reliable and valid evidences to convince the scientific world.

Evidence based practice (EBP) is one such way in which scientific community is convinced regarding a treatment procedure. Evidence Based Practice is all about answering a critical question "How do you know that what you do works" (Bury, 1998). Although asking the question is important, how the answer is derived is of greater significance. EBP places emphasis on using scientific evidence to answer this question, rather than opinions, past practice and past teaching (Reilly, S., 2004).

The standard definition of Evidence Based Practice (EBP) is "the conscientious, explicit and judicious use of current best evidence about the care of individual patients" (Sackett, D.L., Richardson, W.S., Rosenberg,W.& Haynes,R.B., 2000).

There is an increasing need for the studies on efficacy of behavior readjustment therapy procedures in human communicative disorders. Legal, social, scientific and professional considerations point the need for more careful documentation of the effects of treatment techniques used by speech-language pathologists (Basiouny, S., 1998).

Enderby,P.& Emerson,J. (1995) stated that clinical practice should be based on research evidence and that evidence about the efficacy of speech pathology services was vital in order to 'offer an improved quality of life to our client group, as effectively as possible, to the maximum number of people'. Evidence-based practice requires speech pathologists to "integrate their individual clinical expertise with the best available evidence from systematic research, to demonstrate that what they do works!" (Reilly, S., Douglass, J., Oates, J., 2004). ;

Difference between efficacy, effectiveness and efficiency

There is a nuance among the terms "treatment efficacy", "treatment effectiveness" and "treatment efficiency". Treatment efficacy involves the extent to which an intervention can be shown to be beneficial under experimental (optimal or ideal) conditions. Efficacy research 'documents that changes in performance are directly attributable to the treatment administered' (Campbell, T., 1995).

Treatment effectiveness studies may also attempt to address variety of questions-for example, the quality of the intervention, the patient's interaction with the therapist and the achievement of functional change (Campbell, T., 1995).

Treatment efficiency refers to the relative merits of one treatment compared with those of another. An efficient treatment means one in which maximum benefit is reached with minimum output (i.e. with respect to issues such as cost, the amount of time taken, etc.) (Carding, P., 2000).

The present study attempts to investigate treatment efficacy that is the usefulness of the head turn technique in natural clinical conditions.

Reilly, S. (2004) reviewed literature pertaining to evidence based treatment of various speech and language disorders. EBP issues related to voice disorders is also discussed (Carding, P., 2000). EBP attains greater significance due to the high incidence of voice disorders and the importance of voice in daily communication.

Recent statistics show that as much as 35% of the working population relies on voice as a primary tool of trade (Titze, Lemke & Montequin, 1996). As observed by Verdolini and Raming (2001) voice problems are common and they matter. Given the importance of voice in significant population, it is important on Speech and Language therapist's part to be equipped with effective prevention and management strategies for the same.

Vocal cord paralysis (VCP) of adductor type is one of the hypo functional voice disorders. Adductor vocal cord paralysis is presented with inability in medializing the paralyzed one (as in Unilateral VCP condition) or both (as in Bilateral VCP condition) the vocal cords. This results in inadequate glottal closure and asymmetric vibration of the two vocal cords (Aronson, 1990). Incomplete glottal closure leads to increased air being allowed to flow through the glottis during phonation, producing breathy voice (Paseman,A., CasperJ., Colton,R., Kelly, R., 2004).

Various voice facilitation therapy techniques have been proposed to improve vocal cord approximation in unilateral vocal cord paralysis conditions (Boone, D.R., 1971;Stemple, J.C., 2000). In our practice we widely employ Pushing approach, Half-Swallow boom technique, Inhalation phonation and Digital laryngeal pressure technique. While Head Turn technique is sparingly employed in treatment of such voice disorders.

Need for the study

Studies on effectiveness of head turn therapy procedure either have included head turn technique along with other techniques (McFarlane, S.C., Watterson,T.L., Lewis,K., 1998) and head turn technique alone in a single session (Paseman,A. et ah, 2004), but these are confounded either by employing many techniques in a single subject group and not tracking the change in glottal closure over a period of time respectively. Therefore, the need for a study was felt that delineates the effectiveness of head turn technique alone as a treatment procedure and also the side of head turn (either towards paralyzed side or the non paralyzed side) that is more effective in the re-establishment of voice.

Statement of purpose

The main purpose of the study was to delineate the efficacy of the head turn technique as a therapeutic measure in treating voice of patients with unilateral adductor vocal cord paralysis. Additionally, this study sought to delineate which side of head turn yielded better improvement in voice.

REVIEW OF LITERATURE

Stemple (1993) acknowledged that "there has been enormous advances in our understanding of the basic science of voice production, etiologies of voice disorders and voice evaluation techniques, but he decided that the same intervention techniques had been used by speech pathologists for decades with little attempt to scientifically evaluate their efficacy and effectiveness".

In general, voice therapy techniques are found to be superior over other surgical procedures in treatment of patients with unilateral vocal cord paralysis (McFarlane, S.C., Holt-Romeo, T.H., Lavorato,A.S., Warner, L.,1991). The study employed 16 vocal cord paralysis patients and 6 normal subjects. The listeners rated the voice of the participants following voice therapy or muscle nerve reinnervation surgery or teflon injection. The results revealed that an average of 9 hours of voice therapy was sufficient to result in perceptual improvement in voice.

Although myriad of voice therapy techniques are available, efficacy of a few voice therapy techniques are evaluated for example, the efficacy of Accent method (Bassiouny, S., 1998), Lee Silverman Voice Therapy (LSVT) for patients with Parkinson's disease (Johnson and Pring, 1990; Ramig,L., Countryman, S., Thompson, L., Horii, Y., 1995; Ramig,L., Countryman, S., O' Brienn, C, Hoehn, M., Thompson, L. 1996), vocal function exercises in subjects with normal voices and teachers (Stemple, J.C., Lee,L., D'Amico,B., Pickup,B.,1994; Roy, N., Gray, S. D., Simon,M., Dove,H., Corbin-Lewis,K., StempleJ.C, 2001) direct and indirect therapy for patients with a variety of non organic dysphonias (Carding,P., Hosely. I.A., Docherty,G.J.,1999), and confidential voice therapy (Verdolini-Marston,K., Burke,M.K, Lessac,A., Glaze,L., Caldwell,E.,1995).

Randomized control trials in voice therapy have either compared two treatment methods (Ramig et al., 1996; Bassiouny, 1998), a treatment approach with no treatment or a placebo (Me Kenzie, K., Millar,A., WilsonJ. A., Sellars, C, DrearyJ. J., 2001) or two treatment methods with no treatment within the same study (Carding et al., 1999; Roy etal., 2001).

It is important to note that comparisons between two treatments only tell us whether or not one technique is superior to the other; this type of study does not inform us whether a particular therapy is more effective than no therapy (Reilly, S., Douglass, J., Oates, J., 2004). The efficacy of head turn procedure in treatment of unilateral adductor vocal cord paralysis is observed along with other techniques. Me Farlane (1988) described usefulness of head turn procedure in a 32-year-old female who presented with unilateral vocal fold paralysis following thyroid surgery. Following voice therapy with the technique the client's voice was "louder, clearer, low pitched and fully voiced". Generalization of established voice quality using head turn was possible in 20 sessions.

McFarlane,S.C. et al. (1991) investigated effectiveness of three separate treatment methods for vocal cord paralysis. The three methods were voice therapy, Teflon injection and muscle nerve reinnervation surgery. Based on perceptual evaluation of voice samples the group that received voice therapy was as successful as the surgery group.

McFarlane,S., Watterson,J., Lewis,K., Boone,D. (1998) evaluated treatment effectiveness of three voice therapy facilitation techniques. The techniques studied were lateral digital manipulation (DP) to the thyroid cartilage, half-swallow boom (HSB) and head turn (HT). Aerodynamic measure (airflow rate) was employed to evaluate glottal closure. Airflow measures in all three-therapy conditions were measured. Airflow measures revealed that the three voice therapy techniques were useful in reducing airflow rate during sustained vowel production. The study notes, "no one technique was always best in terms of reduction of airflow, one technique worked best for some subjects whereas another technique was more effective in other subjects". The study could not conclude which side of head turn practice (towards paralyzed side or unparalyzed side) was more helpful.

Paseman,A.,Casper,J.,Colton,R.&Kelly,R.(2004) assessed the effect of head position on glottic closure as reflected in airflow rates (open quotient and maximum flow declination rate) in patients with unilateral vocal cord paralysis. Airflow measures were taken during sustained phonation of vowels in three head positions (center, right and left). The results indicated that head position did not improve glottic closure in these patients. The study questioned " the utility and underlying theoretical construct for the use of head turning as a therapeutic technique for improvement of voice in patients with unilateral vocal cord paralysis". But this study is confounded by lack of practice using the technique and also it being a single session recording.

Usefulness of acoustic parameters in verifying success of treatment methods

Acoustic analysis is also used to evaluate treatment methods for unilateral vocal cord paralysis. Jung-Eun Shin, Soon Yuhl Nam, Seung Joo Yoo, and Sang Yoon Kim (2001) evaluated the effectiveness of Thyroplasty type I employing acoustic parameters such as fundamental frequency, mean jitter, shimmer, noise-to-harmonic ratio as well as aerodynamic measure such as maximum phonation time (MPT) and mean airflow rate (MFR). These measures were selected to infer about glottal gap.

It was found that acoustic parameters such as fluctuation per second in fundamental frequency (Fo) and amplitude, extent of fluctuation in Fo and amplitude, jitter ratio, jitter factor, shimmer, Psigma and maximum phonation duration were helpful in differentiating unilateral vocal cord paralysis from normal subjects (Patel,R., Parsram,K.S., 2005). Hence, the same parameters would be employed to quantify improvement in voice post therapy.

METHOD

Objectives

The objectives of the study were,

1) To examine the effectiveness of the head turn technique as a facilitatory procedure in treatment of patients with unilateral vocal cord paralysis of adductor type and,

2) To examine a preferred head position for practice of head turn technique in unilateral vocal cord paralysis condition

Participants

Participant group consisted of one female and two males, all with unilateral vocal cord paralysis of adductor type. Among three, two participants had left vocal cord paralysis and one had right vocal cord paralysis. A certified Otolaryngalogist diagnosed all the participants as vocal cord paralysis of adductor type and recommended for voice therapy. Vocal cord paralysis was of recurrent laryngeal nerve lesion. Table 1 compares the participants on various clinically relevant factors.

Table 1: Comparison of participants on clinically significant factors.

Factors	**Participant**		
	1	2	3
Age	51 yr	30 yr	46 yr
Gender	Female	Male	Male
Vocal cord involved in paralysis	Left	Left	Right
Post onset duration of the condition at the initiation of therapy	15 days	21 days	6 months
Position of the affected vocal cord	Cadeveric position	Paramedian position	Paramedian position
Pathophysiology	Rheumatoid Arthritis	Idiopathic	Intubation
Specific medication for voice	No	No	No
Head side chosen for initiation of voice therapy	Right (Opposite side)	Left (Same side)	Left (Opposite side)

Instrumentation

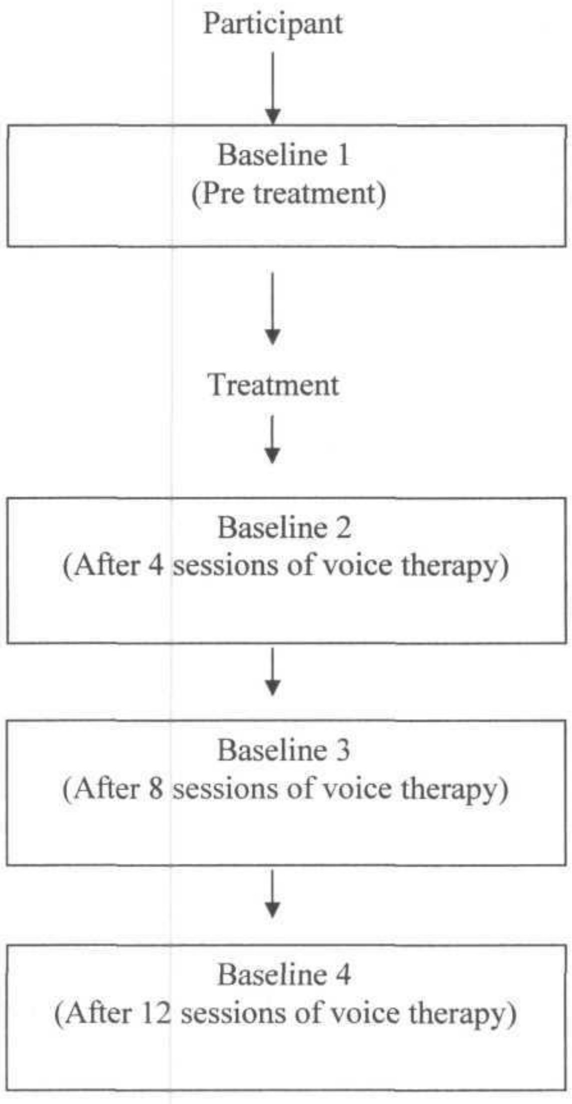
- Vitalograph (Model: 2120) was employed to obtain the aerodynamic measure Mean Air Flow Rate (MAFR).
- Sony Mini Disk Recorder MZ R 30 was used to record voice samples of the **clients**
- Multi-Dimensional Voice Program (CSL, Kay Elemetrics, Model: 4500) was used to measure acoustic parameters.

Setting

The examiner marked a point on the facing wall at eye-level. The patient chair was positioned 3 meters away from the center mark. Two more marks were made on the same wall on the either side of the center mark at a distance of 6 meters each. Each mark made an angle of 70° with the center marking. An angle of 70° was chosen based on the early attempts at evaluating the efficacy of head turn procedure (Paseman, A, et.al., 2004).

Research design

Multiple baseline research design was followed. The study design is depicted in diagram 1.



Flow chart 1: Study design

Therapy protocol

General procedure

All the participants were,

> Counseled regarding the nature of the problem

> Given an overview of the therapy technique to be followed and the duration of the therapy for monitoring voice improvement.

> Provided suitable demonstrations regarding the 70° head turn and the experimental task they were supposed to perform.

> A total of 12 individual voice therapy sessions were provided for each participant using head turn technique. Each session lasted for 45 minutes.
(See Appendix -I for rationale and procedure of Head Turn technique)

Specific procedure

> Specific procedure consisted of random assignment of the side of head turn for initiation of voice therapy. Random assignment was chosen as it increases the quality of treatment effectiveness research (Carding,P., 2000).

Clinicians

Two postgraduate students studying for postgraduate qualification in Speech Language Pathology provided voice therapy to the clients. Each clinician had exposure to voice and related management at least for four years. Two participants were provided therapy by one clinician and one participant with right vocal cord paralysis was provided therapy by another clinician. Primary researcher monitored the clinical intervention program.

Data recording

Both phonation samples and aerodynamic samples were recorded before initiation of the therapy (Baseline 1) and after 4th (Baseline 2), 8th (Baseline 3) and 12th (Baseline 4) individual voice therapy sessions.

Experimental task:

- Phonation of vowel /a/ was recorded thrice for each head turn (right and left) as well as center head orientation directly on to the module on Computerized Science Lab (CSL; Model: 4500) for Multi-Dimensional voice Program analysis. Head turn of 70° angle was maintained during recording of both left and right head turn. The participants were instructed to phonate /a/ at their comfortable pitch and loudness levels as long as possible.

> Aerodynamic measure, mean airflow rate (MAFR) was measured. The participants were instructed to phonate /ah/ into the mouthpiece of Vitalograph as long as possible at their comfortable pitch and loudness.

Data analysis

Phonation samples of vowel /a/ for each head orientation (left, right and center) for all participants for all four baselines were subjected to MDVP analysis for acoustic information. Mean airflow rate was calculated as the volume of airflow per unit of time while producing vowel /ah/.

Acoustic parameters

Fo, vFo, VTI were selected as it is found to be significantly different in vocal cord paralysis cases (Patel, R., Parsram, K.S., 2005), acoustic parameters PPQ, APQ were selected as they were significantly affected in vocal cord paralysis cases and were proved to be useful in monitoring the effects of treatment (Hirano,M., Hibi,S., Yoshida,T., Hirade,Y., Kasuya, H., Kikuchi, Y.,1988), and SPI is selected as it is found to indicate vocal cords adduction (Nancye, C, R., Mary, L., 2006).

Aerodynamic measures

Aerodynamic measure Mean Air Flow Rate (MAFR) was selected, as mean air flow rate can be regarded as a criterion for judging degree of glottal closure (Murry, T., Xu, J.J., Woodson, G. E. (1998). MAFR was also employed in earlier studies to monitor medial approximation of vocal cords following Thyroplasty I and examining its effect on glottal closure (Kraus, D.H., Orlikoff, R. F., Rizk, S. S., Rosenberg, D.B., 1999).

Statistical analysis

Statistical tools could not be administered, as the sample size was less. Measures of central tendency, mean and standard deviation were obtained and the results are tabulated in the form of graphical representation.

RESULTS

Participant 1:

Graph 1: Effect of treatment on six acoustic parameters in Participant 1.

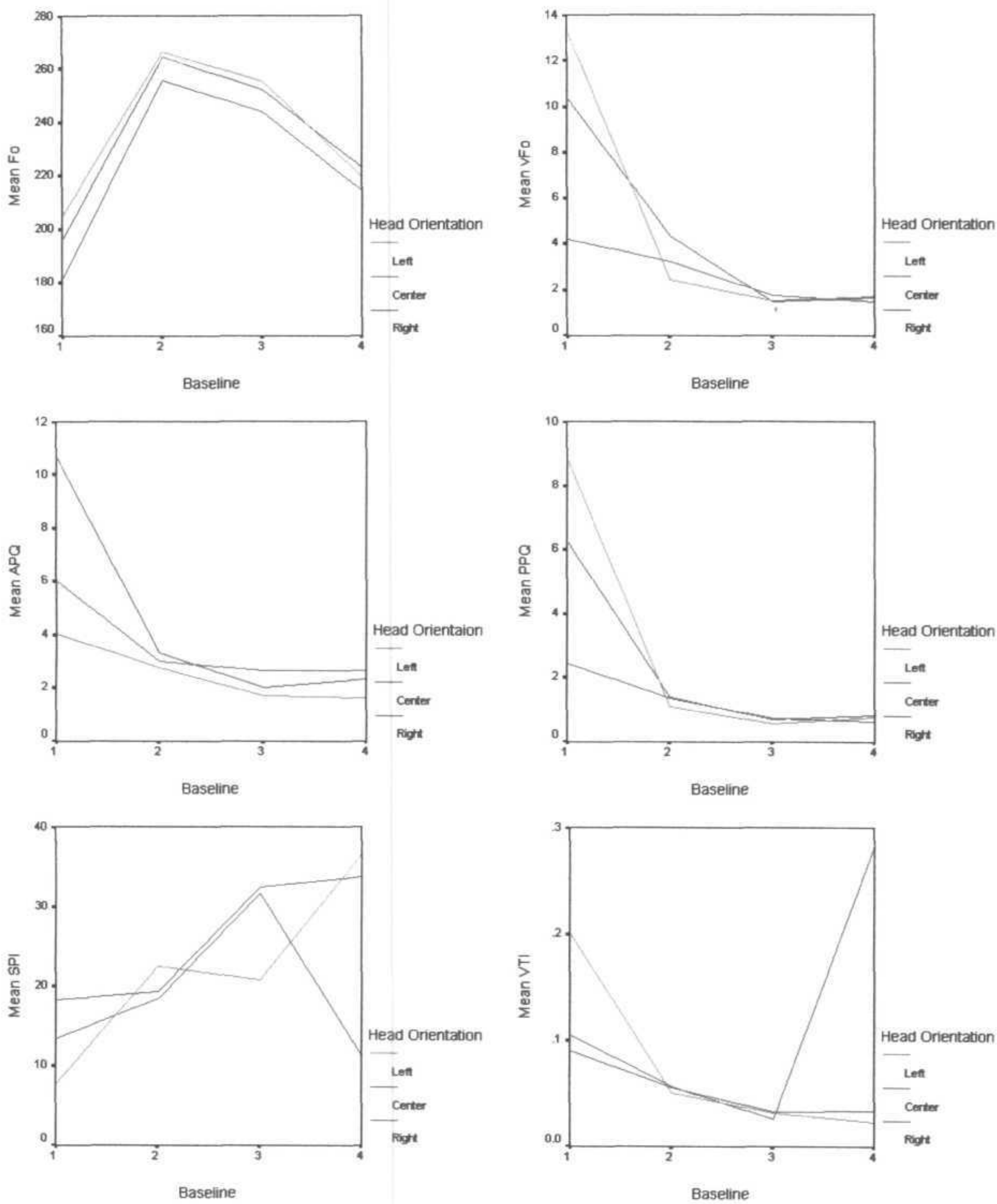


Table **2: Mean and Standard deviation** (SD) of acoustic parameters across baselines for the participant **1.**

Acoustic parameter	**Head Orienta -tion**	**Baseline 1**		**Baseline 2**		**Baseline 3**		**Baseline 4**	
		Mean	*SD*	*Mean*	*SD*	*Mean*	*SD*	*Mean*	*SD*
Fo	*Left*	205.04	72.47	266.55	9.18	255.51	9.10	219.22	8.35
	Center	181.53	85.85	255.72	6.89	243.89	5.71	214.28	4.61
	Right	196.42	72.38	264.45	6.11	252.18	6.82	223.12	10.47
VFo	*Left*	13.27	14.48	2.43	0.66	1.543	0.64	1.70	0.64
	Center	4.22	2.43	3.24	0.61	1.780	0.51	1.46	0.80
	Right	10.34	6.43	4.34	0.89	1.470	0.51	1.67	0.68
APQ	*Left*	4.00	2.00	2.66	0.57	1.72	0.57	1.66	0.57
	Center	6.00	1.73	3.00	0.00	2.66	1.52	2.66	0.57
	Right	10.66	9.07	3.33	0.57	2.00	1.00	2.33	0.57
PPQ	*Left*	8.82	9.93	1.10	0.09	0.57	0.37	0.75	0.48
	Center	2.43	1.12	1.33	0.40	0.73	0.46	0.61	0.18
	Right	6.24	4.63	1.39	0.42	0.70	0.16	0.83	0.55
SPI	*Left*	7.72	6.92	22.53	25.17	20.91	16.74	36.67	25.60
	Center	13.47	8.23	18.53	15.54	31.73	23.23	11.23	9.98
	Right	18.36	14.34	19.44	16.92	32.54	37.03	33.78	29.70
VTI	*Left*	0.20	0.15	0.05	0.01	0.03	0.005	0.02	0.04
	Center	0.10	0.04	0.05	0.01	0.02	0.02	0.28	0.43
	Right	0.08	0.06	0.05	0.01	0.03	0.01	0.03	0.01

With participant 1, the right side (opposite side to the paralyzed cord side) was chosen randomly to practice the head turn. The same is indicated in red colour in the graphs 1 and 2.Table 2 and 3 depicts all the details of mean and standard deviation for the acoustic and aerodynamic parameters across all baselines. As demonstrated in Graph 1 the means of frequency related parameters viz. Fo and vFo have increased and decreased respectively for all head orientations. Fo showed considerable increase in the values from baseline 1 to baseline 2 and then on a gradual decrease. Overall, the mean vFo values at baseline 4 were less compared to that at baseline 1 for all the head orientations i.e., left, center and right. The decrease in vFo is greatest for left head turn (non initiated head turn indicated in green ink in graphs) (decreased from 13.27 % to 1.70 %) and least for center head orientation (decreased from 4.22 % to 1.46 %).

Perturbation related measures both APQ and PPQ decreased from baseline 1 to baseline 4. The decrease in APQ from baseline 1 to 4 is greatest for right head turn (decreased from 10.66 % to 2.33 %) and least for left head turn (decreased from 4.00 % to 1.72 %). The decrease in PPQ was greater for left head turn (decreased from 10.66% to 2.33 %) than right head turn (decreased from 6.24 % to 0.83 %) or center head orientation (decreased from 2.43 % to 0.61 %).

Glottal closure related measure, SPI showed haphazard pattern. However, the mean SPI value for left and right head turn was more at baseline 4 compared to baseline 1 while left showed greater increase (increased from 7.72 to 36.67) than right (increased

As shown in graph 2 the mean MAFR values for the participant 1 reduced for all head orientations as an effect of treatment. The reduction in MAFR values is greatest for right head turn (997.30 cc/sec to 222.57 cc/sec) and least for left head turn (440.33 to 210.53 cc/sec). But the values were near normal for center head orientation.

Participant 2

With participant 2, left head turn (same side to the paralyzed cord side) was chosen randomly to practice the therapy procedure. The same is indicated in red colour in the graphs 3 and 4.Table 4 and 5 depicts all the details of mean and standard deviation for the acoustic and aerodynamic parameters across all baselines. As shown in graph 3, frequency related parameter Fo values increased at baseline 4 compared to that at baseline 1 for all the head orientations. Another frequency related parameter vFo increased for both left (therapy initiated head turn indicated in red ink in graphs) (increased from 12.47 % to 14.55 %) and right (non initiated head turn indicated in green ink in graphs) (increased from 11.27 % to 13.67 %), it showed decrease for center head orientation (decreased from 11.01 to 10.33).

Perturbation related measure APQ decreased for all head orientations at the baseline 4 compared to baseline 1. The greatest reduction is seen for center head orientation (decreased from 20.09 % to 13.00 %) and least for right head turn (decreased from 13.47 % to 12.21 %) compared to right head turn. PPQ increased for both left

Graph 3: Effect of treatment on six acoustic parameters in Participant 2.

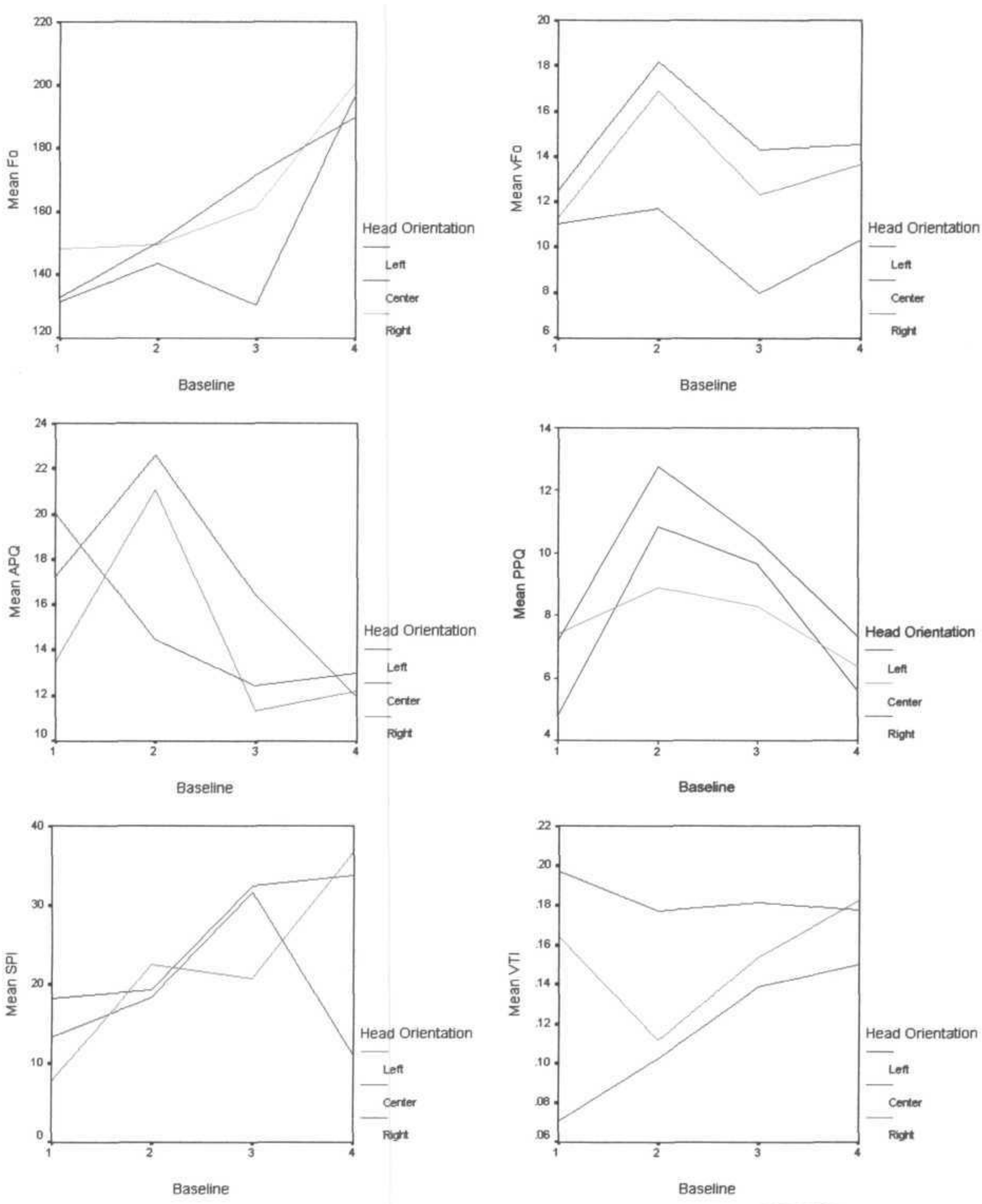


Table 4: Mean and Standard deviation (SD) of acoustic parameters across baselines for the participant 2.

Acoustic parameter	**Head Orient -ation**	**Baseline 1**		**Baseline 2**		**Baseline 3**		**Baseline 4**	
		Mean	*SD*	*Mean*	*SD*	*Mean*	*SD*	*Mean*	*SD*
Fo	*Left*	132.74	6.28	150.26	64.13	171.88	4.82	189.88	48.66
	Center	131.61	2.43	143.86	3.84	130.54	42.36	196.79	20.58
	Right	148.27	21.26	149.78	21.34	161.65	7.51	200.91	41.96
VFo	*Left*	12.47	4.62	18.22	4.30	14.34	5.04	14.55	5.50
	Center	11.01	3.56	11.71	6.69	8.00	3.46	10.33	0.58
	Right	11.27	6.27	16.93	5.11	12.33	10.12	13.67	7.37
APQ	*Left*	17.21	6.30	22.61	4.50	16.44	1.24	12.00	2.65
	Center	20.09	6.94	14.50	4.74	12.47	4.67	13.00	2.00
	Right	13.47	3.32	21.10	4.45	11.33	1.15	12.21	3.93
PPQ	*Left*	7.16	3.74	12.79	2.31	10.46	5.06	7.35	3.67
	Center	7.42	2.63	8.91	6.72	8.30	3.84	6.39	1.60
	Right	4.77	1.50	10.84	5.64	9.67	0.58	5.62	1.20
SPI	*Left*	21.08	20.04	14.31	15.90	16.81	17.36	11.81	8.54
	Center	24.50	20.52	19.65	16.76	10.05	0.75	12.57	8.64
	Right	11.12	5.85	15.81	14.52	14.80	11.90	14.69	15.18
VTI	*Left*	0.19	0.27	0.17	0.14	0.18	0.13	0.17	0.12
	Center	0.07	0.04	0.10	0.07	0.10	0.09	0.15	0.10
	Right	0.16	0.14	0.11	0.08	0.15	0.11	0.10	0.11

Glottal closure related measure SPI decreased for both left (decreased from 21.08 to 11.81) head turn and center head orientation (decreased from 24.50 to 12.57), while right head turn showed an increase (increased from 11.21 to 14.69) at the baseline 4.

Breathiness related acoustic measure VTI almost remained same for left (mean value of 0.17 at baseline 4 compared to 0.19 at baseline 1) head turn while it increased for center head orientation (increased from 0.07 to 0.15) and decreased for right head turn (decreased from 0.16 to 0.10).

Graph 4: Effect of treatment on mean MAFR values across baselines in participant 2.

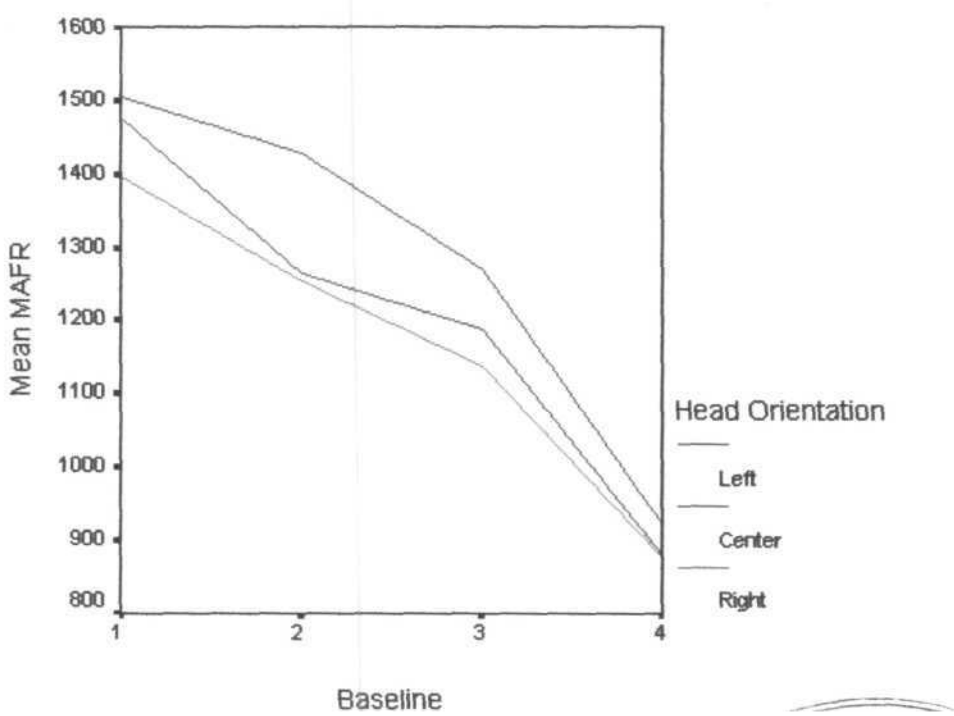


Table 5: Mean and SD of mean MAFR for participant 2 across baselines.

Head orientation	**Baseline 1**		**Baseline 2**		**Baseline 3**		**Baseline 4**	
	Mean	*SD*	*Mean*	*SD*	*Mean*	*SD*	*Mean*	*SD*
Left	1475.00	70.00	1265.00	117.58	1180.00	34.87	879.67	34.44
Center	1505.00	15.00	1428.33	99.29	1270.67	16.17	921.33	4.04
Right	1397.33	7.51	1253.33 **1**	140.03	1138.67	62.14	877.00	119.53

As shown in graph 4 the mean MAFR values for participant 2 decreased for all head orientations as an effect of treatment. The decrease in mean MAFR values is greatest at left head turn (decreased from 1475.00 cc/sec to 879.67 cc/sec) and least at right head tum (decreased from 1397.33 cc/sec to 877.00 cc/sec).

Participant 3:

Graph 5: Effect of treatment on six acoustic parameters in Participant 3.

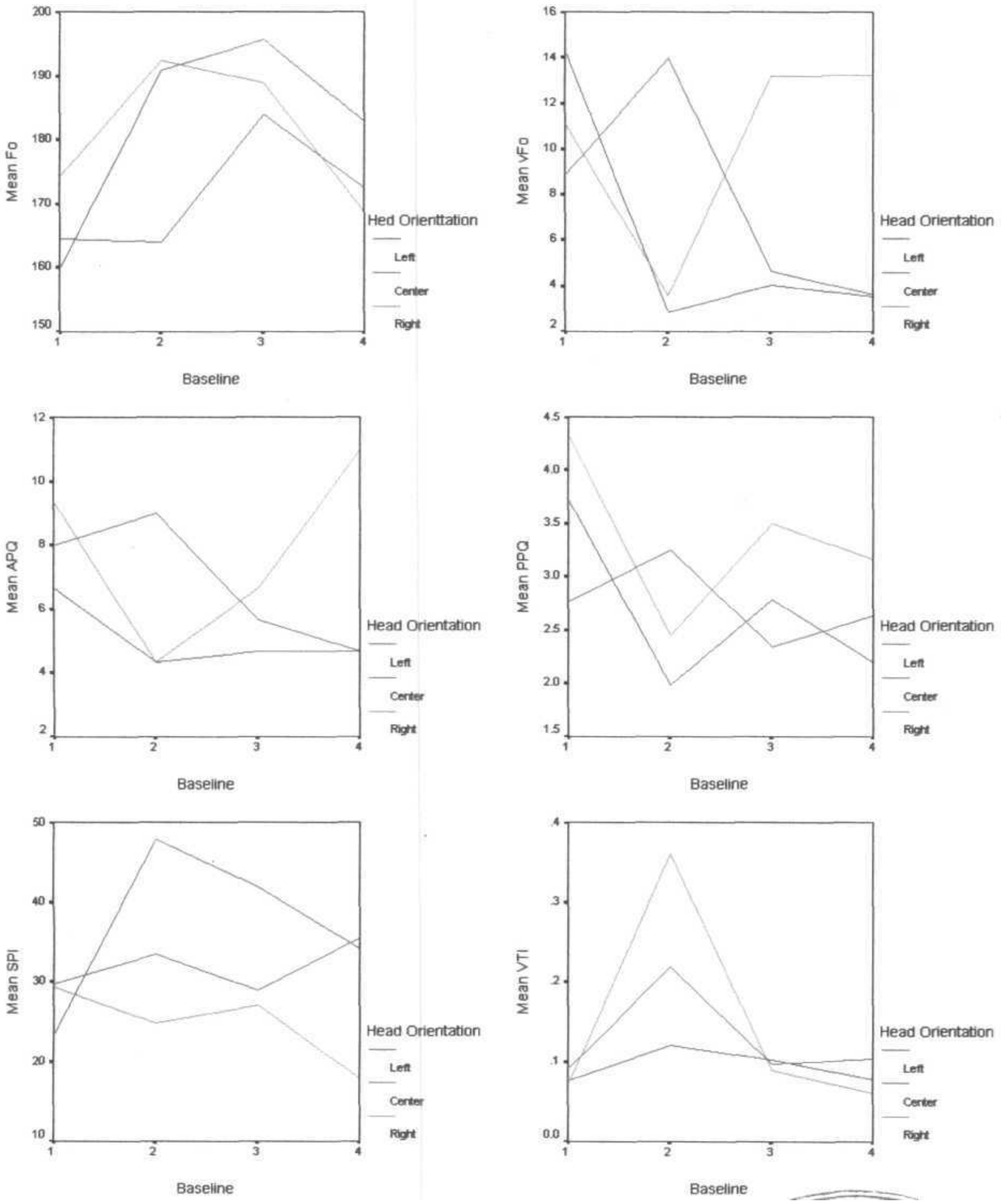


Table **6: Mean and Standard deviation (SD) of acoustic parameters across baselines for** the participant 3

Acoustic parameter	**Head Orientation**	**Baseline 1**		**Baseline 2**		**Baseline 3**		**Baseline 4**	
		Mean	*SD*	*Mean*	*SD*	*Mean*	*SD*	*Mean*	SD
Fo	*Left*	160.13	17.36	190.94	11.10	195.78	10.41	182.91	5.95
	Center	164.45	6.07	164.08	26.33	183.93	7.84	172.48	13.95
	Right	174.37	0.55	192.46	11.29	188.94	5.44	168.72	27.95
VFo	*Left*	14.25	18.25	2.83	0.52	4.01	0.59	3.51	1.51
	Center	8.87	7.17	13.99	17.59	4.65	2.90	3.61	0.39
	Right	11.06	13.87	3.59	1.30	13.17	15.18	13.21	15.36
APQ	*Left*	6.66	3.05	4.33	0.57	4.66	2.08	4.66	1.15
	Center	8.00	3.00	9.00	7.93	5.66	2.51	4.66	1.52
	Right	9.33	8.38	4.33	1.15	6.66	3.05	11.00	8.88
PPQ	*Left*	3.66	2.87	2.00	0.40	2.79	0.009	2.20	0.92
	Center	2.66	0.57	3.33	1.52	2.33	0.80	2.63	0.20
	Right	4.33	3.93	2.33	0.78	3.50	0.90	3.17	0.93
SPI	*Left*	23.66	15.14	47.66	54.99	42.00	51.15	34.00	28.68
	Center	29.66	28.93	33.33	27.97	29.33	29.19	35.66	38.47
	Right	29.33	20.55	25.00	15.71	27.00	20.22	18.33	11.01
VTI	*Left*	0.07	0.04	0.12	0.07	0.10	0.07	0.07	0.03
	Center	0.09	0.03	0.22	0.22	0.10	0.05	0.10	0.08
	Right	0.07	0.04	0.36	0.49	0.09	0.06	0.06	0.05

With participant 3, left head turn (opposite side to the paralyzed cord side) was chosen randomly to practice the therapy procedure. The same is indicated in red colour in the graphs 5 and 6.Table 6 and 7 depicts all the details of mean and standard deviation for the acoustic and aerodynamic parameters across all baselines. As evident from graph 5, as an effect of treatment frequency related acoustic measure Fo increased at both left head turn (therapy initiated head turn indicated in red ink in graphs) (increased from 160.13 Hz to 182.91 Hz) and center head orientation (increased from 164.45 Hz to 172.48 Hz) while it showed decrease at right head turn (non initiated head turn indicated in green ink in graphs) (decreased from 174.37 Hz to 168.72 Hz).

The variation in fundamental frequency (vFo) decreased considerably for both left head turn (decreased from 14.25 % to 3.51 %) and center head orientation (decreased from 8.87 % to 3.61 %) while it increased at right head turn (increased from 11.06 to 13.21).

Amplitude Perturbation Quotient (APQ) decreased at both left head turn (decreased from 6.66 % to 4.66 %) and center head turn (decreased from 8.00 % to 4.66 %) while it showed an increase for right head turn (increased from 9.33 % to 11.00%).

Pitch Perturbation Quotient (PPQ) decreased for all head orientations. The decrease is greatest at left head turn (decreased from 3.66 % to 2.20 %) and least at center head orientation (decreased from 2.66 % to 2.63 %).

Glottal closure related measure SPI increased at both left head turn (increased from 23.66 to 34.00) and center head orientation (increased from 29.66 to 35.66), while decreased at right head turn (decreased from 29.33 to 18.33) as an effect of treatment.

Breathiness related acoustic measure VTI remained same at left head turn while it increased at center head orientation (increased a unit from 0.09 to 0.10) and decreased a unit at right head turn (decreased from 0.07 to 0.06).

Graph 6: Effect of treatment on mean MAFR values across baselines in participant 3.

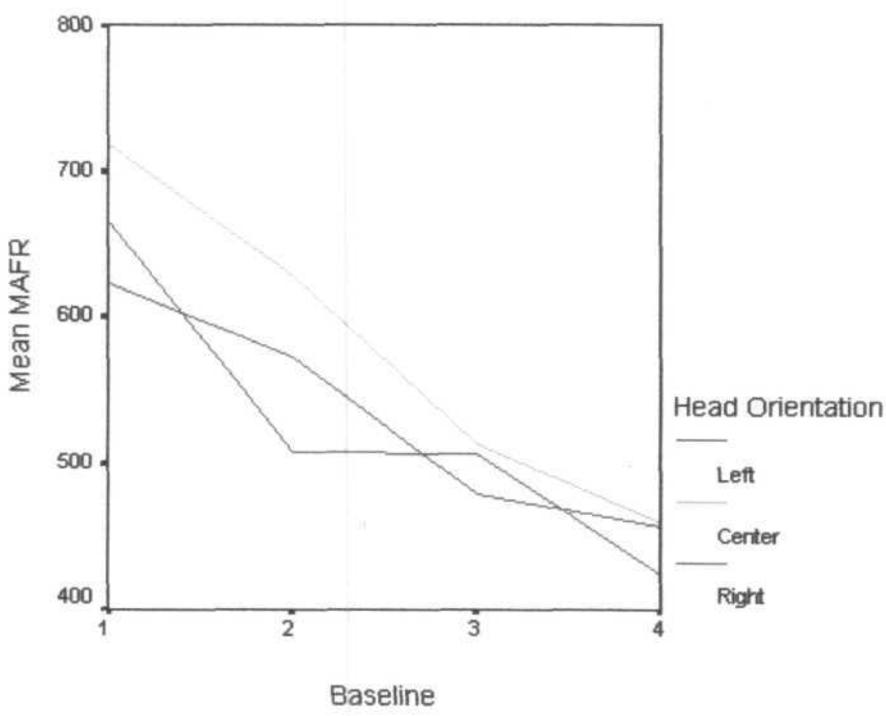


Table 7: Mean and SD of mean MAFR for participant 3 across baselines.

Head orientation	**Baseline 1**		**Baseline 2**		**Baseline 3**		**Baseline 4**	
	Mean	*SD*	*Mean*	*SD*	*Mean*	*SD*	*Mean*	*SD*
Left	665.00	59.86	507.67	39.58	507.67	38.51	423.67	43.68
Center	717.67	33.26	628.67	18.04	513.00	34.18	459.00	30.05
Right	623.00	93.64	573.33	37.86	459.00	19.30	457.00	15.00

As shown in graph 6 the mean MAFR values for the participant 3 decreased for all head orientations as an effect of treatment. However the decrement is greater for both left head turn (665.00 to 423.67 cc/sec) and center head orientation (717.67 to 459.00 cc/sec to) than right head turn.

Table 8: Comparative summary of **the overall changes in acoustic and** aerodynamic **parameters for three participants**

Acoustic measure	**Participant 1**			**Participant 2**			**Partcipant 3**		
	Left	**Center**	**Right**	**Left**	**Center**	**Right**	**Left**	**Center**	**Right**
Fo	Increased	Increased	Increased	Increased	Increased	Increased	Increased	Increased	Decreased
vFo	Decreased	Decreased	Decreased	Increased	Decreased	Increased	Decreased	Decreased	Increased
APQ	Decreased	Decreased	Decreased	Decreased	Decreased	Decreased	Decreased	Decreased	Increased
PPQ	Decreased	Decreased	Decreased	Increased	Decreased	Increased	Decreased	Decreased	Decreased
SPI	Increased	Decreased	Increased	Decreased	Decreased	Increased	Increased	Increased	Decreased
VTI	Decreased	Increased	Decreased	Decreased	Increased	Decreased	No change	Increased	Decreased
Aerodyna-mic measure MAFR	**Decreased**	Decreased	Decreased	Decreased	Decreased	Decreased	Decreased	Decreased	Decreased

Breathiness related measure VTI decreased for both left (decreased from 0.20 to 0.02) and right (decreased from 0.08 to 0.03) head turns while increased for center head orientation (increased from 0.10 to 0.28).

Graph 2: Effect of treatment on mean MAFR values across baselines for participant 1.

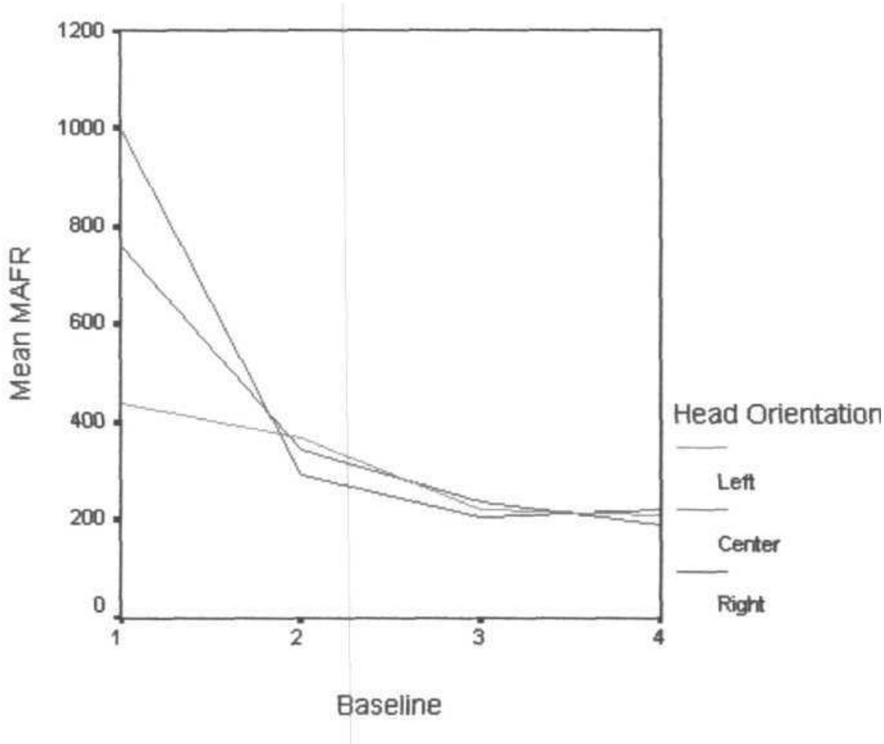


Table 3: Mean and SD of mean MAFR for participant 1 across baselines.

Head orientation	Baseline 1		Baseline 2		Baseline 3		Baseline 4	
	Mean	*SD*	*Mean*	*SD*	*Mean*	*SD*	*Mean*	*SD*
Left	440.33	72.78	367.97	21.34	222.80	6.84	210.53	8.26
Center	759.32	13.54	343.83	16.02	238.73	21.50	188.48	25.66
Right	997.30	179.62	293.33	8.33	204.50	7.05	222.57	12.95

DISCUSSION

The study explored the efficacy of head turn technique in treatment of patients with unilateral vocal cord paralysis. The acoustic measures Fo, vFo, APQ, PPQ, SPI and VTI and aerodynamic measure MAFR were employed to track the improvement in voice (indirectly inferring about vocal cords closure as well as periodicity of vibration).

With participant 1, head turn procedure was initiated with the opposite side (right head turn) to that of the paralyzed vocal cord (left vocal cord paralysis). As results indicate there was an increase in mean Fo at the baseline 4. However the mean Fo values are decreasing gradually from baseline 2, indicative of condition approaching normalcy (Patel, R., Parsram, K. S., 2005). The decrement in mean Fo was not stabilized but continued to decrease which indicates the requirement of many more sessions to observe a plateau. And also participant 1 showed reduced vFo, which is indicative of stable Fo production. The understanding that Fo production is stabilizing is complemented by reduced PPQ across the baselines. Glottal closure related measure SPI tracks systematic changes in vocal fold adduction (Nancye, C, R., et.al., 2006) and vocal fold adduction is Fo related in that glottal adduction decreases with increase in Fo (Titze, I. R., 1993). The decreasing VTI in both left and right head turn positions suggestive of reduced breathy component, as VTI is indicative of breathiness (as cited in CSL Manual, Kay Elemetrics, 4500) The decrease in VTI across baselines in participant 1 could be indicative of reduced breathiness. The decreasing mean MAFR values support the understanding that glottal closure improved compared to premorbid status. Hence, the decrease in vFo, APQ, PPQ, VTI and MAFR insinuates the efficacy of head turn procedure in achieving glottal closure in participant 1.

With participant 2, head turn procedure was initiated with the same side (left head turn) to that of paralyzed vocal cord (left vocal cord paralysis). Here, mean Fo increased gradually across baselines. Although increasing Fo is indicative of condition moving away from normal condition (Patel, R., et.at., 2005), decreased SPI values are indicative of reducing glottal gap. As well, decreasing perturbation related values (APQ and PPQ) and vFo are indicative of stabilized phonation. Decreasing mean MAFR supports the understanding that glottal leakage is reducing thereby indicating better vocal cord valving.

With participant 3, head turn procedure was initiated with the opposite side (left head turn) to that of paralyzed vocal cord (right vocal cord paralysis). Increasing Fo across baselines in participant 3 is indicative of persistence of premorbid status (Patel, R., Parsram, K. S., 2005). However, the decreasing vFo indicates that the phonation though at higher fundamental frequency, could suggest stable production of Fo. Decreasing perturbation related measures (both APQ and PPQ) were indicative that head turn practice resulted in stable frequency and intensity production. The SPI values are high at all head orientations at baseline 4 compared to baseline 1 which supports high Fo production, thereby indicating that glottal closure is not complete at high frequency productions. However, decreasing mean MAFR insinuates increasing glottal closure.

SUMMARY AND CONCLUSION

To summarize, the main aims of the study were (a) to delineate the efficacy of head turn technique in treatment of unilateral vocal cord paralysis, and (b) to delineate the preferred head turn at the initiation of therapy. Three individuals (two male and a female) ranging in age 30 to 52 years participated in the study. Participants were randomly assigned head turn (either left or right) at the initiation of therapy. All the three participants received three weeks, in other words 12 sessions of individual voice therapy by two postgraduate students.

Acoustic measures Fo, vFo, APQ, PPQ, SPI and VTI and aerodynamic measure MAFR were employed to examine the change in the voice as an effect of head turn therapy procedure. It was expected that if the therapy was efficacious it would result in considerable change towards normalcy in the parameters. As revealed by the results of these objective parameters, the function of glottal closure and stability of voice production with decreased perturbations both in frequency and intensity are noticeable but the stabilization in values were not noticed only to indicate that 12 sessions were not sufficient to show plateau. In addition, the degree of improvement was not same across the participants. It was expected that that the therapy would result in considerable difference in the values between the same and opposite sides of the paralyzed vocal cord depending on therapy initiated and non-initiated head turn. The results did not support the notion that the therapy shows differential improvement in voice with respect to the side of head turn employed for investigation in voice therapy.

Considering the above observation the following conclusions would be drawn,

- Head turn therapy procedure was useful in attaining glottal valving and also elicit stable voice production as measured on acoustic and aerodynamic parameters
- However, the degree of improvement was not same across the participants, which may be due to patient related variables such as age, onset, duration and severity of the problem, pathophysiology, and spontaneous recovery, patient motivation.
- The therapy procedure resulted in generalized improvement in all head orientations irrespective of the side of head turn chosen to initiate voice therapy.

Caveats and future directions

Although the study examined the efficacy of head turn technique in treatment of patients with unilateral vocal cord paralysis of adductor type using indirect measures of glottal closure such as both acoustic and aerodynamic measures, the results could have been supported with perceptual evaluation of the voice and/or the participants' self rating of voice. This is because the change in voice as indicated through acoustic measures may not always bring about functional change in a person. The future studies may consider the following aspects in planning the study,

- A large participants group
- Direct measures of glottal valving (such as Electroglottogram (EGG)) may be more helpful in determining the extent of glottal closure

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APPENDIX-II

Description of acoustic parameters employed in the study as described in Manual, Multi-Dimensional Voice Program (MDVP, Kay Elemetrics, Model: 4500).

Amplitude Perturbation Quotient (APQ): APQ measures the short-term period-to-period variability of the peak-to-peak amplitude within the analyzed voice sample at smoothing of 11 periods. Breathy and hoarse voices usually have an increased APQ.

Average Fundamental Frequency (Fo): Average value of all extracted period-to-period fundamental frequency values. Voice breaks are excluded.

Pitch Period Perturbation Quotient (PPQ): PPQ measures the short-term period-

to- period variability of the pitch with a smoothing factor 5 periods. Voice breaks are excluded. Hoarse and/or breathy voices may have an increased PPQ.

Soft Phonation Quotient (SPI): SPI is an average ratio of the lower-frequency harmonic energy in the range 70-1600 Hz to the higher-frequency harmonic energy in the range 1600-4500 Hz. Increased value of SPI is generally an indication of loosely or incompletely adducted vocal cords during phonation.

Coefficient of Fundamental Frequency Variation (vFo): vFo is a relative standard deviation of the fundamental frequency. It reflects, in general, the variation of Fo within the analyzed voice sample.

Voice Turbulence Index (VTI=0.06): VTI in absolute terms, is a ratio between noise in the range 2800-5800 Hz and the harmonic energy in the range 70-4500 Hz(harmonics/noise ratio on the high frequencies of the specrum.

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APPENDIX-I

Head turn technique (McFarlane, S.C., 1988)

Rationale : A change in head position away from the paralysis side may improve vocal quality and airflow by stretching the paralyzed vocal cord in an anterior-posterior manner, thus improving vocal cord contact at midline. Conversely, head turn to the side of the paralyzed vocal cord shortens the affected vocal cord thus enhancing the extent of the mucosal wave and resulting in improved vibration and better glottal valving.

Procedure:

- Instruct the patient to slowly turn head to one side and then to the other side while prolonging vowels /i/, /a/, /e/, */u/* while listening for improved vocal quality, intensity and airflow
- When optimum quality is achieved, head is kept in the new position while the patient practices nonsense syllables employing vowels and glides
- Patient is encouraged to kinesthetically appreciate the new configuration of the vocal cords as well attend to the auditory feedback of the improved voice. Nonsense syllables are extended to short phrases and sentences
- The head is gradually returned to midline while retaining the optimum quality