Efficacy of Head Turn Technique in Treatment of Unilateral Vocal Cord Paralysis: An attempt at evidence based practice

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Abstract

The present was designated to assess the efficacy of head turn technique in treatment of unilateral vocal cord paralysis. Three patients, 2 males and 1 female ranging in age from 30 to 51 served as participants. Acoustic and aerodynamic measures were obtained four times, that is, before, after 4^{th}, 8^{th} and 12^{th} therapy session. The head turn to initiate therapy was determined in random order to see the effect of head turn on the measures. Acoustic data was obtained by having the client phonate vowel /a/ in three head positions, right, center and left. Both right and left side made 70^{0} angle with the central marking. Aerodynamic measures and mean air flow rate was obtained in three head positions. The results indicated that head turn therapy procedure was useful in attaining glottal valving and also to elicit stable voice production. However the magnitude of improvement was not the same across participants. Also, the therapy procedure resulted in generalized improvement in all the head positions irrespective of head turn of therapy practice.

Introduction

Evidence Based Practice is all about answering a critical question "How do you know that what you do works". 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) who reviewed literature pertaining to evidence based treatment of various speech and language disorders. EBP issues related to voice disorders are 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., Casper,J., Colton,R. & Kelly, R., 2004).

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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.

The efficacy of head turn procedure in treatment of unilateral adductor vocal cord paralysis is observed along with other techniques. Mc 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, 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 re-innervation 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. and 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 could not conclude which side of head turn practice (towards paralyzed side or un-paralyzed side) was more helpful.

Paseman, Casper, Colton and Kelly (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.

Method

Participants

Participant group consisted of one female and two males all with unilateral vocal cord paralysis of adductor type. Among these two participants one had left vocal cord paralysis and another had right vocal cord paralysis. A qualified otolaryngologist diagnosed all the participants as having vocal cord paralysis of adductor type and recommended for voice therapy. Vocal cord paralysis was of recurrent laryngeal nerve lesion.

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

Three markings were made on the wall at eye-level. The patient's chair was positioned 3 meters away from the center mark. Two more marks were made on the same wall on either side of the center mark at a distance of 6 meters each. Each side marking made an angle of 70^{o} with the center marking. An angle of 70^{o} was chosen based on the earlier attempts at evaluating the efficacy of head turn procedure (Paseman, et.al., 2004).

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. They were also provided suitable demonstration regarding the 70^{0} 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, 2000).

Clinicians

Two postgraduate students 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 4^{th} (Baseline 2), 8^{th} (Baseline 3) and 12^{th} (Baseline 4) individual voice therapy sessions. 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 (MDVP) analysis. Head turn of 70^{o} 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 and mean airflow rate (MAFR) were 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 individuals with vocal cord paralysis (Patel & Parsram, 2005). Acoustic parameters PPQ, APQ were selected as they were significantly affected in individuals with vocal cord paralysis and were proved to be useful in monitoring the effects of treatment (Hirano, Hibi, Yoshida, Hirade, Kasuya & Kikuchi, 1988) and SPI was selected as it is found to indicate vocal cords adduction (Nancye & Mary, 2006).

Aerodynamic measures

Aerodynamic measure of 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, Xu & Woodson, 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, Orlikoff, Rizk & Rosenberg, D.B., 1999).

Statistical analysis

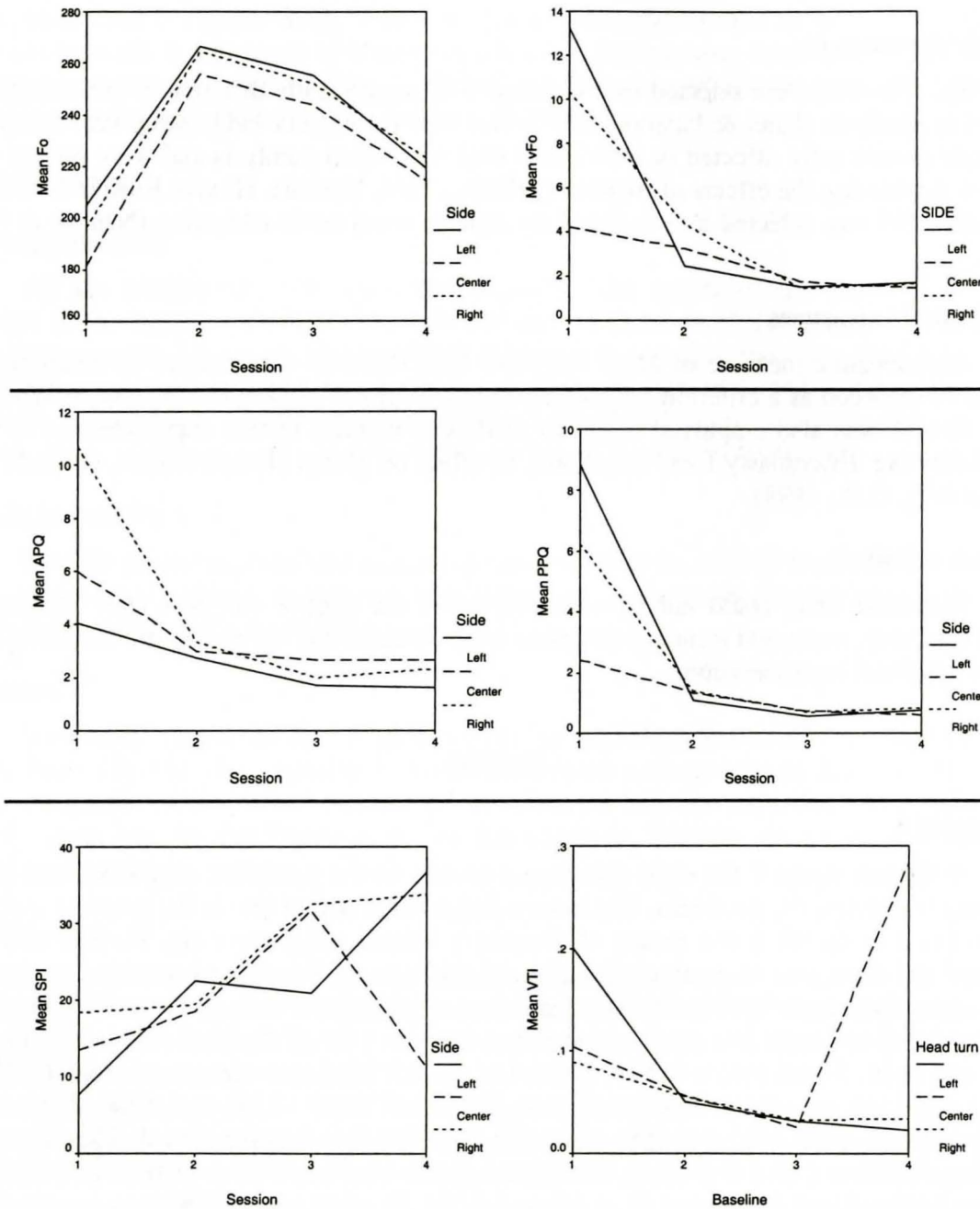
Statistical tools could not be administered as the sample size was less. Measures of central tendency, mean and standard deviation were obtained and the results are tabulated in the form of graphical representation.

Results

Participant 1

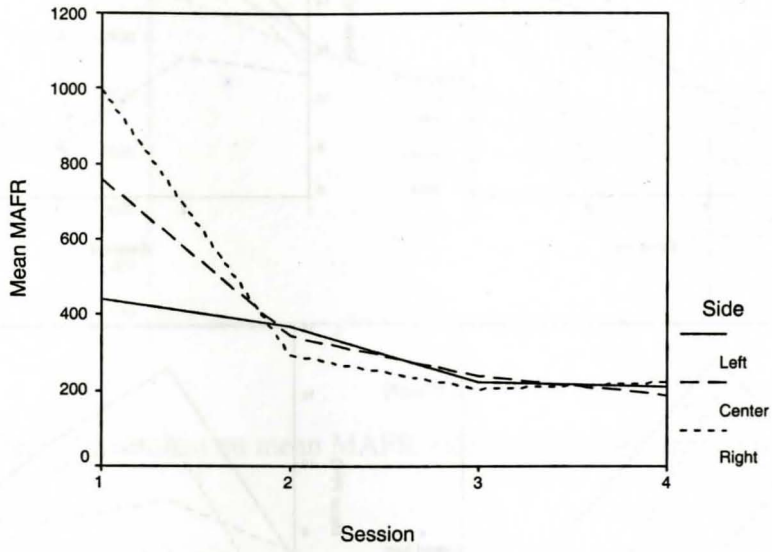
With participant 1 the right side (opposite side to the paralyzed cord side) was chosen randomly to practice the head turn. The same is indicated in dotted line in the graphs 1 and 2. As demonstrated in Graph 1 the means of frequency related parameters viz. Fo and vFo have increased and decreased respectively 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 (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% 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 from 18.36 to 33.78). However the SPI values for center head orientation decreased minimally (decreased from 13.47 to 11.23). 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 1: Effect of treatment on six acoustic parameters in Participant 1

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.

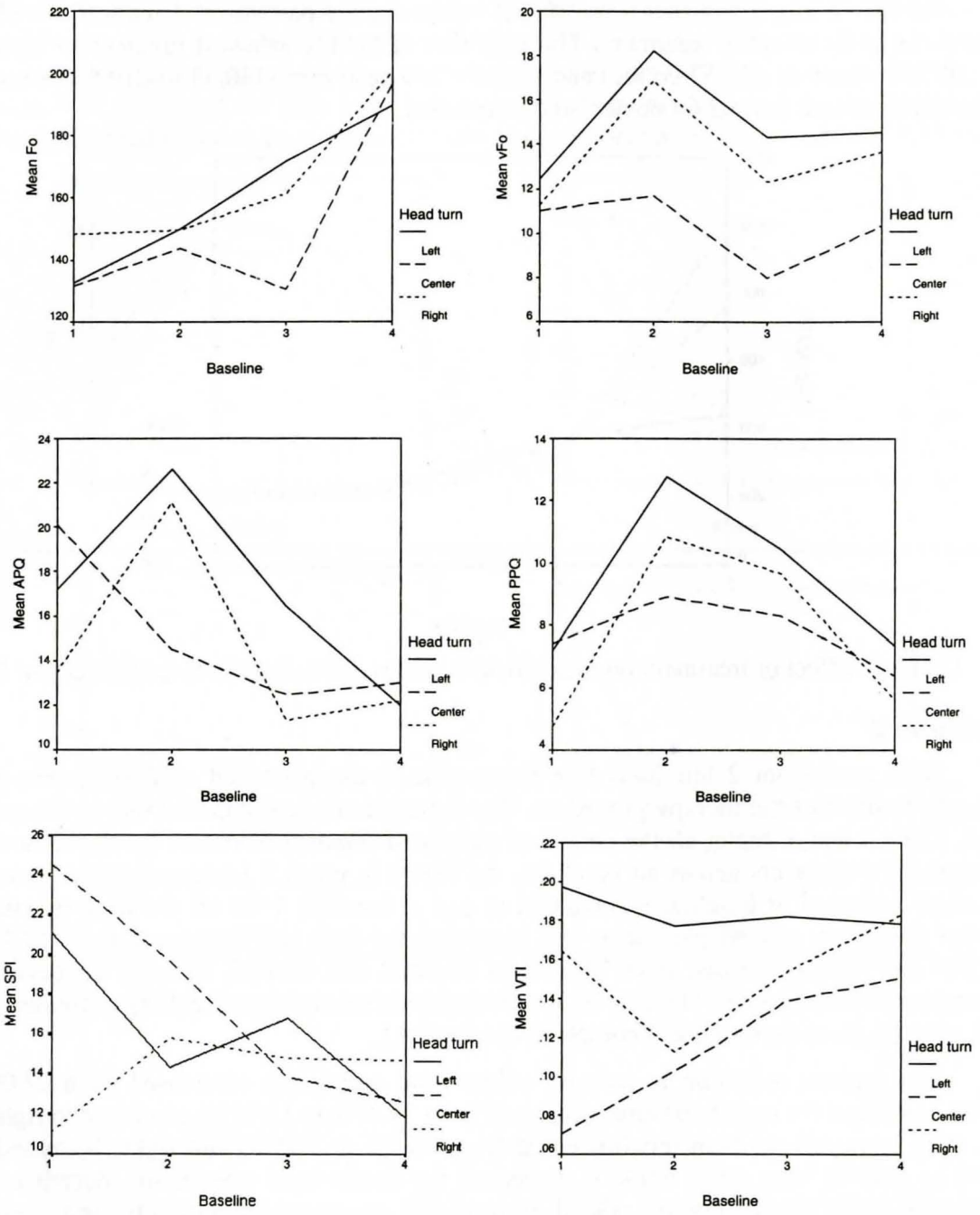


Graph 2: Effect of treatment on mean MAFR values across baselines for participant 1

Participant 2

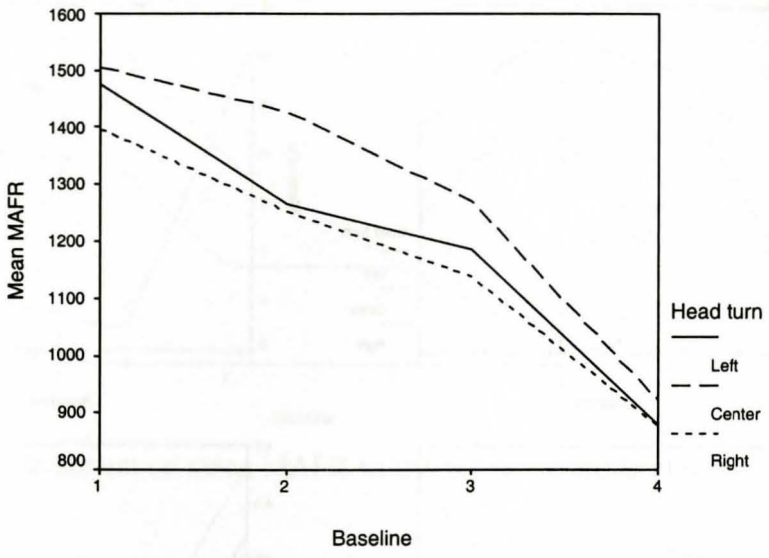
With participant 2 left head turn (same side to the paralyzed cord side) was chosen randomly to practice the therapy procedure. The same is indicated in dotted line in the graphs 3 and 4. Table 4 and 5 depict all the details of mean and standard deviation for the acoustic and aerodynamic parameters across 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 (increased from 12.47% to 14.55%) and right (increased from 11.27% to 13.67%) and 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 (increased from 7.16% to 7.35%) and right (increased from 4.77% to 5.62%) head turns while it decreased for center head orientation (decreased from 7.42% to 6.39%). 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 3: Effect of treatment on six acoustic parameters in Participant 2

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 was greatest at left head turn (decreased from 1475.00 cc/sec to 879.67 cc/sec) and least at right head turn (decreased from 1397.33 cc/sec to 877.00 cc/sec).

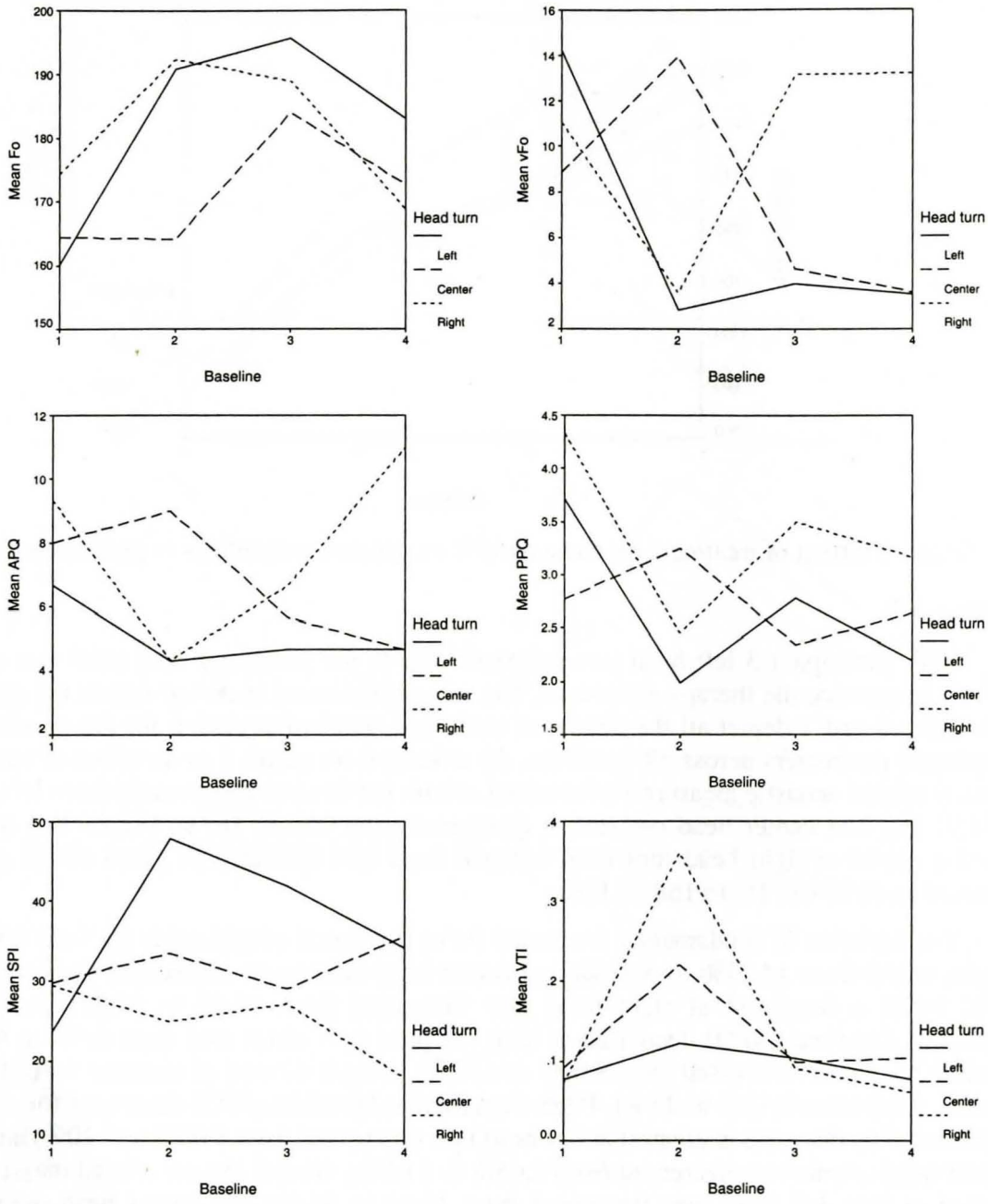


Graph 4: Effect of treatment on mean MAFR values across baselines in participant 2

Participant 3

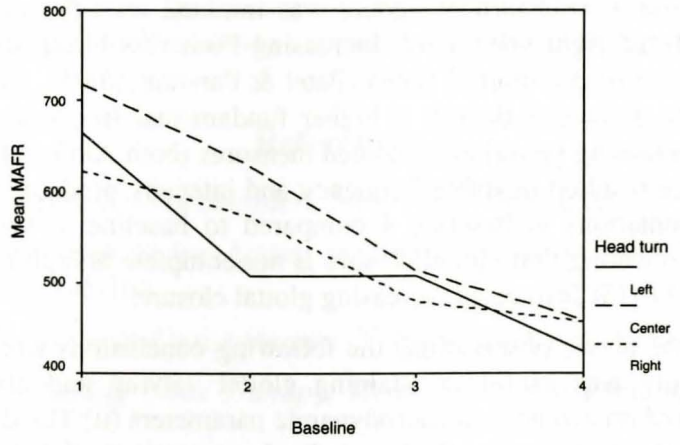
With participant 3 left head turn (opposite side to the paralyzed cord side) was chosen randomly to practice the therapy procedure. The same is indicated in dotted line in the graphs 5 and 6. Table 6 and 7 depict all the details of mean and standard deviation for the acoustic and aerodynamic parameters across all baselines. As evident from graph 5 as an effect of treatment frequency related acoustic measure Fo increased at both left head turn (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 6.6% 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%). 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 5: Effect of treatment on six acoustic parameters in Participant 3

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.



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

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 were decreasing gradually from baseline 2 indicative of condition approaching normalcy (Patel & Parsram, 2005). The decrement in mean Fo was not stabilized but continued to decrease which indicates the requirement of many more sessions to observe stability. Participant 1also showed reduced vFo, which is indicative of stable Fo production. The understanding that Fo production was stabilizing is complemented by reduced PPQ across the baselines. Glottal closure related measure SPI tracks systematic changes in vocal fold adduction (Nancye et.al., 2006) and vocal fold adduction is Fo related in that glottal adduction decreases with increase in Fo (Titze, 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 pre-morbid 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 et.al. 2005) decreased SPI values are indicative of reducing glottal gap. Also decreasing perturbation related values (APQ and PPQ) and vFo are indicative of stabilized phonation. Decreasing 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 right vocal cord. Increasing Fo across baselines in participant 3 was indicative of persistence of pre-morbid status (Patel & Parsram, 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 MAFR insinuates increasing glottal closure.

Considering the above observations the following conclusions would be drawn (i) Head turn therapy procedure was useful in attaining glottal valving and also elicit stable voice production as measured on acoustic and aerodynamic parameters (ii) 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 spontaneous recovery and patient motivation. (iii) The therapy procedure resulted in generalized improvement in all head orientations irrespective of the side of head turn chosen to initiate voice therapy

Conclusions

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 from 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/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 were 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.

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:

(i) A large participants group (ii) 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-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