

BACKGROUND & METHODS

BACKGROUND

Tinnitus has been defined as hearing sounds that are not produced from external auditory stimuli (1). There are two major types of sounds from tinnitus; white noise and a high pitched ringing (2).

Reports on the incidence of tinnitus vary from 5% to 15% for the U.S. population, and is positively correlated with age (3,4). A discussion of the various causes that have been proposed for tinnitus is beyond the scope of this paper (5-7).

To learn more about the causes, incidence, and treatment of tinnitus, Snow’s classic text on tinnitus is suggested (1). Two publications, in particular, report on the use of brain wave biofeedback, neurofeedback, to reduce tinnitus (8,9).

One common finding was that an increase in the alpha brain wave (ABW) of the electroencephalogram (EEG) was a factor in this reduction. In a seemingly unrelated area, biofeedback of ocular accommodation has been reported to similarly increase the ABW (10).

METHODS

Participants

After the decision was made to conduct the experiment, the first 11 patients receiving vision training from a private optometric practice were selected.

Of the 11, four self-reported as having tinnitus. The age range was from 7 to 67 years with a mean of 43.5 years.

Instruments

The vision training was conducted using the Accommotrac® Vision Trainer (AVT)* (Biofeedtrac Inc.). Details of the instrument are fully described elsewhere (10,11).

PROCEDURE & RESULTS

METHODS (continued)

Participants had their hearing measured pre- and post-vision training using the Hearing Test iPhone App by Piezo Hearsay Pte, Ltd, with Bose QuietComfort 15 noise cancellation headphones (12).

PROCEDURE

The instructional set given to and explained to the participants for the hearing tests was to use the ascending and descending method of limits.

After the pre-training hearing test each participant received one vision training session with the Accommotrac® Vision Trainer.

Following the vision training the post-training hearing test was conducted as per the pre-training procedure.

RESULTS

Overall there was a significant improvement, greater than 2 dB, in hearing for the tinnitus group at the 8k Hz frequency, with a 6.4 dB mean difference between the tinnitus minus the non-tinnitus group (13). See Figures 1-4, and Tables 1-4 for the specific changes.

CONCLUSIONS

The research hypothesis was that by using biofeedback of accommodation to increase the ABW, there will be an improvement in hearing and a reduction in tinnitus. As can be noted, this is a pilot study with a limited number of participants and tests for tinnitus, particularly in the tinnitus participant group, n = 4.

TRAINING & AUDIOGRAM RESULTS

TINNITUS AND NON-TINNITUS RESULTS

TABLE 1 ALL PARTICIPANTS

FREQUENCY**	AGE (YEARS)	GENDER	250 Hz	500 Hz	1kHz	2kHz	4kHz	8kHz
1 RE	36	M	6	0	2	0	0	2
1 LE			8	0	2	0	0	6
2 RE	36	F	0	0	0	0	0	6
2 LE			0	0	0	0	0	5
3 RE	7	M	14	10	0	10	0	19
3 LE			20	16	0	2	0	14
4 RE	65	M	4	0	0	0	0	47
4 LE			4	0	0	0	-6	20
5 RE	41	F	0	0	0	0	0	0
5 LE			0	0	0	0	0	0
6 RE	67	M	0	0	0	0	0	0
6 LE			0	0	0	0	0	10
7 RE	43	M	0	0	0	0	0	4
7 LE			0	0	0	0	0	10
8 RE	30	M	7	-6	10	0	-4	34
8 LE			-4	-2	-2	0	-4	-6
9 RE	57	F	0	0	0	0	0	0
9 LE			0	0	0	0	0	0
10 RE	34	M	0	0	0	0	0	0
10 LE			0	0	0	0	0	0
11 RE	63	M	0	0	0	5	0	0
11 LE			0	0	0	0	0	0
MEAN	43.5		2.5	0.9	0.5	0.8	-0.9	7.8

TABLE 3 TINNITUS PARTICIPANTS

FREQUENCY**	250 Hz	500 Hz	1kHz	2kHz	4kHz	8kHz
1 RE	6	0	2	0	0	2
1 LE	8	0	2	0	0	6
4 RE	4	0	0	0	0	47
4 LE	4	0	0	0	-6	20
6 RE	0	0	0	0	0	0
6 LE	0	0	0	0	0	10
11 RE	0	0	0	5	0	0
MEAN	3.1	0.0	0.6	0.7	-0.3	12.1

TABLE 2 NON-TINNITUS PARTICIPANTS

FREQUENCY**	AGE (YEARS)	GENDER	250 Hz	500 Hz	1kHz	2kHz	4kHz	8kHz
2 RE	36	F	0	0	0	0	0	6
2 LE			0	0	0	0	0	5
3 RE	7	M	14	10	0	10	0	19
3 LE			20	16	0	2	0	14
5 RE	41	F	0	0	0	0	0	0
5 LE			0	0	0	0	0	0
7 RE	43	M	0	0	0	0	0	4
7 LE			0	0	0	0	0	10
8 RE	30	M	7	-5	10	0	-6	34
8 LE			-4	-2	-2	0	-4	-6
9 RE	57	F	0	0	0	0	0	0
9 LE			0	0	0	0	0	0
10 RE	34	M	0	0	0	0	0	0
10 LE			0	0	0	0	0	0
11 RE	63	M	0	0	0	5	0	0
11 LE			0	0	0	0	0	0
MEAN	38.9		2.2	1.2	1	1	-1	5.7

TABLE 4 NON-TINNITUS VS. TINNITUS PARTICIPANTS

FREQUENCY*	250 Hz	500 Hz	1kHz	2kHz	4kHz	8kHz
NON-TINNITUS	2.2	1.2	0.5	0.8	-0.7	5.7
TINNITUS	3.1	0	0.6	0.7	-0.9	12.1
DIFFERENCE***	0.9	-1.2	0.1	-0.1	-0.2	6.4

* Post-Training Minus Pre-Training Audiogram Results by Frequency (dB)
** RE = Right Eye; LE = Left Eye
*** Tinnitus minus Non-Tinnitus value

PRE & POST TRAINING AUDIOGRAMS

FIGURE 1 Participant 1

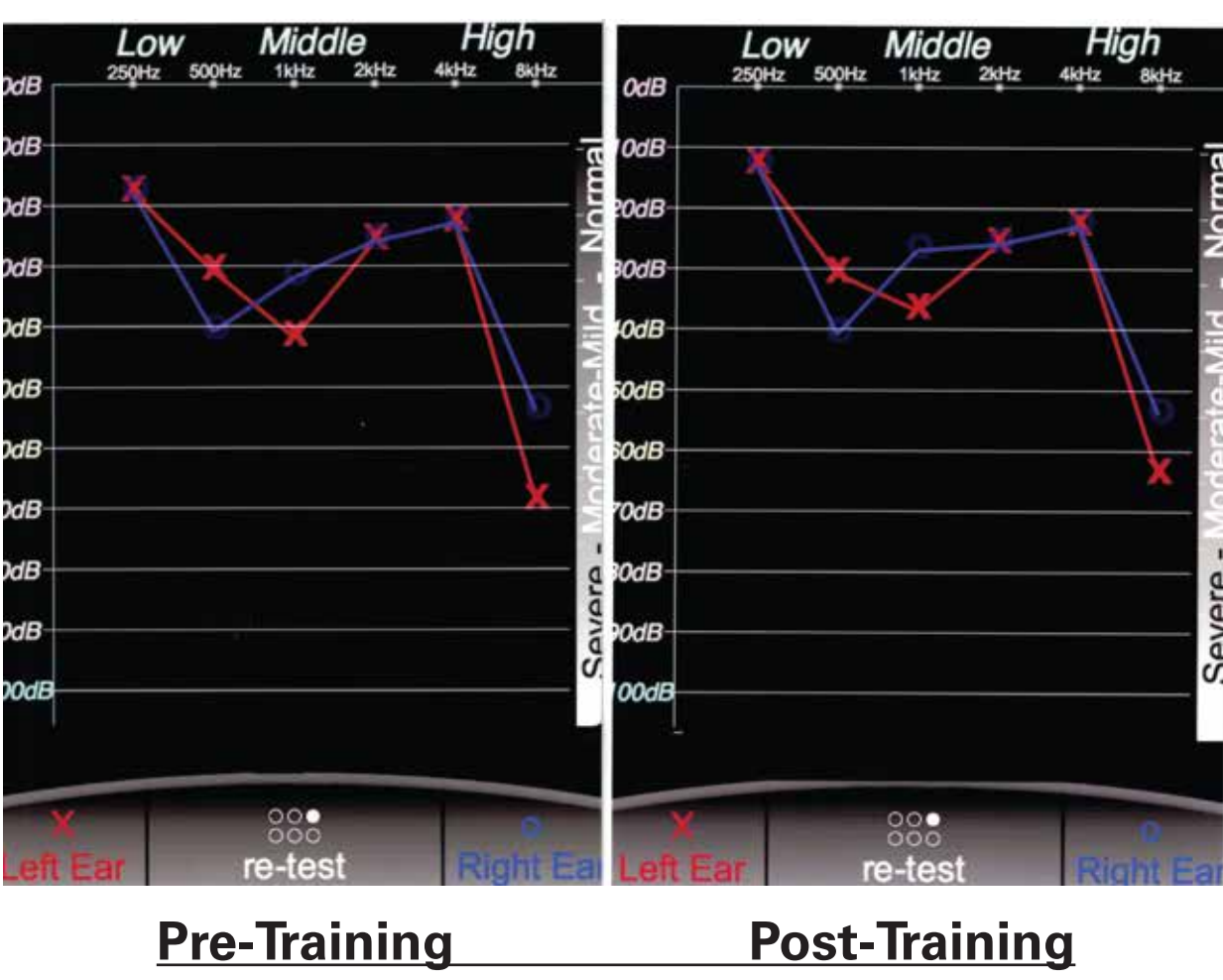


FIGURE 2 Participant 4

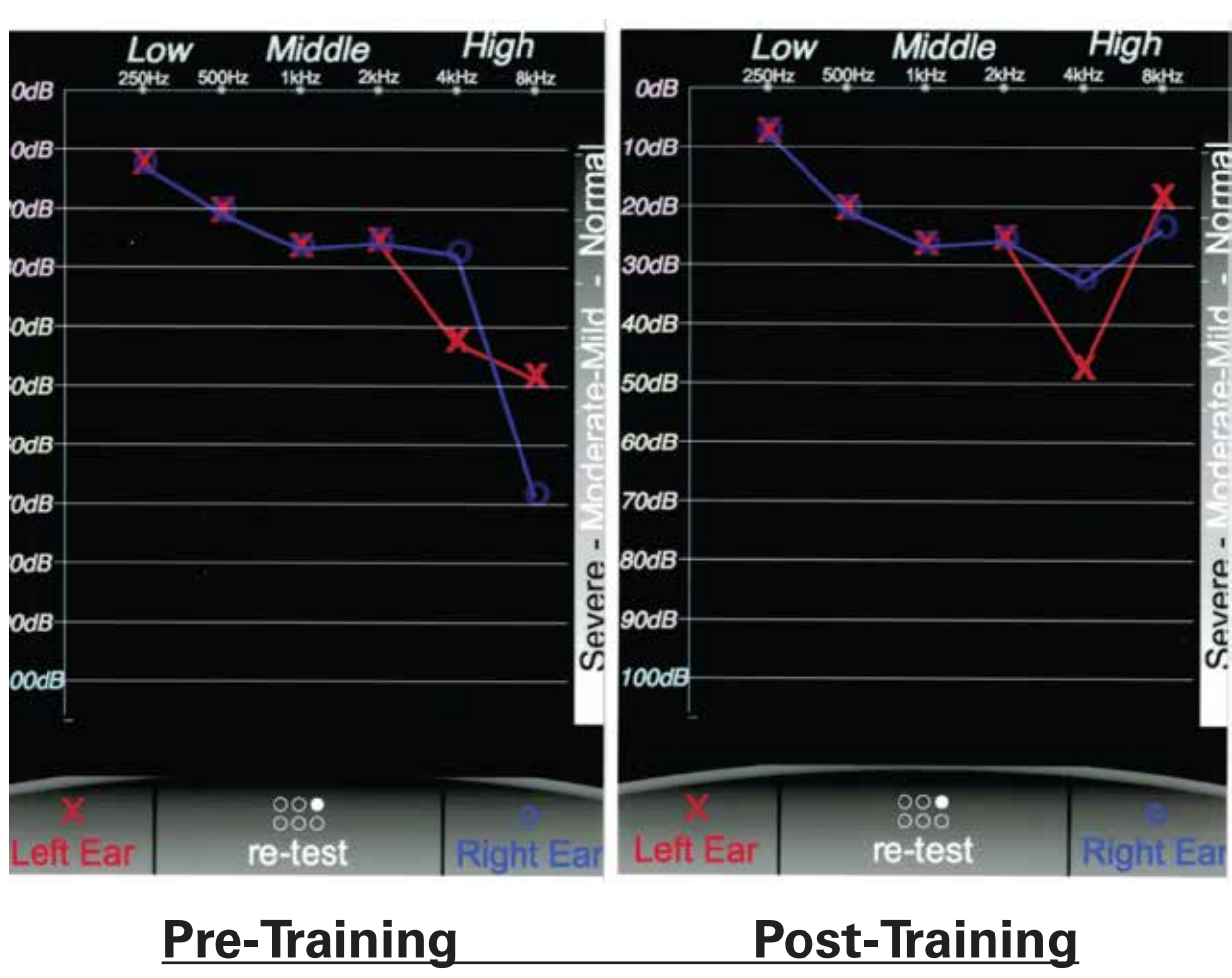


FIGURE 3 Participant 6

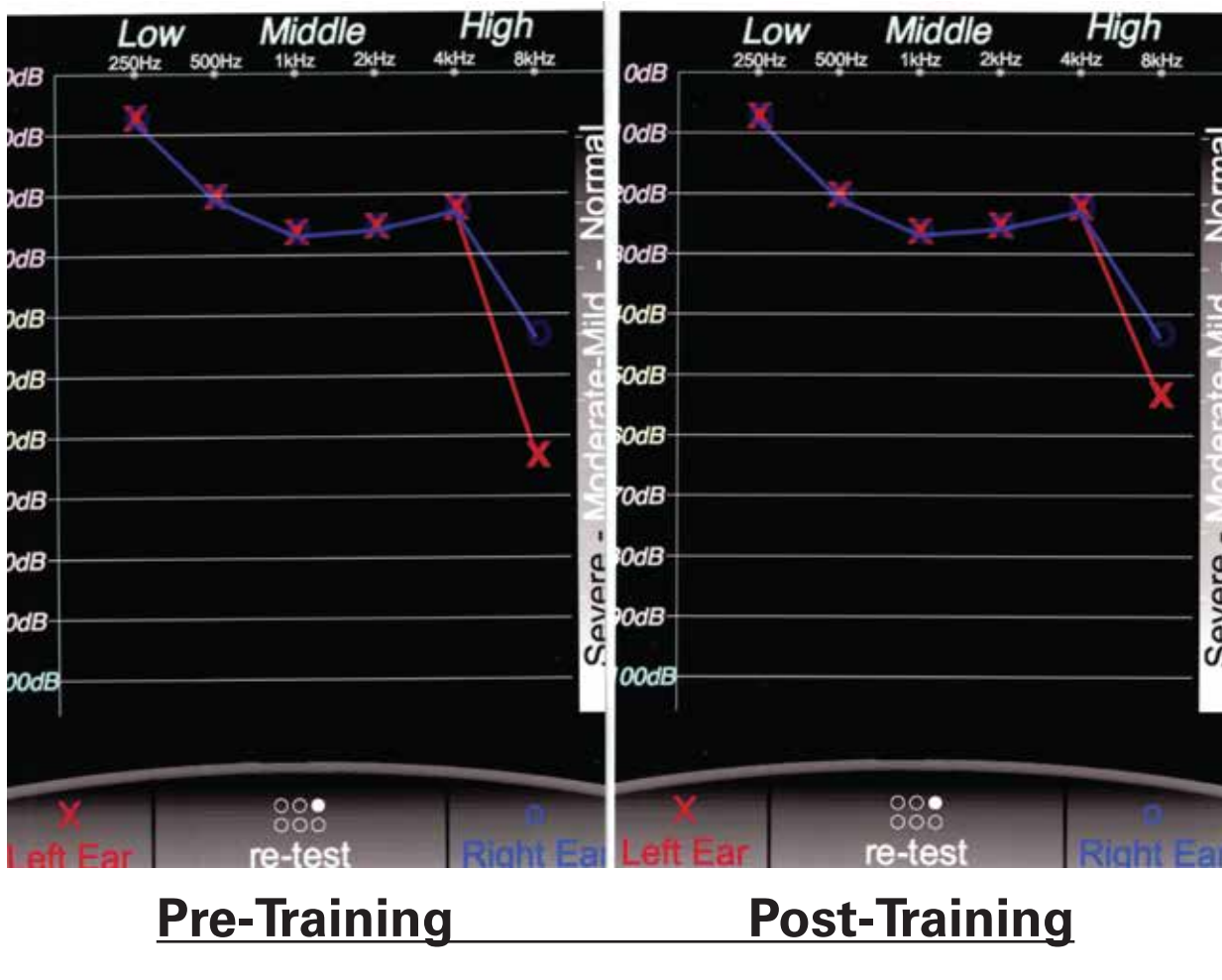
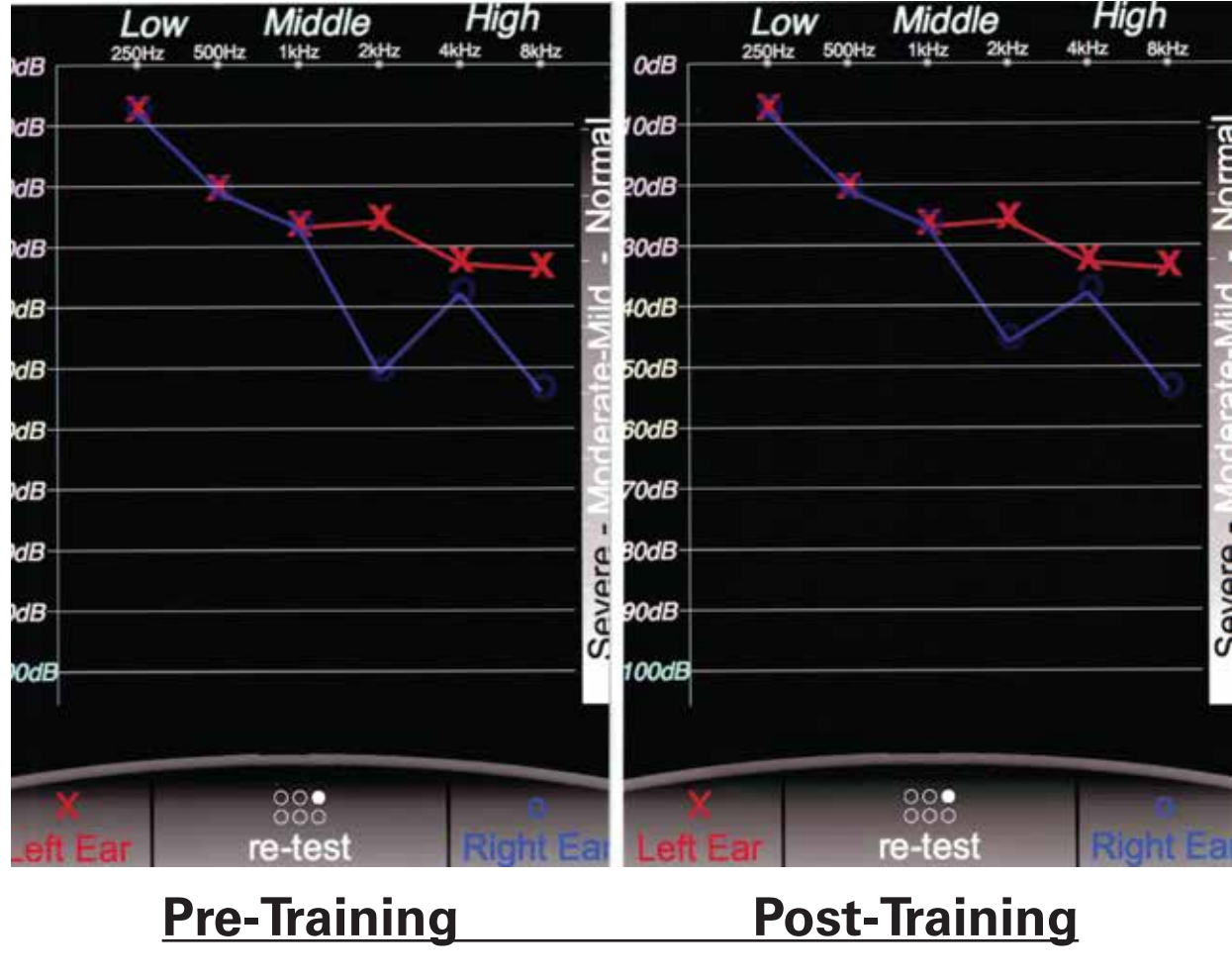


FIGURE 4 Participant 11



CONCLUSIONS

CONCLUSIONS (continued)

Overall in the non-tinnitus participant group there were significant improvements, according to the pre-determined 2 dB criterion, at 250 Hz and 8k Hz with a mean of 2.3 dB and 5.7 dB, respectively.

For the tinnitus group there was improvement at 250k Hz, and 8k Hz, with the most improvement at 8k Hz, a mean of 12.1 dB.

When comparing the two groups there was more benefit from the training, a mean of 6.4 dB, for the tinnitus group than for the non-tinnitus group.

Taking a look at individual data, a notably change was for participant 4’s LE at 8k Hz with a 47 dB hearing improvement post-training.

A possible explanation is that participant 4’s had a more severe case of tinnitus than the other participants.

Whether this is an accurate measurement or not is questionable, and can only be answered with a replication of the procedure using standard hearing testing.

Future research should include testing with an audiology testing booth, otoacoustic emissions test, an objective measure of tinnitus, and one of the standard tinnitus questionnaires, i.e. the Tinnitus Problems Questionnaire or the 52-item Tinnitus Questionnaire.

SOURCES

- 1 Snow JB, Jr. *Tinnitus: Theory and Management*. Hamilton, London: BC Decker, Inc; 2004.
- 2 Snow JB, Jr. History of the tinnitus research consortium. *Hear Res*. 2016;334: 2–6.

SUGGESTED READING

SOURCES

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