

## Use of a Bone-conduction Pillow and an Air-conduction Sound Pillow® Sleep System to Provide Tinnitus Relief and Promote Sleep

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### Introduction

The link between chronic tinnitus and sleep disturbance is well documented in the literature.<sup>1,2,3</sup> In clinical practice, patients often report difficulty falling or staying asleep due to their tinnitus. Addressing sleep disturbance is an essential element of a patient's plan of care due to the mental, emotional, and health effects of inadequate sleep. Sound therapy commonly is recommended to reduce tinnitus awareness and can come in many forms including tabletop sound spas, ear-level sound generators, or pillows containing one or more speakers. Use of an air-conduction pillow for tinnitus relief may be precluded by the severity of the patient's hearing loss. Thus, a bone-conduction pillow may be an option if it can provide sufficient stimulation for patients with asymmetric hearing loss or hearing loss with a conductive component. Use of a bone-conduction pillow with patients who have tinnitus has not been reported to date. The present investigation compared ratings for two pillows, one with air-conduction (AC) speakers and one with a bone-conduction (BC) transducer (see below for a description).

## Comparison of Two Pillows



- Sound Pillow® *Sleep System* with air-conduction speakers
- Fluffy pillow
- MP3 Player with 18 One-Hour Tracks: Nature, Music and Noise Files
- [www.soundpillow.com](http://www.soundpillow.com)



- Dreampad™ bone-conduction speaker (Intrasound Technology™)
- Flatter pillow used alone or on top of existing pillow
- Digital player with 5 relaxing music selections
- [www.dreampadsleep.com](http://www.dreampadsleep.com)

### Methods

Ten adult patients volunteered to participate in the study, which was approved by the Institutional Review Board at the University of North Carolina at Greensboro. All subjects reported significant tinnitus and sleep disturbance due to tinnitus as measured by baseline questionnaires.

- <sup>4</sup>*Tinnitus Reaction Questionnaire (TRQ)*: mean score = 49 (range: 17-100); 80% of subjects responded to Question #23 ("My tinnitus has interfered with my sleep.") with "3" ("a good deal of the time.") or "4" ("almost all of the time").

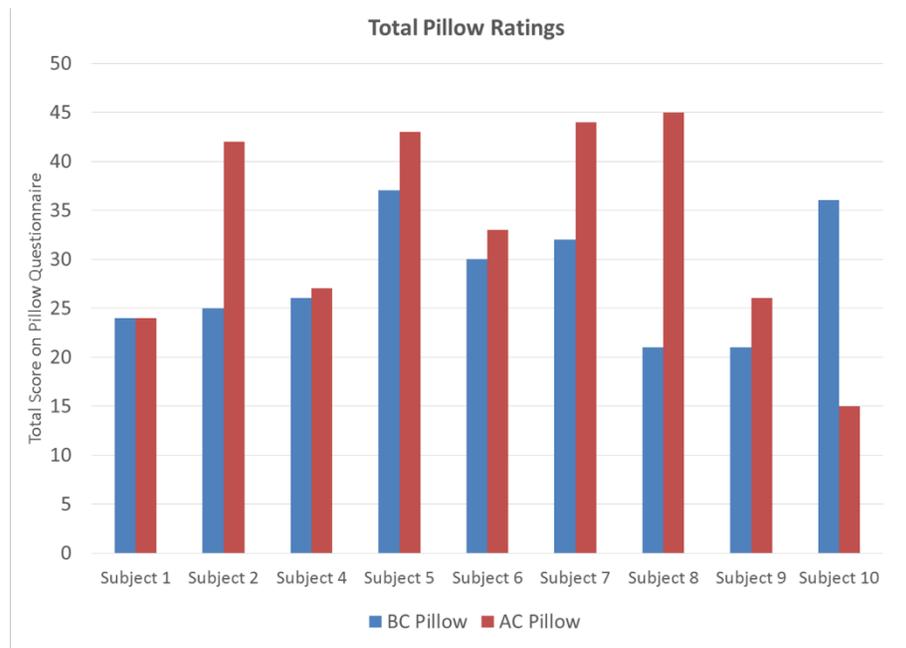
- <sup>5</sup>Tinnitus Primary Function Questionnaire (TPFQ) – 20-item version: mean total score = 52 (range: 21-96); mean score = 58 (range: 20-100) on sleep subscale.
- <sup>6</sup>Sleep Disorder Screening Questionnaire: mean total score = 10 (range: 3-18); 80% of subjects reporting symptoms consistent with “insomnia” (i.e., a persistent inability to fall asleep or stay asleep).

In addition, pure-tone hearing thresholds were measured to document severity of hearing loss. The majority of subjects had a sloping sensorineural hearing loss with normal pure-tone averages (average PTAs = 21 dB HL in right ear and 27 dB HL in left ear). Two subjects had an asymmetric hearing loss, one of which also had a significant air-bone gap consistent with a mixed hearing loss.

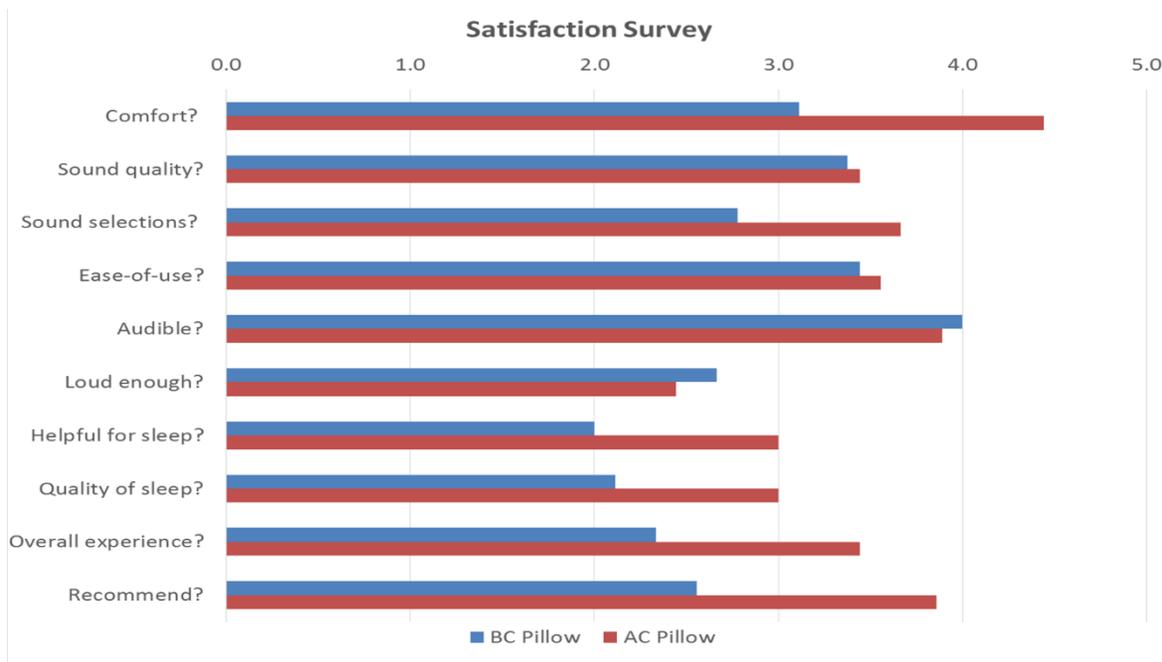
Participants were asked to use each pillow for one week (the order was counterbalanced). They completed the TRQ and TPFQ after using each pillow as well as a satisfaction survey evaluating each pillow. Upon completion of the study, subjects also completed a survey comparing the two pillows. One subject did not complete the study or any of the surveys. Results for the remaining nine participants are reported.

## Results

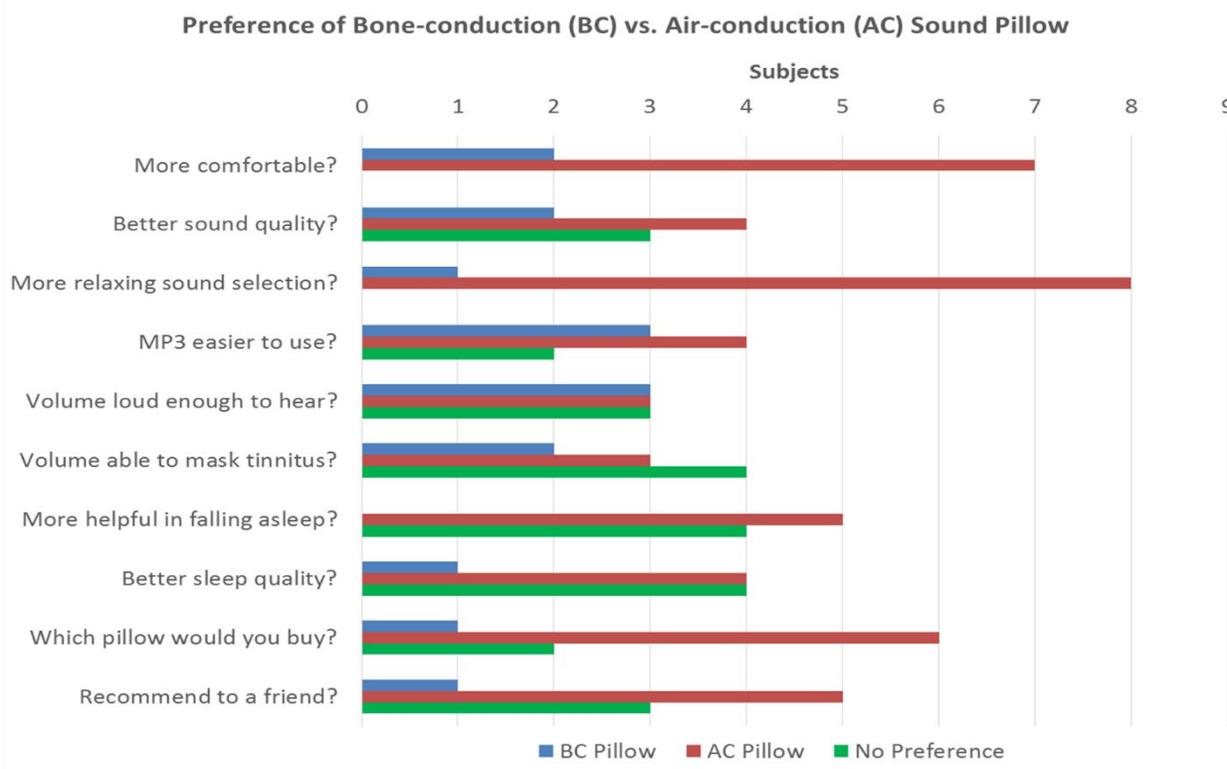
As shown in Figure 1 below, the majority of subjects (7 of 9) rated the AC pillow higher overall on a satisfaction survey. One subject rated the BC pillow higher and one subject rated both pillows equally. Average ratings on specific aspects of each pillow are provided in Figure 2 (upper right). Only two ratings reached the level of “good” (4): comfort for the AC pillow and audibility of the BC pillow. Although none of the average ratings approached the level of “excellent” for either pillow, individual ratings differed among subjects with the AC pillow receiving 23 “5” ratings and the BC pillow receiving only 10.



**Figure 1.** Total ratings on a satisfaction survey completed after a one-week trial with each pillow. Only subject #10 rated the BC pillow higher. Total possible score = 50.



**Figure 2.** Ratings on each item of the Satisfaction Survey completed after a one-week trial with each pillow. “1” = very poor/strongly disagree; “2” = poor/disagree; “3” satisfactory/neither; “4” = good/agree; “5” = excellent/strongly agree.

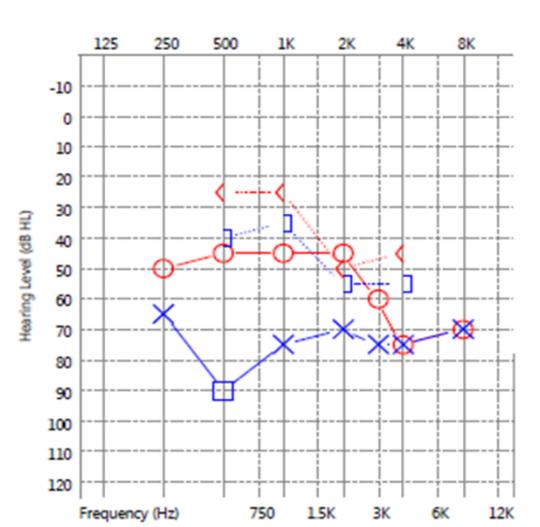


**Figure 3.** The number of subjects who preferred each pillow (or indicated “no preference”) on a satisfaction survey completed following trial of both pillows.

Preference for the Sound Pillow Sleep System was largely based on pillow comfort and available sound selections (see Figure 3). Although no clear preference was observed for audibility, two subjects reported they could not turn up the AC pillow loud enough to hear. When asked whether the volume was able to mask their tinnitus, half of the subjects reported neither pillow was loud enough. Several subjects also commented subjectively that the music provided with the BC pillow did not effectively mask their tinnitus, was distracting, or offered too few sound selections.

When comparing scores on questionnaires before and after pillow use, subjects reported little if any improvement in tinnitus or sleep disturbance. Some subjects even reported increased tinnitus disturbance following pillow use. This is possibly due to the short time of the trial (one week per pillow) and/or increased attention to tinnitus brought about by a change in sleep routine (e.g., perceived discomfort of the pillow).

Findings suggest the patient's hearing profile likely influenced pillow selection. One patient with a bilateral mixed hearing loss (see Figure 4) was unable to use the air-conduction pillow because it was not loud enough to hear. However, she was able to use the bone-conduction pillow with success. This patient has pulsatile tinnitus causing significant sleep disturbance. She wears a BAHA on one ear and a receiver-in-the-ear hearing aid on the other. Follow-up with this patient indicates continued usage of the BC pillow over time; however, she preferred a "waterfall" sound stimulus for better masking of her tinnitus. Subjective feedback about her experience with the BC pillow over ten months is provided below.



### Subjective Feedback

**6-Month Follow Up:** "The (bone-conduction) pillow has made a drastic difference in my sleep. I was not even sleeping in my bed before the pillow and was awake most of the night. Even though I am still struggling with the tinnitus...it has made a big difference because I am at least getting some rest now. The Sound Pillow did not work for me because I could not hear it when I took my BAHA off to sleep. The Dreampad has been a life saver. Because it is bone conduction I can hear it when my BAHA comes off and it is loud enough that it drowns out the tinnitus so I can go to sleep. I have used it every night. Thank you for introducing the Dreampad to me—it has made a tremendous difference in my quality of life."

**10-Month Follow Up:** "I am still using the pillow every night and am absolutely relieved to have it—it has been the only way that I have been able to sleep. In return, I do much better during the day because I have rested."

### Conclusions

This study has implications for sound therapy recommendations for patients with tinnitus and sleep disturbance. The AC pillow was preferred by the majority of subjects in this study. However, the BC pillow was preferred by one subject with bilateral mixed hearing loss. More research is needed comparing bone- and air-conduction pillows with equivalent comfort and sound selections to determine patient preference. The BC pillow now is available in a variety of sizes. A longer trial also may be required to observe measurable improvements in tinnitus and/or sleep disturbance. Additional benefits of bone-

conduction also may be investigated such as whether it elicits a calming effect through stimulation of the vagal nerve and activation of the parasympathetic nervous system.<sup>7</sup>

## References

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<sup>4</sup>Wilson, P.H., Henry, J., Bowen, M., & Haralambous, G. (1991). Tinnitus reaction questionnaire: Psychometric properties of a measure of distress associated with tinnitus. *Journal of Speech, Language, and Hearing Research, 34*, 197-201.

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<sup>6</sup>Sleep Disorder Screening Questionnaire. Retrieved from: <https://www.ghs.org/wp-content/uploads/2016/12/Sleep-Disorder-Screening-Questionnaire.pdf>.

<sup>7</sup>Olson, K. (2014). *Pilot Study: Measuring Relaxation Response to the iLs Dreampad*. Retrieved from: <http://integratedlistening.com/research/olson-hrv-study-sleepimage/>.

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***Results of this study were presented in April 2017 at the American Academy of Audiology (AAA) AudiologyNow! Conference held in Indianapolis, IN.***