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# Enhancing the Students Understanding of Place Theory of Hearing Using a Sonometer

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## ABSTRACT

The place theory of hearing considers the basilar membrane to be a series of stretched strings with different resonant frequencies. We have attempted to enhance the students understanding of this concept using a small group demonstration with a sonometer. Our results show that ninety five percent were of the opinion that this demonstration enhanced their understanding, ninety percent opined that this demonstration helped review this topic. We conclude that our model is suitable for resource limited settings and can be used for small group discussions.

***Keywords****: Place theory of hearing, sonometer*

## INTRODUCTION

The first MBBS students are introduced to the various theories of hearing in their curriculum. One among the theories is, the "*Place theory of hearing"* proposed by Georg v. Békésy. The place theory of hearing considers the basilar membrane like a series of stretched strings each, resonating at a different frequency[1]. We felt that, explaining the theory with a demonstration along with the conventional lecture would enhance the students understanding of this concept.

Life size micro-machined models[2,3], real time visualization of the oscillations of the model could be done[1]. However we felt that usage of cost effective items to would be better in resource limited settings. Hence we chose to use the sonometer for this demonstration.

## MATERIALS AND METHOD

A wooden sonometer, along with tuning forks (128 hz, 256 hz, 512 hz and 1024 hz) of various frequencies were used in the demonstration. The demonstration was done to first year medical graduates in small groups of 15 each. The students had already attended a lecture on theories of hearing a week back.

A schematic of the sonometer is shown in Figure 1. When a vibrating tuning fork is placed on the top of the sonometer, the stretched string between the two wooden bridges begins to resonate if the length is appropriate. The length can be quickly determined by adjusting the wooden bridges. The resonance can be demonstrated by placing a rider paper over the string, when the string resonates, the rider paper falls. Thus different lengths of the stretched string resonates at different frequencies.

Prior to the demonstration, the students were briefed what a sonometer was. They were also briefed that, the resonant frequency of the stretched string depended inversely on the frequency (higher the frequency, shorter the length of the stretched string). The students were then demonstrated how tuning forks of different frequencies required different lengths of the stretched string for resonance. They were then asked to imagine the basilar membrane to be a series of such stretched strings each of which would resonate at a particular frequency.

To assess the usefulness of the demonstration, students were asked to give a anonymous written feedback (Table 1).

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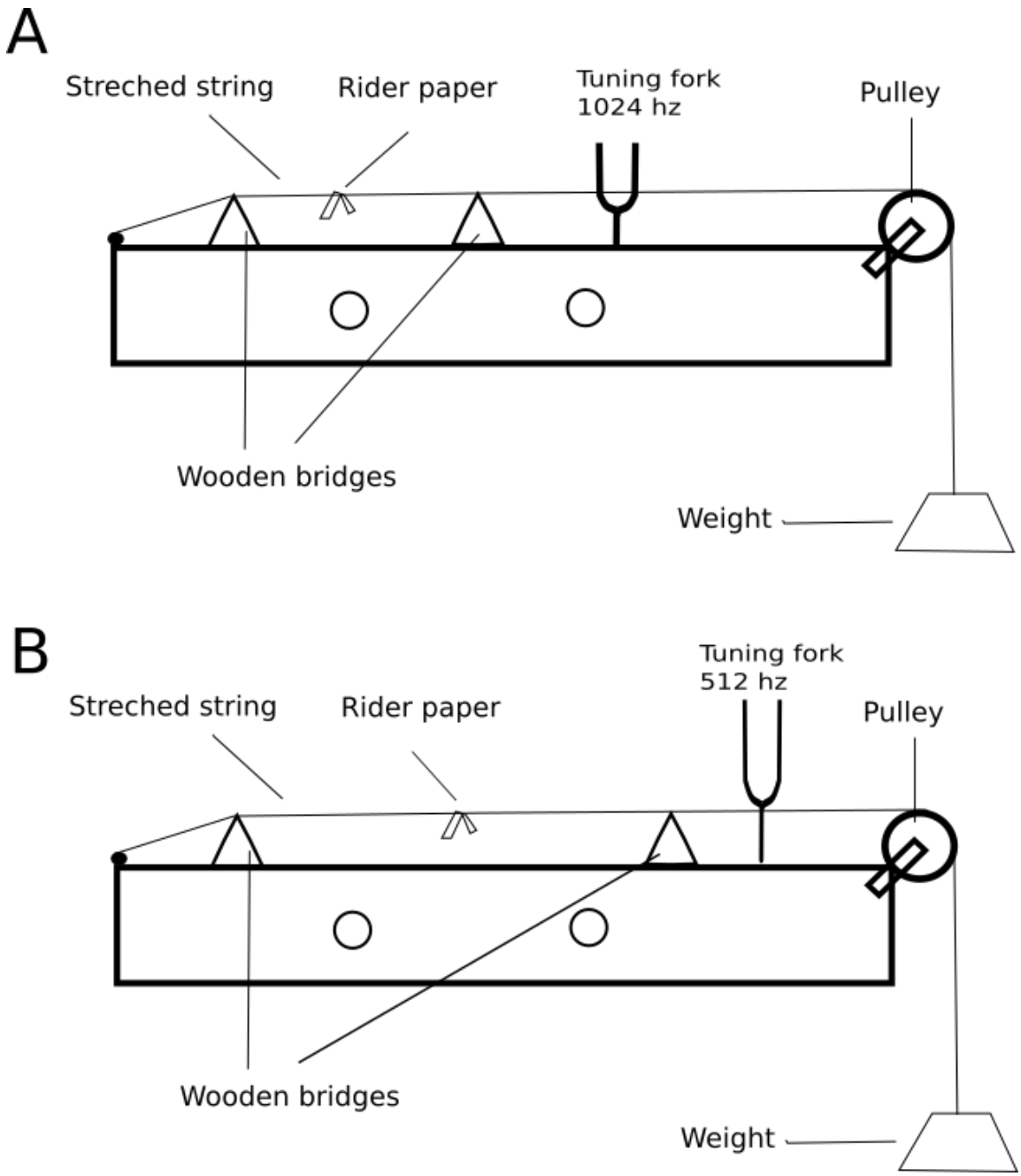


**Figure 1: Schematic of the sonometer. (A) Shows the length of the string when a high frequency (1024 hz) tuning fork would be used. (B) Show the length of the string when a relatively low frequency (512 hz) tuning fork would be used.**

## RESULTS

The feedback was completed by one hundred and twenty five students. The data collected is expressed as percentage of the total students who responded (see Table 1). 95 % of student opined that this demo helped them in improving their understanding of the place theory of hearing. 89 % percent of students felt that the demo helped them review the topic. 97 % of the students responded that they would recommend this demonstration to future batches of students and 85 % of the students felt that this demonstration made their learning fun and exciting. They used words like "innovative" and "helpful" to describe the demonstration and no comments were negative.

**Table 1: Consolidated feedback from students.**

| Question | Yes (%) | No (%) | Not sure (%) |
|---|---|---|---|
| My understanding of the place theory of hearing improved with this demo | 95.2 | 0.8 | 4 |
| This demo helped me review the topic | 89.6 | 0.8 | 8.8 |
| I would recommend such demo for the future batches of students | 97.6 | 0 | 2.4 |
| Was learning exciting and fun with demo? | 85.6 | 4 | 10.4 |

## DISCUSSION

Medical students now prefer multiple modes of information delivery to learn4. Demonstrations form an excellent supplement to the traditional didactic lectures. Demonstrations enhances the enthusiasm and interest in learning and thus enhances the active learning and understanding of the subject[5]. The students get time to interact and discuss with the demonstrator and among themselves regarding the concept, which again enhances the students interest in the subject which enhances the students understanding[6,7].

Our demonstration uses a ready made sonometer which costs around Rs 1000 only. For demonstrating to a single group, it took only 15 min. Thus our model could be used in resource limited settings.

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## CONCLUSION

Our model is suitable for teaching the concept of place theory of hearing in small groups. It can be used in resource limited settings and thus can enhance the students understanding of the place theory of hearing by increasing the students enthusiasm and interest in learning.

**Conflicts of Interest:** Nil

**Ethical Clearance:** Taken from The Ethical committee, KAPV Govt. Medical College, Tiruchirapalli.

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