

Is Blu-tack as effective at attenuating sound as over-the-counter ear plugs?

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Abstract

Objective: To demonstrate that Blu-tack is equally effective at attenuating sound as over-the-counter ear plugs.

Methods: Nineteen healthy volunteers had their hearing thresholds assessed before and after the insertion of over-the-counter ear plugs. The results were compared with hearing thresholds following the insertion of Blu-tack. Thresholds were tested at: 0.5, 1, 2, 3, 4, 6 and 8 kHz. The differences were compared, and *p* values of less than 0.02 were regarded as significant. Using a visual analogue scale, volunteers were asked to assess the comfort and ease of insertion of the ear plugs and Blu-tack, and their peace of mind whilst using the ear plugs and Blu-tack.

Results: Blu-tack was less effective at attenuating sound at low frequencies, but was as effective as over-the-counter ear plugs at attenuating sound above 3 kHz. Blu-tack was significantly more comfortable to wear (*p* = 0.006). There was no difference in terms of ease of insertion and peace of mind.

Conclusion: Blu-tack can be regarded as a comfortable alternative to over-the-counter ear plugs for the attenuation of everyday sound.

Key words: Ear, External; Hearing Loss; Sound; Acoustic Stimulation; Ear Protective Devices

Introduction

We are exposed to noise on a daily basis and this can have physiological and psychological effects.^{1,2} Numerous hearing protection devices exist, including over-the-counter ear plugs in the form of foam, putty, wax and silicone polymers. This paper aimed to determine whether Blu-tack (Bostik, Leicester, UK) was as effective at attenuating sound as over-the-counter ear plugs.

Materials and methods

Study design

This was a prospective, case-control (within subjects) pilot study.

Participants

Twenty healthy volunteers from the ENT and audiology departments were approached to take part in the study. The volunteers were given information sheets on what to expect during the study and, if they agreed to take part, consent was obtained.

Inclusion criteria consisted of normal hearing thresholds and middle-ear impedance (type A). Exclusion criteria included: active external or middle-ear conditions, conductive hearing loss, abnormal

impedance (types B or C), and active skin conditions (eczema, psoriasis or contact dermatitis).

Study setting

The study took place in the Audiology Department at Withington Community Hospital, which is part of the University Hospital of South Manchester, from January 2010 to July 2010.

Procedure

Prior to inserting the ear plugs or Blu-tack, measurements were taken of each volunteer's air conduction thresholds (at 0.5, 1, 2, 3, 4, 6 and 8 kHz) and bone conduction thresholds (at 0.5, 1, 2 and 4 kHz) to ensure that there was no conductive hearing loss. Middle-ear impedance was also measured to ensure normal middle-ear compliance.

In order to avoid variability, the volunteers were tested by the same senior audiologist, using the same audiometer (Practice Navigator; Siemens, Camberley, UK), tympanometer (Kamplex KT20; Stockwell, London, UK) and sound booth (in the audiology department).

The volunteers were provided with: E-A-Rsoft disposable yellow foam plugs (Aearo, Poynton, Stockport, UK), Boots Muffles wax ear plugs (Boots, Nottingham, UK),

Boots Flight ear plugs (Boots, Nottingham, UK) and Blu-tack. They were then shown how to insert each ear plug correctly according to the manufacturers' instructions. (Blu-tack was rolled into a ball the size of the conchal bowl and pressed firmly into the ear to conform to the shape of the bowl and outer aspect of the auditory canal).

Once each ear plug (or Blu-tack) was in position, changes in air conduction thresholds were then re-measured in the right and left ears. The differences in air conduction thresholds for each ear plug were calculated and compared with the thresholds for Blu-tack.

Using visual analogue scales (VAS), volunteers were asked to assess the ease of ear plug or Blu-tack insertion, the degree of discomfort and their peace of mind using the ear plugs or Blu-tack. (Very easy to insert, very comfortable and total peace of mind corresponded to VAS scores of 1, and very difficult to insert, very uncomfortable and no peace of mind were associated with scores of 10.)

Ethical considerations

Full local ethical approval to carry out the study was obtained from the North West 2 Research Ethics Committee – Liverpool Central (10/H1005/11). The study was also approved by the Research and Development Department at the University Hospital of South Manchester NHS Trust (2009ET004).

The Safety Executive of Bostik was contacted and queried regarding the compounds in Blu-tack to ensure they were inert and that Blu-tack was safe to be placed in the conchal bowl. Permission was also sought to use Blu-tack for the purpose of an ear plug.

Statistical methods

The results of the respective audiograms were compared using a generalised estimating equation regression model to assess differences between ear plugs and Blu-tack, and between frequencies within subjects. A similar method of analysis was used for the VAS scores. A *p* value of less than 0.02 was regarded as significant. Data were analysed using the Statistical Package for the Social Sciences version 19 statistical software program (IBM, New York, USA).

Results

Of the 20 volunteers approached, 1 did not take part as they were unavailable for the duration of the study. There were 5 male and 14 female volunteers, with ages ranging from 17–56 years. All volunteers had normal middle-ear impedance and there was no significant difference in the hearing between left and right ears. The amount of sound attenuated by the over-the-counter ear plugs and Blu-tack is summarised in Table I and demonstrated graphically in Figure 1.

On visual inspection, the values in Table I and the graphical representation indicate a similar pattern between the different ear plugs (including Blu-tack).

TABLE I
SOUND ATTENUATION LEVELS FOR EAR PLUGS AND BLU-TACK

Ear plug	Frequency (kHz)							
	0.5	1	2	3	4	6	8	
Blu-tack	13.0 (9.7, 16.3)	14.7 (11.4, 18.1)	25.3 (21.8, 28.7)	27.0 (23.4, 30.6)	26.7 (23.2, 30.2)	26.2 (23.0, 29.4)	28.0 (23.2, 32.9)	
Foam	18.8 (16.1, 21.50)	18.4 (15.9, 21.0)	26.3 (22.4, 30.2)	30.3 (26.3, 34.2)	31.6 (27.0, 36.1)	30.7 (25.8, 35.5)	30.8 (24.6, 36.9)	
Silicone	19.7 (13.6, 25.9)	22.4 (17.0, 27.8)	29.0 (23.9, 34.0)	29.1 (24.4, 33.7)	26.8 (21.6, 32.1)	29.7 (24.0, 35.5)	30.4 (24.2, 36.6)	
Wax	16.8 (13.1, 20.6)	17.4 (14.1, 20.6)	28.6 (23.2, 33.9)	30.9 (26.4, 35.4)	30.8 (26.3, 35.3)	31.3 (24.6, 38.0)	34.1 (26.6, 41.6)	

Data represent intensity values (mean (95% confidence interval); dB)

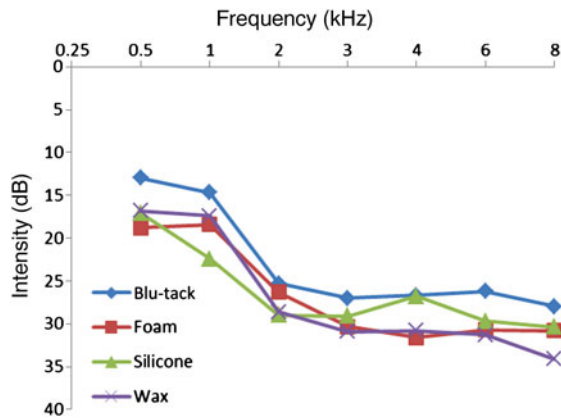


FIG. 1

Sound attenuation levels of ear plugs and Blu-tack.

However, analysis of the difference in the sound attenuated between Blu-tack and the ear plugs (Table II) revealed that Blu-tack had significantly lower sound attenuation at 0.5 and 1 kHz ($p = 0.001-0.019$). At 2 kHz, foam had similar sound attenuation to Blu-tack ($p = 0.38$), but wax and silicone flight ear plugs were better ($p = 0.06$ and 0.09 respectively). At 3 kHz, silicone flight ear plugs had a similar sound attenuation to Blu-tack ($p = 0.21$), but foam and wax ear plugs were better ($p = 0.09$ and 0.08 respectively). At 4 kHz, Blu-tack was associated with lower readings compared with foam and wax ear plugs, but this difference was not significant at the adjusted threshold of $p = 0.02$. There was no difference between ear plugs (including Blu-tack) at 6 kHz. At 8 kHz Blu-tack was associated with lower readings compared with wax ear plugs, but again this difference was not significant at the adjusted threshold of $p = 0.02$.

Analysis of the VAS scores (Table III) showed Blu-tack was rated as significantly better than the ear plugs in terms of comfort, with a p value of 0.006 . There was no difference between the ear plugs (including Blu-tack) when it came to ease of insertion or peace of mind.

Discussion

We are exposed to excessive noise on a daily basis. Fortunately, most of the time this is short-lived and does not result in inner-ear damage or psychological problems.¹⁻³ However, exposure to prolonged periods of noise above 80 dB can result in noise-induced hearing loss, with a characteristic notch at 3 kHz on a pure tone audiogram.³⁻⁵

A variety of hearing protection devices are currently available. A range of over-the-counter ear plugs can be purchased at pharmacies, including foam, rubber, silicone and wax ear plugs. They are all affordable, comfortable, disposable, and aim to attenuate mid to high frequency sounds by 20-30 dB.

Blu-tack, which has been available since the 1970s, is a non-toxic, inexpensive, self-adhesive putty produced by Bostik. It can easily be moulded into the

TABLE II
DIFFERENCE BETWEEN EAR PLUGS AND BLU-TACK

Comparison	Frequency (kHz)							
	0.5	1	2	3	4	6	8	
Foam vs Blu-tack	5.8 (2.4, 9.2)*	3.7 (0.6, 6.8)*	1.0 (-1.4, 3.4)	3.3 (0.8, 5.8)*	4.9 (0.3, 9.4)†	4.5 (-0.2, 9.2)†	2.8 (-1.9, 7.5)	
Silicone vs Blu-tack	6.7 (1.5, 11.9)*	7.6 (2.8, 12.4)*	3.7 (-0.6, 8.0)†	2.1 (-1.7, 5.9)	0.1 (-1.7, 5.9)	3.6 (-2.8, 10.0)	2.4 (-3.0, 7.8)	
Wax vs Blu-tack	3.8 (0.6, 7.0)*	2.6 (-1.4, 6.6)*	3.3 (-0.2, 6.8)†	3.9 (0.9, 6.9)*	4.1 (0.9, 6.9)†	5.1 (-1.3, 11.5)	6.0 (0.8, 11.2)†	

Data represent difference values (difference (95% confidence interval)). * $p < 0.02$, † $p < 0.10$

TABLE III
VAS RESULTS FOR EAR PLUGS AND BLU-TACK

VAS item	Ear plug				<i>p</i>
	Blu-tack	Foam	Silicone	Wax	
Ease of insertion	3.3 (2.6, 4.1)	3.5 (2.6, 4.4)	3.7 (2.6, 4.9)	3.8 (3.0, 4.6)	0.61
Degree of discomfort	3.6 (2.7, 4.6)	4.8 (4.1, 5.4)	5.4 (4.3, 6.5)	4.0 (3.2, 4.8)	0.006*
Peace of mind	4.2 (3.5, 4.9)	4.8 (3.9, 5.8)	5.0 (3.9, 6.1)	4.7 (3.9, 5.5)	0.59

Data represent visual analogue scale scores (mean (95% confidence interval)). * $p < 0.02$. VAS = visual analogue scale

shape of the conchal bowl. It was personally used by the main author to prevent water entering the ear following the insertion of ventilation tubes, whereupon it was noted to attenuate sound. As a result of this observation, we set out to determine how much sound Blu-tack attenuated, and if Blu-tack could be used as a possible alternative to over-the-counter ear plugs.

Analysis of the air conduction threshold differences showed that Blu-tack was not as effective at attenuating sound at low frequencies (0.5 and 1 kHz) as the over-the-counter ear plugs. There were mixed results at 2 and 3 kHz. From 4 kHz onwards, Blu-tack attenuated sound to a similar degree to the over-the-counter ear plugs, with no significant statistical difference.

Due to the soft, compliant nature of Blu-tack, and its ability to mould to the shape of the conchal bowl and external auditory meatus, it scored favourably in terms of comfort (on the VAS). There was no difference between the ear plugs (including Blu-tack) for peace of mind or ease of insertion.

- A variety of ear plugs are available from pharmacies, including silicone, foam and wax types
- Blu-tack is a non-toxic, inexpensive, malleable, self-adhesive putty that easily conforms to the shape of the conchal bowl
- This study showed that Blu-tack was as effective as ear plugs at attenuating sound above 3 kHz
- Blu-tack was more comfortable to wear than ear plugs
- Blu-tack can be regarded as a safe alternative to ear plugs

Strengths

In order to prevent bias, only one senior audiologist was used to check hearing thresholds. The volunteers had hearing tests performed on different days to

prevent test–retest and learning effects. Standardised equipment was also used. In addition, each volunteer was shown how to insert the ear plugs and Blu-tack in order to avoid irregular readings.

Weaknesses

The insertion of Blu-tack into the conchal bowl was inevitably associated with some degree of doubt due to the fact that it was a novel idea. In addition, the degree of sound attenuation may not be as good as the ear plugs simply because of incorrect insertion (despite clear instructions and supervision).

Conclusion

This small pilot study revealed that Blu-tack was as effective as over-the-counter ear plugs at attenuating frequencies above 3 kHz. It was considered comfortable and safe to use and could therefore be regarded as an alternative option when wishing to attenuate every-day sound.

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