
Child-proofing of Hearing Aids to Prevent Hazards Posed by Battery Swallowing

Mesures pour éviter que les enfants n'avalent des piles de prothèses auditives

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Key words: hearing aids, battery, swallowing, medical device

Since 1978, there have been four incidents of children swallowing hearing aid batteries reported to the Bureau of Radiation and Medical Devices of Health and Welfare Canada, two in 1978, one in 1980, and one in 1990. These accidents prompted the Bureau to publish an article in the *Journal of Otolaryngology* (Cooper & Katz, 1978) detailing the dangers associated with swallowing batteries. The National Capital Poison Control Center in Washington DC ((202) 625-3333), which receives emergency calls about battery swallowings from throughout the United States and from Canada, reports that out of 2320 button battery swallowing cases reported between 1983 and 1991 (about 290 cases per year), 952 (41% and about 119 per year) were batteries used with hearing aids. In Canada, there are no national statistics available on these incidents. The Product Safety Branch of the Department of Consumer and Corporate Affairs reports 25 accidents between 1984 and 1991 involving batteries of all kinds, but none involving swallowings. Several provincial poison information centres were not able to state how many of the reported battery swallowings involved hearing aid batteries; they provided information about swallowings of all types of button batteries as shown in Table 1; this information indicates that the accidental swallowing of button batteries is not infrequent.

Hearing aid battery packages now show warnings such as, "WARNING: Keep batteries away from children. If swallowed, consult a physician at once." Many battery manufacturers selling hearing aid batteries in Canada now show on the battery package the phone number of the Ontario Regional Poison Centre in Toronto ((416) 598-5900). Other manufacturers may show the phone number of the National Capital Poison Control Center in Washington DC ((202) 625-3333).

The Canadian Auditory Equipment Association (Thomas, L. 1992) represents various hearing aid manufacturers throughout Canada. The Association has indicated that its members are aware of the potential hazard but do not feel that a fully tamper proof opening mechanism for the battery compartment of the hearing aid could be devised easily. Furthermore, the Association has indicated that no hearing aid battery

swallowings have been reported to it and that such incidents can be avoided best through education of the dispenser and the end user (or parents). The Canadian Battery Manufacturers Association (Moran, J. 1992) has proposed banning mercuric oxide hearing aid batteries by July 1993; this will reduce some of the risk because these types of batteries are more dangerous than others due to their composition.

The accidental ingestion of small foreign objects is not infrequent with small children. Approximately 90% of ingested foreign bodies pass through the digestive tract uneventfully regardless of their size, shape, or composition (Willis & Ho, 1982). The dangers with swallowing batteries come from two sources. First, the battery may leak and release harmful corrosive substances (Blatnik, 1977) that can cause tissue necrosis. However, poisoning by mercuric oxide or toxic metals from a disintegrating battery appears to be very rare (Millar, Rode, Cywes, & Van Der Walt, 1985). Second, the battery may impact somewhere in the digestive tract and cause electrolysis of saline resulting in electrochemical burns (Leeming, Ray, & Howland, 1970). Pressure necrosis is also a possibility (Millar, Rode, Cywes, & Van Der Walt 1985).

All audiologists should be aware of the hazards posed by battery swallowing and the deterrents manufacturers of hearing aids offer to prevent children from gaining access to the battery of hearing aids. But there appear to be no guidelines for audiologists regarding safety precautions when prescribing aids for children.

The Bureau of Radiation and Medical Devices contacted every manufacturer of behind-the-ear (BTE) or in-the-ear (ITE) hearing aids registered with the Bureau and asked what type of deterrents their hearing aids had (if any). The results of this survey are shown in Table 2. Manufacturers of bone conductor hearing aids were not included in the survey because these devices would not normally be used on small children. It must be stressed that the table reflects a survey of only those BTE and ITE manufacturers that have notified the Bureau. Furthermore, notification does not imply approval by Health and Welfare Canada.

Table 1. Incidence of button battery (all types) swallowings.

POISON INFORMATION CENTRE	TIME PERIOD	NUMBER OF SWALLOWINGS OF BUTTON BATTERIES
Ontario Regional Poison Centre (Toronto)	January to September 1990	54 of which 41 (76%) were in children less than 5 years of age.
Centre Anti-Poison du Québec	January 1988 to November 1991	134
Poison Centre of Alberta	April 1989 to March 1991	52
British Columbia Drug and Poison Information Program	January 1989 to October 1991	49 of which 22 (45%) were in children less than 2 years of age and 21 (43%) in children between 2 and 12 years of age.

Of 19 manufacturers, 16 have some sort of a tamper resistant device; of these 16, 14 remove the battery compartment door's finger nail notch, 1 uses a screw lock or a T-shape anchor system which fits over the battery compartment door, and 1 uses a "lock plug" which fits over the battery compartment door. Another manufacturer uses sealed rechargeable batteries and another states that the battery compartment door is tight enough that a small child would have difficulty opening it. Finally, one other manufacturer uses no deterrent whatsoever. Most manufacturers will, at no extra cost, remove the battery compartment door notch, but only when asked by the purchaser, usually the audiologist. Removal of this notch is an easy operation and the audiologist can do this himself, if necessary. In most cases, the removal of the finger nail notch is sufficient. If not, the parent or audiologist should order, if available, a more effective deterrent from the manufacturer.

The following alternatives are also possible: (1) taping the door shut, (2) spot-gluing the door shut and breaking the glue when it is desired to open the battery compartment, (3) purchasing a Huggie Aid which is used to keep hearing aids from falling off while participating in sports but which can also cover the compartment door, and (4) obtaining Super Seals, a latex sheath designed for moisture proofing of BTEs which can act as a deterrent because it covers the entire aid except the microphone. The Huggie Aid is available in the United States from Hal Hen and is available in Canada through Dahlberg Sciences Ltd. or hearing aid dispensers. The Super Seals is also available in Canada from Dahlberg Sciences Ltd.

It should be emphasized that perhaps the best method of preventing battery swallowings is never to show a child that the hearing aid has a battery compartment that can be opened until the child is old enough to understand the hazards associ-

ated with swallowing the battery. Furthermore, unused batteries should be kept out of view from children as their shape and size may suggest to a young child that they are candy. Audiologists are encouraged to stress this to the parents of their young patients.

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Dahlberg Sciences Ltd., 500 Trillium Drive, Unit 15, P.O. Box 9022, Kitchener, Ontario, N2G 4J3, (800) 265-8250

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Thomas, L. (1992). Private communications with Ms. L. Thomas, President of the Canadian Auditory Equipment Association, Scicore Inc., 14 Connie Crescent, Unit 5, Concord, Ontario, L4K 1L5, (416) 738-4949.

Willis G.S., Ho W.C. (1982). Perforation of Meckel's diverticulum by an alkaline hearing aid battery. *Canadian Medical Association Journal*, Vol 126, March 1, 1982.

Table 2. Battery accessibility deterrents.

MANUFACTURER	ADDRESS	BATTERY ACCESSIBILITY DETERRENTS
3M HEARING HEALTH	270-4S-16 St. Paul, Minnesota 55144-1000 (612) 736-5843	A "lock plug" which fits in the direct audio input socket of their BTE hearing aids also locks the battery compartment door. There is no deterrent for ITE aids.
ADVANCED HEARING AIDS	P.O. Box 13271 31 Pippy Place St. John's, Newfoundland A1B 4A5 (709) 754-5602	Make only ITE hearing aids. No deterrents available.
AUDIOTONE INC.	4120 Olson Memorial Highway Golden Valley, Minnesota 55542 (612) 520-9723 (800) 727-8055	Battery compartment door notch removed. Also, the compartment door may be taped shut.
BELTONE ELECTRONICS OF CANADA LTD.	37 Martin Ross Ave. Downsview, Ontario M3J 2L3 (416) 736-4444	Battery compartment door notch of BTE aids can be removed.
DAHLBERG SCIENCES LTD.	500 Trillium Drive Unit 15 P.O. Box 9022 Kitchener, Ontario N2G 4J3 (800) 265-8250	Battery compartment door notch removed on request. They suggest obtaining a "Huggie Aid" available from them; it is used to hold an aid in place on the ear, but it can also prevent opening the battery compartment door. Also, a product called Super Seals can be used as a deterrent. It is a latex sheath designed for moisture proofing of BTEs but would also act as a deterrent as it covers the entire aid except the microphone. "Just Bekuz Products Co." in Casselrock Colorado makes it and it is available in Canada through Dahlberg.
DANAVOX CANADA LTD.	2475 Skymark Ave. Unit #5 Mississauga, Ontario L4W 4Y6 (416) 629-4223	Battery compartment door notch of BTE aids removed on request. For ITE aids, a hole is made in the door to allow insertion of a tool to open it.
MAGNATONE QUALITY HEARING INSTRUMENTS	170 North Cypress Way Casselberry, Florida 32718-0964 (407) 339-2422	Rechargeable ITE hearing aids using no external batteries are available. The rechargeable battery is sealed inside the casing.
MAICO HEARING INSTRUMENTS	7375 Bush Lake Road Minneapolis, Minnesota 55439 (612) 835-4400	BTE aids have the battery compartment door notch removed. In the case of ITE aids, not all of them have notches on the battery compartment door but these may also be removed. A small object such as a screwdriver is then required to open the door. This modification is made only upon request.

Table 2. Battery accessibility deterrents (cont'd).

OTICON INC.	29 Schoolhouse Road P.O. Box 6724 Somerset, New Jersey 08875-6724 (908) 560-1220	BTE and ITE aids have the battery compartment door notch removed. A small object such as a screwdriver is required to open it. This modification is made only upon request.
PHILIPS ELECTRONICS INDUSTRIES	Hearing Aid Department 601 Milner Avenue Scarborough, Ontario M1B 1M8 (416) 292-5161	The battery compartment doors are tight and difficult to open by a small child. Philips is looking at developing a locking mechanism for the battery compartments.
PHONIC EAR LTD.	7475 Kimbel Street Unit 10 Mississauga, Ontario L5S 1E7 (416) 677-3231 (800) 387-3158	All Phonak hearing aids (supplied by Phonic Ear Ltd.) are tamper-proof. The PICO and PICO-FORTE models can be equipped with a battery compartment door which uses a screw-lock system. All other models can use a metal clip with a T-shape anchor which fits over the door; it can only be removed by using the screwdriver supplied. Both of these modifications are made on demand at no extra charge.
QUALITONE	4931 West 35th Street Minneapolis, Minnesota 55416 (612) 927-7161	For BTE aids, the battery compartment door notch is removed and a hole is drilled in the casing to allow insertion of a pin to open the door. For ITE aids, the compartment door notch is removed. These modifications are performed on request only, at no additional charge.
SIEMENS HEARING AIDS	320 Pinebush Road Cambridge, Ontario N3C 2V3 (519) 622-5200	BTE and ITE aids have the battery compartment door notch removed upon request. Siemens also reinforces CAUTION to parents of small children in it's user guide supplied with each instrument.
STARKEY LABS CANADA, LTD. (also Bosch, Fidelity and Viennatone)	7310 Rapistan Court Mississauga, Ontario L5N 6L8 (800) 387-9327	Will remove the battery compartment door notch on request.
STARKEY LABORATORIES, INC. (also Bosch, Fidelity and Viennatone)	6700 Washington Ave. South Eden Prairie, Minnesota 55344 (612) 941-6401	Will remove the battery compartment door notch on request.
UNITRON INDUSTRIES LTD.	20 Beasley Drive P.O. Box 9017 Kitchener, Ontario N2G 4J3 (519) 895-0100	Will remove the battery compartment door notch on request; a pin is then inserted in a hole in the door to open it. They also provide a volume control cover.
VANCO INDUSTRIES	1770 North Hercules Ave. Clearwater, Florida 34625 (813) 446-8392	Will remove the battery compartment door notch of BTE and ITE aids on request. Also, some BTE aids are rechargeable and therefore have no door. There are volume control covers available for both BTE and ITE aids.