Can Older Adults use Child Resistant Bottle Closures?

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U.S.L. Nayak, Can Older Adults use Child Resistant Bottle Closures? Gerontechnology, 2002; 2(2): 198-202. The objective of this study was to examine the design concepts used in child resistant closures with reference to ease of use by older adults. Included in the study design were a focus group (n=9) and user evaluation of a child resistant closure by a cross-section of older adults living independently in the community (n=103). A push and turn action seems to be the most favoured in comparison to a squeeze and turn action. Designers in consultation with older adults can arrive at easy-opening packaging for physically challenged people. Such a design is eligible for an award of the Owl Mark.

Keywords: child resistant closures, older adults, Owl mark

Child resistant closures can be defined as 'Packaging designed and constructed to be difficult for young children, under the age of five, to open (or gain access to the contents) within a reasonable time and which are not difficult for adults to use properly' [1,2]. Older adults may find child resistant closures difficult to use and consequently avoid them or use them improperly by leaving the closures off, or by transferring the contents to a non-child resistant closure[3]. Consequently, it is important to take into account views and needs of older adults while designing child resistant closures.

The three main functions involved in opening child resistant closures are visual, cognitive, and manual. The visual function is employed in inspecting and identifying the mode of opening. The near reading visual acuity diminishes with age and for a 70-year-old (age group) it is 30% of that of a 20-year-old[4]. The cognitive function includes perceiving, learning, remembering, and decision making[5]. It relates to understanding and adapting to unfamiliar mechanisms, while the manual function uses muscular forces in opening closures. A 70-year-old is as weak as a 10-year-old is and only 60% as strong as a 20-year-old[6]. Older adults with a further reduction in strength due to arthritic conditions in fingers and wrists may not be able to apply pinch grip and hand torque that are necessary to open child resistant closures.

FOCUS GROUP DISCUSSION

A focus group was arranged to understand problems experienced by older adults in using four designs used for child resistant closures. The participants for the discussion group (5 males and 4 females, aged 69-86 years) were selected from the Thousand Elders consumer panel[7]. These are 'design sensitive' (or 'critical users'[8]) participants who take part in various research activities of the Centre for Applied Gerontology.

Align arrows (or steps) and push off design

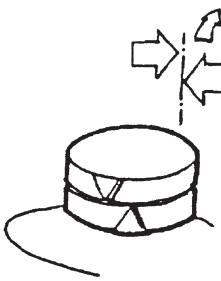

Fig 1. 'Align arrows and push off' closure

Evaluation:
- Lining up arrows (or steps) not clearly visible, due to a lack of contrast between arrows (4 participants),
- Pushing off the closure too difficult, due to diminished strength in the thumb (6 participants),
- Spillage of the contents (3 participants).

Squeeze pads and turn design

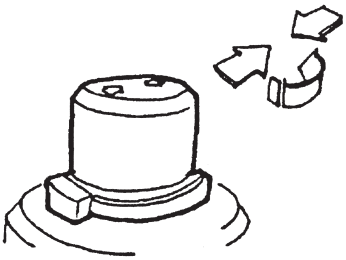

Fig 2. 'Squeeze and turn'closure

Evaluation:
- After application of a chuck pinch using the thumb, index finger and middle finger (to deform the rigid plastic neck), the localised finger force caused discomfort and pain (7 participants),
- Slippage due to a lack of grip while turning the closure (3 participants),
- No clear instruction on when to apply the squeeze force (5 participants).

Push down and turn design

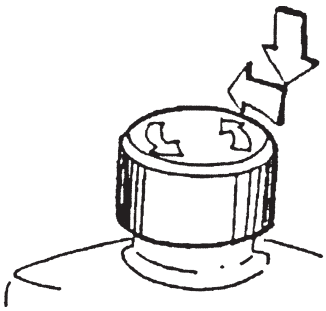

Fig 3. 'Push down and turn' closure

Evaluation:
- Small sized closures too difficult to grip and to maintain the force while turning (4 participants),
- Difficult to apply the force needed to push the closure down (3 participants).

However, the concept was acceptable for 8 participants since they could use their body weight and palm of the hand to execute a push and turn action. The instructions were generally easy to follow. The tamper-evident collar found on some designs was seen as an important requirement in a child resistant design by 9 out of 9 participants.

Blister pack design

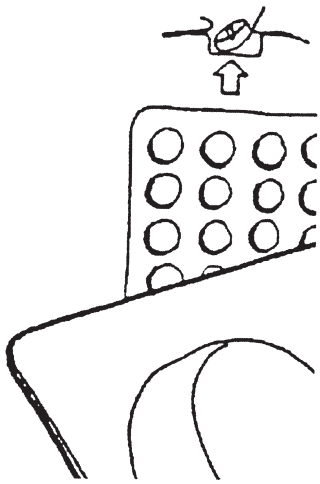

Fig 4. 'Pierce foil' closure

Evaluation:
- Tactile information on the pack would be useful as a guide for the visually impaired people in avoiding spillage of the contents (4 participants).

CASE STUDY

After 'iterative-design' discussions with the members of the Thousand Elders group, the United Closures & Plastics Plc (UK) produced a final version of a tamper-evident, reclosable, child resistant closure for a medical bottle. The downward pressing force needed for opening was 25N and the minimum removal torque (counter-clockwise) was 1.016Nm. Its outside diameter was 32mm; the closure height was 28mm. The outside surface of the closure had coarse ribs to stabilise the grip while turning. The rib dimensions were 2 mm in width and 1 mm in height and there were

24 ribs on the surface with a pitch of 4mm (Figure 5).

Fig 5. 'Developed child resistant closure

The closure was submitted to a 'user evaluation' programme with participants (37 males, 66 females) chosen, at random, from the Thousand Elders group. Participants' ages ranged from 60 to 80 (Table1).

Out of the 103 participants, 16 reported having no age-related impairment, and were declared physically healthy older adults. The remainder suffered from one or more of the following: Arthritis of wrist/fingers/elbow (n=68), Back problems (n=43), Partial loss of finger sensation (n= 19), Poor eyesight, not corrected by glasses (n=15), Tremor/ Parkinsonian / other Neurological Disorders (n= 4). One of the males was registered blind and one of the females was in a wheelchair.

Table 1. Age and sex distribution of the participants in the Case Study

Age group	Males	Females
60 - 64	5	13
65 - 69	10	21
70 - 74	13	17
75 - 80	9	15
Total	37	66

Evaluation Method

The participants' power grip strength in their dominant hand was measured by a grip dynamometer (Takei Kiki, Kogyo).

A brown, glass bottle was filled with cold water and the developed child resistant closure (white in colour) was secured to the top of the bottle. The base of the bottle was 60 mm in diameter; the length of it up to the neck was 110 mm. The neck had a diameter of 28 mm, with a height of 20 mm.

Participants were expected to break the tamper-evident seal (red in colour) by pressing down and turning the closure in a counter-clockwise direction with their dominant hand. The evaluation programme consisted of separating the child resistant and tamper-evident plastic closure from the glass bottle and then reclosing the bottle top securely. One participant at a time was allowed to carry out this activity within a time period of 3 minutes each. No demonstration was given beforehand. At first no discussion between participant and supervisor took place. The supervisor only recorded the answers to the questions in a task analysis questionnaire. For those who could not open the closure, a verbal instruction was given and further 3 minutes were allowed to complete the task. The remaining participants were given a full demonstration on how to open the closure.

Results

A wide variation in measured grip strength of participants is similar to that observed in a random sample of 359 men and 561 women aged over 65 years[9], indicating the heterogeneous nature of the study sample which is not biased towards strong older people (Table 2).

Table 2. Grip strength (Newton) of the participants in the Case Study

Participants	Mean	Standard Deviation	Minimum	Maximum
Males (n=37)	360.9	97.1	53.9	509.9
Females (n=66)	187.3	54.9	39.2	318.7

80% of the participants (n= 82) were able to open the closure without instruction and this activity was completed within the first 3 minutes of the test.

17% of the participants (n=18) needed verbal instruction even after studying the graphics. These elderly were able to open the closure within 6 minutes. 1% of the participants (n=1) needed a demonstration before successfully opening the closure. 2% (2 participants) failed to open the closure even after a demonstration.

Discussion

The torque needed to release the closure is above the torque that can be applied by children under the age of 5 years, and is also well within the range that can be applied by older adults (Figure 6)[10,11].

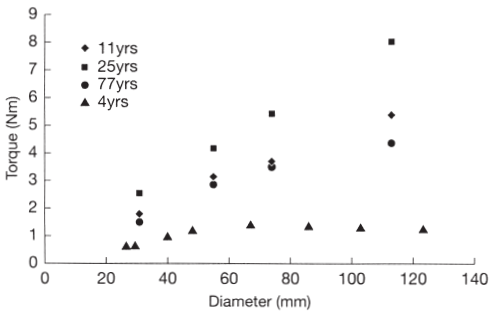

Fig 6. Variation of torque capability with age and diameter of females [10,11]

According to the manufacturer's technical information[12] the above closure was approved to be child resistant as given by the British Standard testing procedure[2]. The British Standard outlines child test, adult test, and optional elderly adult test. In the optional elderly adult test at least 85% of a test panel aged 60 to 75 years should be able to open and properly reclose the closure after having been given a demonstration. Also in German and Dutch[13] Standards on child resistant packaging, the design is certified as child resistant if it is acceptable to 85% elderly adults sample (between 61 and 65 years).

In our case over 97% of the test panel were able to remove the closure within a short time interval with or without verbal instruction. They were also able to secure the closure back on to the base unit, thus ensuring the child resistant properties. Consequently, this design of the closure was awarded the Owl Mark (Figure 7)[14] to indicate that the closure was generally suitable for use by older adults.

Fig 7. The Owl Mark[14]

CONCLUSIONS

A push and turn action design seems to be the most favoured for a child resistant closure, as it can be opened not only by a pinch grip but also by a palm grip. Designers should (i) choose an appropriate 'removal torque' to match the performance of older adults, (ii) use simple graphics, (iii) print instructions in high contrast text, and (iv) consult older adults before embarking on new design concepts.

Acknowledgement

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