Study on Opening Motion of PET Bottle Cap for Elderly People.

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ABSTRACT

The aim of this study is to propose the easy-to-open plastic bottle cap or opener. First, the muscle activity was measured while opening various plastic bottles as feasibility study. Next, behavior observation and questionnaire while opening the cap were performed. The forms extracting from opening motion of cap were measured by 3D scanner. The average form of elderly women taking hold the cap from above was designed. Muscle activity did not vary according to the type of plastic bottles. Many elderly women feel hard to open PET bottle cap.

Keywords: Cap opening motion, plastic bottle, Easy-to-open cap, EMG

1. Introduction

It is becoming an aging society globally. Especially, Japanese super-aging society is the highest rate in the world. (1) Therefore, elderly people are needed to live an independent life in a long time. However, it is reported that female’s grip strength declines at the age of 49, and at the age of 69 it reaches 70% at the peak. (2)

One of the important work in daily life is opening the caps of plastic bottles. Containers equipped with caps containing a wide variety of plastic bottles are currently used in many homes, but since the size, shape, etc. of plastic bottle caps do not match the human body size, they are handled by individual hands. It is speculated that there are various opening methods because there are. Also, no research has been done on the size and shape of plastic bottle caps. (3)(4)(5)(6)

Based on the above, this research aims at elderly people to live at their own home longer, aims to help themselves to live even with reduced grip strength, aims at manufacturing self-help devices or product proposals of new shapes from the human body size, actual condition survey, analysis aiming to do.

2. Method

At first, in order to examine the influence of muscle between size and materials of the plastic bottle during an opening motion and whether use the result as an evaluation index, we investigated that significant differences the opening operation in plastic bottles of young people (female, right handedness, 6 tries) And then, one-way analysis of variance was performed based on Electromyogram results.

Next, in order to investigate the actual situation, we conducted a questionnaire investigation and asked problems when opening the plastic bottles on the elderly people (female, over 65 years old, right handedness, 19 tries). At the same time, we suggested elderly people grasp the plastic bottles with paper clay wrapped and analyzed these moldings.

In order to calculate the average shape using common parts, the grasped moldings were taken in by a 3D scanner and used Rapidform XOR Software to calculate the mesh deviations. Although curvature of the fingers are matched, we could not find a place where we could predominate.

The grasped moldings’ average shape was derived based on a cross-sectional view with grasped shape that cut in 5-millimeter intervals and outputted with a 3D printer. At this time, since the coincident parts differ depending on the pattern of the grasp method, we analyzed this mold which is the most grasped method “the type of grasp from above” in this research.

3. Results

There was no significant difference in the integral...
EMG and average EMG for the type of plastic bottle. The muscle force while opening bottle cap was stronger than the muscle force while grasping the fist with maximum force.

As a result of hearing from elderly participants, half of them feel the drop in the grip strength and it turns out that there are multiple difficulties feeling actions as in the concrete example. In this research, the opening operation of the plastic bottles are most cited as a concrete example which is difficult at the same point as the opening operation of the bottle. As a result of behavioral observation of elderly participants, three kinds of grip patterns were found. First type is taking hold from above (Fig. 1(a)), second type is taking hold from the side (Fig. 1(b)), and third type is taking hold from the opposite side (Fig. 1(c)). Approximately 80% participants were the first type.

Fig.1 Three kinds of the grip patterns. (a) form above (b) from side (c) from opposite side

Although roundness of the thumb themselves matched, since it is not possible to find a place where it seems to be superior, such as the positional relationship of other fingers in the mesh deviations method. It was difficult to calculate the average shape by this method.

Averaged paths of cross-sectional views taken from the top (vertical) are shown at Fig.2. Sections contacting with the fingers from 1 to 3 are distorted edges. But,

Fig.2 Averaged paths of cross-sectional taken from the top (vertical).

they become the top of the cap, the contact area with the finger is small, the dent becomes gentle and gradually small. It turns out that it is becoming a circle.

4. Conclusion

In this study, three kinds of gripping type were found in elderly women. The most typical type was ‘from above’. The typical grip shape 3D model of elderly women was created. But muscle activity while opening the plastic bottle cap which proposed in this study. Therefore, it is necessary to analyze using that model in the future. It aims to derive an ideal shape ergonomically to produce self-help devices, and later to lead to the development of the shape of the plastic bottles’ cap itself.

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