Design of Porcelain Parts Breathing Trainer for Middle-Aged and Elderly People Based on User Experience

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Abstract: The mortality rate and incidence of chronic obstructive pulmonary disease are increasing year by year, and the age range of patients is gradually expanding. Society is beginning to seek to improve the patient's breathing status to a certain extent through breathing training, and breathing trainers combined with home aerobic exercise have been shown to have early prevention and rehabilitation effects for patients with chronic obstructive pulmonary disease (COPD). Through the analysis of the patient's use of the traditional three-ball breathing trainer, it is understood that most of the users lack guidance in the process of use, and the effect is not timely feedback, which makes the patient's use effect poor. The purpose of this study is to collect data through user interviews and assist market research on the basis of user experience, analyze the advantages and disadvantages of the existing three-ball breathing trainer, and then design a breathing trainer that is simple to use, portable and with simple visual guidance, and improve the efficiency and satisfaction of middle-aged and elderly people with breathing trainers by optimizing the user experience.

Keywords: Chronic Obstructive Pulmonary Disease; COPD; Breathing Trainers; User Experience

1. Introduction

User experience theory was first proposed by Donald Arthur Norman in the 90s of the 20th century. A subjective, complex, dynamic, and multidimensional experience. Its main purpose is to better meet the needs of users in product design or system design, focusing on the subjective concept formed by users when using products or systems, including all the content involved in the interaction between customers and products or systems.

On the premise that the basic functions of the product are guaranteed, in order to stand out from similar products, designers need to fully consider the various details and emotional needs of users in the process of using the product[1]. In addition to the appearance and ease of use of the product, the user experience helps the designer to comprehensively observe and design the emotional experience and overall evaluation generated by the user in the process of using the product. Designers need to start from the user's point of view, on the premise of a comprehensive understanding of the user's living habits, to ensure that the product can meet the user's daily life needs and expectations, improve the applicability and reliability of the product, and gain the user's trust. Promote positive interaction between users and the product to achieve a good user experience.

Chronic obstructive pulmonary disease (COPD) is a common, preventable, but incurable respiratory disease, the World Health Organization released a report showing that the mortality rate of chronic obstructive pulmonary disease can rank third among various diseases, usually the cause of COPD is caused by long-term exposure to harmful particles or gases, respiratory diseases of residents in heavy industrial areas. The incidence of illness should be high. With the continuous advancement of industrialization and the deterioration of the environment, the incidence of COPD has begun to develop from the elderly to the middle-aged and the young. People with a normal respiratory system need to contract their respiratory muscles to perform normal exhalation and inhalation. Patients with COPD have an increase in the amount of breath required to breathe and a decrease in the elasticity of respiratory muscles, resulting in the need for long-term contraction of respiratory muscles to meet the patient's respiratory needs, which is aggravated. Burden on respiratory muscles[2]. The 2022 Global

Initiative for Chronic Obstructive Pulmonary Disease (GOLD) guidelines point out that stable non-pharmacological treatments (including exercise training combined with disease education, etc.) can improve exercise tolerance, clinical symptoms, and quality of life for patients with COPD of all severity. At the same time, relevant research literature shows that breathing training can effectively improve the pulmonary ventilation function and dyspnea of patients with COPD, and improve the daily life of patients. The use of breathing trainers is a type of breathing training, which can train respiratory muscle groups through the principle of resistance, thereby improving the user's respiratory [3] .With the epidemic of chronic respiratory diseases and asthma, doctors pay more attention to the importance of respiratory training, and relevant experiments have proved that breathing training can improve the quality of life of patients, and then make the respiratory trainer be used in a wider range. With the development of science and technology, there are more and more types of breathing trainers, including adjustable resistance, electronic display, etc., but the basic principle is to train by adjusting the resistance of exhalation and inhalation.

The traditional three-ball breathing trainer is a cheap and widely used respiratory rehabilitation device in the mid-20th century. From the beginning, it was accepted by the medical community and began to carry out assisted rehabilitation training. The initial three-ball breathing trainer adopts a simple mechanical structure, usually composed of three colored balls, each with different weight and elasticity, and the user inhales through the mouth to make the ball rise, so as to achieve the purpose of training the breathing muscles.

With the gradual understanding of respiratory diseases, especially the increasing attention to patients with chronic obstructive pulmonary disease (COPD), asthma and other respiratory disorders, various shortcomings of the three-ball breathing trainer have begun to appear. For some elderly or frail patients, the use of the device may require some oral strength and coordination, which not only limits its use, but can also cause the user to lose confidence during training, which in turn affects the effectiveness of the exercise. Secondly, the traditional three-ball breathing trainer lacks a device to adjust resistance, which may lead to the patient's inability to accurately assess his or her progress and training status during training, and the user cannot adjust the gear of the trainer during training. Adapt to the patient's own training situation, and then reduce the motivation and purpose of his training. Most three-ball breathing trainers are made of plastic materials, which can become a breeding ground for bacteria after long-term use, and because the trainer is only divided into two parts, the airway and the main body, it cannot be disassembled, and the depth cannot be effectively cleaned, which is not conducive to the health of patients. Under such conditions, the use of breathing trainers can not only lead to illness, but may also have a negative impact on the patient's experience.

2. User Interviews

At present, the popularity of breathing trainers on the market is small, most of them are three-ball breathing trainers, and the data collection uses the observation method to collect relevant data on the use process of the target population. Target Observation Population: COPD admitted to Bei ma Village Community Health Service Center, Wu ji County, Shijiazhuang City, Hebei Province from January 2024 to April 2024There were 10 patients. Observation group: All subjects were treated with breathing training-guided intervention, and the breathing trainer product used was a three-ball breathing trainer, and the target sampling population was given COPD knowledge and a three-ball breathing trainer. The explanation of relevant instructions for use comprehensively understands the user's use and cognition of the traditional three-ball breathing trainer after a period of use, and asks patients about relevant questions .The specific intervention methods are as follows:(1) Explain the relevant knowledge about COPD to the target object in the early stage, emphasize the importance of respiratory trainer for the rehabilitation of COPD patients, improve the patient's cognitive level, improve the patient's recognition of respiratory training treatment mode by answering

questions, and reduce the patient's distrust of using respiratory trainer. (2) Explain and guide the training methods of contracted lip breathing and abdominal breathing to the target object, so that the target object can compare the use

experience of the subsequent breathing trainer and improve the accuracy of the answers in the subsequent questionnaire collection process. (3) Explain and demonstrate the use mode of the three-ball respiratory trainer to the target user, label and replace the respiratory trachea before and after each use process of the target user, ensure the hygiene and ensure the accuracy of data collection during the use process of the patient, once a day, at the same time when the target object performs medical consultation with the doctor, and consult the target object after the end. By sorting out part of the collected information, the statistical results are shown in Figure 1.

Figure 1. User Interview Data

3. Market Research

The method of this market research is field research, and the goal is to determine the market share of various breathing trainers, understand the purchasing power of target users, and provide more basis for the design of breathing trainers. The working principle of the existing breathing trainer is to exercise the respiratory muscles to achieve the purpose of alleviating and treating COPD by increasing the resistance in the breathing process and delaying the process of breathing, and there are three kinds of breathing trainers mainly circulating on the market, single ball, triple ball and abdominal breathing trainer, usually the abdominal breathing trainer has a higher price, is mainly used for special exercise, and is not suitable for therapeutic training. In general, the cheap single-ball and three-ball breathing trainers are inconvenient to use because of their large size and unsuitable shape.

Through user interviews and the actual experience of using the three-ball breathing trainer, the problems are as follows:(1) The three-ball breathing trainer adopts a fixed structural design, which does not have the adjustment function and cannot be adjusted according to the lung function and training needs of different users. This lack of feedback can make it difficult for the user to stay motivated, affecting the continuity and effectiveness of the training. (2) The design of the traditional three-ball breathing trainer is relatively simple, and most of them do not consider whether the user's operation is convenient and comfortable. (3) The internal structure of the traditional three-ball breathing trainer is complex, and it is easy to accumulate dirt and germs.

4. Product Design Technical Solutions

4.1 Option 1

The first plan is to design a small hand-held breathing device with ceramic parts that is inexpensive, has a simple training effect indication function, can adjust the gear, and is easy to disassemble and wash. The buttons of the device are simple and straightforward, avoiding complicated operation processes. Use large buttons and icons to ensure that users can understand and quickly grasp the operation method. Ensure that the shape and material of the device are ergonomic, adapt to the physical characteristics of middle-aged and elderly people, reduce accidental slippage when used in hand, and improve safety and comfort. This product can provide middle-aged and elderly people with treatment options other than drug treatment, the price is cheap, multi-level adjustment can be applied to most of the population, and the product is small and can be used for breathing training at any time. The shape is shown in Figure 2 and shape 1.

4.1.1 Provide feedback through visual lighting.

Although the existing breathing trainer can determine the breathing effect through simple ball movement, the size and visibility of the sphere can be greatly affected in the handheld product designed for

convenience of use, and there are certain defects in determining the use effect by observing the motion of the sphere. The product has been modified to use a vertical gas pipe, which is the same principle as that of

single-ball and three-ball breathing trainers, and is equipped with an indicator light to help the patient determine the training situation. When blowing, the gas will make the ball contact with the top of the pipe by pushing the sphere, so that the channel inside the product will be formed to make the indicator light up to achieve the indication function, and the simple guidance function will be achieved according to the time and number of times the indicator light is lit. A valve is set at the airway connection position where the ceramic breathing airway and the sphere are located, and the size of the airway cross-section is controlled by rotating the valve to achieve the effect of controlling the gas flow.

4.1.2 Ceramic breathing airway

In medical products, ceramic materials have the advantages of corrosion resistance, toughness, and easy replacement, and at the same time, they are easy to clean and not easy to breed bacteria. The breathing device needs to be in contact with the user's mouth, and the use of ceramic material can effectively prevent bacteria from entering the body through the mouth. Chinese ceramics production has a history of thousands of years, the elderly often have a deep emotion for traditional culture, it is easier to cause the cultural identity of middle-aged and elderly users, ceramics is not only an item, but also a symbol of history, can cause resonance among the elderly, evoke a sense of identity and appreciation of traditional culture. Middle-aged and elderly people in daily life both the pursuit of practicality, but also pay attention to the beauty of the object, ceramics just to meet this demand, with the elderly to health and health care, ceramic drinking utensils (such as teapots, porcelain cups, etc.) contained in the traditional tea culture and health concept combined, more likely to arouse their pursuit of a healthy lifestyle.

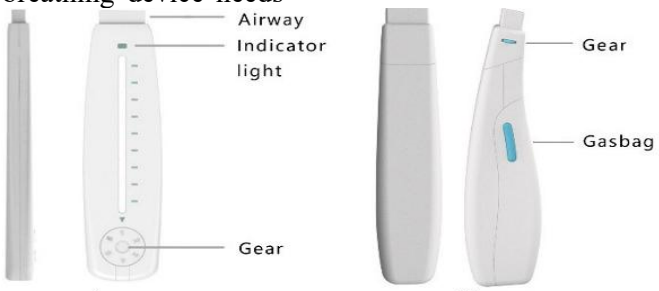

Figure 2. Breath Trainer Model Scheme

4.2 Option II

Scheme 2 intends to design a small breathing trainer that can provide feedback on training results through touch, which also has the advantages of low price and easy to disassemble and wash, and compared with scheme 1, it is no longer necessary to observe through the patient's realization to obtain good information feedback. The shape is shown in Figure 2.

4.2.1 Provide feedback through built-in airbags

Compared with the traditional three-ball breathing machine, option 2 uses an internal airbag to provide feedback on the premise that it can be carried around. The internal principle is that the patient blows through the internal air bag, and the gas enters the air bag through the valve that can adjust the ventilation volume, the air bag is elongated, the air bag is flat when there is no gas in, and is squeezed by the internal plastic square, when there is gas entering, the gas enters from the bottom and makes the plastic square rise by squeezing the plastic square, providing space for the expansion of the internal air bag. When the patient does not blow up, the weight of the internal spring and the plastic cube will cause the plastic cube to descend to the starting position, and at the same time, all the gas inside the device and the inside of the balloon will be expelled, and the device will return to the starting state. Because the internal balloons are set on both sides of the device, when the patient holds them with one hand with his left or right hand, the palms will cover the top of the left and right airbags, and in the process of use, the use effect of the current gear will be felt through the squeezing sensation caused by the size change of the balloon, so as to obtain good feedback on the training status.

4.2.2 Ceramic breathing airway

Due to the many advantages of ceramic materials in medical products, ceramic

breathing airways are also used in scheme 2.

5. Conclusion

As the global aging process accelerates, chronic obstructive pulmonary disease (COPD) has become one of the main diseases threatening the health of middle-aged and elderly people. User experience theory focuses on the user's psychological experience, and improves the user's feeling while ensuring the basic function, because the existing breathing trainer has some problems in the use process, it will cause certain psychological obstacles in the user's use process, and the good user experience can belt plays a good role in promoting the recovery of users. Improvements to the product based on the user experience theory can make it easier for users to understand and operate the equipment, reduce the learning curve, and ensure that users can get started quickly. While simplifying the steps and strengthening the training process, reducing the frustration of users when using, the ceramic breathing tube in the product can be disassembled, which not only arouses the interest of middle-aged and elderly people, but also helps to reduce the growth of bacteria inside and facilitate cleaning. Breathing training is a more commonly used training method in the rehabilitation process of respiratory diseases, which can effectively improve the physical condition of patients, but because the existing respiratory trainer has many defects, most patients will not take this as a rehabilitation option, and at the same time, the trust in such products is also insufficient, and the promotion of respiratory trainer requires the joint efforts of medical staff and patients.

Based on the user experience theory, this paper systematically analyzes the inconvenience of the traditional three-ball breathing trainer in the process of use, and makes corresponding improvements to the breathing trainer, aiming to provide a practical and inexpensive breathing trainer for middle-aged and elderly people, not only from the perspective of use, but also pay attention to the emotional needs of users. With the acceleration of the global aging process and the deterioration of the environment, chronic obstructive pulmonary disease (COPD) has become one of the main diseases threatening the health of middle-aged and elderly people. According to data from the World Health Organization, among the approximately 384 million COPD patients worldwide, more than 60% are over 65 years old. The number of people with respiratory diseases in our country is increasing, and improvements to traditional respiratory training devices can provide patients with more treatment options in addition to medication.

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