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Development of a Web Exercise Video for Patients With Shoulder Problems

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The purpose of this study was to develop a Web video designed to promote regular shoulder joint exercise on a continuous basis among patients with shoulder joint disease. This is a methodological research. A shoulder joint exercise video was developed through the five stages of the ADDIE model: analysis, design, development, implementation, and evaluation. The video demonstrates exercises that stretch and strengthen the joints and muscles of the shoulders. Stretching exercises include the pendulum, forward elevation, outer rotation, crossover arm stretch, inner rotation, and the sleeper; strengthening exercises include dumbbell exercises, a chair exercise, wall push-ups, and rowing. This Web exercise video can be used as an educational resource for preventing shoulder joint diseases by middle-aged and elderly people and those seeking to restore shoulder joint function damaged by shoulder joint diseases.

KEY WORDS: Exercise, Internet, Shoulder, Video recording

Shoulder joint disease, a degenerative disease, is rapidly becoming widespread because of the aging of populations. In Korea, shoulder joint disease became the eighth most common cause of hospitalization in 2014, an extremely steep climb from its 101st position in 2007.[1] Total medical bills for shoulder joint disease treatment were $210 million in 2010 and $340 million in 2014; this $130 million increase (64.9%) over 5 years reflects an average increase rate of 13.3% a year.[2]

The most common shoulder diseases are rotator cuff disease and adhesive capsulitis, both caused by prolonged overuse of the shoulders, as well as calcific tendinitis.[3] These shoulder diseases affect many busy individuals in the age bracket of the late 40s to early 50s and can have a negative impact on their productivity.[4] Shoulder joint disease limits the range of motion (ROM) of the shoulder joints and thus inhibits physical functions, reduces the scope of daily activities, and causes pain, ultimately reducing the patient's quality of life.[5] Like other chronic diseases, the treatment of shoulder joint disease should include medication, as well as exercise and proper nutrition. Exercise, in particular, is essential in the prevention and treatment of joint atrophy and hypofunction.[6,7] Exercise that promotes recovery from shoulder joint disease includes ROM exercise, stretching, and joint/muscle-strengthening exercise.[8]

The positive effect of exercise is negligible if done only occasionally, and regular exercise is required in order to attain the sought-after benefits. Shoulder joint exercise that is customized to an individual's capacity and needs is beneficial, but excessive or poorly performed exercise can worsen existing conditions. Healthcare institutions, to promote beneficial exercise in everyday life, distribute shoulder joint exercise manuals and provide outpatients with training instructions. Many shoulder joint disease patients forget how to perform exercises over time and as a result fail to exercise in their everyday lives. Ongoing training regarding correct shoulder joint exercise is vital, but hospital environments are usually very busy, and setting aside the time and resources for such ongoing training is difficult.

As such, the development of training materials that can be continuously used would reduce the workload of healthcare service providers, increase the likelihood that patients will engage in ongoing exercise, and be well worth the time and cost of their initial development. Continuous exercise in the home environment has been reported to reduce shoulder pain and improve shoulder function,[9] so the development of a shoulder joint exercise video that can be viewed and followed in the home environment would be of great value.

Korea's smartphone use rate, 83% as of March 2015,[10] creates an environment that is conducive to the efficient online dissemination of healthcare information. Videos, a mode of visual communication, have been reported to be more effective than expository texts.[11] Moreover, video-aided intervention has been reported to be more cost-effective than face-to-face intervention.[12] On the other hand, training videos uploaded to the Internet are not utilized and rendered useless if not managed sufficiently by a set entity. Thus, videos should be uploaded to the Web site of an institution that is frequented by users and well managed by a specific entity. Featuring exercise videos on site of a

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hospital can provide site visitors with sound healthcare information and promote better health management. Active utilization of healthcare Web sites can contribute to the creation and utilization of big data, a salient topic in the news today, and also spearhead the creation of user privacy protection policies. Increased utilization of healthcare organizations' Web sites will enhance health and reduce expenses for users.

The purpose of this study was to develop a Web video designed to promote continuous exercise by patients with shoulder joint disease in order to improve physical function and quality of life. There were two objectives: first, to develop a shoulder joint exercise Web video based on the ADDIE (analysis, design, development, implementation, evaluation) model; and second, to optimize the developed shoulder joint exercise Web video based on evaluations by experts and users.

METHODS

Research Design

This is a methodological research study. Literature review, interviews, and consultations with professionals were used as the basis to develop a Web exercise video for clients with shoulder problems.

Research Process

The Web video that is the objective of this study was developed using each of the five stages of the ADDIE model, that is, analysis, design, development, implementation, and evaluation.[13] This model is commonly used in instructional development as a systematic means to achieve desired results.[14]

The purpose and content of the exercise video were specified at the analysis stage. The analysis included a demand for a shoulder joint exercise video and a review of the condition and quality of existing shoulder joint exercise videos. In the demand analysis, target conditions to be achieved by users and the current capacities of users were analyzed, and results were consulted in setting training objectives. In the user analysis, general traits of users and their exercise capacities were analyzed. In the present condition analysis, existing shoulder joint exercise videos were analyzed.

At the design stage, the findings of the preceding stage helped to determine execution objectives, evaluative criteria, and media. Strategies and media that would efficiently achieve the set execution objectives were defined. In the development phase, the exercise video was developed according to a blueprint established in the design phase. At the implementation stage, the developed Web video was shown to users. The shoulder joint exercise video was evaluated in terms of content, efficiency, and feasibility in the evaluation phase (Figure 1).

Ethical Considerations

A detailed explanation regarding the purpose and procedure about the development of the Web exercise video was provided to, and written consent was obtained from, the interview participants. Also, prior to the commencement of this study, the research proposals were submitted to the institutional review board of the affiliated institution, and it was exempted from the institutional review board review.

RESULTS

Stage 1: Analysis

To verify the demand for an exercise video, 10 patients with shoulder joint disease were interviewed. The participants interviewed ranged in age from their 40s to 70s, and their mean age was 60 years. The interview used a semistructured questionnaire with open-ended questions asking about the necessity of exercise, the practice of exercise, obstacles to doing exercise, preferred exercise methods and tools, and achievements expected through exercise. The participants were keenly aware of the necessity of exercise (mean, 90/100) but recorded a rather low score with regard to the practice of exercise (mean, 52/100). A major obstacle to doing exercise was lack of time, and the most preferred types of exercise were walking and stretching. What they expected to gain from exercise was the removal of discomfort from their everyday life and pain relief—in short, healthy living. The users were aware of their need for ongoing exercise but unsure as to whether they would or could commit to a regular exercise regimen. They indicated that, because they tend to easily forget exercise instructions, an instructional exercise video would likely contribute to forming a regular exercise habit.

Most patients preferred an instructional video over written exercise instructions. Patients in their 40s and 50s stated their preference for a Web video accessible by smartphone rather than time-consuming hospital visits for exercise progress management. Notably, patients also stated their preference for a video containing easy-to-follow exercise movements rather than one providing information on how to manage disease. They preferred that such information be provided as a brochure.

Existing exercise videos for shoulder joint disease patients were searched for and found. Originating from Korea and abroad, these videos differed in the exercises they demonstrated. The majority focused on certain exercises and demonstrated only limited shoulder exercises. However, the exercise video produced as a result of this study contained a comprehensive regimen of shoulder joint exercises intended to have a preventive, rehabilitative, and counterregressive effect on patients with rotator cuff disease and adhesive capsulitis. Data from Web sites hosting existing research literature and government information, as well as the National

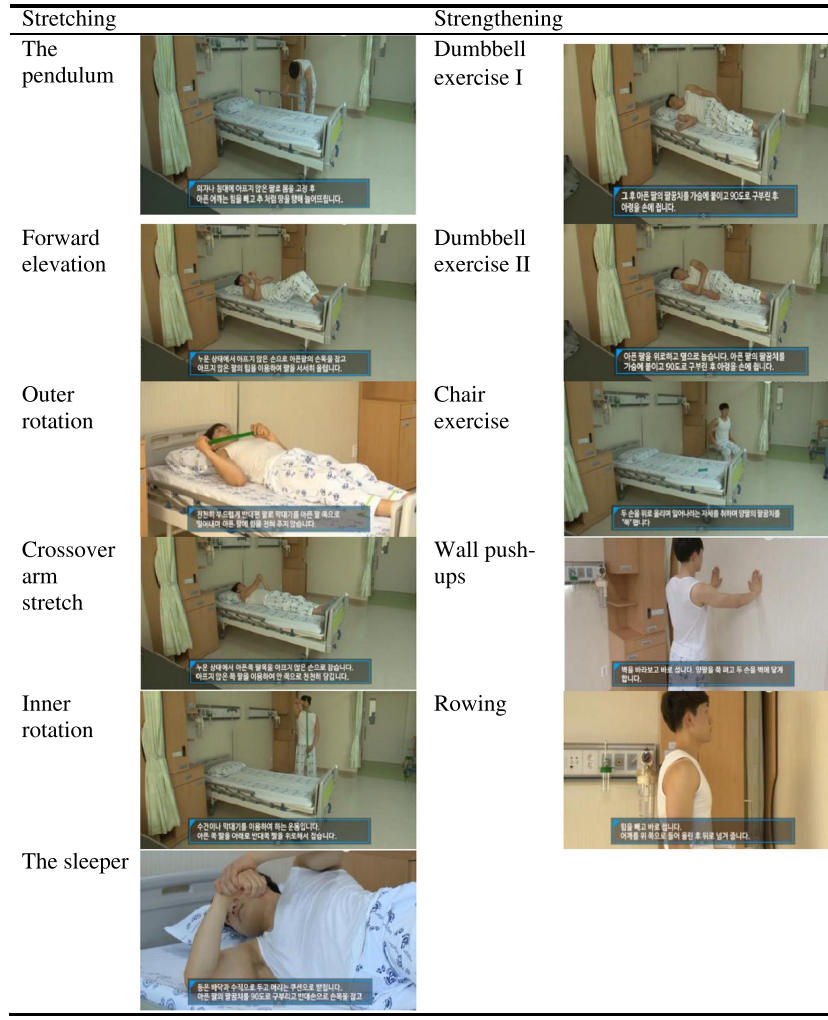

FIGURE 1. Shoulder joint exercise.

Assembly Library of Korea, Research Information Service System, PubMed, and CINAHL, were utilized to gather relevant data for the video.

To determine the content to be included in the shoulder exercise video, existing data were analyzed, and expert consultation was sought, and as a result, it was determined that shoulder joint disease patients need exercises that stretch and strengthen the shoulders. Stretching the muscles is important for restoring ROM and preventing injury. Gently stretching after strengthening exercises can help reduce muscle soreness and keep muscles long and flexible. Strengthening the muscles supports the shoulder joint and keeps it stable. Keeping these muscles strong can relieve shoulder pain and prevent further injury.[15,16] Target muscles are the deltoid, infraspinatus, trapezius muscles, subscapularis, rhomboid muscles, bicep, teres muscles, triceps brachii, and supraspinatus. Specific stretching exercises include the pendulum, forward elevation, external rotation, internal rotation, and the sleeper. Strengthening exercises included dumbbell exercises, a chair exercise, wall push-ups, and rowing.

Stage 2: Design

As corroborated by the data obtained at the analytical stage, the purpose of the exercise video development was defined as promoting the healthy everyday life of shoulder joint disease patients through pain relief and shoulder function enhancement. The target of development was a Web video demonstrating shoulder joint exercises that can be conveniently performed in everyday life (Tables 1 and 2). Video running time was set at approximately 10 minutes to maximize focus and time efficiency. To depart from the style of existing exercise videos that demonstrate a single movement followed by a verbal or written instruction to repeat the movement for a desired number of repetitions, the video to

Table 1. Shoulder Joint Stretching Exercises

Video	Movement	Main Muscles Worked
The pendulum	a. Using an arm without pain, fix the body against a chair or bed.	Deltoids, supraspinatus, infraspinatus, subscapularis
	b. Relax the sore shoulder and let the arm hang to the floor like a pendulum.	
	c. Swing the arm from side to side like a pendulum. Repeat movement 10 times.	
	d. Maintaining the same form, swing the arm forward and back. Repeat movement 10 times.	
	e. Maintaining the same form, draw a circle clockwise with the arm shaking occasionally. Repeat movement 10 times.	
	f. Maintaining the same form, draw a circle counterclockwise with the arm shaking occasionally. Repeat movement 10 times.	
Forward elevation	a. Lying down comfortably, hold the wrist of the sore arm with the other hand.	Supraspinatus, infraspinatus, teres minor, subscapularis
	b. Slowly raise the held arm with the holding arm. Keep the held arm completely relaxed.	
	c. Raise as high as you can and count to 10.	
	d. Lower slowly.	
External rotation	a. Lie down comfortably with the elbow of the sore arm up against your side.	Supraspinatus, infraspinatus, teres minor, subscapularis
	b. Hold the bar and bend the elbow by 90 degrees.	
	c. Using the other arm, slowly push the bar toward the sore arm keeping the sore arm relaxed.	
	d. Push all the way, and count to 10.	
	e. Straighten up slowly.	
Crossover arm stretch	a. Lying down comfortably, hold the wrist of the sore arm with the other hand.	Supraspinatus, infraspinatus, teres minor, subscapularis
	b. Slowly pull the sore arm in toward you with the other arm.	
	c. Pull all the way, and count to 10.	
	d. Straighten up slowly.	
Internal rotation	a. This exercise requires a towel or bar.	Supraspinatus, infraspinatus, teres minor, subscapularis
	b. Hold the object vertically with the sore arm at the bottom and the other arm on top.	
	c. Slowly pull up with the sound arm.	
	d. Pull the way and count to 10.	
	e. Lower slowly.	
Sleeper stretch	Lying down	Supraspinatus, infraspinatus, teres minor, subscapularis
	a. Lie on the side of your sore arm.	
	b. Keep the width of your back perpendicular to the floor, and prop the head with a cushion.	
	c. Bend the elbow of the sore arm by 90 degrees, and hold the wrist with the other hand. Pull in toward you slowly, and count to 10.	
	d. Straighten up slowly.	
	Standing up	
	a. Standing up straight with the sore arm facing the wall bend its elbow by 90 degrees.	
	b. Holding the wrist of the sore arm with the other hand, pull it toward you slowly, and count to 10.	
	c. Straighten up slowly.	

be developed was to feature a clock icon that indicates the number of times a single exercise is performed, the entire regimen featured in the target video being a single exercise. In order to make the target video easily accessible to anyone, it was decided that it would be uploaded to the Web site of a hospital with a dedicated Web administrator. The public's Internet aptitude has improved with the popularization of smartphones, meaning that Internet training was not a required component of the development of this tool; nevertheless, users with limited experience in Internet use were to be provided with assistance in order to conveniently view the video on a smartphone.

The evaluative criteria to be applied to the analysis of the target video's effect on users were determined to be pain (the most common complaint from users), joint ROM, and muscular strength. Verifying change in the pain, joint ROM,

Table 2. Shoulder Joint Strengthening Exercises

Video	Movement	Main Muscles Worked
Dumbbell exercise I	Start with 0.5-kg dumbbells, and increase weight every 2 wk. Reduce weight if pain is experienced.	Subscapularis, teres major
	a. Lie on the side of your sore arm.	
	b. Keep the elbow of the sore arm up against your side, and bend the arm by 90 degrees and hold the dumbbell in hand.	
	c. Turn the arm holding the dumbbell up toward the ceiling, and count to 10.	
	d. Lower slowly.	
Dumbbell exercise II	Start with 0.5-kg dumbbells, and increase weight every 2 wk. Reduce weight if pain is experienced.	Infraspinatus, teres minor, posterior deltoid
	a. Lie on your side, with the sore arm above you.	
	b. Keep the elbow of the sore arm up against your side, and bend it by 90 degrees and hold the dumbbell.	
	c. Turn the arm holding the dumbbell up toward the ceiling.	
	d. Count to 10.	
	e. Lower slowly.	
Chair exercise	a. Sit comfortably in a chair with armrests and no wheels.	Periscapular muscle
	b. Position yourself as if to stand up with both hands up.	
	c. Fully extend both arms toward the ceiling.	
	d. Maintain position, and count to 10.	
	e. Return to original position.	
Wall push-ups	a. Stand up facing a wall.	Periscapular muscle, triceps
	b. Fully stretch out both arms, and put the hands on the wall.	
	c. Perform a push-up movement against the wall.	
	d. Repeat 10 times.	
Scapular elevation and adduction	a. Stand up straight, relaxed.	Periscapular muscle, middle trapezius, serratus
	b. Raise the shoulders up, and lower to the back.	
	c. Repeat this rowing movement 10 times.	

and muscular strength of users who use the target video is necessary for understanding the efficacy of the target video.

Stage 3: Development

In accordance with the outcome of the analysis and design stages, the development stage was executed to produce a shoulder joint exercise Web video (http://www.cnubh.com/news/qna.html?table_id=hb_qna&pid=&target=&keyword=&formtype=view&page=1&code=168987). Exercise movements were monitored in the presence of an orthopedic specialist and rehabilitative exercise trainer. In parts of the video where a more in-depth explanation was required, such as the motions involved in exercise and the number of repetitions, annotations were added to the screen. The featured shoulder joint exercises, ideal for the home environment, utilized a bed or chair. Filming was done by an expert who was made aware of the purpose and nature of the exercises, and multiple takes were recorded in order to meticulously capture exercise movements and allow for the selection of the best shots at a later time. The stretching exercises, including the pendulum, forward elevation, outer rotation, crossover arm stretch, inner rotation, and the sleeper, target the supraspinatus, infraspinatus, teres minor, and subscapularis muscles. The strengthening exercises, including the dumbbell exercises, chair exercise, wall push-ups, and rowing, target the periscapular muscles (serratus anterior, pectoralis minor, levator scapulae, rhomboideus minor and major, and trapezius), subscapularis, and infraspinatus muscles.

Stage 4: Implementation

The users reported that the video would be beneficial in promoting ongoing, regular exercise because of the relative ease of the act of emulating the movements shown on the screen. The exercise video was uploaded to a university hospital Web site in June 2015, and as of August 2016, the number of views was recorded at 1000. Of the users who visited the hospital for shoulder joint treatment, those who were not familiar with the Internet were instructed on how to record the video on their smartphone for later viewing. Such users commented on the advantage of being able to view the video repeatedly on their smartphone in order to become familiarized with shoulder joint exercises, as they always carried their smartphone on their person. It was decided to gradually increase the exercise intensity based on the level of shoulder

joint function and pain of the users.[8] Individual users performed shoulder joint exercises at varying frequencies, from one to three times a day, and at varying intensities.

Stage 5: Evaluation

The Web video was evaluated by experts and participants. The validity of the contents of the Web video was tested by six experts including orthopedic specialists, orthopedic nurses, and a physical therapist. They judged the video content to be appropriate and sound. Some orthopedic residents, who had experience demonstrating exercises to gathered patients, applauded the video for its time effectiveness. Feedback received on the font size and color displayed on the screen was incorporated into the revisions.

Participant evaluation included patients ranging in age from their 40s to 70s who exercised with the video, and questionnaire-based interviews were conducted. For questionnaire used in the evaluation process, the researcher created a six-question test tool based on an evaluation tool for education videos used in the previous studies.[17–20] Moreover, the tool was reviewed by three nursing informatics professionals with experience in developing Web education video. The questionnaire included 5-point-scale items about the understandability, interestingness, and usefulness of the Web video content accessibility, feasibility, and use time of the video; and the method of using the Web video. The participants gave the highest score to "the contents are easily understandable" (mean, 4.53/5) and "the contents are helpful for shoulder exercise" (mean, 4.53/5), and most of the participants reported that they would use a smartphone. Feedback received from the users included praise for the simple nature of the video and a request for easier access, which was fulfilled with a YouTube upload (https://youtu.be/aY3wBeUbMF0) (YouTube, San Bruno, CA). The users reported that the video would be beneficial in promoting joint ROM and in relieving pain. By measuring the change in the users' pain, joint ROM, and muscular strength at a later time in order to make necessary changes to the video to achieve better results, the video can be utilized as a shoulder joint exercise Web video with verified effectiveness.

DISCUSSION

As of August 3, 2016, the video had received 1000 views on the hospital Web site after it was uploaded in June 2015. Because some 77 patients visited the hospital with a shoulder complaint each month, it can be deduced that quite a large proportion of these patients viewed the video on the hospital Web site. The video was uploaded on YouTube in May 2015, and as of August 3, 2016, the video had received 1542 views, meaning that the video was viewed even though it was not well known, which indicates that there are individuals interested in learning about shoulder joint exercise methods. With proper promotion, the video would be expected to receive more views. The number of visitors watching this exercise video on YouTube was 1.5 times higher than the number who visited the hospital homepage. This implies that YouTube is more widely used to watch health-related videos than the hospital homepage, but the difference in the efficacy of the two methods must be examined.

The shoulder joint exercise video developed in this research was configured for users to view the demonstration and exercise simultaneously, not to provide information on exercise methods. The video demonstrated basic exercise movements in a way that allowed the viewer to repeat the movements. The users responded positively to the exercises.

Some movements were filmed in greater detail for better understanding. A brief outline of the benefits to be obtained from each exercise component would be a source of motivation for the users. Such information should be provided in a shoulder joint exercise brochure to be distributed among users.

The developed shoulder joint exercise Web video must be verified for efficiency. Pain, joint ROM, and muscular power can serve as the best efficiency indexes.[21,22] The exercise video was created because a single exercise training session would not suffice; nevertheless, there needs to be some impetus or incentive for users to view the video and exercise on a regular basis. E-mail, text messaging, or retraining at follow-up visits could be used to maintain user motivation. The concrete objectives of this exercise video were to decrease pain, enhance joint ROM, and increase muscular strength from shoulder joint exercise; however, research on how all of these variables ultimately affect individual quality of life is needed.

Advanced information technology enables the use of computers and the Internet in diagnosis and treatment. Hospital Web sites can be utilized to promote ubiquitous healthcare. Featuring a patient management program that would allow for better intervention in users' health issues on a Web site will increase their satisfaction. This Web exercise video may be used as a nursing intervention tool in order to help patients who are trying to restore shoulder joint function but who live in isolated or remote areas where medical services are limited. The development and application of Web-based programs may contribute to the expansion of nursing knowledge systems and the utilization of nursing information.

This study was carried out among the patients of a university hospital and hence on a limited number of participants. Despite this limitation, its advantage lies in the fact that it can be accessed anytime and anywhere by the patients and can help a large number of people at once without having to meet the patient face to face, because it is openly available on the Web.

Big data on users that are accumulated on Web sites will contribute to solving more healthcare problems and increasing public well-being. In such systems, there will need to be security measures in place for protecting patient privacy.

We also recognized that there may be participants who cannot use this tool because the Internet is not available or for other reasons, and those without a smartphone may be excluded. In that case, we have to search for other solutions or measures to address such issues.

FUTURE WORK

In future studies, it will be required to monitor changes in shoulder joint function, pain, activities of daily living, quality of life, and so on, over time as participants use the Web exercise video. For the purposes of generalization, it is necessary to test its effects on shoulder function, activities of daily living, quality of life, and so on, after the application of this Web exercise video. Because the number of cases is increasing also among young people because of sporting injuries and traffic accidents, it is necessary to develop Web videos for different age groups. If a barcode is provided in the brochure of the Joint Center and people can access the exercise video directly using the barcode, it will increase patients' performance of exercise after surgery. For this reason, the use of a barcode needs to be considered. We live in a highly advanced information society. Thus, we need to utilize information technologies to promote health activities that can benefit people with physical ailments caused by aging and disease and help them lead a healthy and active life.

CONCLUSION

This study was conducted to develop a Web video to train shoulder joint disease patients in how to perform shoulder joint exercises. The ADDIE model of instructional design was applied in the development process. A shoulder joint exercise video was developed through the five stages of the ADDIE model: analysis, design, development, implementation, and evaluation. The developed shoulder joint exercise Web video was then optimized, after evaluation by experts and users. The video demonstrates exercises that stretch and strengthen the joints and muscles of the shoulders. Stretching exercises include the pendulum, forward elevation, outer rotation, crossover arm stretch, inner rotation, and the sleeper; strengthening exercises include dumbbell exercises, a chair exercise, wall push-ups, and rowing. The video is available for viewing on the Web site of a university hospital and on YouTube. At some point in the future, changes with regard to pain, joint ROM, and the muscular strength of users who exercised while viewing the shoulder joint exercise video will need to be assessed in order to verify whether their quality of life has been improved by the video.

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