

The Impact of Imagery Therapy on Rheumatoid Arthritis Patients

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Abstract.

This paper concerns computer applications in medicine that exploit the potentially powerful interconnection between psychology and physiology. An important class of applications involve patients who suffer chronic pain caused by rheumatoid arthritis; these patients look for any kind of therapeutic technique to use in addition to traditional medicine in order to alleviate pain, reduce physical disabilities caused by the disease or delay disease progress and improve their lifestyle. This paper focuses on a particular class of therapeutic techniques that provide imagery therapy using virtual reality in the treatment of rheumatoid arthritis. We describe imagery therapy involving guided imagery and illustrate its effects. We particularly describe the application of VR and IT in the treatment of rheumatoid arthritis. A brief introduction to our system and the research we have done in this field is presented, showing some preliminary results that support our hypothesis.

Keywords: Virtual reality, guided imagery, imagery therapy, rheumatoid arthritis.

1. Introduction

Arthritis is a term defining more than 100 different diseases. Rheumatoid arthritis is considered as one of the most common types of arthritis. According to a study published by the Arthritis Foundation in 2004 [1], about 1.2 million Americans have been diagnosed with the disease. Since there is no effective treatment for rheumatoid arthritis (RA), managing this disease is crucial. RA is a chronic disease that cannot be cured and might in time lead to joint deformation. These distortions could cause disabilities. Many interventions, such as reduction of pain and stress, may control this persistent disease. In this stage, imagery therapy can be used to alleviate pain. Imagery therapy (IT) is one of the most effective complementary therapies in the United States and it has become one of the most successful and harmless treatments, as explained in a study published by a medical research team led by Wolsko [2]. Imagery therapy uses the imagination to control the body using positive influences. It is considered as a language that is used to create a discussion and to build a rapport between the brain and the body. In this manner, the brain can communicate with the body and sends signals to modify and change the body or part of the body. This technique could be implemented using one or more of the human sensory systems such as the visual system, the

somatosensory system, the auditory system, the olfactory system or the reproductive system. Scientists, researchers and health specialists have conducted number of studies investigating the effectiveness of this technique. Studies show promising results in several diseases. Imagery techniques depend heavily on stimulating positive images for patients as presented by [3]. Computers enhance these images by creating an appropriate virtual world that enables patients to interact with a three-dimensional environment using virtual reality technology. Therefore, imagery therapy using virtual reality is much better than regular images for many reasons, including patient interaction and the influence of other sensations.

Virtual reality (VR) is a computer technique full of excitement, challenges and effects. This field is growing so rapidly. Virtual reality has the advantage of being an efficient tool to interact with the body and has an influence on the mind. VR is mostly about building virtual environments to simulate reality. Imagery therapy depends heavily on advanced computer systems and computer graphics to present the environment using science fiction and images. Using VR, a user can live, act or interact in a virtual world which absolutely simulates reality. Interaction with the environment and presentation of the world is achieved using assistive devices such as a head mounted display (HMD), data gloves, joystick, mouse, and other devices. VR helps in a large number of applications such as medicine, education, training and others. In this paper, we will look at the impact of VR in medicine focusing on rheumatoid arthritis.

Virtual reality has the following properties:

Immersion: where a person feels that he or she is in a particular environment, connected to it and totally immersed in the environment.

Interactivity: the ability of a user to control and respond to the environment. All of what we see in virtual reality is a computer graphics re-draw. Therefore, if we have too many details, the system has to process all of them, which results in prolonged processing time. So, this has to be taken into consideration.

The system requirements of virtual reality:

The virtual reality system needs a high performance computer system to process the sophisticated graphics. However, for the hardware requirements and according to the required environment, we may need a head mounted display (HMD), virtual environment cave, manipulation and control devices such as a mouse, a joystick, and 5DT data gloves. We may also need a head and hand tracking device, an ultrasonic sensor, magnetic

trackers and an optical position tracker. For the software requirements, Robinette and Manseur [4] showed that the virtual environment needs a high degree of interaction with the user. This could be achieved using advanced state-of-the-art software with high performance rendering. The authors concluded that decent software at a low price is currently available.

This paper presents a number of studies focused on the impact of imagery therapy and VR on some diseases with an extended research on rheumatoid arthritis. This research focuses on the impact of imagery therapy and virtual reality for rheumatoid arthritis patient to find out if VR and imagery therapy would help in any way to reduce pain and symptoms.

The studies presented in this paper shows the importance of imagery therapy and VR. Applying this type of technology may significantly improve a patient's lifestyle. Many people have been diagnosed with rheumatoid arthritis. This is an interesting motivation to investigate the possibilities of pain reduction and lifestyle improvement. Lack of awareness in society regarding imagery therapy motivates us as researchers to provide scientific evidence and knowledge to patients and families to help them employ modern technologies to end their suffering and pain. Previous research and experiments on many diseases have established a sound relationship between pain sensation and mental concentration. We claim that if we implement imagery therapy using virtual reality, the pain level of rheumatoid arthritis patients will decrease dramatically. This claim can be measured using some pain estimation scales. Pain is the main symptom of this disease. Consequently, it is necessary to find different methods either to remove the pain entirely or to alleviate it to some degree. One of the methods used to achieve this goal is the use of local anesthesia. Because rheumatoid arthritis is a chronic disease, the drug dosage should be carefully reduced, so that it does not lead to addiction. In most cases, local anesthesia does not minimize pain sufficiently and causes some side effects. For this reason, safe and effective complementary methods are adopted and used with medication to obtain satisfactory pain level reduction. One of these newly-adopted methods is virtual reality technology. When imagery therapy is engaged, the patient's attention and concentration move from the present painful situation to an exciting and attractive virtual world. Scientists have provided experimental scientific proof which supports the effectiveness of VR in minimizing pain by distracting the activities of pain sensation in the brain to the exciting virtual world. Our study shows the great influence of VR and imagery therapy in RA. These studies have demonstrated considerable reduction in pain and anxiety and improve lifestyle with a high degree of effectiveness. The studies which are presented in this paper shows that there are a quite large number of patients who suffer from rheumatoid arthritis. These patients can use the system presented in this paper to reduce pain and improve lifestyle.

Our hypothesis is built on the belief that any disease, unease or physical discomfort which has strong ties with the spirit and mind and can be controlled using VR and imagery therapy.

In many cases, only psychological means, such as relaxation, imagery therapy and cognitive behavioral therapy are used to alleviate pain. The assumption and fundamental goal of the studies presented in this paper are to determine whether the

emotional, physical, visual, and functional status changes in patients with rheumatoid arthritis after treatment with imagery therapy. To initiate this research, we obtained some high-tech virtual reality systems. We used questionnaires throughout the course of the treatment and conducted some qualitative analyses to reflect a deeper understanding of the patients and their feelings.

The paper is organized as follows. In section two, we present an extended literature review followed by a review of some virtual reality equipment available on the global market which help in the treatment of the disease. Section 3 describes our proposed virtual reality method for rheumatoid arthritis treatment. The setting of the experiments and methodology are presented in section 4, and the results are shown in section 5. The overall problem addressed in this paper is the pain associated with rheumatoid arthritis; we show how such pain could be alleviated using imagery therapy and virtual reality.

2. Background

Imagery therapy is a method categorized as psychological therapy or cognitive behavioral therapy. Imagery therapy is a class of therapies based on strong ties between the mind and the body. The psychological effect of the body appears to be reflected accordingly on the immune system and its reactions. In practice, imagery therapy exposes the body to a virtual environment that may combine one or more sensations such as visual, auditory, somatosensory, gustatory, and/or olfactory. Imagery therapy provides a mechanism for communication to the body through the mind resulting in relaxation and the release of tension, which in turn reduces pain or distracts attention and enhances pleasure or entertainment.

Imagery therapy generally involves the use of guided imagery, which is methodology that involves directing the thoughts of a subject through a particular sequence of states of the mind. Guided imagery appears to be most effective when it provides the subject with stimulation involving multiple senses that in combination provide a realistic imagery.

Imagery therapy is considered as a complementary therapy used with traditional medicine. This technique is used to employ the power of the mind when dealing with breast cancer. Imagery therapy for cancer patients focuses on:

1. Helping patients to cope with chemotherapy.
2. Controlling the amount pain to an acceptable level.
3. Providing a positive influence on the outcome of surgery.
4. Improving patient quality of life.

In their research, Richardson and his team [5] wanted to compare two groups: the imagery therapy group and a support group, in terms of coping with the disease, lifestyle, immune function, quality of life, and emotional well-being after breast cancer. Forty-seven participants were divided into three groups:

1. Standard care (N=15).
2. Support group (N=16).
3. Imagery group (N=16).

Many factors were measured in the study including: improvement of the immune system, natural killer cell activity, plasma neopterin (a substance found in body fluids which helps

stimulate the immune system), interferon-gamma (a substance which improves the body's natural response to injury), the division of cancer cells, tumor growth, and interleukin expression (a collection of proteins which are involved in intracellular signaling in the immune system). The results were as follows:

1. For all women, interferon-gamma increased, neopterin decreased, quality of life improved, and natural killer activity remained unchanged.
2. Compared to the standard care group, the imagery therapy and support groups showed improvement in dealing with and tolerating the disease, and improvement in their views on the meaning of life.
3. Compared to the support group, imagery therapy participants had less stress, and in addition showed an improvement in the quality and functionality of their social lives.

Another study was conducted by Bakke and his team [6] to determine the effectiveness of hypnosis-guided imagery on the psychological well-being and immune function in patients being treated for stage I or stage II breast cancer. After eight weeks of an imagery training program and at three months of follow-up, NK cell number and activity, as well as psychological states, were measured. The results reflected a significant improvement in depression and an increase in the absolute number of NK cells, but these were not retained after the end of the treatment. Therefore, we note the positive impacts of hypnosis-guided imagery in the psychological state of patients even if these changes were not retained after the treatment ended.

Fox and Kolcaba [7] presented a study to measure the effectiveness of imagery therapy in improving the feeling of comfort for women with early stage breast cancer. Fifty-three participants, aged 37-81, 80% European and 10% African American with stage I or II breast cancer, participated in the study to receive radiotherapy. Participants were divided into two groups:

1. The experimental group (N=26), who received imagery therapy through listening to an audio recording once a day during the treatment period.
2. The control group (N=27).

The Radiation Therapy Comfort Questionnaire, geared towards assessing the feelings of patients with regard to radiotherapy, was conducted at three time points during the study:

1. Time point 1 – before the intervention and the beginning of radiotherapy.
2. Time point 2 – three weeks later.
3. Time point 3 – three weeks after completing radiotherapy.

The results reflected the effectiveness of guided imagery intervention for enhancing the comfort of patients who are undergoing radiation therapy for early stage breast cancer. The intervention was especially salient in the first three weeks of therapy.

Walker and his team [8] studied the effectiveness of imagery therapy (through helping patients to imagine and visualize host defenses destroying tumor cells) combined with a relaxation technique in order to improve the response to chemotherapy and quality of life. Ninety-six participants with breast cancer were divided into two groups:

1. Control group (standard care).
2. Experimental group (standard care plus relaxation training and imagery).

Psychological tests to assess patient mood and quality of life were conducted before each of the six cycles of chemotherapy and three weeks after cycle six. Tests were used to evaluate personality and coping prior to cycles one and six. Response to chemotherapy was evaluated using standard UICC criteria after six cycles of chemotherapy, and the pathological response (to assess structural and functional changes in molecules, cells and tissues) were assessed in the tissue removed during surgery. The results were as follows:

1. Mood Rating Scale: patients in the experimental group were more relaxed and receptive to therapy.
2. Global Self-assessment and Rotterdam Symptom Checklist: quality of life was better in the experimental group.
3. Courtauld Emotional Control Scale: emotional suppression was reduced in the experimental group.

Diane Tusek, the president and founder of Guided Imagery Inc., published a study (guided imagery inc, n. d.) [9] which contains a review of some of the diseases which can be treated using imagery therapy. The study presents an introduction to imagery therapy and a brief introduction to how this therapy works and how it interacts with the body. The author discussed the effects of imagery therapy on addiction and anger management. She discussed its benefits for cancer pain, chemotherapy and radiotherapy side effects. The author showed how imagery therapy helps in reducing childhood depression and pretest anxiety in students. Colonoscopy was discussed in her study as well. The author showed how imagery therapy can be used in dental procedures, diabetes, divorce, fibromyalgia, obesity, headache and infertility. Many other diseases were discussed as well. For more details, please refer to [9].

In their research, Brawn and his team [10] discussed the benefits of the computer game Packy and Marlon which they designed for children diagnosed with diabetes. In this game, children act in the game to control the glucose level of a baby elephant. The computer game encourages children to use the insulin injection to control the glucose level. It also encourages them to take the proper food on time, and thus control their weight and glucose levels. This computer game has many activities which encourage children to acquire some useful habits. When the authors conducted their studies, the patients who used this computer game reduced their clinic visits by 77%.

Rheumatoid arthritis is a chronic disease that cannot yet be cured clinically. The intensity of pain could, however, be alleviated, which may result in more controllable and stable disease. For this disease, many physicians prescribe painkillers as an essential part of the treatment plan. Pain occurs when pain signals are transmitted to the brain through networks of nerves. The body intercepts these signals by generating endorphins, a chemical that kills the feeling of pain. There are several factors that motivate the body to generate endorphins; the most important one is motivating the mind to think of and immerse itself in positive images [11]. Using imagery techniques in the treatment plan has a great advantage in enhancing endorphin production and in

alleviating the sensation of pain, so the need for painkillers is reduced.

Sridhar and his team [12] reported that cognitive behavioral therapy attention and mental imagery helped patients with rheumatoid arthritis in alleviating pain and improving self-esteem [13]. Astin and his team [14] found strong evidence of the effectiveness of imagery therapy techniques for rheumatoid arthritis patients in alleviating pain and disabilities. Varni and Gilbert [15] have proven that imagery techniques can lead to reduced intensity of rheumatoid arthritis pain through a remarkable treatment plan that consists of relaxation exercises, breathing techniques and imagery techniques.

Another study analyzed 501 patients (68% with osteoporosis, 15% with rheumatoid arthritis and 17% with other forms of arthritis), using a program called "self-control of arthritis", an educational and health program in which patients undergo a number of treatments such as imagery techniques and other treatments. Lorig and his team [16] found that when patients followed this program for four years, it led to a 20% decline in pain and reduced clinic visits by 40%. In addition, patients who followed this program saved approximately \$648 a year per person for those with rheumatoid arthritis and \$189 a year per person for those with osteoporosis. Kim and Sohng [17] proved that imagery techniques can significantly improve the quality of life of patients with rheumatoid arthritis.

Previous studies which focused on the impact of imagery techniques in rheumatoid arthritis treatment have provided clear scientific support for our hypothesis with regard to the design of a computer environment to control pain for people who suffer from rheumatoid arthritis. Consequently, the impact of imagery techniques when using virtual reality as we hypothesize should provide the same results as those reported in studies investigating other diseases. This paper presents a research review on the impact of imagery techniques on rheumatoid arthritis treatments. As shown, the impact of imagery techniques using virtual reality in rheumatoid arthritis treatment requires further investigation. Campbell and his team [18] presented a paper in 2001 introducing a learning environment for a virtual anatomy lab. The authors showed that their system introduced the 3D space and online features for the learning environment. Their system has various levels of complexity. Rajaram and Marsic [19] presented their virtual biology lab in 2001, claiming the cost effectiveness of using this kind of environment; moreover, the system did not negatively impact learning quality. Safigianni and Pournaras [20] introduced their high performance and low cost software laboratory tool for a virtual lab to enhance learning for students in electrical engineering. Riva and his team [21] presented an extremely extended review on a virtual reality-based experimental cognitive treatment of obesity. Their work presented a large number of studies provided by experts in the field of obesity, binge-eating disorders and virtual reality. For more details on the studies carried out in this field, it is recommended to refer to this review [21].

3. The Systems

Virtual reality system has been used with imagery therapy to distract patients' attention away from the painful real world to a positive virtual environment which helps in alleviating pain in numerous diseases including leukemia, breast cancer, burns, phobia, and many others. From prior data and scientific evidences, we can infer that the percentage of imagery therapy methods using virtual reality techniques which have been successfully implemented in controlling pain associated with rheumatoid arthritis is very high.

The greatest help needed by rheumatoid arthritis patients is pain relief. When we design a virtual environment to stimulate relaxation and immerse patients in its quiet world, we can say that the patient is controlling the disease and can control the amount of pain. We have implemented a scenario where the patient in the virtual world wants to go after their dream and bring it to reality. The character in the virtual world embarks on a quest to tour the world and enjoy the sunset in different locations around the globe. These unforgettable scenes attract patients' attention and immerse them into a virtual world full of relaxation. Listening to different music according to the location where the patient is virtually visiting gives the patient a wonderful experience. This scenario supports patient confidence and charges him or her with a lot of energy to cope with their disease. Imagery Way is a virtual reality program used in the treatment of acute lymphoblastic leukemia in children by solving the following problems:

1. The pain with acute lymphoblastic leukemia resulting from chemotherapy, especially in the first year of treatment.
2. The need to improve children's quality of life and their requalification.
3. Depression resulting from long stay in hospital (about six months with complete isolation because of weak immunity). This situation generates a feeling of isolation for children and a feeling of missing out on the normal life enjoyed by other children of the same age.
4. The side effects of chemotherapy in the first year of treatment such as nausea and vomiting.

The game was divided into five main stages; all of these stages are within the human body and vary depending on the location of the body and the form of cells surrounding the player as well as the form of cancer cells which should be eliminated by the player and the type of alternative medicine (honey, grapes, special water, green tea, bees) which is collected in each of these five stages. The sites of the five stages were selected as follows: the right hand represents the first stage, the left hand represents the second stage, the left leg represents the third stage, the right leg represents the fourth stage, and the middle of the body represents the fifth stage. Finally, the player reaches the stage of the beast and beats him, thus overcoming the disease [22].

Our newly designed system helps patients to relax and do not feel that much pain. It is built on top of the imagery way discussed earlier in this section, but for the rheumatoid arthritis patients.

4. Results

Once the system was implemented and used, we ran the test using observation on two groups, the test group and the control group.

The test group used the same medication prescribed by their physicians, however, they were under the influence of VR and imagery therapy systems. According to MADRS [23], we obtained the following results:

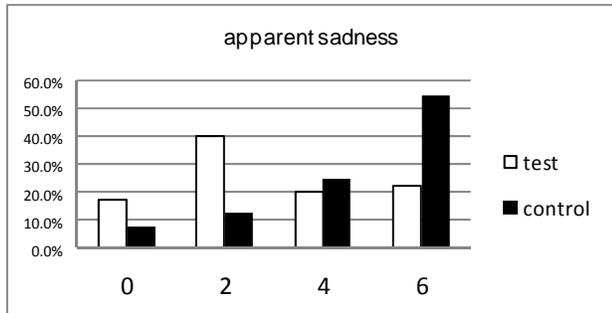


Fig. 1

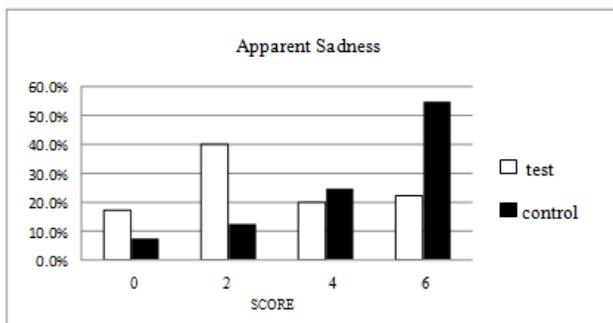


Fig. 2

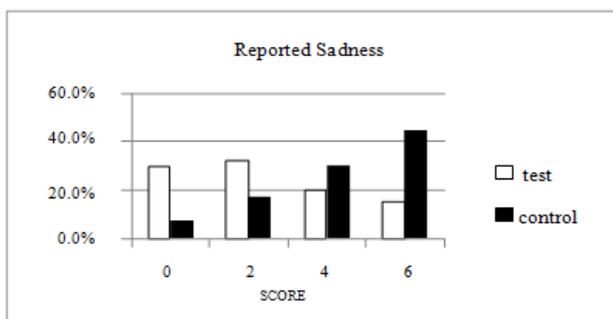


Fig. 3

Questionnaires:

Throughout the course of the treatment, data were collected for both groups for several months. Data were analyzed using the following questionnaire and scales: MADRS [23], CPRS [23] and SSP [24].

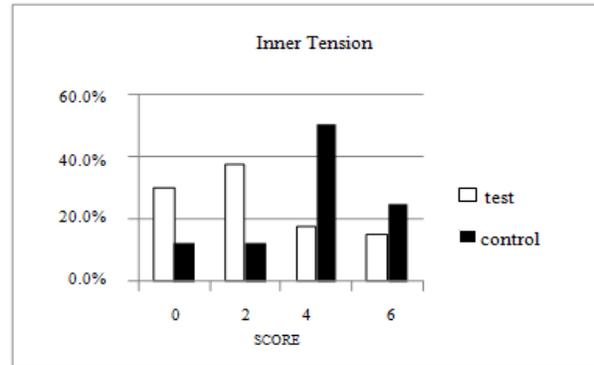


Fig. 4

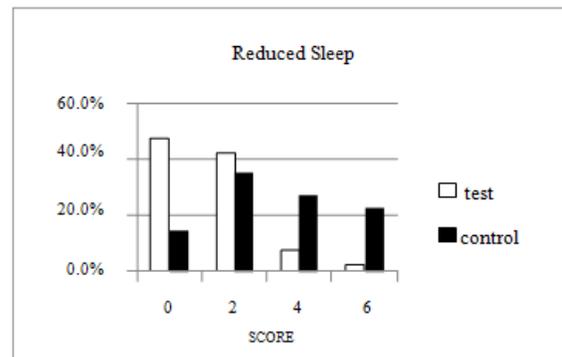


Fig. 5

5. Discussion:

The results presented in Section 4 provide clear quantitative evidence that imagery therapy using virtual reality can aid in the reduction of various negative factors such as sadness, tension or inability. These initial results appear to us to be quite promising, and provide encouragement to motivate further work in this field seeking improvements. Our ongoing and future work will explore potential improvements that include an even more engaging VR interface, the use of further advances in guided imagery, and improved statistical analysis of the experiments.

6. Conclusion

Many complementary therapies have shown efficiency and effectiveness in treating a variety of chronic diseases. Imagery therapy is one of the most successful therapies in this field and rheumatoid arthritis is representative of the chronic diseases. Using imagery therapy techniques in the treatment plan should help with alleviating pain, which is the main symptom of this disease.

Imagery techniques are a useful method for reducing pain intensity, as they have demonstrated their ability to improve the quality of life in depressed patients who feel helpless and isolated. Moreover, imagery techniques are used as a tool to reduce disability and slow down the progress of disease. This

paper provided some of the results of using virtual reality in the treatment of rheumatoid arthritis and shows that the impact of imagery techniques using virtual reality in rheumatoid arthritis is noticeably high.

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