

The use of mirror therapy in the treatment of phantom limb pain in amputees

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Abstract

Mirror therapy is a non-invasive and inexpensive therapeutic procedure indicated for the treatment of post-amputation phantom limb pain. This technique has proven its effectiveness and consists of bringing into play brain plasticity in order to reshape the central body architecture after amputation. This is a quantitative and descriptive study, which aims to objectify the use of mirror therapy on phantom pain in amputees, by combining the results in order to evaluate its effects, its application and its limits in the management of post-amputation.

Keywords: Mirror therapy; Phantom limb; Pain management; Amputation; Rehabilitation

1. Introduction

Amputation of a limb represents the loss of one or more segments of the musculoskeletal system. It is indicated in irreversible tissue damage, chronic permanent ischemia without possible revascularization, which does not respond favorably to medical treatment or whose general repercussions are life-threatening to the patient. Removal of a limb may or may not cause neurological damages, which are grouped into three distinct groups: phantom limb pain, residual limb pain and phantom sensation [1].

Nowadays, it should be noted that the rate of aging is increasing further thanks to new scientific discoveries and advances in medical technology. Knowing that the average age of amputation is 59 years [2], and as the world population gets older, the care of amputees takes its interest.

The early support of amputated patients is essential in order to fight against ankyloses and preserve the axis of the limb by directing the modifications of the amputation stump. The amputee patient must also be assisted through a rehabilitation protocol which consists of restoring walking function but also restoring balance in order to allow the patient to be as independent as possible in his daily life.

However, the quality of life of the patient can also be affected by phantom pain since it prevents the fitting and complicates the social life of the amputee. It is important to support the patient so that he accepts his new body image, by first improving his self-esteem, in order to allow him a better social reintegration.

For 90% of patients amputees, feeling phantom (the sensation that the amputated limb is still present) is always present e, and 95% of these patients have pain of phantom (pain in an amputated limb). According to Dr. Tamar Makin, with a post at University College London, "80 % of amputees experience pain associated with the lost limb".

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In addition, phantom limb pain coincides with painful or unpleasant sensations present in an amputated limb [2]. They are variable and varied from one patient to another. These pains generally occur in the first six months postoperatively but can persist for years afterwards, and this in 85% of cases. After a well-detailed literature review in pain management, the conclusion is that it is essential that the patient become the actor in his management of his regular pain. To relieve the pain of these patients, a large dose of medication is taken every day but according to several authors they are not sufficient to treat them [1].

There are many therapies that have been invented or implemented with the aim of relieving or abolishing phantom limb pain in amputees. Nowadays, therapeutic treatments are oriented towards the neurological field, thanks to a better understanding of brain mechanisms and new medical imaging techniques [3].

The use of mirror therapy relieves painful phenomena or sensations felt in the absent limb. These two neurological approaches show a break with the old methods, because they seek pain in the areas of cortical projection and not in the stump or phantom limb [3]. As a result, the mirror box resides in the use of a movement of a part of the body which will allow a confusion originating from the brain to be treated remotely.

2. Material and methods

We have chosen as methodology a survey filled in by specialists in physical medicine and rehabilitation in order to have their feedback on mirror therapy in amputees. Then, we carried out a second study with amputees because the human experience is very important, it allows individual feedback. Therefore, surveys will rely on quantitative studies. Below, we will discuss the strategy for carrying out these questionnaires:

2.1. Type of study

This is a quantitative, descriptive and exploratory study at the first level, which aims to explain the use of mirror therapy on phantom pain in amputees.

2.2. Study environment

We chose physical medicine and rehabilitation centers based on our experience and their reputations, we then contacted the managers of each center in order to send them by email the link to answer the questionnaire. These centers are located in France, in Deauville, Brest, Lille and Bordeaux but also in Morocco in Casablanca.

Regarding the survey for amputee patients, we found on the social network "*Facebook*", some groups whose creators and members are people who have undergone an amputation. The groups selected are: "Advice, Discussions and Tips for amputees: " *CEA* ", "*Amputés de France* ", and "*ADEPA* ". On these groups we have published the link to the survey intended for amputees with a little message to explain our approach to them. This allowed us to obtain several responses and many messages of congratulations and encouragement.

2.3. Target population

The target population is made up of 27 specialists in physical medicine and rehabilitation practicing in France and Morocco. We chose the following inclusion criteria: specialists with a state diploma, having amputees with phantom pain. Then we chose these exclusion criteria: patients with cognitive impairment, visually impaired and the patients with bilateral amputation.

2.4. Sample

Since our target population is small, the technique used is systematic sampling, which consists of taking the number of the target population. Therefore, our sampling for health professionals and 27 and 44 for amputees.

2.5. Data collection method

The two questionnaires are distinguished by a series of standardized questions in order to collect and standardize numerous testimonies. At the beginning of each part the first question concerns the inclusion criteria, if a person meets one of the exclusion criteria, it will be sent directly at the end of the survey so as not to distort the rest of the results of. He will find a thank you message for taking the time to respond.

2.6. Data collection and synthesis instruments

For both questionnaires, data was collected through a direct online interview guide using the “Google Forms” platform. The questionnaires were sent by email, telephone, social networks or by message from April 20, 2020 to May 12, 2020. Each questionnaire is made up of four parts as follows: socio-demographic data, amputation, pain in the chest. Phantom limb and mirror therapy.

3. Results

In a first step, we will process the data collected through questionnaires completed by 27 health professionals. Then, in a second step, we will process the data collected thanks to the questionnaires filled in by the 44 amputees.

3.1. The survey dedicated to professionals

The majority of the patients who consult present an amputation: femoral, tibial and partial of the foot with respective percentages of 17.6%, 20, 3% and 18.9%.

The most widely used pain assessment technique is the Visual Analog Scale (39.6%). The DN4 questionnaire and the Short- Form mcGill Pain Questionnaire (2 to 17%) are also heavily used.

Only 5 in 25 of professionals do not use mirror therapy with amputees for FMD (20%). They are therefore sent directly at the end of the questionnaire because they are not part of the inclusion criteria.

The majority choose to use mirror therapy based on: patient's attention span (25%), patient acceptance of disability (22.9%) and bothersome pain (29.2%).

13 out of 20 professionals believe that there are contraindications to mirror therapy which are mainly dominated by the psychological aspect and cognitive disorders.

The limitations that emerged the most are the following: strong patient attention (6), patient motivation (4), bilateral amputation (4), and psychological aspect of the patient (4).

7.15 is the average of the effectiveness of mirror therapy which emerged from health professionals.

3.2. The survey dedicated amputees

The majority of people are amputated at the level: femoral (38.6%) and tibial (38.6%).

54.5% of the 44 people questioned have amputations due to accidents.

Our 44 individuals only 5 of them have or have had in the DMF absent member (11.4%), thus they are sent directly to the end of the questionnaire because they are not parties to inclusion criteria for this study.

87.2% of amputees performed mirror therapy for their DMF. The 5 people who have never practiced it are sent directly at the end of the questionnaire because they are not part of the criteria.

70.6% of the 34 amputees had no difficulty in performing mirror therapy.

On average after one month of mirror therapy, the intensity of DMF for these 34 people is 4.5 out of 10.

27 out of 34 amputee patients did not experience any side effects during their mirror therapy session

4. Discussion

Mirror therapy is quite simple, it is a technique that you can do yourself at home. All you need is a mirror and dedication to follow the treatment every day.

Mirror therapy is a non-invasive and inexpensive therapeutic process that can be used for several purposes: in the reduction of pain, mainly in phantom limb pain, but also in the rehabilitation of motor skills during a stroke.

This technique makes it possible to form the illusion of a reconstituted amputated limb by replacing the image of the absent limb with the image of the healthy limb so as to reduce the pain felt or restore motor function [4]. When mirror therapy is performed, the brain receives the information that both limbs are intact and functional. It is widely accepted that cortical restructuring occurs in the brain when this new information is received and therefore restructuring decreases or resolves pain [5].

The objective of this written work is to identify if mirror therapy has the possibility of reducing or eliminating phantom limb pain in amputees. The difference in language between the data in the literature and the returns from the questionnaires allowed us to carry out a more in-depth analysis, the aim of which is to assess the extent and the reasons for the differences observed.

The survey of amputees did not reveal the same figures as those described in the literature concerning the aetiology of amputations. Throughout the literature 80% of amputations are due to illnesses and 20% to accidents. In contrast, in our survey of 44 amputees, 54.5% are due to accidents and 38.6% to illnesses. If our survey had been carried out on a larger sample, the results would probably have been similar to those reported in the literature.

On our sample of amputees, we observe that the majority of amputees are in the lower limb with 95.3%. In addition, in the multiple-choice question intended for healthcare professionals, they indicate that amputation generally occurs in the lower limb. It should be noted that during the amputation procedure, the surgeon systematically reflects on the patient's recovery capacities, which vary with age and the cause of amputation.

The majority of those interviewed in our survey are over 36 years old. The brain in adulthood has a very limited capacity to adapt compared to the brain of a child. For this reason, it is preferable to stimulate the nervous system early and over a long period. However, and following this phenomenon of cortical reorganization after amputation, the pain can be alleviated by imaginary perception of the limb [6, 7].

In the literature, we found that the most experienced complications postoperatively by amputees is the sensation of phantom limb and sometimes can be accompanied by phantom pains in the residual limb. And as shown by the study conducted by Doctor Lefèvre-Balleydier in 2018, patients with partial amputations experience phantom sensations in 90% of cases. In addition, almost all of them claim to have phantom pain in their absent limb [8]. We can see in our survey of amputees that 86.6% have or have already had DMF in their abolished limb.

Moreover, for the 39 people who had DMF the average intensity is 7/10 on the pain scale. We can explain this high intensity because our sample is composed of 54.5% of amputees for accidental cause, it appeared suddenly, so the person did not have time to prepare for it. The opposite of amputation due to infection or tumor.

To reflect on the study by Doctor Lefèvre-Balleydier, which states that postoperatively, amputee patients feel phantom sensations in the absent limb in 90% of cases, Flor by his article in 2002, describes these phantom sensations like an electric current, a sting, a burn, a crushing, a pressure and a stab [9]. Furthermore, in our survey we do not have the same descriptions of pain from limb amputees, they describe this sensation as being mainly electric shocks (38 responses), tingling (27 responses) and crushing (15 responses). These results diverge from Flor's article since pain is specific to everyone's perception and feeling, everyone perceives pain from a different point of view. To best quantify this pain in amputees, many questionnaires and scales exist. This is why we found it interesting to ask the question in our investigation to know that they were the most used tools to measure this pain with our population of healthcare professionals. Note that for the 25 professionals who responded, they mainly use the Visual Analogue Scale (VAS) at 39.6% to assess pain in an amputee patient, but also the DN4 Questionnaire and the Short- Form McGill Pain at 17%.

The objective of the use of estimating pain in an amputee patient is to gain a better knowledge of the clinical manifestations which will subsequently help to provide much better therapeutic management to the patient. We can notice that in our survey, 92.3% of amputees benefit from drug treatment against phantom pain and that 79.4% of people also benefit from mirror therapy. It can be observed that it is thanks to this knowledge that much better management can be achieved, despite the fact that researchers still do not know the true origin of phantom limb pain.

However, through the literature we have read that the combination of different therapeutic treatments would act in cortical areas and reduce or abolish phantom pain in some amputees.

We are continuing our investigation with an article that challenged us, it is that of Ephraim et al. in 2005, which specified that cortical reorganization was the most cited reason for the cause of DMF in recent years and would explain the neurophysiological origin of these [10]. Note that the therapy mirror is inexpensive and especially practical in self-

treatment. Thus, in Morocco, amputees do not necessarily benefit from close post-operative care due to lack of communication between services, lack of means of transport, etc. it is therefore a practice that could fully adapt to the country.

Mirror therapy shows a break with the old methods (massage on the stump, cold, heat, electrostimulation, etc.), because these seek pain in the cortical area [2]. It is important to remember that mirror therapy is a simple method and it intervenes on the cortical reorganization since it would reduce the pain of the absent limb thanks to the reduction in cortical influx according to Ramachandran [11].

Following this analysis, which evokes that mirror therapy is rather simple and that one can do oneself at home, our two surveys reveal that this information is true because 100% of the professionals questioned know it and 80% of them use it for the treatment of DMF. In addition, our second survey showed that 87.2% of amputees performed mirror therapy for their phantom pain. Being a simple therapy to set up, which is non-invasive and inexpensive, it is for these reasons that our two samples use it so much. Would it be used as much by health professionals if the results had not proven their effectiveness in reducing phantom limb pain?

Our investigation is in agreement with this study which affirms that the results obtained demonstrate that mirror therapy is effective in reducing DMF after one month of regular practice.

Our results highlight that of the 39 respondents who used mirror therapy, the intensity of their phantom pain increased on average from 7 to 4.5 out of 10 after 4 weeks of daily mirror therapy. We found another study by Darnall and Li in 2012 on a sample of 40 people with phantom limb pain, who performed mirror therapy themselves at home and saw the same benefits [5]. In addition, our surveys attest to the effectiveness of mirror therapy in reducing DMF, since professionals are convinced of its effectiveness, 7.5 out of 10 and 82.4% of amputees questioned recommend it.

For the 20 professionals questioned in our survey using mirror therapy, 60% of them use it between 15 to 25 minutes per session. However, for Darnall in 2010 in his book, he expresses that mirror therapy on a patient with DMF is carried out over a period of 20 to 25 minutes per day [1, 3]. We can see that between our investigation and what Darnall said, there is a slight difference. We can put this difference on the fact that our sample of 27 professionals has been practicing for less than 5 years for 10 of them. As a result, the practice of these young people may have shown that mirror therapy was more effective over a shorter session because the patient can be more focused on the reflection of his limb in the mirror over a shorter period of time, this is for these reasons that some use it 15 minutes only.

To bounce back from this drawback (the concentration time), we can say that the limits of mirror therapy would be the patient's concentration on the reflection of the "intact" limb to give the brain the illusion of a new limb. We were able to verify these statements in our survey since 20 health professionals confirm that the strong attention of the patient was the main limit.

The analysis of our survey shows the same main limitation, that of the patient's concentration. However, although the second limit of Cole et al. is consistent, we did not find the same result with our investigation.

5. Conclusion

Phantom limb pain is a real problem encountered during amputations. However, mirror therapy decreases or sometimes eliminates these phantom pains. And since there is no universal recipe for overcoming an amputation. Each individual experiences it differently depending on personal factors such as their social environment, their experience, their psychological state, the circumstances of the amputation, which are all parameters that influence the post-amputation phase and the quality of life of these patients. Through this study, we believe that visual inference therapy is a good way to treat DMF. Mirror therapy seems to be the best bet when caring for an amputee patient. In particular by its simplicity, its effectiveness, its possible use in self-treatment and its lower cost. And despite the various studies published on this subject, the need to carry out studies on this subject is of interest in order to develop recommendations. Although mirror therapy was invented primarily to reduce phantom limb pain, to date it is also indicated for improving motor control in hemiplegic patients and the results are encouraging

Compliance with ethical standards

Disclosure of conflict of interest

The authors agree no conflict of interest.

Statement of informed consent

Informed consent was obtained from all individual participants included in the study.

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