Evaluation of upper limbs movements after surgery in breast cancer patients

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Abstract
With the high survival rate associated to breast cancer, there is more concern with the quality of life of the patient after the surgery. Likewise, non-invasive procedures have been used in order to reduce the impact that breast cancer may cause. Nevertheless, there is a chance to have some sort of impairment, since the surgical removal of the lymphatic nodes and radiotherapy, a common practice in breast cancer treatment, leads to damage in the upper limb mobility. This impairment is essentially characterized by low shoulder mobility and swelling, which precedes a chronic state of lymphedema, affecting the women's daily life.

In order to prevent such loss, it is recommended that the patient does some sort of exercise, keeping a daily routine of physical activity of the upper limb. This plan is developed accordingly with the clinical conditions presented by the patient; however, the measurement of these is usually made through subjective techniques, implying the possibility of errors. Similarly, in order to get better results, it is necessary an evaluation method able to measure all the factors that may interfere in the construction of the plan itself as, for example, the range of motion or the presence or absence of lymphedema. It is also important to have a system that, from the presented characteristics, is able to evaluate the manifestation of pain in the patient, its level or the existence of muscle sternness.

The use of a RGB-D sensor like the Microsoft Kinect will allow collecting data to evaluate this parameters, using color and depth information and a skeleton algorithm for human body tracking. The method will then be validated through traditional measurements, like the water displacement and the circumferential measurement methods and personal surveys to understand the upper body function.

1. Introduction
Cancer is, nowadays, a disease with great impact in society. Breast cancer is the leading cause of cancer in women, with an estimated 1.383.500 new cases in 2010 [1]. Nevertheless, mortality rate is 27% or less in developed regions [2], due to effective therapies and procedures as well as early diagnosis. Since survival rates are so high, it is important to understand the Quality of Life (QOL) of women after breast cancer surgery.

Breast Cancer problems are associated with surgical procedures, some of which can lead to sever Upper Body Function (UBF) problems of the patient. These problems can also be related to radiation therapy post-surgery. However, these do not have resolution, leading to lower QOL and difficulty in accomplishing daily activities. Concerns with QOL of breast cancer patients have been growing, with several studies trying to address this problem and showing that QOL can be affected by several clinical problems related to breast cancer surgery, such as impairments in upper limb function, depression, anxiety and problems with body image [3]. However, UBF assessment is usually performed by subjective self-reports. Even though self-reports have shown good results, these are limited and can present inaccurate results. Also, usually used self-reports only assess UBF or QOL, leading to a limited understanding of patients condition.

An important factor that causes impairments in UBF and less QOL is the presence of lymphedema. This is common in women after breast cancer surgery where the removal of the axillary lymph node system is needed. Lymphedema can be related with pain and restricted shoulder mobility. So, a early detection is important to diminish the impact of
lymphedema in breast cancer patients. However, its detection is usually performed by subjective methods that can be unreliable or very time consuming. Objective methods to lymphedema assessment can be found, though they are expensive. So, nowadays, the rehabilitation process for breast cancer patients is inaccurate and restricted to the limited information available. This can lead to impairments in patients QOL, due to poorly planned programs, or incorrect analysis of patient condition.

2. **Motivation**

Breast cancer has a high survival rate, nonetheless survivors from the disease can experience long-term sequelae from treatment including possible presence of lymphedema or lower range of motion (ROM). Assessment of UBF and QOL of these patients are usually performed separately by subjective methods, which can be inaccurate and very time consuming. Although objective methods have been proposed their use is limited, mainly due to cost associated.

Also, an early diagnosis can be difficult to perform by traditional methods. Studies showed that subjective self-reports are more sensitive and can lead to a more premature detection of reduced UBF [4]; however, these can be inaccurate. So, nowadays there is the need of an objective method that can assess UBF and QOL. This method needs to be accurate, low-cost, producing results in quick time, reproducible and capable of early diagnosis of upper-limb impairments.

It is also important associate UBF assessment with QOL of the patient and also understand the impact of treatments in the patients’ daily life. This association can lead to a deeper knowledge of patient problems, allowing the creation of a better rehabilitation planning and higher success in rehabilitation process.

3. **Objectives**

The main purpose of this study is to improve methodology, initially developed by Moreira [5], to assess UBF of breast cancer patient using Microsoft Kinect, a low cost equipment capable of producing 3D images of its surroundings. Microsoft Kinect will provide RGB and depth data and a skeleton tracking algorithm. Using that is possible understand the movements of the patient and, from these, will be extracted as well as several measures to assess UBF, presence of lymphedema or pain. This evaluation will also allow a more complete understanding of UBF and the relation with the treatment carried out in the patient.

**References**


