

# Rehabilitation of hand through leap motion control on burn injury patients

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## Abstract

Burn injuries, especially severe burns, triggers immune and inflammation response, disturbances of metabolism and distributive type of shock, all of this can be said as hard to treat and may lead to cause multiple organ failure. The fact that the injury not only effects physical health but also mental health his mental health and quality of life is critical. As a result, people with burn injuries cannot be deemed recovered if wounds have healed; rather, burn injuries cause long-term fundamental changes that must be focused in order to improve quality of life. As a result, burn care providers encounter a variety of issues, including managing acute and critical care, long-term care, and rehabilitation. Hand is the most commonly injured body part out of all accidents that are work related , ranks third of all workplace injuries and necessitating surgical and lengthy recovery. Hand burns make it difficult to function. The rehabilitation process has benefited from the usage of virtual reality (VR). LMC is a form of virtual reality game that uses new technology to provide biofeedback and training for fine motor function and functional skills. According to this review paper, leap motion training will enable hand burns patient to enhance finger mobility, reduce scar thickness, and improve hand function along with enhancing quality of life of patient. Although improvement in condition depends on severity of burn but this gadget proved to be a boon for hand rehab. on burn population. . Finally in conclusion of review it can be said that leap motion training may aid patients with hand burns in increasing finger range of motion, reducing scar thickness, and improving hand function.

**Keywords:** burn rehabilitation, virtual reality, leap motion, hand burns, scar management, burn scar.

## INTRODUCTION

Burn trauma has an impact on physical ,psychological and social functioning of the people, may lead to considerable morbidity, mental distress, and poor effects on their looks and relationships. (1).

Contractures and restricted range of motion (ROM), impairment of upper and lower limb , and hypertrophic scars are a few of the challenges that patients with burn injuries face during their recovery. These common and difficult issues can hinder functional tasks such as activities of daily living, movement, and transitions skills, resulting in long- term functional impairment. Upper limb injuries account for more than half of all burns, up to 80 percent in patients with severe burns. Overall loss of functions of hand can result in a loss of whole-body function of up to 57 percent. Furthermore, lower limb function might be considerably impaired for up to a year following the original trauma. Furthermore, six months after a burn injury, functional exercise ability is still significantly diminished.(2).

Hand burns make it difficult for survivors to function and carry out daily tasks.(3) patients suffer from reduced muscle strength, restricted joint mobility, and a low fitness level as a result of prolonged hospitalisation and a lack of daily physical activity and exercise.

Furthermore, even after small burns, hypertrophic scarring is a typical consequence that appears 6–8 weeks following reepithelialisation. These scars are reddish-purple in colour, and they become more raised, stiff, hypersensitive, itchy, heated to the touch, contract, and impair range of motion.(4).

Managing scars and contractures are major concerns that can lead to a bad body image as well as health and mental issues. (5). By limiting scar tissue formation, through massage therapy, pressure clothing, and steroid injections can help avoid contractures. Burn rehabilitation is an important aspect of the recovery process(6).In current scenario, virtual reality (VR) training systems have been employed in conjunction with computers and mobile applications to supplement traditional treatment. These techniques open up new platform to improving the sense of immersion in interactive apps, and they may be integrated with some other game design methods to boost user involvement and, as a result, improve the entire experience.(7).

A 3-D infrared sensor gadget is used to create a virtual reality environment with equally real pictures and sounds. Attention in VR technique for neurorehabilitation has developed in recent years, due to the availability of commercially accessible systems such as PlayStation, Wii, and Xbox Kinect. However, these are frequently either too challenging for patients or the games develop too fast, resulting in a lack of impairment-specific training or specific attention to patients' needs.(8) Previous research has discovered that virtual reality visual-motor tasks engage the ventrolateral prefrontal cortex, which has implications for the processes of VR.(9) The VR system is ideal for hand or finger rehabilitation at home. Patients can enhance their driving skills for strengthened wheelchair manoeuvres by participating in VR exercises.

The leap motion controller is a non-invasive, cheap, handheld motion control gadget that is kept at the front of a screen and connected to the computer via USB. This machine follows hand and finger locations and motion without contacting true things as input data. It checks the motion of users' wrist and phalanx while swiping, pinching, or gripping and shows the interactions on the screen. .

LMC enhances functions of hand, thickness of scar ROM , and grip and pinch power by analysing questionnaires given to patients based on earlier research. Burn patients were trained and rehabilitated through LMC games. (10)

#### EITIOLOGY AND PATHOGENESIS OF BURN:

More than 44-degree Celsius heat can cause skin burn, which can be caused due to factors like thermal, chemical, electricity, and radiation. thermal burns take place by direct contact of hot steam, liquid. Chemical burns include salts of acid or alkali. Other burns include electric current rays etc.

When cells of skin get denature and coagulate as a cause of burns, leads to development of thrombosis in the arteries. Denatured cell particles elevate intercellular osmotic pressure and rises vascular permeability.

The burning tissue generate few vasoactive amines they are histamine, kinin, prostaglandin, and serotonin.In platelets and leukocytes adhesion of endothelium takes place . When there is activation of complement system, the count of cytotoxic T cells in the body goes on increasing , and the tissue becomes an infection target.(11) Based on the severity of the burns it is classified into 3 types; A first-degree burn is a shallow type in which only the epidermis is damaged. The burned skin has a severe erythema and edema. Pain goes away after 12–24 hours, and first-degree burns heal in a week with desquamation and no cicatrix. First-degree burns are those that occur as a result of exposure to the sun. Pain is also relieved by applying cold to erythematous and edematous areas. As a symptomatic treatment, topical analgesic creams might be used..(12)

There are two types of second-degree burns: superficial and profound. In the superficial type , down to the sebaceous glands the epidermis and dermis layers are affected (13). On the skin, there is edema and the production of subepidermal bullae. The roots of the hair are unaffected by the burns. The deep form burns all the way down to the reticular dermis. The skin has become paler and thicker. When there is opening of bullae, due to the plasma leak surface looks moist, and certain places show erythema. The pain will worsen if the surface remains dry throughout this time, hence wet dressing is recommended.(14)

Third-degree burns impact the entire skin (epidermis, dermis, and hypodermis). Muscles, tendons, and bones can be affected by more severe burns. The skin's surface is dry and erythema-free. Eschar is a term used to describe a tissue that has lost its life and has become hard. When there is removal of eschar layer few days later, there is visibility of deep granulation tissue . With cicatrix, this healing of tissue is complete. Larger scars take a long time to heal, and skin grafting may be required.(15)

#### LEAP MOTION CONTROL (LMC) DEVICE

LMC is a new technology that delivers visual and audio feedback for fine motor rehab and functional training which improves motor function in the upper extremities.(16) .

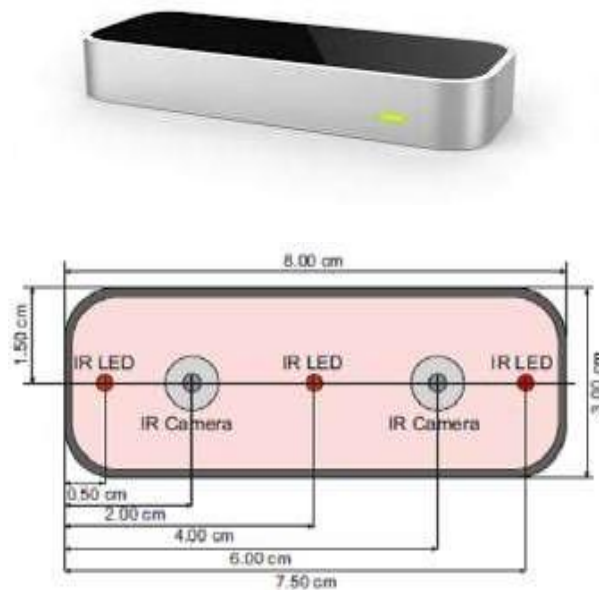
LMC is a low-cost marker less hand tracker device, although its use is restricted by its narrow field of view and reliance on proper sensor placement. A new upgrade from leap motion has permitted the usage of numerous LMC devices on a single computer, potentially bypassing the aforementioned constraints by allowing the tracking of hands from various directions.(17) Early attention components increase latencies in the occipital cortex for visual sensory, but latencies in the frontal lobe for attention and action preparation decrease while completing LMC.(18). LMC also uses no contact between the hand and gadget for fine motor training, which is important to train burn victims with wounds that are unhealed on their hands.(10)

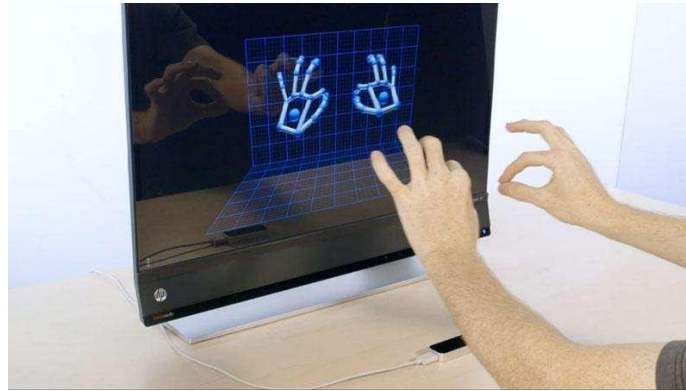
It's typically used in interactive software programmes to detect hand gestures and finger positions. Arm, wrist, and hand tracking, as well as the tracking of stick-like equipment, are all enabled. The device includes two CCD cameras in addition to three IR emitters All calculations are done on the host computer with patented technique to extract object positions from stereo-vision images. Sensor efficiency in tip of finger location tracking is roughly 0.01 mm, according to the manufacturer.

Those who had their burns treated surgically and medically, as well as undergone occupational and physiotherapy specific to their disabilities are appropriate for this therapy. Both inpatient and outpatient OT/PT therapy programmes OT be available.

proper conscious; 30 minutes independent sitting; and burns including both upper limb resulting in improper function and the need for care of self-support are additional inclusion criteria for rehabilitation with LMC. Patients with dependency on ventilator, having dementia or seizure history, or whose upper limb muscular power is below three on a medical research council scale are not candidates for LMC rehabilitation.

The LMC gadget is used to teach burn injury survivors how to move their fingers and hands in precise ways. The LMC gadget detects hand motion, which has been shown to motivate rehabilitation patients to cooperate and complete therapeutic exercises.(19) Through this Burn victims can enjoy video games such as gripping of cube, removing petals of flowers, bird or balloon shoot. Finger flexion is the important movement in the cube grabbing game, pinching is the main movement in the flower petal removal game, and finger abduction and adduction are the key movements in the shooting game.(10). This process can take 5–10 min at most.(20)





## METHODOLOGY

Therapy sessions are the most common kind of rehabilitation. Patients participate in these sessions under the guidance of a professional, usually a physical therapist or an occupational therapist, who performs prescribed exercises for a set period of time.

The LMC System employs a sensor that captures patient's forearms and hands movements without any need for sensors to be placed on the patient's body. On a computer screen, a virtual representation of the upper extremity is generated, and the patient is instructed to conduct motions in accordance with the functional task. Because of its mobility, easy use, market availability, inexpensive, and non-penetrating nature, this technology has significant advantages over other motion capture systems.(21-35).however more evidences are to support hand rehab. training in burn injury patient.

We priorities scar care with use of splints , stretches, and motor training to improve ROM and hand function (36-40), focusing on typical burn therapy.

Using Splint is a vital part of acute burn care because it helps to keep the patient in a functional position and protects the wounds. It also helps to prevent contractures of joint. Burn patients who play LMC activities are motivated to move their hands and fingers as soon as feasible. Such device has the benefit of avoiding contact contamination at burn wounds and is simple to use during the subacute and chronic phases of burn therapy due to its lack of direct body contact. Several hand motor exercises will help you enhance your ROM , grip strength, and pinch power . LMC is a novel gadget that records and captures hand movements, including wrist upward and downward movement , as well as radial and ulnar deviation.(23).

Four different technologies were used to track hand movements: LMC, gloves, video cameras, and haptic gadgets. Haptic gloves were employed as the intervention delivery equipment in three of the four investigations that emphasized on stroke patients(24)The following tools can be used to assess hand function: Barthel index, burn specific health scale-brief (BSHS-B), instrumental activities of daily living (iADL) ,quick disabilities of the arm, shoulder, and hand (QuickDASH).(41-48)

The range of thumb interphalanges, strength of pinch and grip of an LMC-rehabilitated hand may improve. Ranges of shoulder flexion and abduction, as well as flexion of elbow , was found to be improved when playing such virtual games on a MS Xbox in a previous study.(26). Jeonghunku et al. VR aids in the recovery of proprioception in stroke victims. And Zoccolillo L et al. Also In children with cerebral palsy, it improves upper limb movements and functions. Yeh et al. Employed a VR training system with a robot to investigate the therapeutic efficacy of pinch-grip training in chronic stroke patient (49-54)

## CONCLUSION

Hand rehabilitation is a technique that can help patients to improve rom, functional activity and ability to do activities of daily living. Through use of web application that uses the results, physicians and physical therapists can check and evaluate patients progression of recovery. Patients who suffer from severe hand burns and use leap motion therapy, increase their motion, scar management, and functions of hand. LMC establishes a natural contactless interface for motor recovery, which could pave the

way for a new age of burn rehabilitation research. LMC develops a natural noncontact link for motor recovery, that could pave the way for a new era of burn rehabilitation research. However, depending on practitioner need, quality training and individualised software designs are required. Future LMC motion tracking validation investigations are required.

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