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Interactive gaming consoles reduced pain during acute minor burn rehabilitation: A randomized, pilot trial

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ARTICLE INFO

Article history:

Accepted 26 June 2015

Keywords:

Acute burn
Rehabilitation
Game console
Pain

ABSTRACT

Introduction: Interactive gaming consoles (IGCs) have been used successfully in rehabilitation settings as an adjunct to conventional exercise for restoring or maintaining active function and augmenting pharmacological analgesia.

Aim: The objective of this pilot study was to assess if adjunctive use of the Nintendo Wii IGC was of benefit to acute burn patients.

Method: This was a randomized, controlled trial. The intervention group received routine rehabilitation in addition to up to 5 days of twice daily, 20–30 min of exercise using the Nintendo Wii IGC. The control group received routine rehabilitation exercise therapy.

Results: A total of 22 subjects were recruited and randomized by location of burn to intervention and control groups. Pain scores were significantly improved in the intervention group ($r^2 = 1.18$; 95%CI -0.584 to -0.298 , $p = 0.019$) as indicated by a 17% greater drop in the pre-post-study pain compared to controls. Fear avoidance and ROM measurements were not statistically different between the groups.

Conclusion: The Nintendo Wii IGC was associated with a greater reduction in pain, particularly in those with higher levels of pain at baseline.

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1. Introduction

Interactive gaming consoles (IGCs) are being used increasingly as an adjunct to standard care or alternative therapies within rehabilitation settings, including those with burn [1,2]. Further, 63% of Australian [3] and 51% of households in the United States [4] own an IGC indicating the ‘exposure’ to the

technology and affordability is high for Western communities [2]. Being less cumbersome than other forms of immersive virtual reality (VR) [5], they are of interest for use in burn rehabilitation. Modern IGCs combine aspects of VR with popular imagery to create a more immersive experience than earlier consoles [1]. Game controls have advanced to become more sensitive to gross and fine movement (Nintendo Wii™ [NW], Playstation 3 Six Axis and Move™) and by incorporating

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<http://dx.doi.org/10.1016/j.burns.2015.06.022>

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cameras to detect movement (Xbox Kinect™, Playstation 2 EyeToy™, Playstation 3 EyeToy™), player interaction with the IGC environment has changed to include active play movements [6] which resemble those of daily life, sport and leisure. After burns, the distal neural fields and thus, the integument feedback 'infrastructure', are damaged. Studies involving visual and sensory training combined with movement have been shown to help to restore limb and body proprioception and the virtual body or homuncular representations in the brain, particularly where pain has altered the body schema [7,8]. Interaction with IGCs requires the user to use visual feedback derived from the limb movement within the field of reception for the gaming device. This potentially enhances and supplements the relative lack of intrinsic sensory feedback with extrinsic mechanisms and is purported to aid the re-development of accurate limb and body proprioception and control [9,10]. Rehabilitation techniques that encourage a patient to close their eyes or obliterate the visual field, expose the individual to reliance on faulty proprioception and virtual representations of the body [11]. This may be maladaptive, particularly when 'reinforced' by pain sensations, consequently perpetuating the incongruity between limb feedback and spatial incongruity of the body [9,10]. If the mismatch between peripheral and cortical neural perceptions is not addressed, chronic pain and hypersensitivity syndromes are common outcomes [12,13]. Video game play increases dopamine release in the midbrain [14] and provides cognitive distraction from noxious stimuli [15], which aids attenuation of supraspinal nociception [16] and modulation of pain perception by diverting attention away from the painful input [17-19]. Thus increased dopamine and distraction caused by IGC game play may result in decreased pain sensation [20]. Further, reduction in pain may lead to less guarding or fear avoidant movement patterns [21-23].

Using IGCs to reduce pain while promoting movement is appealing for post-burn rehabilitation [2]. Depending on the severity, location and size of the burn, the patient suffers regular pain due to repeated efforts to move, exercise and function with the aim to reduce the risk of contractures and complications of excessive scarring [19]. Thus, the aim of this study was to examine the use of the Nintendo Wii IGC as an adjunct to routine exercise therapy. The hypothesis was that in acute burn patients, the NW IGC, would be associated with reduced pain and fear avoidance while promoting or maintaining joint range of motion (ROM).

2. Methods

2.1. Study sample

This pilot study was designed as a randomized, controlled intervention trial. Subjects were recruited at Royal Perth Hospital (RPH) between 2009 and 2011. The study was established by the senior co-authors and subsequently completed, with ongoing support, as fulfillment of medical student research training requirements during 2010 and 2011. The sample size and recruitment pattern were dictated by the available student time within the university framework. The participants were block randomized into control and

Table 1 – Inclusion and exclusion criteria.

Inclusion criteria	Exclusion criteria
<ul style="list-style-type: none"> • Patients with a burn with a total burn surface area (TBSA) $\leq 10\%$ 	<ul style="list-style-type: none"> • TBSA $>10\%$ • Limb amputation • Electrical injury • Neurological conditions affecting participation • Non-English speaking • Poor English and intellectually challenged i.e. those who could not complete study independently • Superficial burn upon admission^a • Patients at high risk of multi-resistant infections^b
<p>^a Patients assessed to be discharged prior to 7 days after burn.</p> <p>^b To minimize the risk of cross contamination.</p>	

intervention groups, by location of burn (upper or lower limb injury). In the circumstance where a subject sustained both upper and lower limb burns then the limb with the larger proportion of the total surface area of burn was selected for sub-group allocation. Inclusion and exclusion criteria are outlined in Table 1. Patient demographic (age, gender); injury (location of burn, TBSA); medical intervention (surgery); and, self-recorded outcomes (number of sessions completed and those below) data were collected for use in the statistical analyses.

2.2. Procedure

The study lasted a maximum of 7 days. During this time the intervention group, was requested to complete up to 5 individual days of twice daily IGC activity. Daily completion was not expected in the first week in order to accommodate acute surgical interventions, which occur routinely by day 5 after burn at RPH. The NW session lasted 20-30 min with down time minimized through the use of pre-set easily accessible avatars; no opponents included; and, schedule of games for each individual. These sessions were self-directed and in addition to their individualized exercise therapy program, which was standardized for this study as prescribed by the senior physical therapist of the burn center. Patients were provided with unhindered access to the NW machine which was set up as part of a mobile television unit. The mobile gaming apparatus was able to be moved into an individual's room as necessary or accessed in the rehabilitation gym area. Each NW session consisted of an individual playing specific games with a standardized order based on the location of burn and the limb involved. Rest periods within session were not specifically encouraged, or discouraged, as the process of changing games provided natural stoppages. The standard NW controller and additional Nunchuk™ configuration was used during upper limb activities. The Wii Fit™ Balance Board was used in the lower limb prescription. All intervention participants were requested to play a minimum of 2 min/game aliquot and then repeat the schedule prescribed, with upper limb subjects alternating between tennis and boxing games from Wii Sports™, and lower limb subjects utilized multiple yoga, step up and sporting type exercises from Wii Fit™. Each intervention subject was given prior instruction as to how to

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