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Effect of isokinetic training on muscle strength, size and gait after healed pediatric burn: A randomized controlled study

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ARTICLE INFO

Article history:
Accepted 21 May 2013

Keywords:
Pediatric burn
Isokinetic strength
Gait
Rehabilitation

ABSTRACT

Objective: The aim of this study was to investigate the effects of isokinetic training program on muscle strength, muscle size and gait parameters after healed pediatric burn.
Design: Randomized controlled trial.
Subjects: Thirty three pediatric burned patients with circumferential lower extremity burn with total body surface area (TBSA) ranging from 36 to 45%, and ages from 10 to 15 years participated in the study and were randomized into isokinetic group and a control group. Non-burned healthy pediatric subjects were assessed similarly to burned subjects and served as matched healthy controls.
Methods: Patients in the isokinetic group ($n = 16$) participated in the isokinetic training program for 12 weeks for quadriceps dominant limb, 3 times per week, at angular velocity 150°/s, concentric mode of contraction, time rest between each set for 3 min, 3 sets/day and control group ($n = 17$) participated in home based physical therapy exercise program without isokinetic.
Main measures: Assessment of quadriceps strength by isokinetic dynamometer, quadriceps size and gait parameters were performed at baseline and at the end of the training period for both groups.
Results: Patients in isokinetic group showed a significant improvement in quadriceps strength, quadriceps size and gait parameters as compared with those in the control group. Quadriceps strength and percentage of improvement was 79.25 ± 0.93 Nm (68.40%) for isokinetic group and 51.88 ± 1.31 Nm (9.84%) for the control group. Quadriceps size and percentage of improvement was 31.50 ± 0.89 cm (7.47%) for isokinetic group and 29.26 ± 1.02 cm (1.02%) for the control group. Stride length, step length, velocity and cadence and percentage of improvement for isokinetic group was 135.50 ± 2.82 (53.97%), 63.25 ± 2.97 (63.77%), 135.94 ± 1.65 (81.42%), 137.63 ± 1.36 (66.96%) and for the control group was 94.00 ± 2.69 (6.68%), 43.76 ± 1.34 (15.15%), 81.11 ± 1.91 (8.6%), 90.35 ± 1.32 (9.01%) respectively.
Conclusions: Participation in the isokinetic training program resulted in a greater improvement in quadriceps muscle strength, size and gait parameters in pediatric burn.

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0305-4179/$36.00
http://dx.doi.org/10.1016/j.burns.2013.05.022

1. Introduction

Severe burns lead to a change in patient metabolism that may persist for over 24 months after the initial event [1]. The ensuing period of hypermetabolism and catabolism following a burn leads to impaired immune function, decreased wound healing, erosion of lean body mass (LBM), hinders rehabilitative efforts and reintegration into society is delayed and quality of life impaired [1,2].

There are at least two major factors that contribute to muscle deconditioning after major burn: bed rest and catabolic processes that lead to muscle atrophy. A serious burn results in the greatest hypermetabolic response in comparison with other physical traumas [3]. Increased metabolic rate can persist until wound closure is achieved [4] and perhaps for 6–9 months after wound closure [5]. Prolonged states of hypermetabolism result in catabolic consequences that may not be recognized in the acute phase of the injury but can later cause significant muscle wasting and deconditioning.

Strategies for attenuating the maladaptive response after burn [6,7] can be divided into non-pharmacological and pharmacological approaches. The non-pharmacological approach includes early excision of burned skin and closure of wounds, pertinacious surveillance for and treatment of sepsis, early commencement of high-protein high-carbohydrate enteral feeding, elevation of the immediate environmental temperature to over 30 °C; and enrollment in an aerobic/resistance exercise program. This integrative approach has been shown to improve outcome [8–10].

Survival rates after severe burn have significantly improved in the past two decades [11,12]. This progressive decline in mortality has highlighted the importance of physical rehabilitation after burn to maximize the recovery of physical function. Typically, standard physical and occupational rehabilitation therapy targets the improvement of overt physical changes associated with burn, such as uncomfortable scarring, range of motion (ROM) limitations, and contractures [13].

Independence in locomotion is the single variable that discriminated between patients who went home after discharge from those who were discharged to another institution. Thus, factors affecting locomotion, such as fatigue and muscle deconditioning, are also important during the rehabilitation phase of burn recovery [14].

Prevention and treatment of deconditioning and muscle wasting are emerging as important areas for research in burn rehabilitation. Exercise has been shown to counteract the muscle-wasting effects of age and inactivity [15,16].

Resistance training for several weeks increases muscle cross-sectional area, strength, and power [17]. Muscular hypertrophy and strength gains following resistance training are thought to be dependent on the intensity of exercise [18].

Isokinetic training caused significant increases in type II AB cross sectional area, with a tendency toward reduction in type II B muscle fibers. Isokinetic training probably imposed different loads on the muscle examined. Also, the isokinetic training had a combination of resistance and endurance characteristics, imposed under constant speed throughout the whole range of motion [19].

Despite the extensive amount of literature on the effects of resistance exercise in healthy non-burned children, there is a lack of data on the effects of isokinetic exercise training on muscle strength, muscle size and gait parameters in children with burn. Therefore, we designed this study to assess whether children with burn would benefit from an isokinetic exercise training program by increasing muscle strength, muscle size and improve gait parameters.

2. Materials and methods

This was a 12-week blinded randomized controlled trial with two measurement points' baseline (pre) and 12 weeks (post) Fig. 1. The assessors were blinded to the participants' treatment assignments. Healed pediatric burned children (male and female) aged 10–15 years were recruited from Umm Almasrieen General Hospital, Giza, Egypt by instructing two physical therapists who were working in the burn unit to report all patients who fulfilled the inclusion criteria of the study and had no exclusion criteria. All participants' relatives provided informed consent form giving agreement to participation and publication of the results of the study. The burned children were categorized as having a circumferential lower limb deep second to third degree thermal injury extends from the lower trunk to the foot. They received the same medical care and physical

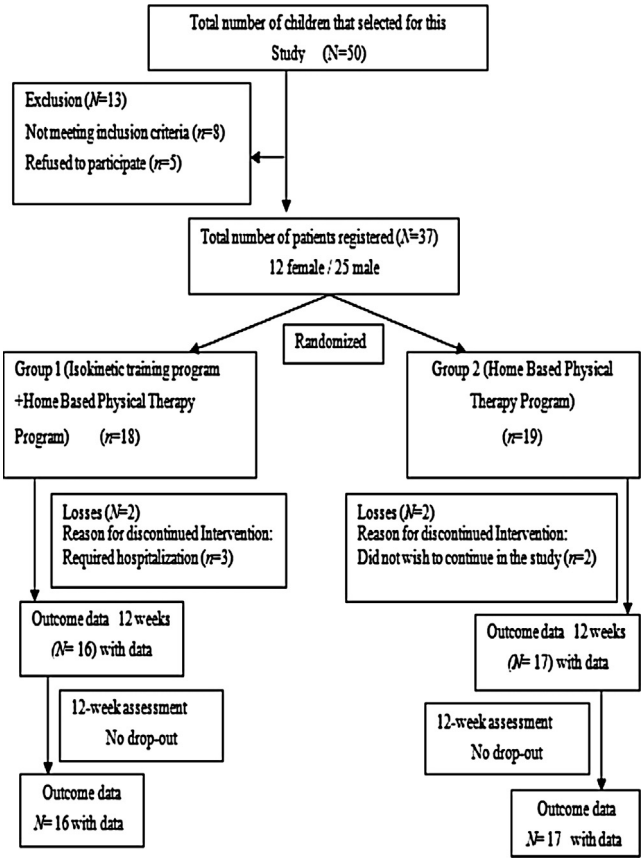

Fig. 1 – Flow diagram of the study.