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Exercise Training Following Burn Injury: A Survey of Practice

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Abstract

Objectives—Exercise programs capable of contributing positively to the long-term rehabilitation of burn patients should be included in outpatient rehabilitation programs. However, the extent and intensity of the resistance and cardiopulmonary exercise prescribed are unclear. This study was conducted to investigate the existence, design, content, and prescription of outpatient cardiopulmonary and resistance exercise programs within outpatient burn rehabilitation.

Methods—A survey was designed to gather information on existing exercise programs for burn survivors and assess the extent to which they are included in overall outpatient rehabilitation programs. Three hundred and twenty seven surveys were distributed among licensed physical and occupational therapists part of the American Burn Association Physical Therapy/Occupational Therapy Special Interest Group.

Results—One hundred and three surveys were completed. Eighty-two percent of respondents indicated that their institutions offered outpatient therapy following discharge. The frequency of therapists' contact with patients during this period varied greatly. Interestingly, 81% of therapists stated that no hospital-based cardiopulmonary endurance exercise programs were available. Patients' physical function was infrequently determined through the use of cardiopulmonary parameters (oxygen consumption, heart rate) or muscle strength. Instead, more subjective parameters such as range of motion (75%), manual muscle testing (61%), and quality of life (61%) were used.

Conclusion—Prescription and follow-up assessment of cardiopulmonary endurance training are inconsistent among institutions, underscoring the need for greater awareness of the importance of exercise in any burn rehabilitation program. Identification of cardiopulmonary and progressive resistance parameters for establishing and tracking exercise training is also needed to maximize exercise-induced benefits.

Keywords

rehabilitation; in-house exercise training; outpatient exercise; hypercatabolic response

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INTRODUCTION

As mortality due to burn injury decreases, new challenges in burn rehabilitation arise. Burn injuries can cause severe muscle loss, muscle weakness, hypertrophic scars, and contractures, leading to lifelong physical impairments.[1–3] Physical and occupational therapy, along with nutritional support, aid in the functional recovery of burn survivors.[4] During the past years, progressive resistance exercise and cardiopulmonary endurance programs have become more common components of outpatient burn rehabilitation programs.[5] Participation in structured exercise routines has been reported to yield multiple benefits, such as a reduced number of surgeries needed for scar release,[6] improved muscle strength, and muscle mass accretion.[5] The ultimate goal of burn rehabilitation is to assist in restoring functional capacity and independence in burned patients.

The extent to which exercise programs (progressive resistance and cardiopulmonary endurance) are prescribed and implemented by burn centers as part of the long-term rehabilitation of burn victims is unclear. Moreover, no consensus has been reached as to which cardiopulmonary and resistance parameters should be used to establish exercise training intensity and track the progress of burned patients so that the maximum benefits of exercise can be obtained. This study was conducted to investigate the prescription, design, and structure of exercise programs as well as the content of current outpatient cardiovascular and progressive resistance exercise training for survivors of ≥30% total body surface area burns. Outpatient physical rehabilitation interventions and parameters of cardiopulmonary and progressive resistance training exercise programs were assessed through surveys of licensed physical and occupational therapists (PTs/OTs) with membership in the American Burn Association Occupational Therapy/Physical Therapy Special Interest Group (ABA OT/PT SIG).

METHODS

A 14-question survey was developed by the physical medicine and rehabilitation services divisions at the Galveston Shriners Hospitals for Children to obtain information about interventions and assessment parameters related to outpatient cardiopulmonary and progressive resistance training exercise programs implemented by members of the ABA OT/PT SIG in the rehabilitation of burn patients (Table 1). For the purposes of this study, “exercise” was defined as any cardiopulmonary (endurance) and progressive resistance exercise training interventions part of an outpatient burn rehabilitation program. These interventions are components of the traditional physical/occupational therapy programs that include positioning, splinting/casting, exercise (range of motion), strength, activities of daily living, scar management, and community reintegration. In this study, areas of outpatient therapy examined included duration, inclusion of progressive resistance or cardiopulmonary exercise conditioning, parameters used when prescribing progressive resistance or cardiopulmonary exercise training, frequency of contact between therapists and patients, and existence of an exercise program at the same location as the burn center. The survey was created using a secure online survey program. Contact lists were obtained from the ABA PT/OT SIG. An email requesting participation in the survey was sent to 392 PTs/OTs. Sixty-five emails were deemed invalid, leaving 327 emails that reached potential respondents. The online survey was made available for 5 months (September 2011 to January 2012).

RESULTS

Respondents

Of the 327 surveys sent, 103 were completed and returned (32% response rate). Forty-five respondents (44%) identified themselves as PTs, while 58 (56%) identified themselves as

OTs. Sixty-one of the respondents (59%) claimed to have at least 11 years of experience in burn rehabilitation, with more than half of these respondents (n = 37) having over 15 years of experience. None of the individuals surveyed reported working fewer than 2 years in their fields. The majority (54%) had experience treating both adult and pediatric burn patients on a daily basis, while 19% reported working with pediatric burn patients and 26% with adult burn patients.

Outpatient Therapy

Eighty-two percent (n = 84) of the respondents indicated that their institutions provided physical therapy/occupational therapy services to patients following discharge. According to 64% (n = 66) of respondents, the duration of the outpatient therapy was determined by both physician prescription and evaluations by the PT/OT. However, 30% (n = 31) reported that the evaluation by the PT/OT was the only aspect dictating the duration of the therapy. Four of the six respondents who selected “other” as a response specified that patient insurance and compliance were the main limiting factors that ultimately determined the duration of outpatient therapy.

The most widely used parameters for assessing a patient’s physical function prior to initiating an outpatient exercise program were range of motion (75%), manual muscle testing (61%), and quality of life (61%). Other reported parameters included maximal oxygen consumption (VO_2 max) (17%), lean body mass (6%), patient tolerance (6%), the 6-minute walk test (4%), Borg’s rating of perceived exertion (2%), basic grip strength (2%), and Lower Extremity Functional Scale (LEFS)/Disabilities of the Arm, Shoulder and Hand (DASH) (1%) (Figure 1).

Contact between the PT/OT and patient during outpatient therapy exercise programs varied from weekly (35%) to daily (23%) and monthly (14%). Sixteen percent of the respondents indicated that the frequency of contact between therapists and patients was determined by previously set goals and the extent to which these previously set goals were attained. Intervals frequently mentioned by respondents who selected “other” as a response (response to question regarding contact between therapists and patients) were contact as needed (7%), two to five times per week (6%), and when the patient returned to clinic for follow up appointments (5%). Some respondents (n = 4) reported that contact frequency was dependent on the patient’s proximity to the clinic.

Home Exercise Program

Prescription of home-based exercise upon discharge was reported by 88% (n = 91) of respondents. However, the majority stated that their home exercise programs did not include cardiopulmonary conditioning exercises. The respondents stated that their programs incorporated age-based fitness assessment; Borg, 6-minute walk test; rate of perceived exertion; baseline functional levels; time, repetition, and duration of a game; and 45 minutes of cardiopulmonary exercise 3 days per week. Only 9% (n = 9) of the programs used heart rate as a guideline for aerobic exercise intensity (Figure 2).

Inclusion of resistive exercises was reported in 48% of the cases (n = 49), and the intensity at which exercise was performed was determined using manual muscle testing (21%), dynamometer (8%), repetition maximum (8%), and/or the exercise-specific tolerance to weights/resistance at discharge (8%) (Figure 3). Less frequent responses included point of maximal fatigue and number of repetitions in the home exercise programs.

Location of Outpatient Therapy

Eighty-one percent (n = 83) of respondents reported not having an outpatient exercise program at the same location (on-site) as their primary burn treatment facility. Details from the 20 (19%) respondents who reported having such an on-site/in-house exercise program as part of the overall outpatient rehabilitation program revealed that cardiopulmonary endurance, strength training, and stretching were the most common mainstays of their exercise programs. Nutritional education (n = 2) was a unique component that was mentioned only by those at Shriners Hospitals for Children, with this being used along with all the aforementioned aspects. One respondent mentioned that the on-site program comprised group dancing and adapted gymnastic classes for children with all diagnoses.

DISCUSSION

Rehabilitation from a burn injury is a lifelong journey. The ultimate goal of burn rehabilitation is to re-integrate the burn survivor into society with the capacity to function and assume social responsibilities. This goal may not be achieved in the short-term, necessitating prolonged and strenuous rehabilitation programs. This study assessed parameters for cardiopulmonary and progressive resistance exercise that are currently used to evaluate physical function in several burn centers. To our knowledge, there is no standard method for establishing appropriate exercise guidelines for severely burned patients or consistent inclusion and monitoring of exercise programs to aid in patient recovery.

This study surveyed therapists regarding the inclusion of exercise training in current burn rehabilitation programs. Our results demonstrate that variability and a lack of continuity exist in the parameters used by different institutions to evaluate physical function and exercise cardiopulmonary endurance in burned patients. Moreover, it seems that the integration of a supervised aerobic and progressive resistance exercise training program is still not widely practiced in the rehabilitation of severely burned patients. Benefits obtained through cardiopulmonary endurance exercise may contribute to more rapid restoration of functional independence.[7] However; prospective multicenter, randomized trials are needed to determine the efficacy of organized in-house exercise programs in the long-term recovery of burn survivors. This will facilitate establishment of institutional guidelines for exercise and lead to consistency in patient care and the way outcomes are presented.[8]

A very limited number of studies have focused on the functional capabilities and effectiveness of therapy in burn victims. Richard et al.[9] suggested that reporting research outcomes is needed to promote progress in burn rehabilitation practice. Here, 82% of the respondents stated that physical/occupational therapy is provided following discharge, and 88% stated that home-based exercise is prescribed. However, great variability existed in the frequency of contact between therapists and patients, reflecting the need for more reliable estimates of patients' progress and more systematic methods for tracking patients. St. Pierre et al. examined muscle strength in adults with burns exceeding 30% of the total body surface area and concluded that, at 1 year post burn, decreased muscle strength may be due to insufficient rehabilitation interventions or to the fact that burned patients are not fully recovered.[10]

It is well known that burn injury induces a hypercatabolic response that leads to muscle loss and weakness. Both are confounded by prolonged bed rest and the development of scarring and contractures, which often limit the physical function of burn victims.[2,11–13] As whole-body lean mass is significantly depleted in these burn survivors, other parameters of functional status are equally affected.

Muscle strength, as measured with an isokinetic dynamometer, has been shown to be significantly lower in burn patients than in healthy controls.[10,14–16] Participation in structured exercise training (supervised in-house/hospital-clinic based program) for 6 – 12 weeks provides substantial improvements in both burned children and adults.[5–7,16–19] Use of anabolic or anticatabolic agents in combination with an exercise program provides even greater improvements.[18,20–22] Here, the majority (52%) of respondents did not include progressive resistance exercises in their home exercise programs. Of those who reported inclusion of such exercises, only 8% used a dynamometer to determine the amount of resistance or load to be prescribed.

Reduced pulmonary function, aerobic capacity, and consequently exercise performance is characteristic of burn injury.[20,23–25] In burn patients, aerobic capacity is severely affected and remains below normal values despite significant improvements obtained through aerobic exercise.[5,24,26] According to a recent study, peak VO_2 has a "tendency to plateau or deteriorate" in burned adults.[7] Seventeen percent of the respondents selected VO_2 max as the parameter used to assess the patient's physical function. However, the majority (59%) stated that their home exercise programs did not include cardiopulmonary endurance conditioning exercises. Interestingly, only 8% (n = 9) of those who reported inclusion of such exercises in their programs used heart rate as a guideline for aerobic exercise intensity.

Providing information on how various programs or therapists prescribe exercise as part of their rehabilitation protocol is important because studies from our institution have demonstrated significant improvements in cardiopulmonary endurance and muscle function following 12 weeks of cardiopulmonary endurance and progressive resistive exercise training.[5,22,24,27] Studies of adult patients have extended these findings, showing that aerobic capacity is significantly improved after 12 weeks of aerobic and progressive resistance exercise.[20,28,29] Recently, a study of 30 burned adults, demonstrated the benefits of structured exercise routines, with increases in peak VO_2 and the modified shuttle walk distance being seen after exercise participation.[7] Moreover, Grisbrook et al. showed that, in nine burned adults, exercise training restored health-related quality of life and activity to levels seen in non-burned individuals.[30]

Responses to this survey revealed that the most widely used parameters for assessing a patient's physical function prior to initiating an outpatient exercise program were range of motion (75%), manual muscle testing (61%), and quality of life (61%). Although measurement of peak VO_2 using indirect calorimetry is the most useful method for determining cardiopulmonary endurance, it can be expensive and often requires technical training.[31, 32] Therefore, alternative approaches to monitoring cardiopulmonary endurance have been proposed. Porro et al. developed a formula for predicting peak VO_2 that relies on clinical information and does not require expensive equipment. Stockton et al. have recommended using the modified shuttle walk test as a cost-effective method for monitoring cardiopulmonary endurance post burn. None of these methods are optimal but can aid in estimating exercise training intensity and progress in situations where no other resources are available.

A community-based exercise program may be an attractive option for patients who cannot easily access burn centers.[7,21] Integration of cardiopulmonary and progressive resistance training into burn rehabilitation protocols is essential and may provide a more comprehensive approach in successfully returning the burn survivor to society. Adequate and detailed information must accompany the patient and caregivers upon discharge from the hospital to facilitate adherence to prescribed exercise protocols. Home-based exercise programs need to assure proper patient understanding of the ultimate goals of the program, and patients should be included in the design of such programs.

One of the limitations of this study is the possibility that multiple therapists from a single center may have completed in the survey, possibly skewing data analysis and limiting our ability draw strong conclusions. Another limitation is that we failed to include a definition of the term “traditional burn care,” which could have been interpreted in several ways by the respondents.

CONCLUSIONS

The prescription of exercise activity and assessment of exercise function as part of the rehabilitation of burn survivors are inconsistent among institutions. Furthermore, information on establishing appropriate exercise guidelines and quantifying burn patients’ progress is scarce. Raising awareness among health care providers about the necessity of integrating an exercise program into outpatient burn rehabilitation programs for severely burned patients is extremely important. Standardizing parameters and guidelines that allow for adequate tracking of progress in this patient population is also necessary.

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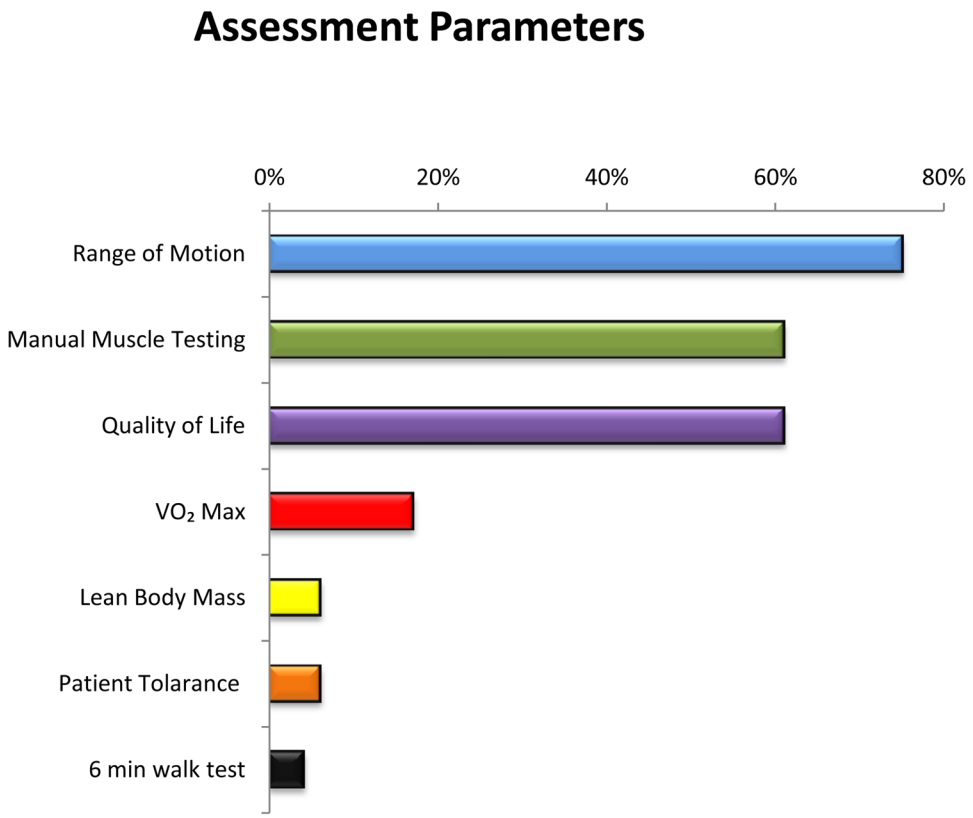

Figure 1.
Parameters most commonly used to assess physical function prior to initiating the outpatient exercise program.

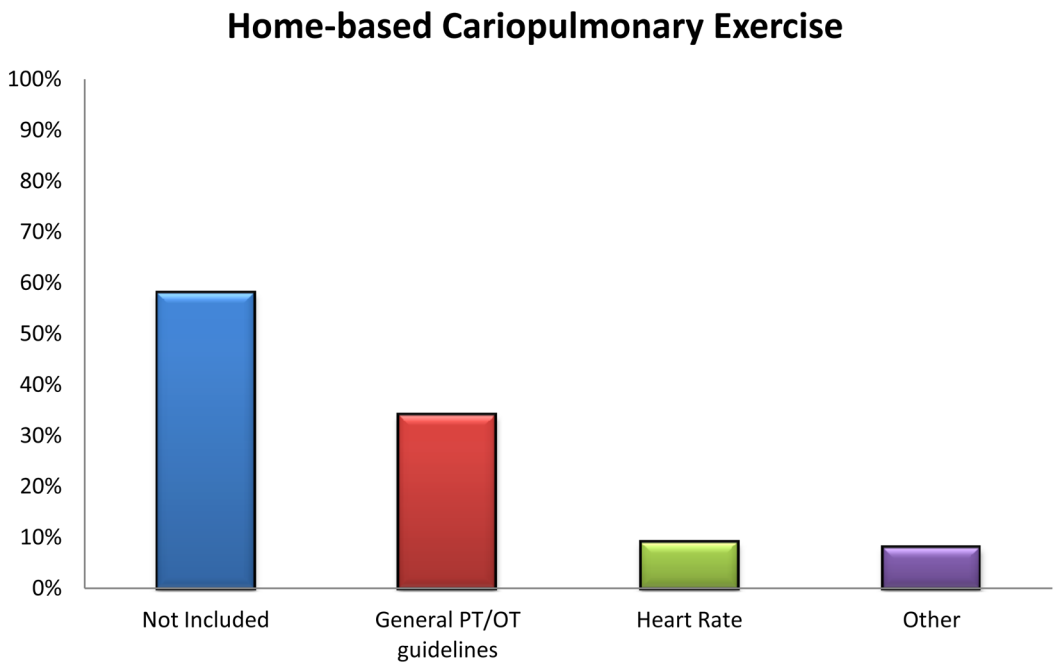

Figure 2.
Parameters used to determine aerobic exercise intensity. The majority of the home exercise programs did not include cardiopulmonary conditioning exercises.

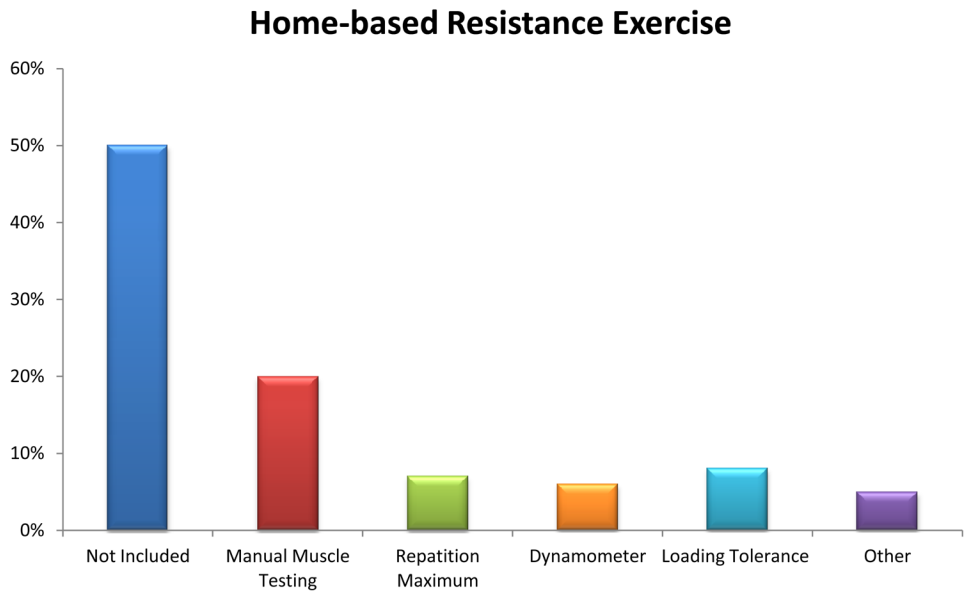

Figure 3.
Parameters used to determine the intensity of progressive resistance exercise. Inclusion of progressive resistance exercise was reported in only half of the home-based exercise programs.

Table 1

Exercise training following burn injury questionnaire

Exercise Training Following Burn Injury Questionnaire	
1	What is your occupation? **A.** Occupational Therapist **B.** Physical Therapist **C.** Medical Doctor **D.** Nurse **E.** Other (please specify bellow)
2	In your daily practice do you treat adult, pediatric burns or both? **A.** Adult **B.** Pediatric **C.** Both
3	How many years of burn rehabilitation experience do you have? **A.** 1 **B.** 2–5 **C.** 6–10 **D.** 11–15 **E.** 16 or more
4	Do you provide PT/OT services after patient discharge? **A.** Yes **B.** No
5	What determines the duration of outpatient therapy? **A.** Physical Prescription **B.** PT/OT evaluation **C.** Both A and B **D.** Other (please specify below)
6	Do you prescribe a written home exercise program upon patient discharge? **A.** Yes **B.** No
7	Does the home exercise program include cardiopulmonary/strength/endurance exercises? **A.** Yes **B.** No
8	If Yes, what do you base the aerobic exercise on when prescribing aerobic exercise intensity? (If you answered ‘No” above then choose N/A) **A.** N/A **B.** Heart Rate **C.** VO2 max

Exercise Training Following Burn Injury Questionnaire	
	D. General PT/OT guidelines **E.** Other (please specify below)
9	Does your home exercise program include resistive exercises (weight, machines, etc.)? **A.** Yes **B.** No
10	If yes, what do you base the amount of workout weights on? (If you answered 'No", choose "N/A") **A.** N/A **B.** Manual Muscle Testing **C.** Dynamometer (e.g. Blodex Cybex) **D.** RMs **E.** Other (please specify below)
11	Do you have an onsite/in-house structured outpatient exercise program that goes beyond the traditional burn rehabilitation program and focuses on cardio/strength/endurance? **A.** Yes **B.** No
12	If you answered "yes" above please describe your program very briefly in the space below (If you answered 'No", just write "N/A")
13	What baseline assessments do you utilize to determine the current status of a patient prior to initiating a cardiopulmonary & strength exercise program? Please choose all that apply. **A.** ROM **B.** Lean Body Mass **C.** Manual Muscle Testing **D.** Endurance (VO2 max) **E.** Quality of life **F.** Other (please specify below)
14	What is the frequency of contact between you (therapist) and the patients in such programs? Please choose all that apply. **A.** Daily **B.** Weekly **C.** Monthly **D.** Annually **E.** As goals are achieved **F.** Other (please specify below)