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THE EFFECT OF INCENTIVE SPIROMETRY AND OSCILLATORY POSITIVE EXPIRATORY PRESSURE THERAPIES ON FUNCTIONAL CAPACITY, DYSPNEA, AND SATURATION IN BURN PATIENTS WITH INHALATION INJURY: A RANDOMIZED CONTROLLED STUDY

İNHALASYON HASARI OLAN YANIK HASTALARINDA İNSENTİF SPİROMETRE VE OSİLASYONLU POZİTİF EKSPİRATUAR BASINÇ TEDAVİLERİNİN FONKSİYONEL KAPASİTE, DİSPNE VE SATÜRASYON ÜZERİNE ETKİSİ: RANDOMİZE KONTROLLÜ ÇALIŞMA

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ABSTRACT

Objective: The aim of this study is to investigate the effects of incentive spirometry (Triflo) and oscillatory positive expiratory pressure therapy (use of Acapella) in addition to standard pulmonary physiotherapy exercises on functional capacity, dyspnea, and saturation levels in burn patients with inhalation injury.

Method: A total of 24 patients hospitalized in the intensive care and service units of the Gaziantep City Hospital Burn Center were included in the study. Patients were divided into three groups using stratified randomization method. The first group received standard physiotherapy exercises in addition to medical and surgical treatment, the second group received incentive spirometry (Triflo) in addition to this standard treatment, and the third group received standard treatment+oscillatory positive expiratory pressure therapy (Acapella). All groups were followed for 4 weeks. Six-minute walk test (6MWT), dyspnea modified medical research council (MMRC) scale, and saturation values were compared for all groups before and after treatment.

Results: A total of 24 patients, 22 males and 2 females, aged 19-63 (38.66±16.77), were included in the study. When the initial and final week measurements of the six-minute walk test, dyspnea scale (MRC), and saturation values of all groups were compared, no difference was found (p>0.05).

Conclusion: Oscillatory positive expiratory pressure therapy (Acapella Use) and incentive spirometry (Triflo) can be given in addition to standard physiotherapy exercises in burn patients with inhalation injury. These exercises are equally effective in the functional capacity, dyspnea, and saturation levels of burn patients with inhalation injury.

Key Words: Burns, Inhalation, Exercise

ÖZ

Amaç: Bu çalışmanın amacı inhalasyon hasarı olan yanık hastalarında standart pulmoner fizyoterapi egzersizlerine ek olarak verilen insentif spirometre (triflo) ve osilasyonlu pozitif ekspiratuar basınç tedavisinin (acapella kullanımı) fonksiyonel kapasite, dispne ve satürasyon üzerine etkilerinin incelenmesidir.

Yöntem: Çalışmaya Gaziantep Şehir Hastanesi Yanık Merkezi yoğun bakım ve servis ünitelerinde yatan toplam 24 hasta dahil edildi. Hastalar tabakalı randomizasyon yöntemiyle 3 gruba ayrıldı. Birinci gruba medikal ve cerrahi tedaviye ek olarak standart fizyoterapi egzersizleri, ikinci gruba bu standart tedaviye ek olarak insentif spirometre (triflo) ve üçüncü gruba da standart tedavi+osilasyonlu pozitif ekspiratuar basınç tedavisi (Akapella) verildi. Tüm gruplar 4 hafta boyunca takip edildi. Tüm grupların tedavi öncesi ve tedavi sonrası olmak üzere altı dakika yürüme testi, dispne modified medical research council (MMRC) skalası ve satürasyon değerleri karşılaştırıldı.

Bulgular: Çalışmaya yaşları 19-63(38.66±16.77) arasında değişen 22 erkek 2 kadın toplam 24 hasta dahil edildi. Tüm grupların altı dakika yürüme testi, dispne skalası (MRC) ve satürasyon değerlerinin ilk ve son hafta ölçümleri karşılaştırıldığında bir fark olmadığı belirlendi (p>0.05).

Sonuç: İnhalasyon hasarı olan yanık hastalarında standart fizyoterapi egzersizlerine ek olarak osilasyonlu pozitif ekspiratuar basınç tedavisi (acapella kullanımı) ve insentif spirometre (triflo) verilebilir. Bu egzersizler inhalasyon hasarı olan yanık hastalarının fonksiyonel kapasiteleri, dispne ve satürasyon düzeylerinde benzer derecede etkilidir.

Anahtar Kelimeler: Yanıklar, İnhalasyon, Egzersiz

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INTRODUCTION

According to the American Burn Association, inhalation injury occurs in one out of every three burn patients, increasing mortality rates tenfold [1]. Inhalation injury causes direct cellular damage, changes in regional blood flow and perfusion, airway obstruction, as well as local damage through toxin and proinflammatory cytokine release [2]. Inhalation injury associated with burns typically results from thermal injury to the face and upper respiratory tract due to inhalation of vapour and/or hot gases, as well as trauma from inhalation of toxic gases causing local and systemic chemical damage to the trachea, bronchi, alveoli and endothelial tissues [3,4].

Inhalation injury is classified in two ways according to the injury site in the respiratory tract and injury mechanism/cause [2,5]. When examined in terms of injury sites, acute upper airway or supraglottic injury and lower airway or subglottic injury are accepted [5]. When analysed according to the mechanism of injury, it is defined as toxic or irritating injuries resulting from thermal burns, drowning or inhalation of various gases-chemicals [2,5].

As a result after inhalation injury: the upper and lower airways become characteristically hyperemic. Blood flow in the lungs increases 4-6 times. This increase in bronchial blood flow causes airway oedema, fluid exudation and the release of inflammatory mediators. The circulation of inflammatory mediators increases the permeability of the bronchial vasculature and pulmonary transvascular fluid flow [1-6].

In recent years, respiratory characteristics of burn patients have been compared with healthy individuals in the literature, and new evidence on how inhalation injury changes these characteristics has been demonstrated. When the respiratory parameters of major burn patients were compared with healthy individuals with similar demographic and physical characteristics, it was found that although the mean values of FEV1/FEVC of burn patients were evaluated as 80%, this ratio decreased to 70-75% in burn patients accompanied by inhalation damage [7,8]. Additionally, recent research by El-Sayed Attalla et al. has provided further insights into the impact of inhalation injury on respiratory function. Their study demonstrated that inspiratory muscle training significantly improved respiratory muscle strength and lung function in burn patients with inhalation injury. They reported marked increases in maximal inspiratory pressure (MIP), forced vital capacity (FVC), and forced expiratory volume in one second (FEV1) in patients who received inspiratory muscle training compared to those who did not. These findings suggest that targeted respiratory interventions can mitigate some of the respiratory deficits associated with inhalation injuries in burn patients, emphasizing the importance of including such training in their rehabilitation protocols [9].

It has been reported that inhalation injury also restricts the diffusion of carbon monoxide in the lungs (DLco: a parameter indicating the gas exchange ability of the lungs in general), causes a decrease in maximal voluntary ventilation (MVV) and lung endurance is also adversely affected. This decrease in respiratory functions is thought to cause decreases in diaphragm movements and exercise capacities [7-10]. When all effects are taken into consideration, decreased respiratory function, increased secretion, decreased functional capacity and dyspnoea are frequently observed in burn patients with inhalation injury [7-12].

In the literature, the use of incentive spirometer (triflo), positive expiratory pressure (PEP) and vibration devices (acapella) in the field of physiotherapy is frequently encountered [13-17]. However, there are no studies in the literature in which such assistive respiratory devices were used in burn patients with inhalation damage. The aim of this study was to investigate the effects of incentive spirometer (triflo) and oscillatory positive expiratory pressure therapy (use of acapella) on functional capacity, dyspnoea and saturation in burn patients with inhalation injury in addition to standard physiotherapy exercises.

METHOD

Study Design and Participants

This study was planned as a randomised controlled study. The randomisation model used in the study was the covariate adaptive randomisation model. With this randomisation model, the groups were divided into three [18]. Burn patients hospitalised in the Burn Centre, ward and intensive care unit of Gaziantep City Hospital were included in this study. Throughout the study, there were no dropouts due to non-compliance with treatment protocols, and no patients were recorded to have experienced compliance issues during the study period.

Inclusion Criteria:

- Patients with a Glasgow Coma Scale score of E4M6V5, indicating open consciousness and cooperation (spontaneous eye opening: 4, obeys motor commands: 6, oriented verbal response: 5).
- Patients receiving enteral nutrition.
- Patients diagnosed with inhalation injury by the unit's burn specialist physician (all patients with inhalation injury were included without consideration of injury mechanisms).
- Patients aged between 18 and 65 years.
- Patients with a burn percentage of 25% or more (major burns) [19].
- Patients with stable hemodynamic values and vital signs, without the need for inotropic medication.

Exclusion Criteria:

- Patients with additional traumas (fractures, limb loss, etc.) in addition to the current burn trauma.
- Patients with organ dysfunction or multiple organ failures.
- Patients with chronic diseases such as COPD, heart failure, or respiratory/neurological/orthopedic diseases that may affect respiratory muscle strength, peripheral muscle strength, and respiratory function, as well as chronic conditions such as diabetes, cholesterol, and hypertension.
- Patients on mechanical ventilation.

Interventions

All patients included in the study received the following exercise protocols in addition to routine medical care, medical treatments, and surgical treatments:

Group 1-Standard Treatment Program: Standard physiotherapy exercises in addition to medical and surgical treatment (provided by the expert physician and nurses in the burn unit): Four sessions per week, lasting 30-45 minutes each, including exercises for normal joint movement, general respiratory exercises, bronchial hygiene techniques, ankle pumping exercises, in-bed isometric exercises, isotonic strengthening exercises, and early mobilization (from the first day onwards) (Table 1) [20].

Group 2-Standard Treatment Program+Incentive Spirometer (Triflo): In addition to standard treatment, patients were provided with education on the incentive spirometer. Respiratory exercises and the incentive spirometer device were practiced in 2 sets of 5 repetitions. Patients were instructed to control their tidal volume during breaths between exercises to prevent respiratory muscle fatigue and hyperventilation. It was encouraged to combine all respiratory exercises with pursed lip breathing. The use of Triflo® was defined as maintaining the maximum inspiratory maneuver following maximum expiration. Patients were taught relaxation positions, both sitting, in-bed, and standing, particularly for application during episodes of increased perception of dyspnea. To enhance the effectiveness of coughing and facilitate the easy removal of secretions, patients were instructed to cough with simultaneous abdominal pressure applied over the abdomen during the expiratory phase following maximum inspiration [21].

Group 3-Standard Treatment Program+Oscillatory Positive Expiratory Pressure Therapy (Use of Acapella): In addition to standard treatment, patients received oscillatory positive expiratory pressure therapy (Acapella). Respiratory exercises and the Acapella device were practiced in 2 sets of 5 repetitions. Patients were instructed to control their tidal volume during breaths between exercises to prevent respiratory muscle fatigue and hyperventilation. For proper use of the Acapella device, patients were instructed to ensure that the mouthpiece is fully sealed with the lips and pressed against the cheeks with the hands to prevent air leakage, and to perform a long and forceful expiration [16].

Table 1. Exercises delivered as part of standard treatment [20]

Features	Treatment properties	Scope of treatment
Duration of treatment	30–45 min	Adjusted based on patient's tolerance and response.
Number of sessions per week	5 days	*Regular sessions for optimal recovery and mobility*
Mobilization	From the first day of admission onwards	*Early mobilization to improve circulation and prevent muscle loss.*
Ambulation	From the first day of admission onwards	Early ambulation to encourage independence and reduce complications.
Post-graft exercise	Active mobilization after day 3	Normal joint mobility (NJM) exercises for non-graft sites for the first 3 days. Breathing exercises
Respiratory physiotherapy	Breathing exercises based on burn size	Bronchial hygiene techniques, coughing training 45° optimal position Diaphragmatic breathing
Exercises	From the first day of admission onwards	Active or passive NJM exercises depending on the patient's condition Distal joint mobility exercises In-bed isometric exercises for all upper and lower extremities Isotonic strengthening exercises Posture exercises

Outcome Measures

Patients were subjected to treatment protocols five days a week, starting from the day of hospitalization until the fourth week.

Functional Capacity: Functional capacity was assessed using the 6-minute walk test. The American Thoracic Society considers the 6-Minute Walk Test (6MWT) as a gold standard for measuring functional exercise capacity. The 6MWT measures the distance an individual can walk on a 30 m, straight, hard surface with two 180° turns during a six-minute period. The 30-meter corridor of the Gaziantep City Hospital Burn Center was utilized for the 6-minute walk test. Patients were instructed to walk as quickly as possible, maintaining the same pace, without running, for 6 minutes [22]. The distances walked at six minutes were recorded for both pre- and post-treatment assessments.

Dyspnea: The Modified Medical Research Council (MMRC) scale was employed. The dyspnea questionnaire, originally developed by a researcher, was modified by the British Medical Research Council. This questionnaire consists of a 0-4 point scale where individuals select the statement that describes their level of dyspnea from five questions related to breathlessness. Patients' saturations were assessed using the Adecon DK-8000S monitor device [23].

Ethical Approval

The study received approval from the Non-Interventional Research Ethics Committee of Hasan Kalyoncu University, Faculty of Health Sciences, with decision number 2024/42 dated 26.03.2024. Informed consent forms, detailing the purpose and content of the study, were provided to each participant who is a citizen of the Republic of Turkey, and information was also provided to foreign nationals through interpreters. Participants who agreed to participate in the study confirmed their participation by signing the voluntary informed consent form.

Statistical Analysis

Statistical analyses were conducted using the Windows-based SPSS (Statistical Package for the Social Sciences) 22.0 statistical package program. A significance level of $p<0.05$ was considered for all statistics. In the research, which was conducted with three groups followed for 4 weeks, with 8 individuals in each group (Group 1=8 individuals, Group 2=8 individuals, Group 3=8 individuals), the power of this study was found to be 85% for n=8 based on the six-minute walk test value (d=2.38) [24]. Descriptive analyses for numerical variables determined by measurement were expressed as mean and standard deviation (X±SD). The Kolmogorov-Smirnov test was used to examine the normal distribution of the parameters investigated in our study. The Kruskal-Wallis test was used to compare the three groups in the study. The Mann-Whitney U test was used for pairwise comparisons between groups, and the Wilcoxon test was used for comparisons within groups. The power of the study was calculated using the programme "G. Power-3.1.9.2". As a result of the analysis applied to 24 people, 8 in the first group, 8 in the second group and 8 in the third group, the effect size was found to be 0.6818 at $\alpha=0.05$ level and the power of the study was calculated as 0.819. P In this case, the power is at an acceptable level, the number of data is sufficient [25].

RESULTS

The study included a total of 24 patients, comprising 22 males and 2 females, with ages ranging from 19 to 63 years. The descriptive characteristics of the individuals are presented in Table 2.

Table 2. Comparison of descriptive characteristics among groups

	1st group n=8 (X±SD)	2nd group n=8 (X±SD)	3rd group n=8 (X±SD)	χ^2	p
Age	35.13±20.55	39.13±12.54	41.75±17.86	0.688	0.709
Height	175.12±10.79	172.75±4.43	175.63±13.31	0.009	0.996
Weight	75.13±16.77	75.13±13.44	84.13±23.57	0.919	0.632
BMI	24.21±2.91	25.18±4.30	26.79±4.68	1.674	0.433
% Burn	31.13±19.83	27.13±14.31	34.63±13.39	1.818	0.403

1st Group: Standard Treatment Program, 2nd Group: Standard Treatment Program + Incentive Spirometer (Triflo), 3rd Group: Standard Treatment Program + Oscillatory Positive Expiratory Pressure Therapy (Acapella Usage), χ2:Kruskal-Wallis Test, BMI:Body Mass Index.

When comparing the initial and final week measurements of the six-minute walk test, dyspnea scale (MRC), and saturation values across all groups, no difference was observed ($p>0.05$) (Table 3). When evaluated the measurements of six-minute walk test (6MWT), Modified Medical Research Council (MMRC) dyspnea scale, and saturation levels within each group during the first and last weeks, it was determined that dyspnea decreased in all groups ($p<0.05$) (Table-4). In the second group, where incentive spirometry (Triflo) was used in addition to standard treatment, it was observed that the data improved compared to the initial measurements ($p<0.05$) (Table 4).

Table 3. Comparison of functional capacity, dyspnea, and saturation values among groups

Variables	1st group n=8 (X±SD)	2nd group n=8 (X±SD)	3rd group n=8 (X±SD)	χ^2	P
6MWT_PRE	274.00±89.61	205.00±80.19	345.00±62.45	5.358	0.069
6MWT_POST	305.00±143.53	410.38±85.88	353.75±136.27	3.014	0.222
MRC_PRE	2.38±1.06	2.75±0.71	2.63±1.19	0.548	0.760
MRC_POST	1.25±1.28	0.63±0.92	0.88±0.64	1.336	0.513
SpO2_PRE	95.63±1.92	95.00±2.45	95.00±2.14	0.279	0.870
SpO2_POST	96.00±2.93	97.13±1.13	96.25±1.28	1.447	0.485

1st Group:Standard Treatment Program, 2nd Group:Standard Treatment Program + Incentive Spirometer (Triflo), 3rd Group:Standard Treatment Program + Oscillatory Positive Expiratory Pressure Therapy (Acapella Usage), 6MWT_PRE:Six-minute walk test pre-treatment, 6MWT_POST:Six-minute walk test post-treatment, MRC_PRE:Dyspnea scale pre-treatment, MRC_POST:Dyspnea scale post-treatment, SpO2_PRE:Oxygen saturation n level pre-treatment, SpO2_POST:Oxygen saturation level post-treatment, χ2:Kruskal-Wallis test.

Table 4. Comparison of within-group initial and final measurements

Variables	1st group n=8		2nd group n=8		3rd group n=8	
	Z	p	Z	p	Z	p
6MWT_POST-6MWT_PRE	-1.483	0.138	-2.201	0.028*	-1.826	0.068
MRC_POST-MRC_PRE	-2.460	0.014*	-2.588	0.010*	-2.392	0.017*
SpO2_POST-SpO2_PRE	-0.702	0.483	-2.032	0.042*	-1.667	0.096

1st Group:Standard Treatment Program, 2nd Group:Standard Treatment Program + Incentive Spirometer (Triflo), 3rd Group:Standard Treatment Program + Oscillatory Positive Expiratory Pressure Therapy (Acapella Usage), 6MWT_PRE:Six-minute walk test pre-treatment, 6MWT_POST:Six-minute walk test post-treatment, MRC_PRE:Dyspnea scale pre-treatment, MRC_POST:Dyspnea scale post-treatment, SpO2_PRE:Oxygen saturation n level pre-treatment, SpO2_POST:Oxygen saturation level post-treatment, Z: Wilcoxon Signed Ranks Test

DISCUSSION

In burn patients with inhalation injuries, standard physiotherapy exercises and incentive spirometry (triflo) and oscillatory positive expiratory pressure treatments (acapella) given in addition to these exercises have healing effects on functional capacity, dyspnea and saturation parameters. These three treatment protocols show similar improvements in functional capacity, dyspnea severity and oxygen saturation levels in patients. According to the results obtained, in burn patients, standard physiotherapy exercises and incentive spirometry (triflo) and oscillatory positive expiratory pressure treatments (acapella) given in addition to these exercises can be evaluated as effective treatment options in the rehabilitation of burn patients. We believe that physiotherapists working in this field can prefer all three protocols depending on the compliance of the patients.

In a study conducted in 2018, the effectiveness of breathing exercises and incentive spirometry was compared. Malik et al. reported that both treatments were equally effective in improving blood gas levels in burn patients with inhalation injury [26]. Abazarnejad et al. 2022, it was emphasised that improving respiratory muscle strength could be an effective method in the treatment of burn patients [27]. In another study conducted by Malik et al., it was reported that breathing exercises were more effective in reducing the risk of pneumonia in burn patients with second-degree inhalation damage than exercises performed with an incentive spirometer [28]. In our study, it was observed that exercises performed with an incentive spirometer given in addition to standard physiotherapy exercises were similarly effective. Despite this similar effect, we believe that improvement in functional capacity, dyspnoea and saturation levels may be faster in the group using an incentive spirometer. However, the 4-week follow-up period may not have been sufficient to draw definitive conclusions.Since there are no studies investigating the effects of different exercise protocols on functional capacity, dyspnoea and oxygen saturation levels in burn patients with inhalation injury, we believe that our study will contribute to the literature in this respect.Further research is needed to investigate the long-term effects of different exercise protocols on functional capacity, dyspnea, and oxygen saturation levels in burn patients with inhalation injury.

In a review investigating the effects of incentive spirometry in patients undergoing coronary artery bypass surgery, it was reported that exercises performed with an incentive spirometer had more favourable effects on oxygenation and haemodynamic values [29]. In another study conducted in 2021, it was observed that incentive spirometer exercises given in the preoperative period prevented post-operative complications in patients who were decided to undergo coronary artery bypass surgery [30]. In the literature, it has been reported that exercises performed with an incentive spirometer in patients with chronic lung disease (such as cystic fibrosis, chronic obstructive pulmonary disease) may be more effective in improving lung capacity than standard physiotherapy programme [31,32]. While incentive spirometry is more effective than standard physiotherapy in chronic lung diseases after cardiovascular surgery, the fact that this effect was not observed in burn patients with inhalation damage in our study suggests that the mechanisms of the pulmonary system may be different in both disease groups. Studies investigating these mechanisms may contribute more to the literature.

In a study conducted in 2020, it was stated that the use of vibrating devices with oscillation effect such as a cappella in chronic obstructive pulmonary disease (COPD) patients and/or chronic bronchitis patients is important in the clinical care of patients and may reduce the frequency of exacerbations [33]. In a review published in 2023, it was emphasised that a cappella application given in addition to standard physiotherapy exercises was effective in improving the clinical status of COPD patients and reducing secretion [34]. In our study, improvement in functional capacity, dyspnoea and saturation parameters were similar in the three groups. In patients with inhalation injury, only standard physiotherapy exercises may be sufficient. The levels of inhalation injury were not examined in the burn patients included in our study. Patients with all degrees of inhalation injury were included in the study. In addition, the secretions of the patients were not evaluated in isolation. This aspect of our study can be considered as a limitation. Studies with a larger number of patients, including patients with certain degrees of inhalation damage (first and/or second degree) may provide clearer evidence of the effects of incentive spirometry and acapella on these patients. Studies in this direction will contribute more to the literature.

Limitations

The study had a short follow-up period, limiting the ability to assess long-term recovery and treatment outcomes comprehensively. Short-term follow-up may not capture how treatment outcomes evolve over time. Conducting the study at a single center may not reflect potential variations in treatment outcomes that could be observed across different healthcare settings. Generalizability of the findings may be limited as the patient population at a single center may not represent patients from other centers.

CONCLUSION

This study is one of the first to compare the effectiveness of incentive spirometry (Triflo) and oscillatory positive expiratory pressure (OPEP) treatments in burn patients with inhalation injuries. This innovative approach may provide significant contributions to the literature. The results of the study may help standardize incentive spirometry and OPEP treatments in the treatment of inhalation injuries in burn patients. Standardization of these treatments may contribute to the development of more effective and safe treatment approaches in clinical practice. In particular, in addition to standard pulmonary physiotherapy exercises, oscillatory positive expiratory pressure therapy (acapella use) and incentive spirometry (triflo) can be given to burn patients with inhalation injuries. These exercises are similarly effective on functional capacity, dyspnea, and saturation levels in burn patients with inhalation injuries. Clinicians working in this field can use all 3 exercise protocols.

Ethical Approval: *2024/42 Non-Interventional Clinical Research Ethics Committee of Hasan Kalyoncu University*

Conflict of Interest: *The authors have no conflicts of interest to declare.*

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REFERENCES

1. Dyamenahalli K, Garg G, Shupp JW, Kuprys PV, Choudhry MA, Kovacs EJ. Inhalation injury: unmet clinical needs and future research. J Burn Care Res. 2019;40(5):570-584.
2. Jones SW, Williams FN, Cairns BA, Cartotto R. Inhalation injury: pathophysiology, diagnosis, and treatment. Clin Plast Surg. 2017;44(3):505-511.
3. Reid A, Ha JF. Inhalational injury and the larynx: A review. Burns. 2019;45(6):1266-1274.
4. You K, Yang HT, Kym D, Yoon J, Cho YS, Hur J, Kim JH. Inhalation injury in burn patients: establishing the link between diagnosis and prognosis. Burns. 2014;40(8):1470-1475.
5. Merrel P, Mayo D. Inhalation injury in the burn patient. Crit Care Nurs Clin. 2004;16(1):27-38.
6. Gupta K, Mehrotra M, Kumar P, Gogia AR, Prasad A, Fisher JA. Smoke inhalation injury: etiopathogenesis, diagnosis, and management. Indian J Crit Care Med. 2018;22(3):180.
7. Won YH, Cho YS, Joo SY, Seo CH. Respiratory characteristics in patients with major burn injury and smoke inhalation. J Burn Care Res. 2022;43(1):70-76.
8. Özkal Ö, Topuz S, Karahan S, Erdem MM, Konan A, Yastı AÇ. Clinical predictors of pulmonary functions, respiratory/peripheral muscle strength and exercise capacity at discharge in adults with burn injury. Disabil Rehabil. 2021;43(20):2875-2881.
9. El-Sayed Attalla AF, Ahmed KT, Abd El Monem M. Effects of Inspiratory Muscle Training on Clinical Predictors of Respiratory Muscle Strength and Lung Function in Burned Patients with Inhalation Injury. Journal of Burn Care & Research. 2023;44(1):140-145.
10. Börekçi Ş, Gemicioğlu B, Görek Dilektaşlı A, Kıyan E, Köktürk N, Ulubay G, YILDIZ Ö. Türk Toraks Derneği Akciğer Difüzyon Kapasitesi Değerlendirme Uzlaşı Raporu.
11. Krzywiecki A, Ziora D, Niepsuj G, Jastrzebski D, Dworniczak S, Kozielski J. Late consequences of respiratory system burns. J Physiol Pharmacol. 2007;58:319-325.
12. Mlcak R, Desai MH, Robinson E, Nichols R, Herndon DN. Lung function following thermal injury in children—an 8-year follow up. Burns. 1998;24:213-216.
13. Eltorai AE, Szabo AL, Antoci V, Ventetuolo CE, Elias JA, Daniels AH, Hess DR. Clinical effectiveness of incentive spirometry for the prevention of postoperative pulmonary complications. Respir Care. 2018;63(3):347-352.
14. Chang PC, Chen PH, Chang TH, Chen KH, Jhou HJ, Chou SH, Chang TW. Incentive spirometry is an effective strategy to improve the quality of postoperative care in patients. Asian J Surg. 2023;46(9):3397-3404.
15. Kotta PA, Ali JM. Incentive spirometry for prevention of postoperative pulmonary complications after thoracic surgery. Respir Care. 2021;66(2):327-333.
16. Demchuk AM, Chatburn RL. Performance characteristics of positive expiratory pressure devices. Respir Care. 2021;66(3):482-493.
17. Alghamdi SM, Alsulayyim AS, Alasmari AM, Philip KE, Buttery SC, Banya WA, Hopkinson NS. Oscillatory positive expiratory pressure therapy in COPD (O-COPD): a randomised controlled trial. Thorax. 2023;78(2):136-143.
18. Kang M, Ragan BG, Park JH. Issues in outcomes research: an overview of randomization techniques for clinical trials. J Athl Train. 2008;43(2):215-221.
19. Hettiaratchy S, Papini R. Initial management of a major burn: I-overview. BMJ. 2004;328(7455):1555-1557.
20. Çınar MA, Bayramlar K, Erkılıç A, Güneş A, Yakut Y. The effects of early physiotherapy on biochemical parameters in major burn patients: A burn center's experience. Turk J Trauma Emerg Surg. 2019;25(5):461-466.
21. Nelson ME, Rejeski WJ, Blair SN, Duncan PW, Judge JO, King AC, et al. Physical activity and public health in older adults: recommendation from the American College of Sports Medicine and the American Heart Association. Circulation. 2007;116(9):1094.
22. Chan WL, Pin TW. Reliability, validity and minimal detectable change of 2-minute walk test, 6-minute walk test and 10-meter walk test in frail older adults with dementia. Experimental gerontology. 2019;115:9-18.
23. Richards JB. Calculated decisions: mMRC (modified Medical Research Council) dyspnea scale. Emergency medicine practice. 2017;19(Suppl 10):1-2.
24. Portney LG, Watkins MP. Foundations of clinical research: applications to practice. Upper Saddle River, NJ: Pearson/Prentice Hall; 2009.
25. Cohen J. Statistical Power Analysis for the Behavioral Sciences (2nd ed.) 1988.
26. Malik SS, Tassadaq N. Effectiveness of deep breathing exercises and incentive spirometry on arterial blood gases in second degree inhalation burn patients. J Coll Physicians Surg Pak. 2019;29(10):954-957.
27. Abazarnejad E, Froutan R, Ahmadabadi A, Mazlom SR. Improving respiratory muscle strength and health status in burn patients: a randomized controlled trial. Qual Life Res. 2022;1-8.
28. Malik SS, Saeed S, Kanwal S. Effect of deep breathing exercises and incentive spirometry on respiratory distress scoring in second degree inhalational burn patients. J Shifa Tameer-e-Millat Univ. 2019;2(1):13-16.
29. Zerang F, Amouzeshi A, Barkhordari-Sharifabad M. Comparison of the effect of incentive spirometry and deep breathing exercises on hemodynamic parameters of patients undergoing coronary artery bypass graft surgery: A Clinical Trial. J Vasc Nurs. 2022;40(3):134-139.
30. Sweity EM, Alkaissi AA, Othman W, Salahat A. Preoperative incentive spirometry for preventing postoperative pulmonary complications in patients undergoing coronary artery bypass graft surgery: a prospective, randomized controlled trial. J Cardiothorac Surg. 2021;16(1):241.
31. Bhosale DA, Agarwal B, Murkudkar P, Bagwe H. Using Incentive Spirometer to Improve Lung Function in Patients With Chronic Lung Disease: A Patient Guide. Arch Phys Med Rehabil. 2023;104(9):1557-1560.
32. Gugnani A. Effects of breathing exercises and incentive spirometry in improving lung capacity on individuals with lung fibrosis. Eur J Mol Clin Med. 2020;1407-1435.
33. Tse J, Wada K, Wang Y, Coppolo D, Kushnarev V, Suggett J. Impact of oscillating positive expiratory pressure device use on post-discharge hospitalizations: a retrospective cohort study comparing patients with COPD or chronic bronchitis using the Aerobika® and Acapella® devices. Int J Chron Obstruct Pulmon Dis. 2020;15:2527-2538.
34. Tayade V, Vardhan V. The Effect of Aerobika Device and Acapella Device on Rehospitalisation and Pulmonary Functions in Patients with Chronic Obstructive Pulmonary Disease-A Systematic Review. J Clin Diagn Res. 2023;17(7).