

Effect of Thermotherapy on Balance in Healthy Adolescent Subjects

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ABSTRACT

Introduction (purpose): Thermotherapy is commonly modalities used in therapeutic intervention of adolescence before and after treatment in physical therapy program, but its effect of on dynamic balance are not discussed yet. The outcomes of this study would provide significant contributions to fill the gap in researches about the effect of thermotherapy modalities on dynamic balance in adolescent subjects. **Methods:** Forty healthy normal adolescent subjects of both genders participated in this study their age ranged from (13-18 years). The dynamic balance was assessed by biodex balance system under two situations (1) control situations: at room temperature, (2) experimental situations after hot pack application on ankle joint. The order of control and experimental was randomized using a coin flip. **Results:** Paired T test revealed that there was significant decrease in dynamic balance values (OAS, AP and ML) after application hot as ($p \leq 0.05$). **Conclusion:** The result suggested that hot pack application of dominant ankle joint improve dynamic balance in healthy adolescent subjects.

Keywords: Dynamic balance, adolescent, hot pack application.

INTRODUCTION

Thermotherapy is modalities that used during rehabilitation in physical therapy program to increase blood flow, increase collagen tissue extensibility, decrease pain and decrease joint stiffness [1-2]. Hot packs application is one of the thermotherapy modalities that used for rehabilitation purposes[3].

Balance is the ability to align body segments against gravity to maintain or move the body within the available base of support without falling[4]. Maintaining balance necessitate assortment of input from three important sensory systems the visual, somatosensory, and vestibular systems[5] For regaining balanced, a standing person should keep the vertical projection of their center of mass within their base of support, causing little medial-lateral or anterior-posterior sway[6]. Impaired balance is the strongest predictor of falls[7]. Dynamic assessment of balance consider the most indication for balance assessment which represent the lower extremity demand during functional tasks [8].

There are limited studies done on effect of thermotherapy application on balance, but their effects in adolescence are not clear. If the dynamic balance is disturbed following the application of hot pack then there is a possibility to cause

injury during rehabilitation. So this study was done to identify if there were disturbance on balance after thermotherapy application in adolescent which is not addressed in any previous research.

MATERIALS AND METHODS

Ethical considerations

This study was conducted from July 2019 to August 2019, ethically approved by the ethical committee of the Faculty of Physical Therapy, Cairo University, Egypt with number NO:P.T.REC/012/002419 and registered on Pan African Clinical Trial Registration (PACTR) by number PACTR201907751587389. Two copies of written consent form were giving agreement to participation and publication of results was signed by all participants.

Design of study

Crossover (single repeated measurements) design.

Participants:

Forty healthy normal adolescent subjects (15 male and 25 female), their age range from 13 to 18 years were recruited using online social media and through publicly distributed posters. The inclusive criteria were, their body mass indexes (BMI) were normal for age and sex and they had normal muscle strength in lower limbs. Excluded if had musculoskeletal disorders in the

lower limb, had infected skin diseases and loss of sensation, had a Metabolic or vascular disease with a neurological component such as diabetes, had previous ankle operation and had a recent injury to ankle joint and athletes. (figure 1).

Material:

Measurement instrumentation

The device used in this study (Biodex Medical Systems Inc., Shirley, New York, USA) was a foot platform (circular in shape with a diameter of 21.5´, which permits up to 20° tilting in all direction from horizontal), support rails that were adjustable from 25´ to 36.5´ above the platform, and could be swung away if desired, a display module whose height was adjustable from 53´ to 68´ above the platform and angle was adjustable from vertical back to 45°, with a screen viewing area of 24.8 × 18.4 cm and a printer. This testing machine had 12 dynamic levels plus locked for static measurements [9]. The subject's capacity to control the degree of platform's tilt was measured by the Biodex system which reported as a stability index. Measuring data included anteroposterior stability index (APSI), mediolateral stability index (MLSI), and overall stability index (OSI). Increasing the number of index indicates considerable motion and high amount of sway which means balance problem [10]

Therapeutic instrumentation:

Reusable hot gel packs 25.4 x 48.1 cm. 40° C (+/- 5° C) degree C used for thermotherapy application.

Methods:

The study procedures were carried out at lab of biomechanics, Faculty Physical Therapy, Modern University. Each participant received a verbal explanation of the test steps.

Each participant had their balance tested during two situations: (1) an experimental situations where the subject received hot pack on ankle for 15 minutes immediately before balance testing and (2) a control situations completed at room temperature. The order of testing situations was randomized through a coin flip. Participants completing the control situations first immediately completed the experimental situations following assessment. Participants randomized to the hot pack situations first had the control session scheduled at a separate time to ensure no lingering effects existed from the hot pack procedures.

Assessment of dynamic balance: The participants were asked to stand on biodex platform bare feet. Name, age, and height of participants were entered and the level of stability was adjusted at 8th level of stability, the test period was for 20 second. Then, the participants were asked to stand on dominant extremity (domain

extremity will determined by asking the subject to kick a ball, ascend and descend stairs. The limb used to kick the ball and the limb used in ascending and descending stairs was considered to be the dominant lower extremity), Subject's foot position on the platform grid will record in which the heel coordinates will recorded from the center of the back of the heel, and the foot angle determined by finding a parallel line on the platform to the center line of the foot passing through the 2nd toe . The arms of participants held at the sides with closed eye then asked them try to control his balance as much as possible. Three test trials were done before assessment and collecting data for each participant to make participant familiar with test procedures. Three trials were obtained for each measurement and when the time ended the OSI, APSI, and MLSI were recorded automatically. Measurements were repeated for the two situations (control situation, immediately after hot pack application).

Thermotherapy application: Reusable hot gel packs at temperature 40° C (+/- 5° C) was used as a heat application modality in this study, Duration of the application was 15 minutes. Wrapping of a pack by towel was applied all around the ankle joint of domain extremity with a towel in between. Two elastic straps used for fixation the hot pack.

Data analysis

Data analysis was performed using the SPSS 25 for Windows statistical software. The appropriate sample size was determined using the pre-post comparison between the subject's responses, and the sample size determined at the effect size of 0.39, power of 80%, and significance level 5%. The appropriate sample was 38 subjects. The normality of data distribution was tested through the Shapiro-Wilk test and it was normally distributed. Descriptive data for participants, characteristics and dependent variables was calculated as mean \pm SD. Paired T test was used to assess the statistically significant effect of heat on (OAS,AP and ML) compared to baseline reading for all the subjects. The alpha level of significance was adopted at 0.05.

RESULTS

40 volunteers of both gender were participated in the study every subject was controlled to himself their characteristics were expressed by descriptive statistics (mean and standard deviation) as presented in table (1).

Table (1): Characteristics of subjects participated in the study

Variable		volunteers
Age(yrs.)		15.25 ± 1.69
Weight (Kg)		54.35 ± 5.45
Height (m)		160.42 ± 7.69
Body Mass Index (BMI)		20.52±1.346
Gender	Males	20(50%)
	Females	20 (50%)

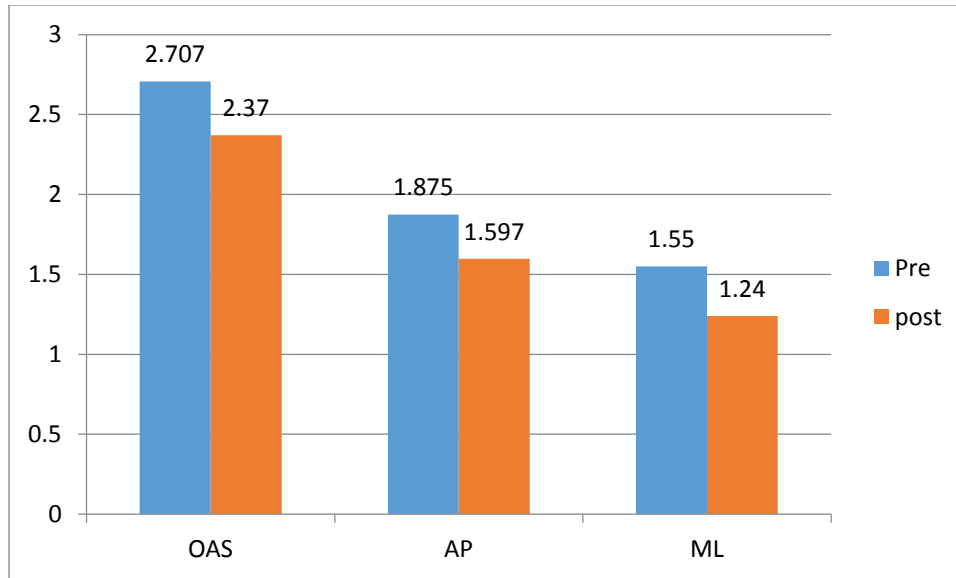
Mean ± SD of Physical characteristics of volunteers

As shown in table (2) there was statistical significant decrease in OAS after application of hot packs as p value was 0.0001 and the percentage of decrease was 12.2 %. Regarding (AP) there was statistical significant decrease in AP after application of hot packs as p value was 0.0001 and the percentage of decrease was 14.8 %. Regarding (ML) there was statistical significant decrease in ML after application of hot packs as p value was 0.0001 and the percentage of decrease was 20 %.

Table (2): Comparison between mean values of OAS, AP and ML measured at pre-and post-heat application

	Overall Stability (OAS)	Antroposterior Stability (AP)	Mediolateral Stablity (ML)
	Mean ± Standard deviation	Mean ± Standard deviation	Mean ± Standard deviation
Pre heat application	2.707 ± 0.520	1.875 ± 0.475	1.550 ± 0.610
Post heat application	2.37±0.621	1.597 ± 0.400	1.240 ± 0.453
Mean difference	0.3325	0.277	0.435
Percentage of change	12.2%	14.8%	20%
P Value	0.0001*	0.0001*	0.0001*

*significant as p value ≤ 0.05 .



Fig(1): Mean value of (OAS ,AP,ML) pre and post heat application

DISCUSSION

Thermotherapy is commonly modalities used in therapeutic intervention of adolescence before and after treatment in physical therapy program, but its effect of on dynamic balance are not discussed before. If the balance is altered following therapeutic applications of thermotherapy, it is possible to cause injury during rehabilitation. The outcomes of this study would provide significant contributions to fill the gap in researches about the effect of thermotherapy modalities on dynamic balance in adolescent subjects. .

The major findings of the current study was

Dynamic balance improved after hot pack application as there were statistical significant decrease in

(OAS,AP, and ML) as p value was ≤ 0.05

The possible causes for the improvement of dynamic balance after hot pack application that the dynamic balance are affected by flexibility[11, 12],,which mean when flexabilty improve this will in turn improve dynamic balance and the hot pack application increase tissue extensibility and flexibility [13] so the dynamic balance affected by increase tissue extensibility and flexibility caused by hot pack application.

Findings of this study are in agreement with those of Kaynak, et al., 2015 who found that elbow proprioception was improved after heat application [14].

And the findings of this study are contradict with those of Altun m et

al., 2014 who found that there was no statistically significant in jump performance after application of heat[3].

CONCLUSION

Our findings suggested that application of 15 minutes hot pack of dominant ankle joint improve dynamic balance in healthy adolescent subjects.

Implementations:

The current study findings could be implemented in the decision making concerning utilizing of hot pack application through treatment sessions.

Abbreviations:

OSI: Overall Stability Index.

APSI: Anterior/Posterior stability Index.

MLSI: Medial/Lateral Stability Index.

P-value: Probability value.

* S: Significant

Pre: Pre-treatment

Post: Post-treatment.

SD: Standard Deviation.

MD: Mean Difference.

F-statistics: MANOVA Test

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Conflicts of interest

There was no inconsistency of interest.

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