Significance of Heating and Traction in Girls With Adolescent Kyphosis

Khaled A. Olama (Ph.D.)
Department of Physical Therapy for Disturbance of Growth and Development in Children and its Surgery, Faculty of Physical therapy, Cairo University

ABSTRACT

Background and purpose: *Historically, the spinal thoracic region has been neglected, with the greatest attention directed to the cervical and lumber region. This study is a trial conduced to determine the effect of heating and traction when simultaneously to correct the kyphotic deformity in adolescent girls.* ***Subjects:*** *Thirty adolescent girls suffering from non-bony structural kyphosis, ranging in age from thirteen to fifteen years represented the sample of the study. They were free from any associated deformities rather than kyphosis of thoracic spine. The angle of kyphosis ranged from fifty five to sixty five degrees. The girls were divided randomly into two groups of equal number (A and B). Evaluation was conducted for each girl of the two groups to determine the Cobb's angle. It was conduced before and after six months of treatment. Group A (control) received an exercise therapy program including postural correction through stretching and strengthening exercises. While group B (study) received heat therapy applied on the anterior chest wall, while traction, in addition to the exercise therapy program.* ***Results:*** *The results of the study revealed significant improvement in the Cobb's angle of the two groups when comparing their pre and post treatment mean values. Highly significant improvement was observed in favor of group (B) when comparing the post-treatment mean values of the two groups. The results proved evidence that combining heat with traction are valuable physical therapy modalities which should be used as an adjunct to other therapeutic modalities to achieve the optimal correction of the kyphotic curve in adolescent girls.*

Key words: *kyphosis, Heating, Traction.*

INTRODUCTION

Normal spinal curves include lack of any lateral deviation of the spine, mild lordosis at the cervical and lumber levels of the spine, mild kyphosis (forward bending) in the thoracic region. Excessive spinal curves in any of these planes can occur as a result of neurological, orthopedic or idiopathic factors[1].

Deformities of the spine can originate from many causes. The pathological disorder of these deformities generally appears at the onset of puberty. According to some investigators, the progression of the deformity may be related to the destabilizing effect of a neurologic postural disorder, produced on the natural curves of the spine[2].

Kyphosis is an excessive forward curvature of flexion of the spine, manifesting in a concave deformity which usually occurs in the thoracic region[1].

Although some degree of curvature is present in normal spine, the term kyphosis is usually applied to the exaggerated curve that results in a rounded or hunched back[3].

Excessive thoracic kyphosis often begins in adolescent girls who assume a round-shouldered slouch to hide their growing breasts. Such poor posture is usually noted to worsen during the adolescent growth spurt, when a child may assume a more pronounced round back[4].

Physical examination should be directed to check for thoracic curvature, rounded shoulder, winging of the scapulae, excessive lumber lordosis and forward bending of the head and neck[5].

Tight musculature and associated connective tissue limit lengthening of the antagonistic muscles which reduces mobility of the body segments[6].

Treatment of kyphosis depends on the cause of the disorder. For kyphosis caused by poor posture, treatment may consist of exercises; affirm mattress for sleeping[7], traction and back brace to straighten the curve and relief pain[8]. Exercises are usually used to strength the scapular muscles and spine extensors[3].

Various forms of heat, the oldest treatment modality, are still in use for a variety of conditions. The use of superficial heat modalities is a common adjunct to other treatment methods and exercises including stretching[9,10].

One of the most important benefits of traction to induce stretching is the potential promotion of relaxation. As the muscle fibers are incapable of lengthening or stretching themselves, a force must be received from outside the muscle itself. Among these forces are gravity, motion, force of antagonistic muscles on the opposite side of a joint, and the force provided by a traction machine, another person or by some part of one's own body[11].

The aim of this study was to determine the combined effects of heating and traction on correcting the abnormal kyphosis in adolescent girls.

SUBJECTS, INSTRUMENTATION AND PROCEDURES

Subjects

Thirty adolescent girls suffering from non-bony structural kyphosis ranging in age from 13 to 15 years (Mean 15.32±0.62 years) with mean weight of 52.7±2.53 Kg. and mean height of 145.18±3.59 cm. represented the sample of the study. They were free from any associated deformities other than kyphosis of the thoracic spine. They were selected from different preparatory schools among Cairo, Egypt. They were chosen to be at about the same socioeconomic and nutritional levels. The angle of kyphosis was determined by the Cobb's method to be ranging from 55-65 degrees. Girls representing the sample of this study were divided randomly into two groups of equal number (A and B). Evaluation of each girl of the two groups was conducted before and after six months of treatment. Group A (control) received exercise therapy program including stretching exercises of the pectoralis muscle, anterior deltoid and teres minor, followed by strengthening exercises of the back extensors, posterior deltoid, scapular adductors. While group B (study) received heat application via using hot packs to the tight muscle groups in conjunction with spinal traction in addition to the same exercise program given to group A.

Instrumentation

I- For evaluation

1- X-ray films (30x40 cm. in size) taken from lateral view to determine the degree of kyphotic curve by the Cobb's angle and from posterior-anterior view to exclude the presence of scoliosis or other spinal abnormalities.
2- Ruler, Marker, and protractor.
3- Tape measurement.
4- Weight scale.

II-For treatment

1- Two hot packs were used for heat application. The hot packs gain a temperature between 41 and 45ºC. Before being placed on the subject, each hot pack was dried and wrapped by a cotton towel before being applied to the subject.

2- A specially designed chair fitted to the girls and a specially designed jacket connected to the rope of the traction unit.

3- Traction unit, a Pagan Electronics' traction unit, Model: Alfa track 1, class: 1, type: BF, power supply: 230V˜± 10%, 50/60 Hz. It produces a digital treatment time up to 60 minutes. For use, the unit was fixed to a traction bed on a proper metallic plate support. The traction unit is supplied with a traction rope ended with a snap-hook. The unit produces static mode of traction. The jacket consists of a well padded square shaped part, made of Dacron Felt (4mm. in thickness) with a hock attached to its center and two rectangular iron, nickel plated loops fixed to its lower corners. Two well padded bands made of Plastozote (4 mm. in thickness) covered with Perlon Stockinette white material (40 mm. in width), extended from the upper corners of the square shaped part and ended with two straps made of non-elastic webbing.

Procedures

I- For evaluation

A lateral plain X-ray was taken for each girl individually, from standing position (stress X-ray), to determine the degree of kyphotic angle, represented by the Cobb's angle, and also to exclude the possibility of presence of any structural changes.

Determination of Cobb's angle: The X-ray film was taken, and then perpendicular lines were extended from lines drawn through the superior end plate of the highest vertebral body and the inferior end plate of the lowest identified vertebral body of the curve. The measured angle at their intersection was then determined (Cobb's angle)[12].

II-For treatment

Group A (control)

Received therapeutic exercise program which was conducted three times/week for six successive months, including:

1- Stretching exercises for pectoralis, teres minor, anterior fibers of deltoid, upper abdominal, hips and knees flexor muscles.

2- Strengthening exercises for scapular, adductors, spinal extensors, hips and knees extensors and lower abdominal muscles.

Group B (study)

Received hot packs on the pectoral muscles (anterior chest wall) and anterior aspect of the shoulder girdle for 30 minutes with spinal traction as follows: each girl was seated on the chair. She wore the designed jacket on a cotton t-shirt, and the therapist fastened it around the girl's shoulder girdles. Pillows were used to adjust the sitting height of each girl, so that, the level of the center of the jacket was at the same level of the traction unit. Each girl was then asked to take the correct upright sitting position and support her back on the back of the chair. External belt was fitted around the thighs to prevent downward sliding. The snap hook of the traction rope was then connected to the central ring of the jacket, so that, the traction rope was in a straight, horizontal state, parallel to the ground. The traction unit was put on, selecting the static mode. The traction time was adjusted for to increase gradually from 15 minutes to reach 30 minutes. The traction force was also increase gradually from 3 to reach 5 Kg per week. This was conducted three times/week for successive six months. In addition to spinal traction, the same exercise program given to group A was also conducted.

RESULTS

The collected data for the two groups were statistically treated and analyzed to show the mean and standard deviation of the Cobb's angle. The student the-test was then applied to determine the significance of treatment in each group. The results revealed no significant difference between the two groups before treatment. Significant decrease was observed in group A, when comparing its pre and post-treatment mean values. Highly significant decrease in the Cobb's angle was observed in group B when comparing its pre and post-treatment mean values and the post-treatment mean values of group A.

As shown in table (1) and fig. (1), the mean values of Cobb's angle for group A pre-treatment was 64.9 ± 3.33º and 58.9 ± 3.95º post-treatment, (P<o.oo1).

Table (1): Mean values of Cobb's angle / degrees for group A, pre and post-treatment.

Cobb's angle/degrees	X`	SD	t-test	P-value	Sig.
Pre-treatment	64.9	±3.33	4.49	<0.001	Significant
Post-treatment	58.9	±3.95			

X`: mean SD: standard deviation Sig.: level of significance

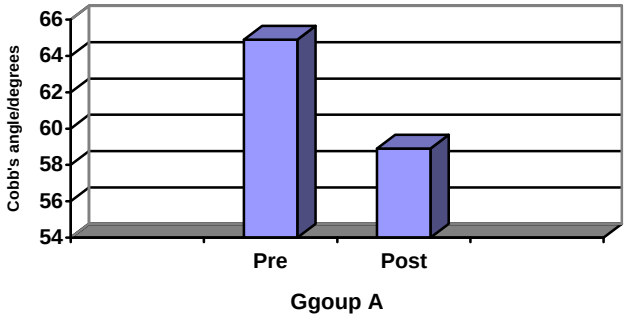

Fig. (1): Showing the mean values of Cobb's angle (degrees) before and after six month of treatment for group A.

Table (2) and fig. (2) revealed significant decrease in the Cobb's angle when comparing its pre and post-treatment mean values. The mean values before treatment was 63.45 ± 3.23º and 50.52 ± 3.80º after six months of treatment, (P<0.0001).

Table (2): Mean values of Cobb's angle / degrees for group B, pre and post-treatment.

Cobb's angle/degrees	X`	SD	t-test	P-value	Sig.
Pre-treatment	63.45	±3.23	10.04	<0.0001	H. Significant
Post-treatment	50.52	±3.80			

X`: mean SD: standard deviation Sig.: level of significance

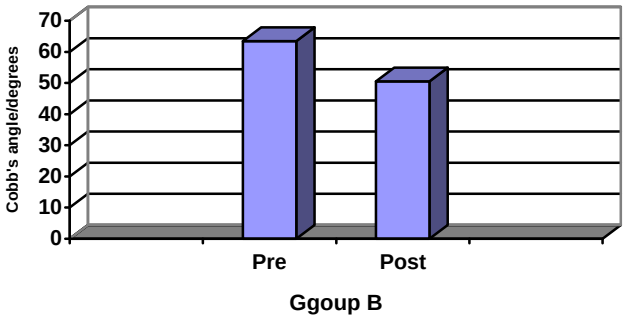

Fig. (2): Illustrating the mean values of Cobb's angle (degrees) before and after six month of treatment for group B.

Comparing the post-treatment mean values of Cobb's angle for the two groups, after six months of treatment, showed highly significant decrease in favor of group B. the Cobb's angle for group A was 58.9±3.95º, while the post-treatment mean values of Cobb's angle for group B was 50.52±3.80º, (P<0.0001).

Table (3): Mean values of Cobb's angle / degrees for groups A and B after six months of treatment.

Cobb's angle/degrees	X`	SD	t-test	P-value	Sig.
Group A	58.9	±3.95	5.92	<0.0001	H. Significant
Group B	50.52	±3.80			

X`: mean SD: standard deviation Sig.: level of significance

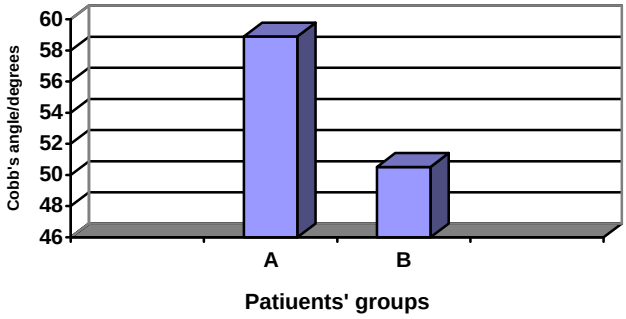

Fig. (3): Post-treatment mean values of Cobb's angle (degrees) for groups A and B.

DISCUSSION

Progressive kyphosis, especially in the thoracic spine not only affects the cosmetic appearance, but may also lead to complications as erosion of the end plates, affected pulmonary function that may lead to respiratory and secondary cardiac failure[13].

This study was conducted to find out the effect of healing when applied with spinal traction for correcting kyphotic deformity, in adolescent girls.

The post treatment results verified clearly that application of heat in conjunction with traction decreased the exaggerated kyphotic curve than traction alone.

Kyphosis occurring in the subjects of this study may be attributed to pro longed faulty sitting position , which allows postural muscles (neck flexors, muscles of the upper extremity originating on the thorax, specially pectoral muscles and anterior thoracic spinal soft tissue structures and abdominal muscles) to be in a shortened position and eventually become tight. This faulty position puts the phasic muscles (neck extensor muscles, scapular retractors, and thoracic erector spinal muscles) in lengthened position, which eventually tend to become weak. It has been reported that in this position, forward inclination of the head, round shoulder, and increased thoracic spinal curve may be attributed to decrease flexibility and strength imbalance. This may be referred to two main causes:

1. Lack of physical activities that encourage development of these muscles.
2. Bad postural habits with shoulder protraction and forward learning oh the head and spine for a prolonged period of time, with lack of normal postural awareness. So, the wrong postural feels habitually natural and the correct position seems strange[14].

Combining heating while applying traction, in the study group (B), showed highly significant improvement in the kyphotic curve, when comparing its pre and post treatment mean values of the measuring variables and also with the post treatment results of the control group (A).

Improvement that occurred in group B may be attributed to the effect of heating and stretching for commonly shorted postural muscles and movements that encouraged complete joint rang mobility and strengthened the antigravity extensor muscles of the trunk. Donatelli and Wooden[15] demonstrated that the muscle tissues are very adaptable. In particular sarcomere number, fiber length and sarcomere lengths have been shower to adjust to functional length of the whole muscle.

In the current study the traction force was given in a transverse form in an attempt to correct the kyphotic deformity which gave a chance for effective force. This agree with white and Panjabi[16] who analyzed the efficacy of different forces in correcting spinal deformities. They reported that the transverse axial traction achieved the best results.

Low traction magnitude of 3 kg was used at first and increased gradually by 1/5 kg per session until it reached 5 kg. The magnitude of the traction did not increased beyond 5 kg as the girls of the study complained of pain and numbness. The traction time started from 15 minutes and increased gradually to 30 minutes (5minutes/week).

This agree with Kumar and Faanos[17] who reported that traction was used to correct spinal deformity they reported that, the weight of traction should be increased gradually and each session lasts from about 15 to 30 minutes.

Horsely el al[18] studies a case with cervical kyphosis of neurofibromatosis; they found that after 6 days of traction, with progression increments up to 7 kg. the kyphosis had improved.

The obtained results confirm the findings of Taylor et al[19] who found evidence that static passive stretching caused a prolonged muscle tendon unit elongation. They attributed their findings that muscle tissue is viscous elastic in natural, thus being able to increase in length when exposed to external loads as passive stretching.

It has also been reported that the muscle tendons change their behavior when they are exposed to temperature between 41C and 45 C, from being predominantly elastic to predominantly viscous[20].

Lehman and De Lateur[21] reported that superficial heating with other modalities including traction to induce stretching can increase extensibility of collagen tissues, decrease joint stiffness and reduce muscle spasm. Also, static traction results in a sustained muscle tendon unit elongation, due to the viso-elastic properties of the muscle.

The work of Michlowiz[10] supports the view that heat combined with sustained passive stretching are more efficient than stretching alone. He reported that hamstrings stretching after superficial heating increased hip flexion range of motion than passive stretching alone.

Erdman et al,[22] established that the extensibility of collagen tissues increases with increased temperature. Greater extensibility of the collagen tissues offered by the increased temperature allowed it to yield to the external force generated by traction.

Significant improvement observed in group B receiving heating in conjunction with traction in addition to the exercise therapy program may be attributed to the effect of:

1- Heating which have a direct effect on the soft tissue receptors and cutaneous nerve ending. It also has an effect in reducing muscle spasm, which is a result of concomitant inhibition of efferent motoneurons.
2- The transverse traction which pulled the upper part of the kyphotic curve of thoracic spine posteriorly, causing maintained stretch of the pectoral muscles, resulting in realignment of the upper part of the spine. The body weight gave stability for the trunk, specially the lumber region, which is also supported by the belt fitted around both thighs. The sustained stretching produced by the traction force involves maintaining a position of maximum length of the muscles and connecting tissues with a low load stretch leads to inhibition or dampening of muscle responses. This stimulus is thought to activate Golgi tendon organs and joint receptors, resulting in autogenic inhibition of the stretched muscles. The spindle secondary endings also may be activated as they are more sensitive to absolute length changes.
3- The designed exercise program which included:
   a- Stretching exercises to the different postural muscles liable to be tight and indirectly has an effect of the kyphotic deformity.
   b- Strengthening exercises for the spinal muscles that give natural stability and maintenance of coned spinal alignment, preventing progression of deformities.

Conclusion

The results of this study strongly support the use of heating in conjunction with traction, than traction alone, for connection of the kyphotic deformity in adolescent girls.

REFERENCES

1- Katherine, T.R.: Clinical pediatric physical therapy, A guide for the Physical Therapy Team. St. Louis, Baltimore, 141-147, 1998.
2- Richard, L., Hubert, L., Fracis, F. and Benoit, P.: Morphologic discrimination among healthy subjects and patients with progressive and non-progressive adolescent idiopathic scoliosis. Spine, 23(10): 1109-1116, 1998.
3- Grame, M. and Hasan: The spinal curve in standing and sitting postures in children with idiopathic scoliosis. 24(2): 169-177, 1999.
4- Nissinen, M.: Anthropometric measurements and the incidence of low back pain in a cohort of pubertal children. Spine. 19(12): 1367-1370, 1994.
5- John, A.O.: Spinal deformities the benefits of early screening and treatment. http:

/www.Coolware.Com /health medical-reported scoliosis html. 2001.

6- Rudolph, F.T.: Spinal deforming: Scoliosis and kyphosis. A handbook for patients. http: / www. Spinal doctor.Com./ scoli. html. 2001.

7- Satyajit, B. and Vinod, V.: Kyphosis correction using the egg shelling procedure. http: // www.aaos. Org / ward html/ anmt 2001/ sciprog/082. html.

8- Lucile Pacharel Children's: Stanford University Medical Center- kyphosis. http//www. Packard Children's hospital. org/health/ orthopedics/ kyphosis. htm. 2001.

9- Henricson, A.S., Fredriksson, K., Pereira, R., Rostedt, Y. and Westtin, N.E.: The effect of heat and stretching on the rang of hip motion, J. Of orthop. and Sports Physical Therapy, 6(2): 110-115, 1994.

10- Michlowitz, S.L.: Biophysical principles of heat and superficial heat agents, In: Thermal Agents in Rehabilitation, F.A. Davis: 99-18, 1986.

11- Alter, M.J.: Science of Flexibility. USA 2nd, 5-7, 2002.

12- Oheneba, B. and Baron, L.: Spinal deformity, Pediatric Clinics of North America, 43(4): 883-897, 1996.

13- Gross, J., Fetto, J. and Rosen, E.: Musculoskeletal Examination. Posture and Gait. Over view of the Spine and Pelvis. Blackwell science. Forest Hills. New York, 1996.

14- Stephan, J., Deed, H. and Donald, D.: Structural rehabilitation of the spine and posture: Rationale for treatment beyond the resolution of symptoms. J. of Manipulative and Physiological Therapeutics, 21(1): 1998.

15- Donatelli, R. and Wooden, M.: Orthopedic Physical Therapy., 1st ed., Churchill Livingston, New York, 113, 1989.

16- White, A.A. and Panjabi, M.M.: Practical Biomechanics of Scoliosis and kyphosis. In: White A.A., Panjabi M.M. eds, Clinical Biomechanics of the spine. 2nd ed., J. B. Lippincott Co., Philadelphia, 138-143, 1990.

17- Kumar, K. and Faanos, P.: Historical perspective spinal deformity and axial traction. Spine, 21(5): 653-655, 1996.

18- Horsely, M., Taylor, T. and Sorby, W.: Traction-induced rupture of an extracranial vertebral artery aneurysm associated with neurofibromatosis. Spine., 22(2): 225-227, 1997.

19- Taylor, D.C., Dalton, J.D., Seaber, A.V. and Garrett, E.J.: Visco-elastic properties of muscle tendon units the biomechanical effects of stretching, Am, J. of Sports Med., 18(3): 300-309, 1990.

20- Halvorsen, G.A.: Therapeutic heat and cold for athletic injuries. J. Physician and Sport Medicine, 18(5): 87-92, 1990.

21- Lehmann, J.F. and De Lateur, J.B.: Therapeutic heat and cold, 4th ed. Williams and Wilkins, Baltimore. 149-153, 1999.

22- Erdman, F., Salcido, R. and Musick, D.: Erdman therapy: A treatment utilizing hot and cold therapy. Am. J. Phys. Med. Rehabilitation. (82): 972-978, 2003.

الملخص العربى

الدلالة الإحصائية للتسخين مع الشد للتحدب في الفتيات البالغات

أجريتْ الدراسة الحالية لتَقْرير تأثيرِ التسخين مع الشد، بالأضافة إلى برنامجَ علاج طبيعي مصمّمَ ،وذلك للسَيْطَرَة على التحدب في الفتيات البالغات. **عينة البحث:** ثلاثون فتاة من المصابات بالتحدب تَرَاوُحت أعُمارهم مِنْ ثلاثة عشر إلى خمسة عشر سَنَواتِ يُمثّلُون عيّنةَ هذه الدراسةِ. وقد إختاروا مِنْ العيادة الخارجيةِ مِنْ كليّةِ العلاجِ الطبيعي، جامعة القَاهرة. وتَراوحتْ درجة التحدب مِنْ خمسة وخمسون الي خمسة وستون طبقاً لمِقياس درجة كوب . وقُسّموا الأطفال بشكلَ عشوائي إلى مجموعتان إثنان مِنْ مجموعاتِ العددِ المساوي : المجموعة الضابطة (أ) ومجموعة الدراسة(ب). **طريقة البحث:** تم تقييم درجة كوب لكُلّ طفلة بالمجموعتين، قَبلَ وَبَعد ستة شهورِ مِنْ المعالجةِ. تلقت المجموعة (أ) برنامج علاج طبيعي مصمّم خصيصاً، بينم تلقت المجموعة (ب) العلاج بالتسخين مع الشد ، بالأضافة إلَى برنامجَ العلاج الطبيعي الذي أعطىَ للمجموعة الأولي. **النَتائِج:** كَشفتْ النَتائِج انه لا إختلافاتَ ذات دلالة احصائية هامّةً عندما تُقارنُ قِيَم المتوسط الحسابيَ قَبْلَ المعالجة مِنْ المجموعتين. اما التحسن الهامّ فقد لوحظَ في كُلّ متغيّراتِ قياس المجموعتين (أ) و(ب)، عندما تُقارنان قِيَمَهم قَبْلَ وما بَعْدَ المعالجةَ. ولوحظَ التحسن الهامّ أيضاً عند مُقارنُة نَتائِجَ ما بَعْدَ المعالجةَ مِنْ المجموعتين لمصلحة مجموعة الدراسة. **المُنَاقشَة:** التحسن الملحوظ الذي حدث في المجموعة(ب) بدرجة كوب قَدْ يُنْسَبان إلى التأثيراتِ المشتركةِ للعلاج بالتسخين مع الشد ، بالأضافة إلى برنامجَ العلاج الطبيعي المُصَمَّم، في السَيْطَرَة على التحدب في الفتيات البالغاتَ.

الكلمات الدليلية: التحدب في الفتيات ، العلاج بالتسخين، شد الفقرات.