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Thoracic Traction Can Be Achieved Using "Combined Lumbar Traction with Cervical Traction" Method - as One Intervention

La tracción torácica se puede lograr utilizando el método de "tracción lumbar combinada con tracción cervical", como una sola intervención

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Abstract. Background: Scientific literature is completely devoid of full and clear morphological description of changes in Thoracic Vertebrae (TV) under the effect of full Thoracic Traction (TT), because of the absence of any direct method that can achieve full TT as it exists in Lumbar vertebrae (LV) and Cervical vertebrae (CV). Therefore, it is necessary to create a method that can achieve full TT in order to obtain a clear scientific morphological description of changes in Intervertebral Spaces (IS) at TV: anterior, posterior and central heights, and also anterior/ posterior ratio (A/p) ratio. Objective: to identify the immediate morphological effect of "Combined Lumbar Traction with Cervical Traction" method -as one intervention (CLTCT) on anterior thoracic IS among thirteen thoracic neurological levels: C7-T1, T1-T2, T2-T3, T3-T4, T4-T5, T5-T6, T6-T7, T7-T8, T8-T9, T9-T10, T10-T11, T11-T12, T12-L1,using X-ray images.Methodology:Ten healthy male volunteers randomly were chosen (mean age=23 ±2.63) had lied down on the X-ray machine board from supine position, legs and hands were extended; then after two minutes relaxing; the first anterior view recording was done- as pre measurement, then they conducted CLTCT Method: [Mechanical Sustained Cervical Traction (MSCT) via the medical nonmetallic portable cervical traction devise (Ospine–NTD-500) from Supine position, then immediately a Positional Sustained Lumbar Traction (PSLT) Hip Flexion (HF)] was applied, then the hip was manually extra pulled and rotated as Manual Lumbar Over Traction (MLOT), after holding this position for ten continues minutes; the second anterior view record was done as post measurement. Pre and post measurements were compared and analyzed using the SPSS system. Results indicated that there were statistically significant differences between the pre and post measurements in favor of the post measurements in terms of all the anterior thoracic IS. Conclusion: CLTCT method can significantly achieve full TT, and achieves Whole Spinal Decompression Therapy (WSDT). Recommendations: to publish CLTCT method for performing thoracic traction, and to conduct further similar researches to detect, describe and measure other potential morphological changes in thoracic IS using other available radiologic diagnostic equipment to obtain full description of IS using MRI or CT-scanning machine.
Keywords: Combined Lumbar Traction with Cervical Traction Method, Thoracic Traction, Intervertebral Spaces.

Resumen. Antecedentes: La literatura científica carece por completo de una descripción morfológica completa y clara de los cambios en las vértebras torácicas (TV) bajo el efecto de la tracción torácica completa (TT), debido a la ausencia de cualquier método directo que pueda lograr la tracción torácica completa como existe en Vértebras lumbares (LV) y vértebras cervicales (CV). Por lo tanto, es necesario crear un método que pueda lograr la tracción torácica completa para obtener una descripción morfológica científica clara de los cambios en los espacios intervertebrales (IS) en las vértebras torácicas: alturas anterior, posterior y central, y también la relación anterior/posterior (relación A/p).Objetivo: identificar el efecto morfológico inmediato del método "Tracción Lumbar Combinada con Tracción Cervical" -como una sola intervención (CLTCT) en los Espacios Intervertebrales torácicos anteriores entre trece niveles neurológicos torácicos: C7-T1, T1-T2, T2-T3, T3- T4, T4-T5, T5-T6, T6-T7, T7-T8, T8-T9, T9-T10, T10-T11, T11-T12, T12-L1, utilizando imágenes de rayos X.Metodología: Se eligieron al azar diez voluntarios varones sanos (edad media = 23 ± 2,63) que se habían acostado sobre el tablero de la máquina de rayos X en posición supina, con las piernas y las manos extendidas; luego, después de dos minutos de relajación; se realizó el primer registro de la vista anterior, como medición previa, luego realizaron el método combinado de tracción lumbar con tracción cervical: [tracción cervical sostenida mecánica (MSCT) a través del dispositivo médico de tracción cervical portátil no metálico (Ospine-NTD-500) desde la posición supina, luego, inmediatamente se aplicó una flexión de cadera (HF) con tracción lumbar posicional sostenida (PSLT), luego se extrajo y giró manualmente la cadera como sobretracción lumbar manual (MLOT), después de mantener esta posición durante diez minutos continuos; el segundo registro de vista anterior se realizó como medición posterior. Las mediciones previas y posteriores se compararon y analizaron utilizando el sistema SPSS. Los resultados indicaron que hubo diferencias estadísticamente significativas entre las mediciones previas y posteriores a favor de las mediciones posteriores en términos de todos los IS torácicos anteriores. Conclusión: El método CLTCT puede lograr significativamente un TT completo y logra la Terapia de Descompresión Espinal Completa (WSDT). Recomendaciones: publicar el método CLTCT para realizar tracción torácica y realizar más investigaciones similares para detectar, describir y medir otros cambios morfológicos potenciales en el IS torácico utilizando otros equipos de diagnóstico radiológico disponibles para obtener una descripción completa del IS utilizando una máquina de resonancia magnética o tomografía computarizada**.**
Palabras clave: Método Combinado de Tracción Lumbar con Tracción Cervical, Tracción Torácica, Espacios Intervertebrales.

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Introduction

The combination of traction therapy with other modalities of physiotherapy and therapeutic exercise is widely used in spinal disorders rehabilitation, such as in Lumbar Disc Herniation (LDH) and Cervical Disc Herniation (CDH) (Al-Jazzazi &Al-Qudah 2021; Gaowgzeh et al., 2020). Traction therapy has a mechanical nature; it vertically increases the spaces between two or more successive vertebrae, so it can reduce spinal nerve root compression, inhibit nociceptive impulses, reduce specific intradiscal pressure and restore disc heights allowing nutrients and

oxygen supply to the specific disc (Macario et al., 2008). Therefore, the efficacy of Lumbar Traction (LT) and Cervical Traction (CT) has been clinically established due to its positive correlation ship with other specific vertebral components (Colombo et al., 2020; Romeo et al., 2018).

Traction therapy has many classifications, it can be classified by modality into mechanical and non-mechanical traction, where mechanical traction can be performed in three modes using specific devices: continuous, sustained and intermittent, and non-mechanicaltraction can be performed manually, by position and by gravity (Colombo et al., 2020). All types can be applied in hospitals, clinics and Rehabilitation centers depending on stage, duration, complication, disability, and pain severity of the case.

Specifically, scientific studies clearly describe the morphological effects of LT or CT on specific spinal vertebrae, such as IS measurement: anterior, posterior, central heights and (A/p) ratio, and also intradiscal pressure and herniation index reduction in disc herniation cases (Yoon et al., 2021; Lee et al., 2021; Chow et al., 2017; Gudavalli et al., 2013; Chung et al., 2009; Rodacki et al., 2007; Sari et al., 2003; Wong, Leong & Chen, 1992). Literature show that LT increase lumbar IS, where the most effect of TT can be detected between the lower LV, and the less effect can be detected between the upper LV (Gaowgzeh et al., 2020; Chow et al., 2017; Apfel et al., 2010; Saunders, 1979) but LT remains ineffective to TV and CV. Also, CT increases cervical IS, where the most effect of CT can be detected between the lower CV, and the less effect can be detected between the upper CV (Chung et al., 2009; Gudavalli et al., 2013; Sari et al., 2003; Sharrak & Al Khalili 2020; Wong, Leong & Chen, 1992) but also CT remains ineffective to TV and LV too. As for TV, it lacks such full scientific morphological description under the effect of full TT as it exists in LV and CV. Despite the existence of different methods of partial TT in clinical recommendations, partial description remains completely unsatisfying and unclear. Therefore, it is necessary to obtain a clear scientific morphological description of the thoracic IS: anterior, posterior and central heights, and also (A/p) ratiounder the effect of full TT, as it exists in LV and CV.

Through all spinal disorders, IS seems to be an important measurement, which may reflect and describe the current situation of vertebral body structure, foramina, deep muscles, ligaments, intervertebral discs and others, where the decrease in IS reflects bad spinal conditions.

Scientific literature had fairly described lumbar IS and had covered its clinical importance. **Lee**, Heo & Park (2021) had evaluated real-time biomechanical changes while applying Lordotic curve-controlled Traction (LCCT) and standard Spinal Traction (ST) in forty subjects with mild non-radicular Low Back Pain (LBP) using X-ray device. They found that intervertebral distances (as IS) were greater during LCCT than those measured prior to applying traction ($p < 0.05$). **Yoon** et al. (2021) had investigated the mechanical changes of lumbar IS, through vertical traction treatment using spinal massage device in ten healthy participants, where they conclude that the posterior-to- anterior vertical traction on L3-L4 and L4-L5 sections using a spinal massage device caused positive and significant changes based on the increasing of the IS heights. **Chow**, Yuen, Xiao & Leung (2017) had provided the evidence of the mechanism of LT on lumbar intervertebral discs (as Lumbar IS) in nine healthy subjects (mean age $=22.1 \pm 0.8$ years) using MRI from laying position under the force of 42% of body weight LT. They found that there was a significant increase in the average disc heights (IS) in all lumbar vertebrae and a significant increase in the average disc height (as IS) was observed only in lower lumbar discs after 30 minutes of traction. **Rodacki** et al. (2007) had analyzed the relationship between load magnitude and time during LT in relation to stature variations in fifteen healthy males (23.1 ± 5.77 years; 1.80 ± 0.17 m and 87.0 ± 9.6 kg). Subjects were assessed under three LT conditions for 42 minutes (0, 30 and 60% of body weight). Stature variation was used to determine intervertebral disc heights (as IS) variation. They found that there were significant differences ($p<0.05$) between 60% of bodyweight and other conditions only after 21 minutes, suggesting that LT under 60% of bodyweight force can significantly increase lumbar IS.

Also, scientific literature had fairly described cervical IS and had covered its clinical importance. **Sari**, Akarirmak, Karacan & Akman (2009) had evaluated the biomechanical efficacy of CT on spinal structures in thirteen patients with acute CDH at C5-C6 level after 20 minutes from supine position in CT scan board. The results detected a regression of herniated disc area, increase in spinal canal area (11.21mm²), spinal column elongation between C2 and C7 (1.39 mm) and intervertebral discal spaces widening as (IS) at the C5-C6 level. So they conclude that CT has a significant biomechanical effect on spinal structures. **Chung** et al. (2009) had quantitatively compared the intervertebral disc spaces (as IS) between axial and anterior lean cervical traction in sitting position through 96 radiographic images. Researchers demonstrate that anterior lean traction in sitting position provides more intervertebral disc spaces (IS) enlargements in both anterior and posterior aspects than the axial traction did. **Wong**, Leong &Chen (1992) had evaluated the cervical intervertebral separation (as IS) under different traction angles through motorized intermittent traction in supine position in seventeen healthy young adults. In all cases, the anterior and posterior intervertebral spaces were increased by traction at neutral position and in 30 degrees flexion, but not in 15 degrees extension. The effects of separation were 1) neutral position: anterior intervertebral separation C4-5 (12%) greater than C3-4 (8%), posterior intervertebral separation C6-7 (37%) greater than C3-4 (22%) greater than C4-5 (19%); and 2) 30 degrees flexion: anterior intervertebral separation C2-3 (21%) greater than C4-5 (16%) greater than C5-6 (15%) greater than C3-4 (10%), posterior intervertebral separation C6-7 (20%)

greater than C5-6 (19%) greater than C4-5 (17%). There was a significant decrease in intervertebral separation posteriorly in extension traction, especially at C6-7 (-50%), C5-6 (-37%), C4-5 (-26%), and C3-4 (-14%).

Unfortunately, scientific literature is poor in describing thoracic IS. The available studies that indirectly hit the title of thoracic IS; were newly published during 2021. Early in 2021, Al-Qudah M.K. suggested a new method called Combined Lumbar Traction with Cervical traction (CLTCT) where LT and CT can be applied together as one intervention. CLTCT is safe, easy, cheap, effective and direct method. **Al-Qudah &Al-Jazzazi** (2021) used CLTCT method with other therapeutic modalities in male athletes with L4-L5 and L5-S1 mild bulging disc. They found that CLTCT has a positive effect on patients with lumbar mild bulging disc in term of trunk range of motion, pain and daily activities. **Al-Qudah** (2021) has also used CLTCT method in twelve outdoor male patients with chronic disc herniation at L4-L5 and L5-S1 levels. He found that CLTCT method has significant positive effect in term of pain and disability too. **Al-Jazzazi & Al-Qudah** (2021) had applied CLTCT method in patients with Cervical Radiculopathy Syndrome (CRS), where they found that CLTCT method has significant positive effect in term of pain and disability. They reported that the use of CLTCT as one intervention might have an immediate morphological positive effect on all thoracic IS due to its dual effect. They recommend to use radiologic diagnostic equipment such as X-ray, MRI or CT-scan to detect and describe any potential morphological changes among the thoracic IS during the use of CLTCT method. It seems that the title of thoracic IS will be an important topic soon.

In fact, there is little partial biomechanical information about TV, including limited thoracic range of motion. The anatomical design of the thorax (vertebral bodies, ribs, clavicle and manubrium sternum) provides support and structural protection to vital internal organs (Heneghan & Rushton, 2016), so that it can offer little mobility in the sagittal (flexion 32.00-degrees, extension 25.80-degrees) and frontal planes (lateral flexion 26.50-degrees) (Willems, Jull &Ng, 1996). The largest range of movement is that of axial rotation with a mean (SD) total range (full right and left rotation) of 85.15 ±14.8 degrees (Heneghan et al., 2009). Being the longest and most anatomically complexspinal region has likely hampered the development of measurement tools to assess thoracic movement (Heneghan et al., 2009), therefore it considered as the most unknown region, so it was called by the Cinderella Region (Heneghan & Rushton, 2016).

The researchers believe that this justified ignorance of Thoracic Region (TR) is due to the absence of any suitable device that can fit TR, furthermore the absence of direct methods that can achieve the full TT as it exists in LV and CV. From other side, clinical recommendations mentioned that it is possible to implement partial TT at the upper TR, such as in Fireman Traction Technique. Furthermore, it is possible to achieve partial TT separately: unilaterally or anteriorly or posteriorly in all spinal regions. The thoracic morphological changes that occurs in positional traction can be considered as partial changes, but it does not include the entire TR; for example: in full cobra exercise (McKenzie): the anterior heights of the LV, TV and CVwill be increased, while the posterior heights will be decreased. In full hip flexion position: the posterior heights of the LV, TV and CVwill be increased, while the anterior heights will be decreased. Also in full left lateral bending position: the rightlateral heights of the LV, TV and CVwill be increased, while the left lateral heights will be decreased (Al-Qudah &Bani Hani, 2013; Owies &Mujalli, 2018). As for TV, full TT is not existing theoretically neither clinically, and there isn't any device or a method that can achieve it. In the current study; researchers noticed that all participants undergoing CLTCT can clearly describe a significant longitudinal stretching in the posterior parts of the whole spinal column including Cervical Region (CR), TR and even Lumbar Region (LR).Therefore; it is extremely important to find a method that can achieve TT to detect and describe the potential morphological effects of CLTCT on the anterior thoracic IS at present time using X-ray images; or further other available radiologic diagnostic equipment such as MRI and CT-scan in the close future to detect other potential morphological changes including posterior, central heights and (A/p) ratio.

The aim of this work is to identify the immediate morphological effect of the use of CLTCT method -as one intervention- on the anterior thoracic IS amongthe thirteen thoracic neurological levels: C7-T1, T1-T2, T2-T3, T3-T4, T4-T5, T5-T6, T6-T7, T7-T8, T8-T9, T9-T10, T10-T11, T11-T12, T12-L1, using X-ray images in order to detect whether CLTCT method achieves the validity specifications for full TT or not.

Methodology

Participants

Ten healthy male volunteers were randomly chosen and agreed to participate this study (mean age=23.6 ±2.6). Subjects who present with any form of musculoskeletal disorders, postural deformities, history of fractures, previous back or neck surgeries, history of malignancy or prolonged use of medications or had been recorded by X-ray in the last six months were excluded from the study. All subjects singed a written informed consent form prior to their participation in the study in Karak governmental hospital. The study was approved by the ethical committee of Ministry of Health and Health Care, Amman, The Hashemite Kingdom of Jordan.

Table. 1
Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
Age	10	20.0	29.0	23.6	2.6	.498	.687	1.112	1.334
Weight	10	55.0	115.0	83.7	18.0	-.125	.687	-.181	1.334
Height	10	163.0	180.0	173.4	5.1	-.755	.687	.520	1.334
Valid N (listwise)	10								

Table 2.
A Wilcoxon signed-rank test

Variable	Test	Median		N	Mean Rank	Sum of Ranks	Z	Sig	R
C7-T1	Pre	.00	Negative Ranks	0	.00	.00	-2.388[b]	*.017	0.53
	Post	.50	Positive Ranks	7	4.00	28.00			
			Ties	3					
			Total	10					
T1-T2	Pre	.00	Negative Ranks	0	.00	.00	-2.214[b]	*.027	0.50
	Post	.25	Positive Ranks	6	3.50	21.00			
			Ties	4					
			Total	10					
T2-T3	Pre	.00	Negative Ranks	0	.00	.00	-2.388[b]	*.017	0.53
	Post	.63	Positive Ranks	7	4.00	28.00			
			Ties	3					
			Total	10					
T3-T4	Pre	.00	Negative Ranks	0	.00	.00	-2.716[b]	*.007	0.61
	Post	1.00	Positive Ranks	9	5.00	45.00			
			Ties	1					
			Total	10					
T4-T5	Pre	.00	Negative Ranks	0	.00	.00	-2.692[b]	*.007	0.60
	Post	1.00	Positive Ranks	9	5.00	45.00			
			Ties	1					
			Total	10					
T5-T6	Pre	.00	Negative Ranks	0	.00	.00	-2.677[b]	*.007	0.60
	Post	1.00	Positive Ranks	9	5.00	45.00			
			Ties	1					
			Total	10					
T6-T7	Pre	.00	Negative Ranks	0	.00	.00	-2.692[b]	*.007	0.60
	Post	.50	Positive Ranks	9	5.00	45.00			
			Ties	1					
			Total	10					
T7-T8	Pre	.00	Negative Ranks	0	.00	.00	-2.552[b]	*.011	0.57
	Post	.25	Positive Ranks	8	4.50	36.00			
			Ties	2					
			Total	10					
T8*T9	Pre	.00	Negative Ranks	0	.00	.00	-2.530[b]	*.011	0.57
	Post	1.13	Positive Ranks	8	4.50	36.00			
			Ties	2					
			Total	10					
T9-T10	Pre	.00	Negative Ranks	0	.00	.00	-2.692[b]	*.007	0.60
	Post	1.25	Positive Ranks	9	5.00	45.00			
			Ties	1					
			Total	10					
T10-T11	Pre	.00	Negative Ranks	0	.00	.00	-2.687[b]	*.007	0.60
	Post	1.13	Positive Ranks	9	5.00	45.00			
			Ties	1					
			Total	10					
T11-T12	Pre	.00	Negative Ranks	0	.00	.00	-2.687[b]	*.007	0.60
	Post	1.13	Positive Ranks	9	5.00	45.00			
			Ties	1					
			Total	10					
T12-L1	Pre	.00	Negative Ranks	0	.00	.00	-2.680[b]	*.007	0.60
	Post	1.00	Positive Ranks	9	5.00	45.00			
			Ties	1					
			Total	10					

×b. Based on negative ranks. Statistical significance atp < 0.05

Experimental design

This is a single blind descriptive study in one group design, per and post data were collected and compared.

Data Collection Form

Researchers designed a special form which was filled out by two spine surgery consultants and one musculoskeletal radiology consultant through X-ray images, they described all anterior thoracic intervertebral heights in three degrees: where Absent degree (0) describes no thoracic intervertebral changes, Mild degree (1) describes minimal thoracic intervertebral changes and Significant degree (2) describes significant thoracic intervertebral changes. The form detects and describes the anterior thoracic IS among thirteen neurological levels: C7-T1, T1-T2, T2-T3, T3-T4, T4-T5, T5-T6, T6-T7, T7-T8, T8-T9, T9-T10, T10-T11, T11-T12, T12-L1.

Variables

Independent variables

1- Laying down position from supine position.

2- Supine position; during the application of full protocol of CLTCT.

Dependent variables

Anterior thoracic IS among the neurological levels: C7-T1, T1-T2, T2-T3, T3-T4, T4-T5, T5-T6, T6-T7, T7-T8, T8-T9, T9-T10, T10-T11, T11-T12, T12-L1.

Measurements

All subjects were recorded by X-ray machine two times from two deferent positions: pre measurements were done during the first position and post measurements were done during the second position.

Pre measurements

All subjects had lied down on the X-ray machine board from supine position, legs and hands were extended; then after two minutes relaxing; the first anterior view recording was done, as a pre measurement.

Post measurements

After the first recording was done; immediately all subjects conducted CLTCT method: Mechanical Sustained Cervical Traction (MSCT) via the medical nonmetallic portable cervical traction devise (Ospine–NTD-500) from supine position, then immediately a Positional Sustained Lumbar Traction (PSLT) (HF)] was applied, then the hip was manually extra pulled and rotated (MLOT) technique, after holding this position for ten continues minutes; the second anterior view record was done as a post measurement. Cervical decompression force was manually controlled and raised gradually to reach pressure **22** (psi) in the monitor of the devise. Protocol of CLTCT method was described in Al-Qudah &AL- Jazzazi (2021).

Blinding

After getting the informed consent, subjects who fulfilled the inclusion and exclusion criteria were informed that the aim of the study was: Dose Cervical Traction

Affect Lumbar Traction When They Are Combined or Not; in order to distract them at the TR.

Results

Statistical Analysis

The data were analyzed using the Statistical Package for Social Sciences (v22.0, SPSS Inc., Chicago, IL, USA), significant values were set up at ($p< 0.05$)

Outcome measurements

A Wilcoxon signed-rank test was conducted to determine whether there was a significant difference between the pre and post measurement on anterior thoracic IS among the thirteen neurological levels: C7-T1, T1-T2, T2-T3, T3-T4, T4-T5, T5-T6, T6-T7, T7-T8, T8-T9, T9-T10, T10-T11, T11-T12, T12-L1, in ten healthy subjects.

The results of table No.2 indicates that there was a significant difference between the pre and post measurements in favor of the post measurements in terms of all anterior thoracic IS among neurological levels: C7-T1 (Z =-2.388, $p< .05$, r = 0.53), T1-T2 (Z =-2.214, $p< .05$, r = 0.50), T2-T3 (Z =-2.388, $p< .05$, r = 0.53), T3-T4 (Z =-2.716 , $p< .05$, r = 0.61), T4-T5 (Z =-2.692 , $p< .05$, r 0.60), T5-T6 (Z =-2.677, $p< .05$, r = 0.60), T6-T7 (Z =-2.692, $p< .05$, r = 0.60), T7-T8 (Z =-2.552, $p< .05$, r = 0.57), T8-T9 (Z =-2.530, $p< .05$, r = 0.57), T9-T10 (Z =-2.692, $p< .05$, r = 0.60), T10-T11 (Z =-2.687, $p< .05$, r = 0.60), T11-T12 (Z =-2.687, $p< .05$, r = 0.60), T12-L1 (Z =-2.680, $p< .05$, r = 0.60).

Discussion

The aim of this study was to identify the immediate morphological effect of CLTCT method -as one intervention on anterior thoracic IS among the thirteen specific thoracic neurological levels using X-ray images. In other words, the current posed question was whether CLTCT method achieves validity specifications for full TT or not, where it is obviously seen that this study appears to be a basic research without conflict.

In the current study, CLTCT method had increased all of the anterior thoracic IS significantly. Depending on effect size (r value); the power of CLTCT method was obviously seen in middle and lower parts of TV: T3-T4, T4-T5, T5-T6, T6-T7, T8-T9, T9-T10, T10-T11, T11-T12, T12-L1; (0.61, 0.60, 0.60, 0.60, 0.57, 0.57, 0.60, 0.60, 0.60, 0.60) respectively, where the largest effect was detected in T3-T4 level (0.0.61). Also CLTCT method had also increased the anterior thoracic IS significantly in C7-T1, T1-T2, T2-T3 levels (the upper parts of TV); but less than it was detected in the middle and lower parts of TV: (0.53, 0.50, 0.53) respectively, suggesting that CLTCT achieves the validity specifications for full TT.

Depending on the results; from an absolute biomechanical point of view, the researchers believe that the morphological changes that occurred in the TV have the same characteristics at the aspect of vertebral displacement under the power of traditional traction. Traditional LT increases the IS in the lower parts of LV more than IS in the upper parts (Gaowgzeh et al., 2020; Chow et al., 2017; Apfel et al., 2010), as well as did the MLOT technique, it had increased the IS in the lower and middle parts of TV more than IS in the upper parts. Heneghan et al. (2009) had confirmed that TV is the longest and most anatomically complex spinal region with limited range of motion, so that it may can explain the involvement of the middle part with the lower part in the TV during performing MLOT technique, so; researchers are wondering if center of gravity displacement can play role of this result or not; where HF position can displace center of gravity upward. Going back to the power of traction; the same is true for traditional CT; where it increases the IS in the lower parts of CV more than IS in the upper parts (Chung et al., 2009; Gudavalli et al., 2013; Sari et al.,2003; Sharrak &Al Khalili 2020; Wong et al., 1992), as well as did the MSCT technique, where it had increased the IS in the upper parts of TV more than the IS in the lower parts theoretically; but practically the MLOT technique had increased the IS in the lower parts of TV. Suggesting that CLTCT method affects all parts in the same manner, where it tracts spine upward and downward in the same time. So; it can stretch the whole vertebral longitudinal deep muscles due to its dual action; Suggesting that CLTCT method achieves whole spinal decompression therapy (WSDT) by achieving CT, LT and TT in one intervention, which it seems to be as a birth of a new standardized and effective method of traction therapy.

From anatomical and physiological point of view, the researchers noted that there was a variation in results between minimal value in T1-T2 level (r =0.50) and maximal value in T3-T4 level (r =0.61) in the sample (in healthy subjects). So; depending on the basic information of anatomy and physiology; the researchers believe that two of four main vertebral components may restrict or limit TT in some neural levels; and may cause this variation in results, whereas the vertebral bones and intervertebral disc components may notrestrict TT because they are constant in healthy subjects**,** while vertebral ligaments and muscles may significantly restrict or limit TT partially; even in healthy subjects. Suggesting that the following factors may play role in TT: vertebral muscles at the aspects of: longitudinal direction; origin; insertion; mass; elasticity and its current condition, as well as vertebral ligaments at the aspects of: mass; elasticity and its current condition. So; the researchers still wondering about the relationship between varied body types and thoracic IS.

While the previous studies didn't hit the title of thoracic IS; the results of the current study are indirectly in agreement with the results of Lee et al. (2021) and Yoon et al. (2021) in increasing lumbar IS under the effect of deferent positions and types of LT; as well as with Chow et al. (2017) and Rodacki et al. (2007) in significant in-

crease of lumbar IS under the effect of deferent intensities, durations and types of LT. Also; the results are in agreement with the results of Sari et al. (2009); Chung et al. (2009); Wong et al. (1992) in increasing cervical IS under effect of deferent positions, angles and types of CT.

From medical point of view, the current results appear to be very important, interesting and promising at many aspects. TT that was achieved by applying CLTCT method might be an effective procedure in nonspecific neck and LBP treatment. Reily, Gersten & Clinkingbeard (1979) found that pelvic-femoral position in 90 degrees have increased lumbar IS significantly at L4-L5 and L5-S1 levels. Suggesting that CLTCT method may significantly stretch the vertebral deep muscles in all spinal regions, so that may be beneficial for acute and chronic LBP which is considered as the most frequent, substantial suffering cause and responsible for worsening in both functional capacity and quality of life (Aparecida da Silva et al., 2024) in adults and even in school children (Hernández et al., 2019).

CLTCT method might be an effective procedure in Thoracic Disc Herniation (TDH) treatment in comparison with CDH and LDH treatment**. Choi**, Lee & Hwangbo (2015) reported that traction therapy vertically increase the distance between two or more successive vertebrae, creating negative pressure phenomena inside the disc capsule which increase water suction and minerals, and finally leads to a decrease in the edges of the herniated disc and a decline in the protruded part of the disc which had been pushed out to the rear of the intervertebral disc, to return inside; so it can significantly reduce spinal nerve root compression, inhibit nociceptive impulses, reduce specific intradiscal pressure and restore disc heights. Suggesting that CLTCT method might be an effective procedure in multi-level disc herniation –CDH and LDH- if combining CLTCT method to other modalities of physiotherapy and therapeutic exercise, where it is clearly seen that the results of the current study are indirectly in a agreement with the findings of Al-Qudah (2021) and Al-Qudah& Al-Jazzazi (2021) where they found that CLTCT method has positive significant effects in patients with chronic LDH and mild bulging disc in term of range of motion,pain, disability and daily activities. Also; the results are indirectly in agreement with the findings of Al-Jazzazi& Al-Qudah (2021) where they found that CLTCT method has positive significant effects in patients with CRS in term of pain and disability.

Also; the researchers believe that TT might be an effective procedure in the treatment of spinal deformities including postural and most types and degrees of structural scoliosis which can affect both adults and school-age adolescents (Dychko et al,2024). Sari et al (2009) found that CT have increased spinal canal area, spinal column elongation between C2 and C7 and also have widened intervertebral discal spaces as (IS). Suggesting that TT may also correct the lateral deviation of the spine and may de-rotate or decrease the abnormal axial rotation in TV. As well as TT that was achieved by applying CLTCT method also might be an effective procedure in Kyphosis treatment which can affect adults, adolescent and even young athletes in tennis players (Velez 2019) and paddlers (Angel &Alacid2010).

Finally, and from surgical point of view; the results of the current study may facilitate the process of spinal local injections and local anesthesia, also it may provide the field of surgery with a new patient-laying position during chest area surgeries, or it can modify all of the four surgical positions: modified lateral decubitus, Andrews frame, Wilson frame, and Jackson frame, by increasing thoracic IS to facilitate surgeon's tasks.

Conclusion

According to the results; where the anterior thoracic IS were increased significantly; researchers believe that:

1- CLTCT method as one intervention achieves the validity specifications for full TT, it appears to be the first scientific method that can achieve TT where it increases anterior thoracic IS.

2- Soon, the thoracic region will not be called Cinderella Region any more.

3- CLTCT method can be considered as Whole Spinal Decompression Therapy Method (WSDT); where it achieves LT, TT and CT in one intervention.

Limitations

Researchers attempted to include a large sample of healthy volunteers (n=60 at least), but Karak governmental hospital administration stipulated that this study be completed with only two months due to technical reasons, moreover; the robust inclusion and exclusion criteria has significantly limited the quantity of sample.

Recommendations

1- To publish CLTCT method for performing full thoracic traction.
2- To conduct further similar researches to detect, describe and measure other potential morphological changes in thoracic IS including posterior, central heights and (A/p) ratio using other available radiologic diagnostic equipment such as MRI and CT-scan.
3- To conduct further similar researches to compare thoracic IS changes under CLTCT effect among various body types.
4- To compare the effect of HF and MLOT technique on anterior lumbar IS changes.

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ANEXOS

Terminology List

Abbreviation	
(CT)	Cervical Traction
(TT)	Thoracic Traction
(LT)	Lumbar Traction
(CV)	Cervical Vertebrae
(TV)	Thoracic Vertebrae
(LV)	Lumbar Vertebrae
(CR)	Cervical Region
(TR)	Thoracic Region
(LR)	Lumbar Region
(CDH)	Cervical Disc Herniation
(TDH)	Thoracic Disc Herniation
(LDH)	Lumbar Disc Herniation
(CRS)	Cervical Radiculopathy Syndrome
(IS)	Intervertebral Spaces
(CLTCT)	Combined Lumbar Traction with Cervical Traction - as one Intervention
(MLT)	Mechanical Lumbar Traction
(MSCT)	Mechanical Sustained Cervical Traction
(PSLT)	Positional Sustained Lumbar Traction
(HF)	Hip Flexion
(A/p) ratio	anterior-to-posterior Ratio
MLOT	Manual Lumbar Over Traction

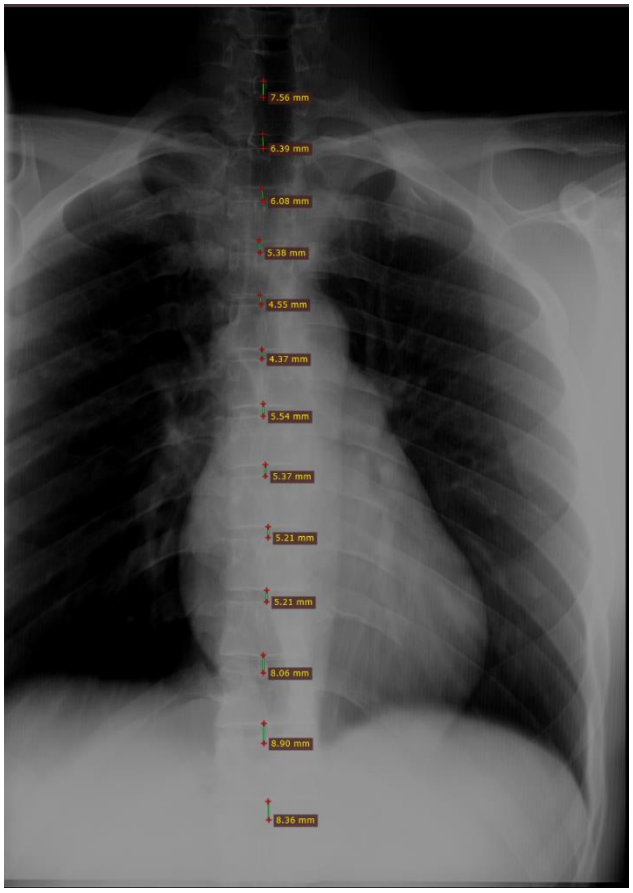
*Data Collection Form

Name: ################ 5

No	Level	Absent	Minimal	Significant
1	C7-T1		*	
2	T1-T2		*	
3	T2-T3		*	
4	T3-T4		*	
5	T4-T5		*	
6	T5-T6			*
7	T6-T7			*
8	T7-T8			*
9	T8-T9			*
10	T9-T10			*
11	T10-T11			*
12	T11-T12			*
13	T12-L1			*

*Designed by the researchers. Comments: AP views of the thoracolumbar spine radiographs pre and post traction reveals the following: In comparison with the pre traction images, the post traction images showed significant increase in the intervertebral space at T5-T6, T6-T7, T7-T8, T8-T9, T9-T10, T10-T11, T11-T12 and T12-L1 levels. Minimal alteration noted at C7-T1, T1-T2, T2-T3, T3-T4, and T4-T5 levels.

Pre traction images



Post traction images