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Effects of Manual Intervention and Self-Corrective Exercise Models of the General Coordinative Manipulation on Balance Restoration of Spine and Extremities Joints

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The purpose of this study was conducted in order to analyze the effects of the manual intervention and self-corrective exercise models of general coordinative manipulation(GCM) on the balance restoration of spine & extremities joints with distortions and mal-alignment areas.

The subjects were the members who visited GCM Musculoskeletal Prevent Exercise Center from March 1 2012 to December 31 2013 because of spine & extremities joints distortion and mal-alignments, poor posture, and body type correction. All subjects were diagnosed with the four types of the GBT diagnosis. And according to the standards of the mobility vs stability types of the upper & lower body, they were classified into Group 1(40 persons) and Group 2(24 persons). For every other day for three times a week, GCM intervention models were applied to all subjects for four weeks, adding up to 12 times in total. Then the balance restoration effects were re-evaluated with the same methods.

The results are as follows. 1) Balance restoration effects of VASdp(Visual analysis scale pain & discomfort) and ER(Equilibrium reaction: ER) came out higher in GCM body type(GBT) Ⅱ·Ⅲ·Ⅳ of Group 1. 2) In case of balance restoration effects in Moire and postural evaluation areas, Group 1 was higher and cervical and scapular girdle were higher in Group 2. The balance restoration of the four GBT types was significant in all regions($p<.05$), and the scapular girdle came out as high in the order of GBTⅡ·Ⅳ·Ⅰ. 3) In case of thoracic-lumbar scoliosis and head rotation·facial asymmetric·cervical scoliosis·ribcage forward, the balance restoration effects of the upper body postural evaluation areas came out the highest in Group 1 and Group 2, respectively. The balance restoration effects of the four GBT types were significant in all regions($p<.05$), and came out the highest in lumbar scoliosis GBTⅢ·Ⅰ, ribcage forward and thoracic scoliosis GBTⅡ·Ⅳ. 4) The balance restoration effects of the lower body postural evaluation areas came out higher in Group 1 and Group 2 for pelvis girdle deviation·patella high·umbilicus tilt and hallux valgus·foot longitudinal arch: FLA·patella direction, respectively. The balance restoration effects of the four GBT types were significant in all regions($p<.05$), and came out the highest in pelvis girdle deviation GBTⅢ·Ⅰ and patella high-direction GBTⅣ·Ⅱ·Ⅰ. 5) The balance restoration effects between the same GBT came out significant ($p<.05$) in all evaluation areas and items.

The conclusions of this study was the manual intervention and self-corrective exercise models of the GCM about the mal-alignment of the spine & extremities joints across the whole body indicated high balance restoration effects($p<.05$) in spine & extremities joints in all evaluation areas.

Key words: *Mal-alignment Areas; GCM; Manual Intervention; Self Management; Correction Exercise; Balance Restoration*

INTRODUCTION

Because of the high rate of absenteeism, difficulties in movement, and the increase in medical expenses, the low back pain that results from the imbalance of the spine & extremities joints has become one of the main health problems in modern industrial societies (1). Correspondingly, many treatments were suggested, but with the limited efficiencies(2). From the overemphasis on the structural diagnosis to the long period bed rests, drug abuse, overuse surgery, use of non-effective physical therapy units, and disregard of abnormality dysfunction, many bad side effects in lumbar areas are produced(3). In particular, repeated activities of daily living and poor posture can lead to the musculo-skeletal system diseases, and without having primary correction, it is hard to expect the full cure for the low back pain and musculo-skeletal diseases(4).

Thus Moon(5) started to design new physical therapy program for the primary treatment and management of the patients with musculo-skeletal systems diseases, including low back pain. The lesions of the musculo-skeletal systems patients, including those with the low back pain, was the pain in the injury area, as well as the imbalance across the whole body(6). In addition, the distribution patterns of this imbalance across the whole body led to the spinal subluxation in posture and walking as well as the mal-alignments in the extremities, indicating the recognition that it could appear as the hyper-hypo mobility chain patters of the joint range of motion(5, 6, 7). Therefore, the design of the new program focused on the understanding of the integrative force chain system across the whole body(5, 6), in a way that the diagnosis and evaluation were accurate, the treatments were simple, and the patients could easily self-manage. Also, in order to understand the force chain system across the whole body, increased movement of spine and upper and lower extremities joints and the hyper-hypo mobility chain patters were researched and analyzed(5, 6, 7). As a result, the human body, according to the four tilt types of scapular and ilium, the proper joint kinematic chain systems across the whole body were discovered. Also, the dysfunctional lesions of the neuro-musculo-skeletal system and its associated joints and soft tissues were analyzed to have correlation with GBT. Based on these results, the whole body intervention program was created, which is known nationally and internationally as General Coordinative Manipulation (GCM)(5, 6, 9, 10, 11). Also, GCM body type(GBT) is referred to as the four tilt types of scapular and ilium (5, 6, 9, 10, 12).

According to the static stand postural analysis, GBT I refers to the tilted style when the tilts of the left scapular and ilium is more to the front compared to that of the right side. Also it is mainly characterized by the left mobility and right stability movement patterns. GBT II, on the other hand, refers to the tilt style when the tilts of the right scapular and ilium is more to the front compared to that of the left side. The right mobility and left stability movement patters of the upper and lower body joints are the main characteristics in this style. For GBT III, the tilts of the left scapular and right ilium are tilted more to the front compared to the opposite side. The left mobility and right stability movement patterns of the upper body joints and the left stability and right mobility movement patterns of the lower body joints are the main characteristics. GBT IV refers to the tilt style when the tilts of the right scapular and left ilium are tilted more to the front compared to that of the opposition side. This is characterized by the left stability and right mobility movement patterns (6, 9, 13). The mobility patterns here mean the combined strength movement of adduction, flexion, and external rotation, which is the open pattern movements. The stability pattern is the combined strength movement of abduction, extension, and internal rotation, or the close pattern movement(12).

According to the dynamic gait analysis, GBT is the tilted style when the right scapular and ilium are tilted more to the front compared to that of the left side. The left mobility and right stability movement patterns of the upper-lower body joints are the main characteristics. GBT II means the tilted style where the left scapular and ilium are tilted more to the right compared to that of the right side. The right mobility and left stability movement patterns of the upper/lower body joints here are the main characteristics. GBT III is the tilted style where the right scapular and left ilium are tilted more to the front compared to that of the opposition side. It is characterized by the left mobility and left stability movement patters of the upper body joints and the left stability and right mobility patterns of the lower body joints. GBT IV refers to the tilted style where the tilts of the left scapular and right ilium are more to the front than that of the opposition side. It is characterized by the left stability and right mobility movement patterns of the upper body joints and the left mobility and right stability movement patters of the lower body joints(9, 13, 16).

The GCM, GBT diagnoses according to the relative

tilt type classifications of left and right scapular and ilium(5, 6, 9, 10, 11). Hyper-hypo mobility patterns of the spine and extremities and postural characteristics are distinguished by the indication and non-indication areas of treatment in accordance with the diagnosed GBT(6, 9, 10, 11). The joints distributed to the whole body, regardless of the presence of any pain, mal-alignments, distortion, and discomfort, once evaluated as the treatment indication area, are treated or intervened in terms of the lesion of the joint(9, 10). The treatment and intervention of GCM use muscle and joint chain mechanism theory across the whole body(6, 10, 11). Therefore, the effects of GCM are that the local injury areas are cured while distortions and mal-alignments of the spine & extremities joints of the whole body are corrected at the same time(5, 6, 9, 10). GCM finishes off with the treatment, acceleration of the intervention effects, and application of the recurrence preventive self-care program(9, 12, 14).

In the numerous past clinical studies on low back pain patients, it was proved that GCM remarkably contributes to the healing of the musculo-skeletal painful injuries and the balance restoration of the spine & extremities joints(8. 11, 12, 14). However, the direct intervention to the injury areas and non-direct intervention to the non-injury areas were mixed so that the degrees of the effects were difficult to distinguish and compare. Thus, further research on the corrective intervention effects is needed for restricted application about the distortions and mal-alignment areas diagnosed as indication areas for GCM intervention.

The current study is only a part of continuous study of GCM and was carried on as the upper & lower body mobility and stability types were classified. The study purpose is to analyze the balance restoration effects of GCM manual intervention on distortions of the spine & extremities joints of the whole body and the balance effects of the self-corrective exercise models on spine & extremities joints.

METHODS

Subjects

The subjects of this study were the members who visited GCM Musculoskeletal Prevent Exercise Center from March 1 2012 to December 31 2012 for distortions and mal-alignments of spine & extremities joints, poor posture, and body type correction. Members who are in disease condition or had received surgical treatment within 3 months were excluded from the subject group and those with musculo-skeletal system pain, who are being jointly treated with analgesic-antiinflammatory drug treatment without special medical problems were included.

The finally selected 64 subjects were then GBT diagnosed and then classified into Groups 1(upper body mobility and lower body stability types) and Group 2(upper body stability and lower body mobility types), for the classification of the mobility vs stability types of the upper & lower body, according to antagonistic approach aspects(9, 10). 12 subjects, 5 subjects, 18 subjects and 5 subjects were classified as GBT I Group, II Group, III Group, and IV Group of Group 1, respectively, and 6 subjects, 3 subjects, 11 subjects and 4 subjects were classified as GBT IGroup, II Group, III Group, and IV Group of Group 2, respectively.

Measurement Tool

VASdp(visual analysis scale pain & discomfort) score sheet

Each subject evaluated the pain or imbalance and discomfort degrees of musculo-skeletal systems related to the spine & extremities and scored(0~10 point) on VASdp Score Sheet, pre and post GCM intervention models application. According to the positive or negative grade gap in the VASdp evaluation results, the study effects were set-up for an analysis.

Equilibrium reaction(ER) test

As shown in Fig. 1, the subjects actively marched in place with their eyes closed in standing position for 30 seconds(measure equipment: second timer, Korea).

Fig. 1. Equilibrium reaction test

Then the displaced distance(measure equipment: 3 Meter Tape measure, Korea) in anterior or posterior direction and displaced rotate position (measure equipment: angle indicator, Korea) in left or right direction were assessed.

This ER Test was conducted in the same method for pre and post application of GCM intervention models. The effects of this study was set-up to be analyzed according to the positive or negative grade of the results of the ER Test.

Static postural evaluation test

In order to evaluate static posture, contour line topographic imaging system(CTIS: JTC-1C, Korea), Posture evaluation kit(PEK: Sammons Preston 5022A, USA), and digital camera(Canon S80, Japan) were used. CTIS is a Moire interferometry system, which uses stereophotogrammetry(15, 16, 17)(Fig. 2).

Fig. 2. Moire Test

Specific lighting is used for photograph shooting to show moire line, and three-dimensional information of the muscle imbalance is obtained(18). Hence, researchers used CTIS to record all subjects in standing postural evaluation position with trunks undressed in maximum. According to the positive or negative grade gap of spinal moire reactions indicated in scapular, pelvis girdles at pre and post application of GCM intervention models, the effects of this study were set-up to be analyzed.

PEK is wood human postural graph with plumb lines in 5cm interval in both horizontal and vertical directions. It is also an assistant equipment, which aids postural mal-alignment assessment of body anterior and posterior aspects(5). With the background of PEK, head rotation, facial asymmetric, ribcage forward, umbilicus deviation, hip and knee flex, patella direction, FLA high, Hallux valgus, and shoulder and elbow flex regions were anterior-photographed with digital camera.

Then head tilt, asymmetry of left·right scapular inferior, spinal scoliosis(cervical, thoracic, and lumbar), iliac crest high, and pelvis girdle deviation regions were posterior-photographed with digital camera. After that, Computer PicPick program (V3.2.5, Software, Korea) with graduated arc, ruler, and protractor assessment functions was used for compared analysis.

According to the positive or negative grade gap of asymmetric size appeared in pre and post GCM intervention models application, the effects of the study were set-up to be analyzed.

Procedures

This study was designed for non-equivalent control group pretest-posttest. The study progress procedure was as shown I Table 1, and the score table designed by Moon(8) was improved for the purposes of the study and used as the score scale for balance restoration effects analysis(Table 2).

Table 1. Study progress procedures

Subject selections and classification → Pre-Evaluation → application of each GCM intervention model to two groups (3 times/week x 4 weeks = 12 times) → Post-Evaluation → Data analysis and Analysis of balance restoration effects

Table 2. Designed score table(8)

0 point	- When there is no or minimal VASdp score Change - When displaced distance of ER anterior or posterior was improved to less than 20㎝, or the displaced rotate position was improved to less than 10˚(when aggravated to exactly 20cm or 10˚, 0 point) - When there is minimal or no balance restoration effects in each of the postural analysis regions

5 point	– When VASdp score is improved by 1~2(–5 point when aggravated 1~2) – When displaced distance of ER anterior or posterior was improved to 21~40㎝, or the displaced rotate position was improved to 11~30° (–5 point when aggravated to exactly 21cm and 11°) – When there is slight balance restoration effects in each of the postural analysis regions(–5 point when slightly aggravated)
10 point	– When VASdp score is improved by 3~4(–20 point when aggravated 3~4) – When displaced distance of ER anterior or posterior was improved to 41~60㎝, or the displaced rotate position was improved to 31~50° (–10 point when aggravated exactly at 41cm or 31°) – When there is moderate balance restoration effects in each of the postural analysis regions(–10 point when moderately aggravated)
15 point	– When VASdp score is improved by more than 5(–15 point when aggravated 5 or greater)point) – When displaced distance of ER anterior or posterior was improved to be greater than 61㎝, or the displaced rotate position was improved to be greater than 51° (–15 point when aggravated exactly to those points)

In case of inter–contradicting displacement distance and displaced rotate position of anterior or posterior, the size of flexor and extensor is superior to that of the rotator, so displacement distance of anterior or interior is evaluated.

GCM Intervention Models

GBT diagnostic methods(6, 9, 10, 12)

Firstly, one researcher palpated coracoid process and inferior angle landmarks of scapular and anterior and posterior superior iliac spine landmarks of ilium to each subject in static standing position. Then the relative left·right anterior tilt degrees of scapular and ilium are compared for GBT decision. Secondly, the same researcher ordered each subject to march in place. Then the relative left·right anterior tilt degrees of scapular and ilium are dynamically palpated for GBT decision. Thirdly, still the same researcher ordered each subject to walk 12m, round–trip, for nine times. Then the relative left·right anterior tilt degrees of scapular and ilium indicated in gait are compared for GBT decision. The final GBT diagnosis were confirmed by the results from using two or more of the above three methods.

Classification criteria of mobility vs stability types of upper & lower body(9, 14)

The classification of mobility vs stability types for upper & lower body was conducted through processes of postural evaluation, joint hyper–hypo mobility evaluation, and gait analysis. The cases dominated by forward head and round shoulder, kyphosis thoracic and upper extremities flexion movements were set as classification criteria for the upper body mobility type. For the lower body mobility type, the classification criteria were characterized by the domination of flat lumbar and posterior pelvis, hip and knee flex and ankle dorsiflexion movements. When the opposite patterns were objected, they were classified as upper & lower body stability types.

Manual intervention and self–corrective exercise models of GCM(9, 10)

Application of GCM intervention models refers the distortions and mal–alignment areas of spine & extremities joints for the whole body, or the indication intervention areas of GBT.

Design of manual intervention and self–corrective exercise models of GCM

GCM intervention models are composed of manual intervention and self–corrective exercise models, and are designed to find out about the corrective intervention effects. Group 1 and 2 are set–up to increase stability for upper body mobility joints and lower body mobility joints, respectively.

It is composed of manual stretch techniques for the shortened muscles of the upper & lower body, manual stability stimulation techniques for instable joints, and self–corrective exercise models that strengthen weak muscles.

Application methods of GCM manual intervention

First of all, for those 2~3 shortened muscles, manual stretch stimulate in accordance with 3S Stretch in the insertion direction. For four weeks of intervention periods, the manual stretch per grade was done with an interval of 30 seconds. The same was repeated for 3~5 times.

Secondly, those 2~3 instable joints were applied with manual stability stimulation techniques in stability increase direction. For 2~3 weeks of intervention periods, graded manual joint stability and rest were repeated 3~5 times in 30 seconds interval.

Application methods of GCM self-corrective exercise

Programmed GBT self-corrective exercise follows the application principle, which states graded application of the crawling exercise in the first week, the crawling exercise and stretch and strength exercises of pelvis and scapular girdle in the second week, exercises of first and second week and upper-lower extremities cross stretch exercises in the third and fourth weeks. For 30~50 interval, the time was extended progressively and then relaxed for the same duration. They were educated to perform the exercise 2~3 times per day.

Data Analysis

This study uses Window SPSS version 18.0(Chicago, IL, USA) program for the analysis of data. For the purpose of analyzing balance restoration effects in the two groups pre and post GCM intervention models application and analyzing four GBT balance restoration effects, the study used Mann-Whitney U Test and Wilcoxon Signed Rank Test, respectively. Then the balance restoration effects between the same GBT were analyzed by using Kruskal-Wallis Test. The statistical data level of significance α was set-up at 0.05.

RESULTS

Balance Restoration Effects of VASdp and ER

In Table 3, the range of VASdp balance restoration score for all GBT of the two groups came out to be 11.66±2.88~13.33±2.58 out of the perfect score of 15, in which Group 2 GBT I had the highest of 13.33 ±2.58 and the lowest of 11.66±2.88 in Group 2 GBT II. The range of ER balance restoration score for all GBT of the two groups came out to be 11.25±4.78 ~ 14.16±2.04 out of the perfect score of 15, in which Group 2 GBT I had the highest of 14.16±2.04 and Group 2 GBT IV had the lowest of 11.25±4.78. Therefore, the VASdp and ER balance restoration scores of the two Group came out higher in GBTⅡ·Ⅲ·Ⅳ of Group 1, which intervened the upper body mobility types, compared to that of Group 2.

VASdp balance restoration effects of the four GBT types in all GBT, as also shown in Table 4, came out to be 12.50±2.67~12.93±3.13 out of 15, which was significantly high($p<.05$) score. In GBT III, the score was 12.93±3.13, the highest, and it was 12.50±2.67, the lowest, in GBT II. The balance restoration effects of four GBT types and ER came out to be significant ($p<.05$) in all GBT, with the score of 12.22±3.63~ 13.75±2.31. It was the highest in GBT II, 13.75±2.31, and the lowest in GBT IV, 12.22±3.63. Between the same GBT, the balance restoration effects did not exhibit any significant difference($p>.05$) for both VASdp and ER as shown in Table 5.

Table 3. Balance restoration score of two groups – VASdp and ER

GBT(n)	Ⅰ(18		Ⅱ(8)		Ⅲ(29)		Ⅳ(9)	
G(n)	1(12)	2(6)	1(5)	2(3)	1(18)	2(11)	1(5)	2(4)
VASdp	12.50±3.37	13.33±2.58	13.00±2.73	11.66±2.88	13.05±3.48	12.72±2.61	13.00±2.73	12.50±2.88
ER	13.33±3.25	14.16±2.04	14.00±2.23	13.33±2.88	13.05±3.03	12.27±3.43	13.00±2.73	11.25±4.78

GBT(GCM body type)

Table 4. VASdp and ER balance restoration effects of four GBT types

GBT	Region	n	M±SD	Z	p
Ⅰ	VASdp	18	12.77±3.07	−3.841	.000*
	ER	18	13.61±2.87	−3.944	.000*
Ⅱ	VASdp	8	12.50±2.67	−2.585	.010*
	ER	8	13.75±2.31	−2.640	.008*
Ⅲ	VASdp	29	12.93±3.13	−4.881	.000*
	ER	29	12.75±3.15	−4.860	.000*
Ⅳ	VASdp	9	12.77±2.63	−2.739	.006*
	ER	9	12.22±3.63	−2.724	.006*

GBT(GCM body type)

Table 5. Balance restoration effect of VASdp and ER between the same GBT

GBT(n)	Ⅰ(18)	Ⅱ(8)	Ⅲ(29)	Ⅳ(9)	Z	p
VASdp	12.77±3.07	12.50±2.67	12.93±3.13	12.77±2.63	-.436	.936
ER	13.61±2.87	13.75±2.31	12.75±3.15	12.22±3.63	-.452	.563

GBT(GCM body type)

Balance Restoration Effects of Moire and Postural Evaluation Areas

Balance restoration effects of moire and postural evaluation areas

As shown in Table 6, cervical balance restoration scores of two groups for all GBT was 9.00±2.23~ 12.72±2.61. In Group 2 GBT III, it was the highest, 12.72±2.61,and lowest, 9.00±2.23, in Group 1 GBT II and IV. Scapular girdle balance restoration scores of two groups for all GBT was 12.08±2.57~15.00±.00, out of 15, with the highest score of 15.00±.00 in Group 2 GBTⅡ·Ⅲ, and the lowest of 12.08±2.57 in Group1 GBT I. Thoracic balance restoration scores of two groups for all GBT was 10.83±1.94~13.00±2.73 out of 15, with the highest score of 13.00±2.73 in Group 1 GBT IV, and the lowest of 10.83±1.94 in Group1 GBT I. Lumbar balance restoration scores of two groups for all GBT was 8.33±2.58~13.88±2.13 out of 15, with the highest score of 13.88±2.13 in Group 1 GBT III, and the lowest of 8.33±2.58 in Group 2 GBT I. Pelvic girdle balance restoration scores of two groups for all GBT was 8.33±2.58~ 14.16±1.94 out of 15, with the highest score of 14.16 ±1.94 in Group 1 GBT I and the lowest of 8.33±2.58 in Group 2 GBT I. In all groups, the score was never aggravated and scapular girdle had the highest balance restoration scores.

Table 6. Balance restoration scores of the two group moire evaluation areas

GBT(n)	Ⅰ(18		Ⅱ(8)		Ⅲ(29)		Ⅳ(9)	
G(n)	1(12)	2(6)	1(5)	2(3)	1(18)	2(11)	1(5)	2(4)
Cervical(area)	10.00±2.13	12.50±2.73	9.00±2.23	11.66±2.88	9.44±1.61	12.72±2.61	9.00±2.23	12.50±5.00
Scapular(girdle)	12.08±2.57	13.33±2.58	13.00±2.73	15.00±.00	12.22±2.55	15.00±.00	13.00±2.73	13.75±2.50
Thoracic (area)	10.83±1.94	11.66±2.58	11.00±2.23	11.66±2.88	12.77±2.55	11.36±2.33	13.00±2.73	11.25±2.50
Lumbar (area)	13.33±2.46	8.33±2.58	13.00±2.73	10.00±.00	13.88±2.13	12.72±2.61	13.00±2.73	10.00±.00
Pelvis (girdle)	14.16±1.94	8.33±2.58	13.00±2.73	10.00±.00	13.88±2.13	12.72±2.61	13.00±2.73	10.00±.00

GBT(GCM body type)

As indicated in Table 7, cervical balance restoration effects of four GBT types for all GBT was significantly high($p<.05$) and came out to be 10.00±2.67~ 10.83±2.57 out of 15. The differences of effects were highest in GBT, of 10.83±2.57, and lowest in GBT II, of 10.00±2.67. The scapular girdle balance restoration effects of the four GBT types for all GBT was 11.11±2.13~12.24±2.53, the significantly high number($p<.05$). Thoracic balance restoration effects of four GBT types for all GBT was 11.11±2.13 ~ 12.24± 2.53 out of 15, and was significantly high($p<.05$). The highest score was12.24±2.53 in GBT III, and the lowest was 11.11±2.13 in GBT I. Lumbar balance restoration effects of four GBT types for all GBT was 11.66±2.50~13.44±2.35 out of 15, and was significantly high($p<.05$). The highest score was 13.44±2.35 in GBT III, and the lowest was 11.66±2.50 in GBT IV. Pelvic girdle balance restoration effects for all GBT was 11.66±2.50~13.44±2.35 out of 15, and was significantly high($p<.05$). The highest score was 13.44± 2.35 in GBT III and the lowest was 11.66±2.50 in GBT IV.

The balance restoration effects of the four GBT types were significant in all regions($p<.05$), and were high in the order of Scapular girdle GBTⅡ·Ⅳ·Ⅰ and low in the order of Cervical GBTⅡ·Ⅳ·Ⅲ·Ⅰ(Fig.2). The balance restoration effects between the same GBT were, as shown in Table 8, did not show significance($p>.05$) in all five regions of Moire evaluation areas.

Table 7. Moire evaluation areas balance restoration effects of four GBT types

GBT	Region	n	M±SD	Z	p
Ⅰ	Cervical	18	10.83±2.57	−3.900	.000*
	Scapular	18	12.50±2.57	−3.834	.000*
	Thoracic	18	11.11±2.13	−3.947	.000*
	Lumbar	18	11.66±3.42	−3.800	.000*
	Pelvis	18	12.22±3.52	−3.816	.000*
Ⅱ	Cervical	8	10.00±2.67	−2.636	.008*
	Scapular	8	13.75±2.31	−2.640	.008*
	Thoracic	8	11.25±2.31	−2.640	.008*
	Lumbar	8	11.87±2.58	−2.598	.009*
	Pelvis	8	11.87±2.58	−2.598	.009*
Ⅲ	Cervical	29	10.68±2.57	−4.936	.000*
	Scapular	29	13.27±2.41	−4.893	.000*
	Thoracic	29	12.24±2.53	−4.853	.000*
	Lumbar	29	13.44±2.35	−4.916	.000*
	Pelvis	29	13.44±2.35	−4.916	.000*
Ⅳ	Cervical	9	10.55±3.90	−2.701	.007*
	Scapular	9	13.33±2.50	−2.762	.006*
	Thoracic	9	12.22±2.63	−2.739	.006*
	Lumbar	9	11.66±2.50	−2.762	.006*
	Pelvis	9	11.66±2.50	−2.762	.006*

GBT(GCM body type)

Table 8. Balance restoration effects of moire evaluation areas between the same GBT

GBT(n)	Ⅰ(18)	Ⅱ(8Person)	Ⅲ(29Person)	Ⅳ(9Person)	Z	p
Cervical	10.83±2.57	10.00±2.67	10.68±2.57	10.55±3.90	−1.972	.914
Scapular	12.50±2.57	13.75±2.31	13.27±2.41	13.33±2.50	−.972	.597
Thoracic	11.11±2.13	11.25±2.31	12.24±2.53	12.22±2.63	−.779	.374
Lumbar	11.66±3.42	11.87±2.58	13.44±2.35	11.66±2.50	−2.886	.119
Pelvis	12.22±3.52	11.87±2.58	13.44±2.35	11.66±2.50	−3.367	.199

GBT(GCM body type)

Balance Restoration Effects of Postural Evaluation Areas

Balance restoration effects of the upper body postural evaluation areas

As shown in Table 9, the balance restoration scores of two groups for all GBT for the head rotation was 10.00±.00~12.72±2.61 out of 15, with the highest of 12.72±2.61 in Group 2 GBT III and the lowest of 10.00±.00 in Group 1 GBTⅡ·Ⅲ·Ⅳ. The balance restoration scores of two groups for all GBT for the facial asymmetric was 7.00±2.73~10.00±5.00 out of 15, with the highest of 10.00±5.00 in Group 2 GBT II and the lowest of 7.00±2.73 in Group 1 GBTⅡ. The

balance restoration scores of two groups for all GBT for the cervical scoliosis was 9.00±2.23~12.72±2.61 out of 15, with the highest of 12.72±2.61 in Group 2 GBT III and the lowest of 9.00±2.23 in Group 1 GBT Ⅱ·Ⅳ. The balance restoration scores of two groups for all GBT for the thoracic scoliosis was 10.83± 1.94~13.00±2.73 out of 15, with the highest of 10.83 ±1.94~13.00±2.73 in Group 1 GBT IV and the lowest of 10.83±1.94 in Group 1 GBT1. The balance restoration scores of two groups for all GBT for the lumbar scoliosis was 8.33±2.58~14.16±1.94 out of 15, with the highest of 14.16±1.94 in Group 1 GBT I and the lowest of 8.33±2.58 in Group 2 GBT II. The balance restoration scores of two groups for all GBT for the ribcage forward was 10.00±.00~15.00±.00 out of 15, with the highest of 15.00±.00 in Group 2 GBT II and the lowest of 10.00±.00 in Group 1 GBTⅣ. As shown above, the highest balance restoration score was shown in ribcage forward items and the lowest balance restoration score was shown in facial asymmetric item.

Table 9. Balance restoration scores of upper body postural evaluation areas of two groups

GBT(n)	Ⅰ(18		Ⅱ(8)		Ⅲ(29)		Ⅳ(9)	
G(n)	1(12)	2(6)	1(5)	2(3)	1(18)	2(11)	1(5)	2(4)
Head rotation	10.83±1.94	12.50±2.73	10.00±.00	11.66±2.88	10.00±.00	12.72±2.61	10.00±.00	12.50±5.00
Facial asymmetric	8.33±3.25	7.50±2.73	7.00±2.73	10.00±5.00	7.22±3.07	8.63±3.23	7.00±2.73	7.50±2.88
Cervical scoliosis	10.41±2.57	12.50±2.73	9.00±2.23	11.66±2.88	9.44±1.61	12.72±2.61	9.00±2.23	12.50±5.00
Thoracic scoliosis	10.83±1.94	11.66±2.58	11.00±2.23	11.66±2.88	12.77±2.55	11.36±2.33	13.00±2.73	11.25±2.50
Lumbar scoliosis	14.16±1.94	8.33±2.58	13.00±2.73	10.00±.00	13.88±2.13	12.72±2.61	13.00±2.73	10.00±.00
Ribcage forward	10.83±1.94	13.33±2.58	11.00±2.23	15.00±.00	11.38±2.30	12.72±2.61	10.00±.00	12.50±2.88

GBT(GCM body type)

As shown in Table 10, the balance restoration effects of two groups for all GBT for the head rotation was significantly high($p<.05$) with the range of 10.62±1.76~11.38±2.30 out of 15, and the differences of the effect was the largest in GBT I with 10.62±1.76, whereas GBT II showed the lowest value of 10.62±1.76. The facial asymmetric balance restoration effects of four GBT types facial asymmetric was significantly high($p<.05$) with the range of 7.22±2.63~8.12±3.72 out of 15, with the highest of 8.12±3.72 in GBT II, and the lowest of 7.22±2.63 in GBT IV. The cervical scoliosis balance restoration effects of four GBT types was significantly high ($p<.05$) with the range of 10.00±2.67~11.11±2.74 out of 15, with the highest of 11.11±2.74 in GBT I, and the lowest of 10.00±2.67 in GBT II. The thoracic scoliosis balance restoration effects of four GBT types was significantly high($p<.05$) with the range of 11.11±2.13~12.24±2.53 out of 15, with the highest of 12.24±2.53 in GBT III, and the lowest of 11.11±2.13 in GBT I. The lumbar scoliosis balance restoration effects of four GBT types was significantly high($p<.05$) with the range of 11.66±2.50~13.44± 2.35 out of 15, with the highest of 13.44±2.35 in GBT III, and the lowest of 11.66±2.50 in GBT IV. The ribcage forward balance restoration effects of four GBT types was significantly high($p<.05$) with the range of 11.11±2.20~12.50±2.67 out of 15, with the highest of 12.50±2.67 in GBT II, and the lowest of 11.11±2.20 in GBT IV.

The balance restoration effects by four GBT types were significant in all regions($p<.05$), in the order of Lumbar scoliosis GBTⅢ·Ⅰ, Ribcage forward과 Thoracic scoliosis GBTⅡ·Ⅳ, from the highest, and Facial asymmetric GBTⅣ·Ⅲ·Ⅰ·Ⅱ, from the lowest. Also the balance restoration effects between the same GBT were, as shown in Table 11, not significantly different($p>.05$) in all six evaluation categories.

Table 10. Balance restoration effects of upper body postural evaluation areas for four GBT types

GBT	Region	n	M±SD	Z	p
I	Head rotation	18	11.38±2.30	−3.906	.000*
	Facial asymmetric	18	8.05±3.03	−3.817	.000*
	Cervical scoliosis	18	11.11±2.74	−3.866	.000*
	Thoracic scoliosis	18	11.11±2.13	−3.947	.000*
	Lumbar scoliosis	18	12.22±3.52	−3.816	.000*
	Ribcage forward	18	11.66±2.42	−3.874	.000*
II	Head rotation	8	10.62±1.76	−2.714	.007*
	Facial asymmetric	8	8.12±3.72	−2.565	.010*
	Cervical scoliosis	8	10.00±2.67	−2.636	.008*
	Thoracic scoliosis	8	11.25±2.31	−2.640	.008*
	Lumbar scoliosis	8	11.87±2.58	−2.598	.009*
	Ribcage forward	8	12.50±2.67	−2.585	.010*
III	Head rotation	29	11.03±2.06	−5.014	.000*
	Facial asymmetric	29	7.75±3.15	−4.824	.000*
	Cervical scoliosis	29	10.68±2.57	−4.936	.000*
	Thoracic scoliosis	29	12.24±2.53	−4.853	.000*
	Lumbar scoliosis	29	13.44±2.35	−4.916	.000*
	Ribcage forward	29	11.89±2.46	−4.875	.000*
IV	Head rotation	9	11.11±3.33	−2.724	.006*
	Facial asymmetric	9	7.22±2.63	−2.739	.006*
	Cervical scoliosis	9	10.55±3.90	−2.701	.007*
	Thoracic scoliosis	9	12.22±2.63	−2.739	.006*
	Lumbar scoliosis	9	11.66±2.50	−2.762	.006*
	Ribcage forward	9	11.11±2.20	−2.810	.005*

GBT(GCM body type)

Table 11. Balance restoration effects of upper body postural evaluation areas between same GBT

GBT(n)	I (18)	II (8Person)	III (29Person)	IV (9Person)	Z	p
Head rotation	11.38±2.30	10.62±1.76	11.03±2.06	11.11±3.33	−1.446	.867
Facial asymmetric	8.05±3.03	8.12±3.72	7.75±3.15	7.22±2.63	−.474	.932
Cervical scoliosis	11.11±2.74	10.00±2.67	10.68±2.57	10.55±3.90	−1.529	.826
Thoracic scoliosis	11.11±2.13	11.25±2.31	12.24±2.53	12.22±2.63	−.779	.374
Lumbar scoliosis	12.22±3.52	11.87±2.58	13.44±2.35	11.66±2.50	−3.367	.199
Ribcage forward	11.66±2.42	12.50±2.67	11.89±2.46	11.11±2.20	−2.062	.682

GBT(GCM body type)

Balance restoration effects of the lower body postural evaluation areas

As shown in Table 12, the umbilicus tilt balance restoration score of two group for all GBT was 8.33±2.58~14.00±2.23 out of 15, with the highest of 14.00±2.23 in Group 1 GBT II and the lowest of 8.33±2.58 in Group 2 GBT I. The pelvis girdle deviation balance restoration score of two group for all GBT was

9.16±2.04~14.16±1.94 out of 15, with the highest of 14.16±1.94 in Group 1 GBT I and the lowest of 9.16±2.04in Group 2 GBT I. The patella high balance restoration score of two group for all GBT was 9.16±2.04~14.16±1.94 out of 15, with the highest of 14.16±1.94 in Group 1 GBT I and the lowest of 9.16±2.04in Group 2 GBT I. The patella direction balance restoration score of two group for all GBT was11.25±2.26~13.63±2.33out of 15, with the highest of 13.63±2.33 in Group 2 GBT III and the lowest of11.25±2.26 in Group 1 GBT I. The FLA balance restoration score of two group for all GBT was 9.00±2.23~12.72±2.61 out of 15, with the highest of 12.72±2.61 in Group 2 GBT II and the lowest of 9.00±2.23 in Group 1 GBT II. The hallux valgus balance restoration score of two group for all GBT was 7.50±3.37~13.33±2.88 out of 15, with the highest of 13.33±2.88 in Group 2 GBT II and the lowest of 7.50±3.37 in Group 1 GBT I. As in the above, pelvis girdle deviation·Patella high regions had the highest balance restoration score and hallux valgus had the lowest balance restoration score.

Table 12. Balance restoration score of lower body postural evaluation areas for two groups

GBT(n)	I (18		II(8)		III(29)		IV(9)	
G(n)	1(12)	2(6)	1(5)	2(3)	1(18)	2(11)	1(5)	2(4)
Umbilics tilt	13.75±2.26	8.33±2.58	14.00±2.23	10.00±.00	12.77±2.55	12.72±2.61	13.00±2.73	10.00±.00
Pelvis deviation	14.16±1.94	9.16±2.04	13.00±2.73	10.00±.00	13.88±2.13	12.72±2.61	13.00±2.73	10.00±.00
Patella H.	14.16±1.94	9.16±2.04	14.00±2.23	10.00±.00	13.33±2.42	12.72±2.61	12.00±2.73	10.00±.00
Patella D.	11.25±2.26	12.50±2.73	13.00±2.73	11.66±2.88	11.94±3.03	13.63±2.33	13.00±2.73	12.50±2.88
FLA	10.00±2.13	12.50±2.73	9.00±2.23	11.66±2.88	9.44±1.61	12.72±2.61	10.00±3.53	11.25±4.78
HV	7.50±3.37	11.66±2.58	8.00±2.73	13.33±2.88	8.05±4.24	10.90±3.01	9.00±2.23	10.00±4.08

GBT(GCM body type), G(Group), FLA(Foot longitudinal arch), HV(Hallux valgus)

As shown in Table 13, the umbilicus tilt balance restoration effects of four GBT types for all GBT was significantly high($p<.05$) with the range of 11.66±2.50~12.75±2.53 out of 15, and the differences of the effect was the largest in GBT III with 12.75±2.53, whereas GBT IV showed the lowest value of 11.66±2.50. The pelvis girdle balance restoration effects of four GBT types for all GBT was significantly high($p<.05$) with the range of 11.66±2.50~13.44±2.35 out of 15, with the highest of 13.44±2.35 in GBT III, and the lowest of 11.66±2.50 in GBT IV. The pelvis high balance restoration effects of four GBT types for all GBT was significantly high($p<.05$) with the range of 11.11±2.20~13.10±2.46 out of 15, with the highest of 13.10±2.46 in GBT III, and the lowest of 11.11±2.20 in GBT IV. The patella direction balance restoration effects of four GBT types for all GBT was significantly high($p<.05$) with the range of 11.66±2.42~12.77±2.63 out of 15, with the highest of 12.77±2.63 in GBT IV, and the lowest of 11.66±2.42 in GBT I. The foot longitudinal arch direction balance restoration effects of four GBT types for all GBT was significantly high($p<.05$) with the range of 10.00±2.67~10.83±2.57 out of 15, with the highest of 10.83±2.57 in GBT I, and the lowest of 10.00±2.67 in GBT II. The hallux valgus direction balance restoration effects of four GBT types for all GBT was significantly high($p<.05$) with the range of 8.88±3.66~10.00±3.77 out of 15, with the highest of 10.00±3.77 in GBT II, and the lowest of 8.88±3.66 in GBT I

The balance restoration effects of four GBT types were significant in all regions, and were highest in the order of pelvis girdle GBTⅢ·Ⅰ, Patella high and direction of GBTⅣ·Ⅱ·Ⅰ. The lowest order was from GBTⅠ·Ⅲ·Ⅳ to the lowest at the hallux valgus. In addition, balance restoration effects, as shown in 〈Table 14〉, did not show significant difference($p>.05$) in all six regions.

Table 13. Balance restoration effects of lower body postural evaluation for four GBT types

GBT	Region	n	M±SD	Z	p
I	Umbilics tilt	18	11.94±3.48	−3.804	.000*
	Pelvis deviation	18	12.50±3.09	−3.825	.000*
	Patella H.	18	12.50±3.09	−3.825	.000*
	Patella D.	18	11.66±2.42	−3.874	.000*
	FLA	18	10.83±2.57	−3.900	.000*
	HV	18	8.88±3.66	−3.745	.000*
II	Umbilics tilt	8	12.50±2.67	−2.585	.010*
	Pelvis deviation	8	11.87±2.58	−2.598	.009*
	Patella H.	8	12.50±2.67	−2.585	.010*
	Patella D.	8	12.50±2.67	−2.585	.010*
	FLA	8	10.00±2.67	−2.636	.008*
	HV	8	10.00±3.77	−2.558	.011*
III	Umbilics tilt	29	12.75±2.53	−4.853	.000*
	Pelvis deviation	29	13.44±2.35	−4.916	.000*
	Patella H.	29	13.10±2.46	−4.875	.000*
	Patella D.	29	12.58±2.87	−4.842	.000*
	FLA	29	10.68±2.57	−4.936	.000*
	HV	29	9.13±4.02	−4.666	.000*
IV	Umbilics tilt	9	11.66±2.50	−2.762	.006*
	Pelvis deviation	9	11.66±2.50	−2.762	.006*
	Patella H.	9	11.11±2.20	−2.810	.005*
	Patella D.	9	12.77±2.63	−2.739	.006*
	FLA	9	10.55±3.90	−2.701	.007*
	HV	9	9.44±3.00	−2.754	.006*

FLA(Foot longitudinal arch), HV(Hallux valgus)

Table 14 Balance restoration effect of lower body postural evaluation areas in between the same GBT

GBT(n)	I (18)	II (8Person)	III (29Person)	IV (9Person)	Z	p
Umbilics tilt	11.94±3.48	12.50±2.67	12.75±2.53	11.66±2.50	−3.108	.722
Pelvis deviation	12.50±3.09	11.87±2.58	13.44±2.35	11.66±2.50	−3.305	.192
Patella H.	12.50±3.09	12.50±2.67	13.10±2.46	11.11±2.20	−3.305	.247
Patella D.	11.66±2.42	12.50±2.67	12.58±2.87	12.77±2.63	−1.031	.578
FLA	10.83±2.57	10.00±2.67	10.68±2.57	10.55±3.90	−1.972	.914
HV	8.88±3.66	10.00±3.77	9.13±4.02	9.44±3.00	−2.361	.939

GBT(GCM body type), n(Number)), FLA(Foot longitudinal arch), HV(Hallux valgus)

DISCUSSION

The spine and extremities muscles are in tensional activities in order to maintain human body at vertical posture on base of surface while being at static standing posture(19). If the center of gravity moves, the human body requires mores muscle activities in order to restore stability in posture. The compensative postural strategy, in this situation, makes the gravity center to return to the stability posture within the base of surface(20). The left or right body imbalance accompanied here appear to be the cause of most spinal scoliosis(21). The main causes for spinal scoliosis are associated with muscle and skeletal imbalances et al in spine and extremities joints(10).

The muscle or skeletal imbalances have influence on balance maintain of musculo-skeletal systems(22). As a result, the ideal postural plumb line is not maintained and human body overuses energy to maintain vertical posture and overcome gravity(23). The spinal erect muscle imbalance accompanied with low back pain, whether by local tissue injury or radiating pain mechanism, leads to the bad cycle of aggravated low back pain(23). Hence, for the effective treatment of the low back pain, without increasing abnormal tone degree of other muscles, the balance needs to be restored by decreasing overstress in muscles(24). Musculo-skeletal systems have important role of maintaining posture and balance control(25). The muscle balance, in particular, is important not only in terms of self exercise but also in maintaining stability of spine & extremities joints during the most activities of the daily living(9, 26, 27).

On the other hand, Imman(28) and Soderbert(29) stated that the imbalance of muscles are caused by change in body condition and height difference of both pelvis and shoulder. By comparing the height difference of both pelvis and shoulder, the muscle imbalance degrees of the whole body can be understood(30).

Human body is different for sex, age, people of color and body types(6, 11). Human body can be classified into athletic type, with tall and developed whole body muscle; pyknotic type, with the big trunk and fact accumulation tendency; and asthenic type, of slim and weak body with less than average level of body weight(31). However, Moon(5, 6) classified human body into four GBT types based on relative tilt types of left·right scapular & ilium. Then he argued that the GBT of the patients' musculoskeletal systems dysfunction is closely related to the behavior patterns. For the correction of the spine & extremities joints mal-alignment in the whole body, integrative program including diagnosis-evaluation treatment & intervention management, GCM was presented(5, 6, 8, 9, 10, 11, 14).

According to the antagonistic approach aspects of upper & lower body joint movements, this study classified into mobility and stability types. Then the stability-increasing intervention models are applied for the mobility types representing the joint hypermobility. The primary reason for distinguishing indication area of intervention is to control hyper-hypo mobility chain patterns of spine & extremities joints across the whole body(1, 9, 11). This is to control the tension degree of muscles and joints of the whole body by facilitating the hypomobility joints, while the hypermobility joints of GBT are inhibited(6, 32).

In Table 3, VASdp and ER balance restoration score of two groups is shown as 11.25±4.78~14.16±2.04 out of perfect score of 15. This signifies that pain or imbalance and discomfort score improved by 3~4 points or more after application of GCM intervention models. And it also means the majority of the subjects had restored the displace distance of the ER anterior or posterior and displaced rotate position to greater than 41~60cm, or 31~50°, respectively, in two groups. In addition, this means the balance restoration effects were higher in GBTⅡ·Ⅲ·Ⅳ of Group 1, which intervened upper body mobility type, than in Group 2, which intervened lower body mobility type. In Table 4, the VASdp and ER balance restoration score of the four GBT types came out to be significantly high($p<.05$) with the score range of 12.22±3.63~13.75±2.31 out of 15 in total. This means the pain or imbalance and discomfort score improved by more than 3~4 points after applying GCM intervention models, as well as that the most subjects restored ER anterior or posterior displace distance and displaced rotate position to more than 41~60cm and 31~50°, respectively, in all four GBT types distribution patterns.

In Table 6, the balance restoration scores of the five Moire evaluation areas of two groups came out to be 8.33±2.58~15.00±.00 after application of GCM intervention models. This means that the subjects restored to moderate level or better were composing the majority of the two groups. In Table 7, the balance restoration scores of the five Moire evaluation areas of four GBT types came out to be 10.00±2.67~13.75±2.31 after application of GCM intervention models, which is statistically significant($p<.05$). This means that the subjects restored to moderate level or

better were composing the majority of the four GBT types.

In Table 9, the balance restoration scores of the six upper body postural evaluation areas of two groups came out to be 7.00±2.73~15.00±.00 after application of GCM intervention models. This means that the subjects restored to moderate level or better were composing the majority of the two groups. In Table 10, the balance restoration scores of the six upper body postural evaluation areas of two groups came out to be 7.22±2.63~13.75±2.31 after application of GCM intervention models, which is statistically significant($p<.05$). This means that the subjects restored to moderate level or better were composing the majority of the four GBT types.

In Table 12, the balance restoration scores of the six lower body postural evaluation areas of two groups came out to be 7.50±3.37~14.16±1.94 after application of GCM intervention models. This means that the subjects restored to moderate or higher level were composing the majority of the two groups. In Table 13, the balance restoration scores of the six lower body postural evaluation areas of two groups came out to be 8.88±3.66~13.44±2.35 after application of GCM intervention models, which is statistically significant($p<.05$). This means that the subjects restored to moderate or higher level were composing the majority of the four GBT types. It was observed that the intervention effects about upper body were more noticeable in lower body joints and that for the lower body were more noticeable in the upper body joints.

Lastly, the balance restoration effects between the same GBT were not significant in all evaluation areas and regions($p>.05$), which means that the balance restoration effects are similar in the same GBT.

To stretch the meaning of the results of this study, the following limitation reasons shall be noted. First, surrounding variables such as taking drug, folk remedy, and medical center were not controlled. Secondly, objective numerical value was not recorded during the pre and post photo interpretation for the postural analysis, and gait analysis unit was not used to measure the gait numerical value. Hence in the future study, these limitations should be made up and the results shall be compared.

CONCLUSION

The manual intervention and self-corrective exercise models of the GCM about the mal-alignment of the spine & extremities joints across the whole body indicated high balance restoration effects($p<.05$) in spine & extremities joints in all evaluation areas.

1. Balance restoration effects of VASdp and ER came out higher in GBT(GCM body type) Ⅱ·Ⅲ·Ⅳ of Group 1.
2. In case of the balance restoration effects of Moire and postural evaluation areas, Group 1 was higher and cervical and scapular girdle were higher in Group 2. The balance restoration of the four GBT types was significant in all regions($p<.05$), and the scapular girdle came out as high in the order of GBT Ⅱ·Ⅳ·Ⅰ.

3. In case of thoracic-lumbar scoliosis and head rotation·facial asymmetric·cervical scoliosis·ribcage forward, the balance restoration effects of the upper body postural evaluation areas came out the highest in Group 1 and Group 2, respectively. The balance restoration effects of the four GBT types were significant in all regions($p<.05$), and came out the highest in lumbar scoliosis GBTⅢ·Ⅰ, ribcage forward and thoracic scoliosis GBTⅡ·Ⅳ.

4. The balance restoration effects of the lower body postural evaluation areas came out higher in Group 1 and Group 2 for pelvis girdle deviation·patella high·umbilicus tilt and hallux valgus·foot longitudinal arch: FLA·patella direction, respectively. The balance restoration effects of the four GBT types were significant in all regions($p<.05$), and came out the highest in pelvis girdle deviation GBTⅢ·Ⅰ and patella high-direction GBTⅣ·Ⅱ·Ⅰ.

5. The balance restoration effects came out significant($p>.05$) in all evaluation areas and all regions.

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