بِسْمِ ٱللَّهِ ٱلرَّحْمَٰنِ ٱلرَّحِيمِ

قَالُوا۟ سُبْحَٰنَكَ لَا عِلْمَ لَنَآ إِلَّا مَا عَلَّمْتَنَآ ۖ إِنَّكَ أَنتَ ٱلْعَلِيمُ ٱلْحَكِيمُ ﴿٣٢﴾

صدق الله العظيم

LUMBAR SPONDYLOSIS, ITS RELATION TO SACRAL ANGLE AND POSTURAL INSTABILITY

خشونة الفقرات القطنية ، علاقتها بالزاوية العجزية وخلل اتزان القوام

ACKNOWLEDGEMENT

THIS THESIS WOULD NOT HAVE BEEN POSSIBLE WITHOUT GOD ALMIGHTY WITH HIS BLESSINGS AND POWER THAT WORK WITHIN ME AND ALSO WITHOUT THE PEOPLE BEHIND MY LIFE FOR INSPIRING, GUIDING AND ACCOMPANYING ME THROUGHOUT MY WORK.

I AM HEARTILY THANKFUL TO **PROF. DR. NAHED A. SALEM**, PROFESSOR OF PHYSICAL THERAPY FOR NEUROMUSCULAR DISORDERS AND ITS SURGERY, FACULTY OF PHYSICAL THERAPY, CAIRO UNIVERSITY. WITHOUT HER GUIDANCE AND SUPPORT, THIS THESIS WOULD NEVER HAVE BEEN COMPLETED.

I OWE MY SINCERE AND DEEPEST GRATITUDE TO **PROF. DR. MOHAMED N. EL-BAHRAWY**, PROFESSOR OF PHYSICAL THERAPY FOR NEUROMUSCULAR DISORDERS AND ITS SURGERY; FACULTY OF PHYSICAL THERAPY, CAIRO UNIVERSITY, FOR HIS INSPIRATION AND ENCOURAGEMENT THAT ALWAYS STIMULATED ME TO SEEK MORE KNOWLEDGE.

I WISH TO EXPRESS MY WARM AND SINCERE THANKS TO **DR. MOHAMED E. EL-AWADY**, PROFESSOR OF NEUROLOGY, FACULTY OF MEDICINE, CAIRO UNIVERSITY, FOR HIS TIME AND INSIGHTFUL COMMENTS ON MY THESIS.

I COULD HAVE NEVER ACCOMPLISHED THIS WORK WITHOUT THE GUIDANCE SUPPORT AND INSTRUCTIONS OF PROF. DR. IBTESAM KHATTAB. WITHOUT HER, THIS WORK WOULDN'T HAVE SEEN THE LIGHT.

AND TO THE REST, WHOM I FAILED TO MENTION, THANK YOU VERY MUCH FOR YOUR PRAYERS.

INTRODUCTION

LUMBAR SPONDYLOSIS REFERS TO ANATOMICAL CHANGES TO THE VERTEBRAL BODIES AND INTERVERTEBRAL DISK SPACES THAT MAY BE ASSOCIATED WITH CLINICAL PAIN SYNDROMES. LOW BACK PAIN (LBP) HAS BEEN RELATED WITH ANTHROPOMETRIC, POSTURAL, MUSCULAR, AND MOBILITY CHARACTERISTICS. NUMEROUS ETIOLOGIC FACTORS HAVE BEEN LINKED TO VARIOUS CONDITIONS INCLUDING OBESITY, INCREASED LUMBAR LORDOSIS, POOR ABDOMINAL MUSCLE STRENGTH, AND IMBALANCE BETWEEN FLEXOR AND EXTENSOR TRUNK MUSCLE STRENGTH, REDUCED SPINAL MOBILITY, TIGHT HAMSTRINGS, AND LEG-LENGTH DISCREPANCY (MIDDLETON AND FISH, **2009).**

THE TERM ‘BALANCE’ REFERS TO A MULTI-SYSTEM FUNCTION THAT STRIVES TO KEEP THE BODY UPRIGHT DURING SITTING OR STANDING AND WHILE CHANGING POSTURE. BALANCE OR THE STATE OF EQUILIBRIUM HAS BEEN DIVIDED INTO STATIC AND DYNAMIC BALANCE, DEPENDING ON WHETHER THE BASE IS STATIONARY OR MOVING **(SPIRDUSO, 1995).**

POSTURAL STABILITY IS THE ABILITY TO MAINTAIN THE BODY IN SPATIAL EQUILIBRIUM UNDER BOTH STATIC AND DYNAMIC CONDITIONS. POSTURAL STABILITY IS AN ESSENTIAL COMPONENT IN ASSESSING THE EFFICACY OF INTERVENTIONS FOR IMPROVING BALANCE.

POSTURAL CONTROL MEANS INTEGRATION OF THE POSTURE AND VOLUNTARY MOVEMENT BASED ON THE SELECTIVE AND RAPID INTEGRATION OF SENSORY INFORMATION (SOMATOSENSORY, VISUAL, AND VESTIBULAR) FROM MULTIPLE SOURCES **(NICOLETA AND JOYCE, 2007).**

THE PELVIS PLAYS A ROLE IN THE MUSCLE ACTIVITY AND RESULTING LOADS ON THE SPINE DURING STANDING. THE BASE OF THE SACRUM IS INCLINED FORWARD AND DOWNWARD. THE ANGLE OF INCLINATION, OR SACRAL ANGLE, WAS DEFINED AS AN ANGLE BETWEEN HORIZONTAL LINE PARALLEL TO BOTTOM END OF THE FILM AND SUPERIOR ENDPLATE OF SACRUM AND IT IS ABOUT 30 DEGREES TO THE TRANSVERSE PLANE DURING RELAXED STANDING **(KIM ET AL., 2006).**

STATEMENT OF THE PROBLEM:

WAS THERE A RELATIONSHIP BETWEEN CHANGES IN SACRAL ANGLE AND POSTURAL INSTABILITY IN PATIENTS WITH LOW BACK PAIN DUE TO LUMBAR SPONDYLOSIS?

PURPOSE OF THE STUDY:

THE PURPOSES OF THIS STUDY WERE:

- TO INVESTIGATE THE BIOMECHANICAL FEATURES OF THE LUMBOSACRAL REGION IN PATIENTS WITH LOW BACK PAIN SECONDARY TO LUMBAR SPONDYLOSIS.
- TO DETERMINE IF THERE IS A RELATIONSHIP BETWEEN POSTURAL INSTABILITY AND SACRAL ANGLE IN PATIENTS WITH LOW BACK PAIN AS A RESULT OF LUMBAR SPONDYLOSIS.

SIGNIFICANCE OF THE STUDY:

LOW BACK PAIN (LBP) IS A HIGHLY COMMON PROBLEM AND CAUSES MUCH MORBIDITY AND SOCIOECONOMIC LOSS IN THE COMMUNITY, WITH LIFETIME INCIDENCE RATES REPORTED BETWEEN 50%AND 90%.

THE IMPORTANCE OF MAINTENANCE OF APPROPRIATE LUMBAR LORDOSIS HAS RECEIVED INCREASING ATTENTION OVER THE LAST FEW YEARS. A DEFINITION OF INSTABILITY OF THE LUMBAR SPINE AND ITS RELATIONSHIP TO CLINICAL SYMPTOMS HAS NOT BEEN ESTABLISHED. SACRAL ANGLE IS AN IMPORTANT DETERMINANT TO LUMBAR LORDOSIS AND IS UNSTABLE BECAUSE IT IS INFLEXION POINT IN SPINAL CURVATURE. IN ADDITION, BECAUSE THE SACRUM IS FIRMLY ATTACHED TO THE PELVIS, THE SACRAL ANGLE ALSO IMPLIES PELVIC TILT **(HO-JUN KIM ET AL., 2006).**

CHANGING LUMBAR LORDOSIS SEEMS TO DEPEND ON THE ABDOMINAL MUSCLES, BACK MUSCLES AND PELVIC/BACK ALIGNMENT AND THIS MAY AFFECT THE DIAGNOSIS AND TREATMENT IN PATIENTS WITH LBP AND ALSO AFFECT THE PLANNING OF A PROPER EXERCISE PROGRAM FOR THESE PATIENTS.

NULL HYPOTHESES:

IT WAS HYPOTHESIZED THAT THERE WAS NO RELATIONSHIP BETWEEN CHANGES IN SACRAL ANGLE AND POSTURAL INSTABILITY IN PATIENTS WITH LOW BACK PAIN OWING TO LUMBAR SPONDYLOSIS.

DELIMITATIONS:

THIS STUDY WAS DELIMITED TO THE FOLLOWING ASPECTS:

-FORTY SUBJECTS FROM BOTH SEXES WERE RECRUITED FOR THIS STUDY.

-TWENTY PATIENT DIAGNOSED AS LUMBAR SPONDYLOSIS AND TWENTY NORMAL PERSONS MATCHED FOR AGE, SEX, WEIGHT AND HEIGHT WERE RECRUITED IN THIS STUDY.

- ALL PATIENTS WERE ABLE TO FOLLOW INSTRUCTIONS AND AGREED TO PARTICIPATE IN THIS STUDY.
- THEIR AGE WAS RANGE FROM 40-60 YEARS.
- ALL OF THE SELECTED PATIENTS RECEIVED THE SAME SYMPTOMATIC MEDICAL TREATMENT.
- THE DURATION OF LOW BACK PAIN WAS MORE THAN SIX MONTHS

LIMITATIONS:

-CO-OPERATION OF THE PATIENTS MAY AFFECT THE RESULTS OF THE MEASUREMENTS.

-PERSONAL AND INDIVIDUAL DIFFERENCES BETWEEN PATIENTS, MAY AFFECT THEIR PERFORMANCE IN FORM OF AFFECTING THEIR UNDERSTANDING TO THE ASSESSMENT PROCEDURE.

BASIC ASSUMPTIONS:

IT WAS ASSUMED THAT:

1-PATIENTS FOLLOWED THE INVESTIGATOR`S INSTRUCTIONS DURING THE TESTING PROCEDURES.

2-ALL PATIENTS EXERTED MAXIMAL EFFORT DURING TESTING PROCEDURES.

SUBJECT MATERIALS AND METHODS

THIS STUDY WAS CONDUCTED IN THE COMPUTERIZED DYNAMIC POSTUROGRAPHY LAB IN KASR EL- AINI, CAIRO UNIVERSITY HOSPITALS, DEPARTMENT OF NEUROLOGY, FROM THE PERIOD OF MAY 2013 TO MAY 2014. THE DATA WAS COLLECTED USING THE NEUROCOM BALANCE MASTER SYSTEM VERSION 7.

SUBJECTS SELECTION

TWENTY PATIENTS FROM BOTH SEXES DIAGNOSED AS HAVING LUMBAR SPONDYLOSIS PARTICIPATED IN THIS STUDY, AND WERE SELECTED FROM KASR EL-AINI HOSPITAL OUTPATIENT CLINICS (NEUROLOGY AND PHYSICAL THERAPY).THEY WERE DIAGNOSED ON THE BASIS OF A MEDICAL REVIEW AND AN OBJECTIVE EXAMINATION BY THE SAME NEUROLOGIST AND PHYSICAL THERAPIST AND THE DIAGNOSIS WAS CONFIRMED BY PLAIN X-RAY ON LUMBAR SPINE.

INCLUSION CRITERIA:

- ALL OF THE PATIENTS WERE ABLE TO FOLLOW INSTRUCTIONS AND AGREED TO PARTICIPATE IN THIS STUDY.
- THEIR AGE RANGED FROM 40-60 YEARS.

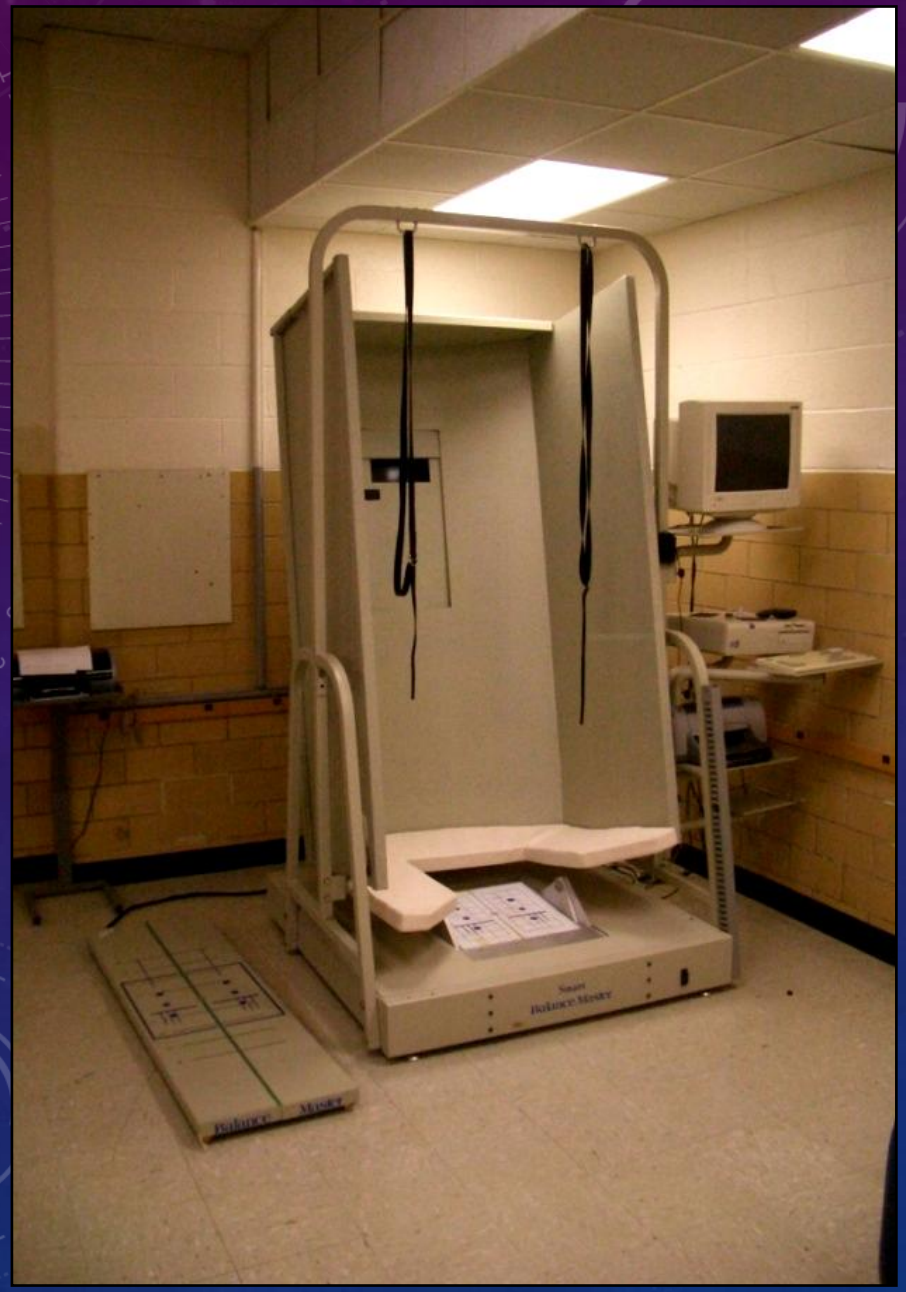
EXCLUSION CRITERIA:

- OTHER NEUROLOGICAL DISORDERS AFFECTING POSTURAL STABILITY (I.E ATAXIA, PARKINSONISM, PERIPHERAL NEUROPATHY).
- MUSCULOSKELETAL DISORDERS INCLUDING LOWER LIMB FRACTURES OR CONTRACTURES OF FIXED DEFORMITY, ESPECIALLY AT THE ANKLE JOINT, LIMITING LOCOMOTION OR BALANCE.
- DEFICITS IN ATTENTION, COGNITION, AND SENSATION.
- PERIPHERAL VESTIBULAR DISEASES .
- HISTORY OF FREQUENT LOSS OF BALANCE OR FALLING.
- PREVIOUS HISTORY OF VERTEBROBASILAR INSUFFICIENCY (VBI).
- MARKED VISUAL IMPAIRMENTS.

INSTRUMENTATIONS AND MATERIALS

COMPUTERIZED DYNAMIC POSTUROGRAPHY:

THE BALANCE MASTER (BM) IS A REHABILITATION TOOL DESIGNED TO PROVIDE PRECISE, OBJECTIVE AND POTENTIALLY MORE SENSITIVE MEASUREMENTS OF STATIC AND DYNAMIC BALANCE PERFORMANCE. IT COMBINES CENTRE OF PRESSURE (COP) MEASURES WITH VISUAL FEEDBACK ON CENTRE OF MASS (COM) DISPLACEMENTS DURING POSTURAL CONTROL TASKS. THE ASSESSMENT OF POSTURAL STABILITY AT THE SUBJECT'S LIMITS OF STABILITY (LOS) IS ONE OF THESE TASKS AND ONE OF THE EVALUATION OPTIONS AVAILABLE IN THE BM ASSESSMENT MODULES. THE SYSTEM UTILIZES FORCEPLATE TECHNOLOGY TO DETERMINE THE LOCATION OF THE COG WITHIN PREDEFINED (THEORETICAL) LIMITS OF STABILITY. THE SOFTWARE PROVIDES MEASURES OF POSTURAL SWAY AND THE ABILITY TO MAINTAIN THE COG WITHIN A DEFINED TARGET AREA ***(WOODHOUSE AND VASSELJEN, 2008).***



Smart Balance Master

THE LIMITS OF STABILITY TEST (LOS):

THIS TEST QUANTIFIES SEVERAL MOVEMENT CHARACTERISTICS ASSOCIATED WITH THE PATIENT'S ABILITY TO VOLUNTARILY SWAY TO VARIOUS LOCATIONS IN SPACE, AND BRIEFLY MAINTAIN STABILITY AT THOSE POSITIONS. THE MEASURED PARAMETERS WERE REACTION TIME, SWAY VELOCITY, DIRECTIONAL CONTROL, END POINT EXCURSION, AND MAXIMUM EXCURSION.

THE LOS TEST CONSISTED OF EIGHT TRIALS, NORMALLY CONDUCTED IN THE FOLLOWING ORDER FORWARD, BACKWARD, FORWARD-RIGHT, BACKWARD-LEFT, RIGHT, LEFT, BACKWARD-RIGHT AND FORWARD-LEFT.

RHYTHMIC WEIGHT SHIFT (RWS):

- THE RHYTHMIC WEIGHT SHIFT TEST MEASURED “ON-AXIS VELOCITY” AND “DIRECTIONAL CONTROL” PARAMETERS.
- THE TEST CONSISTS OF SIX TRIALS, CONDUCTED IN THE FOLLOWING ORDER LEFT/RIGHT, SLOW (THREE SEC TRANSITIONS), LEFT/RIGHT, MEDIUM (TWO SEC TRANSITIONS), LEFT/RIGHT, FAST (ONE SEC TRANSITIONS), FORWARD/BACKWARD, SLOW (THREE SEC TRANSITIONS, FORWARD /BACKWARD, MEDIUM (TWO SEC TRANSITIONS) AND FORWARD/BACKWARD, FAST (ONE SEC TRANSITIONS).

RESULTS

Descriptive statistics of the mean age, weight, height and BMI of the study group.

$\bar{x}$	$\bar{X}$ ±SD	Minimum	Maximum	Range
Age (years)	44.7 ± 4.4	40	60	50
Weight (Kg)	75.3 ± 5.75	65	88	23
Height (cm)	172.75 ± 3.46	160	175	15
BMI (Kg/m2)	25.22 ± 1.62	22.49	28.73	6.24

$\bar{x}$

$\bar{X}$: Mean

SD : Standard Deviation

RELATIONSHIP BETWEEN SACRAL ANGLE AND LIMITS OF STABILITY:

THERE WAS A MODERATE POSITIVE SIGNIFICANT CORRELATION BETWEEN SACRAL ANGLE AND DIRECTIONAL CONTROL , A MODERATE POSITIVE SIGNIFICANT CORRELATION BETWEEN SACRAL ANGLE AND END POINT EXCURSION , A MODERATE POSITIVE SIGNIFICANT CORRELATION BETWEEN SACRAL ANGLE AND MAXIMUM EXCURSION , A VERY WEAK NEGATIVE NON SIGNIFICANT CORRELATION BETWEEN SACRAL ANGLE AND MOVEMENT VELOCITY , AND A MODERATE NEGATIVE SIGNIFICANT CORRELATION BETWEEN SACRAL ANGLE AND REACTION TIME .

RELATIONSHIP BETWEEN SACRAL ANGLE AND RHYTHMIC WEIGHT SHIFT:

THERE WAS A MODERATE POSITIVE SIGNIFICANT CORRELATION BETWEEN SACRAL ANGLE AND ON AXIS VELOCITY IN FRONT-BACK DIRECTION, WHILE THERE WAS A VERY WEAK NEGATIVE NON SIGNIFICANT CORRELATION BETWEEN SACRAL ANGLE AND ON AXIS VELOCITY IN LEFT-RIGHT DIRECTION, A MODERATE NEGATIVE SIGNIFICANT CORRELATION BETWEEN SACRAL ANGLE AND DIRECTIONAL CONTROL IN FRONT- BACK DIRECTION, AND A MODERATE NEGATIVE SIGNIFICANT CORRELATION BETWEEN SACRAL ANGLE AND DIRECTIONAL CONTROL IN LEFT- RIGHT DIRECTION .

DISCUSSION

IT WAS FOUND THAT SA WAS LOWER IN MALE PATIENTS WITH LBP COMPARED TO MALE HEALTHY NORMAL CONTROLS(HNCS) WITHOUT LBP.

IN ADDITION, SIA AND BMI WERE HIGHER IN FEMALE PATIENTS COMPARED TO MALE PATIENTS.

DIFFERENCES IN RESULTS MIGHT HAVE BEEN CAUSED BY DIFFERENCES IN REGIONAL ANGLE MEASUREMENT METHODS, NUMBER OF PATIENTS INVOLVED, AGE OF PATIENTS, AND DIAGNOSTIC DIFFERENCES. PLACEBO-CONTROLLED STUDIES WITH HIGHER NUMBER OF PARTICIPANTS IN WHICH STANDARDIZED ANGLE REGIONS AND METHODS ARE USED ARE NEEDED FOR EXACT DETERMINATION OF THE EFFECTS OF LBP ON SA . RESULTS OF SUCH STUDIES MAY GUIDE THE CLINICIAN DURING EXAMINATION OF SA OF PATIENTS WITH LBP.

DYNAMIC MOVEMENTS OF THE LUMBAR REGION ARE CRUCIAL TO OUR LIVES. THEREFORE, WE AIMED AT INVESTIGATING WHETHER OR NOT ANGLES OF THE LUMBOSACRAL REGION IMPACTED ON DEVELOPMENT OF CHRONIC LBP.

RECOMMENDATIONS

- MORE RESEARCHES ARE NEEDED TO INVESTIGATE THE BIOMECHANICAL FEATURES OF THE LUMBOSACRAL REGION IN PATIENTS WITH LOW BACK PAIN SECONDARY TO LUMBAR SPONDYLOSIS.
- FURTHER STUDIES AND RESEARCH ARE REQUIRED TO DETERMINE IF THERE IS A RELATIONSHIP BETWEEN POSTURAL STABILITY AND SACRAL ANGLE IN PATIENTS WITH LOW BACK PAIN AS A RESULT OF LUMBAR SPONDYLOSIS.
- MORE RESEARCHES INCLUDING LARGER SAMPLE SIZE ARE NEEDED TO DETERMINE AND CONFIRM INVESTIGATE THE BIOMECHANICAL FEATURES OF THE LUMBOSACRAL REGION IN PATIENTS WITH LOW BACK PAIN SECONDARY TO LUMBAR SPONDYLOSIS.
- FURTHER STUDIES ARE NEEDED TO EVALUATE THE ABILITY OF OTHER CLINICAL TESTS FOR ASSESSMENT OF LUMBAR STABILITY.

THANK YOU