Anterior Head Carriage and Balance

Joshua Nichols

Christina Lynch

Advisor: Rodger Tepe, PhD

A senior research project submitted in practical requirement for the degree Doctor of Chiropractic

June, 24 2013

ABSTRACT

Objective: To identify a relationship between anterior head carriage and balance in normal chiropractic college students.

Methods: This was an Institutional Review Board approved study that was a one group pre-post clinical trial. A convenience sample of 38 consenting adult students had lateral and anterior digital posture photographs taken (PostureScreen). Postural parameters measured were taken based on various markers placed on the participants. Balance was then analyzed utilizing NeurCom's Limit of stability protocol where eight directions of balance were measured and the averaged.

Results: No statistically significant relationship between participants with normal head carriage and limits of stability as compared with participants with anterior head carriage and their limits of stability. A multivariable linear regression model was derived using Anteriority as the dependent variable, with the others as independent, and no comparisons achieved statistical significance (all $p>.05$) SAS 9.3(Cary NC) was used for all analysis.

Conclusion: The Results of the current study found no statistically significant relationship between anterior head carriage and the limits of stability.

Key Words: *Anterior head carriage, posture, balance, limits of stability*

INTRODUCTION

"Posture, which is the relative disposition of the body at any one moment, is a composite of the positions of the different joints of the body at that time. The position of each joint has an effect on the position of the other joints".[1] Correct posture requires minimal energy expenditure demand and places minimal stress on the joints, whereas improper posture can lead to pathology including stiff joints, joints that are too mobile, and muscles that are weak, shortened and lengthened. The pathology can result from not only macrotrauma but also microtrauma, such as repetitive movements, leading to wearing of the articular surfaces of joints and stabilizing measures by the body like osteophyte production. The pathology results in soft tissue weakening, over stretching or traumatized which leads to symptom development.

Posture is cause and consequence of a dynamic biomechanical model factors including overuse, underuse, work and ergonomic factors, injury and body composition and size.

Anterior Head carriage is a common postural deficit. The muscles that have to increase their work load in the opposite direction of control are the upper trapezius, levator scapulae, sternocleidomaastoid and the suboccipital muscles.

Anterior Head carriage is where the head is held forward from the correct anatomical position. Causes of anterior head carriage have increased with the advancement of technology and the increase of sedentary lifestyles. Anterior head carriage has been associated with overworking at computers, laptops and overall bad posture. The repetitive strain on the cervical spine while performing daily activities, as well as trauma and injuries, place an increased load on the spine. According to Kapandji in the Physiology of joints, for every inch of forward head posture, it can

increase the weight of the head on the spine by an additional 10 pounds.[2] Anterior head carriage is associated with headaches, decreased ranges of motion, loss of lung capacity and other postural changes. With the head translated anteriorly the body fights to keep the righting reflex as level as possible, which is your eyes keeping you level with horizontal gaze. Proprioception is the awareness of one's self, limb, body part in space in accordance with gravity. According to Mosby's Medical Dictionary, neck reflexes are reflex adjustments in trunk posture and limb position caused by stimulation of proprioceptors in the necks joints and muscles when the head is turned, tending to maintain a constant orientation between the head and the body.[3] Mosby's also states that a normal righting reflex is dependent on normal vestibular, visual and proprioceptive functions[3]. The ability to maintain balance is a process that depends on three components: 1) sensory systems for accurate information about the body's position relative to the enviroment; 2) the brains ability to process this information; and 3) muscles and joints for coordinating the movements required to maintain balance. The sensory system for the body includes the sense of touch in feet, ankles and joints, vision and the vestibular system. [4]

Upper crossed syndrome is defined as tightness of the upper trapezius, pectoralis major, and levator scapulae and weakness of the rhomboids, serratus anterior, middle and lower trapezius, and the deep neck flexors, especially the scalene muscles. The condition was named "Upper Crossed" because the connection of these weak and shortened muscles forms a cross in the upper body. This syndrome produces elevation and protraction of the shoulders, a winging pattern of the scapula, and an anterior projection of the head. This abnormal posture puts a stress on the junction between the occiput and the upper cervical spine, the cervical and

thoracic transitional segments, and the joints of the shoulder due to atypical motion of the glenohumeral joint.[5]

Balance can be linked to motor impairment with consequent changes in bodily biomechanics. Posture is an important variable in NMS conditions. Posture represents the summation of hard/soft tissue relationships reflecting influences ranging from trauma/injury, overuse, degenerative joint disease (DJD), and the effects of activities of daily living (ADL). Various studies have investigated the origins of postural configurations, the measurement of posture in standing and sitting and means of correcting postural faults.

Abnormal posture has been shown to be associated with numerous conditions such as, myofascial pain syndromes*, joint pain*, and movement disorders.*

Systematic study of posture has been handicapped by a lack of consensus about the accurate, reliable measurement of posture and a lack of reference data. The current study aims to collect reference data on standing posture a cohort of college students.

Studies have shown the correlation of upper extremity musculoskeletal disorders are ergonomic risk factors (fast work pace, repetitive movement, short time for recovery, forced exertion, non-neutral static and dynamic postures, mechanical pressure, vibration) and psychosocial (high psychological demand, low job control, high job strain, low social support at work, fewer opportunities to take rest breaks).[6] Many factors can be changed in the workplace to improve posture such as changing the keyboard height, having a lumbar support placed in the office chair, change the monitor height to eye level, and having the correct desk

height along with correct chair height. Many workplace risk factors for neck-shoulder symptoms were associated with insufficient working space, poor desk lighting, incorrect keyboard height, elevated noise, poor supervisor support or recognition, inadequate microclimatic conditions and seniority.[7] The risk for neck and back symptoms are high among people who drive long distances and who have much sedentary work. [8] A person's way of coping with a potential stressor in the work environment could determine whether or not the stressor will have an adverse effect. [9] When breaks during computer work using signals are compared to no breaks significant differences in favor of breaks were found.[10] Employee motivation and the involvement of employees in decision-making processes are measures that may increase job satisfaction and, in doing so, can have a positive impact on the physical as well as mental well-being of the employees. With regard to musculoskeletal symptoms, preventive measures should focus on neck and shoulder disorders. Work organization plays an important role, especially when ergonomic measures are largely implemented. [11]

PostureScreen is a posture analysis and movement screening and evaluation software, used via iPad, geared towards professionals that want to objectively analyze the posture and movement of patients. According to NeuroCom's website information, NeuroCom's Limit of Stability (LOS) quantifies the maximum distance a person can intentionally dispalace their center of gravity in eight trials. The measured parameters are Reaction Time (RT), Center of Gravity movement veloicity (MVL), Directional Control (DCL), End Point Excursion (EPE), and Maximum Excursion (MXE). They go on to state that limitations in patients Limits of Stabilty may correlate to risk for fall or instability, during weight shifting activities…Patients

with reduced stability limits in the AP direction tend to take smaller steps during gait, while laterally reduced limits can lead to broad-based gaits.[12]

The Purpose of this investigation is to investigate the relationship between anterior head carriage as measured with PostureScreen and balance as measured with NeuroComs' Limit of Stability protocol.

MATERAILS AND METHODS

Design

This was an IRB approved study that was a one group pre-post clinical trial to investigate the relationship between Anterior Head carriage and Limits of Stability. Participants were a convenience sample of thirty eight fully ambulatory consenting chiropractic college students between the ages of 18 and 45.

Inclusion criteria

Logan students, staff, faculty or general public, ages between 18 and 60, male and female will be able to be included in this study. All subjects must be able to maintain erector posture without the use of aids during the investigation, not suffer from vestibular conditions, systemic or autoimmune disorders, marked degenerative process, infectious process including meningitis, encephalitis, syphilis, have prosthetic limbs, suffer from neurologic disorders, such as epilepsy. No participants can be on medications which could alter awareness, including stimulants, muscle relaxants. Applicants with congenital deformities which alter posture will not be admitted.

Exclusion criteria

Exclusion of participants will be based on the following indicators; Marked degenerative disease that would affect balance. Any know visual, vestibular, or systemic disturbances that

would affect balance, i.e. any form of vertigo, disequilibrium. Systemic disturbance in relation to balance such as multiple sclerosis, Parkinson's disease. Severe migraine, epilepsy, CNS neoplasm or other neurological disorder. Any prosthesis device. Any medications; prescription or herbal muscle stimulants, relaxants, etc. Ages under 18 and over 60. Autoimmune disorders such as Cogan syndrome. Infectious processes, meningitis, encephalitis, epidural abscess, syphilis. Any congenital or acquired deformity that would alter posture or ability to stand own for 15 minutes without the use of aids.

Sample composition

After fulfilling the eligibility criteria, the subjects will be divided into Two: 1) those who have an anterior head displacement angle that is less than 90 degrees from a lateral upright position according to the PostureScreen readings and 2) those who have more than 90 degrees based on PostureScreen readings. Both groups will have same evaluation and testing

Students from the student body, as well as faculty and staff of Logan College of chiropractic will be recruited and instructed to maintain their normal daily activities before and after the study. See Table 1 for flow chart of sorting participants.

Equipment

NeuroCom's The SMART Balance Master® provides objective assessment and retraining of the sensory and voluntary motor control of balance with visual biofeedback on either a stable or unstable support surface and in a stable or dynamic visual environment. The System utilizes a dynamic 18" x 18" dual forceplate with rotation capabilities to measure the vertical forces exerted by the patient's feet; and a moveable visual surround.

Instruments

PostureScreen is a software program available on Apple products and will be utilized using an iPad. The PostureScreen application assesses subject's posture using an anterior and a lateral photograph. Appropriate markers will be placed on the subject to aid in the assessment of the photograph. Measurements will be taken in inches anterior or posterior.

Procedures

Each subject will be assigned a number based on the order that the subject presents to the study. The identification of each subject is to be protected by the assignment of subject numbers and following each with the subject's birth date. The information is protected under supervision in accordance with HIPPA laws as they may apply.

Each subject will have two pictures taken using the PostureScreen software; one taken from the anterior and the other taken from the right lateral side. Markers for the anterior assessment will be placed at each eye, one over the frenula of the mouth, two over each acromion process, one over the manubrium, approximately the anterior lateral 10^{th} rib, each anterior superior iliac spine (ASIS), over each anterior ankle. Makers for the right lateral assessment will be placed at the tragus of the ear, acromion process, greater tuberosity of the humerus, posterior to the patella, and the lateral malleolus.

After the subjects have been assessed using PostureScreen they are to have shoes removed and proper placement of the feet on the Neurocom balance plate. The subject will undergo 'Limits of stability' NeuroCom program. The subject is to hold an approximated neutral and will be tested

in eight directions of movement and attempt to hold each posture. The directions are tested clockwise in order of movements starting with Forward direction (F), followed by right forward (RF), Right (R), Right backward (RB), Backward (B), Left Backward (LB), Left (L), Left Forward (LF).

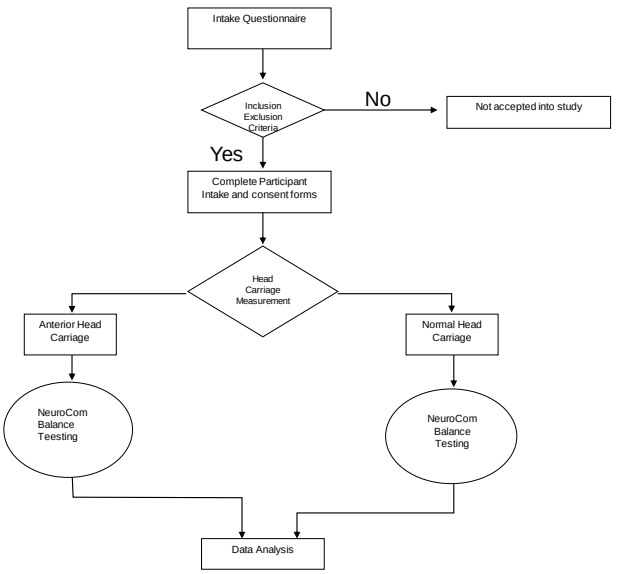
RESULTS

Complete data from 36 individuals was gathered with measurements on: Anteriority, RT Comp, MVL comp, DCL Comp, EPE, MXE.

Univariate correlations were all non-significant ranging from r=-.011, EPE, p=.949 to r=.252, MVL Comp, p=.139. Correlations < .30 are considered weak.

A multivariable linear regression model was derived using Anteriority as the dependent variable, with the others as independent, and no comparisons achieved statistical significance (all p>.05)

SAS 9.3(Cary NC) was used for all analysis.



Variable	Correlation with Anteriority Measurement
RT Comp	.036 (P=.835)
MVL Comp	.252 (P=.139)
DCL Comp	-.099 (P=.568)
EPE	-.011 (P=.949)
MXE	-.086 (P=.617)

Variable	Label	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	Intercept	1	1.76559	5.81851	0.30	0.7636
RT_Comp	RT Comp	1	0.23482	0.83579	0.28	0.7807
MVL_Comp	MVL Comp	1	0.18316	0.13517	1.35	0.1855
DCL_Comp	DCL Comp	1	0.01126	0.04781	0.24	0.8154
EPE	EPE	1	0.00294	0.02079	0.14	0.8884
MXE	MXE	1	-0.02361	0.05087	-0.46	0.6459

The REG Procedure
Model: MODEL1
Dependent Variable: Anteriority_measurement Anteriority measurement

Number of Observations Read	38
Number of Observations Used	36
Number of Observations with Missing Values	2

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	5	2.23448	0.44690	0.48	0.7898
Error	30	28.05499	0.93517		
Corrected Total	35	30.28948			

Root MSE	0.96704	R-Square	0.0738
Dependent Mean	1.74083	Adj R-Sq	-0.0806
Coeff Var	55.55041		

DISCUSSION

The authors were unable to find studies that directly compared the degrees of anterior head carriage and posture as they relate to the limits of stability. However, a study by Henry et, al. found that subjects with low back pain have altered automatic postural coordination, both in the terms of magnitude and timing of responses, indicating alteration in neuromuscular control.[13]

Anterior head carriage stresses the cervical spine and reduces the cervical curve, or creates a reverse lordosis. This study was to investigate a possible relationship between anterior head carriage and its affect on posture and subsequent balance. There may be a possible relationship between the vestibular pathway and the degree of anterior head carriage. Our study hypothesized that deviation from the plum line by anterior head carriage has a distinct relationship with poor balance and slower reaction time.

According to kapandji, for every inch of forward head posture, the increase of the weight of the head on spine is increased by an additional 10 pounds.[2]

Great care was taken in the placement of the markers, taking the photographs against a backdrop and proper placement of the subject on the NeuroCom plate, therefore the authors believe the anterior head measurement and limits of stability data are representative of the participants actual head carriage and balance as measured with the limits of stability.

Several limitations were worth noting. The data collected was on relatively young, healthy, chiropractic students and thus a generalization is limited. The “gold standard” of posture analysis, PosturePrint, was not utilized as a limit of time for the study. Future studies should include larger sample populations, along with other measurements and performance as they relate to balance

CONCLUSION

The results of the current study found no statistically significant relationship between anterior head carriage and the limits of stability. The amount of anterior head carriage had no correlation with how well each participant performed on the limits of stability. Future studies warrant investigation comparing limits of stability between participants with normal head carriage versus participants with anterior head carriage greater than 10 degrees.

REFERENCES:

1. Magee, David J., Orthopedic Physical Assessment. 5th edition. Saunders Elsevier 2006
2. Kapandji, IA, The Physiology of the Joints: the Turnk and the Vertebral Column, Volume 3, 2e (Trunk and Vertebral Column).
3. Mosby's Medical Dictionary, 8th edition. 2009, Elsevier. http://medical-dictionary.thefreedictionary.com/righting+reflex
4. *Neurocom products for balance and mobility*. (n.d.). Retrieved from http://www.onbalance.com/products/
5. Moor, Michele. Upper Crossed Syndrome and Its Relationship to Cervicogenic Headache. Received 30 September 2002; Revised 13 November 2002. Available online 19 August 2004.
6. National Research Council, Institute of Medicine. Musculoskeletal disorders and the workplace: Low back and upper extremities. National Academy Press, Washington, DC, 2001.
7. Journal of Occupational Health, Risk factors for upper extremity musculoskeletal symptoms among call center employees. Epidemiology Unit and Documentation Center for Health Promotion, ASL TO3-Piemont Region, Italy, 2010.
8. Torsten Skov, Vilhelm Borg, Elsa Orhede, Occupational and Environmental Medicine. Psychosocial and physical risk factors for musculoskeletal disorders of the neck, shoulders, and lower back in salespeople. National Institute of Occupational Health, Lerse Parkalle, Denmark, 1996.
9. Cooper CL, Payne R, eds. Causes, coping and consequences of stress at work. Chichester, New York, Brisbane, Toronto, Singapore: John Wiley, 1988.
10. Van den Heuvel SG, de Looze MP, Hildebrandt VH, the KH. Effects of software programs stimulating regular breaks and exercises on work-related neck and upper-limb disorders. Scand J Work Environ Health 2003; 29:106-16.
11. Raine, S.; Twomey, L.T. (1997). Head and Shoulder Posture Variations in 160 Asymptomatic Women and Men. *Arch. Phys. Med. Rehab.* Vol 78, pp. 1215-1223.
12. *Neurocom protocols: Motor impairment assessments*. (n.d.). Retrieved from http://www.resourcesonbalance.com/neurocom/protocols/motorImpairment/los.aspx
13. Henry, S., Hitt, J., Jones , S. & Bunn, J. (2006, June 27). Decreased limits of stability in response to postural perturbations in subjects with low back pain.*Clinical Biomechanics*, *21*(9), 881-92. Retrieved from http://bigbrother.logan.edu:2067/pubmed/16806618