

Static and dynamic balance in subjects with ankylosing spondylitis: literature review

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ABSTRACT

To analyze the musculoskeletal changes of individuals with ankylosing spondylitis (AS) and their repercussions on postural control, a literature review was carried out in the BIREME and EBSCO HOTS databases and Pubmed site with the following keywords: “ankylosing spondylitis”, “postural balance”, and “posture”. Articles involving human beings, assessing the postural control and balance of individuals with AS, written in English or Portuguese and published between 1999 and 2010, were selected. Of the total number of articles found, only four met the requirements. Of those, three compared the outcomes of patients with AS with data obtained from healthy individuals, and one article assessed individuals with AS. No article used the same method of postural analysis. To assess balance, Berg Balance Scale, Force Plate, and Magnometry were used. The major postural deviations found were increased thoracic kyphosis and hip flexion, which lead to a forward displacement of the body’s center of gravity, with knee flexion and ankle plantar flexion as compensation to control balance. Only one author reported worsening of functional balance in subjects with AS. All assessment methods used were considered capable of measuring balance, and no specific scale for patients with AS exists.

Keywords: ankylosing spondylitis, postural balance, posture.

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INTRODUCTION

Ankylosing spondylitis (AS) is a chronic inflammatory disease characterized by inflammation of the axial skeleton and by entheses, causing pain, stiffness, and occasionally progressing to joint ankylosis.¹⁻⁴ Postural control is defined as the capacity to maintain an appropriate relation between the body segments and the environment, adjusting the body to gravity and the task performed, in addition to properly positioning the center of mass in relation to the support base.⁵

To achieve postural stability, several systems, such as the vestibular, visual, somatosensory, and musculoskeletal systems, are used.⁵ In the individual with AS, those systems are sound, except for the musculoskeletal one, which is the effector portion related to the motor responses of postural control. The

patient’s joints are restricted, with muscle shortening and atrophy, leading to a reduction in the range of motion and flexibility, pain, in addition to deficient balance responses and strategies.^{6,7}

Thus, individuals with AS have a deficient postural control, with reactions of trunk adjustment restricted by the lack of mobility, altered ankle, hip and step postural control strategies, and altered muscle activation patterns. The reduction in the range of motion of the head and neck also affects postural adjustments, hindering gaze stability.⁸

Reviewing the literature about postural control in individuals with AS is extremely important, because it allows more effective and realistic interventions in such individuals. Thus, this review study aimed at assessing the musculoskeletal alterations in individuals with AS and their repercussions on postural control, in addition to assessing the scales used for that purpose.

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METHODS

A bibliographic review was performed in the Bireme and EBSCO HOTS databases and in the PubMed site with the following keywords: “ankylosing spondylitis”, “ankylosing spondylitis balance”, “ankylosing spondylitis postural control”, and “ankylosing spondylitis postural stability”. Articles involving human beings, assessing the postural control and balance of individuals with AS, written in English or Portuguese, and published between 1999 and 2010, were selected. The articles were analyzed according to the type of study, the case series, the postural analysis method used, the postural shifts found, and the respective changes in postural control.

RESULTS

Only four articles met the inclusion criteria established (Table 1). All of them involved field research, but the ways of analyzing postural control and balance differed, hindering the data analysis as a whole. To assess balance, the instruments used were the Berg Balance Scale (BBS),⁹ the study of the center of gravity displacements with force platform,⁸ and the Bath Ankylosing Spondylitis Metrology Index (BASMI).⁶ The major postural disorder found was an increase in thoracic kyphosis and hip flexion, leading to the forward displacement of the body’s center of gravity. Because of that position, compensation of knee flexion and ankle plantar flexion occurred to maintain balance.⁶⁻⁹

Because of those postural changes, two authors have found worse balance in individuals with AS, and one of them has reported a correlation between balance and pain.^{6,9} The authors have not ruled out the hypothesis that, with disease progression, the patients could not compensate the postural changes that lead to imbalance.

DISCUSSION

The studies assessed were analytical and cross-sectional, considered adequate for the questions proposed. The studies had significant sampling of the experimental and control groups, ranging from 30–70 individuals, except for that by Bot et al.,⁸ which assessed only four individuals with AS and 18 controls.

The studies by Souza et al.,⁹ Bot et al.,⁸ and Murray et al.⁷ have not reported some important data, such as the exact time the patient had to remain in the required posture, the position of the shoulders when measuring the occipital-wall distance and that of the arms when measuring chest expansion, whether there was an interval between the tests, and at which day time the assessment was performed. The interval between assessments, aiming at eliminating the effect of muscle fatigue, and the day time of the assessment, because of morning stiffness, should be controlled because they can influence the results.⁸

Swinkels et al.¹⁰ have suggested some hypotheses to explain the postural changes in AS. In addition to mobility limitation, antalgic position in response to sacroiliac or vertebral joint inflammation and muscle weakness due to a possible primary

Table 1
Summary of the articles found that met the study requirements

	Souza et al., 2008	Bot et al., 1999	Aydog et al., 2006	Murray et al., 2000
Objective	To assess balance and to correlate it with pain and quality of life	To assess the mechanism of compensation of trunk forward displacement	To assess the existence of deficient dynamic balance and the relation between balance and impairment	To assess the existence of deficient balance in individuals with AS as compared with healthy individuals, and whether balance and posture are related
Cohort	30 AS 30 control	4 AS 18 control	70 AS 35 control	30 AS 58 control
Type of study	Cross-sectional, controlled, cohort; field research	Field research	Field research	Field research
Method of analysis	BBS, VAS, SF-36	Force plate	BASMI, BSS	MST, OWD, CET, magnometry
Postural displacements	Pelvis retroversion	Hip flexion while standing; progressive kyphosis with forward displacement of the trunk CG	Thoracic kyphosis; forward displacement and lowering of the CG	Trunk forward flexion
Postural control changes	Worse functional balance of individuals with AS	Compensation: knee flexion and/or ankle plantar flexion	No deficient balance was found in the AS group. Compensation: knees and ankles	Insufficient balance with eyes open and eyes closed

AS: ankylosing spondylitis; BBS: Berg Balance Scale; SF-36: general questionnaire for assessing quality of life SF-36; VAS: Visual Analogue Scale; BASMI: Bath Ankylosing Spondylitis Metrology Index; BSS: Biodex Stability System; CG: center of gravity; MST: modified Shober’s test; OWD: occipital-wall distance; CET: chest expansion test.

denervation process might be related. Murray et al.⁷ have also considered the adoption of an antalgic position (the forward trunk inclination) as a possible trigger for postural changes. According to those authors, the forward flexion shortens the soft tissues and increases calcification of the entheses, establishing postural changes. The characteristic changes in patients with AS include straightening of the lumbar lordosis, accentuation of the thoracic kyphosis, and head protraction, manifesting as an increase in upper cervical extension and lower cervical flexion, in accordance with the findings of the studies assessed.¹⁰

Souza et al.⁹ have reported worse balance in individuals with AS as compared with that of healthy individuals, in addition to a positive correlation between pain (assessed by use of the pain Visual Analogue Scale) and balance (assessed by use of the BBS). Aydog et al.⁶ have reported no balance deficiency, but a positive correlation between the occipital-wall distance (BASMI) and the mediolateral stability measure assessed by use of the Biodex Stability System (BSS). A high occipital-wall distance indicates deficient balance – thus, a disorder in dynamic balance can actually occur in AS.

The results by Bot et al.⁸ have shown that individuals with AS can hardly extend their hips when in the standing position, maintaining that joint flexed. This increases imbalance, because it causes forward displacement of the center of gravity. The study by Van Royen et al.¹¹ has assessed, by use of sagittal vertical axis radiography, individuals with vertebral deformities correlating postural changes and compensations to maintain balance. The increase in hip extension is used to compensate the forward displacement of the trunk's center of mass, thus maintaining balance in the standing position. As deformities progress, the compensation generated by the hips is no longer effective.

According to Aydog et al.,⁶ other compensations found are knee flexion and ankle plantar flexion. Due to musculoskeletal changes, individuals with AS do not use the hip strategy, requiring the other two strategies as compensatory adjustments to avoid falling when the projection of the center of gravity is outside the supporting base.⁵ Disease progression changes postural stability and compensations, mainly aimed at maintaining functionality and adaptation to daily activities.¹²

Murray et al.,⁷ studying patients with AS, have assessed their static balance with eyes open and eyes closed and compared the results with those of normal individuals. In addition, the modified Schober's test, occipital-wall distance, and chest expansion test were used. The values achieved by the group

with AS were below the normal limit with eyes open and eyes closed. Those results can indicate that patients with AS might have proprioceptive deficits due to the pathology.

The same has been proposed by Swinkels et al.,¹⁰ who have reported that the proprioceptive deficit leads individuals with AS to impaired balance. According to those authors, the possible proprioceptive deficit results from the pathologic involvement of the spinal entheses, characteristic of patients with AS. The entheses contain proprioceptive afferents, leading to a change in the spinal position sense. That hypothesis has been verified by an electromagnetic movement analysis system, which measured the accuracy of those subjects in repositioning their spines in the standing and flexed positions. No significant changes in the spinal position sense were found in patients with mild to moderate disease. The researchers have suggested that other proprioceptors might have compensated the affected proprioceptors, because recent research has shown that the capacity of conscious perception of posture and movement depends basically on the information provided by the muscle fuses and Golgi tendon organs, the other receptors playing a secondary role.^{13,14}

Butler et al.¹⁵ have reported that the decrease in proprioception might be related to muscle weakness of the lower limbs, the segment that represents the major source of sensory input used to detect body sways. For that, the researchers have measured the muscle strength of the lower limbs, by using a torquemeter, in three groups as follows: subjects with post-poliomyelitis syndrome, 60–69 year-old women, and women over 70 years. Subjects with significant weakness, even detecting instability, cannot generate an adequate torque in the ankle muscles to correct imbalance. Thus, they compensate increasing the muscle contraction status, which might affect proprioceptive accuracy.

One can suppose that the association between enthesopathy, which affects the afferent proprioceptors, and muscle weakness can justify the deficient balance of individuals with AS. In addition, Murray et al.⁷ have emphasized that, in the aging process, a reduction in balance and loss of mobility occur. The aging process causes a decline in the functional quality of all systems participating in postural control, mainly in sedentary individuals, who also experience a reduction in the muscle strength of their lower limbs.¹⁶

The articles discussed here used methods that assessed only the anticipatory component of balance. The BBS assesses the static and dynamic balances by using usual tasks, such as reach, standing position, and transferences.⁶ The BSS assesses static balance by using a mobile balance platform that provides up to 20° of inclination on a 360° surface.⁸ Magnometry assesses

static balance by measuring the movement of the hips on the horizontal plane, by using electromagnetic transmitters and coil receptors.⁹

The authors consider that the methods used can measure the balance of individuals with AS, but no specific scale to measure balance in that population has been developed. Regarding the assessment of the compensatory adjustments, the existing scales of easy clinical applicability are scarce. Of the methods related to the assessment of compensatory postural adjustments, dynamic posturography,¹⁷ postural stress test,¹⁸ and sternal nudge test stand out, although, so far, no studies of such instruments in individuals with AS exist.¹⁹

CONCLUSION

The major postural changes found in patients with AS were accentuation of thoracic kyphosis with forward displacement and lowering of the center of gravity, and hip flexion, which causes the compensations in knee flexion and ankle plantar flexion. The assessment methods used were considered capable of measuring static and anticipatory balance, but no specific scale has been found to assess the balance of individuals with AS.

The population with AS has been rarely studied regarding postural control, both dynamic and static. Further studies are required to establish the actual status of postural control in that population.

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