ABSTRACT
Ankylosing spondylitis is a chronic inflammatory disease that mainly affects axial joints and the changes in the vertebrae cause typical kyphotic posture. In patients with ankylosing spondylitis, the postural changes, including cervical flexion, decreased lumbar lordosis, posterior rotation of pelvis, hip extension, knee flexion, and plantar flexion of ankle along with kyphosis, may occur in the upcoming terms of the disease and may negatively affect balance. Joint and eye involvements; muscular, vestibular and proprioceptive changes can also affect balance. This review evaluates the ankylosing spondylitis-equilibrium relationship together with posture and other parameters of balance.

Keywords: Ankylosing spondylitis, balance, posture

Introduction
Ankylosing spondylitis (AS) is a chronic inflammatory disease that mainly affects axial joints and may cause limitations in spinal mobility [1]. As the disease progresses, the changes in the vertebrae cause typical kyphotic posture [2]. There is also pain and limitation in joint range of motion due to peripheral joint involvement and enthesis.

Balance disorders in AS may develop as a result of postural changes, muscle shortness, atrophy, joint involvement secondary to the disease, and movement limitations due to pain [3].

Parameters such as pain, function, spinal mobility, stiffness, fatigue, and patient global assessment were proposed for evaluation of patients in the core set of criteria described by the Assessment of Spondyloarthritis International Society and there is no recommendation for assessing equilibrium. There is limited number of studies on balance with AS patients in the literature. Many of these studies focused on the postural features of patients with AS [4].

In this review, the association between AS and balance is discussed in regard to muscle strength, proprioception, and vestibular and visual changes together with posture.

Discussion
Balance is defined as postural adaptation to changes in the gravity center at times of rest and activity [5]. It requires the coordination of visual, auditory, proprioceptive, and neuromuscular systems along with the central nervous system [6]. Balance plays an important role in maintaining daily activities. The musculoskeletal system may be exposed to trauma after falling in people with...
Postural and structural changes can also be seen in peripheral joints. In a study that examined the characteristics of patients with AS, involvement one or more peripheral joints was detected in 65.7% of patients. It was reported that the vast majority of them were in the lower extremities as hypothesized previously by Bot et al. [8]. However, in another study conducted with the same model device, only one patient with tragus wall distance longer than 30 cm was included and it was shown that the anteroposterior, mediolateral, and mean balance values were all negatively affected [13]. However, the use of different model devices makes it difficult to compare the assessments and analyses between studies.

Peripheral joints
Postural and structural changes can also be seen in peripheral joints. In a study that examined the characteristics of patients with AS, involvement one or more peripheral joints was detected in 65.7% of patients. It was reported that the vast majority of them were in the lower extremities and that they presented asymmetric patterns. Enthesis may also affect joint structures and are often observed around the Achilles tendon [14]. Although it is suggested that the lower extremity joints may contribute to the preservation of the compensatory balance in relation to changes in the spinal column [8], it should be considered that arthritis and enthesis may occur in the lower extremity joints and this may affect adaptation.
Muscles
Muscle structures are also important in the preservation of posture. Hip and knee joints tend to extend while the ankle joints tend to dorsiflex. When patients with AS were compared with healthy populations, a reduction in the strength of the quadriceps was found in several studies with different methods such as isokinetic tests [15] and quantitative surface electro neuro myography [16]. It is known that there is a tendency for knee flexion and ankle plantar flexion posture in the patients with AS; but planar flexor muscle strength reduction was found in an isokinetic test assessment study [17].

Proprioception
Another factor that affects balance is proprioception. In a study with mild AS patients, there was no worsening in the proprioception of the spine as the disease progressed [18]. Çınar et al. [19] reported that a tandem Romberg test with closed eyes was an indicator of proprioception and significant impairment was detected in patients with AS compared to healthy subjects. However, the proprioceptive change may also occur in peripheral joints. In a study conducted with osteoarthritis patients, there was increased impairment in knee proprioception compared to healthy volunteers [20]. It is known that joint effusion has negative effects on proprioception [21]. Although active disease state is often excluded in balance studies of AS, there may be subclinical effusion and degeneration in the peripheral joints.

Vestibular system
There are studies that reported increased frequency of vestibular pathologies in patients with AS, which may be due to an intra labyrinthical autoimmune process or ischemia [22]. In a study that evaluated patients with psoriatic arthritis, which is another type of spondyloarthritis, the frequency of bilateral symmetrical hearing loss and abnormal vestibular test results were higher than in the control group [23]. However sensorineural dysfunction was shown in vasculitis and diseases in which autoimmune mechanisms are predominant, such as systemic lupus erythematosus [23]: vestibular dysfunction in the patients with spondyloarthritis appears to be a topic that is open to investigation.

Visual system
The visual system provides the strongest support to the vestibular system and even the smallest defects in the visual system can negatively affect balance [24]. The most discussed issue in the literature is the restriction of gaze due to decreased spinal motion in patients with advanced kyphosis and cervical involvement [8].
However, when evaluated in terms of ocular findings, typical ocular involvement in AS is anterior uveitis and mechanical ptosis. Also, superficial epithelial keratitis, episcleritis, scleritis, and corneal ulcer rarely occur. Especially long-lasting and uncontrolled attacks can lead to the spread of inflammation to the posterior segment and to decreases in vision [25].

The effect of visual status on balance in AS has been investigated quite rarely. In a study investigating the effect of visual inputs on the postural control of patients with AS, measurements were taken on a baropodometric platform (FDM-S, Zebris, Germany) in healthy subjects when the eyes were closed and open. The most striking result in the computer-aided measurements was observed in the frequency bandwidth. The increase in frequency bandwidth indicates an increase in the efficacy of posture graphic motor commands, which provide rapid control of oscillations in the foot pressure center. The visual input changes between AS and healthy subjects were similar for almost all parameters but no difference was observed in frequency bandwidth in the anteroposterior direction in the individuals with AS. When the eyes were closed, the oscillations were wide and were low velocity in the anteroposterior direction for healthy subjects, and they were rapid and had high amplitude in the patients with AS. The researchers surmised that the patients with AS were more likely to rely on visual input for sustaining the balance and that there was increased worsening in balance compared to healthy subjects when their eyes were closed [26]. The authors suggested that this change, which occurred without pathology in the central nervous system or visual pathway, could indicate impaired motor control or problems in the feedback mechanisms from lower extremity musculature.

In another study evaluating visual input, visual frontal panel pressure center was increased on the force platform (AMTI, Model OR6-7; Advanced Mechanical Technologies, Inc., Watertown, MA, USA) in patients with AS. The authors suggested that the confidence in visual input may be increased due to the somatosensory or vestibular pathologies in AS patients [2].

In conclusion, AS is a disease that mainly involves axial joints and may also influences other systems. These impairments may have negative effects on balance. Considering that balance may be affected by visual, vestibular, and proprioceptive changes in addition to skeletal muscle structures, more multidimensional studies on the association between AS and balance are needed.


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References