

Cervical Vertebral Squaring in Patients without Spondyloarthritis

To the Editor:

Vertebral squaring, or straightening of the anterior border of the vertebral body, is a well recognized radiographic feature of spondyloarthritis (SpA)¹. Squaring can be designated as a pathological change when it occurs in vertebrae in which the normal contour of the anterior border is concave. If the normal contour is not concave, it would not be possible to designate squaring as a pathological change. Although lumbar vertebrae typically have a concave anterior border, the radiographic appearance of cervical vertebrae is more heterogeneous. For example, the sagittal projections of C2 and C3 are normally square or trapezoidal. To be able to ascribe squaring as a pathological change in patients with SpA, it is necessary to know what proportion of cervical vertebrae naturally has the prerequisite concave anterior border and what proportion is naturally square on radiographs.

We examined lateral cervical spine radiographs of 100 adults without SpA who were participants in clinical protocols at the National Institute of Arthritis and Musculoskeletal and Skin Diseases. All patients provided written informed consent. We first identified all patients who had lateral cervical radiographs between 2002 and 2011 from computerized medical records. After excluding patients with any form of SpA and radiographs of suboptimal quality, we randomly selected the radiographs of 50 women and 50 men. Radiographs were read independently by 2 experienced readers, a rheumatologist (MMW) and a musculoskeletal radiologist (TJL). Each reader scored vertebrae C3 through C7 for shape (concave or square). As a second method of evaluation, each reader also scored the radiographs for squaring by the modified Stoke Ankylosing Spondylitis Spine Score (mSASSS)².

The median age (25th, 75th percentile) of the patients was 53 years (range 42–60). The most common diagnoses were rheumatoid arthritis (35%), osteoarthritis (24%), and neck/arm pain (23%). Interreader agreement on vertebral shape was good (pooled $\kappa = 0.60$). The proportions of patients with concave anterior vertebral borders were 0% for C3, 8% for C4, 40% for C5, 46% for C6, and 18% for C7, based on averaged results of the 2 readers. Results were closely similar between men and women. Scores for squaring of vertebral corners with the mSASSS method provided similar results, although readings differed somewhat between readers (Table 1). Between 4% and 23% of vertebral corners of C5 and C6, and up to 53% and 55% of vertebral corners of C4 and C7, were found to have squaring by this scoring method.

These results indicate that C4 and C7, in addition to C3, rarely have

concave anterior borders normally, and that C5 and C6 are concave in fewer than half of patients. These findings confirm the results of Kim and colleagues, who reported squaring in 44% to 63% of vertebral corners of C4 and C7, and in 2% to 15% of corners of C5 and C6, in a sample of younger healthy subjects³. The finding that concave anterior borders are commonly present in only C5 and C6, and here in only a minority of patients, raises questions regarding the face validity of vertebral squaring as a radiographic feature of SpA in the cervical spine.

Although squaring is most evident as a change at the waist of the vertebral body, in the mSASSS abnormalities are credited to the vertebral corner. The absence of concavity in cervical vertebrae makes it difficult to apply these scoring rules to detect squaring. This uncertainty likely contributed to the variation in scores among readers, and may increase measurement error of the mSASSS⁴.

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Table 1. No. patients (n = 100) with squaring by modified Stoke Ankylosing Spondylitis Spine Score in cervical vertebrae 4 through 7.

Vertebral Corner	Proportion with Squaring	
	Reader 1	Reader 2
C4 upper	20	37
C4 lower	55	37
C5 upper	4	9
C5 lower	16	9
C6 upper	9	7
C6 lower	23	7
C7 upper	43	30
C7 lower	53	30