Computerized Quantification of Inflammatory Activity in Ankylosing Spondylitis

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Background. Enthesopathy is the hallmark of inflammatory activity in ankylosing spondylitis (AS) and primary affects the vertebral body corners. Several subjective scoring systems are used to grade the degree of enthesis or inflammatory activity on MR imaging. While computerised quantification methods have been effectively used to measure inflammatory activity on MRI in other inflammatory disorders such as rheumatoid and psoriatic arthritis, to date no such quantification system exists for AS. Such a system would allow a more objective assessment of inflammatory activity and a treatment response applicable to everyday practice and clinical trials.

Purpose: To provide a computerized quantification of the degree and location of inflammation (enthesitis) on MRI.

Materials and Methods: Twenty-eight patients (age>18 yrs) with active AS were treated with a metotrexate-infliximab combination for 30 weeks. Spine MRI examination was performed at baseline and 30 weeks on a 1.5T MRI system with fat-suppressed sagittal T1-weighted images being acquired. Following manual location of the four vertebral corners, vertebral body segmentation of five midline parasagittal images from T5 to L5 was automatically performed using a novel deformable model. For each vertebral corner , a 'vertebral corner area' was automatically assigned (Fig. 1) with corner area programmed to vary according to vertebral body area thus ensuring that vertebral corner area increased or decreased proportionate to vertebral body size. The 'non-corner area' was that portion of the vertebral body excluding the vertebral corner areas and a posterior triangle incorporating the basi-vertebral vein (also automatically assigned) (Fig 2). As absolute signal intensity and enhancement is not standard for all MRI examinations, 'relative corner enhancement' was employed i.e. the signal intensity of a vertebral corner divided by the average intensity of the non-corner vertebral area. Analysis for each spine study took only eight minutes to complete. The following comparative analyses were performed , inter-rater reliability, comparison with subjective MR assessment (ASspiMRI index) and comparison with subjective clinical assessment (BASDAI)

Results: Excellent inter-rater correlation for quantitative analyses was found (R>0.99). Pre-treatment, RCE was greater in the lumbar than the thoracic vertebrae (P=0.005) and posteriorly rather than anteriorly (P<0.001). Following treatment, larger decreases were found at the anterior corners than in the posterior corners (P<0.001). There was no significant difference in post-treatment response for the thoracic or lumbar spine (P=0.715) or the superior corners compared with the inferior corners (P=0.403). Overall RCE decreased by 2.0%±3.3% post-treatment. Moderate correlation (R=0.347, P=0.009) were found between subjective and automatic overall measurement results.

Conclusion: Computerized quantification of inflammatory activity in AS is possible. The proposed quantification method seems objective, sensitive, discriminatory and practical.
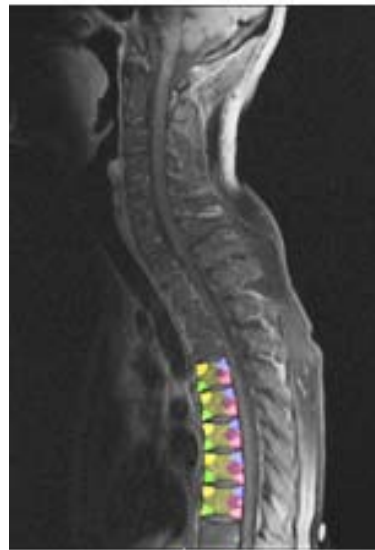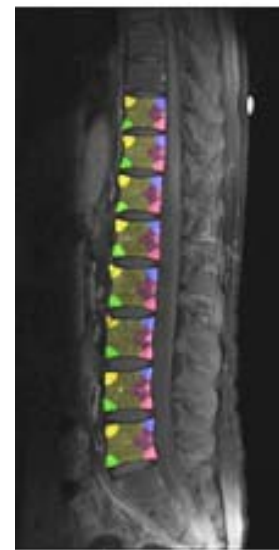

Figure 1

Figure 2(a)

Figure 2(b)