Abstract. Morphometric techniques, which use conventional lateral spine radiographs to quantify vertebral body shape (morphometric radiography, MRX), have proved a useful tool in the identification and evaluation of osteoporotic vertebral deformities. Recently a new method of acquiring the images required for vertebral morphometry using dual-energy X-ray absorptiometry scanners (morphometric X-ray absorptiometry, MXA) has been developed. In this study we compare repeat analysis precision of vertebral height measurement using MXA and MRX. Twenty-four postmenopausal women were recruited (mean age 67 ± 5.8 years): 12 normal subjects and 12 with osteoporosis and vertebral deformities. Each subject had a MXA scan and lateral thoracic and lumbar radiographs at a single appointment, which were each analyzed quantitatively in a masked fashion, using a standard 6-point method, twice by one observer and once by a second observer. Anterior (Ha), mid (Hm) and posterior (Hp) vertebral heights were measured and wedge (Ha/Hp) and mid-wedge (Hm/Hp) ratios calculated for each vertebral body. Intra- and interobserver precision were consistently poorer in MXA compared with MRX in both normal subjects and those with vertebral deformities, with MXA CV% generally at least 50% higher than corresponding values for MRX. For both MXA and MRX interobserver precision was clearly poorer than intraobserver precision, a problem associated with any morphometric technique. MXA intra- and interobserver precision were significantly poorer for subjects with vertebral deformities compared with those without, with a CV% for deformity subjects up to twice that of normal subjects. Conversely, MRX showed little or no obvious worsening of intra- or interobserver precision for deformity subjects. Comparison of MXA precision in the normal and deformed vertebrae of the deformity subjects demonstrated that the poorer precision in these subjects compared with normal subjects was the result of increased variability in point placement on the deformed vertebrae themselves. However, the precision for normal vertebrae in these subjects was also somewhat poorer than the precision in normal subjects. We conclude that MXA precision is generally poorer than that of MRX and that the presence of vertebral deformities has a more pronounced effect on MXA precision than on MRX precision.

Keywords: Morphometric radiography; Morphometric X-ray absorptiometry; Osteoporosis; Precision; Vertebral deformities

Introduction

Vertebral fractures are the most frequently observed osteoporotic fracture [1] and are an integral part of the so-called osteoporotic syndrome [2]. It has been estimated that 1 million women in the UK, aged 50–79
years, have some kind of vertebral deformity [3]. The consequences of vertebral fractures include back pain, kyphosis and loss of height [2] and they are associated with reduced survival rates [4,5]. The presence of one or more vertebral fractures also substantially increases the risk of further vertebral [6] and nonvertebral [7] fracture. However, two-thirds of radiographically diagnosed vertebral fractures are asymptomatic [8] and as a result many fractures do not come to medical attention.

Morphometric techniques, which use conventional lateral radiographs of the thoracic and lumbar spine to quantify vertebral body shape (morphometric radiography or MRX), have been applied to the identification and evaluation of osteoporotic vertebral deformities since the 1960s [9,10]. They have proved a useful tool in the identification of both prevalent and incident vertebral deformities [11], in epidemiologic studies [3,12] and clinical trials [13]. However, MRX is affected by inherent problems such as the image magnification and distortion associated with the use of a cone-beam and exposure of the subject to a relatively high radiation dose [14].

Recently a new method to acquire the images of the spine required for vertebral morphometry has been developed utilizing fan-beam dual-energy X-ray absorptiometry (DXA) scanners [15–23]. Term morphometric X-ray absorptiometry (MXA), the technique has several advantages compared with conventional MRX. These include a significant reduction in effective patient dose [14,18], no magnification or distortion of the image by utilizing orthogonal fan-beam geometry, acquisition of a single image of the whole spine, and simple and reproducible patient positioning. However, the reduced spatial resolution and increased image noise characteristic of MXA images result in a decrease in image quality when compared with MRX (Fig. 1).

![Fig. 1a–c. Lateral images of the spine of a 72-year-old female study subject (BMI 21.6, lumbar sBMD 492 mg/cm^2, T-score −5.36). a Single-energy MXA scan; b dual-energy (high-definition) MXA scan; c thoracic and lumbar conventional radiographs.](image-url)