Is there any difference between the British and Japanese definitions of the mandibular cortical index (MCI) on panoramic radiographs? A pilot study

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Abstract

Objectives. To assess the reproducibility of the mandibular cortical index (MCI) on panoramic radiographs among British and Japanese observers, and to investigate the difference between the British and Japanese observers in the definition of MCI.

Methods. Three observers, a Japanese oral radiologist, a British oral radiologist, and a British prosthodontist, classified the inferior cortex of the mandible on a set of 100 duplicated films of randomly selected panoramic radiographs twice, 2 weeks apart, using the MCI. The kappa index for intra- and interobserver agreement was calculated for the three observers.

Results. The kappa index for intraobserver agreement was moderate (0.56) to perfect (0.86) for the three observers. Interobserver agreement between the Japanese and the British oral radiologists was moderate at the first reading (kappa, 0.59) and substantial at the second (0.61). Interobserver agreement between the prosthodontist on the one hand and each of the oral radiologists on the other was fair (0.35, 0.38) at the first reading, but moderate (0.43, 0.60) at the second reading. The prosthodontist tended to overestimate the MCI compared with either of the oral radiologists.

Conclusion. Our results suggest that the definition of MCI used by Japanese observers is basically similar to that used by British observers, although some improvements in the definition of MCI would be necessary for clinical dental practice.

Key words Index · Mandible · Cortex · Radiograph · Panoramic · Reproducibility

Introduction

Some investigators have suggested that the mandibular cortical index (MCI) on panoramic radiographs, originally devised by Klemetti and coworkers in 1994, may be associated with mandibular bone mineral density (BMD), mandibular cortical bone quality, general skeletal BMD, and general skeletal bone turnover rate. Bollen et al. and Persson et al. demonstrated that the MCI can be used to predict an increased risk of osteoporotic fracture. We recently demonstrated that the MCI can also be used to identify women who are at an increased risk for atherosclerosis or osteoporosis. These findings imply that dentists may be able to identify asymptomatic persons with osteoporosis, atherosclerosis, or both from among their dental patients, and thus to facilitate medical care. Further, the MCI might be used to predict an increased risk of periodontal disease progression.

Since the MCI is a subjective assessment of the morphology of the inferior cortex of the mandible on panoramic radiographs, reproducibility among observers is an important factor in judging whether the MCI can be a useful tool in clinical dental practice. Klemetti et al., Zlataric et al., Taguchi et al., and Bollen et al. have independently reported satisfactory levels of intra- and interobserver agreement among trained dentists and oral radiologists. However, British investigators have suggested more
limited interobserver agreement. Jowitt et al.,14 in a study of dental students as subjects, reported fair interobserver agreement among four MCI assessment experts using the kappa index. On the other hand, Devlin et al.15 found marked variations in the repeatability of MCI in a group of British general dental practitioners. Therefore, it is controversial whether the reproducibility of the MCI is sufficiently high to permit its clinical use. Furthermore, it is not known whether the definition of the MCI varies among institutions. If the original definition of the MCI presented by Klemetti et al.2 is interpreted in different ways, then there will be difficulties in reconciling research findings from different institutions and doubts over the worldwide applicability of the index.

The aims of this study were therefore to measure the reproducibility of the MCI among British and Japanese observers, and to investigate any difference in the definition of the MCI among these observers.

Materials and methods

Panoramic radiographs

The radiographs used in this study came from a pool of 810 patients (297 men, 513 women) aged 40 years or more (range 40 to 89 years) who had visited the Hiroshima University Dental Hospital between 1999 and 2000. We selected 100 panoramic radiographs randomly and were blinded to patient age or sex; the record number was the only identifier. Radiographs were excluded if destructive bone lesions (e.g., malignancy) were present, or if the mandibular inferior cortex was not clearly visible bilaterally. All panoramic radiographs were obtained with an AZ-3000 X-ray unit (Asahi, Kyoto, Japan) at 12mA and 15s; the voltage varied between 70 and 80kV. Speed group 200 screens (HG-M, Fuji Photo Film, Tokyo, Japan) and film (UR-2, Fuji Photo Film) were used. To make copies of the 100 original panoramic radiographs, we used a set of duplicating film (MI-Dup, Fuji Photo Film), processed by an automatic film processor (Cepros M, Fuji Photo Film).

Assessment of mandibular cortical index (MCI)

Three observers – one Japanese oral radiologist (observer A), one British oral radiologist (observer B), and one British prosthodontist (observer C) – were asked to determine independently the MCI on a duplicate of each of the 100 panoramic radiographs. At the time of MCI measurement, observer A had 12 years’ experience as a specialist practising in panoramic radiography, and observer B had 15 years’ experience. Observer C had 20 years’ experience in clinical dental practice. All observers had 5 years or more experience in using the MCI. The definition of Klemetti et al.1 was used to determine the MCI, as shown in Fig. 1:

Class 1 (C1): the endosteal margin of the cortex is even and sharp on both sides;

Class 2 (C2): the endosteal margin shows semilunar defects and/or endosteal cortical residues;

Class 3 (C3): the cortical layer forms coarse endosteal cortical residues and is clearly porous.

Prior to this study, there was no calibration of or discussion about the definition of the MCI between the Japanese and the two British observers. All three observers independently read the 100 duplicate films twice, with an interval of 2 weeks between their assessments.

Data analysis

The intra- and interobserver agreements on the MCI among the three observers were calculated as Cohen’s kappa index using SPSS software (SPSS 4.0, SPSS, Chicago, IL, USA). Kappa index values ranging from 0.00 to 0.20 were termed “slight,” 0.21 to 0.40 “fair,” 0.41 to 0.60 “moderate,” 0.61 to