

# Mandibular cortical width measurement based on dental panoramic radiographs with computer-aided system

\*Przemysław Maćkowiak, \*\*Tomasz Kulczyk, \*\*\*Elżbieta Kaczmarek

\*Faculty of Electronics and Telecommunications  
University of Medical Sciences  
Poznań University of Technology, Poland

\*\*Department of Biomaterials and Experimental Dentistry  
University of Medical Sciences  
Poznań University of Technology, Poland

\*\*\*Department of Bioinformatics and Computational Biology  
University of Medical Sciences,  
Poznań University of Technology, Poland

**Abstract**—The paper presents a method of the determining a mandibular cortical width on dental panoramic radiographs. Cortical width of lower border of mandible may potentially be associated with recognition of osteoporosis in postmenopausal women. An algorithm to perform a semiautomatic cortical width measurement in a given region of interest was developed. The algorithm is based on separate extraction of lower and upper boundaries of cortical bone. Results of boundaries extraction performed on 34 panoramic radiographs of healthy and osteoporotic individuals are presented, together with automatic measurements of particular distances. They were compared with results of hand-made measurements done by two maxillofacial radiologists. Presented algorithm may potentially be useful for screening patients with osteoporosis.

**Index Terms**— dental panoramic tomogram, dentistry, edges extraction, osteoporosis, segmentation.

## I. INTRODUCTION

Osteoporosis is characterized by low bone mass density and deterioration of microarchitecture of bone. This disease is resulting in increased skeletal fragility and fracture susceptibility and is recognized as one of causes of morbidity and mortality in postmenopausal women [1]. Low bone mass density (BMD) can be diagnosed by means of densitometric techniques such as double-energy X-ray

absorptiometry (DEXA) method performed in the region L1-L4 of spinal column or a hip. This method is very precise however is rather expensive, requires some fine equipment usually located in specialized medical centers and cannot be performed on large population group. Therefore many authors suggest that some other potentially cheaper and more accessible methods of recognition of disease should also be developed. These methods may not necessarily be used to make a full diagnosis of the osteoporosis but to be helpful for screening of larger populations. One of proposed method is based on estimation of some parameters of mandible. Correlations between low parameters of mandibular BMD and the BMD of the spinal column and hip have been found in some studies [2],[3]. Also a densitometry of the mandible has been done by some of the authors but this method is restricted to be used in edentulous patients only [4]. Dental panoramic images are used extensively in dental practices all over the world. The sample image was shown in Fig. 1A. On these radiographs some anatomical and pathological structures can be found and information provided by panoramic images are helpful to establish a proper diagnosis, to propose a treatment plan and to evaluate the results of the treatment. Panoramic radiograph provides an excellent image of mandible with clear details of cortical bone and as truly cheap and easily available method for the large population should be considered one potentially useful for screening of osteoporosis. A number of studies in this field use panoramic X-rays for the estimation of different mandibular parameters [5]. These are mainly the distances between particular elements on the body of mandible. As a result thickness of cortical part of the bone (so called cortical width) can be

















