THE INNOVATIVE REMS TECHNOLOGY FOR EARLY OSTEOPOROSIS DIAGNOSIS AND FRACTURE RISK PREDICTION

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Worldwide, osteoporosis causes more than 8.9 million fractures annually, resulting in an osteoporotic fracture every 3 seconds1 that evokes the need for the introduction in the clinical routine of innovative tools able to better define and estimate bone strength and to predict the risk of fracture.

This work summarises the features and basics principles of the innovative non-ionizing, portable, fast and fully-automatic method for bone health evaluation called Radiofrequency Echographic Multi-Spectrometry (REMS). The innovative ultrasound-based approach enables the evaluation of the bone mineral density (BMD) on the axial sites (hip and lumbar spine) considered by the World Health Organization (WHO) as the reference sites for the diagnosis of Osteoporosis.

The REMS densitometer is represented by a small ultrasound device equipped with a 128-element convex probe with a frequency of 3.5 MHz and a proprietary software that provides a user interface and a diagnostic algorithm. When a REMS measurement is performed on either of the two axial sites, a fully automatized algorithm recognizes the native raw unfiltered ultrasound signals and converts it into spectra that will be compared with derived reference spectral model of normal and pathological conditions. The signals deriving from the region of interest comprising the bone will be used to estimate the bone density expressed in terms of BMD (g/cm2), T-score and Z-score, whereas signals affected by the presence of artefacts will be automatically recognized and discarded.2

The results of a multicentre study conducted on 1914 postmenopausal Caucasian women aged-between 51 and 70 years show a sensitivity and specificity of above 90% for both lumbar and femoral sites, a very good diagnostic concordance with Dual-energy X-ray absorptiometry (DXA) and precision (intra–operator repeatability RMS-C 0.38% for spine and 0.32% for femur) and repeatability (inter-operator repeatability RMS-C 0.54% for spine and 0.48% for femur) higher than the gold standard DXA3. Such results have been confirmed on additional data analysed in different European studies4-5. In addition, another study that enrolled and followed 1370 women between 2013 and 2017, assessed the incidence of fragility fractures in patients who suffered a fragility fracture during the follow-up period and in those who did not. All patients underwent both DXA and REMS lumbar scans and results show that REMS had a better performance than DXA in the considered population, showing higher values for both sensitivity and specificity in the identification of fragile patients and identifying REMS T-score as an effective predictor for the risk of incident fragility fractures6. The advantages of REMS technology compared to the currently existing image-based methods for bone strength assessments have recently been confirmed by the European Society for Clinical and Economic Aspects of Osteoporosis, Osteoarthritis and Musculoskeletal Diseases (ESCEO) that recognize REMS as an innovative device able to satisfy the actual clinical needs in terms of non-invasiveness, timing in osteoporosis diagnosis and bone status follow-up7.

The non-invasive nature of REMS examination widens out the borders of investigation on osteoporosis diagnosis, and more in general, on the bone health status of the entire population being suitable also for young population and pregnant women; it also narrows the time-window requested for drug treatment follow-up, supporting the chance for a fine-tuned drug therapy. Finally, the easiness of use and portability as well as the fully-automatic diagnosis makes REMS the first non-invasive direct method for the estimation of BMD and a promising tool which adoption in clinical routine is expected to increase in the near future.

KEYWORDS: REMS technology; osteoporosis; fracture prediction.

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