INTRODUCTION

The Trabecular Bone Score (TBS) is a grey-level texture measurement. It permits to accurately differentiate between two 3D microarchitectures that exhibit the same amount of bone, but different trabecular characteristics [1]. Recently, we have extended the TBS process in creating a coloured TBS map reporting at each point an information of “local” TBS value. A high value of TBS (green colour) is related to a good microarchitecture and low value of TBS (red colour) is related to a bad microarchitecture.

In a set of 289 lumbar DXA scans from Prodigy Lunar database, a validation has been done in evaluating the correlation between TBS value, as evaluated from global process [1], and mean local TBS value, as evaluated from TBS map calculation at L1-L4 spine region. (P=0,98,p<0,0001).

OBJECTIVE

The aim of the study was to determine and evaluate a classification method of fractured and non-fractured subjects based on TBS map visual analysis and performed by an operator.

METHODS

STUDY DESIGN

Retrospective double blind pilot study based on the re-analysis of spine DXA images.

POPULATION

- General inclusion criteria
  - Caucasian postmenopausal women
  - 50-70 years
  - 195M<33
  - Osteoporotic (T-score<2 at L1-L4)
- Fractured subject matched for age (±3 years) with 2 control subjects
- Specific inclusion criteria for fractured subjects
  - A low energy fracture at spine defined by the semi-quantitative classification of Genant
  - Specific exclusion criteria for control subjects
  - A low energy fracture at any skeletal site

METHODOLOGY

From a list of 119 labelled subjects (randomly selected by the clinician) and applying inclusion and exclusion criteria, a study population has been obtained. BMD measured at L1-L4 lumbar spine were obtained from Prodigy densitometer (GE LUNAR) - DXA database directly. Then, DXA scan files were exported onto a dedicated workstation for grey level image re-analysis and calculation of TBS map in the same L1-L4 region. TBS maps of the population study group were computed. Range of colours (representing local TBS values) was normalized in order to compare TBS maps.

The classification method was based on pattern and colour analysis:

- If TBS map shows organised and well defined patterns with high TBS map values (green-yellow colours) then bone microarchitecture is “good”
- If TBS map shows no-organised and not defined patterns with low TBS map values (red-yellow colours) then bone microarchitecture is “bad”

Double blind TBS maps analysis of study group was performed two times by an operator, trained to this specific classification method. Classification status for each TBS map (good or bad microarchitecture) was compared to the clinical status “fractured” / “non-fractured”. Operator classification rate, sensitivity, specificity and intra-operator agreement (Kappa Test) were calculated in order to evaluate the classification method.

RESULTS

Population study group was composed of 20 control subjects matched with 10 fractured subjects at spine.

<table>
<thead>
<tr>
<th>Classification</th>
<th>Appropriate Classification rate %</th>
<th>Sensitivity %</th>
<th>Specificity %</th>
<th>Kappa Test [95%CI]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Classification 1</td>
<td>80</td>
<td>80</td>
<td>80</td>
<td>0.571 [0.265-0.878]</td>
</tr>
<tr>
<td>Classification 2</td>
<td>87</td>
<td>90</td>
<td>90</td>
<td>0.714 [0.434-0.975]</td>
</tr>
</tbody>
</table>

Intra-observer reproducibility between the 2 sessions of classification

Kappa Test [95% CI] = 0.861 [0.675-1.00]

EXAMPLES OF TBS MAPS OBTAINED FOR CONTROL AND FRACTURED SUBJECTS

DISCUSSION

In average, the accuracy of classification is good (mean Kappa Test = 0.642 [0.359-0.926]) with a slight improvement between the two classification sessions, expected as a learning curve occurred. In addition, the intra-observer reproducibility is very high since the Kappa Test between the two sessions is at a level of 86% [0.675-1.00].

REFERENCES