Bone material strength by microindentation in patients initiating glucocorticoids and effect of treatments

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Introduction

Glucocorticoids (GC)-induced osteoporosis (GIOP) is the most common cause of secondary osteoporosis, which leads to an increased fracture risk in patients.
Fracture risk increases very early after starting glucocorticoids (GC), well before bone mineral density (BMD) shows any change. The increased risk of fracture has been reported with doses of prednisone or its equivalent as low as 2.5 to 7.5 mg daily (1). Thus, glucocorticoid-induced bone loss should be treated aggressively, particularly in those already at high risk for fracture. Microindentation can detect changes in Bone Material Strength (BMS) of bone tissue, related with bone fragility and fracture, independent of BMD. We assess early changes in BMS in patients initiating glucocorticoids and the response to treatment.

Materials and methods

A series of 26 consecutive patients were included in the study at the time of starting glucocorticoids. Patients were diagnosed with polymyalgia rheumatica/Horton arteritis (11 cases), sarcoidosis (6 cases), myasthenia gravis (2 cases), rheumatoid arthritis, scleroderma, pemphigus, serositis, systemic vasculitis, and adult Still's disease (1 case of each). A general laboratory workup, BMD by DXA, and BMS measurement at the anterior midtibia were performed with an Osteoprobe® (Figure 2, 3, 4) (Active Life Scientific Sta Barbara, CA) device (2). Measurements were performed at baseline and after 7+1.5 weeks of treatment with either calcium + vitamin D3 (Ca+D3) alone, bisphosphonates (BP) plus Ca+D3 or teriparatide (TPTD) plus Ca+D3 for the different risk categories, according to the official guidelines of the Spanish Bone and Mineral Society (SEIOMM) (3). Median age for the different groups were: Ca+D3: 55.9+14.9, BP: 80+6, PTH: 62.2+27.6. Age adjusted no differences between groups.

Results

For the 14 patients treated with Ca+D3, BMS significantly declined from baseline (81.8+5.3) to the follow up visit (72.8+8.1, p<0.001). Non-significant increase was observed for the 6 cases treated with bisphosphonates (78.7+6.6 to 81.9+12.4) while teriparatide-treated patients (6 cases) significantly increased BMS from baseline to week 7 (72.8+7.5 vs. 85.2+4.9, p<0.001). No changes in BMD between baseline and follow up were observed in any of the groups. The main results are displayed in the figure1. Further follow up is underway at week 20.

Figure 1: BMS values: baseline and after 7 weeks treatments

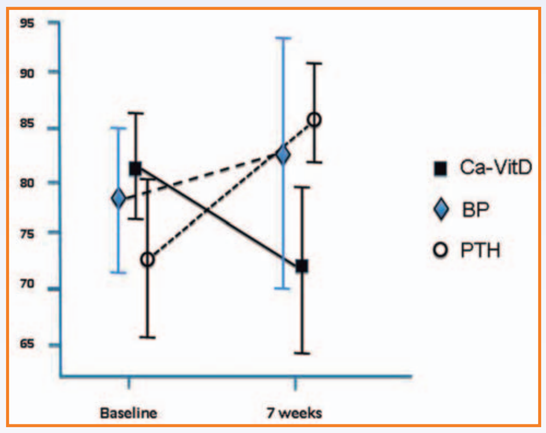


Figure 2: Microindentation as performed at the anterior mid tibia

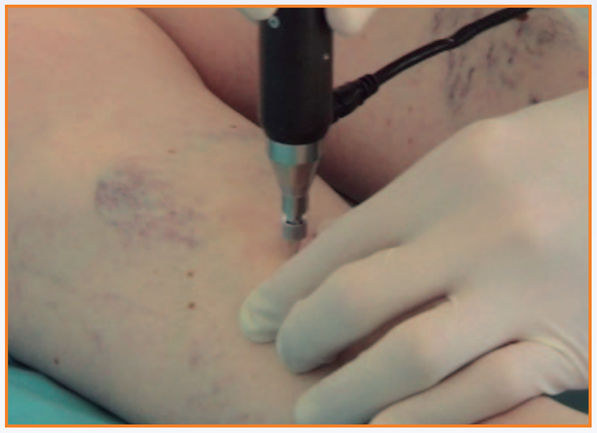


Figure 3: Screen capture during an indentation

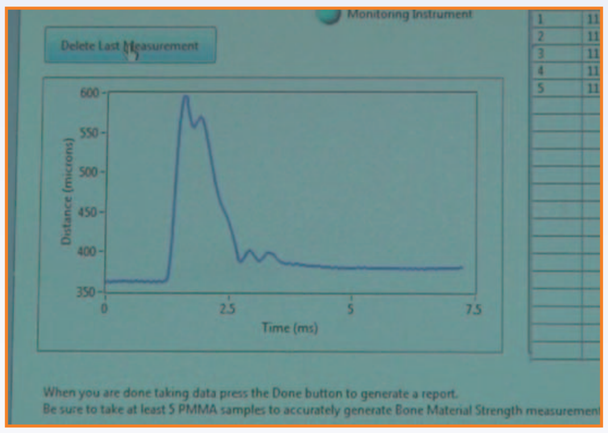
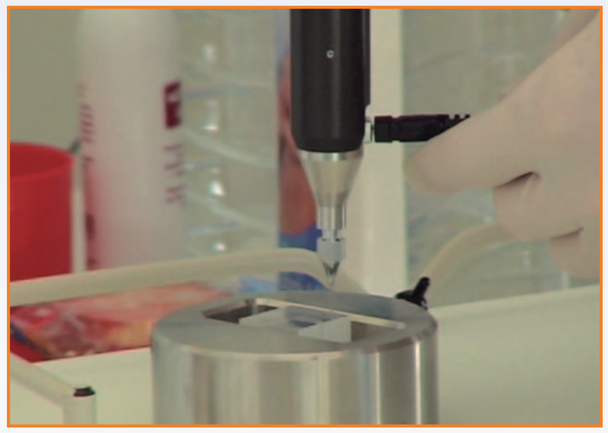


Figure 4: Calibration on PMMA ater each measurement in patients



Conclusions

We conclude that microindentation can detect very early changes in bone material strength at a tissue level induced by GC. Effect of different treatments is diverse in these cases and can be tracked prematurely. The effect of GC and the different treatments in bone tissue properties, related with fracture propensity, might offer an opportunity for monitoring changes induced by GC and their treatments well beyond what BMD currently allows.

References

1) Van Staa TP, Leufkens HG, Cooper C. The epidemiology of corticosteroid-induced osteoporosis: a meta-analysis. Osteoporos Int 2002; 13:777.
2) Daniel Bridges,Connor Randall, and Paul K. Hansma. A new device for performing reference point indentation without a reference probe. Review of Scientific Instruments.2012;83, 044301
3) J. González Macías, N. Guañabens Gay, C. Gómez Alonso, L. del Río Barquero, M. Muñoz Torres. clinical practice guidelines for postmenopausal osteoporosis, esteroid and male osteoporosis. Spanish society for bone and mineral research. Rev Clinic Esp- 2008; vol 208.

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