SUMMARY
We compared the viscoelastic properties changes in OVX rat femur response to ibandronate or PTH. By using nanoindentation technique, elastic modulus (E), hardness (H) and viscosity (η) of cortical bone were determined. IBAN group has higher η than PTH group. This study revealed that anti-resorptive drugs (ibandronate) inhibit bone resorption and increase mineralization, which may lead to a higher η; in contrast, anabolic drugs intensify remodeling causes a lower η.

INTRODUCTION
Viscoelastic response upon loading is one of the mechanical properties exhibit by bone [1]. Creep is a time-dependent viscoelastic deformation that has been observed under constant stress. Since bone viscoelasticity correlate to load bearing capacity [2], the aim of this study is to investigate the viscoelastic properties (ie. indentation modulus, hardness and viscosity) in ovariectomized and drug-treated (anti-resorptive & anabolic agents) rats femur.

METHODS
35 female SD rats of age 10-12 weeks were divided into 4 groups (SHAM, OVX+VEH, OVX+PTH, OVX+IBAN). The rats were subjected to ovariectomy or sham surgery. PTH or ibandronate or its vehicle was administered subcutaneously to the respective groups from 4th week post-surgery. On the 12th week, rats were euthanized. Femurs were embedded in epoxy and metallographically polished to produce the smooth surface which was 3mm above the distal condyle. After rehydration, nanoindentation was conducted using continuous stiffness measurement (CSM) method to determine elastic modulus (E) and hardness (H) of cortical bone. Basic creep test was also conducted; creep displacement-time curve was fitted using the Voigt model. Viscosity (η) is computed based on the curve fitting of creep displacement by non-linear regression.

RESULTS AND DISCUSSION
For the purpose of eliminating surface roughness interference, all the results were taken at a displacement range of 800 to 1000 nm. As shown in Fig 1, Statistical analysis showed significant difference (p<0.05) in E, H and η between OVX group and all other groups. IBAN group has higher η than PTH group, which is in accordance with mBMD results (IBAN=711.41mg/cm³, PTH=614.42mg/cm³). Slope of E/η of drug treated bones differ from SHAM group.

Figure 1: CSM measured elastic modulus, hardness and viscosity.

Figure 2: Morphological changes for different treatment groups yield by pQCT (above) and μCT (below).
CONCLUSIONS
Osteoporosis induced deterioration in micro-level bone quality resulted in reduced E, H and η. The source of creep may contribute to the internal friction at cement lines [3]. Active bone remodeling, which is caused by osteoporosis, results in an increased number of newly formed osteons and cement lines. Thus more creep deformation (lower η) would take place under constant loading (ie. weight-bearing). Anti-resorptive drugs (ibandronate) inhibit bone resorption and increase mineralization, which may lead to a higher η; in contrast, anabolic drugs intensify remodeling causes a lower η. Further studies are in progress to investigate the efficacy of combined treatment in OVX rat regards to viscoelastic properties.

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REFERENCES