# *IN VIVO* MECHANICAL CHARACTERIZATION OF THE OSTEOPOROTIC DISTRACTION CALLUS

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## Introduction

Osteoporosis (OP) is a skeletal disorder characterized by a bone mineral density (BMD) decrease and a microarchitectural deterioration of the bone tissue, leading to an increase in bone fragility and risk of sudden fractures. Furthermore, one of the main problems of osteoporotic patients is their poor osteogenesis capability [1].

At present, quantitative knowledge reported about the influence of osteoporosis on bone regeneration is still limited. Bone transport (BT) through distraction osteogenesis (DO) is a recognized clinical bone regeneration process to repair large bone defects or traumas [2,3].

This work aims to mechanically characterize the evolution of osteoporotic BT distraction callus *in vivo*, quantifying the traction forces of the callus during the distraction phase.

## Methods

In this study, BT *in vivo* experiments were carried out in 8 female merino sheep metatarsi, which were previously subjected to an OP induction protocol [1,4,5]. It has consisted of performing an ovariectomy, periodic injections of glucocorticoids, and low calcium and vitamin D diet until reaching a 20-30% reduction in BMD [6]. The OP progress was monitored by tracking the BMD by computed tomography images (CT), reporting a mean reduction of 25% at the beginning of the BT experiment (6 month after induction). Afterwards, the BT protocol consisted of a latency period of 7 days, followed by a distraction phase applying a daily of 1 mm bone fragment transport for 15 days, and a consolidation phase in which specimens were sacrificed at different time-points between 35 and 100 days after surgery. Distraction force records were monitored by using an instrumented fixator with load cells during the distraction stage [4,5].

## Results

An example of OP distraction force measurement is shown in Figure 1. It may be seen the relaxation of the callus tissues post-distraction. Figure 2 shows the peak and post 8 minutes distraction forces recorded along the distraction phase in healthy [4] and OP sheep. It can be seen how the peak forces are significantly lower in OP animals. differentiating with healthy animals increasingly throughout the days. Furthermore, differences with control animals increase throughout the distraction days. However, the interdifference between groups is not as significant when comparing 8 minutes post-distraction force values.

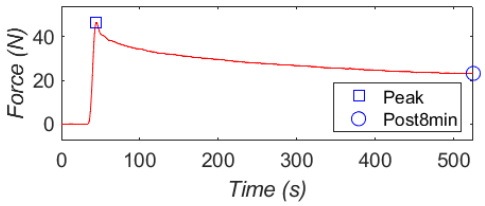


*Figure 1: Distraction force measurement example.*

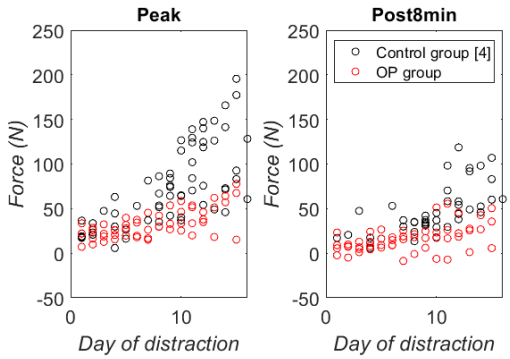


*Figure 2: Peak (Left) and post 8 minutes (Right) distraction force in control [4] and OP group.*

## Discussion

This work reports quantitative results about the force applied to OP bone fragment being displaced along BT the gap. It shows how the recorded distraction force increases over the days, indicating a positive response of OP bone cells to the mechanical stimulus applied by distraction. However, the callus stiffening is generally slower than in healthy animals [4].

## References

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## Acknowledgements

We thank the financial support from project PID2020-113790RB-I00 and FPI grant PRE2021-097629 by the Ministry of Science and Innovation (MCI) of the Spanish Government and the Spanish State Research Agency (AEI).