Abstract— The purpose of this study was to examine whether sciatic nerve injury induces trabecular bone loss in the tibia and to evaluate the correlation between baseline bone quantity and the magnitude of bone loss. Sixteen male C57BL/6 mice were used. Sciatic neurectomy was performed out on both hind limbs. The tibiae (T) were scanned using in-vivo micro-CT at 0 and 2 weeks. At 2, BV/TV of T in sciatic nerve injury group (SNI) was significantly lower than that in normal group (NOR). There was no negative correlation between BV/TV at 0 weeks and the relative variation (RV) in T at 2 weeks. This study suggested that SNI can induce bone loss in the tibia, however, no negative correlation was shown between baseline bone quantity and the magnitude of bone loss.

Keywords—Sciatic nerve injury, Bone loss, Baseline bone quantity

I. INTRODUCTION

The sciatic nerve injury (SNI) is widely known as most popular method to simulate bone loss on hindlimb during space flight. SNI can induce the biomechanical characteristics weakness at the musculoskeletal system [1],[2]. In addition, numerous studies have presented that considerable bone loss in lower extremities is occured following SNI [3]. However, there were few studies that have evaluated the correlation between magnitude of bone loss and basal conditions. Although a considerable lower extremities bone loss is occured following SNI, the magnitude of bone loss can differ according to age, gender or genetic factors[3],[4],[5]. Moreover, baseline bone quantity could be also one of the factors that affects the magnitude of bone loss[6]. Thus we aimed to evaluate whether SNI can affect the tibia. Moreover, we investigated the correlation between baseline of bone quantity and the magnitude of bone loss.

II. METHOD

Animals and sciatic neurectomy

All procedures were performed under a protocol approved by the Yonsei University Animal Care Committee (YWC-110408-2). Sixteen male mice (12-week-old, C57BL/6, 24.55 ± 0.17 g) were used and randomly allocated into 2 groups for each 8: SNI (8, sciatic neurectomy) and NOR (8, intact sciatic nerve). Sciatic neurectomy was performed out on the bilateral hind limb (both) of each mouse in SNI. All mice were anesthetized using a combination of xylazine (0.5ml/Kg, Bayer Korea, Korea) and ketamine (1.5 ml/Kg, Huons, Korea) during sciatic neurectomy.

Bone Analysis

The right tibia of mice were scanned at 0 and 2 weeks to evaluate the changes of morphological characteristics at the trabecular bone using in vivo micro-CT (Skyscan 1076, SKYSCAN N.V., Aartselaar, Belgium). The samples were scanned with 18μm resolution for the right tibia, with voltage of 85 KV, current of 120 μA. To reduce beam hardening artifacts, a 1.0 AL filter was used and the exposure time was 2065 ms. Each of mice was received inhalation anesthetic (1.2ml isofluran per 1.5ml oxygen, Hanaph, Seoul, Korea) during the scan. From the images, BV/TV on the right tibia trabecular bone was analyzed using CT-An 1.8 software (Skyscan).

Statistical Analysis

All data were presented as the mean ± standard deviation (SD). A two-way analysis of variance (ANOVA) with repeated measurement was performed. A Pearson correlation was evaluated where BV/TV was an independent variable at 0 weeks and the relative variation at 2 weeks (RV, 1 at 0 weeks) was an dependent variable. The p values < 0.05 was regarded statistically significant. All statistical analyses were performed using the SPSS (SPSS Inc., USA) software.

III. RESULTS

Table 1 shows BV/TVs at 0 weeks. At 2 weeks, BV/TV of T in SNI was significantly declined (p < 0.05), while there was no significant changes in the NOR (p > 0.05). Moreover, BV/TV of T in SNI was smaller than that in NOR (p < 0.05).
Longitudinal changes in BV/TV are shown in Fig 1. At the correlations between BV/TV at 0 weeks, there was no significant negative correlation at 2 weeks (p>0.05). Fig. 2 depicts BV/TV correlations between 0 weeks BV/TV and its RV at 2 weeks. The longitudinal changes with 3D images were shown in Fig 3.

IV. DISCUSSION AND CONCLUSIONS

We demonstrated that SNI might affects the trabecular bone quantity on the tibiae. However, the magnitude of bone loss was not according to the baseline bone quantity. Although it is commonly accepted that significant bone loss in the lower extremities is occured by SNI, there were diverse results from difference factors [3][4][5][6]. Our result shows that BV/TV of the right tibia in SNI was lower than that in NOR. These results show that SNI induces significant bone loss in the tibiae. In previous studies, SNI induces skeletal unloading and therefore considerable bone loss is occured at lower extremities [7][8]. Moreover, It has been also reported that nerve injury induce changes in hormones related with bone homeostasis [9][10][11]. Therefore, SNI might disarrange bone homeostasis itself, resulting in bone loss. Taken together, in this study, in spite of local nerve injury at the femoral region, we observed a significant bone loss at the tibia trabecular bone in 2 weeks. Our results indicate that skeletal unloading[7][8], hormone release[9][10] and disruption of neural regulation[12] may be linked with the systemic bone loss.

We showed that no negative correlation between baseline bone quantity and RV at 2 weeks in T. These results showed that the baseline bone quantity do not affects the magnitude of bone loss after SNI untill 2 weeks.

In conclusion, we showed that SNI can induce systemic bone loss. However, there was no correlation between the magnitude of bone loss and the baseline bone quantity untill 2 weeks. Future work needs to evaluate the correlation between baseline bone quantity and bone loss severity following SNI more than 2 weeks period.

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