Letter to the Editor

Advances in titanium alloys and orthopedic implants: new titanium alloys and future research directions

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To the editor,

We read with great interest the article by Tan et al. titled "**Accelerated fracture healing by osteogenic Ti45Nb implants through the PI3K–Akt signaling pathway**" [1]. In this research, the bone-forming capabilities of Ti45Nb alloy were thoroughly examined. The in vitro studies revealed that Ti45Nb alloy enhances the osteogenic differentiation of MC3T3-E1 cells more effectively than the Ti6Al4V alloy controls, showing no noticeable cytotoxic effects. In vivo tests demonstrated that Ti45Nb alloy implants improved fracture healing in comparison to Ti6Al4V alloy, with its biological safety verified through histological assessments. Additionally, immunohistochemical staining indicated that Ti45Nb alloy could enhance bone generation by activating the PI3K/Akt signaling pathway. Ti45Nb alloy promotes bone formation and fracture healing compared to Ti6Al4V alloy, making them promising new orthopedic materials.

There have been several reports of clinical successes of new titanium alloys in orthopedics. A new hip prosthesis using a TiNbSn alloy, which combines low Young's modulus (40Gpa) with strength and biocompatibility, has reported good clinical results in clinical trials by eliminating the stress imbalance between cortical bone and the hip stem and reducing stress shielding [2]. On the other hand, preclinical studies have been reported in animal models using rabbits to demonstrate the usefulness of TiNbSn alloy as a fracture treatment material compared to intramedullary nails or plates made of Ti6Al4V alloy in the treatment of fractures [3,4]. Evaluation of a tibia fracture model

with TiNbSn alloy intramedullary nails in mice reported enhanced expression of Runx2, which is understood to be an effect of the low Young's modulus of the TiNbSn alloy equalizing the load sharing between bone and metal [5]. Although Young's modulus of Ti45Nb alloy used in this study is not precisely described, it is predicted to be lower than that of Ti6Al4V alloy, which may also be expected to promote bone formation by dispersing stress between bone and metal. If Nb, as discussed by the authors, has the effect of promoting fracture healing by upward regulation of the PI3K-Akt signaling pathway, we considered the possibility that Nb-containing titanium alloys could be useful as orthopedic implants.

The accelerated fracture healing effect of Ti45Nb alloy shown in this study is expected to be investigated in more detail in future studies with fracture treatment plates to investigate the usefulness of Ti45Nb alloy. As strength and corrosion resistance are also important for orthopedic implants, as well as bone osseointegration effect, it is expected that research on these important factors will be developed.

Conflicts of Interest

The authors declare no conflicts of interest associated with this manuscript.

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