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Enhancement of orthodontic tooth movement and root resorption in ovariectomized mice

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Introduction

Osteoporosis is a bone metabolism disease characterized by age-related changes in bone metabolism, bone resorption and destruction of bone microstructure. Considering that the number of orthodontic patients with bone metabolic diseases such as osteoporosis will increase in an aging society, we need to comprehensively study the relationship between changes in bone metabolism and orthodontic tooth movement and root resorption. However, the effect of osteoporosis on orthodontic tooth movement and root resorption is still unclear. In this study, we investigated the effects of osteoporosis on orthodontic tooth movement and root resorption in an ovariectomized mouse model.

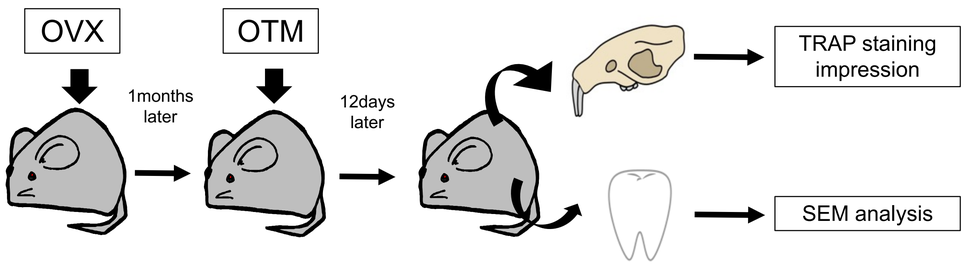
The purpose of this study is reveal the following:

1. To investigate whether osteoclast and odontoclast formation is enhanced during orthodontic tooth movement under osteoporotic conditions.

2. To investigate the effect on the odontoclast formation and the root resorption.

Methods

- Ovariectomy(OVX) were performed bilaterally from the dorsal side to create a mouse model of osteoporosis.
- One month later, orthodontic tooth movement(OTM) was performed for 12 days.
- Maxillary bones and maxillary left first molars were removed and analyzed.



Mouse ovariectomy

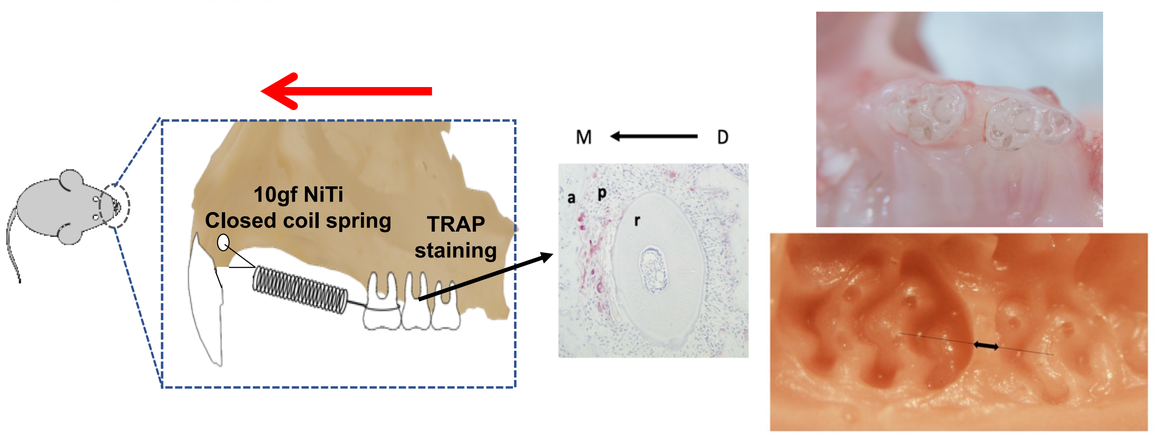
- An incision was made from the dorsal side, and the ovary was removed after ligating between the ovary and uterus with a silk thread.
- In the sham surgery group (Sham), only an incision was made in the skin, and the wound was sutured and closed.
- After one month, the mice were used as osteoporosis models.

Orthodontic tooth movement in ovariectomized mice

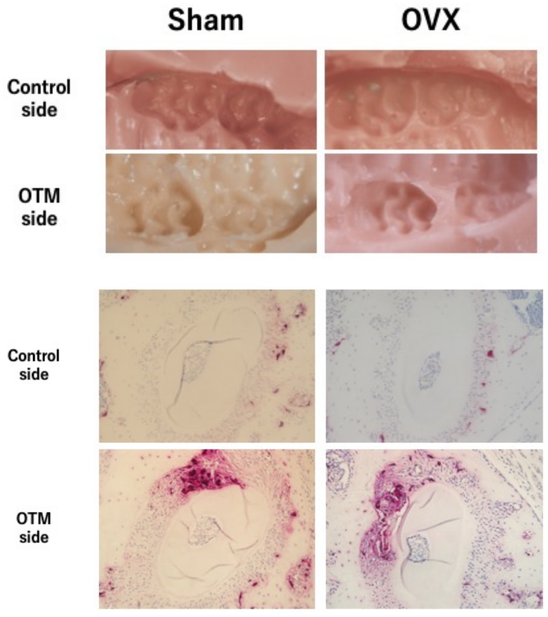
- The maxillary left first molar was moved in a mesial direction for 12 days.
- After OTM, the maxillary bone was removed and tissue sections were prepared.
- M: Mesial, D: Distal, a: alveolar bone, p: periodontal ligament, r: root of maxillary left first molar

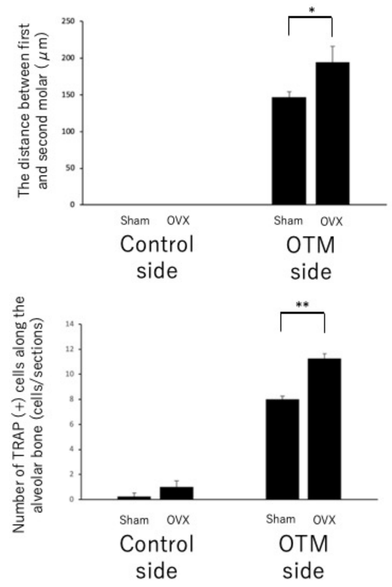
Measurement of tooth movement

- After OTM, impressions are taken with silicone impression material.
- Measure the distance of tooth movement from the impressions.
- Measure the distance between the marginal ridges on a straight line connecting the central fossa of the maxillary left first and second molars.

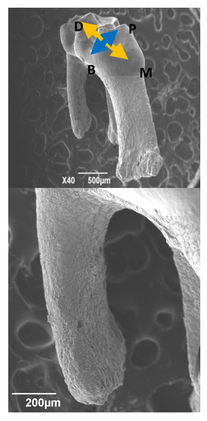


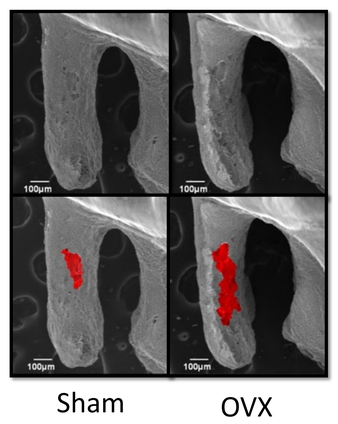
Results

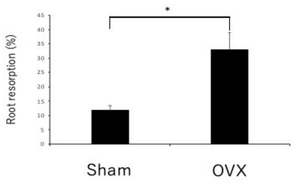




- Orthodontic tooth movement was enhanced by OVX.
- OVX enhanced osteoclast formation.





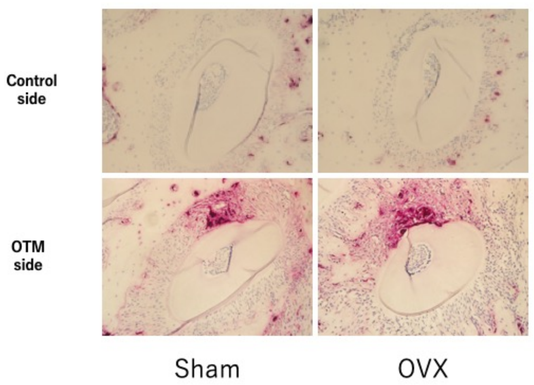


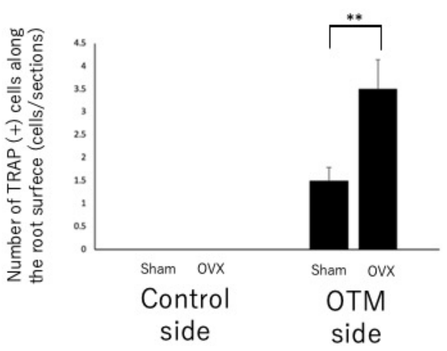
Red:
Resorption area

Gray:
Non-resorption area

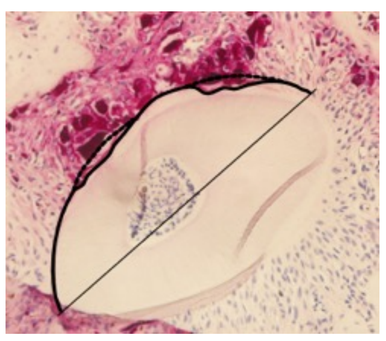
Percentage:
Red/(Red + Gray)

- OVX increased the area of root resorption.





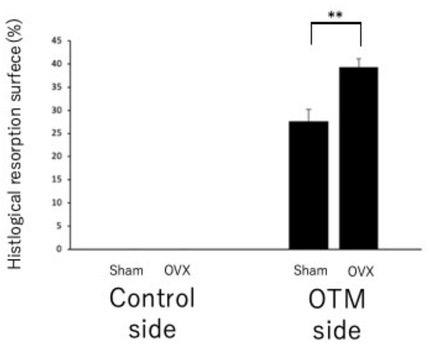
- OVX enhanced osteoclast formation.



Solid line:
Root surface

Interrupted line:
Resorption surface

Percentage:
Interrupted/Solid



- Root resorption was increased by OVX.

Conclusion

- Under osteoporotic conditions, osteoclast formation in alveolar bone and odontoclast formation were increased, and distance of tooth movement and root resorption area were increased.
- If the patient has osteoporosis during orthodontic treatment, the orthodontist should understand and be aware that there is a higher risk of root resorption than usual.