### Introduction

**Repair of bone defects using artificial bone grafts**

It is necessary to accelerate osteogenic differentiation of bone marrow cells which adhere on artificial bone grafts for early fixation between host bone and bone graft.

Previous studies:

- Development of surface roughness, wettability and morphology of bone grafts
- Novel treatment is required to improve fixation between host bone and artificial bone graft.

**We focused on piezoelectric thin film coat on bone graft**

It is expected that stress-generated potential on piezoelectric thin film can enhance osteogenic differentiation of bone marrow cells in vivo.

Barium titanate (BaTiO₃) ↓ Biocompatible lead-free material

High piezoelectric property

Previous studies

- There is no report about the effects of potential of piezoelectric ceramics on bone marrow cells under dynamic loading in vitro.

**Objective**

To investigate the effects of cyclic surface potential of BTO ceramics with deformation on osteogenic differentiation of rat bone marrow cells in vitro.

### Materials and Methods

**BTO ceramics**

- Polarized BTO
- Non-polarized BTO

**Cell seeding**

Seeded at 3.0 × 10⁴ cells/cm² on polarized BTO and non-polarized BTO.

**Culture medium**

DMEM + 10%FBS Antibiotics
10 nM Dexamethasone
10 mM β-Glycerophosphate
82 μg/ml Ascorbic acid

**Dynamic cultivation for 6 and 9 days**

Stimulation condition

- Compressive waveform
- Sinusoidal wave

Maximum strain of BTO (με) 65

- DNA amount
- Alkaline phosphate activity (ALP activity)

**Results and Discussion**

**Surface potential of BTO ceramics**

<table>
<thead>
<tr>
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<th>Polarized BTO</th>
<th>Non-polarized BTO</th>
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<tbody>
<tr>
<td>Surface potential by spontaneous polarization</td>
<td>-1.44 V</td>
<td>-1.54 V</td>
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<tr>
<td>Surface potential by deformation</td>
<td>8.37 V</td>
<td>7.5 V</td>
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- There was no difference in ALP activity in all conditions.

**Effects of piezoelectric stimulation on ALP activity**

- There was no difference in ALP activity in all conditions.

**6 days cultivation**

- ALP activity was not affected by spontaneous polarization.
- ALP activity was affected by strain of BTO ceramics with deformation.
- ALP activity was much affected by synergistic effects of surface potential and strain of BTO ceramics compared with only strain.

**Surface properties**

- Difference in ALP activity was not affected by surface properties of BTO ceramics.
- Surface potential of polarized BTO enhances osteogenic differentiation of bone marrow cells.

**Conclusions**

It is suggested that surface potential of polarized BTO enhances osteogenic differentiation of rat bone marrow cells under dynamic loading in vitro.