Efficacy of Extracorporeal Shockwave Therapy to Accelerate Healing for Osteochondral Injury in a Pig Model

Department of Orthopedics, Tokushima University Hospital
Joji Iwase
Department of Rehabilitation Medicine, Tokushima University Hospital
Tetsuya Matsuura
Department of Orthopedics, Tokushima University Graduate School
Kenji Yokoyama, Koichi Sairyo

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COI Disclosure Information

We have no financial relationships to disclose.

Introduction

- Osteochondral injury could be caused by trauma or excessive loading during sports activities.
- It could progress to osteoarthritis and affect daily activities.
- Early diagnosis and treatment was important.

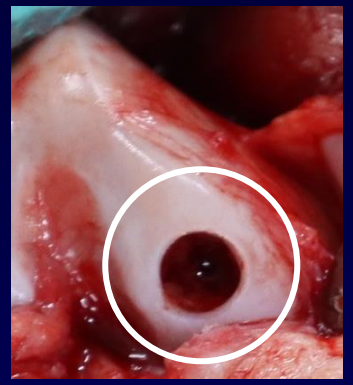
Aim

- To show extracorporeal shockwave therapy (ESWT) could accelerate repair of osteochondral injury.

Material & Methods

Animals: 6-week-old 15 pigs (8 males, 7 females)

Rt. knee



Lt. knee

Osteochondral injury model

2 weeks after surgery

ESWT exposure (rt. knee)

（STORZ MEDICAL Duolith SD1）

Rt. knee

Energy flux density:
4 Hz
0.20 mJ/mm^2 × 2,500 impulses

6 weeks after ESWT

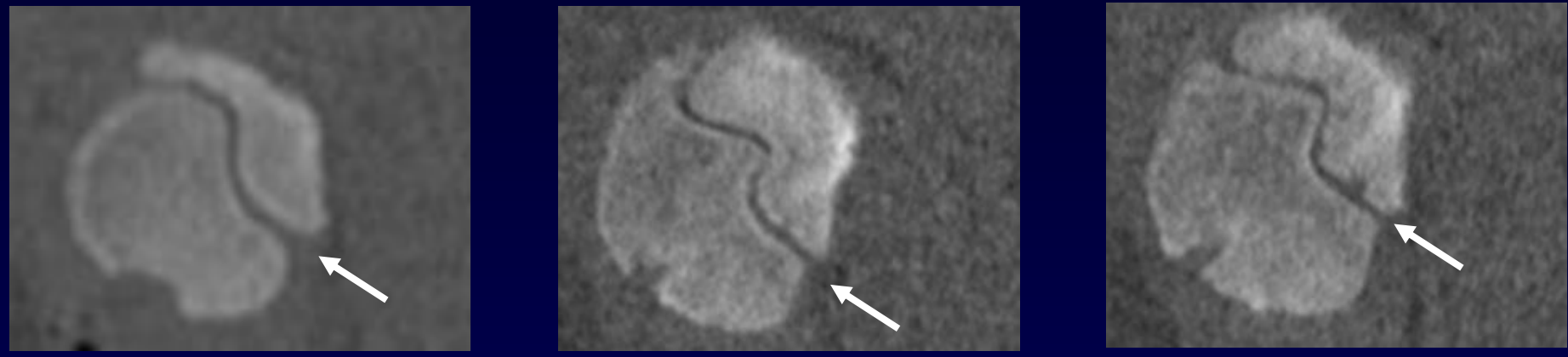
Euthanization

Exposure (+): shockwave group (S)

Exposure (−): control group (C)

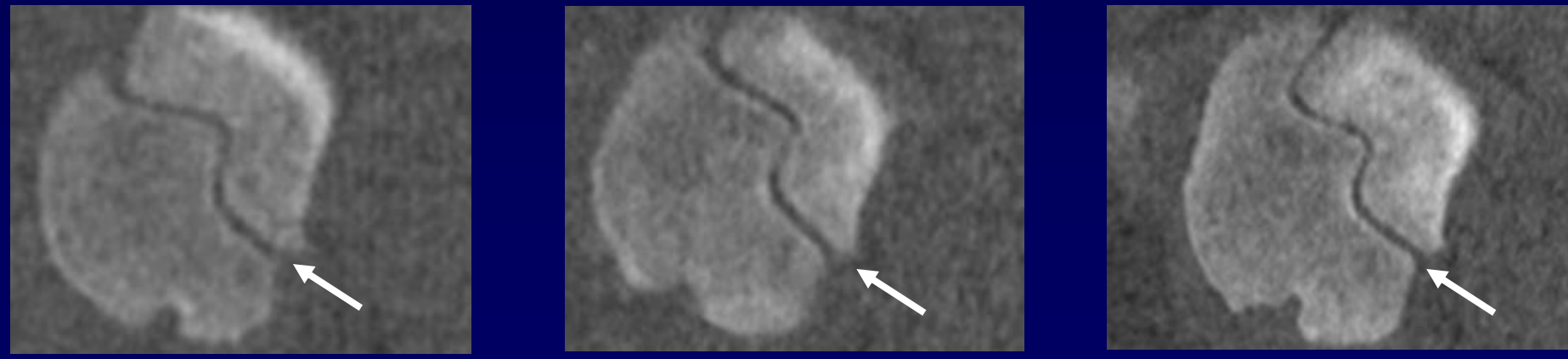
Computed Tomography（Sagittal view）

S group



2 weeks after ESWT → 4 weeks after ESWT → 6 weeks after ESWT

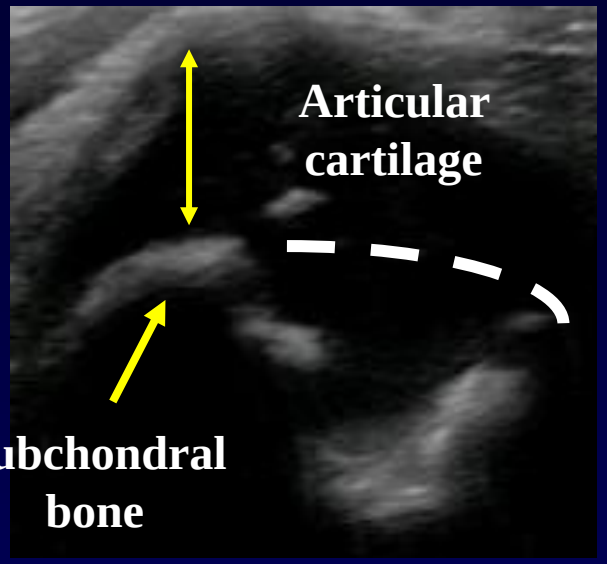
C group



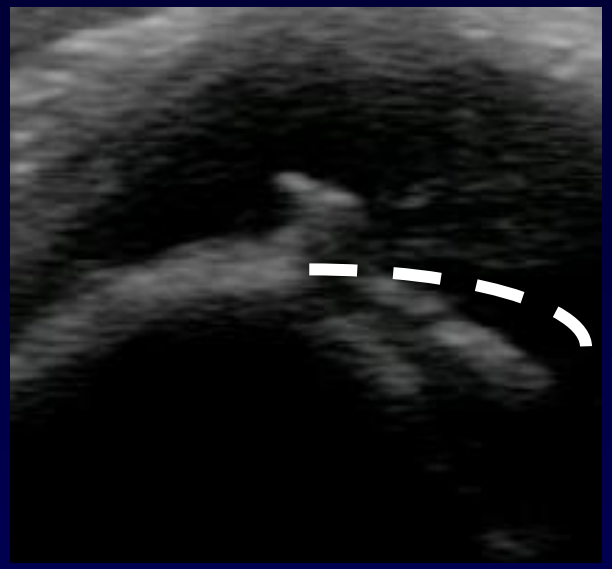
No early epiphyseal disclosure in S group

Ultrasound images (short axis)

S group



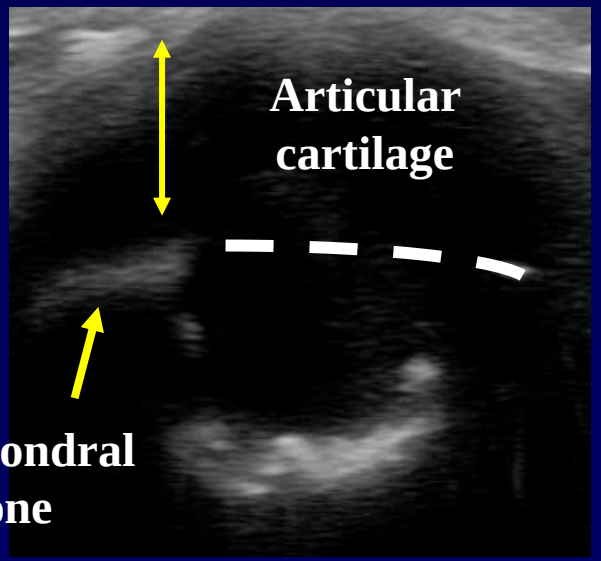
2 weeks after surgery

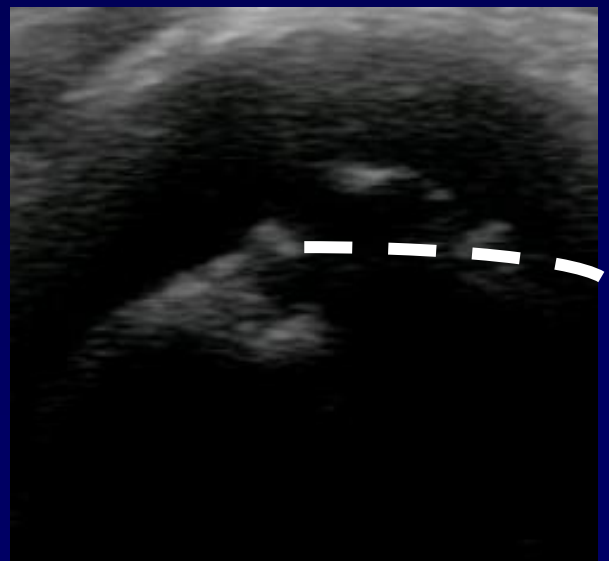


6 weeks after ESWT

Subchondral bone was smoother than in C group

C group





Macroscopic examination

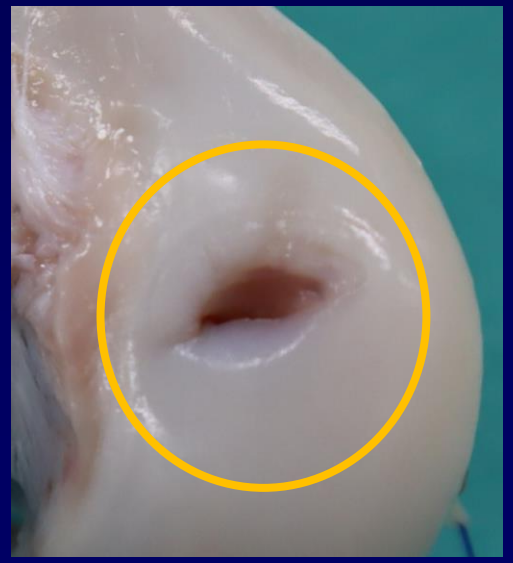
S group

2 weeks after ESWT

4 weeks after ESWT

6 weeks after ESWT

C group



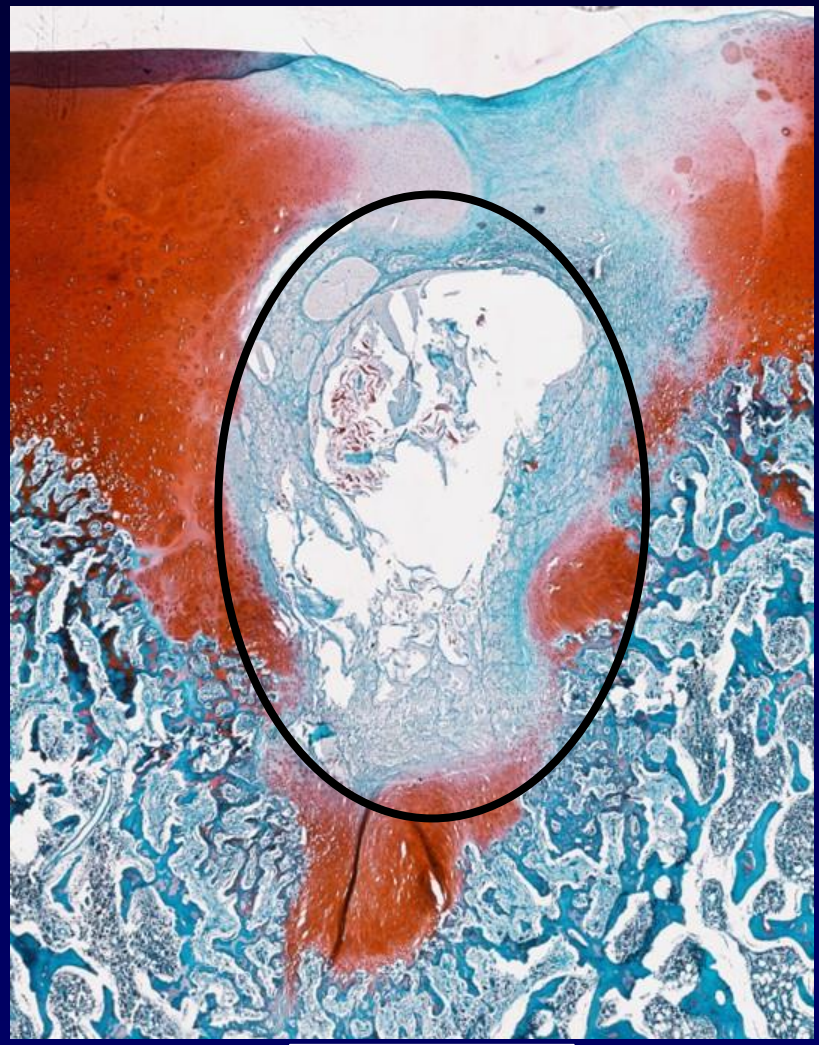
S group had more granulation and smoother articular cartilage surface than C group at 4 weeks and 6 weeks after ESWT

Histologic examination (Safranin-O stain)

6 weeks after ESWT

S group

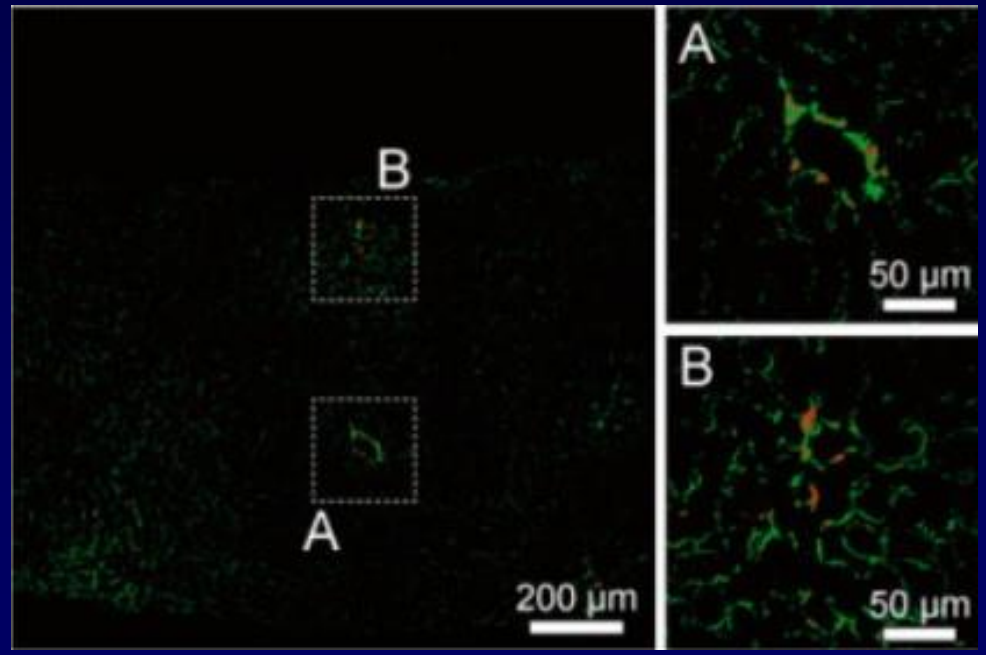
6 weeks after no treatment

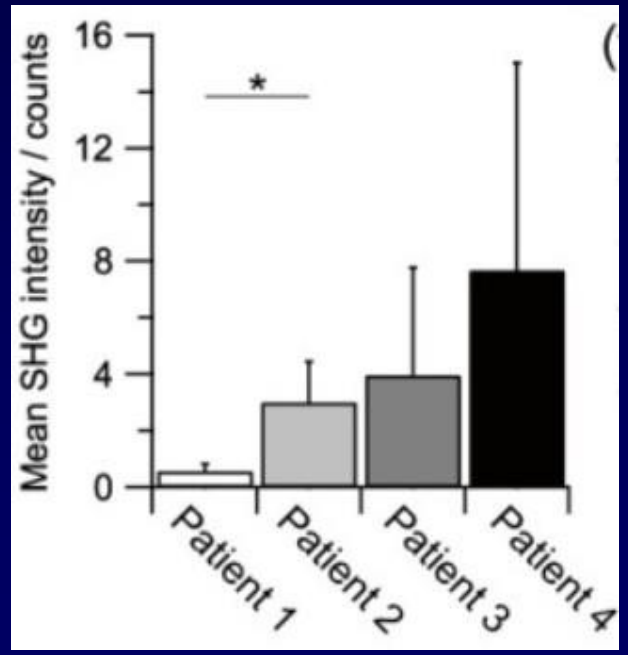


C group

Applications of Second-harmonic generation (SHG) microscopy

Specific quantification of collagen in selected regions

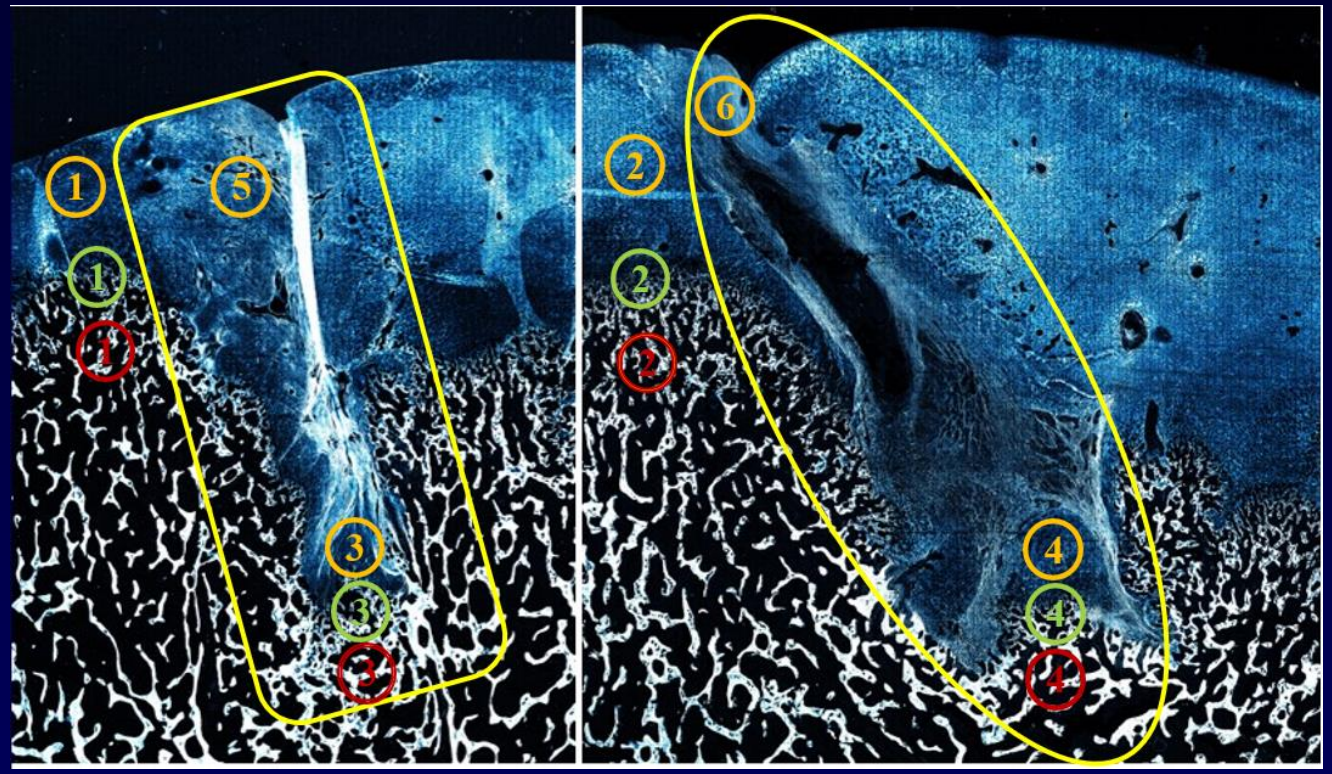




（Minamikawa T, et al, Int J Mol Sci., 2022）

6 weeks after ESWT

6 weeks after no treatment



S group

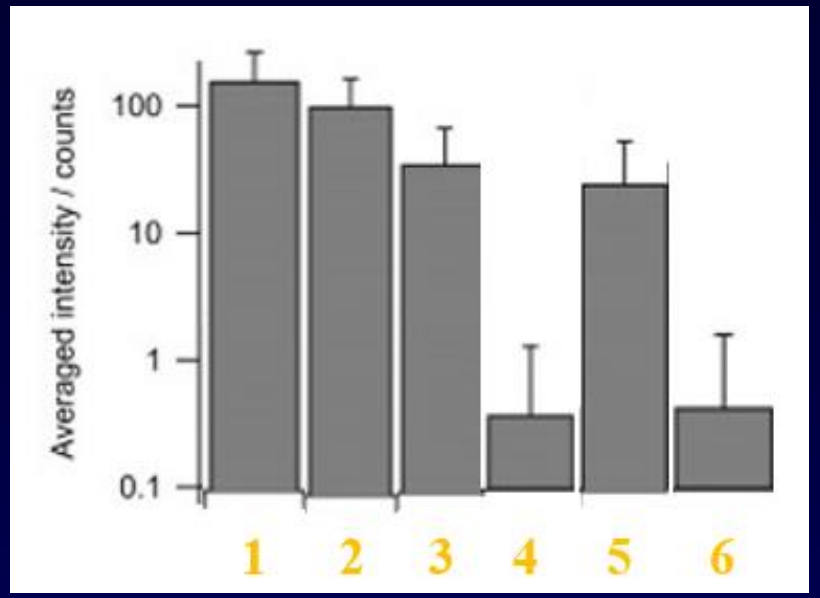
C group

1. undamaged area（S)
2. undamaged area（C)
3. damaged area （S)
4. damaged area （C）
5. damaged surface（S）
6. damaged surface（C）

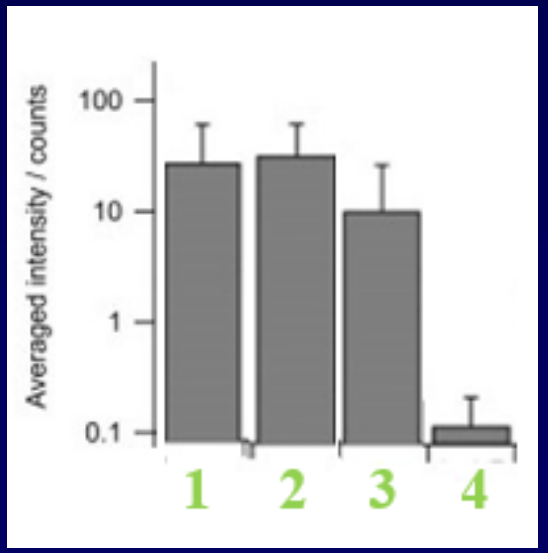
damaged area（S）

damaged area（C）

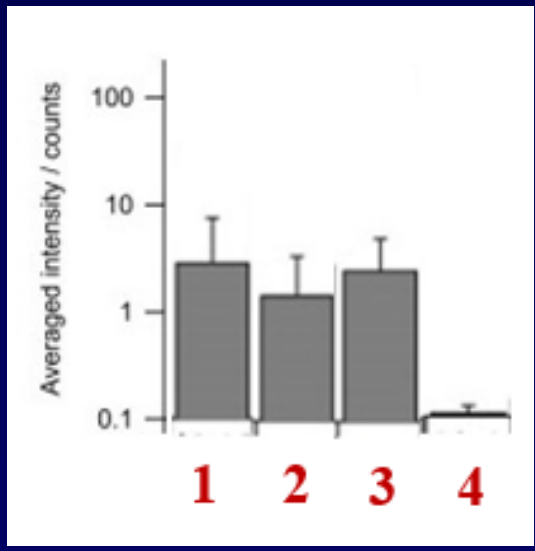
1. Articular cartilage



2. Subchondral bone



3. Bone marrow



Discussion

- Remodeling subchondral bone by direct stimulation of ESWT

(Timothy M et al., Tissue Eng Part B Rev. , 2009)

- Tissue repair associated with indirect stimulation

→ Cavitation effect

(Hara et al., J Bone Miner Res., 2015)

Conclusion

- This study suggest that ESWT accelerated tissue repair in a pig model of osteochondral injury.