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Correlation between MRI and histological analyses for repair tissue of knee chondral lesions treated with allogenic mesenchymal stem cell-based therapy or microfracture in a phase III clinical trial cohort

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ISAKOS Congress 2025 in Munich, Germany

COI Disclosure

Presenter’s names:

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Assessment of cartilage repair

- Morphological assessment
  - MRI
  - Arthroscopy → Invasive!
- Biochemical assessment
  - Biomarkers
  - T1ρ, T2 mapping MRI
  - Histology (Biopsy) → Invasive!

MRI vs. Histology

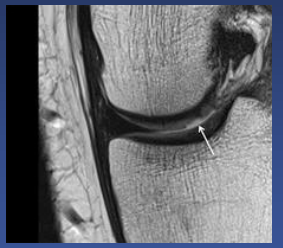
⇩

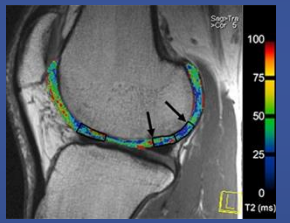
Still unclear on both correlations[1)2)].

⇩

Aim: To investigate the correlation between MRI and histology.

Hypothesis: Both are correlated.





MRI and histological assessments are widely used to evaluate cartilage repair, particularly for newly developed repair methods.

Patients

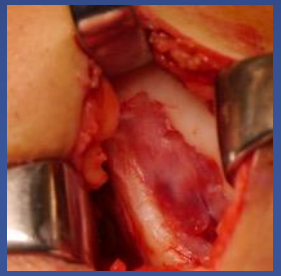
76 patients with knee chondral injury

MSC-based therapy or microfracture were performed.
(Phase III clinical trial cohort*)

63 patients were assessed for cartilage repair tissue with both MRI & histology (biopsy) at 1 year post-op.

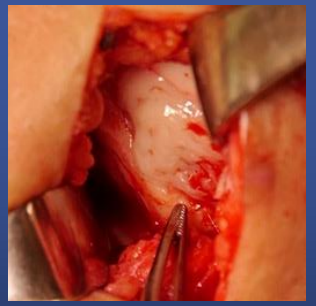
*JRCT ID: jRCT1080223548, TWOCELLS, Co. Ltd.

Cartilage defect



RCT

Microfracture
w/ arthroscopy
(Size: 2.1±0.9 cm^2)



Implantation of MSC-derived 3D tissue
w/ arthroscopy or mini-arthrotomy
(Size: 2.8±1.4 cm^2)

Scaffold-free MSC-derived tissue-engineered construct (TEC)

Cell bank

Osaka University Hospital

Ascorbic acid

Monolayer culture of **allogenic** synovial MSCs

Matrix synthesis

Mechanical shear stress

Cells (●) + ECM (▬)

Cytoskeletal contraction

MSC-derived TEC (gMSC®1)[3)-6)]

Implantation to chondral defect

Cultured in chemically defined serum-free media (TWOCELLS Co. Ltd.)

Assessments

MRI @ 1 year post-op
MOCART 2.0 score[7)]

VS.

Histology @ 1 year post-op
ICRS II score[8)]

- ✓ Both were scored in a blinded fashion by an independent assessor.
- ✓ Correlation was calculated using Spearman's rank correlation coefficient. (JMP pro 17)

Correlation between MOCART 2.0 & ICRS II

- All patients（N = 63)
- MSC-derived TEC (N = 33)
- Microfracture（N = 30）

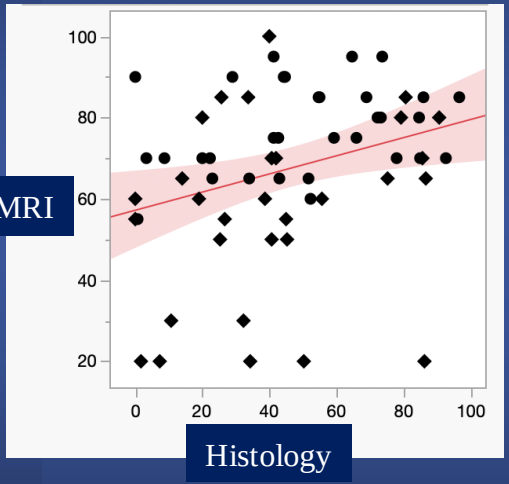
} Evaluation for each surgical procedure

- Femoral condyle（MFC+LFC）（N = 33）
- Trochlear groove （N = 23）

} Evaluation for each chondral injury site

Correlation (All patients)

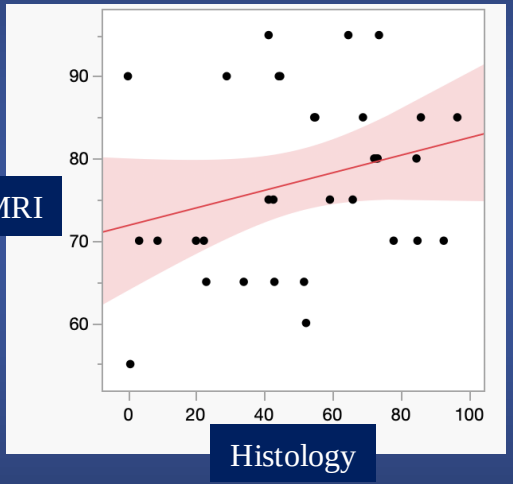
All patients (N=63)



Correlation coefficient 0.3179

P value 0.0111

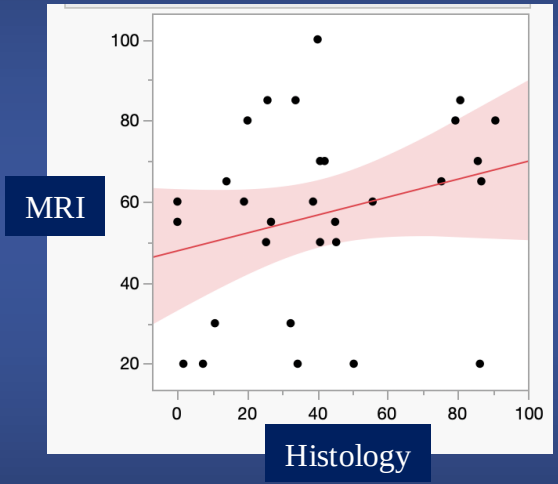
MSC-derived TEC (N=33)



Correlation coefficient 0.2499

P value 0.1607

Microfracture (N=30)

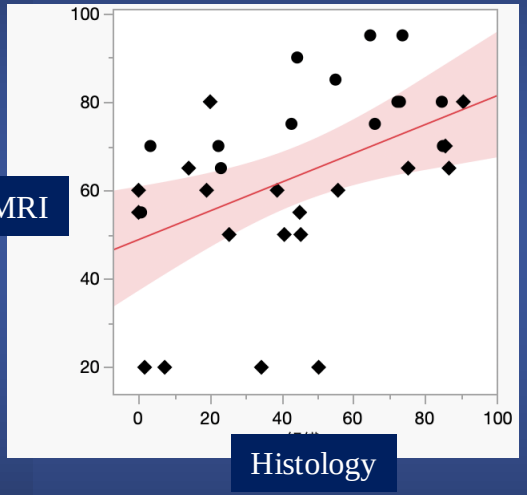


Correlation coefficient 0.2683

P value 0.1516

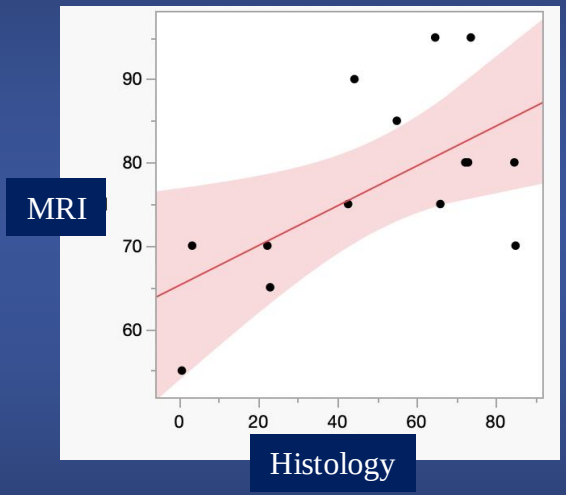
Correlation (Femoral condyle)

Femoral condyle
All patients (N=33)



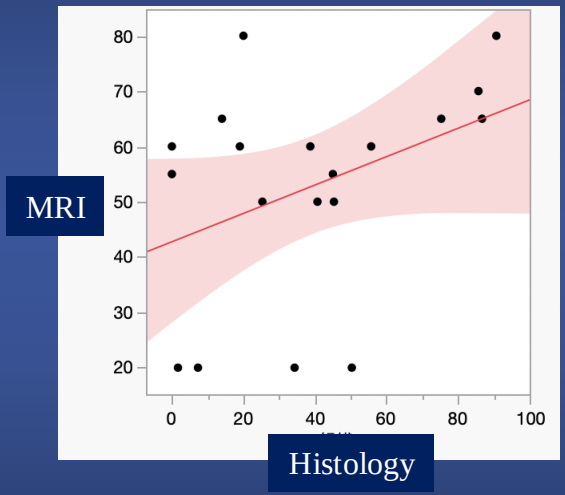
Correlation coefficient	0.4972
P value	0.0032

Femoral condyle
MSC-derived TEC (N=14)



Correlation coefficient	0.5045
P value	0.0658

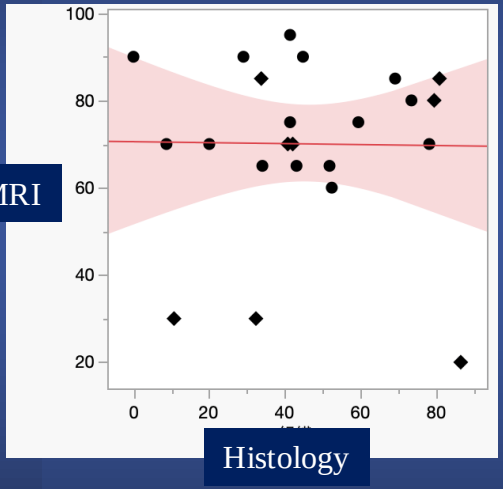
Femoral condyle
Microfracture (N=19)



Correlation coefficient	0.3744
P value	0.1143

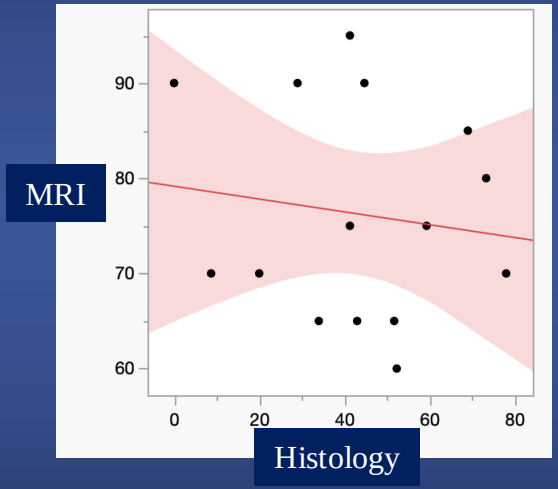
Correlation (Trochlear groove)

Trochlear groove
All patients (N=23)



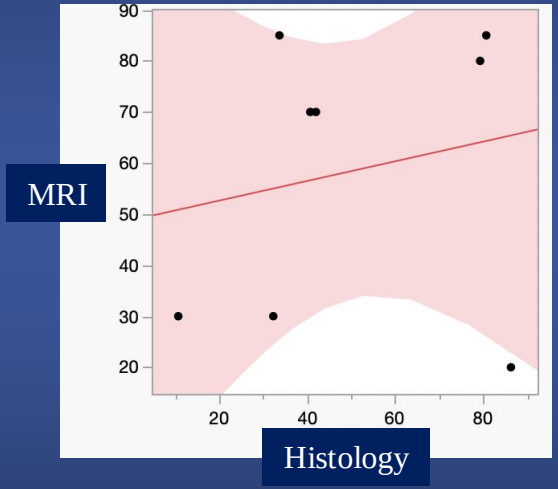
Correlation coefficient	-0.0177
P value	0.9361

Trochlear groove
MSC-derived TEC (N=15)



Correlation coefficient	-0.1456
P value	0.6047

Trochlear groove
Microfracture (N=8)



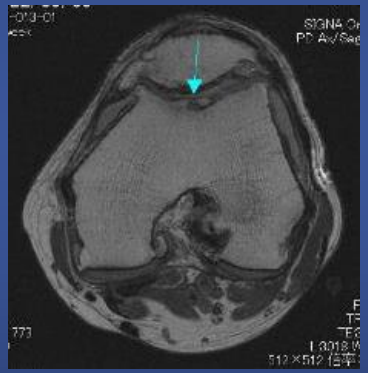
Correlation coefficient	0.1212
P value	0.7749

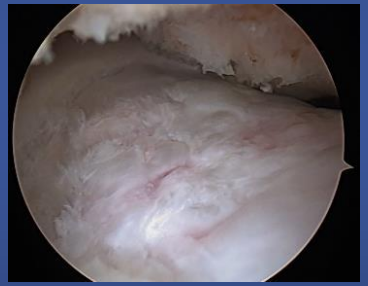
Case presentations

46 years old male patient
MSC-derived TEC implantation
@ MFC, 1 year post-op

- ✓ MOCART 2.0 score: 70
- ✓ ICRS repair assessment: Grade I
- ✓ ICRS II score: 85.0

39 years old male patient
Microfracture
@ TG, 1 year post-op





- ✓ MOCART 2.0 score: 20
- ✓ ICRS repair assessment: Grade II
- ✓ ICRS II score: 86.3

Discussion

- MRI vs. Histology
  - All patient: weak positive correlation
  - Femoral condyle: moderate positive correlation
  - Trochlear groove: no correlation
  - Surgical techniques: same trend

MRI
Evaluation for entire repair tissue
⇩
Low inter-rater error

vs.

Histology (biopsy)
Evaluation for a part of repair tissue
⇩
Potentially high tissue sampling error
(Especially at trochlear groove)

Conclusions

- Comparison of MRI and histological findings of cartilage repair tissue showed a weak positive correlation.
- A moderate positive correlation was found in the repair tissue of femoral condyle, while no correlation was found in that of trochlear groove.
- It should be noted that tissue biopsy in trochlear groove may result in potential tissue sampling errors.

References

1) Schagemann JC, et al. Cartilage 2022.
2) Shimomura K, Nakamura N, et al. Cartilage 2021.
3) Ando W, Nakamura N, et al. Biomaterials 2007.
4) Shimomura K, Nakamura N, et al. Biomaterials 2010.
5) Shimomura K, Nakamura N, et al. Am J Sports Med 2018.
6) Shimomura K, Nakamura N, et al. Orthop J Sports Med 2023.
7) Schreiner MM, et al. Cartilage 2019.
8) Mainil-Varlet P, et al. Am J Sports Med 2010.