A Cartilage-on-Chip Platform for Human MSC Mechanobiology

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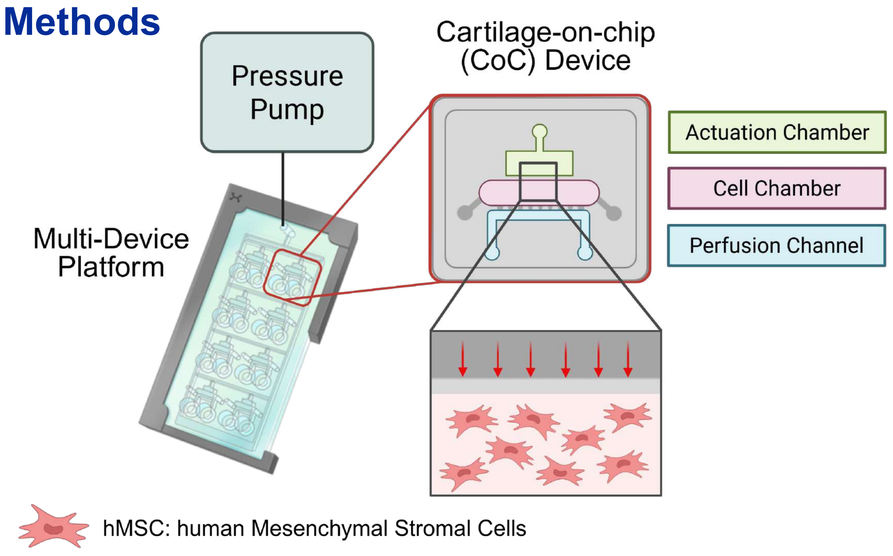
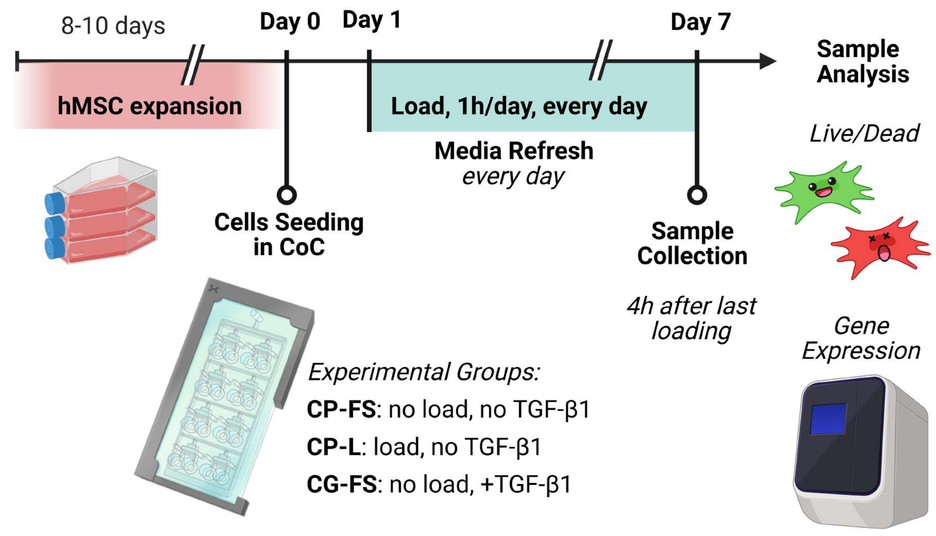
Aims

- Assess feasibility of integrating hMSCs in a cartilage-on-chip platform
- Evaluate viability after encapsulation and mechanical loading
- Investigate early mechanobiological responses under dynamic loading

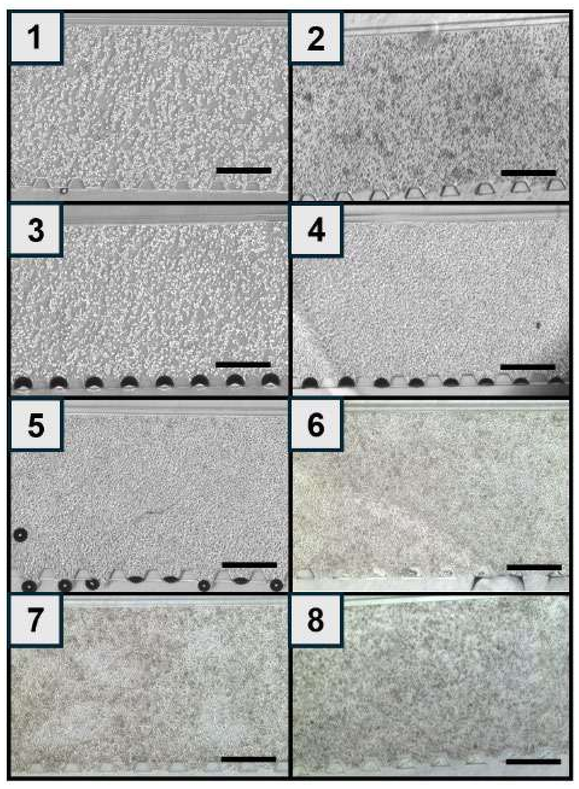
Methods





Results

Multi Re-plate Devices



Scale bars = 500 µm.

Fig 1: Feasibility of Seeding hMSC Within CoC. hMSC were seeded into CoC to assess feasibility. Representative images show successful cell incorporation within the CoC.

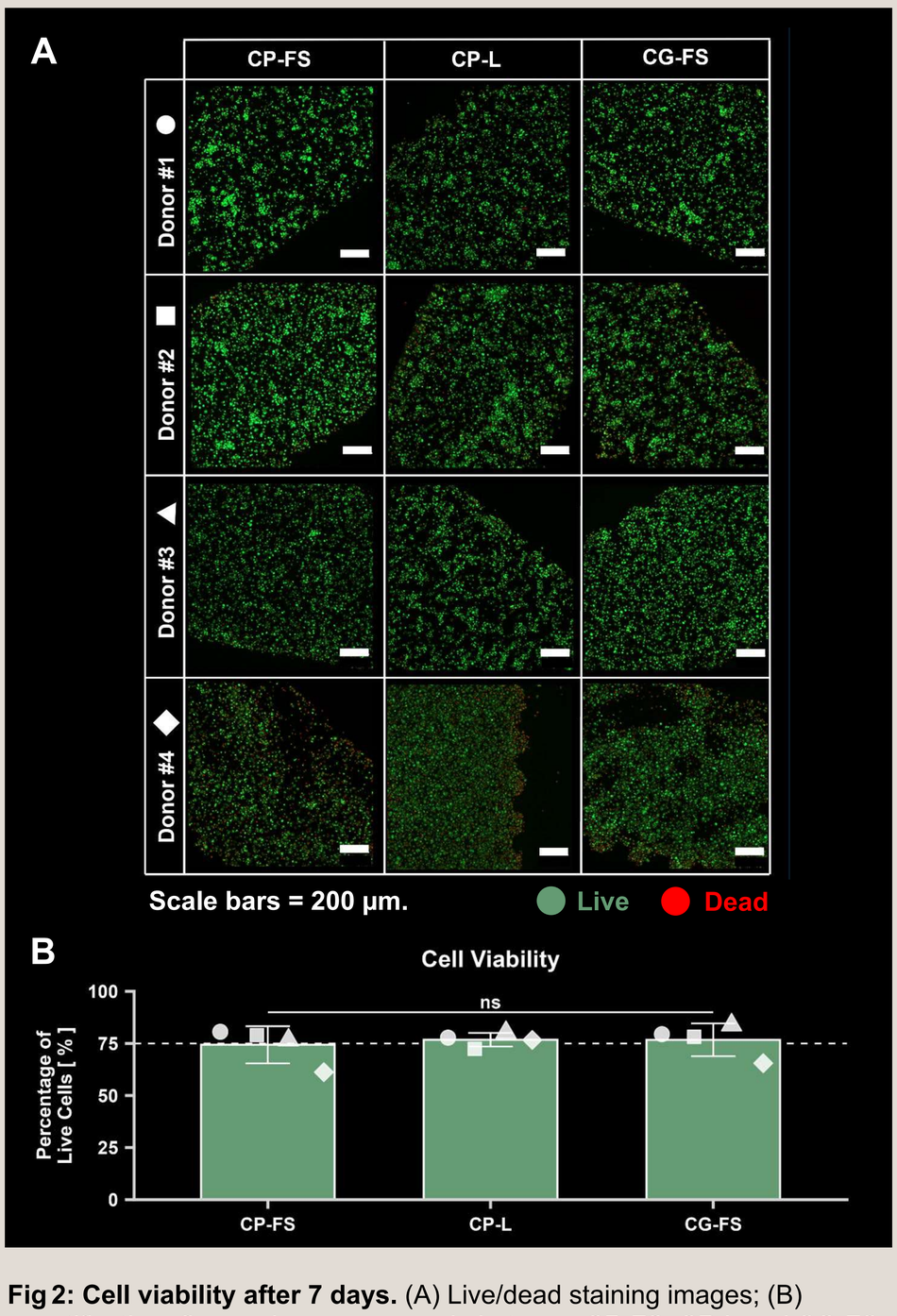


Fig 2: Cell viability after 7 days. (A) Live/dead staining images; (B) quantification. Comparisons were made between CP-FS, CP-L and CG-FS. Data are shown as mean ± SD (n = 4 donors). Statistical analysis was performed using a linear mixed-effects model with donor as a random effect and experimental group as a fixed effect, followed by Tukey-corrected post hoc testing. No significant differences were detected between groups.

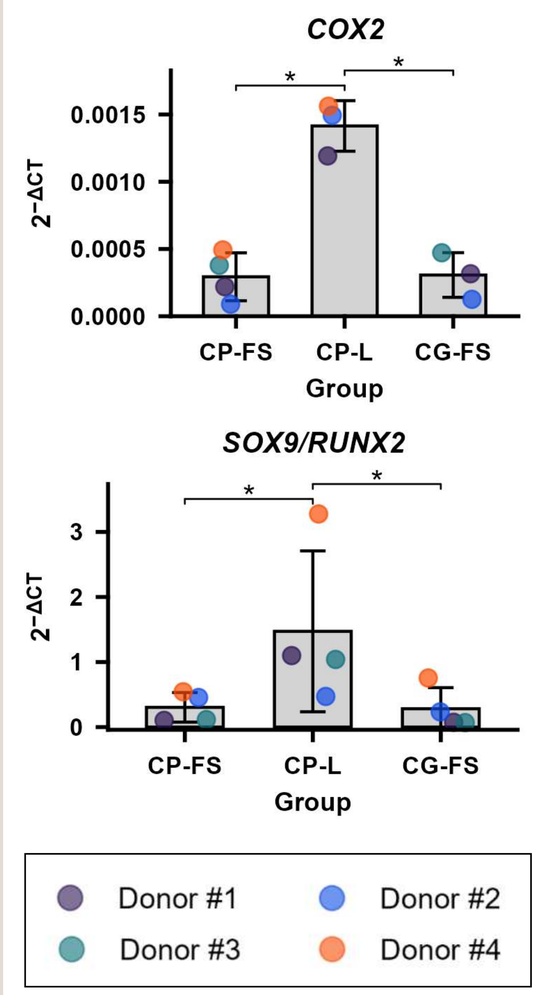


Fig 3: Gene expression after 7 days. (A) COX2; (B) SOX9/RUNX2 ratio. Expression was compared between CP-FS, CP-L and CG-FS. Data are shown as mean ± SD (n = 2–4 donors) and expressed relative to the housekeeping gene RPLP0 using the 2^−ΔCT method. Statistical analysis was performed using a linear mixed-effects model with donor as a random effect and experimental group as a fixed effect, followed by Tukey-corrected post hoc testing. *p < 0.05.

Discussion

- Incorporation into the cartilage-on-chip (CoC) platform and mechanical loading do not impair hMSC viability
- The platform supports robust cell survival under both chondro-permissive and chondrogenic conditions
- Cells sense mechanical stimulation (↑ COX2 expression)
- Mechanical loading promotes a more chondrogenic phenotype, reflected by an increased SOX9/RUNX2 ratio after 7 days

Conclusion

CoC enables early mechanobiological studies in hMSCs while preserving high cell viability.

References

Paggi, C. A., J. Hendriks, M. Karperien and S. Le Gac (2022).

Peitso, V., Z. Sarmadian, J. Henriques, E. Lauwers, C. A. Paggi and A. Mobasheri (2024).

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