Table E-1: Histologic, gross, and mechanical properties (mean ± SD) of femoral head articular cartilage from control, stage IV ON, and stage V ON patients

Parameter	Control	Stage IV ON	Stage V ON
Histologic Score	22.3 ± 6.9	71.4 ± 30.9**	64.8 ± 27.2**
Gross Appearance	1.8 ± 1.4	4.4 ± 3.7	4.2 ± 3.4
Aggregate Compressive Modulus (MPa)	4.1 ± 1.4	1.7 ± 1.3**	0.9 ± 1.3**
Permeability (m^4/Ns)	$1.01 \pm 0.98 \times 10^{-15}$	$1.13 \pm 1.14 \times 10^{-15}$	$8.20 \pm 2.70 \times 10^{-16}$
Equilibrium Tensile Modulus (MPa)	57.9 ± 33.4	44.5 ± 46.9	30.8 ± 18.1
Dynamic Tensile Modulus (MPa)	152.3 ± 68.1	122.7 ± 73.5	103.0 ± 45.2
Failure Strain	0.17 ± 0.08	0.20 ± 0.05	0.18 ± 0.08
Failure Stress (MPa)	19.8 ± 9.3	21.0 ± 15.2	13.3 ± 3.2
Strain Energy Density to Failure (MPa)	1.5 ± 0.8	1.8 ± 1.3	1.0 ± 0.5
Poisson's Ratio	1.1 ± 0.7	1.9 ± 0.7	1.3 ± 0.9
Equilibrium Shear Modulus (MPa)	1.64 ± 0.55	0.81 ± 0.76*	0.54 ± 0.38**
Dynamic Shear Modulus at 0.01 strain/s (MPa)	2.30 ± 0.74	1.18 ± 0.96*	0.83 ± 0.52**
Dynamic Shear Modulus at 0.1 strain/s (MPa)	2.50 ± 0.79	1.34 ± 1.05*	0.93 ± 0.56**
Dynamic Shear Modulus at 1 strain/s (MPa)	2.81 ± 0.88	1.56 ± 1.20*	1.06 ± 0.63*
Dynamic Shear Modulus at 10 strain/s (MPa)	3.31 ± 1.04	1.92 ± 1.45*	1.28 ± 0.73*
Dynamic Shear Modulus at 100 strain/s (MPa)	3.95 ± 1.23	2.37 ± 1.73*	1.56 ± 0.86*
Tan Loss Angle at 0.01 rad/s	0.22 ± 0.06	0.33 ± 0.05**	0.31 ± 0.07*
Tan Loss Angle at 0.1 rad/s	0.20 ± 0.06	0.26 ± 0.05	0.24 ± 0.06
Tan Loss Angle at 1 rad/s	0.21 ± 0.06	0.26 ± 0.06	0.24 ± 0.06
Tan Loss Angle at 10 rad/s	0.23 ± 0.06	0.29 ± 0.07	0.25 ± 0.07
Tan Loss Angle at 100 rad/s	0.22 ± 0.05	0.27 ± 0.05	0.26 ± 0.07

* Significantly different from control ($p < 0.05$)
** Significantly different from control ($p < 0.005$)

Table E-2: Summary of the Correlation of Mechanical Properties with a Less Degenerated Gross Cartilage Appearance in Post-Collapse Cases of Osteonecrosis of the Femoral Head

Mechanical Property	Degree of Correlation	Statistical Significance
Equilibrium Tensile Modulus	$R^2 = -0.43$	$p < 0.05$
Dynamic Tensile Modulus	$R^2 = -0.51$	$p < 0.01$
Central Aggregate Compressive Modulus	$R^2 = -0.38$	$p < 0.05$
Peripheral Aggregate Compressive Modulus	$R^2 = -0.32$	$p < 0.05$
Central Fluid Permeability	$R^2 = 0.36$	$p < 0.05$
Central Equilibrium Shear Modulus	$R^2 = -0.45$	$p < 0.05$
Central Dynamic Shear Modulus*	$R^2 = -0.48$	$p < 0.01$
Central Loss Angle*	$R^2 = 0.51$	$p < 0.01$
Peripheral Equilibrium Shear Modulus	$R^2 = -0.53$	$p < 0.01$
Peripheral Dynamic Shear Modulus*	$R^2 = -0.52$	$p < 0.01$

*at 0.01 rad/s