Introduction. Collagen is main structural protein in extracellular matrix (ECM) and connective tissue. It is widely used in 3D scaffolds for cell culture, tissue engineering, and biophysical studies. 3D gels allow studying the effects of mechanical properties on cell differentiation, development, migration and morphology, as integrin-dependent and -independent cell-matrix adhesions and cell migration can depend on matrix stiffness, rigidity and dimension (3D vs. 2D). Therefore, tailoring and measuring matrix elasticity with precision and without perturbation is essential. In this work, the gelation of various collagens was monitored in real time using a new non-destructive and contactless mechanical testing instrument, ElastoSens™ Bio.

Materials and Methods. ElastoSens™ technology (Rheolution) is based on non-destructive acoustic vibration of sample and laser measurement of response without contact. Response is converted into elasticity. ElastoSens™ Bio has been validated by comparing its results with a rotational rheometer for same samples. Here, Type I human, bovine and porcine collagens (Advanced BioMatrix) were tested for gelation kinetics and gel elasticity.

Results and Discussion. The kinetic elasticity curves for all collagens were sigmoidal when incubated at 37 °C. The results showed rapid gelation with highly repeatable gelation times ($t_{onset} = 12 ± 2$ min) and gel elasticities with mean Young’s modulus of 854 ± 74 Pa for Nutragen® (bovine, 6 mg/mL), 735 ± 41 Pa for PureCol® (bovine, 3 mg/mL), 719 ± 36 Pa for GelCol® (bovine, 3 mg/mL). 667 ± 46 Pa FlexiCol® (porcine, 3 mg/mL) and 582 ± 32 Pa for VitroCol® (human, 3 mg/mL), as shown in Figure 1.

Comparison of multiple lots of PureCol® (bovine, 3 mg/mL) showed excellent repeatability of gelation times ($t_{onset} = 10$ min) and mean gel elasticities with 736 ± 40 Pa for PureCol® Lot #1 and 690 ± 49 Pa for PureCol® Lot #2, as shown in Figure 2.
Conclusion

Tested collagens rapidly produced stable gels at 37 °C with highly repeatable elasticities and only minor lot-to-lot variability, confirming their high quality and consistency. Non-destructive mechanical testing of soft 3D gels using ElastoSens™ Bio² enables: (1) the determination of gelation kinetics and elasticity of 3D gels, (2) its use as a routine quality control tool and (3) as a development tool to test and design products with specific mechanical properties and to fine-tune gel elasticity for desired applications. Although not shown here, ElastoSens™ Bio² also enables comparing the elasticities of both cell-seeded and acellular gels.