

## Introduction

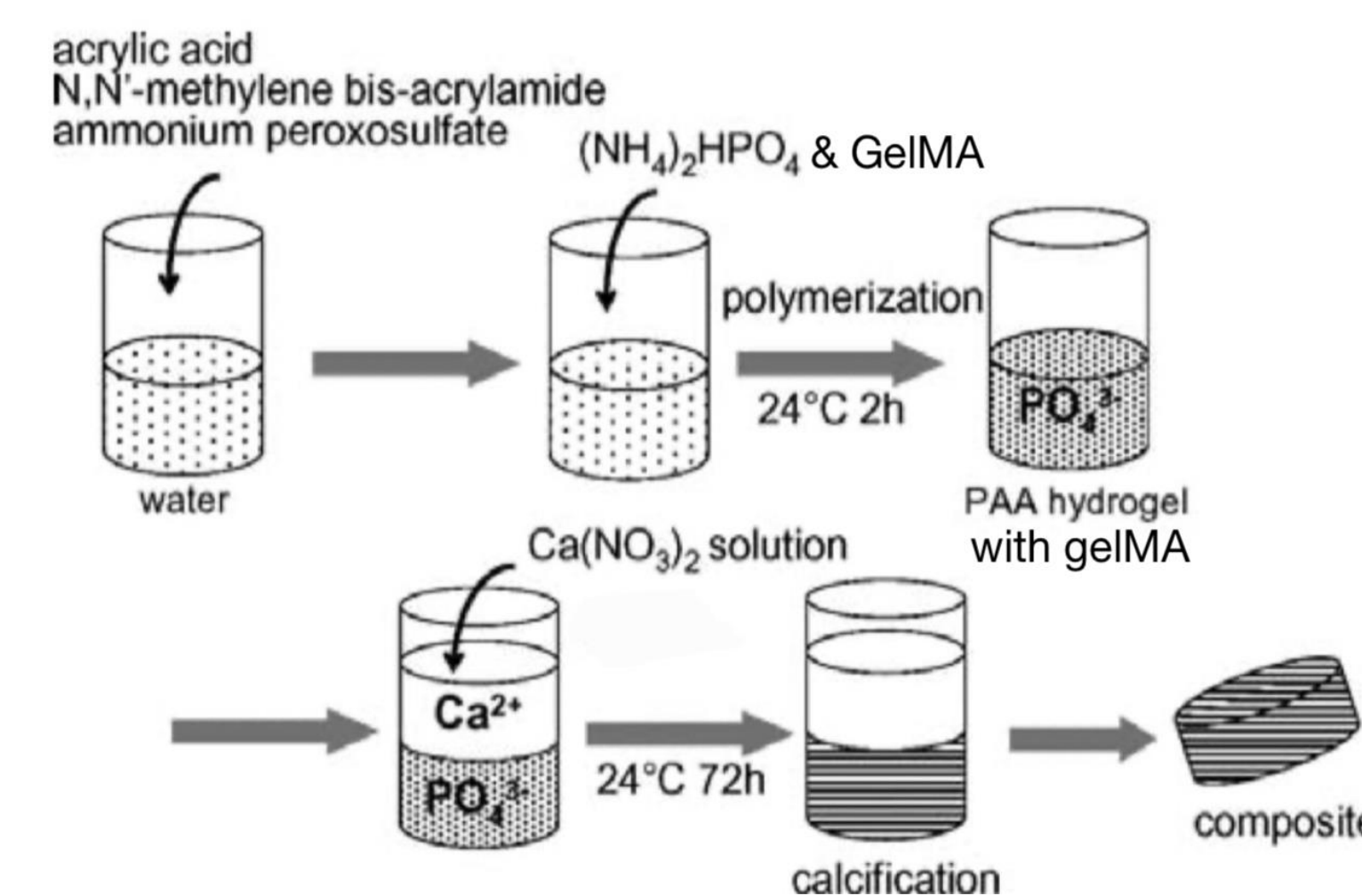
GelMA has superior cell adhesion and higher porosity compared to stiffer counterparts. This facilitates improved distribution of calcium and phosphate ions within the hydrogel, promoting enhanced mineralization throughout the 3D network. However, gelMA alone does not mineralize in the absence of cells. To address this limitation, we propose augmenting gelMA composition with collagen Type I and evaluating its hardness and modulus of elasticity when combined with a calcium phosphate solution. Therefore, a hypothesis is formed that mixing gelMA, collagen, and calcium phosphate solution at specific concentrations will yield a dentin-like tissue.

## Objective

The aim of this study is to combine a phosphate hydrogel with gelMA and collagen solutions to produce "dentin-like" construct.



## Methods

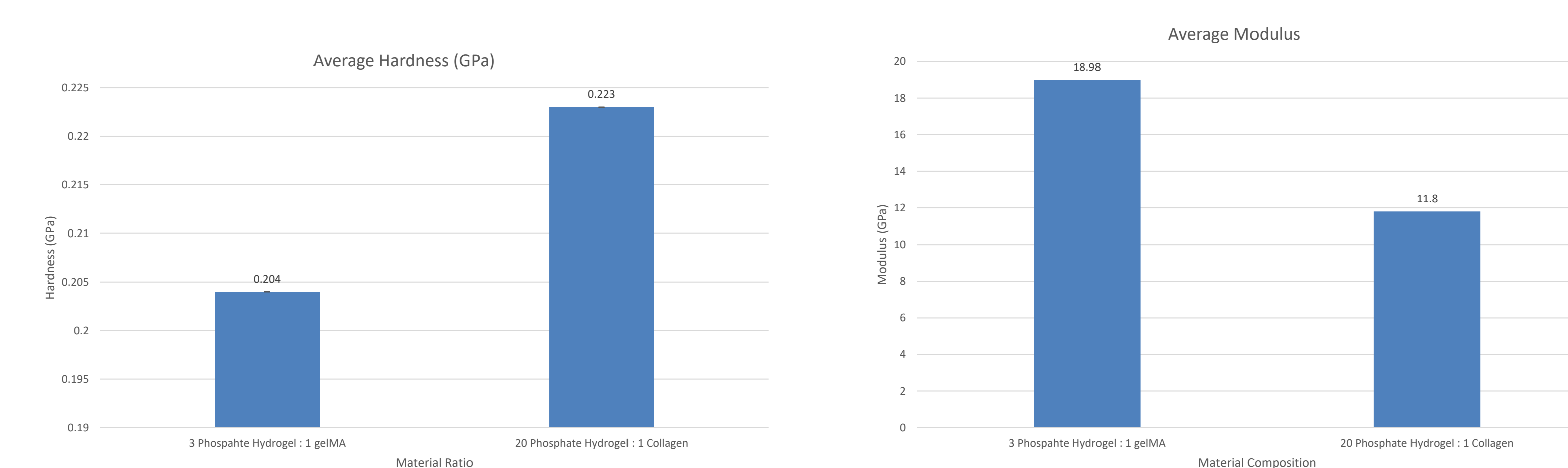


A gelMA and collagen solution, containing 1.5mg/mL collagen, was prepared. This was mixed with a phosphate hydrogel solution at a 3:1 ratio. Gelation was induced by incubating the solution at 60°C for 2 hours. A 3.34M calcium nitrate tetrahydrate solution was then added in equal volume and left for 72 hours for mineralization. The resulting product was a gelMA/collagen infused HAp–PAA composite.

Four samples were embedded in epoxy resin and polished using an EcoMet 30 in decreasing coarseness. Material hardness was measured using KLA's iNano Nanoindenter with testing parameters set at a 50mN load and 250nm depth. Each sample underwent four indentations at different locations, resulting in sixteen data points.

## Results

After running eight tests on the 3 Phosphate Hydrogel:1 gelMA samples, the hardness was an average 0.204 gPa plus a standard deviation of 0.089. The eight tests of 2 phosphate hydrogel:1 collagen material yielded an average hardness of 0.233 gPa with a standard deviation of 0.0252. The reported values on the literature for dentin hardness and modulus are 1.0gPa and 19gPa, respectively.



The average modulus was 18.98gPa with a standard deviation of 12.03 for the phosphate hydrogel with gelMA. The average modulus for the phosphate hydrogel with collagen was 11.8 gPa with a standard deviation of 4.16.

## Discussion

Out of sixteen tests conducted, four reported hardness and modulus values of 0, which were excluded from the data. These zero values might indicate nonuniform mineralization homogeneity in the material. Additional experiments are underway to investigate mineralization uniformity.

## Conclusions

GelMA mixed with type I collagen and a calcium phosphate HAp–PAA solution forms a structure with hardness akin to natural dentin.

## Acknowledgements

REDE/SoDM Start up fund for Saulo Geraldelli.