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Capillary rise in demineralized dentin and more generally in a fibrous tissue

Dental practioners are currently facing a lack of durability of composite resin used in restorative dentistry on dentinal substrate.
This lack of durability stems from infiltration defaults of the dentinal substrate. This substrate is a superficial demineralized dentin layer that is infiltrated by a resin to seal the dental composite to the tooth. The resin penetrates by capillarity in the porous demineralized dentin and our goal is to better understand this infiltration step to point out the optimal infiltration parameter set.
Demineralized dentin is a collagen fiber network with two types of porosities. This issue raises the more general problem of capillary rise in fiber network. So in a more global approach, we first modeled the capillary rise in a vertical cylinder array using Finite Elements to solve the generalized Laplaces equation. Then the geometry has been complexified to approach this complex network. The model is coupling Navier Stokes equations (modified to take into account capillarity) and a level set method to follow the infiltration front moved by capillarity. This model has been used to model capillary infiltration of a wetting fluid and forced infiltration of a non-wetting reproducing Mercury Intrusion Porosimetry (MIP).