

A Fluid Particle Simulation to Study the Motion Sickness in Semicircular Canal

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Introduction: The benign paroxysmal positional vertigo(BPPV) which comes from moving an otolith in semicircular canal called as motion sickness. The symptom occurs when otoconia enters a semicircular canal thereby creating the sensation of motion. This study is about the mechanical malfunction of the inner ear.

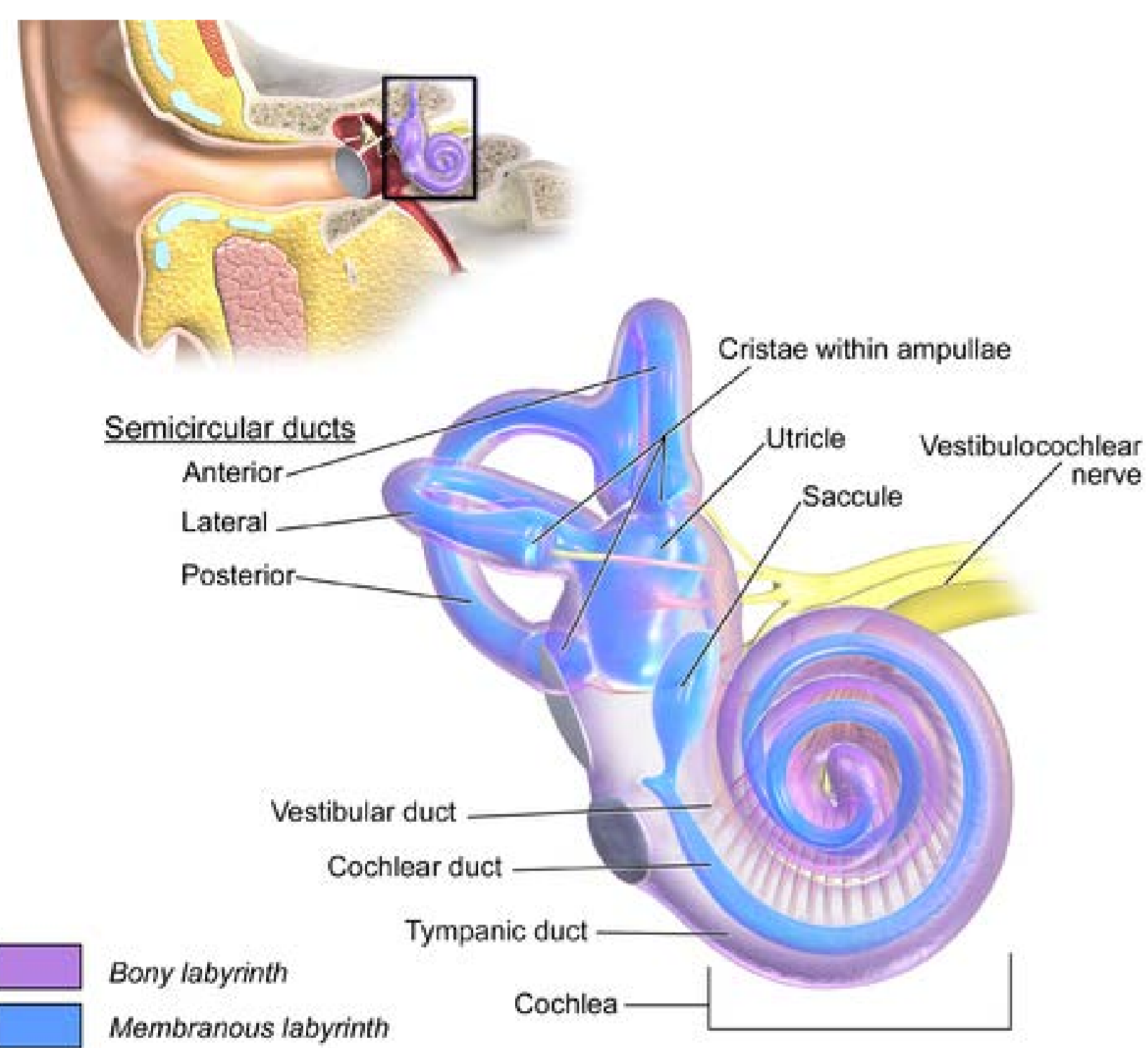


Figure 1. The Inner Ear and Semicircular canal

Computational Methods: A 2-dimensional FE linear model was made using the Particle Tracing Module. The Particle Tracing for Fluid Flow interface is used to study the trajectory of otolith in the canal and Laminar Flow interface is used to study endolymph that is background flow. The motion of particles are driven by flow and gravity and include particle-fluid interaction. This problem is about fluid structural interaction with contacts between particle and cupula or wall. The simulation of contacts in the fluid area is not supported by current version. But particle tracking approach has been offered reasonable results in this case.

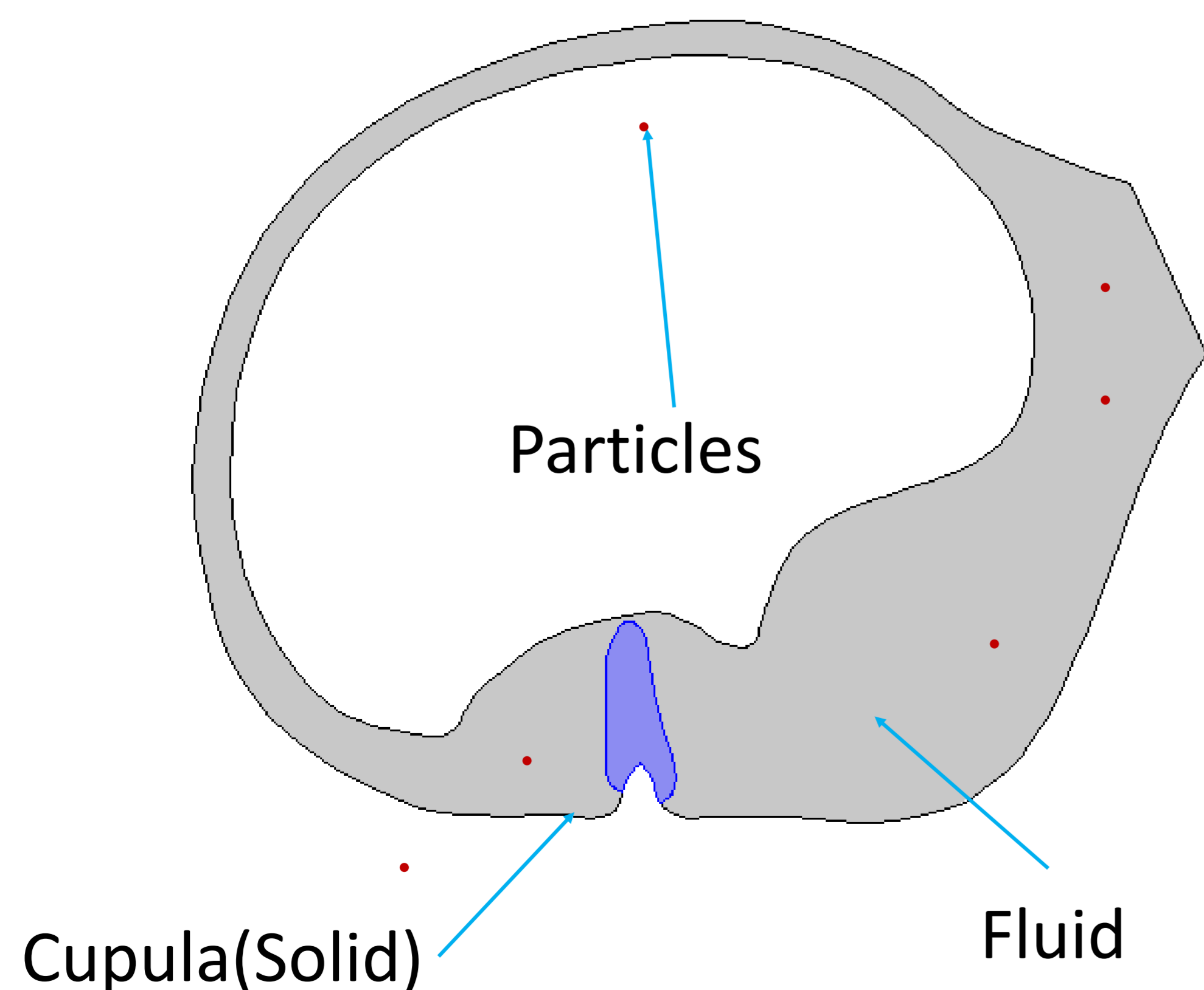


Figure 2. The FE model for Semicircular canal

Results:

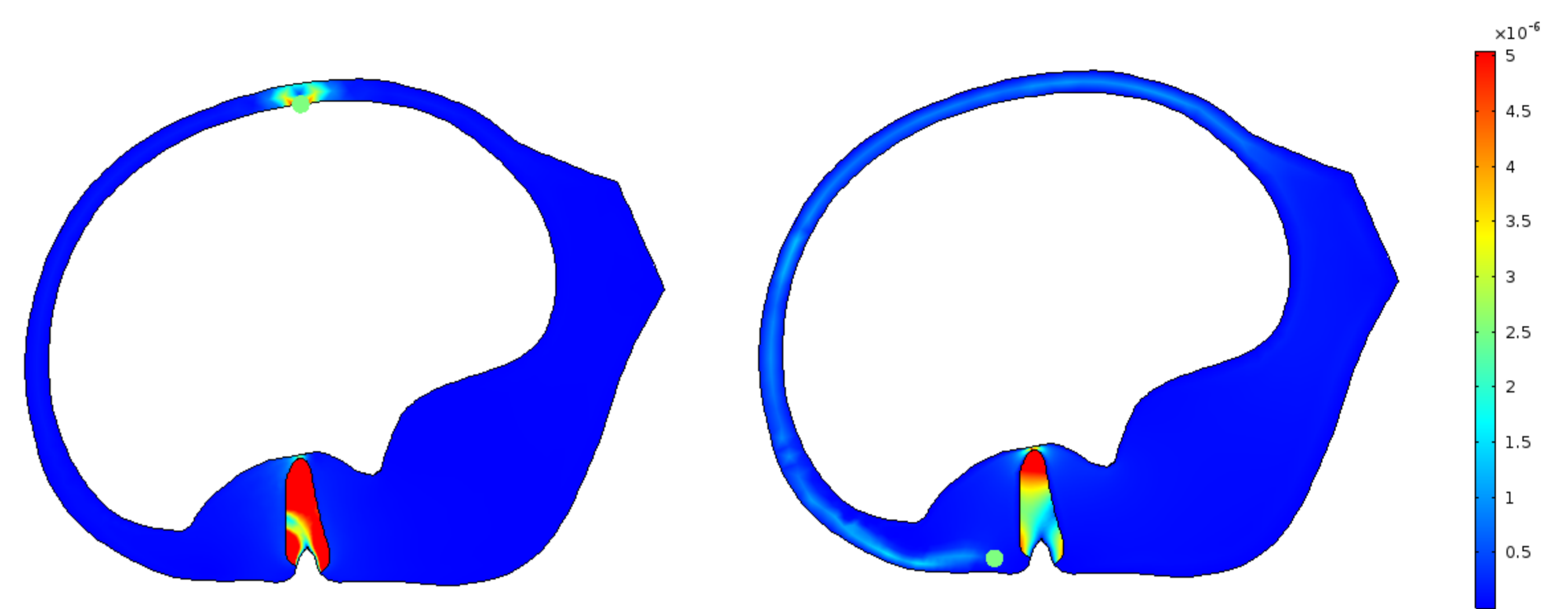


Figure 3. Velocity magnitude , Particle trajectories and Stress at different times

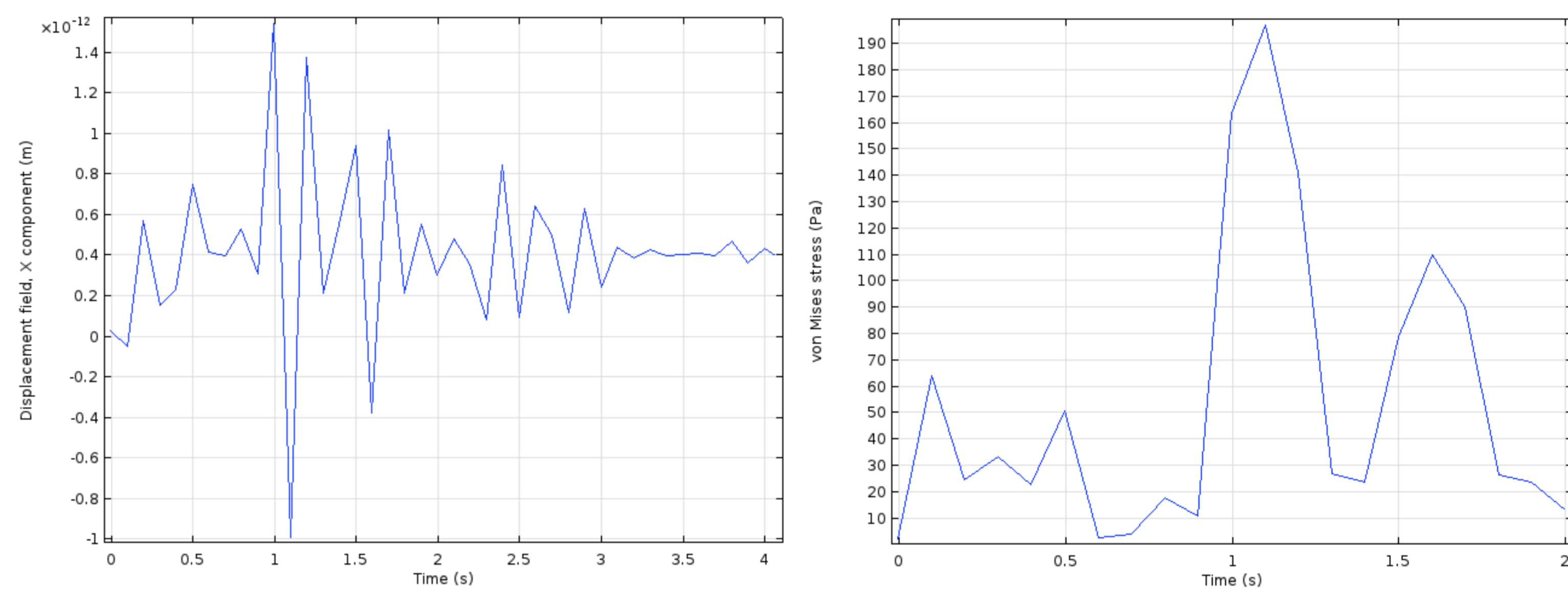


Table 4. Displacement of x component(left) and maximum stress(right) in the cupula

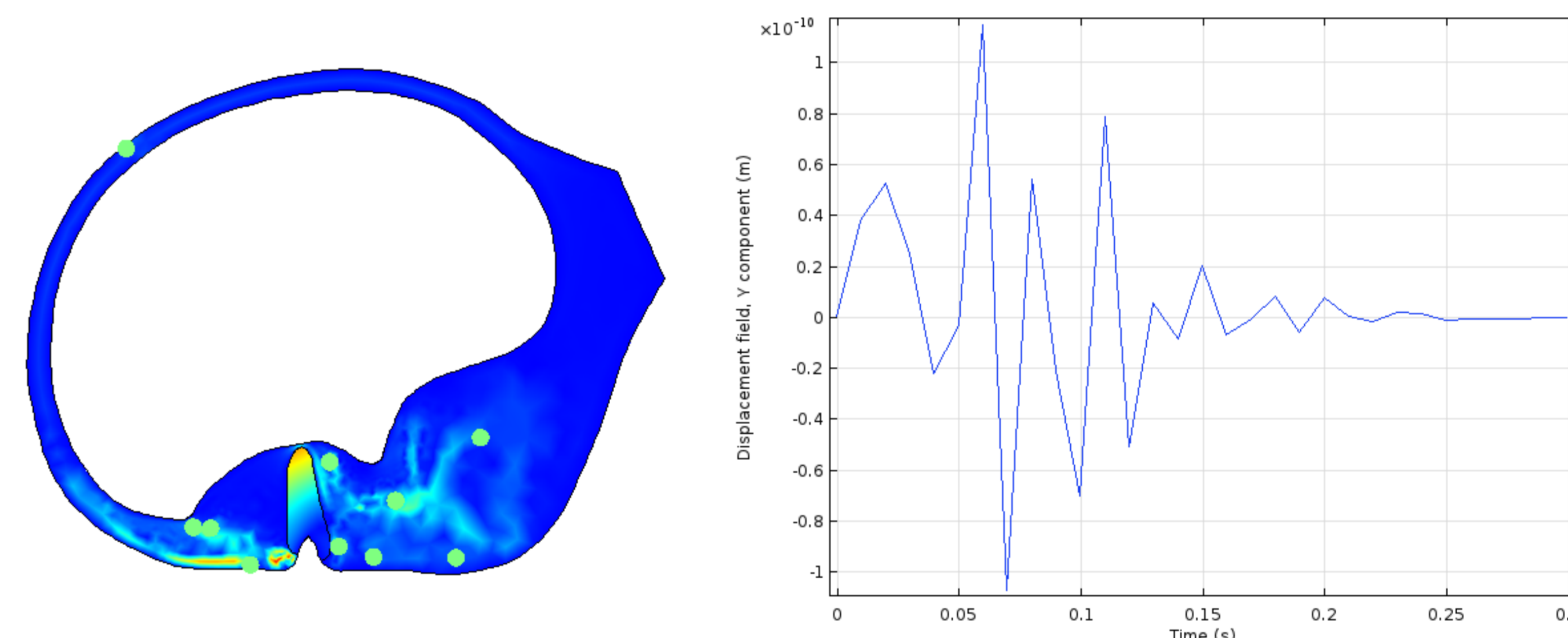


Table 4. Applying 10 otolith. Velocity magnitude, Particle trajectories and stress.

Conclusions: Through the results, the particle tracking is suitable for fluid structure interaction problem and also can reduce computational time and resources. This simulation can be enhanced to rehabilitation therapy and understand the symptom.

References:

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