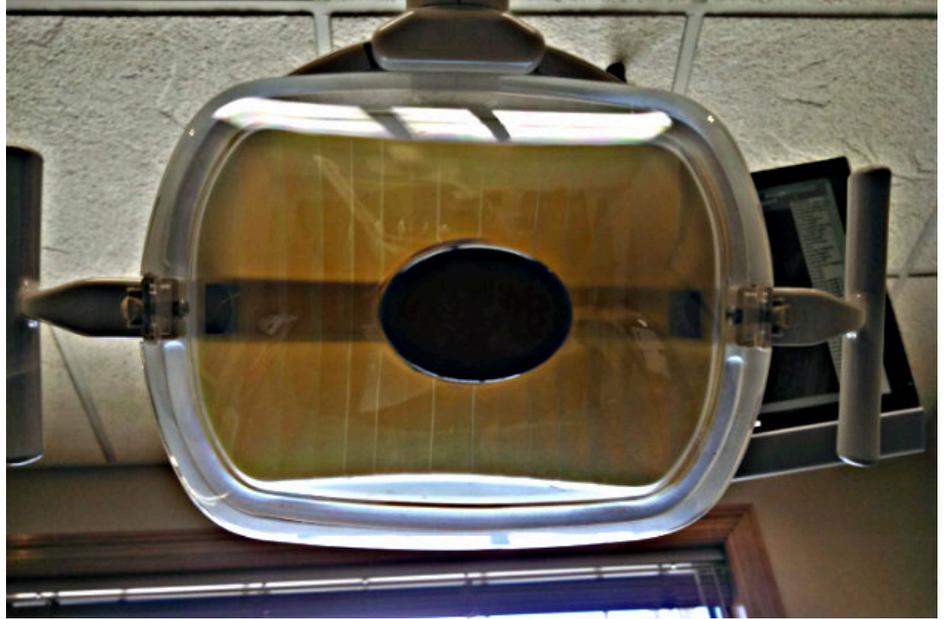


## 2.77 Seek and Geek #5: Dental lights

Last week I heard that the Harvard Dental students were about to take their final exams, and needed patients to do cleanings and simple fillings. Since I'm poor, I figured it was a pretty good deal to find out if I have any cavities, get them filled for free if so, and make some easy money as a bonus. Turns out I had the smallest cavity ever. Dentist would normally ignore it, but it was enough to be eligible for the exam, so for the first time ever I voluntarily climbed into a dentist's chair to get my tooth scraped and sawed.



During the screening and filling, I noticed that almost every instrument (xrays, lights, computers, tools) they use is mounted on arms with several rotary joints, like the classic dental lights shown in the photos. These arms are human-actuated, and are designed to hold themselves in the position that the dentist manipulates them to. Although this is simple in concept, it is actually a challenging engineering and human use design problem. Because the arms have a classic C-shaped open structural loop, their stiffness needs to be high. Thus, on many tools each link gets larger and larger as it approaches its mount on the floor, wall, or ceiling.

Each rotary joint has to be compliant enough that the physician can manipulate the "end effector" to the desired position relatively easily, while being stiff enough to hold its weight in place. The geometry and kinematics also has to be planned out in such a way as to avoid singularities and provide enough of a lever arm in the intended workspace to be moved with the correct amount of effort.

The halogen lamp itself is actually pretty interesting. Outside of the intended illumination zone, it's not very bright. The bulb points away from the patient, into a curved mirror covered with a plastic sheet with ridges. When the light is shining at the mouth, the light does not even reach the eyes, and it actually looks like it is turned off.



With rubber in my mouth, tools grinding away at my teeth, and trying not to choke on my own spit, I had lots of opportunities to distract myself by looking at and thinking about the engineering feat above my head shining a light on my teeth!