

**LEO MAGUIRE:** Hello again. I'm Leo Maguire, one of the corneal specialists here at Mayo Clinic. In this video, we'll teach you how to place a needle through the graft with a high degree of accuracy and consistency. Welcome to part two of our series of short videos that discuss a curriculum for corneal suturing we've used with our residents here at Mayo, for the last 15 years.

We want to set up our forceps and our needle in such a way that a straight gross motor movement will allow the needle to enter the cornea 0.8 to 1.0 millimeters from the graft edge, exit the edge of the graft at a depth of at least 80%, and do so along an axis exactly radial to the graft. The following slides will show the setup steps that allow this to occur.

First, the surgeon has to look at the cornea and identify the plane that is radial to the graft edge, and then identify the exact positions where the surgeon plans the needle to enter and exit the corneal graft. The first step is placing the needle parallel to the host cornea. This position is a neutral needle-holder position for most of the needling we will do on host and graft. Neophytes cannot always tell when they are not parallel to the corneal surface, and so we teach them this strategically important position before they move the needle to the graft surface.

The next step moves the needle to the graft along the radial line, perpendicular to the graft edge, and maintains the same needle position, parallel to the graft surface. The needle, then, remains stationary, until we properly position the forceps. Precise forceps positioning is the most important skill the neophyte must learn, so we will spend a lot of time on this slide.

First, we separate the two tips of the forceps to make sure the tips are parallel to the radial line along which we propose to pass the needle. Next, we ensure that the two tips are angled at an approximately 45-degree angle, relative to the surface of the cornea. Next, we walk the inferior tip down the edge of the graft, until we are just above the deep margin. The resident can judge the depth of the tip once they learn how to look through the cornea from the surface and note how the resolution of the tip blurs as it moves deeper and deeper down the graft edge.

Next, the resident gazes at the deep forceps' tip to make sure that it stays perfectly still, while the top tip moves to engage the surface of the graft. Since one has oriented the forceps' tips at a 45-degree angle, the line between the forceps' tips is the hypotenuse of an isosceles triangle. The wound edge of most grafts is 800 to 1,000 microns, so the distance to the surface forceps' tip from the wound margin should also be the same distance, and that distance is the distance from the edge of the graft we want our needle to enter.

At this point, you've positioned the forceps in such a way that describes the intended point of entry and exit of the needle, while also ensuring that the needle will pass along the intended radius. You've also set things up so that if the needle comes in too flat, it will hit the deep forceps' tip and give the negative feedback that tells the surgeon to reorient the line of the needle's passage, so that it goes under the deep forceps' tip.

Now, we're ready for the needle. Confirm the needle is oriented along the radial axis described by the two tips. Rotate the needle so that it is oriented at a 45-degree angle relative to the surface-- the same as the tips of the forceps. The needle enters the cornea as close to the top tip as possible. Barely engage the cornea and pause, so that your eye has a chance to look at the angle of the needle to make sure that it is not too shallow so that it will hit the bottom tip, or so steep that it will drive through and through the cornea before it reaches the wound margin.

The needle movement should be a straight line drive with no use of a wrist or supination of the hand-- a straight drive. When performed correctly, the surgeon feels an even, smooth movement through the cornea, and cannot help but have the proper length, depth, and radially, because proper setup and execution guarantees that result. Once the needle is through the edge, don't let go, because you want the length of needle exiting the deep wound margin to be approximately the length of the proposed insertion into the host cornea.

Now, we will review the steps in text form on this page and the next. So take your time. Study this page.

And this page.

In the following slides, we'll show you the same information, but at high speed, to make it into an animation.

[MUSIC PLAYING]

I hope you found this video helpful, and stay tuned for part 3, where we learn how to engage the needle radial to the host margin, so that it is deep and parallel to the posterior host surface. I'm Leo McGuire, and thank you for watching.