

The Suction/Biopsy Channel

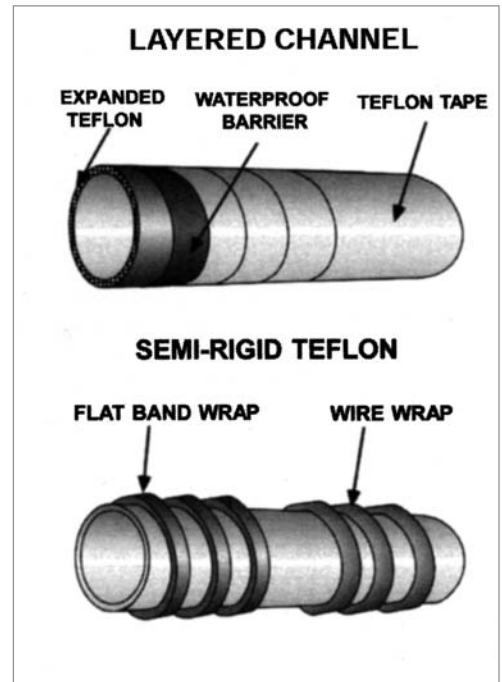
What could be more trouble free than a length of tubing from one end of the scope to the other with a single on/off valve in the middle? So why are there so many problems related to this channel?

THE MATERIAL

In the early days of the flexible endoscope's development, the suction/biopsy channel was basically problem-free. Scopes were only required to angulate to 120 degrees maximum and were used more for diagnostic rather than therapeutic procedures. Fewer procedures were performed with biopsy forceps or injection needles. The only abrasive object passing through the channel was an occasional cleaning brush. Any length of medical grade tubing was sufficient. However, as endoscope design advanced over the years the limitations of plastic tubing became more apparent.

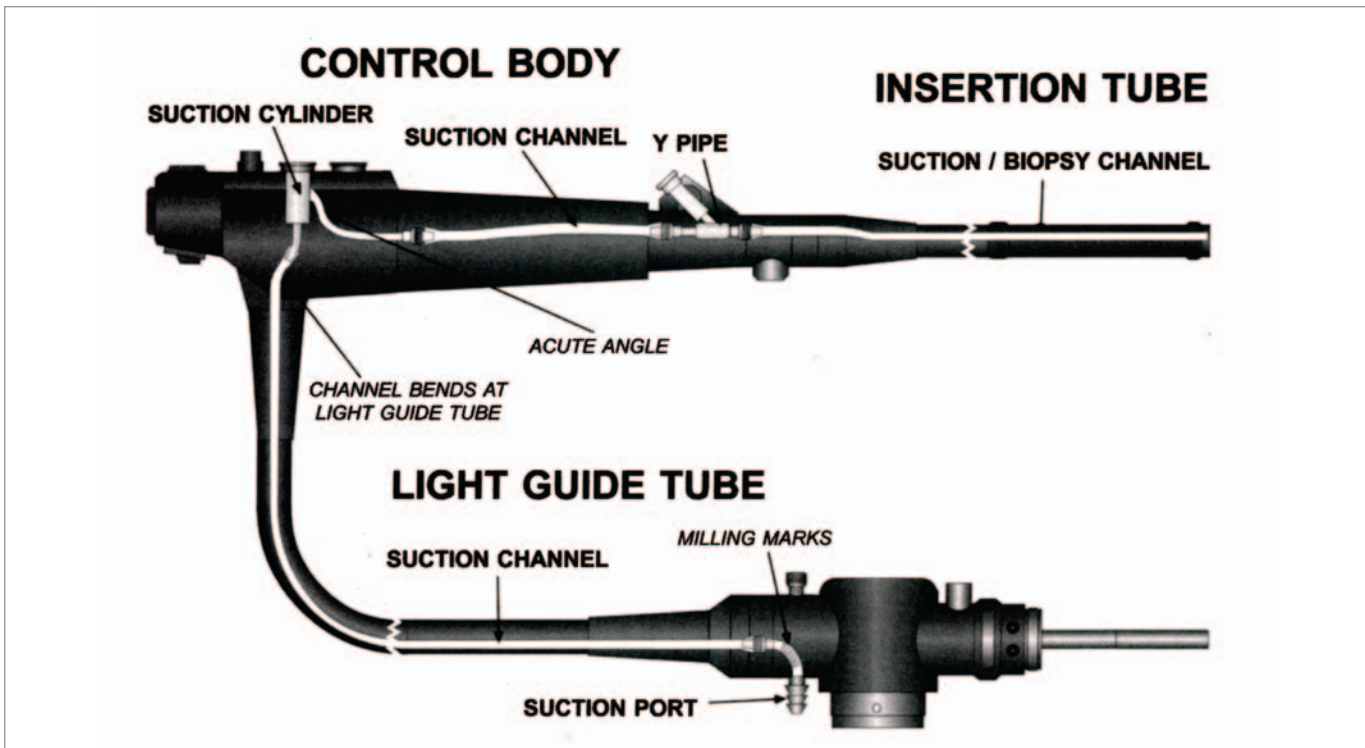
A good suction/biopsy channel material must have several important characteristics. It must be flexible and capable of bending 240 degrees in a one inch diameter circle to facilitate movement of the bending section. The material must be stiff enough to keep its round shape yet, it must be pliable enough so pressure is not exerted against the delicate fiber bundles. It should not buckle while flexing so instruments can easily pass. The inner surface of the channel that makes contact with the instruments should be solid, slippery and durable. Channel tubing must be chemical resistant and not degrade from alcohol, disinfectants, mild acid sterilants or body fluids. The channel and seals must be capable of withstanding pressure as high as 20 pounds per square inch to allow for leak testing and automated reprocessing. Another important characteristic is the material's ability to be attached to a fitting. The tubing's outer surface must be smooth to prevent binding or snagging the other internal components.

The most common suction tubing used in the production of the endoscopes between 1983 and 1993 was a multi-layered tube. The inner surface was expanded Teflon which had the consistency of a slippery sponge. Another layer was applied over it to give it water retention and wall form integrity. This material had several problems that made it unsuitable for this purpose. When new, it offered a flexible and chemical resistant membrane as a contact surface and instruments easily passed through it. But, expanded Teflon was porous



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and it was very difficult, if not impossible, to remove debris and reprocess. If debris was left in the membrane pores and subjected to glutaraldehyde, the once slick inner surface would become tacky because it was coated with a protein layer. This protein-glut layer would grab instruments as they passed through the channel, particularly in the bending section. This resistance caused channel failure due to buckling or delaminating. Continued use would even damage forceps by buckling the coil springs. So many unexplained channel blockages were reported that all usage of this channel was abruptly stopped.

In the haste to switch to a new material, insufficient research was conducted by most manufacturers to find a suitable replacement. Many took the easy route by selecting a biologically safe plastic which has poor flexing properties, instead of looking for a material that serves the needs of the scope. Manufacturers are all using Teflon tubing with some form of metal springs or bands used to prevent the rigid Teflon from collapsing at critical bend areas. Teflon is certainly slippery, water-proof, durable and resistant to chemicals and abrasives. But, in its solid tubing form, it is much too rigid to make the bends required of it in the light guide and insertion tubes of an endoscope, let alone in the bending section. This may be why customers have seen an increase in the number of collapsed channels since 1993. The stiffness of the Teflon is also the reason there has been an increase in angulation adjustments and angulation wire breakage. A wire's breaking strength is pushed past its limits when it has to fight the channel's resistance to bend. The reason for most channel overhauls is the failure of the material and is seldom related to improper use or handling.

FiberTech has developed a channel material that is superior to existing technology currently being utilized. Our proprietary new FiberFlex channel combines the best properties of the other channels on the market. The channel material is extremely flexible like the laminated channel, but the channel is reinforced by a fine mesh within the channel material itself. The inner surface of the channel remains very slippery, debris and chemicals will not adhere to the channel and the channel is very resistant to kinking and collapsing.

THE ASSEMBLY

Let's examine the suction system to understand potential problem areas. The suction system consists of a couple of lengths of medical grade tubing attached to stainless steel connectors with either epoxy or mechanical fasteners. Each attachment of tubing to connector is critical. The assembly must be closely monitored and inspected to ensure a perfect union and to ensure that the tight fitting connector has not scratched the inner wall of the tubing.

The first potential problem area is in the light guide connector. The metal fitting at the channel port follows a right angle turn. Often, there are milling marks left on the inner surface after machining which increase the likelihood of something catching. Cotton applicators should not be used to probe this or any channel port during cleaning. The applicator may wedge itself between opposing interior walls, catch on the milling marks and eventually break off inside as the user attempts to work it free.

Another area of concern is the bend in the channel where the light guide tube meets the body. Aggressive cleaning with a coil spring cleaning brush or damaged brush can gradually wear through the channel. The joining of the channel to the suction valve unit must be secure since the cleaning brush exerts pressure at this junction, which occasionally separates.

There is a short length of tubing between the suction valve and Y pipe at the biopsy port. This is a section that is often missed when brushing gross debris from the scope. Cleaning it requires inserting the brush at an acute angle into the valve unit. Remember, this is only a short length of less than eight inches. Damage to the suction cylinder or valve port may occur with repeated use of a metal coil cleaning brush that is inserted into the cylinder and passed all the way through the distal tip. Brush the short length through the suction valve and brush the insertion tube channel through the biopsy port.

THE OPERATION

When the suction pump is operating and its tubing is connected to the endoscope, a

vacuum is pulled through the suction channel in the light guide tube up through the body. The suction valve is designed to leak surrounding air into the suction system. When the valve is activated, the air leak is sealed and the vacuum is passed through the biopsy channel to the tip. The biopsy valve must be in place and in good working order or this will leak outside air and circumvent the passage of a vacuum to the distal tip.

RECOMMENDATIONS

Using caution when inserting anything into the channels and prompt cleaning of the endoscope after procedures is the best way to assure proper suction system operation. To prevent kinking or collapsing of the Teflon channel, avoid over-flexing the light guide tube and the insertion tube. If resistance is felt when passing instruments through a channel, the channel may be damaged. Instruments may eventually puncture a damaged channel if their use is continued. A hole in the channel increases the risk of fluid invasion and damage to other internal components of the scope. We recommend having the channel replaced before the damage becomes too severe.