Since the invention of pars plana vitrectomy by Robert Machemer in 1969, the complexity not only of the vitrectomy devices, but also of the vitreous cutters has grown considerably. Due to small incision vitrectomy, which was introduced by Gildo Fujii in 2002, the vitrectomy procedure became gentler for the patient. At the same time, from the instruments, which diminished in size, new challenges emerged to the surgeons and the instrumentarium with reference to surgical strategy, stability of instruments, cut rate and quality, as well as aspiration performance of the system surgical device and vitreous cutter system.

For the surgeon the tractive strain to the retina is the most important and visible influence during the surgical procedure. The most feared complication during vitrectomy, which is associated to traction, is an undiagnosed micro foramen in the thin peripheral retina with a secondary retinal detachment.

For this reason vitrectomy devices today are equipped with complex aspiration systems and optimized duty-cycle-managements for the control of the vitreous cutter or are operated with oversize instruments. However, Hagen-Poiseuille’s law persists, in which the radius is entered into the equation in the fourth degree, and with that as the most important variable, and so the dynamic viscosity gains importance for a well functioning vitreous cutter.

With the development of the double blade vitreous cutter some of the above mentioned device characteristics shrink in importance, without admittedly sinking into insignificance. The double blade vitreous cutters improve considerably the performance of the systems for small incision vitrectomy. Especially the aspiration flow benefits from that. As the guillotine blade carries out two cuts per work step, the vitreous is cut into smaller pieces compared to conventioal cutters. These smaller pieces can now be aspirated more easily, especially by vitreous cutters with small lumina, what results in a higher and more permanent flow (fig. 1). Admittedly this does not abrogate Hagen-Poiseuille, but it does improve the fluidics of the system’s surgical device and vitreous cutter system and reduces the dynamic viscosity \( \eta \) with the result of a significantly better aspiration flow. As a positive side effect the durability of the blades is increased in comparison to single blade vitreous cutters, what becomes particularly evident with more complex indications like trauma, organized vitreous, vitreous hemorrhage or luxated lenses.

Figure 1: Fluid movement of different vitreous cutter types
Besides the extremely high cut rates and the safe and fast cutting of the vitreous, the virtually complete immobility of the retina, even when cutting near the retina periphery, is remarkable. This cutting smoothness is, compared to single blade vitreous cutters, an outstanding characteristic of the dual cut with high cut rate.

When using single blade vitreous cutters the surgeon must control two interdependent parameters, the vacuum respectively the flow and the cut rate. The higher the cut rate, the lower the aspiration flow because the aspiration window is, cumulated over time, closed longer. With the MACH2 double blade vitreous cutter the aspiration window remains permanently open and decouples the cut rate from the aspiration flow (figs. 2 & 3). This enables the separate control of these two important surgery parameters. The result is a faster core vitrectomy and a better controllable vitreous shaving.

These two characteristics of the MACH2 double blade vitreous cutter, its ability to cut the vitreous into smallest pieces and to make the flow directly controllable due to the permanently open aspiration window, constitute a significant enhancement of the device/vitreous cutter system.

Literature:
3 The American Heritage Medical Dictionary 2004 by Houghton Mifflin Company. Published by Houghton Mifflin Company