

Blood Vessel Sealing by Microwave and Radio Frequency Current

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In recent years, various types of medical applications of microwave have widely been investigated and reported. The authors have been studying surgical devices which employ the microwave thermal effect. In the recent surgical operations, electrical scalpel has widely been used and employs the radio frequency (RF: from several hundred kHz to several MHz) current. It can realize both tissue coagulation and dissection. Even so, this device has some problems in the tissue coagulation. On the other hand, the surgical device based on the microwave technique can coagulate the tissue without any problems. However, the microwave device cannot cut the biological tissue without any devices. Therefore, in this study, a hybrid surgical device using the microwave and the RF current is developed. Moreover, when the device is used for vessel sealing, withstand pressure is measured as performance evaluation of the proposed device.

Figure 1 illustrates the developed hybrid surgical device. This device is composed of two parts: a fixed part and a movable part. These two parts grasp the biological tissue like forceps. The microwave antenna is embedded into the fixed part and the operating frequency of the antenna is 2.45 GHz, which is one of the industrial, scientific and medical (ISM) frequencies. Moreover, the microwave antenna is also used for active electrode for the RF current, and peripheral four electrodes (ground electrodes) retrieve the RF current. Figure 2 shows the operation of the device. The grasped biological tissue is coagulated by the microwave energy radiated from the antenna. After the coagulation of grasped tissue, the RF current is emitted from the active electrode to the ground electrodes. At the time, the grasped tissue will be cut. These operations can realize a blood vessel sealing.

In this study, a swine blood vessel, whose diameter is approximately 3 mm, is sealed by the microwave and is also cut by the RF current. After that, the withstand pressure at the sealing part is measured by a pressure sensor. The withstand pressures are around 27 kPa (approx. 200 mmHg) in all cases. From the results, it can be said that the proposed device can be used for blood vessel sealing in the surgical operations.

As a further study, prototype devices, which can be used for actual surgical treatment, will be developed by considering usability of surgeons.

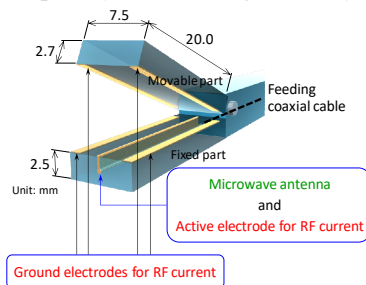


Figure 1. Hybrid surgical device.

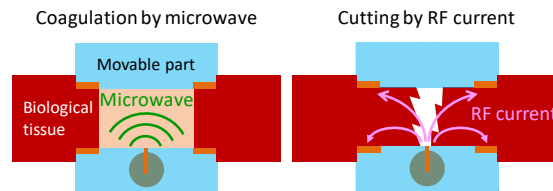


Figure 2. Operation of developed device (cross sectional view).