# CHAPTER 6

# FUTURE RECOMMENDATIONS

This experiment studied the affects of beamwidth, pulse repetition frequency, and carrier frequency. Future recommendations regarding these variables as well as the duty cycle will be discussed.

The beamwidth study showed that as beamwidth increased, the threshold water-breaking pressure decreased. The beamwidths used in this study ranged from 0.37 to 2.7 mm. Future studies should study the continuous affect of beamwidth. This should be done such that the beamwidth increases incrementally and not in large steps. The large beamwidth increases were from 0.38 to 1.1 mm and 1.7 to 2.7 mm. The carrier frequency in this study ranged from 3.0 to 10 MHz. Similar to the beamwidth, the carrier frequency increased in varying step sizes such that the continuous affect of the carrier frequency could not be studied.

In conjunction with the beamwidth study, a frequency study could be performed to test whether beamwidth or ultrasonic frequency affect threshold water-breaking. This would eliminate the dependency that beamwidth has on the frequency and f-number. Also, an f-number study could be performed to test if f-number would have an effect on threshold water-breaking.

The pulse repetition frequencies used in this study were 9 kHz and 11 kHz for the yellow transducer and 500 Hz and 1 kHz for the other transducers. The pulse repetition frequencies could be increased or decreased to further test how the threshold water-breaking radiation force would be affected. However, it is not recommended that the pulse repetition frequency be lowered much more than the 9 kHz for the yellow transducer nor 500 Hz for the other transducers. This is because the input transducer voltage would be increased and the transducer

capabilities may be exceeded causing the transducer crystal to be damaged. Increasing the pulse repetition frequency to greater than 11 kHz or 1 kHz would decrease the input voltage, thus not compromising the transducer crystal.

Future studies to determine if there is a pulse duration affect on the threshold water-breaking radiation force should be studied. In addition, the interaction between the pulse duration and the pulse repetition frequency should be studied in conjunction with one another and how the threshold water-breaking radiation force would vary. This would also test how the duty cycle affects the threshold water-breaking radiation force.

In addition to these factors that affect threshold water-breaking, a theoretical modeling of this water-breaking phenomenon should be made. This theoretical modeling could study the affects of pulse repetition frequency, duty cycle, beamwidth, and ultrasonic frequency. In addition, this theoretical modeling could also propose a mathematical equation for the water-breaking and determine if water-breaking would occur, given certain parameters.