Report of experiment in vitro: plaque biofilm removal with JetPik Smart Floss

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Objective:

Harmful bacteria can be removed from teeth by water with a certain pressure using a Waterpik Water Flosser. Its efficiency depends on the amplitude of pulse pressure (Kelly, 1985). The pressure setting is limited by the sensitivity of the oral environment. An innovation was made by JetPik Smart Floss (JetPik) by combining a dental floss with the pulse of water and air so that the cleaning efficiency would be significantly increased under the same pressure. The aim of this study was to compare the effect of plaque biofilm removal on teeth using JetPik with that of Waterpik Water Flosser (Waterpik) in vitro.

Instruments:

1. Waterpik: Water Flosser WP-450, WaterPik, USA
2. JetPik: Smart Floss JP-100, Nucleatronics Electronic Technology (Shanghai) Co.,LTD, China
3. Stereo microscope: Stemi SV11, Zeiss, Germany
4. Data Analysis software ImageJ2X , National Institutes of Health, USA
5. Ultrasonic scaler: BOBCAT Pro, Dentsply, USA

Materials:

GC Plaque disclosing gel: GC, Japan

Brian Heart Infusion (BHI) medium: Baomanbio, China

84 disinfectants: Beijing LongAn medical technology development company, China

Phosphate Buffered Saline (PBS): Shanghai biological technology co., LTD, China

Methods:

1. To prepare a plaque culture for seeding teeth, saliva was taken from a volunteer. Fresh BHI medium was sterilized. The saliva (15ml) and the BHI medium (15ml) were mixed under aseptic conditions and incubated for 24 hrs at 37 ℃.

2. Seven completely extracted molars from patients with periodontal diseases were soaked in 5% 84 disinfectants for 24 hrs to remove endogenous biofilm. Plaque on molars was visualised with GC Plaque disclosing gel (to coat the gel on molars for 30 seconds and rinse with the distilled water for 30 seconds). Calculus, plaque and

pigment on the molars were removed with ultrasonic scaler. Then, teeth were polished with slow turbine and soaked in 5% 84 disinfectants for 24 h to remove resident bacteria. Teeth were rinsed with sterilized PBS prior to bacterial seeding, so the baseline microbial load of all teeth used in the tests was the same.

3. Molars were incubated with the plaque culture medium (Saliva & BHI medium) for 4 days at 37°C. Fresh BHI medium was changed daily (1:1000).

4. Plaque on molars was visualised with GC Plaque disclosing gel. One molar was randomly selected as control and named group C. Three couples of molars were selected according to plaque accumulation. Each pair of molars contains 2 teeth with similar plaque accumulation. A black dot was marked in the middle of the surface of the stained dental enamel. Teeth in these 3 pairs were numbered as J1/W1, J2/W2 and J3/W3. Each molar in group J and group W were photographed with camera and observed under a stereoscopic microscope (1.6 times, 2.5 times and 5 times magnification).

5. JetPik Smart Floss was used according to the manufacturer's instruction for the standard jet tip. The unit was set on high-pressure. Each molar in Group J was treated at a distance of 3 mm for 5, 8, 11, 14 and 17 seconds cumulative time. After each timepoint, the teeth were photographed with camera and observed under a Stereoscopic microscope (1.6 times, 2.5 times and 5 times magnification).

6. Waterpik Water Flosser was used according to the manufacturer's instruction for the standard jet tip. The unit was set on high-pressure. Each molar in Group W was treated at a distance of 3 mm for 5, 8, 11, 14 and 17 seconds. After each timepoint, the teeth were recorded with camera and observed under Stereoscopic microscope (1.6 times, 2.5 times and 5 times magnification).

7. The molar in Group C was treated with high-pressure water and air for 5, 8, 11, 14 and 17 seconds cumulative time to mimic routine dental hygiene cleaning regimen. After each timepoint, the teeth were recorded with a camera and observed under a Stereoscopic microscope (1.6 times, 2.5 times and 5 times).

Evaluation:

Images of the Group C, J and W teeth were taken using the stereoscopic microscope (5 times magnification) at each timepoint and analyzed with ImageJ2X software. The area (mm^2) of plaque biofilm was measured at each timepoint. Plaque biofilm removal efficiency was recorded as the percent reduction of the stained area of plaque biofilm post-treatment compared to pre-treatment for each tooth.

The percentage reduction was calculated as follows:

(1-area of plaque biofilm after treatment/the area of plaque biofilm before treatment) × 100

Results:

The results are shown in Tables 1 and 2.

For Group C, there was no substantial effect on the stained area of plaque biofilm at 5, 8, 11 or 14 seconds (Figure 2);

For Group J the stained area of plaque biofilm gradually reduced at 5, 8, 11, 14 and 17 seconds (Figures 3-5). The average reduction ranged from x mm^2 at 5 seconds to y mm^2 at 17 seconds following cleaning.

For group W, the stained area of plaque biofilm gradually reduced at 5, 8, 11 and 14 seconds (Figures 6-8). The average reduction ranged from x mm^2 at 5 seconds to y mm^2 at 14 seconds following cleaning.

Discussion:

The aim of this experiment was to compare the cleaning efficiency of two electronic teeth floss devices. No reduction in plaque biofilm was observed when teeth were treated with high-pressure water and air (Table 2).

For both flossers, reduction of bacteria increased cumulatively over time. JetPik achieved a 90% reduction after 17 seconds of treatment, whereas Waterpik achieved only 36% reduction after 14 seconds of treatment. At each timepoint, the JetPik Smart Floss was resulted in at least two-fold more efficient plaque biofilm reduction than the Waterpik Water Flosser (Table 2 and Figure 1).

Conclusion:

The data show that over a treatment period of up to 14 seconds on high-pressure, the JetPik Smart Floss was at least twice as effective at removing plaque biofilm from human teeth as Waterpik Water Flosser.

References:

Kelly A, Resteghini R, Williams B, Dolby AE. Pressures recorded during periodontal pocket irrigation. *J Periodontol.* 1985 May;56(5):297-9.

Table 1 Stained area of plaque biofilm before and after treatment for all groups analyzed with ImageJ2X software.

	Area of plaque biofilm (mm^2)					
Time (sec)	0	5	8	11	14	17
Group						
C	2.886	2.954	2.931	2.929	2.973	n.d.
J1	2.214	1.420 (35.9%)	0.867 (60.8%)	0.613 (72.3%)	0.523 (76.4%)	0.184 (83.1%)
J2	1.762	1.414 (19.8%)	1.149 (34.8%)	0.703 (60.1%)	0.350 (80.1%)	0.018 (99.0%)
J3	2.659	1.128 (57.6%)	0.932 (64.9%)	0.872 (67.2%)	0.542 (79.6%)	0.312 (88.3%)
W1	1.642	1.422 (13.4%)	1.324 (19.4%)	1.154 (29.7%)	1.076 (34.5%)	n.d.
W2	1.727	1.525 (11.7%)	1.374 (20.4%)	1.218 (29.5%)	1.043 (39.6%)	n.d.
W3	1.484	1.265 (14.8%)	1.126 (24.1%)	1.017 (31.5%)	0.980 (34.0%)	n.d.

n.d = not determined

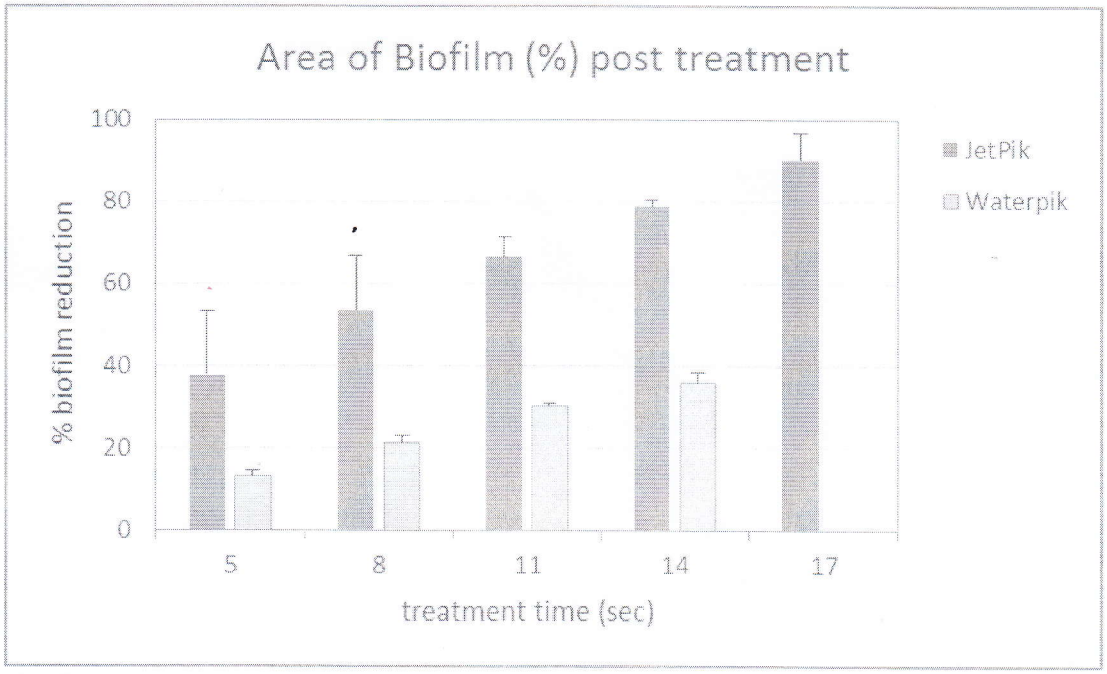
Results in parentheses represent % reduction from pre-treatment

Table 2: Reduction of plaque biofilm

	Reduction in area of plaque biofilm (%)				
Time (sec)	**5**	**8**	**11**	**14**	**17**
Control	-2.4	-1.6	-1.5	-3.0	n.d.
JetPik	37.8 ± 15.5	53.5 ± 13.3	66.5 ± 5.0	78.7 ± 1.6	90.1 ± 6.6
Waterpik	13.3 ± 1.3	21.3 ± 2.0	30.2 ± 0.9	36.0 ± 2.5	n.d.

Data represent mean ± std deviation

Figure 1: Summary of treatment effects



Data represent mean ± s.d.

Figure 2: Treatment images for Group C

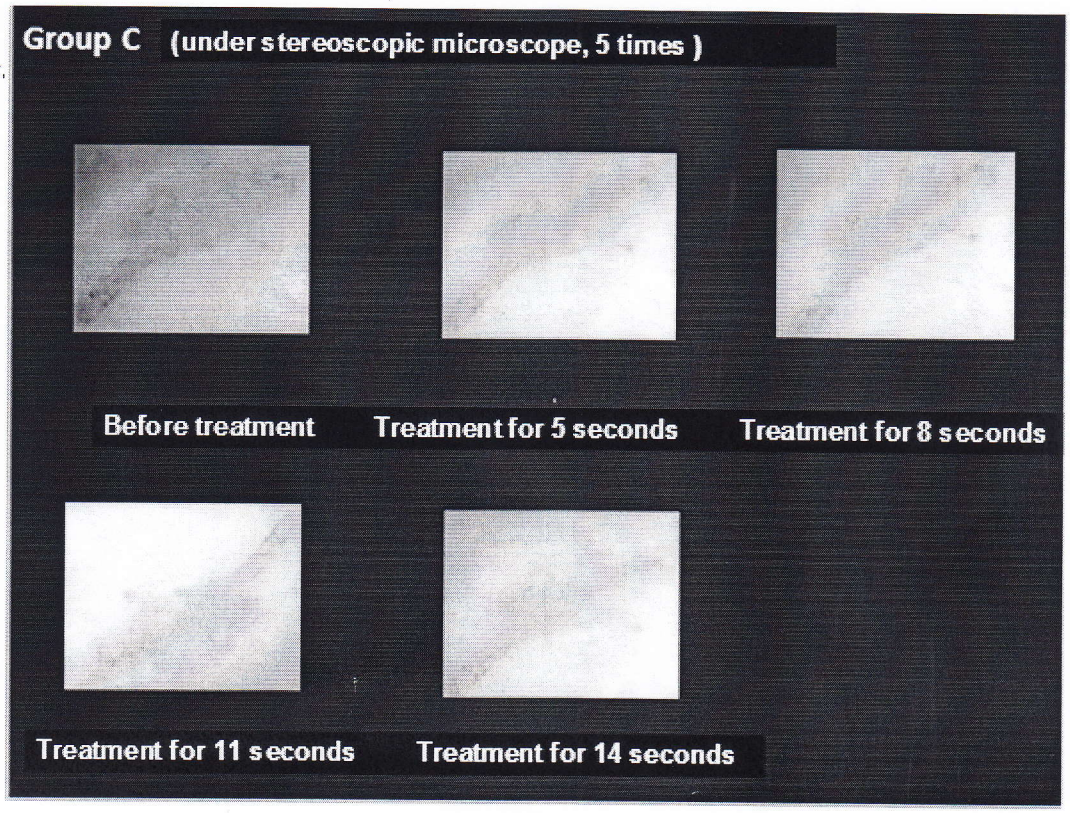


Figure 3: Treatment images for J1

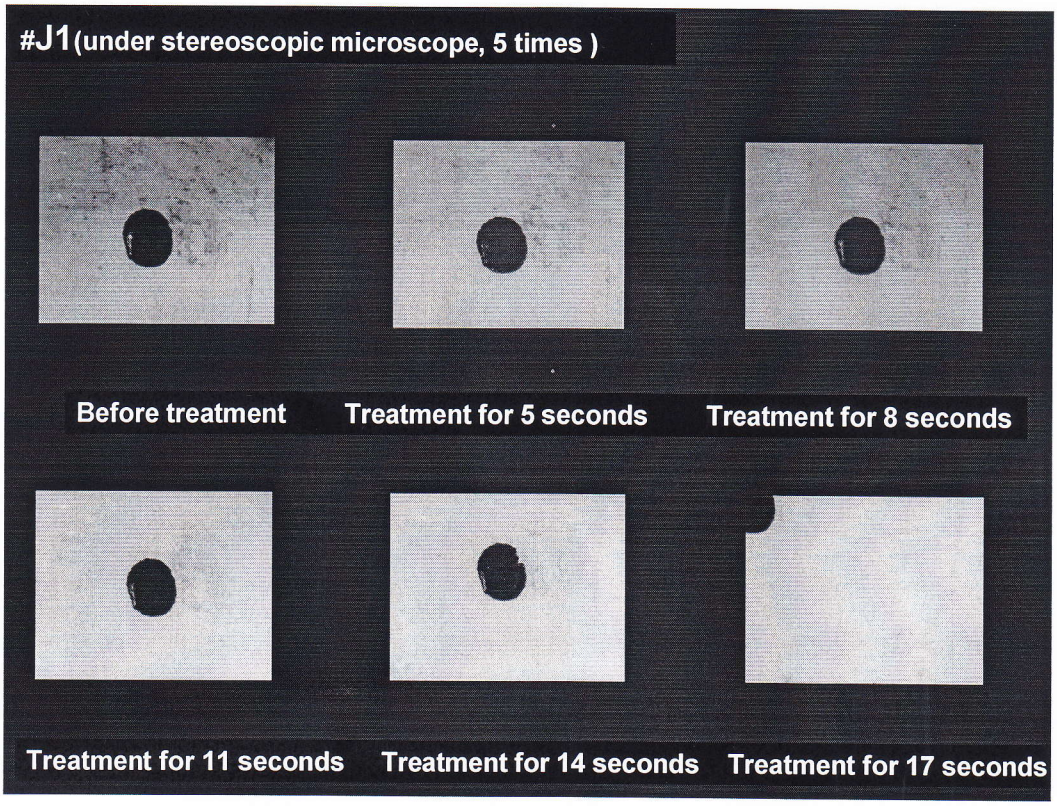


Figure 4: Treatment images for J2

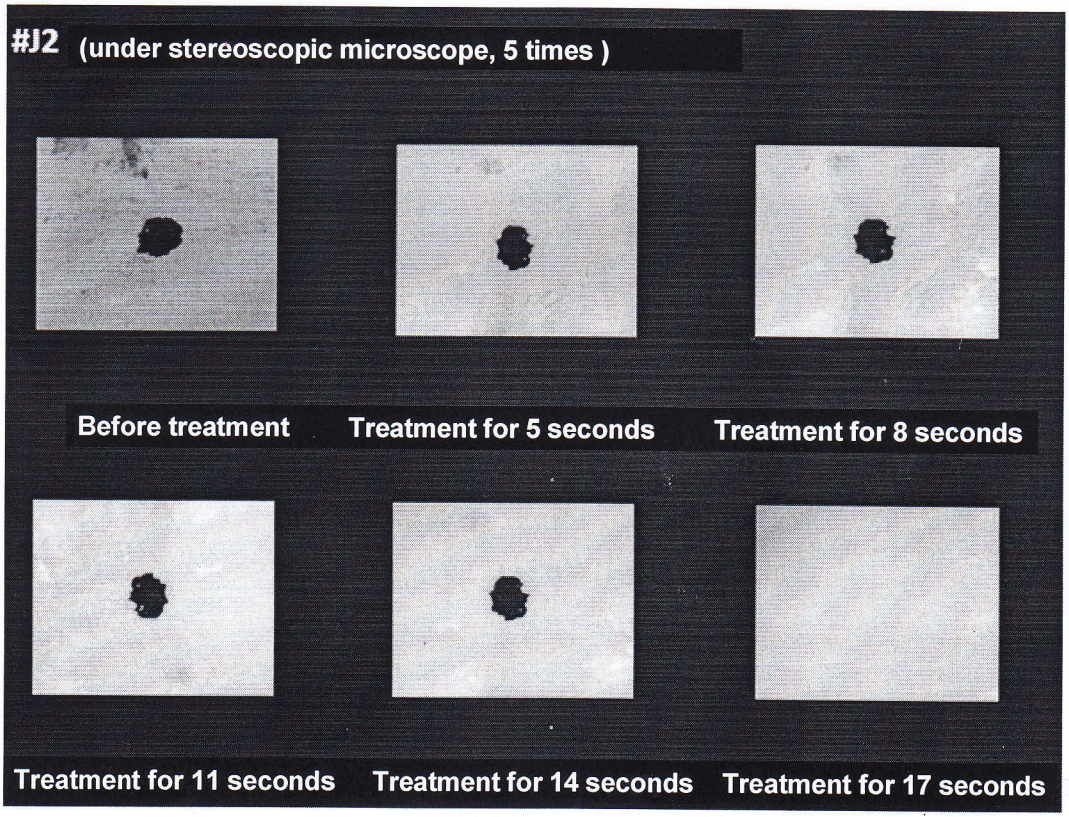


Figure 5: Treatment images for J3

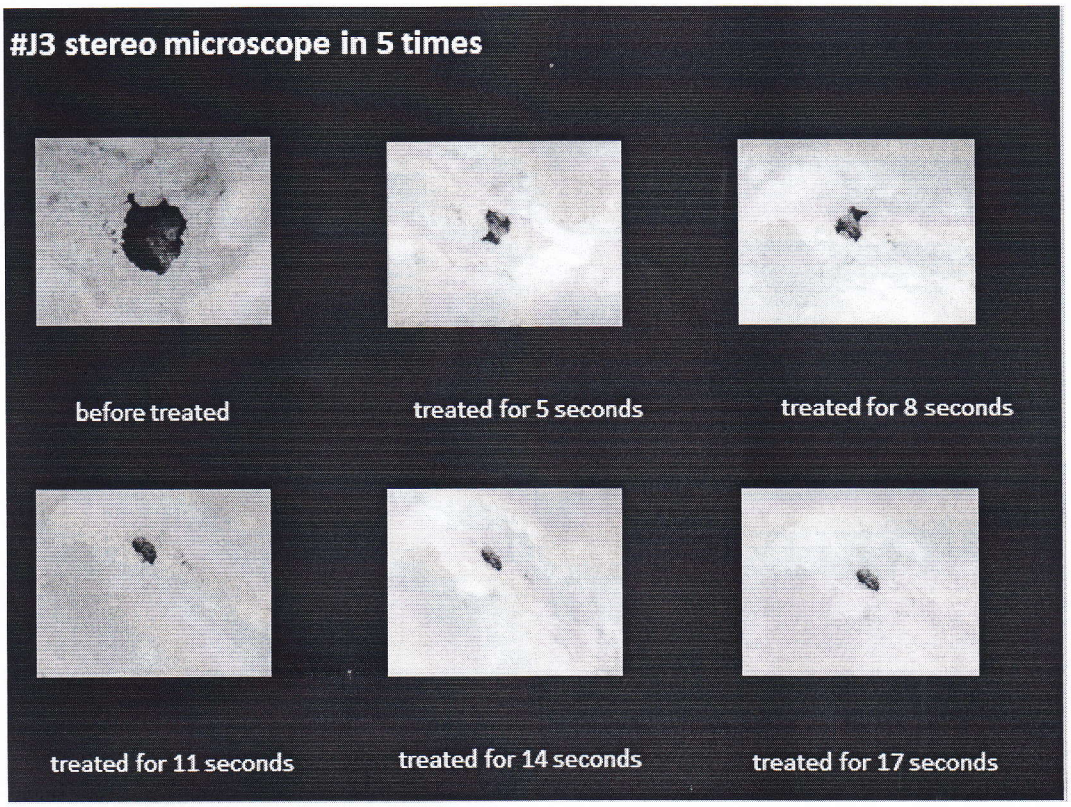


Figure 6: Treatment images for W1

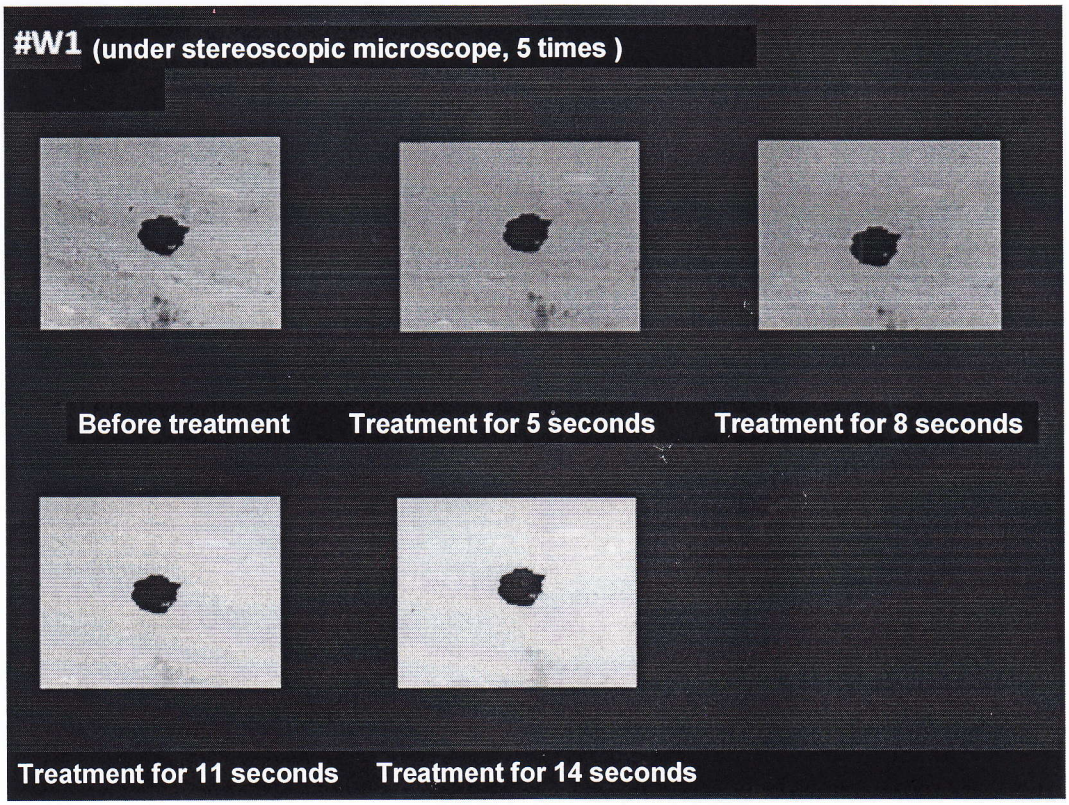


Figure 7: Treatment images for W2

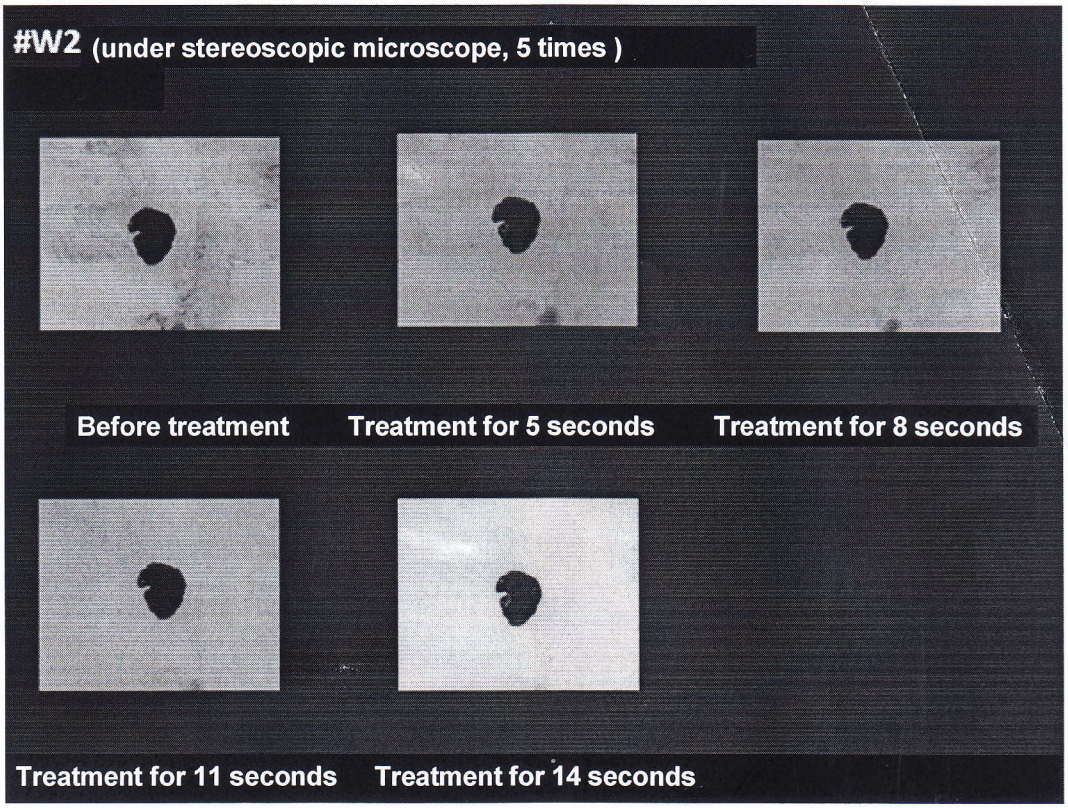


Figure 8: Treatment images for W3