Helica Thermal Coagulator

In Vitro Comparison of the Helica Thermal Coagulator and the Argon Beam Coagulator

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Summary:
The helium unit does have a much better control of the depth of necrosis that the ABC but slightly less control over the width, perhaps due to the significantly greater Power applied by the ABC to get the same effect. However, the judgement of effect of each of these unite while in use during surgery is visual and it will be easy to judge the spread of the effect and not easy to judge the depth.

It can therefore be concluded that the use of the HTC should be easier than the ABC even given similar results, and the HTC should be considered "safer" with it's much lower power at point of application.

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This comparison will use 126 tissue samples – 63 soft tissue (beef liver) and 63 muscle tissue (flank steak). Each full size tissue sample will be cut to a uniform ½ inch thickness. A grid of 1-inch squares will be formed on a graph and numbered for each full size tissue sample. Tissue sample squares will be chosen at random from each full size grid for each plasma test.

HTC eschar – liver.

3 squares of tissue will be tested at 6 watts for 4 seconds, 3 squares of tissue will be tested at 6 watts for 6 seconds and 3 squares of tissue will be tested at 6 watts for 10 seconds. Eschar diameter will be measured and averaged for each cell in millimetres. See figure 1.

3 squares of tissue will be tested at 12 watts for 4 seconds, 3 squares of tissue will be tested at 12 watts for 6 seconds, and 3 squares of tissue will be tested at 12 watts for 10 seconds. Eschar diameter will be measured and an average for each cell in millimetres. See figure 1.

3 squares of tissue will be tested at 33 watts for 4 seconds, 3 squares of tissue will be tested at 33 watts for 6 seconds, and 3 squares of tissue will be tested at 33 watts for 10 seconds. Eschar diameter will be measured and averaged for each cell in millimetres. See figure 1.

ABC eschar – liver.

3 squares of tissue will be tested at30 watts for 4 seconds, 3squares of tissue will be tested at 30 watts for 6 seconds, and 3 squares of tissue will be tested at 30 watts for 10 seconds. Eschar diameter will be measured and averaged for each cell in millimetres. See figure 1.

3 squares of tissue will be tested at 40 watts for 4 seconds, 3 squares of tissue will be tested at 40 watts for 6 seconds, and 3 squares of tissue will be tested at 40 watts for 10 seconds. Eschar diameter will be measured and averaged for each cell in millimetres. See figure 1.

3 squares of tissue will be tested at 60 watts for 4 seconds, 3squares of tissue will be tested at 60 watts for 6 seconds, and 3 squares of tissue will be tested at 60 watts for 10 seconds. Eschar diameter will be measured and averaged for each cell in millimetres. See figure 1.

3 squares will be tested at 80 watts for 4 seconds, 3 squares will be tested at 80 watts for 6 seconds, and 3 squares of tissue will be tested at 80 watts for 10 seconds. Eschar diameter will be measured and averaged for each cell in millimetres .See figure 1.

HTC depth – liver

3 squares of tissue will be tested at 6 watts for 4 seconds, 3 squares of tissue will be tested at 6 watts for 6 seconds, and 3 squares of tissue will be tested at 6watts for 10 seconds. Depth will be measured and averaged for each cell in millimetres. See figure 2.

3 squares of tissue will be tested at 12 watts for 4 seconds, 3 squares of tissue will be tested at 12 watts for 6 seconds, and 3 squares of tissue will be tested at 12 watts for 10 seconds. Depth will be measured and averaged for each cell in millimetres. See figure 2.

3 squares of tissue will be tested at 33 watts for 4 seconds, 3squares of tissue will be tested at 33 watts for 6 seconds, and 3 squares of tissue will be tested at 33 watts for 10 seconds. Depth will be measured and averaged for each cell in millimetres. See figure 2.

ABC depth – liver

3 squares of tissue will be tested at 30 watts for 4 seconds, 3 squares of tissue will be tested at 30 watts for 6 seconds, and 3 squares of tissue will be tested at 30 watts for 10 seconds. Depth will be measured and averaged for each cell in millimetres. See figure 2.

3 squares of tissue will be tested at 40 watts for 4 seconds, 3 squares of tissue will be tested at 40 watts for 6 seconds, and 3 squares of tissue will be tested at 40 watts for 10 seconds. Depth will be measured and averaged for each cell in millimetres. See figure 2.

3 squares of tissue will be tested at 60 watts for 4 seconds, 3 squares of tissue will be tested at 60 watts for 6 seconds, and 3 squares of tissue will be tested at 60 watts for 10 seconds. Depth will be measured and averaged for each cell in millimetres. See figure 2.

3 squares of tissue will be tested at 80 watts for 4 seconds, 3 squares of tissue will be tested at 80 watts for 6 seconds, and 3 squares of tissue will be tested at 80 watts for 10 seconds. Depth will be measured and averaged for each cell in millimetres. See figure 2.

HTC eschar – flank steak

3 squares of tissue will be tested at 6 watts for 4 seconds, 3 squares of tissue will be tested at 6 watts for 6 seconds, and 3 squares of tissue will be tested at 6 watts for 10 seconds. Eschar diameter will be measured and averaged for each cell in millimetres. See figure3.

3 squares of tissue will be tested at 12 watts for 4 seconds, 3 squares of tissue will be tested at 12 watts for 6 seconds, and 3 squares of tissue will be tested at 12 watts for 10 seconds. Eschar diameter will be measured and averaged for each cell in millimetres. See figure 3.

3 squares of tissue will be tested at 33 watts for 4 seconds, 3 squares of tissue will be tested at 33 watts for 6 seconds, and 3 squares of tissue will be tested at 33 watts for 10 seconds. Eschar diameter will be measured for each cell in millimetres. See figure 3.

ABC eschar – flank steak

3 squares will be tested at 30 watts for 4 seconds, 3 squares of tissue will be tested at 30 watts for 6 seconds, and 3 squares of tissue will be tested at 30 watts for 10 seconds. Eschar diameter will be measured and averaged for each cell in millimetres. See figure 3.

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3 squares of tissue will be tested at 80 watts for 4 seconds, 3 squares of tissue will be tested at 80 watts for 6 seconds, and 3 squares of tissue will be tested at 80 watts for 10 seconds. Eschar diameter will be measured and averaged for each cell in millimetres. See figure 3.

HTC depth – flank steak

3 squares of tissue will be tested at 6 watts for 4 seconds, 3 squares of tissue will be tested at 6 watts for 6 seconds, and 3 squares of tissue will be tested at 6 watts for 10 seconds. Depth will be measured and averaged for each cell in millimetres. See figure 4.

3 squares of tissue will be tested at 12 watts for 4 seconds, 3 squares of tissue will be tested at 12 watts for 6 seconds, and 3 squares of tissue will be tested at 12 watts for 10 seconds. Depth will be measured and averaged for each cell in millimetres. See figure 4.

3 squares of tissue will be tested at 33 watts for 4 seconds, 3 squares will be tested at 33 watts for 6 seconds, and 3 squares will be tested at 33 watts for 10 seconds. Depth will be measured and averaged for each cell in millimetres. See figure 4.

ABC depth – flank steak

3 squares will be tested at 30 watts for 4 seconds, 3 squares will be tested at 30 watts for 6 seconds, and 3 squares will be tested at 30 watts for 10 seconds. Depth will be measures and averaged for each cell in millimetres. See figure 4.

3 squares of tissue will be tested at 40 watts for 4 seconds, 3 squares of tissue will be tested at 40 watts for 6 seconds, and 3 squares of tissue will be tested at 40 watts for 10 seconds. Depth will be measured and averaged for each cell in millimetres. See figure 4.

3 squares of tissue will be tested at 60 watts for 4 seconds, 3 squares of tissue will be tested at 60 watts for 6 seconds, and 3 squares of tissue will be tested at 60 watts for 10 seconds. Depth will be measured and averaged for each cell in millimetres. See figure 4.

3 squares of tissue will be tested at 80 watts for 4 seconds, 3 squares of tissue will be tested at 80 watts for 6 seconds, and 3 squares of tissue will be tested at 80 watts for 10 seconds. Depth will be measured and averaged for each cell in millimetres. See figure 4.

Photographs will be taken of each test.

The additional test will be made with the ABC at 30 watts to determine if wattage below 40 watts will form a plasma stream and if such plasma will form an eschar or penetration of the tissue.

Grid Results

Figure 1 Eschar – liver (soft tissue). In mm

HTC	4secs	6secs	10secs	ABC	4secs	6secs	10secs
6 W	9.00	14.33	14.00	30 W	Will	not	work
12 W	13.00	15.33	16.66	40 W	8.66	10.66	10.66
33 W	15.00	17.00	18.33	60 W	11.00	11.66	13.66
				80 W	11.33	13.66	13.66

Figure 2 Depth – liver (soft tissue). In mm

HTC	4secs	6secs	10secs	ABC	4secs	6secs	10secs
6 W	0.43	0.46	0.83	30 W	Will	not	work
12 W	0.66	0.80	1.06	40 W	0.40	0.60	0.63
33 W	1.00	0.93	1.13	60 W	0.86	1.30	2.00
				80 W	1.53	1.63	2.43

Figure 3 Eschar – flank steak (muscle tissue). In mm

HTC	4secs	6secs	10secs	ABC	4secs	6secs	10secs
6 W	10.00	9.66	13.33	30W	Will	not	work
12 W	11.66	13.33	16.00	40 W	13.66	12.00	11.33
33 W	13.00	13.00	16.00	60 W	11.00	10.33	12.66
				80 W	11.33	13.33	13.80

Figure 4 Depth – flank steak (muscle tissue). In mm

HTC	4secs	6secs	10secs	ABC	4secs	6secs	10secs
6 W	0.20	0.53	1.03	30 W	Will	not	work
12 W	0.73	0.63	1.03	40 W	0.50	0.70	1.13
33 W	0.70	1.20	1.13	60 W	0.63	1.00	1.80
				80 W	1.70	2.00	2.46

HTC Liver Test

7			8			9		
0.7 13 4secs 12 W	1.0 14 4secs 33 W	0.5 13 4secs 6 W	0.4 13 4secs 6 W	0.8 16 6secs 12 W	1.0 16 10secs 12 W	0.5 14 6secs 6 W	0.8 15 10secs 6 W	1.0 18 10secs 12 W
0.5 15 6secs 6 W	0.7 12 4secs 12 W	1.2 14 10secs 33 W	0.8 15 6secs 12 W	0.4 14 6secs 6 W	1.0 16 6secs 33 W	0.8 15 6secs 12 W	1.0 19 10secs 33 W	1.2 19 10secs 33 W
1.0 14 4secs 33W	1.0 12 10secs 6W	1.2 16 10secs 12W	1.0 18 6secs 33W	0.8 17 6secs 33W	0.4 13 4secs 6W	1.0 17 4secs 33W	0.6 14 4secs 12W	0.2 15 10secs 6W

HTC Flank Steak Test

11								
0.8 11 4secs 12 W	0.6 11 4secs 33 W	1.0 12 10secs 6 W	1.0 15 10secs 12 W	0.6 10 6secs 6 W	0.6 13 6secs 12 W	0.2 10 4secs 6 W	1.2 16 10secs 33 W	0.5 14 6sec 12 W
0.5 10 6secs 6 W	0.2 10 4secs 6 W	1.1 17 10secs 12 W	1.2 15 10secs 33 W	1.0 16 10secs 12 W	0.5 9 6secs 6 W	0.6 11 4secs 12 W	0.8 13 4secs 12 W	1.0 15 1 0secs 6 W
1.0 17 10secs 33 W	0.8 13 6secs 12 W	1.2 12 6secs 33 W	0.2 10 4secs 6 W	0.8 14 4secs 33 W	0.7 14 4secs 33 W	1.2 13 6secs 33 W	1.1 14 10secs 6 W	1.2 14 6secs 33 W

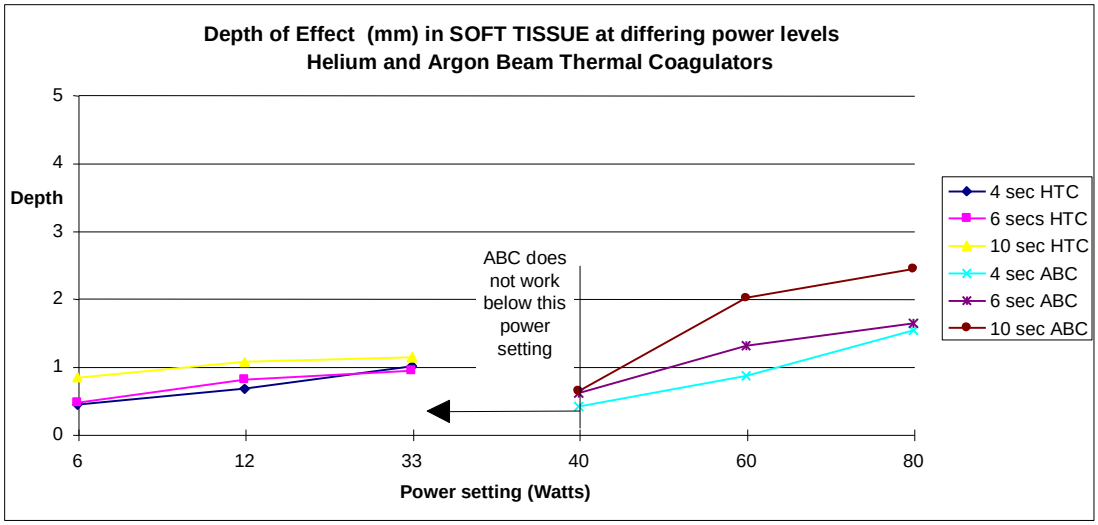
ABC Liver Test

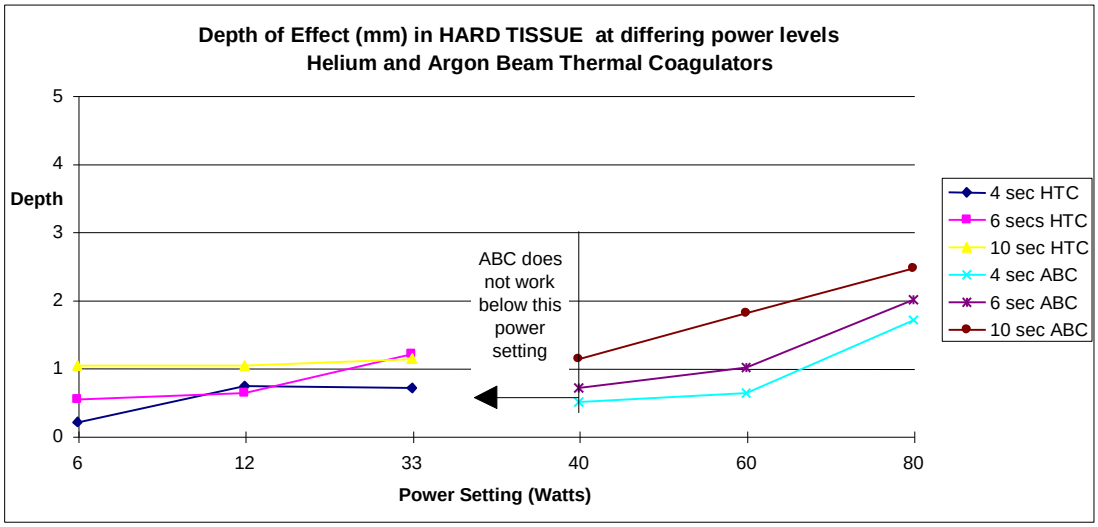
1-2-3				4				5-6			
1.2 12 6secs 60 W	0.6 10 10secs 40 W	1.7 13 4secs 80 W	1.5 12 6secs 60 W	0.4 9 4secs 40 W	0.7 10 10secs 40 W	0.8 13 4secs 60 W	1.7 14 6secs 80 W	2.5 14 10secs 80 W	
1.2 14 6secs 80 W	1.5 15 10secs 60 W	0.5 8 4secs 40 W	1.7 10 4secs 80 W	0.6 12 10secs 40 W	2.7 14 10secs 80 W	1.2 11 6secs 60 W	0.3 9 4secs 40 W	0.6 11 6secs 40 W	
0.5 9 6secs 40 W	1.0 11 4secs 60 W	0.7 12 6secs 40 W	2.0 13 10secs 80 W	2.5 13 10secs 60 W	1.2 12 4secs 80 W	1.0 12 6secs 80 W	0.4 9 4secs 60 W	2.0 13 10secs 60 W	

ABC Flank Steak Test

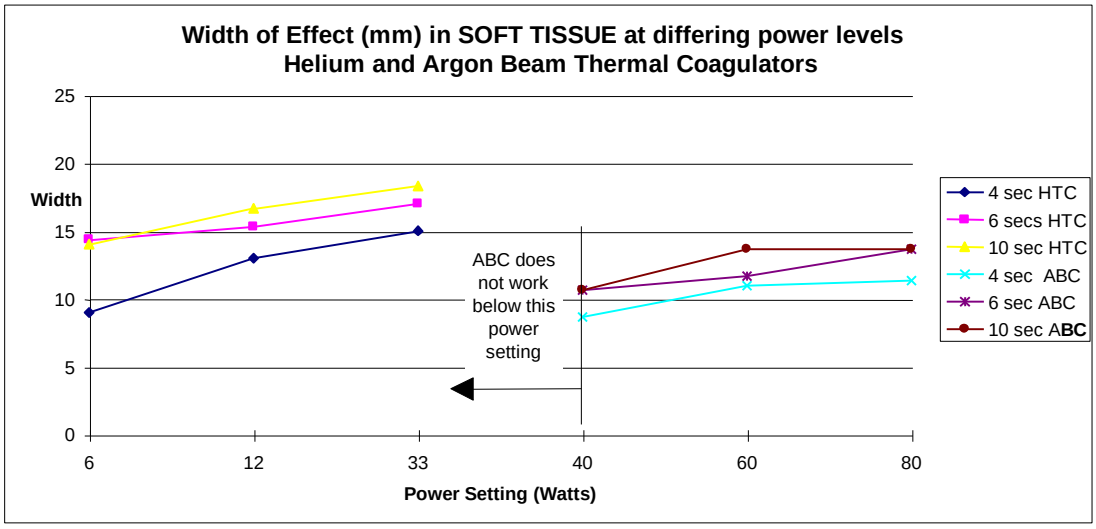
10									
0.5 15 4secs 40 W	1.2 14 10secs 60 W	1.2 13 10secs 40 W	1.7 12 4 secs 80 W	0.6 12 6secs 40 W	2.2 14 10secs 60 W	0.4 13 4secs 40 W	2.7 14 10secs 80 W	1.6 12 4secs 80 W	
1.0 12 6secs 60 W	2.0 15 10secs 80 W	0.8 11 6secs 40 W	0.6 10 4secs 60 W	2.0 14 6secs 80 W	2.2 13 6secs 80 W	0.5 11 4secs 60 W	2.5 15 10secs 80 W	1.2 8 6secs 60 W	
0.7 13 6secs 40 W	0.8 12 4secs 60 W	1.2 12 6secs 60 W	0.5 10 4secs 40 W	2.6 15 10secs 80 W	2.0 10 10secs 60 W	0.7 11 6secs 40 W	2.5 10 10sec 80 W	0.6 13 4secs 40 W	
1.0 10 10secs 40 W	1.8 10 4secs 80 W	1.2 10 10secs 40 W	1.8 13 6secs 80 W						

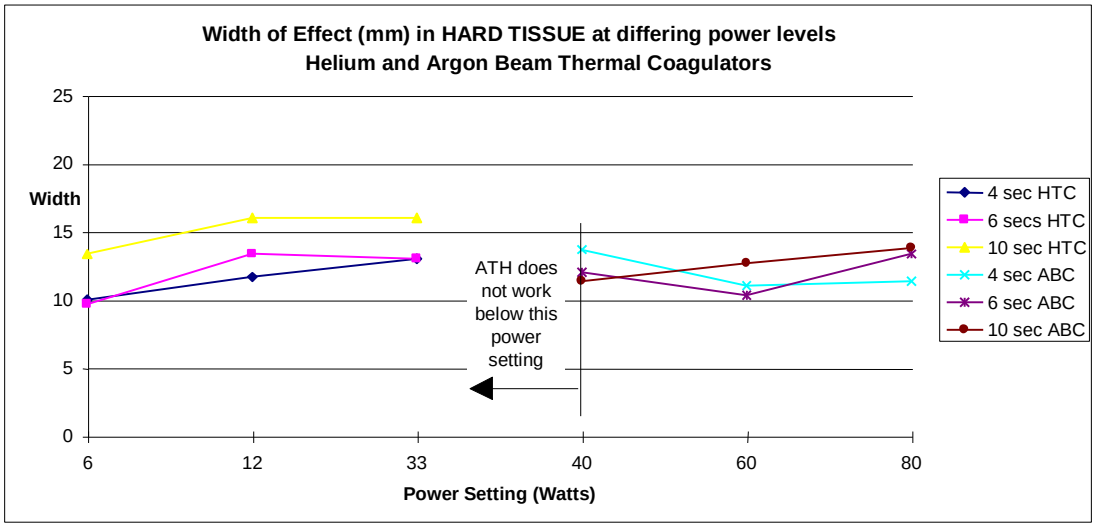
Appendix 2


Depth of Effect (mm) in SOFT TISSUE at differing power levels
Helium and Argon Beam Thermal Coagulators
Depth
5
4
3
2
1
0
6
12
33
40
60
80
Power setting (Watts)
ABC does not work below this power setting
4 sec HTC
6 secs HTC
10 sec HTC
4 sec ABC
6 sec ABC
10 sec ABC


Depth of Effect (mm) in HARD TISSUE at differing power levels
Helium and Argon Beam Thermal Coagulators
Depth
5
4
3
2
1
0
6
12
33
40
60
80
Power Setting (Watts)
ABC does not work below this power setting
4 sec HTC
6 secs HTC
10 sec HTC
4 sec ABC
6 sec ABC
10 sec ABC

Appendix 3


Width of Effect (mm) in SOFT TISSUE at differing power levels
Helium and Argon Beam Thermal Coagulators
Width
25
20
15
10
5
0
6
12
33
40
60
80
Power Setting (Watts)
ABC does not work below this power setting
4 sec HTC
6 secs HTC
10 sec HTC
4 sec ABC
6 sec ABC
10 sec ABC


Width of Effect (mm) in HARD TISSUE at differing power levels
Helium and Argon Beam Thermal Coagulators
Width
25
20
15
10
5
0
6
12
33
40
60
80
Power Setting (Watts)
ATH does not work below this power setting
4 sec HTC
6 secs HTC
10 sec HTC
4 sec ABC
6 sec ABC
10 sec ABC

Comparative Results for

- **The Helium Thermal Coagulator (HTC)**
- **The Argon Beam Coagulator (ABC).**

This comparison has 112 sample results taken from soft tissue (beef liver) and muscle tissue (flank steak). Each type of tissue is cut to a uniform ½" thickness and a grid of 1" squares marked in a matrix to form the basis of a random sample of squares for the variety of treatments.

Power Settings

The Helium Coagulator works at significantly lower level of power than the Argon Unit and it is therefore not possible to test the two units at the same power setting. It is only possible to compare the results for the ranges of power recommended by the manufacturers.

The power settings used are

HTC		6 Watts	12 Watts	33 Watts
ABC	30 Watts*	40 Watts	60 Watts	80 Watts

* This setting is generally accepted as being outside the normal range of operation but was include to ensure that the lowest possible power setting could be determined.

Time Settings

The time settings used are

HTC	4 Secs	6 Secs	10 Secs
ATC	4 Secs	6 Secs	10 Secs

Randomisation and Repeatability

The effect of both units is not only a factor of the power setting used and the elapsed time of application but also of the type and condition of the tissue sample. This variability has been compensated for by firstly, selecting two different types of tissue, liver to represent "soft" tissue and steak to represent "muscle" tissue, secondly by randomising the application across the sample tissues and thirdly by taken three or more separate results for each of the combinations of time and power.

The plan of the sample tests for each type of test - HTC liver and steak and ABC liver and steak is shown in appendix 1.

Photographs

Photographs of all results are included.
Liver - ABC Results - 3 off photos, # 3, 4 and 6
- HTC Results - 3 off photos, # 7, 8 and 9
Steak - ABC Results - 1 off photo
- HTC Results - 1 off photo

Refer to Appendix 1 for randomised settings used on each of the samples.

Results

The effectiveness of each unit is assessed by measuring the width and depth of visible results (cauterisation and necrosis) at the point of application on the surface.

These were measured in mm and averaged for each of the settings of time, power and tissue type.

The averaged results are shown in Appendix 2 and graphed in Appendix 3

Observations

Power Settings

The Argon Beam Coagulator was tested at 30 Watts in an independent area of the tissue but did not have any effect and to all intents and purpose does not function at this level of power and no results are include.

The selected range of power used represents the full operating range of each machine and while the ABC unit applies much more power the effects are similar for each of the application times.

Depth of Effect

Both units had similar depths of effect at lower levels of power and time but the HTC displayed a much narrower effect over the whole power range than the ABC. This should allow an easier control of the depth of penetration during operation.

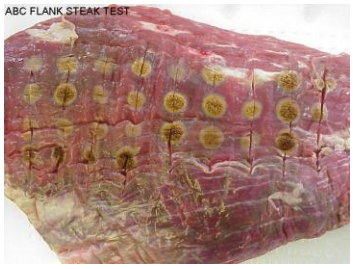
Width of Effect

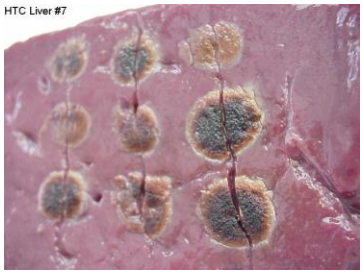
Again both units had similar effective widths over the power bands with the ABC being slightly narrower and slightly more directional.

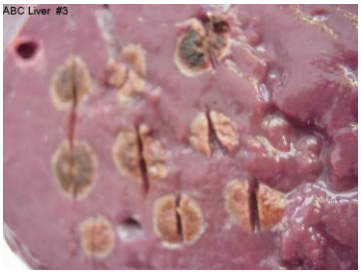
Conclusion

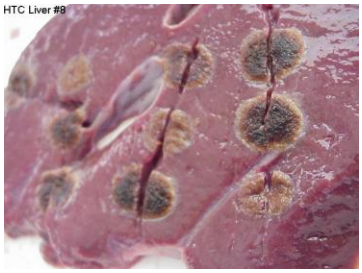
The helium unit does have a much better control of the depth of necrosis than the ABC but slightly less control over the width, perhaps dues to the significantly greater power applied by the ABC to get the same effect. However the judgement of effect of each of these units while in use during surgery is visual and it will be easy to judge the spread of the effect and not as easy to judge the depth.

It can therefore be concluded that the use of the HTC should be easier than the ABC even given similar results, and that the HTC should be considered "safer" with it's much lower power at point of application.









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