Resectoscopy using monopolar or bipolar energy

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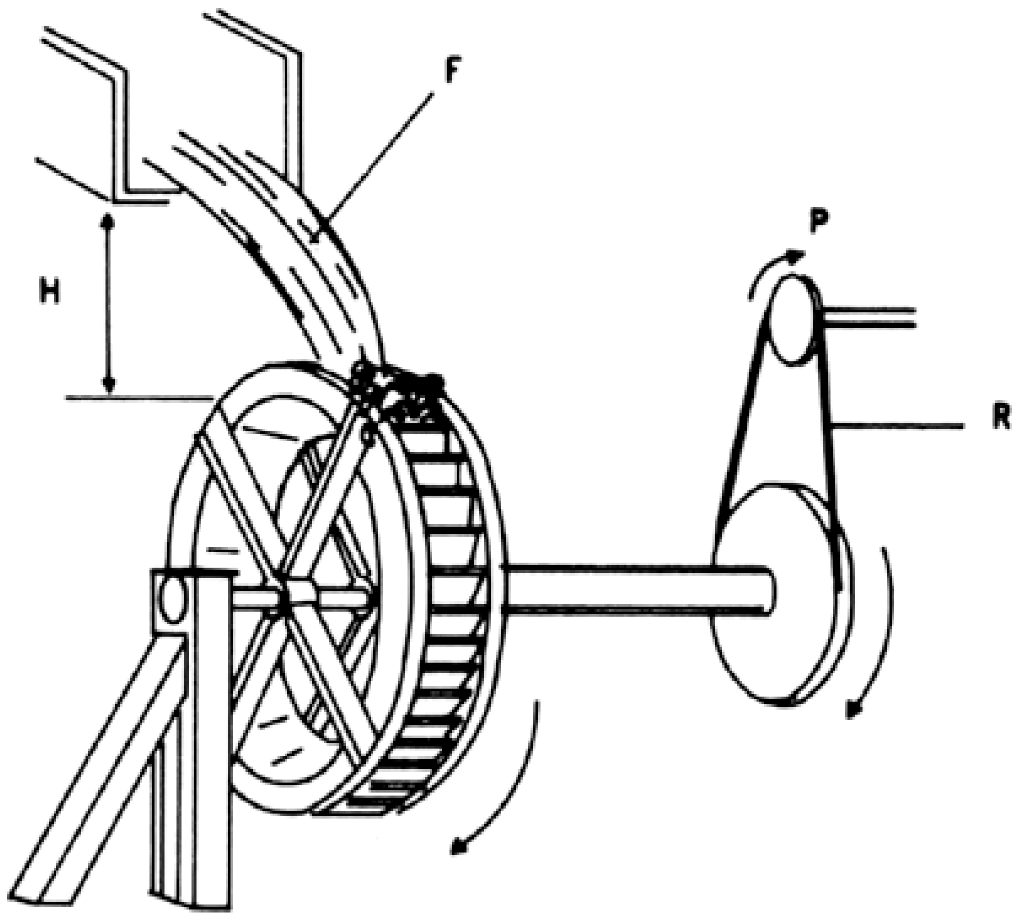


Power (watts): A function of current (amps) and pressure (volts).
H, water pressure (voltage) generated by height;
F, flow (current)—volume of water;
R, resistance (weight of the mechanism on the belt);
P, power—the amount of motion produced by pressure × flow against the resistance.

Basic Physics Therminology

- **Voltage (volts)**: force that pushes the current ("Potential Energy").
  - –More force = more destruction
- **Resistance(ohm)**: quality of tissue that impedes flow of current.
  - More resistance = less current flow.
  - Resistance of skin > bone > fat > muscle > bowel wall (326 ohms) > blood.
- **Current Density (amp/cm^2)**: amount of current flowing through a cross sectional area = Current Intensity(amps)/area(cm2)

Basic Physics Therminology

Generated heat: is proportional to the square of the current density: $(\text{Intensity/area})^2$.

– Small area of lesion/stalk causes disproportional high heat.

Power output: Is given in Watts = amps x volts. Voltage is constant, hence higher output increases the intensity of current (amps).

– –Higher output = higher current density = much higher heat

Delivered Energy: Is given in Joules. Energy (watts) x time (seconds)

Types of Currents

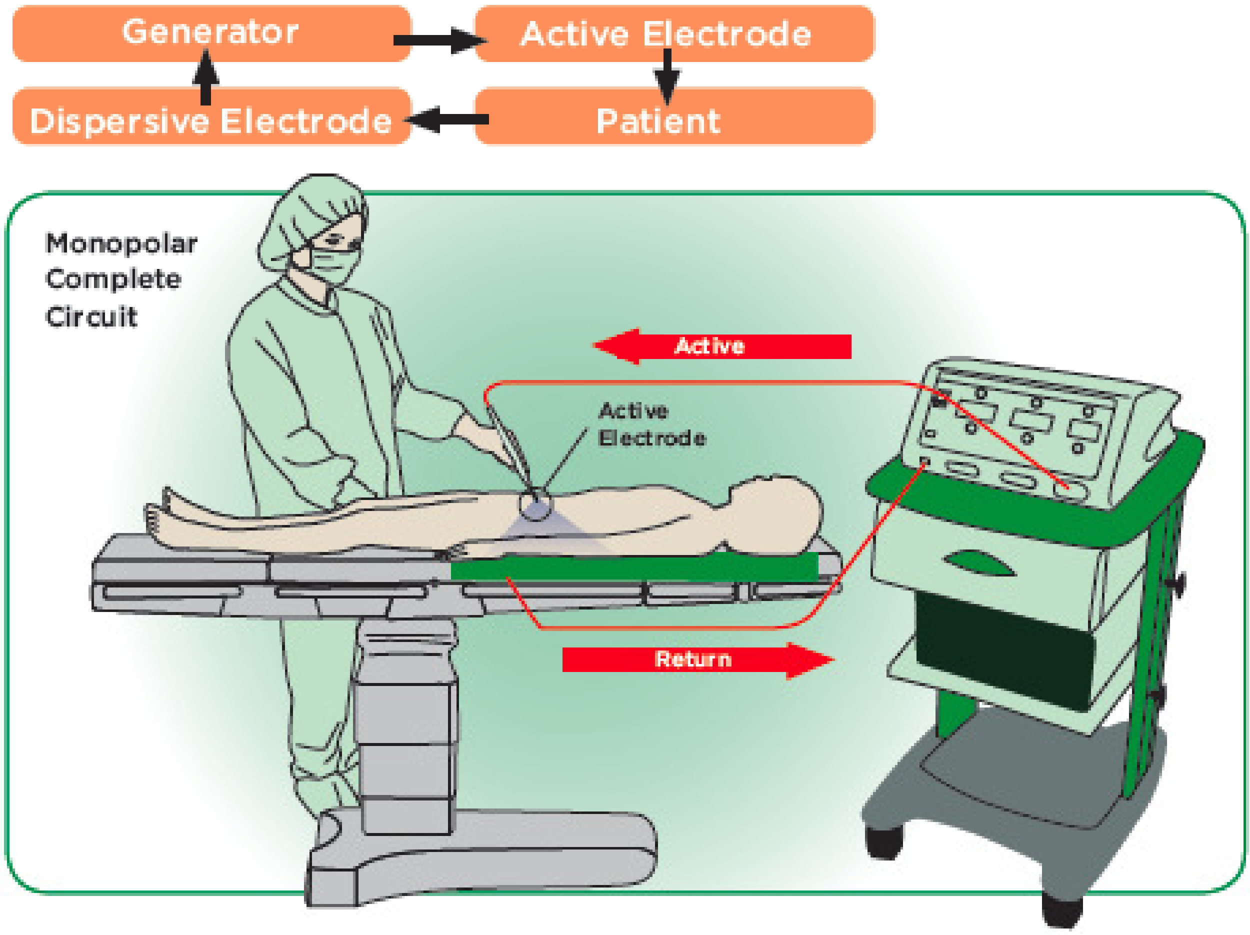
- Electrosurgical generators are capable of producing a variety of current waveforms. Depending on the clinical results desired, different waveforms can be used to produce differing tissue effects. An understanding of the ways in which the electrosurgical generator can modify current is necessary to better understand the options available to the surgeon.

Electrosurgery

- Two basic types of electrical circuits: monopolar and bipolar

- MONOPOLAR (monoterminal) is an electrosurgical technique in which the tissue effect takes place at a single active electrode and is dispersed (circuit completed) by a patient return electrode.

Monopolar energy

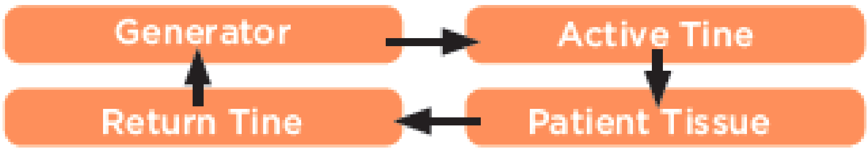


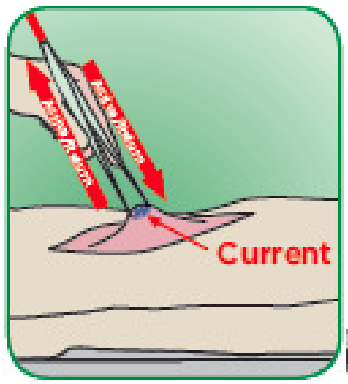
Point to Remember

The amount of ENERGY delivered to the "active"device is the same delivered to the "indifferent plate", but the "current density"is very different due to the small "active end", compared with the large "indifferent plate"

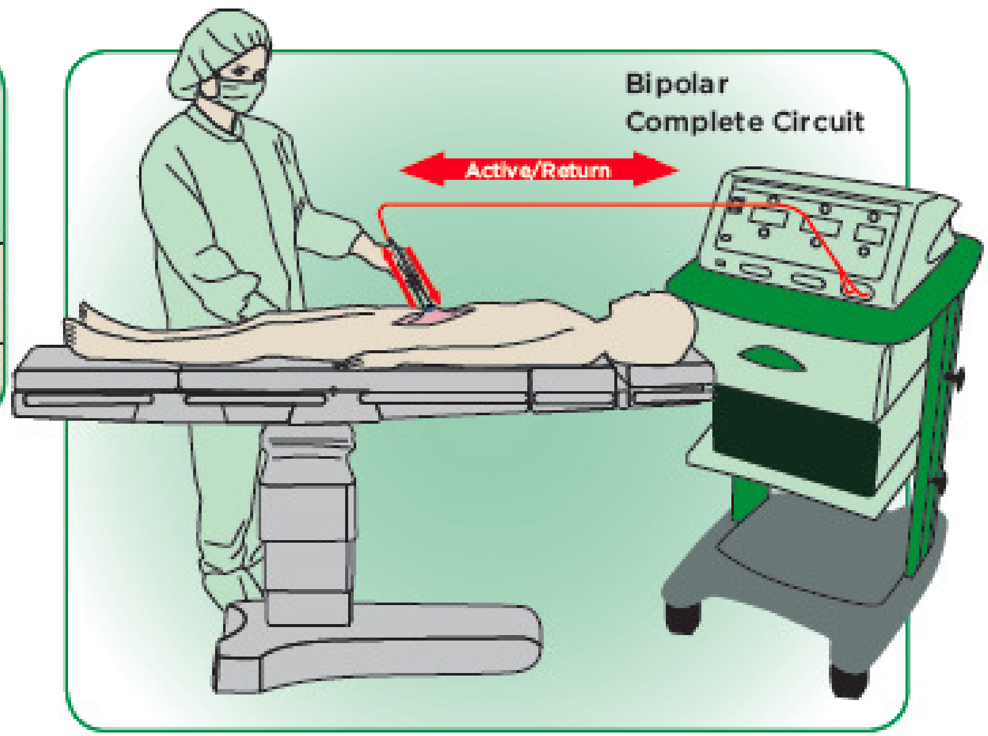
- BIPOLAR (biterminal) is an electrosurgical technique in which the electrosurgical effect takes place between paired electrodes placed across the tissue to be treated. No patient return electrode is needed.

- The distance between the active and return electrodes in a bipolar circuit is very small since both electrodes are adjacent to each other. The distance of the current flows is limited and is contained in the vicinity of the two electrodes. As current passes through the tissue from one electrode to the other, the tissue is desiccated and the resistance increases. As resistance increases current flow decreases.





Close up of bipolar grasp of tissue



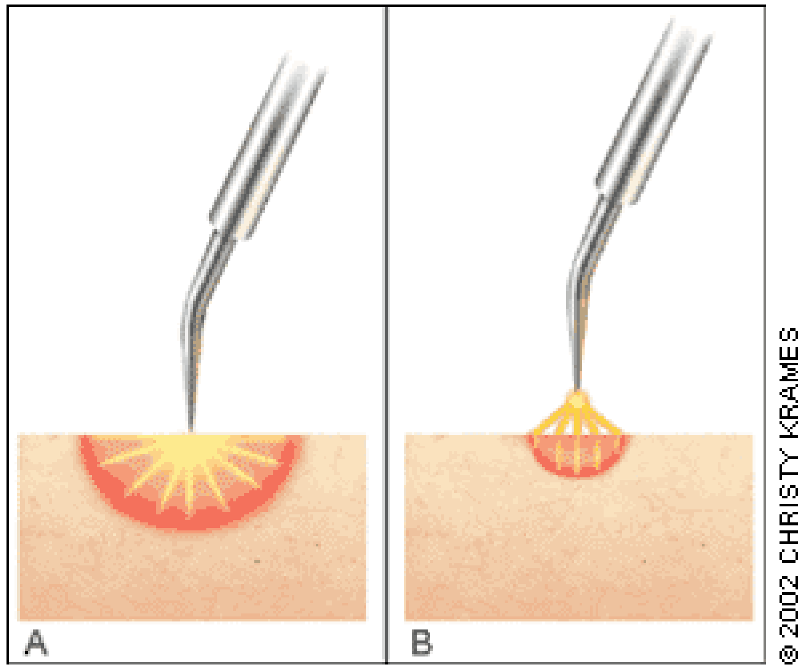
Physical process: Dessication

Desiccation is produced by low current and relatively higher voltage applied over a broad area, producing a low current density. In desiccation, the cells are shrunken and shriveled with elongated nuclei. Cellular detail is preserved. This effect is produced by the loss of water from the cells, without extensive coagulation of proteins.

Physical process: Coagulation

Coagulation occurs at higher current densities than are used in desiccation, resulting in higher tissue temperatures. The tissue fluids boil away and the proteins become denatured, forming a white coagulum similar to that produced when an egg white is boiled. There is loss of cellular definition as all tissue structures fuse into a formless, homogenous mass with a hyalinized appearance. This is the classic appearance of coagulation necrosis

Physical process: Dessication (coagulation)



Slow heating of tissue in close contact, then fluid loss with bubbling, then steam release with cooling, then slow heating of tissue in close contact, then …

The effect of Desiccation/Coagulation, is HEMOSTASIS.

If setting is too low, may desiccate too deep.

If too high and monopolar, may give deep fulguration.

Pressing on wall increases burn depth

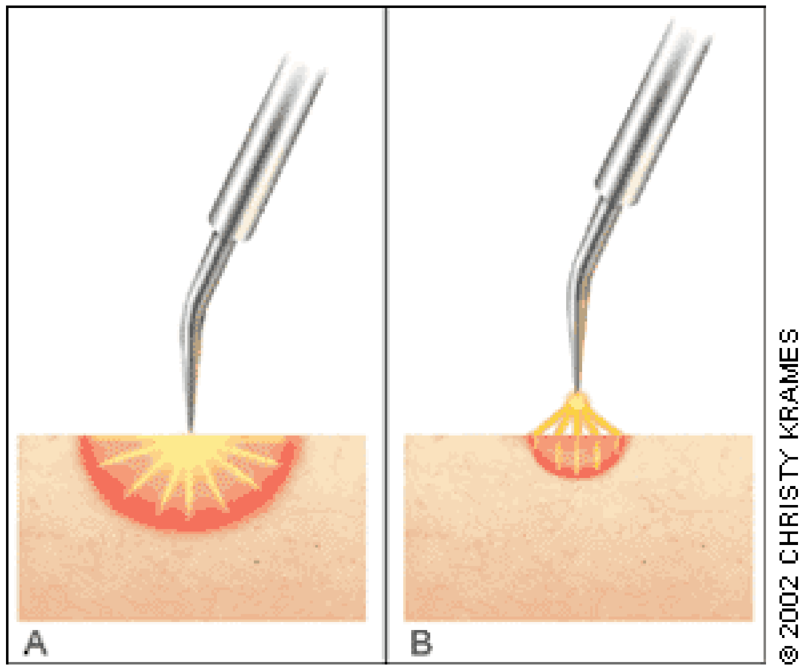
Physical process: Fulgoration

- Results from the action of electrical arcs striking the tissue at widely divergent locations, producing a high localized instantaneous current density, but a low average current density.
- The characteristics of fulguration are the superficial nature of the tissue destruction, and the presence of large amounts of carbonization.

Physical process: Fulgoration

- Fulguration requires low amperage and high voltages to overcome the resistance of the large distances between electrode and tissue.

Physical process: Fulgoration



Electrode not in contact with tissue (or insulated by desiccated tissue): ionization of surrounding air or liquid media, then long spark with high current density, then superficial coagulation, then (if you continue) deep necrosis with black eschar

Physical process: Cut (Vaporization)

- The cutting of tissue by electrical current is due to the vaporization of cells.
  - Cutting tissue requires that a spark be present between the electrode and the tissue. An arc may be present in coagulating currents, and is necessary in fulguration. In the formation of an arc, little happens until a sufficient voltage is reached to allow the electrons to traverse the air gap between electrode and tissue. When this voltage is reached, electrons jump across the gap.

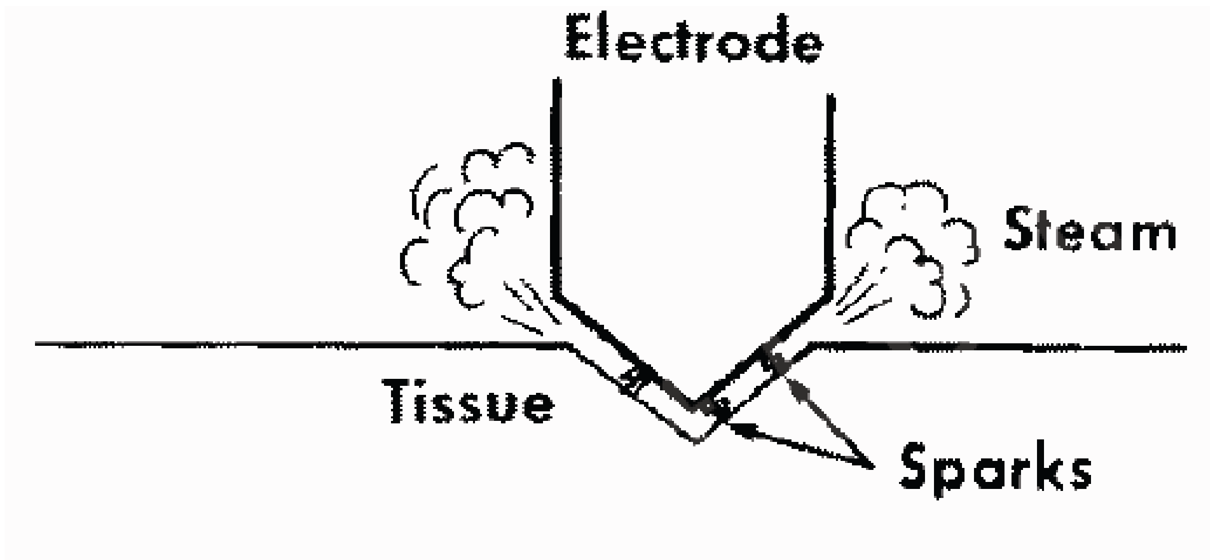
Physical process: Cut (Vaporization)

- The degree of tissue damage caused by electrical energy is determined by numerous factors in addition to waveforms and current density.
- The electrical resistance of the tissue is important as is the inherent sensitivity of the tissue to damage by heat.

Physical process: Cut (Vaporization)

- The rate of tissue destruction, however, decreases with increasing duration of application;
  - after the resistance of the destroyed tissue becomes greater than the ability of the current to penetrate it, no further damage occurs
  - Increasing levels of power also tend to increase the degree of tissue damage, with increasing amperage causing more damage than increased voltage.

Physical process: Cut (Vaporization)

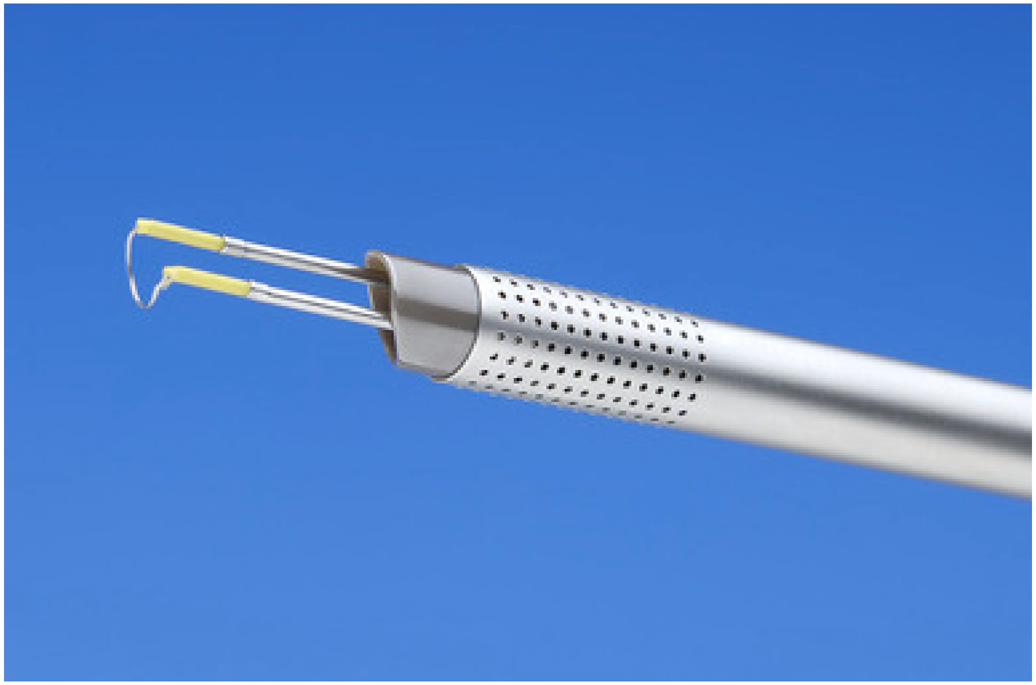


Initial desiccation, then increased tissue resistance, then short spark, then very rapid tissue heating, then intracellular boiling, then cell explosion, then steam release, then desiccation, then increased tissue resistance, then, …

Needs water in tissue (not desiccated) and loose contact (short sparks).

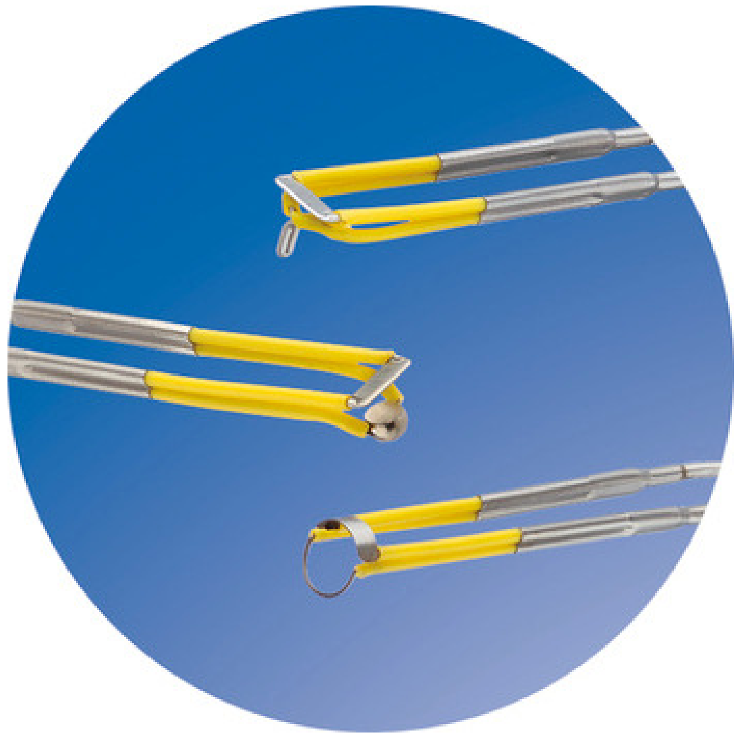
Works better with high-continuous energy 60-100 Watts

MONOPOLAR RESECTOSCOPE



Continuous sinusoidal wave without cooling-off period.
Causes very rapid heating with cell explosion

BIPOLAR RESECTOSCOPE



Usually gives low-energy. Has two or more small active electrodes very close to each other (active and return electrode)

Advantages of bipolar cutting in resectoscopy

- limited spread of electrical effect
- the current flow is essentially limited to a small area.
- requires less voltage (less likelihood that current will follow unexpected pathways, such as sparking to adjacent structures)

Advantages of bipolar cutting in resectoscopy

Does not use “indifferent plate”.

Less depth of injury

Excellent desiccation and coagulation at low settings

Resection in saline system allows the electric current to complete the circuit without passing through the patient.

Advantages of bipolar cutting in resectoscopy

- The use of bipolar resectoscope utilizing 0.9% saline as a distention media is not associated with hyponatremia or hyposmolarity unlike monopolar resectoscope utilizing 1.5% glycine distending media
- Thus, it may potentially reduce the risk of TUR syndrome during resection

Literature

- Few papers in literature compare the two tools.
- More papers compare monopolar resectoscope with Versapoint (5 fr)
- More papers in urology. All the articles stress the advantage of reducing the consequances of TUR syndrome

MATERIALS AND METHODS

308 metroplasties done between January 2002-December 2007 (General hospital “dr. Franca Derganca” Nova Gorica, Slovenija)

220 metroplasties were performed using a 8 mm Storz monopolar operative hysteroscope with a sorbitol-mannitol solution as distension medium.

88 metroplasties were performed using an 8 mm Olympus TCRis bipolar resectoscope with saline solution as distension medium.

The two groups were compared.

Then both groups were compared to perinatal results of 4155 women who gave birth in the same hospital in the same period (NPIS*)

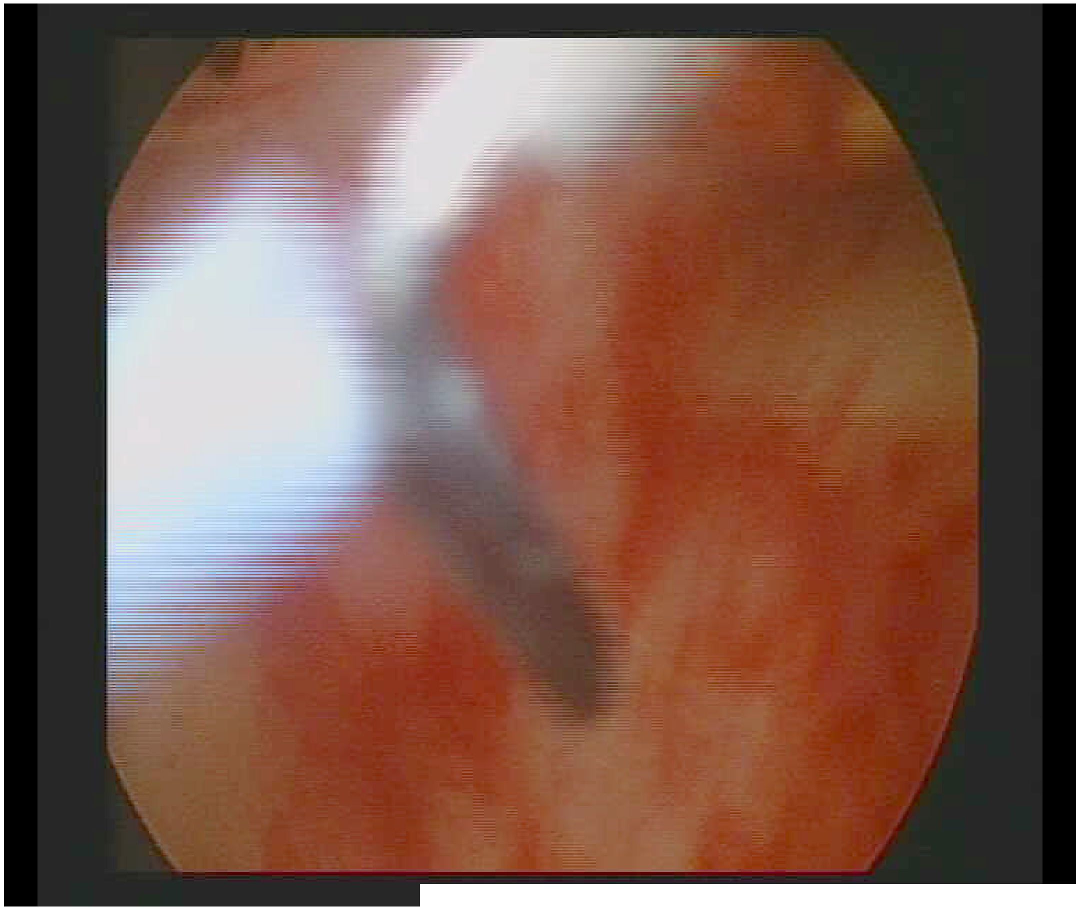
Only the first delivery after metroplasty was analyzed

Preparation of endometrium:
Contraceptive pill till 10 days before metroplasty (synchronization)

8 mm monopolar operative hysteroscope with sorbitol-mannitol solution as distension medium
or a bipolar resectoscope and saline solution as distension medium.

No postoperative complications

Day surgery



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Results

Variable	Monopolar (n = 220)	Bipolar (n = 88)	p
Pregnancies	**150 (68.2%)**	**59 (67.0%)**	**n.s.**
Deliveries	**121 (80.7 %)**	**51 (86.4 %)**	**n.s.**
Miscarriages	**25 (16.7 %)**	**8 (13.6 %)**	**n.s.**
Ectopic	**4 (2.7 %)**	**0**	**n.s.**
Preterm delivery **	9 (7,4%)	4 (7,8%)	n.s.
Mean week of gestation	39,32±2,4	39,52±1,6	n.s.
Mean birth weight (g) ***	3410±430	3422±466	n.s.
Caesarean section	17 (14,0%)	9 (17,6%)	n.s.
Breech presentation	4 (3,3%)	2 (3,9%)	n.s.
Placental abruption	1 (0,8%)	0 (0%)	n.s.
Placenta praevia	1 (0,8%)	0 (0%)	n.s.
Uterine atony	2 (1,7%)	1 (2,0%)	n.s.
Retained placental fragments	2 (1,7%)	1 (2,0%)	n.s.
Adherent placenta	2 (1,7%)	0 (0%)	n.s.
Early postpartum hemorrhage	2 (1,7%)	1 (2,0%)	n.s.
Late postpartum hemorrhage	0 (0%)	0 (0%)	n.s.
Uterine rupture	0 (0%)	0 (0%)	n.s.

(*) Weeks of gestation - **(**) multiple pregnancies excluded** - (***) mean birth weight at term

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Results

Variable	Monopolar (n = 220)	Bipolar (n = 88)	Control group (n = 4155)	p
Pregnancies	150 (68.2%)	59 (67.0%)		n.s.
Deliveries	121 (80.7 %)	51 (86.4 %)		n.s.
Miscarriages	25 (16.7 %)	8 (13.6 %)		n.s.
Ectopic	4 (2.7 %)	0		n.s.
Preterm delivery **	9 (7,4%)	4 (7,8%)	161 (3,9%)	n.s.
Mean week of gestation	39,32±2,4	39,52±1,6	39,47±1,6	n.s.
Mean birth weight (g) ***	3410±430	3422±466	3453±466	n.s.
Caesarean section	17 (14,0%)	9 (17,6%)	59 (15,9%)	n.s.
Breech presentation	4 (3,3%)	2 (3,9%)	161 (3,9%)	n.s.
Placental abruption	1 (0,8%)	0 (0%)	40 (1%)	n.s.
Placenta praevia	1 (0,8%)	0 (0%)	3 (0,1%)	n.s.
Uterine atony	2 (1,7%)	1 (2,0%)	73 (1,8%)	n.s.
Retained placental fragments	2 (1,7%)	1 (2,0%)	41 (1%)	n.s.
Adherent placenta	2 (1,7%)	0 (0%)	39 (0,9%)	n.s.
Early postpartum hemorrhage	2 (1,7%)	1 (2,0%)	26 (0,6)	n.s.
Late postpartum hemorrhage	0 (0%)	0 (0%)	5 (0,1%)	n.s.
Uterine rupture	0 (0%)	0 (0%)	2 (0,04)	n.s.

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CONCLUSIONS

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No differences have been found between women operated with monopolar resectoscope and those who underwent metroplasty with bipolar hysteroscope. Patients who underwent hysteroscopic metroplasty either with monopolar or bipolar resectoscope are at no higher risk of adverse obstetric outcome at term and during labour compared to the general population. Vaginal delivery seems to be safe and hysteroscopic metroplasty, in experienced hands, seems not to be harmful for mothers and their newborns, no matter if monopolar or bipolar resectoscope has been used.