

## **An appraisal of Medical Shockwaves for healing all Skin Ulcers.**

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### **Declaration**

We used a CellSonic Medical hand-held, electro-hydraulic shockwave lithotripter and have no financial interest in the manufacturer, CellSonic Limited.

### **Summary**

Medical shockwaves are capable of healing skin ulcers however caused. The procedure is non-invasive and drugs need not be used.

The same technology is also used to fracture calcifications and stones in the body, to heal bone and repair sports injuries.

Preparation is the same as for any other method and the procedure takes only a few minutes. The skills required are low so a trained nurse can carry out the operation. This can be useful in developing countries where ulcers caused by infectious diseases can be treated by a locally trained nurse speaking the patient's language; a big help with children suffering from buruli ulcer where drugs are losing the battle.

### **Medical Shockwaves**

Shockwaves are pressure waves that travel fast through the body to damage or provoke. They are generated by a sonic bang when a high voltage jumps between electrodes in an aqueous medium from where the waves are directed by a parabola into the body passing always through an aqueous medium.

The essential feature of a successful shockwave is that it has a sudden rise of decibels and the fastest method is by a high voltage jumping a gap in electrodes. The same phenomenon is a lighting strike in the sky and the sound is thunder. This technique is called electro-hydraulic. The machine is called a lithotripter and has become known as a shockwave machine.

The machines that break kidney stones are very powerful and focussed at about 140 mm into the kidney. Although the shock wave is the same as used for wound healing it has to be much weaker on wounds and the depth of penetration has to be controllable. Often a head shooting parallel waves, described as infinity, is used on wounds and if concentration and limited penetration is preferred then a short focus such as 5 mm or 20 mm can be used. The shocks are generated at a rate of four a second. The bang is not dangerous to hearing although in a room with a tiled floor it does sound louder due to the acoustic resonance.

ESWT stands for Extracorporeal Shock Wave Therapy and is a term applied to all non-invasive shockwaves from breaking kidney stones to healing ulcers. The word lithotripter is becoming reserved for the kidney stone machines and shockwave machine is the term being applied to small hand held machines which are the concern of this article.

### **Application on skin ulcers**

All skin ulcers can be treated. To treat, first clean the wound thoroughly and fill with sterile gel over which a barrier film is placed with more gel on top to transmit the sonic waves from the shock head to underneath the wound where the healing will start. Any air gaps or gas will block the sound wave.

The shock head of a lithotripter is held by hand in the gel pointing into the wound and moved slowly as it bangs at a rate of four times a second directing the shocks into and around the wound. This kills all infections be they viral, bacterial or parasitical. Nitric oxide forms under the wound. Vascularisation improves delivering additional blood cells. Rat skin flap trials have proved that healing on uninfected wounds is quicker with shockwaves than without.

The protocol with an electro-hydraulic machine is 100 shocks for each square centimetre of wound plus 350 shocks. This amount is not to be exceeded.

The number of treatments required varies from one for a simple wound to a sequence of sessions for big wounds.

Anaesthetic is seldom required and with the CellSonic Medical machine there is a Soft Start programme using the analgesic effect of shockwaves to numb the nerves and avoid anaesthetic. The results are better without anaesthetic.

### **Grades of ulcers**

All ulcers may be treated. All infection is killed. No anti-biotics are needed. However, the doctor will be aware that infections may have travelled beyond the site of the wound and prefer to administer drugs. A benefit of not using anti-biotics is that the patient may derive full nutrition from food needed to re-build their body. The resistance of micro-organisms, including mycoplasma, to drugs becomes irrelevant because they will be killed or damaged mechanically by the shockwaves rupturing them.

Shockwaves are compatible with existing methods of wound healing. Advice to diabetic foot patients about lifestyle, smoking and diet still applies. Protection from the sun for skin cancer patients is also sensible.

### **Type of ulcers**

- Arterial (ischemic ulcer)
- Venous/varicose veins
- Neurotropic (Diabetic)
- Traumatic wounds including burn
- Infected ulcer(viral, bacterial, fungal, parasite) e.g. chronic TB ,Leprosy , Buruli
- Inflammatory ulcer (various Rheumatology illness, lupus)
- Tumour /benign and malignant

### **Grades of skin ulcer**

For simplicity we grade ulcers into 3 groups:

1. Pre ulceration -redness, swollen, blisters.
2. Ulceration - skin gone revealing tissue under the skin.
3. Complicated -with extension and or gangrene.

The most common ulcer is the vascular ulcer. The shockwaves enhance vascularisation of small arteries and arterioles to stimulate the healing. It disables and kills the bacteria which are the worst enemy for the healing process.

Our main work has been on diabetic ulcers with the advantages of cost savings for both the patient and the health services, less attendance of the patient for traditional treatments, the patient's comfort and as the ulcer heals the patient becomes more mobile and can return to work.

### **Skin cancer**

Basal cell carcinoma and melanoma can be treated. There are no side effects with shockwaves. This compares with radiology where the operators must be protected and the machines are immobile and expensive. Take care on the face and seek the advice of the manufacturer.

### **Blocking shockwaves**

Care must be taken when cleaning the wound to remove all old, flaky tissue under which there could be an air pocket when gel is applied. That pocket of air will block shockwaves; they cannot pass through any gas. The trick in research is for the placebo patient to not have gel applied. They hear the bangs and think they are receiving shocks but in fact they are not because the shocks cannot travel without the aqueous medium.

This same method can be used, for example, to stop shockwaves hitting the intestines and lungs where they may cause damage. On the limbs there are no risks; it is on the torso and head where care has to

be taken. In the case of a child with a lot of the torso affected by buruli ulcer and with no layer of insulating fat, the shockwaves have to hit the bacteria and go under the wound but no further. Use the CellSufflator made by CellSonic Limited to inject medical quality carbon dioxide below the wound. Dextrous work with the injection needle will place a layer of impenetrable gas that blocks the shockwaves and is also anti-bacterial.

### **Future**

It is the wish of leading doctors in Europe that hand held lithotripters be available in all casualty departments for the first treatments on injured patients. Research has shown that in plastic surgery, shockwaves can be given before, during or after the operation. Similarly, the healing process can be started on a wound before the patient is taken to theatre. In a military situation, the sooner shockwaves can be applied the better because there is no knowing whether germs are deliberately being deployed by the enemy and whatever they may be the shockwaves will stop them before they have travelled further into the body.

Since the 1980's when shockwaves broke kidney stones it was concluded that there was no effect on the blood. Certainly in that application there were no side effects. Research is now being done on the effect of shockwaves on blood cells with the objective of cleaning the blood of infections leaving it safe for transfusions. From that follows the removal of infections in the blood in the body and then there could be a means of enabling the body's immune system to be released from overload and combat Hepatitis, malaria and maybe HIV. The likely outcome will be combination therapy for shockwaves are now a non-invasive, drug free, no-side-effect means of healing.



