I have been intensively involved in the management of bone infection for thirty five years. Initially deep pessimism prevailed regarding chronic bone infection. The popular idiom was “once you have osteomyelitis, you always have osteomyelitis”. The sustained cure rate of osteomyelitis was less than 10%. I say sustained because the longer patients were followed up, the more frequently one found relapses of infection. Such relapses can occur up to fifty years after apparent cure.

In the 1960’s the traditional method of treating chronic bone infection and chronic wound infection was to lay the wound open, cut a gutter in the bone and leave it open to heal by secondary intention. The idea was to achieve maximum drainage so that all the diseased bone and soft tissue could be exposed for regular cleaning and application of antiseptics while one monitored the formation of granulation tissue as it slowly filled in the cavity.

Compound fractures were managed by extending the wound and then leaving the wound open after debridement. Internal fixation was avoided. Five days later, if there was no apparent infection, a delayed closure was performed otherwise the wound was still left open. If the wound had to be left open, desiccation and death of the bone frequently ensued. Healing of these gaping wounds could take months and months. It required trained staff to change the dressings and debride the wound. This was usually extremely painful and a torture dreaded by the patients. It also necessitated a long stay in hospital. Treatment was indeed time consuming and very expensive. These gaping wounds were inevitably infected by nosocomial bacteria in the hospital environment with each septic patient contributing to the free exchange of bacteria.
Systemic antibiotics appeared to be useless under these circumstances. The resulting scars were hideous and disfiguring. It was clear that a method of treatment had to be found which would permit one to close the wound thus restoring the normal anatomy while administering antibiotics within.

At first this was achieved with a single tube delivering the antibiotic and a second passively draining the effluent. At first the two tubes entered in the same direction. Then, to improve the distribution of fluid, the entrance and exit tubes were laid in opposite directions. It was then thought that this uni-directional flow did not distribute the instilled fluid evenly. Systems were devised to allow the irrigation to flow to and fro - at first with one pair of tubes and then with two pairs of tubes. Suction was added to enhance drainage.

The ultimate was a system published in the late 60’s which allowed for a wound to be closed leaving a deep lying tube and a superficially positioned tube. One could then reverse the flow to and fro by cyclical changes of the eight valves in an attempt to improve the spread and distribution of fluid. Blockage of the tubes was common.

It was soon discovered that communication to the tubes broke down fairly early. Under these circumstances the wounds, which had been closed, became distended. The suture line would yield and burst open or the skin edges would necrose and slough. Irrigation fluid would leak from the wound giving rise to a sodden bed which was all very unhygienic. If the bacteria didn’t gain access when the wet dressings were changed, they could simply swim through the wet dressings. Not surprisingly, the whole concept of local instillation of antibiotics was condemned and abandoned throughout the world ...... except in Johannesburg.
While I was concentrating on improving irrigation and suction drainage, other researchers came up with other solutions over the years. These included:

- Filling the dead space with muscle transposed from the vicinity or transposed from a distance. This entailed hooking up a new local blood supply via an arterio-venous pedicle.
- The dead space, or interspaces, were packed with methyl methacrylate cement impregnated with antibiotics - either in a solid lump or broken up into small fragments. Even chains of beads.
- Fibrin impregnated with antibiotic was used.
- Then calcium sulphate granules impregnated with antibiotic.
- Lately Collagen has been introduced as a vehicle for the antibiotic. (Read Australian paper to see if any more).

I steadfastly applied my mind to the solution of all the problems of the management of bone infection. From the start it was clear that radical surgery was the first and most important step towards curing bone infection. Then the wound had to be closed to prevent contamination. A barrier had to be maintained isolating the wound from the environment until the wound edges had healed. This entailed fewer dressings but one still had to monitor the progress of the wound inside. Antibiotics had to be delivered in sufficient concentration at the operation site. This required extensive research into the many factors which control bacteria in these circumstances.

These include:

- The hydraulics of wound irrigation.
- The concentration of antibiotic achieved in the tissues at the heart of the infection by various methods of antibiotic delivery.
- The chemical, physical and biological interactions between antibiotics and the tissues.
- A better understanding of bacteria and their antibiotic sensitivity.
- The degree of spread or penetration of infection to the neighbouring tissues.
- The prevention of the obstruction of irrigation tubes and the maintenance of their patency.
Hydraulics of Irrigation:

**FIG. 1**
At pressures usually obtained in the tubes used for irrigation and suction, entrance and exit is almost entirely through the nearest patent hole in the tube.

**FIG. 2**
With two tubes placed side by side, in the same direction, the irrigation fluid will actually flow over a small area close to the entry as the fluid short circuits between the nearest two holes. The rest of the tubing is non functional.
FIG. 3

Placing the tubes side by side but in opposite directions, directing a steady stream in one tube and out the other washes a larger area if this area is still confined to the immediate vicinity of the tubes. The outlying pockets are frequently not reached by the fluid. This explains some of the more complex systems of irrigation I referred to during the introduction.

Single lumen tubes used this way must be placed close to each other, if not in contact, because granulation tissue or clot forms in the gap between the tubes and rapidly isolates them from each other.

The concept of a double lumen tube, that is a tube within a tube, has been a major advance.

This can deliver fluid reliably at one end and remove it at the other end. With one tube inside the other close communication between the two tubes is optimised. An independently mobile inner tube makes it possible to unblock any system. Using two double lumen tubes, laid in opposite directions and intermittently filling and exhausting the cavity, enhances this distribution even further by creating two infusion points and two evacuation points. Later, as the volume of the cavity diminishes, one can cope adequately with one double lumen tube so decreasing the space occupied by tubing. (See figs. 4 & 5)
Intermittently filling the cavity achieves more efficient distribution of the antibiotic fluid even with a small volume of instillation. Naturally this is much more economical. A continuous infusion needs 3 litres of Saline and 3 vials of antibiotic per day as opposed to 50 ml of Saline and 1 vial of antibiotic which could be enough for six days. To put that another way, 18 litres of Saline and 18 vials of antibiotic are used for a continuous infusion and drainage in six days, as opposed to 50 ml of Saline and 1 vial of antibiotic instilled intermittently during the same period.
SIX DAYS OF THERAPY WITH

<table>
<thead>
<tr>
<th>Continuous infusion</th>
<th>Intermittent instillation</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 Litres per day</td>
<td>1 ml 4 hourly</td>
</tr>
<tr>
<td>18 Litres Saline</td>
<td>50 ml Saline</td>
</tr>
<tr>
<td>18 vials antibiotic</td>
<td>1 vial antibiotic</td>
</tr>
</tbody>
</table>

**TABLE I**

One cannot empty a rigid cavity completely unless one allows air to be drawn into the cavity to replace the fluid. This principle also allows one to measure the volume of the cavity very accurately. First one empties the cavity completely by allowing the ingress of air and records the volume evacuated. One should make allowance for the volume in the tubing and then one fills the cavity with fluid through the inner tube until it overflows passively through the outer tube. This is generally more accurate.

*Pharmakocinetics or Antibiotic Concentrations Achieved after administration by different routes:*

If 500 mg of antibiotic is administered as a bolus intravenously this will be dissolved in the 5 litres of whole blood which is the blood volume of the average man. This concentration diminishes rapidly as the antibiotic is either absorbed or bound to protein or fat or it is metabolised or excreted. Typically 10 micrograms per milligram will be found in muscles, 5 micrograms per milligram will be found in cancellous bone and even less in cortical bone – not to mention sclerotic infected bone. Remember also that small concentrations of antibiotics will be found in every secretion and exudate in the body, including sweat, saliva, and all the alimentary secretions. There it will affect and disrupt the local population of normal friendly commensal bacteria and encourage the development of antibiotic resistance in totally uninvolved bacteria.

If the antibiotic is administered intramuscularly blood and tissue concentrations rise gradually to ultimately lower levels and dissipate more slowly. If one makes a solution of 500 mg of antibiotic in 50 ml of solvent and instills 1 ml of that, you will be administering 10 mg/ml or 10 000 micrograms per ml. Frequent checks have confirmed that the concentration of antibiotic to be detected in the systemic circulation during local instillations is infinitesimal.
Selection of local antibiotic:

- Whenever treating infections it is mandatory to identify the organism and its antibiotic sensitivity.
- When there is a selection of effective antibiotics available choose an inexpensive non toxic antibiotic for systemic use.
- With local irrigation it is important that that the antibiotic is not toxic to the tissues locally.
- Fucidic acid, Vancomycin and Teicoplanin are very irritating to the tissues in concentrations greater than 1%. This generates a heavy gelatinous secretion which tend to block the tubes, especially when they are used for longer than a week.
- Systemically toxic antibiotics can be used locally with confidence because of the tiny doses used and the infinitesimal amounts absorbed.
- The selected antibiotic should also be stable in solution at room temperature.
- It should of course dissolve readily in saline. Chloramphenicol and Tetracycline dissolve poorly and may precipitate from a 1% solution. 0.5% is a better concentration.

Interactions between antibiotics: Antibiotic incompatibility is an important point to be kept in mind. There is a natural temptation to use a combination of antibiotics either to prevent drug resistance or to cover a mixture of organisms with different antibiotic sensitivities. It should be remembered however that certain antibiotics such as Erythromycin, Tetracycline, Vancomycin, Lincomycin, and Clindamycin are incompatible with each other and other antibiotics.

One has to be mindful of physical as well as biological incompatibility. e.g. Carbenicillin inactivates Gentamicin in the same solution, but when administered by separate routes, these two may even be synergistic. When in doubt use a single antibiotic in the irrigation fluid, another antibiotic can be given systemically if necessary.

There are few antibiotics equally effective against both gram negative rods and gram negative anaerobes. When there is a mixture of these I usually eliminate the more delicate anaerobes first by using Metronidazole or Clindamycin before tackling the more resistant gram negative bacilli. Many antibiotics, such as the Penicillins, are unstable in solution at room temperature and need to be discarded and renewed daily.
Prevention of obstruction and maintenance of the patency of tubes:  
Historically many agents have been tried to prevent clotting in and around irrigation tubes. In practice it is not desirable to prevent normal physiological clotting postoperatively. The consequences of success in this endeavour can and have been disastrous. One needs an agent to dissolve clot after it has arrested haemorrhage. The most effective agent for dissolving already formed clots is Urokinase but this is very expensive. Streptokinase is more cost effective. In vitro experiments have shown that Streptokinase is the most useful fibrinolytic. I use 20 000 units in 50 ml Saline and instill just over 1 ml containing 400-700 units into each tube. This will dissolve a 250 ml clot in three to seven days. Streptokinase is unstable in solution at room temperature. One can refrigerate the balance for up to three days.

Vehicle or Solvent: Any simple isotonic electrolyte solution will suffice although some antibiotics need a buffer to maintain a certain PH. Sugars in the solution should be avoided. They may favour the bacteria. Amino-acids and proteins may interfere with certain antibiotics.

Surgical debridement in preparation for irrigation:  
Bacteria travel fairly freely along the medullary canal, especially if there is an intramedullary nail. It should be remembered that the bacteria dwell not only in the bone but in all the surrounding soft tissue particularly compromised scar tissue. All of this should be thoroughly removed. Indeed all non functional tissue that looks altered should be debrided so that one is left with only healthy well vascularised tissue.

The full length of the femur should be reamed so that it can accommodate two 6 mm double lumen tubes. The bone and the wound are thoroughly flushed out to remove all debris. In order to facilitate this I use a trap in the line of the suction system along with pulsed lavage and I continue until no more debris is seen in this trap.
**FIG. 6**

Placement of tubes:

- Pass tubes through skin and cut away trocar at marked point.
- Lay tubes in medulla in as straight a line as possible so that perforations extend along the full length of the surgical cavity or reamed medulla but not beyond the cavity into healthy intact tissue.
- Cut the end of the tube at the nearest convenient mark.
- Two tubes can be laid in opposite directions with great advantage.
- Attach evacuation component to the perforated tube.
- Pass a 2mm catheter through the Y connection of the evacuation component and through to the end of the perforated tube. Lock it in place, apply traction to the distal end, and cut it so that it retracts back within the perforated tube.
- Anchor perforated tube to skin at the point where it emerges (No. 1 silk makes the most secure knots.)
- Close wound in layers. If wound cannot be closed seal it with adhesive plastic dressing e.g. Tegaderm, Opsite.
- Attach administration set and bag of appropriate antibiotic.
**LAUTENBACH ANTIBIOTIC ADMINISTRATION AND EVACUATION SYSTEM**

The entire system consists of a 50 ml bag of antibiotic solution, an administration set with a drip chamber to measure the volume of fluid instilled – this connects via a 3-way stopcock to a 2mm catheter which delivers the antibiotic at the far end of the perforated tube. The perforated tube is connected via the other two limbs of the Y connection to a suction apparatus. There is a T-tube along this line which can be used to obtain samples or unblock the tubes. The direction of flow is controlled by the pinch clamps on either side. A recoiling bellows provides negative pressure. When this is full, the contents can be pushed on to a disposable bag. One way valves at the entry into the bellows and the entry into the disposable bag ensure unidirectional flow. If excessive air accumulated in this bag, it can be safely released without spilling the fluid content. When the bag is full, it can be safely discarded without contaminating the environment.

**Operation of the System:**

**Irrigation Fluid:**

Antibiotics must be chosen according to the sensitivity of bacteria cultured. About 500 mgm of chosen antibiotics is dissolved in 50 ml of saline. Streptokinase (20,000 to 30,000 international units) is dissolved in 50 ml saline and kept refrigerated. 2 ml of this solution is added freshly each day to the antibiotic solution.

An initial bolus is injected into the wound at the end of surgery and left for 4 hours. After 4 hours suction is applied for 30 minutes to each tube. The suction is stopped and 20 drops (about 1.5 ml) of antibiotic and Streptokinase solution is instilled into each tube. This cycle is repeated every 4 hours.

The tubes may block with clot during the first 48 hours. This is normal and desirable for haemostasis. After that the clot can be removed to clear the tubes by a combination of powerful suction with a 20 ml syringe at the sampling port and instilling or injecting irrigation fluid at the three-way tap inlet. So long as the inlet tubes are patent, blockage of the suction tubes can be safely ignored. Only 1.4 ml is being instilled into the wound at 4 hourly intervals and this will certainly not cause over distension of the wound. When bleeding has stopped, Streptokinase can be discontinued. One should check the patency of the system frequently by applying strong suction with a syringe connected to the sample port.
**Twice a week** withdraw fluid from each perforated tube using a syringe in the sampling port and send for bacterial culture and sensitivity. If the patient finds this uncomfortable you can relieve this by allowing air through the air vent. You may have to change antibiotics to suit changes in the bacteria cultured from the wound fluid.

**Once a week** measure the volume of the cavity. The cavity can only be emptied by allowing air in to replace it (via the air vent). The volume of the involved irrigation tubes is 5 ml – subtract 5 ml from the volume withdrawn in the syringe to determine the approximate volume of the cavity.

An alternative and more accurate method is to place the limb horizontally and slowly inject saline via the three way stopcock while the sampling port is left open. All the other taps and stop cocks are closed so that there is only one route of escape for the fluid.

Once the system is working well the patient can lie at home to perform his own instillation and suction under the supervision of a visiting nurse who checks the function of the system, determines the volumes and draws samples for bacterial culture regularly. The volume of the cavity often appears to increase slightly during the first week because of clot retraction or dissolution and its removal. Then follows a period of rapid shrinkage of the cavity. The rate is such that the volume is usually halved every week. Eventually the cavity diminishes to zero as the cavity fills in with granulation tissue. This is assisted by suction drawing the walls of the cavity together one tube can be removed. Eventually granulation tissue begins to grow through the perforations of the suction tube blocking the lumen of this tube. Such blockage will not be influenced by Streptokinase which can only dissolve fibrin not granulation tissue.

If at this stage the fluid is physically clear, there is no bacterial growth, and the cavity has diminished to zero, one can remove the last remaining tube. I usually run in antibiotic as I slowly remove this tube, in order to fill the space hitherto occupied by the tube with antibiotic solution. Before removal of the last tube the wound is flushed vigorously by rapid injection and suction to extract loose clot, fibrin and loose granulation tissue around the tube. One now has a potential cavity of about 3 ml. The outer wound through which the tube had merged is covered with a dry dressing and in a matter of hours it closes with granulation tissue. In a matter of a few days the internal cavity once more shrinks to zero.
The accessory line can serve many purposes:

**A.** The top end has a filter. The bottom end may be connected to the 3-way tap at the end of the instillation catheter. In this position filtered air can be allowed to enter the catheter to relieve pain sometimes caused by negative pressure or to enable a cavity in rigid bone to be emptied by allowing air to displace fluid within. The top end should be level with the drip chamber so that solution will not rise up and spill through the filter if both control clamps are inadvertently opened at the same time. Besides it is better for air to enter from this level rather than down at the level of the bedding.

**B.** The filter at the top end can be removed and the tube connected to the side port below the drip chamber. The lower end can then be connected to a second instillation catheter. A single bag of antibiotic can thus supply two or more sites. This will prove economical when using an expensive antibiotics or one which is unstable in solution at room temperature (e.g. Penicillins or Streptokinase).

**C.** By adding a second 3-way stopcock in tandem, a syringe can be used to forcefully inject saline while applying strong suction in order to flush out the system when mucoid, fibrinous or other sludgy by-products in the wound fluid slow down or obstruct the flow out of the wound. One can connect a second bag and administration set to the free port of the 3-way stopcock when there is
a mixed infection and two antibiotics which may be incompatible in solution need to be used, or when one is using an expensive but stable antibiotic and one needs streptokinase which is unstable in solution at room temperature

**Quality of effluent fluid:** It has been my observation that even when surgery has been inadequate, the wound fluid is usually initially bloodstained with clots and then bloodstained without clots, and then clear. The earliest sign of persistent infection, namely turbid fluid or positive cultures usually only becomes apparent after two weeks. For this reason one should continue with irrigation with at least one double lumen tube for at least three weeks.

**MANAGEMENT OF COMPLICATIONS:**

<table>
<thead>
<tr>
<th>CHANGES IN FLUID DISCHARGED FROM SUCTION TUBE</th>
</tr>
</thead>
<tbody>
<tr>
<td>BLOOD AND CLOT</td>
</tr>
<tr>
<td>BLOOD STAINED FLUID</td>
</tr>
<tr>
<td>CLEAR WATERY FLUID</td>
</tr>
<tr>
<td>STRAW COLOURED FLUID</td>
</tr>
<tr>
<td>BLOCKAGE BY GRANULATION</td>
</tr>
</tbody>
</table>

- Turbid Fluid
- Fibrinous Fluid
- Purulent Fluid
- Blockage by Debris
- Chronic infection continuous or relapsing

Fig. 9
**Causes of Turbid Fluid:**

- Necrotic and/or infected tissue may not have been completely excised at surgery and pus subsequently forms.
- Necrosis and sloughing following devitalisation of tissue during surgery with subsequent liquefaction. Although such tissue is very liable to become infected, this is not necessarily inevitable.
- Toxic irrigation fluid including hypertonic solutions, can give rise to the formation of fibrin. This can blanket the wound with a membrane. This in time becomes detached, breaks up and is suspended in the fluid. 1% Fucidin, Vancomycin and Teicoplanin solution in buffer tends to form a thick mucoid solution which can obstruct the system.
- Tetracycline and Chloramphenicol dissolve poorly in saline and these two frequently precipitate out of solution.
- Secondary infection may occur. This may be in the form of re-infection with the original organism or superinfection with new micro-organism which may include fungi.

### CAUSES OF TURBID FLUID

- Necrotic tissue incompletely excised
- Necrosing tissue devitalised by surgery
- Irritant irrigation fluid
- Hypertonic solution
- Fucidin, Vancomycin, Teicoplanin
- Low soluble Tetracycline and Chloramphenicol
- Secondary infection, re-infection, super-infection

**TABLE II**
A frequent cause of failure is abandoning the irrigation and suction too soon because the tubes appear to be irreparably blocked. With the intelligent manipulation of an inner catheter inside a well-laid suction tube, there are very few obstructions indeed which cannot be overcome. One may have to be patient with blockage which occurs immediately after operation as a result of fresh clot formation, and accept that such blockage may take up to two days to slowly dissolve and be broken up by the Streptokinase and the body’s endogenous fibrinolytics. Thereafter the suction tubes must be kept patent at all costs until fluid is clear and free of bacteria and the cavity has shrunk to closure. If a heavy precipitate appears, an isotonic solution can be used as a wash-out once or twice a day, see Fig. 8 C. The solution is forcibly injected into the inner catheter to dislodge and suspend the debris in solution which is then forcibly sucked out through the suction tube. This procedure is repeated often enough to obtain a clear return.

The appearance of a new micro-organism may well call for a change of antibiotic. If after a couple of weeks no improvement is seen, I cut my losses and make an early decision to perform a secondary debridement before fresh scar tissue matures making further dissection difficult.

If, however, the initial wound debridement has been compromised by the presence of an essential metal fixation device, or the patient’s condition makes it inadvisable to re-operate, I gracefully accept temporary defeat and conserve and consolidate my efforts for a renewed attack later when it will be possible to remove the foreign body. If the bacteria are still there after four weeks one is unlikely to succeed by persevering. Indeed the tubes themselves may be the foreign body providing a nidus for perpetuating the bacteria.
Manoeuvres to Unblock Tubes:

**Fig. 10**
Attach a syringe to the sample port, open the near side clamp and apply strong suction. If the tube is only partly blocked and the cavity is even partially collapsible and it contains fluid, such fluid will appear in the syringe and will not draw back when the syringe is released.

**Fig. 11**
If the fluid does draw back when you release the plunger, open the third port of the three way stopcock and draw again. Air should be drawn into the inner catheter and then travel along the outside and/or inside of the suction tube and enter the syringe when suction is applied again.
If this does not occur, check the patency of the inner catheter by allowing antibiotic solution to drip in through the administration set, or inject 1 or 2 ml of fluid with a syringe. If the inner catheter cannot be unblocked, replace it with a new one.

If this manoeuvre is unsuccessful, the obstruction may be due to granulation tissue, or consolidated blood clot formed in a continuous mass from outside the tube through one or more of the holes in the suction tube and connected to the mass in the lumen of the tube. When this happens I would tug on the tube where it emerges from the skin. This can be painful. If this is intolerable or ineffective, I would cut the suture holding the outer suction tube and withdraw it momentarily for about 2 cm. This divides the linkage between clot and granulation tissue inside and outside the tube and allows them to be sucked out towards the syringe.

As a last resort, the inner catheter may be removed while applying continuous suction to it hoping to pick up and remove the offending plug. Suction can then also be applied directly to the outer tube later in order to remove stubborn plugs. When the outer perforated tube has been cleared, a new inner tube and three way stopcock can be attached to it.

### FACTORS DETERMINING SUCCESSFUL ERADICATION

In order of priority:
- General Health and nutrition
- Tissue immunity
- Humoral immunity
- Tissue perfusion
  (arterial, venous, lymphatic)
- Fibrosis and scarring
- Adequacy of debridement
  (overlooked foci of infection)
- Retained foreign bodies
- Haematoma
- Immobilisation

Only then can we consider the contribution made by antibiotic delivery.

### TABLE III
RESULTS: There are many factors which determine the success or failure of an attempt at eradicating the infection. Of these the most important is the general health of the patient and his immunity – both in the tissue and the bloods. Then comes the local health of the tissue and the contributions of arterial, venous and lymphatic drainage. After that comes the adequacy of debridement and whether hidden foci of infection were overlooked, foreign bodies were retained, or too much compromised fibrous tissue was retained. Haematomata can ruin everything. Immobilisation of the operated limb should be maintained not only to reduce stress on these tissues but also to reduce the risk of infection coming in along the tubes pistoning in the skin.

I am very particular about monitoring results. I believe there are degrees of success and failure.

In determining this I look at many criteria beginning with clinical criteria, which range from the most obvious evidence of failure to very mild frequently overlooked factors like local warmth.

<table>
<thead>
<tr>
<th>CLINICAL CRITERIA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pyrexia</td>
</tr>
<tr>
<td>Exudate</td>
</tr>
<tr>
<td>Inflammation</td>
</tr>
<tr>
<td>Induration</td>
</tr>
<tr>
<td>Oedema</td>
</tr>
<tr>
<td>Lymphadenopathy</td>
</tr>
<tr>
<td>Local warmth</td>
</tr>
</tbody>
</table>

TABLE IV
The laboratory can indicate progress long after all the clinical signs have disappeared, the most obvious being activity tests like erythrocyte sedimentation rate, plasma viscosity and C-reactive protein. The most subtle changes can be picked up by monitoring the iron profile based on the fact that the anaemia of chronic inflammation is reflected by a low serum iron in the presence of an elevated blood ferritin.

### LABORATORY CRITERIA

**Activity tests ESR**
- Plasma viscosity
- C-Reactive protein
- Neutrophil leucocytosis
- Red cell morphology
- Anaemia
- Iron deficiency
- Blood ferritin

### TABLE V

The radiological features of success or failure are very slow to be manifest. Whereas further bone destruction and sequestrum clearly indicate failure, the return of a regular trabecular pattern, which is the hallmark of definite cure, can take many years to develop.

### RADIOLOGICAL CRITERIA

- Further bone lysis
- Sequestrum formation
- Periosteal reaction
- Furry or layered – (onion)
- Increasing sclerosis
- Reconstitution of medulla
- Re-trabeculation
- Persistent sclerosis

### TABLE VI
CONCLUSION:
Local irrigation is a valuable adjunct in the treatment of chronic osteomyelitis. Though it may appear to be time consuming and demanding of attention to detail, the effort is rewarded in many ways: it is a clean technique which obviates the necessity for frequent and unpleasant wound dressings. Hospital stay is shortened to a few weeks instead of months. I frequently allow patients home after three or four days when their condition has stabilised after the operation. They then operate the administration of antibiotic and suction of the wound themselves. A trained nursing sister calls on them regularly to mix new bags of antibiotic and to help maintain the patency. She also takes samples of the wound fluid twice a week for bacterial culture and antibiotic sensitivity. The system greatly reduces the risk of cross infection. Indeed I do not isolate my infected patients after surgery when they are treated with this system and after twenty years of closely monitoring bacterial populations, I have had no reason to regret this.
Fig. 12
You see here a wound treated by packing after wide drainage two months after surgery.

Fig. 13
Here is the same patient two weeks after debridement, reaming and irrigation of the femur, completed by immediate reconstruction of his soft tissues and closure of the wound.