

## GUY L. BOWDON MEMORIAL LECTURE

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### AN OSTEOPLASTIC OPERATION FOR CHRONIC DISEASE OF THE FRONTAL SINUSES

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#### Introduction

Despite the work of Arthur Proetz, Victor Negus and others the function of the Paranasal Sinuses is still uncertain. We can only guess at why they are there and what they do. Certainly in some animals with a keen sense of smell they are invaded by prolongations of the Turbinate systems, which themselves bear olfactory epithelium. In man the antra and frontals are empty and this accords with his vestigial sense of smell. Negus regards them as unwanted space. The idea that they are formed by the pull of the facial muscles upon the bony cage of the nasal cavities during development will serve to explain the large size of the sinuses occurring in animals with active muscles of the face. Man, monkey, dog and cat all have active muscles of expression and all have large frontal and maxillary sinuses. The sheep is relatively expressionless and has small ones. The elephant has that enormous prehensile proboscis and its frontal sinuses are enormous too. The Ethmoidal and Sphenoidal Sinuses are developed in relation with the olfactory function in quadrupeds, and although their origin is different, they too must be regarded as mere relics in man.

We do know something, however, about the functional Physiology of the sinuses, and even more about that of the nasal cavities. We know that the sinuses are lined by a simplified respiratory epithelium continuous with that of the nasal cavities. If the ostia of the sinuses remain open atmospheric pressure can be maintained within them. If the ciliary surface is uninterrupted in their orifices and ducts, the secreted mucus can get out. Anything which damages ostium or cilia impairs function and the individual has symptoms. In other words we have the paradoxical situation that the sinuses only begin to have a function when their activity is impaired. On the other hand the individual can get along splendidly if the sinus cavities are effectively

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eliminated — just as he can get along without his appendix. This accords well with Negus' view that in man the sinuses represent unwanted space of vestigial type.

The nasal cavities, however, are quite another matter. Here the mucosal lining is highly complex and there are those projections into the cavities called the Turbinates, all of which are of the utmost importance to the patient's comfort and well-being. The sinus linings are expendable, the nasal cavities are sacred.

The operative surgery of the nasal apparatus in the past fell down because it tried to ventilate the nose by chipping away bits of valuable Turbinates, and because in trying to ventilate and drain the sinuses it damaged the ostia and ruined the ciliary blanket. Secondary scarring then was added and the disease continued. So it is small wonder that one often heard patients say "I have been told that if you have your sinuses operated upon you will never be free of trouble"; alas there was a lot of truth in what they said.

In fact the Physiology of the Sinuses cannot come to terms with surgery; it must win or lose, be all or nothing, and surgery must either help it, or defeat it totally. There is no half-way stage.

The Physiology of the nasal cavities on the other hand must always be allowed to win, or the patient is certain to grumble.

### **Reversibility**

Arising out of this modern outlook comes the further concept that just as a pneumonitis can be reversible, or drift into fibrosis of the lung, so infections of the sinuses may be reversible or irreversible. If we believe that a sinusitis is reversible we must deploy all our knowledge to cause return to normal — by drugs, by improving nasal ventilation, and by irrigations conducted away from and without damage to the ostia. (On no account should we cram canulae into antral ostia or fronto-nasal ducts). When irreversibility has occurred, so-called drainage operations are valueless, and the chronically diseased mucosa continues to plague its owner. The assessment of reversibility is not really difficult, though it turns to some extent upon the experience of the surgeon.

The genuinely acute case offers no problem. At the other end of the scale the patient with chronic grumbling symptoms over the years has clearly irreversible trouble. In between is the patient who has been treated conservatively and who may or may not have improved a little. Here bacteriological examination may help, but because we may have been using antibiotics it is an uncertain guide. A continuance of symptoms and a continuance of impairment of the suspected sinus on serial radiography should give one the clue that eradication is needed.

Perhaps the prototype of the successful operation on the irreversibly damaged sinus is the Caldwell Luc operation on the Maxillary Antrum. Here we have almost perfect access, almost perfect capacity for removal of disease, and no resulting disfigurement. The problem has been to translate these principles into relief of Chronic Frontal Sinus Disease. The old-fashioned Radical operation on the Frontals sometime failed for technical reasons, but its major disadvantage was the resulting disfigurement. The history of the operative surgery of the frontal sinuses has been a dismal one, very largely because

we have tried to avoid this disfigurement; and in doing so we have committed every sin against already impaired Physiology. We have even inserted grafts of squamous epithelium where squamous epithelium has no business to be. The dilemma lay in trying to eliminate disease without disfigurement, and the solution has been to carry out some kind of osteoplastic operation — in other words to take the lid off the frontal box, deal with the contents of the box and put the lid back again.

Desmond Dawes of Newcastle-on-Tyne reviewed the subject in 1961 and illustrated the many and various incisions which have been made.

The possibility of an osteoplastic operation upon the frontal sinuses appears to have been considered by German authors before 1900, but the first English-speaking writer to describe such a method was Lothrop of Boston in 1899. He carried out the operation on a living patient only once, with initial success. Unfortunately the patient died of Meningitis a few months later, and at autopsy a hole was found in the posterior wall of the Sinus.

Despite this unhappy outcome of the first case it is rather surprising that the method was not pursued. Of course the antibacterial drugs were then unknown and a spreading osteomyelitis of the diploetic frontal bones was very properly dreaded. Coming as I do from the University where Penicillin was first developed as a practical weapon, I must give the antibiotics full honour, but I have a suspicion that even without them the compact bone of the anterior sinus wall could have been opened with reasonable safety. The fact is that in the United States the technique was virtually forgotten while in Britain we tended to plod along with methods designed to drain rather than cure.

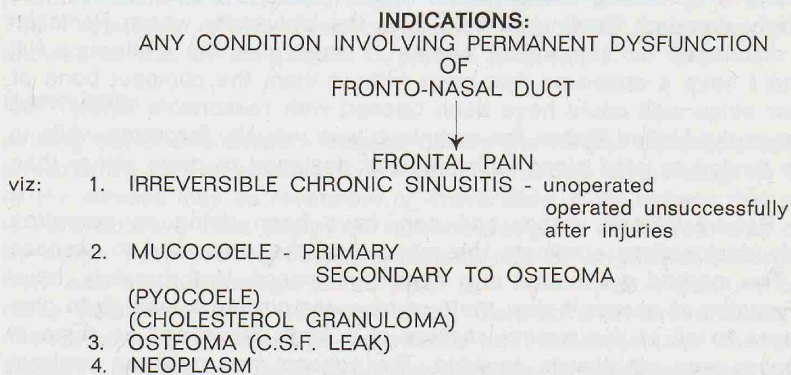
In Dublin Robert Woods, father and son, have been doing an operation deliberately designed to eradicate the mucosa of the sinus and to stenose the duct. The method succeeded in a number of cases. Unfortunately, however, the incision of access below the eyebrow was not large enough to give visual access to all of the remote corners of a large Sinus and so removal of the mucosa was not always possible. The concept was in direct contrast with tradition and provided a valuable step in the evolution of the osteoplastic procedure.

Hilding of Duluth, Minnesota, in 1933 carried out experiments on the frontal sinuses of dogs, in which he showed that after removal of the mucosa the cavities filled with new bone. In that same year Goodale of Boston began to write about an osteoplastic operation, thus rekindling the local flame, and he has steadily evolved a technique which he has used with modifications up to the present time. One must give him great credit of his pertinacity, and for his animal experiments, but as I see it, he bases his technique upon some inherent fallacies and I shall have occasion to cross swords with him about these later.

My interest in the procedure was awakened in 1952 by an article in the British Journal of Plastic Surgery by Gibson and Walker, who had used it for gaining access to a large osteoma. I was becoming more and more convinced that the traditional so-called drainage operations on the Frontals were unsatisfactory, and I was not convinced that Wood's operation could always be carried out. I was in fact looking for something analogous to the Caldwell-Luc operation on the Maxillary Sinus. I have taken the operation of Gibson

and Walker and made various modifications of it to produce what I believe to be a satisfactory technique in practically all conditions of irreversible disease of the Frontal Sinuses. At the outset I should say that both sinuses are opened at every operation. In justification I would make the following points:

1. In many cases the inter-sinus septum will be found to have given way already.
2. Even where this has not taken place the irregularity of the sinus boundaries is such that complete exposure is impossible to guarantee without opening both sinuses.
3. Although there may well be differences in the degree of mucosal change in the two sinuses, experience has shown that more often than not the supposedly normal sinus is in fact pathological to a greater or less degree.
4. If we agree with the concept of Negus (and I do) that the Frontal Sinuses in man represent useless empty space, then clearly nothing of value is sacrificed if we remove the lining of the less diseased sinus along with that of the more diseased.



**THE TECHNIQUE** (This was shown in detail in the Ciné film which followed at this point).

### **Mapping of the Sinuses on the skin**

We are indebted to Dr. Philip Sheldon of the Department of Radiology at the Radcliffe Infirmary for this manoeuvre. It is vital to the accuracy of the cutting of the bone flap. In essence it consists in making a template, or cut-out of the sinuses from a spare X-ray film and drawing the outline of the sinuses upon the skin with indelible pencil. This is usually done on the day before operation.

### **The anaesthetic**

This is general and endotracheal but its details are left to the anaesthetist.

### **The incision**

Where the patient has well-marked creases in the skin of the forehead one of these may be used as the site of the incision, but this should be well

above the upper limits of the Sinuses in order to maintain a good blood supply to the bone flap. Where the patient's forehead is smooth it is best to make a coronal incision from ear to ear within the hair-line. In either case the line of the incision is injected subcutaneously by the anaesthetist with Xylocaine  $\frac{1}{2}$  % containing Adrenalin 1 : 100,000 before the patient comes to the table. This greatly diminishes the bleeding.

### **The scalp flap**

The skin incision is taken straight down to bone, and its edges are picked up by means of Raney's skin-clips as used by the Neurosurgeons.

The next step is to pass a series of hypodermic needles through the scalp along the line of the upper limit of the sinuses. These needles are inserted vertically till they hit bone and then turned upwards towards the cranial vault for 2 or 3 millimetres. These needles will aid in identifying where to cut free the lid of the box.

The flap is then pushed off the bone subpericranially. This proceeds right to the orbital margins lateral to the outer limits of the sinuses. More medially the stripping goes forward to just below the point of emergence of the hypodermic needles.

We now have a semi-mobile flap and the value of the needles becomes evident.

### **The bone flap**

A conical dental fissure burr is mounted on the drill. It is pushed into the bone very obliquely first on one side of the midline and then on the other just caudal to the point of emergence of the needles. Continuous irrigation and suction are used during this process. Usually there is no doubt about entry into the sinus, the sensation is rather like that obtained in doing a lumbar or antral puncture. A bubble of air or a bead of pus may emerge. A whole series of such holes then made around the outline of the sinuses. These holes are then joined by means of a cylindrical fissure burr, or, if preferred, a small electrically driven saw.

The lateral ends of the bone flap are completed by a sharp blow by hammer and osteotome into the orbit on each side.

Two broad osteotomes are now inserted beneath the superior margin of the bone flap, and are used rather like tyre-levers to cause a fracture across the naso-frontal suture line and through the thin orbital roof.

The whole osteoplastic flap is now turned downwards digitally, revealing completely the pathology within.

### **Removal of Contents of Sinuses**

Pus and blood are now sucked out, and all septa are nibbled away. If an osteoma be present this is removed — sometimes by nibbling, sometimes by burring. The mucosa is removed from the bone flap, and then from the sinuses proper.

The next step is to clean all bone surfaces within the flap and the sinuses by means of a round cutting burr, under suction-irrigation. In many ways this is the most important single step in the operation, and it must be complete.

## **The Ethmoidectomy**

This is easily carried out from above. It has three objects: firstly to enlarge temporarily the drainage, secondly, by destroying the mucosa of the duct to ensure ultimate stenosis; thirdly to make certain that orbito-frontal cells (if present) are completely exenterated. It is a help in doing this to pass as a guide a frontal cannula from the nose, under the middle turbinal. By this means a very complete Ethmoidectomy may be achieved, without interference with the Turbinates.

### **Closure**

The cavity and the bone flap are both generously filled with Sulphonamide-Penicillin powder, the lid is replaced and the scalp is sutured in layers. Drainage tubes are unnecessary and are never used. The skin wound is covered by a collodion dressing and a cuirass of Stent's dental mould is placed over the forehead.

### **After-care**

The patient is given Penicillin and Sulfa drug for a week, and such simple analgesics as Aspirin and Codein. He usually in fact has no pain. His "lovely black eyes" are regarded as usual and are depreciated. He is out of bed the day after operation. At the end of the week his splint, dressing and stitches are removed, and he goes home.

While it is obviously disadvantageous that he should pick up an intercurrent infection in the nose in the succeeding 2 or 3 weeks, thereafter he need take no particular care. After 3 months he may be allowed to swim and behave entirely normally.

### **Follow-up**

I usually see these patients at 3 weeks after operation, i.e. before they return to work, and then again at 3 months. On the second visit they have a routine P.A. and Lateral check-up X-ray to assess the degree of osteogenesis.

My experience is that usually these people are so happy that they do not trouble the Rhinologist again. This must be regarded as very gratifying since Frontal Sinus patients are not uncomplaining as a race, and one can bet one's bottom dollar that if they do complain to their physicians they will be back in our offices at the drop of a hat.

## **HEALING AIMS — DISCUSSION**

The objects of the exercise are to eliminate a useless, diseased secretory cavity and to prevent the return of function within its site. Obviously the requisites of the situation will be met if the cavity can be drained post-operatively while blood-loss is present, if healing by new bone at best and fibrous tissue at second best can be stimulated, and if the frontal end of the fronto-nasal duct can be induced to close.

- a. Preliminary drainage. This is met by opening from above the Ethmoidal cells along side the fronto-nasal ducts.
- b. Healing by bone. All vestiges of lining membrane of both sinuses must be destroyed. This is achieved by nibbling away all septa, by stripping the mucosa by means of a dissector, and by eburnating the bony walls by means of a round cutting dental burr. Since the bone walls are made of compact bone (and not diploe) and antibiotics are available to us, there need by no anxiety about inducing a spreading osteitis of the frontal bones.
- c. Closure of the duct. Provided that the mucosa is totally removed at the exit point, there should be no difficulty about ensuring closure by scarring. Closure was the item which was so difficult to prevent in the unenlightened days of attempts to establish drainage in Chronic Sinusitis. Now we welcome it.

As I see it the rationale of the situation is met by elevating a living lid from the box, cleaning out the box and putting the lid back again.

### **Grafted tissue in the cavity**

In the old days when the obliterative radical operation was carried out a serious disfigurement remained. This was rectified by a variety of methods involving the use of inert foreign body inserts, or more commonly by the use of autogenous mesoblastic tissue such as fat, fragmented cartilage or bone. Perhaps the most satisfactory was fat. This was moulded to overcorrect the depression, and because it contracted and was partly converted to fibrous tissue it gave quite pleasing results.

Habits and traditions die hard. So now we find surgeons on both sides of the Atlantic carrying out osteoplastic operations and filling the cavities left behind with autogenous tissue. I have tried to understand why they do this, and believe that it is because they find it hard to shake off a habit. They attempt to justify the practice on the mistaken idea that thereby re-aeration of the cavity is prevented.

In my view the use of fat grafts in this situation betrays either a lack of comprehension of the principles involved or a lack of confidence in one's own ability to eradicate the secreting mucosa. Goodale has done some beautiful experiments on dogs in which he has shown that fat implanted in the denuded sinuses remains as fat, but he admits that it seems to impede the obliterative function of osteogenesis. When he used boiled — i.e. devitalised — fat this was invaded by osteogenetic tissue. MacNeil, now of Edinburgh has done similar experiments using a variety of grafts with similar results. He is only now trying the effect on animals of allowing osteogenesis to occur spontaneously. (In passing one is reminded that the Frontals of a dog are not strictly analogous to those of the human, since Ethmo-turbinals are present in their floor. Obliteration by osteogenesis might therefore be expected to be more difficult to achieve, and recanalisation by mucosa might be expected to be easier than in man.)

I have never used any kind of graft in my cases, and I do not believe that their use contributes in any way to healing. With the exception of 2 of the 3 cases which came to re-opening and which I shall describe later, I believe that closure by bone or fibrous tissue has been complete in all.

There is one other point of technique which seems to me to be important. Where the lid of the box is hinged only upon pericranium as in Goodale's technique (and in particular where only one Frontal is opened) it seems to me that the blood supply reaching the lid may well be insufficient to maintain its vitality. In such a case the lid merely remains as an inert bone graft and is not a source of osteogenesis. In the technique I have used the scalp itself is the source of blood supply and it is broadly based. When burring away the mucosal lining of the frontal wall or lid I have always been impressed by the free bleeding encountered. This surely must contribute to good osteogenic healing. In other words I have tried to enlist the aid of Physiology in the direction of normal healing to defeat the impaired Physiology of aeration. Those who insert grafts are enlisting the aid of abnormal processes.

ANALYSIS OF CASES OF OSTEOPLASTIC OPERATIONS	
CHRONIC SINUSITIS	
PRIMARY OPERATION	39
SECONDARY OPERATION	17
MUCOCOELE	11
CHOLESTEROL GRANULOMA	1
OSTEOMA	11
FRACTURES	4
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#### RESULTS OF OSTEOPLASTIC OPERATION

Totally relieved of main symptoms (previous operations on antra etc. 8)	68	82 %
Relatively relieved of main symptoms	14	16.8 %
Unrelieved	1	1.2 %
Reoperated	3	3.6 %

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#### THE FAILURES

When a recommended technique fails we should be at least as interested in the failures as in the successes. Not only is this good discipline, but it may lead to improvements in selection of cases and in the technique itself.

a. One total failure is listed. He was an intelligent and introspective young man who persistently complained about Left Frontal pain. He had had conservative operations, after each of which his pain had been temporarily relieved only to return a month or so later, and after each of which his Frontal Sinus was a little more opaque on X-Ray examination. Rather against my better judgment I did an osteoplastic operation for him and found very little wrong inside the Sinus.

He ended up in a mental hospital. It is clear that the help of the Psychiatrists should have been sought earlier.

b. The relative successes are those who complained of minor twinges, headaches, etc.

c. The relative failures which needed a re-opening operation are worth a close study.



**1. M.B. Hosp. No. 2891.**

This young man haunted the Department from the age of 6. He was a chronic nasal sufferer in whom there was hardly an operation which we did not do. Finally in 1954 when he was 17, he had a supposedly satisfactory osteoplastic operation via a hair-line incision.

In 1959 he began to complain of Right Frontal headaches. This settled down and he was not seen again until 1963, when again he had his Right Frontal pain. This settled once more on antibiotics.

In 1964 it became evident that there was a loculus of infection in the lateral end and floor of the Right Frontal Sinus. At re-operation an infected mucocoele was found on the Right side. The lining was exenterated with care and downward clearance of Ethmoids was carried out. A small incision and burr-hole over the Left Frontal revealed only clean spongy bone.

The lining membrane removed at operation showed chronically diseased sinus mucosa.

**2. J. B. Hosp. No. 82348.**

This young man had a history rather similar to that of the last described. He had had a complicated series of operations in another centre, including a Howarth type of operation on the Right Frontal Sinus, I saw him in October 1960 and did an osteoplastic operation for him.

All was well for 2 years, but he then had an attack of Right Frontal pain which settled on antibiotics.

He reappeared in January 1965 with pain and swelling over the Right eye. Re-operation showed an infected mucocoele; the lining was exenterated and the Ethmoids opened into the nose from above. Around the mucocoele was good new-bone formation.

**Comment on Cases 1. and 2.**

In both of these lads a new mucocoele was found. It is of course possible that the original operations were imperfectly carried out. I think, however, that there is an additional explanation and it turns on the fact that they were only 17 years of age when their osteoplastic operations were carried out — i.e. before their sinuses had become fully developed.

In support of this idea I would quote the case of a teenage girl who was admitted in 1942 with osteomyelitis of her Frontal Bones. As was the habit then, her Frontal Bones were removed subtotally. Not only did she grow herself new skull bones, but those new bones actually showed new Frontal Sinuses within them.

I think it at least possible that the 2 lads grew new Frontal Sinuses from an Ethmoid residue on the Right side.

**3. A.T. Hosp. No. 102265.**

This was a man of 40 years. He had had a long nasal history, with vasomotor as well as septic symptomatology. Latterly his symptomatology had localised

itself in the Right Frontal Sinus, and this had been trephined and irrigated on one occasion.

It was notable that whatever was done for this man the symptoms were immediately relieved.

In the end, however, it was decided that he had a genuine chronic irreversible sinusitis. The osteoplastic operation was carried out and the diagnosis was completely confirmed.

Nine months later he returned with the story that his Frontal headache was as bad as ever and that he had had swelling again. He was re-admitted for observation for ten days and no swelling was noted. Because he begged for something to be done I re-opened the sinus beneath the eyelid and found a well fixed bone-flap beneath which lay clean, spongy new bone and nothing else. His symptoms were immediately relieved.

#### **Comment:**

In spite of genuine original pathology this man is one of those whose threshold for pain is extremely low and whose personality is highly unstable. Everyone here must be familiar with this man or his cousin Jim. I have told him that we are now at the end of the trail — but, I wonder . . .

The lecture was accompanied by a colour film illustrating technique.

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