SURGICAL PROCEDURES IN GENERAL PRACTICE

This is one of a series of articles contributed by invitation

SCALP WOUNDS AND FRACTURES OF THE SKULL

BY

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It has often been said that in cases of head injury it is the condition of the brain which really matters, while that of the integuments is of relatively minor significance. Although the truth of this statement is undoubted it must not be regarded as a reason for minimizing the importance of scalp wounds and skull fractures. It is my object in this paper to concentrate upon these lesions, leaving the question of the degree of damage to the brain and its treatment for consideration in the next article. It will be realized, however, that the conditions are so often associated that treatment is frequently required for damage to the intracranial contents as well as to their envelopes.

Scalp Wounds: Some Anatomical Considerations

The scalp is characterized by its extreme vascularity and relative insensitivity. Many of us have experienced a trickle of blood running over the face from a scalp wound which, because of its painlessness, we were unaware had taken place. Haemorrhage from the scalp is profuse on account both of the number of vessels and of the fact that they lie in the dense subcutaneous connective tissue and are thereby prevented from retracting when divided. The blood supply of this region is so rich that even in extensive injuries, such as partial avulsion, there is very little risk of tissue necrosis, and it is well known that because of its vascularity incisions may be made in the scalp with impunity in any direction.

The most important layer of the scalp, considered from the surgical aspect, is the subaponeurotic lymph space, which lies beneath the epicranial aponeurosis (galea aponeurotica), separating it from the pericranium. Because of this space the scalp is free to move on the skull. Effusions may collect within it, and because of venous connexions (emissaries) with the intracranial venous sinuses an intracranial spread of infection may result; hence this space is termed the *dangerous area of the scalp*. The epicranial aponeurosis is attached posteriorly to the linea suprema of the occipital bone and on either side to the zygoma, but in front it is unattached to the frontal bone, so that while subaponeurotic effusions are prevented from spreading into the neck or the temporal fossa, they readily extend anteriorly into the loose tissue of the eyelids.

Treatment of Scalp Wounds

The treatment of an injury to the scalp may constitute a relatively minor part of the management of a case of head injury, but it may be the all-important part, and many scalp wounds are the result of a comparatively slight blow, which has not been sufficient to concussion the patient or damage the brain. Scalp wounds are generally of the contused or lacerated variety, less often of the incised or punctured type. There is usually a good deal of matting of hair from coagulated blood, and this should first be cut away and shaved from the edges of the wound, which may then be the better examined.

If a main vessel such as the superficial temporal artery has been divided and is bleeding it should be secured with a catgut ligature, which may need to be passed on a needle. If the margins of the wound are bleeding freely, haemorrhage may be controlled either by the pressure of an assistant's fingers along the wound edge or by applying a series of artery forceps to the cut edges of the epicranial aponeurosis and drawing this outwards over the wound. Mattress sutures along the edges of scalp wounds are apt to introduce infection, but a troublesome bleeding point may in emergency be secured by means of a mattress suture passed down to the bone. Where possible, the underlying bone must be carefully examined by inspection and, if necessary, by the use of a probe to ascertain if a fracture is present; because if there is one we are no longer dealing with an uncomplicated scalp wound, but with a case of compound fracture of the skull, treatment of which is urgent and is considered under a separate heading.

Except for the most trivial cases, and but few even of these, scalp wounds almost always extend into the dangerous subaponeurotic area. Once haemorrhage has been arrested, therefore, and it has been ascertained that the bone is undamaged, our object must be to protect the patient from the dangers of infection and to try to promote healing of the wound by first intention. For these reasons scalp wounds should be treated as emergencies as soon after their infliction as possible. The edges must be cleaned well with soap and water, and if bruised, irregular, and dirty, excised with a sharp scalpel and approximated with a series of interrupted fine silkworm-gut sutures passed on a curved cutting needle through the whole thickness of the scalp on either side. A dressing of gauze wrung out of spirit is then applied, and if healing occurs per primam the sutures may be cut on the fifth or sixth day and removed a day or two later. If infection and suppuration ensue the wound must be opened and drained at once to allow free egress of the products of infection from the dangerous area, for the possibility of an intracranial spread of infection by emissary veins has always to be kept in mind. It was because of this that Percival Pott wrote of the scalp: "This though it be called the common tegument of the head, yet injuries to it become of much more consequence than the same kind of ills inflicted on the common teguments of the rest of the body." Owing to the extreme vascularity of the scalp, however, infection is unusual, and in most cases healing of scalp wounds is both rapid and uncomplicated.

Fractures of the Skull

It has long been realized that extensive fractures may occur with very little apparent damage to the brain, while, on the other hand, serious intracranial complications may result from head injuries in which the skull has not been fractured. In none of four cases of traumatic intracranial haemorrhage requiring craniotomy which I have recently reported was the skull fractured (Rogers, 1937). Fractures of the skull, like fractures in general, may be the result of direct or indirect violence. In the former case they tend to radiate from the point of impact of a localized blow delivered to the head, while in the latter they may result from such an injury as a fall from a

height on to the feet, causing fracture of the base. The fractures occur at or near to the site of maximum impact, and, while it is not intended to discuss in detail the mechanism of production of fractures, some reference may be made to the term "contrecoup," which every student seems to remember. It is about as unreasonable to assume that a blow delivered to one part of the skull will fracture the diametrically opposite part as it is to expect that when we tap one end of an egg with a spoon the other end will crack. It is important to remember, however, that gross damage to the brain may occur by contrecoup, and I have several times noted extensive cerebral contusion at a point on the surface of the brain diametrically opposite the point on the skull at which the blow had been delivered and at which fracture may have taken place.

Skull fractures may conveniently be grouped into those of the base and those of the vault, since there are certain characteristics and indications for treatment that apply to each group. Many fractures, however, involve both vault and base—for example, those running through the squamous temporal bone into the floor of the middle fossa.

Fractures of the Base

The importance of fractures of the base lies in the fact that these are usually the outcome of a degree of violence which has produced much damage to the brain. Sir Astley Cooper held that fractures of the base were invariably fatal, but we now know that many cases recover. These fractures are often compound either into the nose or into the tympanic cavity, and owing to the close attachment of the dura mater over the skull base this membrane is lacerated and with it the arachnoid, so that occasionally blood and cerebrospinal fluid escape from the nose or the external auditory meatus. The clinical picture is usually that of the accompanying contusion and laceration of the brain, and treatment (which will be detailed next week in a paper on concussion and compression) must be directed to such. Owing to anatomical considerations local treatment for the majority of these compound fractures cannot be complete. Our object again, however, must be to protect the patient from infection, so far as possible, by keeping the nasal cavities or the external auditory meatus clean with pledgets of wool well wrung out of dilute phenol solution (1 in 200) and by administering 10 grains of hexamine by the mouth three times a day. This substance enters the cerebrospinal fluid, and in the presence of acid-forming organisms is decomposed, yielding formaldehyde, which is inimical to them.

Fractures of the Vault

These fractures may be simple or compound, linear or comminuted; they may be complicated either by being depressed or through fragments being driven into the meninges or the brain itself.

Compound Fractures of the Vault

Like compound fractures elsewhere in the body, these require urgent treatment with the object of preventing or at least minimizing the ravages of infection. They should therefore be operated upon as soon as possible and a surgical toilet of the wound effected. This involves the excision of damaged tissue and the exploration of the fracture, for which purpose the bone must be opened at the fracture site, if necessary by using a perforator and burr or a small trephine. If the dura is undamaged and clean, removal of bone need not proceed beyond this, but

if debris and foreign bodies are found within the skull and if dura and brain have been torn and contused a wider removal of bone is necessary, with further excision of damaged tissue. Hot saline should be used throughout, and bleeding vessels under-run with fine catgut passed on a small curved needle or secured with silver clips. Drainage of the wound by small rubber or glass tubes is then instituted and the scalp wound closed with interrupted silkworm-gut sutures. As a rule the drains may be removed at the end of forty-eight hours and the scalp sutures on the eighth day.

It is important to open up and explore the fracture, because otherwise it cannot be ascertained how much, if any, damage has been done to the brain and its meninges at the site of fracture. Sometimes a surprising amount of road dirt is found within the skull, lying beneath the crack in the bone. This dirt has been left in the skull, which has burst open on striking the road and, as it closed, retained some of the material with which it has been in contact. Fragments of bone are sometimes deeply driven into the brain, and these require carefully removing with sequester forceps. A suction apparatus is useful in assisting the removal of intracerebral foreign bodies. In all cases of compound fractures of the vault and in grossly contaminated scalp wounds 1,000 international units of antitetanus serum should be given intramuscularly, whatever the age of the patient.

Gunshot Wounds

The principles underlying the treatment of gunshot wounds of the scalp and skull are similar to those which we have considered in the case of the more common lesions produced by street accidents and blows. Treatment for gunshot injuries is along lines similar to those already discussed. The removal of a bullet, a piece of shrapnel, or a number of shot may be difficult if the foreign body is deeply placed and not at first readily accessible, and rather than inflict undue damage on cerebral structures it may on rare occasions be advisable to leave it in place.

Depressed Fractures

All depressed fractures should be elevated, but if these are simple fractures there is rarely any indication for urgency; time may therefore be chosen when the patient's condition permits intervention. The area of depression is exposed by an appropriate scalp incision and the fragments levered into place: this may require a small opening in the bone, and the dura should be inspected for evidence of damage. Some textbooks state that certain depressed fractures may be left unraised; but in order to safeguard the patient from possibly unpleasant results that may follow it is inadvisable to leave his intracranial space diminished through encroachment by the depressed fragments, and the restoration of the contour of the skull is desirable. The wound made for the purpose of elevating the fragments when the fracture is a simple one should be closed in layers, using fine interrupted silk sutures for the epicranial aponeurosis and waxed thread or fine silkworm-gut for the skin.

Haematoma of the Scalp

A haematoma forms readily in the scalp but rarely requires any active treatment, the effused blood absorbing in the course of time; but because the central soft fluid part of the haematoma when palpated gives to the examining finger a sense of subsidence here, a depressed fracture is sometimes diagnosed. As a rule when there is any doubt a depressed fracture is not present.

Importance of Radiography

All cases of head injury should be radiographed (Rogers, 1933), when possible. Clinical examination alone may fail to find a depressed fracture, especially if this is in the temporal fossa, beneath the temporal fascia rendered tense by blood-clot. To reveal such a fracture a series of plates may be required, with a different degree of rotation of the skull shown on each. Fractures must be differentiated from the grooves for the meningeal vessels. These grooves are sometimes abnormally deep and well developed. Their position will usually serve for recognition, since linear fractures tend to be horizontal rather than vertical.

Anaesthesia

Provided it is not introduced by passing the needle through infected tissue, thereby risking the spread of infection, local analgesia may be used, the whole operation site being surrounded by an area infiltrated with procaine hydrochloride (1 per cent.) or novocain (1 per cent.) to which adrenaline ($m\text{ vij ad } 3j$) has been added. As much as 200 c.cm. or more of this solution may be used without ill effects.

When the patient is quiet and unconscious no anaesthetic whatever is needed, while if he is irritable and restless it is usually advisable to employ general anaesthesia; and if the services of an expert anaesthetist are available, nitrous oxide, oxygen, and chloroform form a useful combination. Ether may be used; but some cases of head injury are found to require a great deal, and it has the disadvantage of raising the cerebrospinal fluid pressure and of increasing the possibility of post-operative bronchitis or bronchopneumonia.

Illustrative Cases

The following examples serve to illustrate some of the principles of treatment which have been considered:

Case 1.—A saw-mill hand, aged 34, was in a stooping position in the pit below a circular saw and in the act of securing a spanner which had fallen into the pit. As he raised his head the saw began to revolve, ploughing through the scalp and skull in a sagittal direction. The engine was stopped at once, and he was taken from the pit unconscious and bleeding profusely from the wound. He soon regained consciousness and was attended by a doctor, who inserted a series of horsehair sutures to arrest the bleeding and sent him to hospital. By the time he arrived he was able to walk unassisted. Examination revealed a lacerated wound, six inches in length, just to the right of, and parallel to, the superior longitudinal sinus. Under nitrous-oxide-oxygen anaesthesia (7 hours 45 minutes after the accident) the scalp was shaved, the horsehair sutures removed, and the wound freely opened up. Both tables of the skull had been divided. Bone was taken away, and it was found that both dura and brain had also been damaged. The lacerated edges of the dura were excised and some bruised cortex was removed. The wound was closed and drained by three small Kocher's glass drainage tubes. Convalescence was uninterrupted, and the wound healed by first intention.

Case 2.—A horsewoman aged 19 was thrown on to the occiput and sustained a contused wound which penetrated the subaponeurotic space. She was put to bed and was attended by her doctor. Five days after the accident the wound edges were inflamed, the scalp and upper part of the face oedematous, and the skin of the frontal region reddened. There were some enlarged tender glands near the apices of both posterior triangles. She was admitted to hospital as an emergency case, and lumbar puncture performed. The cerebrospinal fluid was clear and as yet uninfected. Under ether

anaesthesia the wound edges were excised and multiple drains of fluted rubber placed into the subaponeurotic space. Suppuration was free, but the oedema gradually subsided and healing took place without intracranial complications. This patient's recovery was fortunate. The wound should have been excised in the first place; surgical aid was sought only when infection had supervened.

Case 3.—A golfer aged 26 was accidentally struck on the left side of the head with the driving club of a fellow golfer. He fell unconscious and was brought to hospital, where a wound 1 cm. in length was apparent in the left temporal region. The edges of the wound were slightly swollen and there was a trickle of blood from it. By this time the patient had recovered consciousness, but was drowsy. When the wound was probed a fracture could be felt, and some flecks of brain came away when the probe was withdrawn. Under ether anaesthesia a scalp flap was reflected and a compound comminuted fracture exposed just posterior to the pterion. A piece of inner table was seen to be driven into the brain. This was removed and haemorrhage from some torn cortical vessels controlled by the application of a piece of temporal muscle. Damaged tissue was excised, and the wound closed after placing a glove drain in its posterior angle. Recovery was complete and uncomplicated.

REFERENCES

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A STUDY OF MENTAL DEFECT

REPORT BY DR. PENROSE

At least two important and extensive researches in regard to mental deficiency have been conducted in England over the last few years. One of these, under the auspices of the Burden Trust, with Professor R. J. A. Berry and Dr. J. A. Fraser Roberts as chief investigators, has been based upon Stoke Park Colony, Bristol, and on the child population of the city of Bath. The other, under the auspices of the Darwin Trust and the Medical Research Council, has been based upon the Royal Eastern Counties Institution at Colchester, and, with the encouragement and help of Dr. J. Douglas Turner, the medical superintendent, has been conducted by Dr. L. S. Penrose, in charge of the research department of that institution. Each of these researches has been productive of valuable interim or incidental publications dealing with certain aspects of the work, and their final reports have been anticipated with much interest. That of the Burden Trust has not yet been issued, though an interim note on the work appeared last autumn.¹ The Medical Research Council has now published "A Clinical and Genetic Study of 1,280 Cases of Mental Defect,"² by Dr. Penrose. It is a report of great value.

The investigation which the report describes was both extensive and prolonged. The scheme of research was planned as long ago as 1930 with the object of increasing knowledge on the causation of mental defect. About the same time the Council of the British Medical Association set up a special Committee on Mental Deficiency, which issued an informative report in 1932. In an appendix to Dr. Penrose's report reference is made to more than fifty publications on the subject during the past eight years, in addition to twenty-nine coming from his own research department; and this list is by no means exhaustive even

¹ *British Medical Journal*, November 13, 1937, p. 973.

² Medical Research Council Special Report Series, No. 229. H.M. Stationery Office. (2s. 6d. net.)