the scalp it was discovered that normal brain pulsation had returned at the opening in the skull. He slept nicely all night—quite a contrast to the moaning and tossing of two or three previous nights of insomnia for which sulfonal and morphin (gr. $\frac{1}{4}$) had given no relief. At 9 A.M. next day he appeared much brighter and nodded and smiled when asked if he felt better; the headache was gone; considerable motion in foot was obtainable upon requesting him to move. Improvement continued from that time on—the temperature being normal, and primary union being obtained. He sat up on the fifth day and on the twentieth day after operation rode more than two hundred miles. The subsequent history is one of restoration to health with ability to walk and care for himself; but the use of the hand has never been regained, nor has his speech.

From the fact that this patient seemed almost *in articulo mortis*, I am satisfied that the operation saved his life and probably had much to do in preventing permanent paralysis of the leg. Sometimes it is possible to give some relief even after a considerable time has elapsed, as is shown in a case almost precisely similar to the one just mentioned, the interesting features of which I will relate:

Case 3.—I. M., of Oklahoma, age 54, came under my care in June, 1892, affected by complete hemiplegia and aphasia due to a cerebral hemorrhage which occurred more than three months before. He complained of much headache upon the left side, insomnia, and general ill health; at times homicidal and suicidal tendencies had been noted following periods of sleeplessness and great irritability. I sent him to the hospital and with the assistance of Drs. T. B. Thrush and J. C. Maxson operated. I removed three one-inch buttons over the leg, arm and speech centers, and joined these openings with bone forceps, placing the fragments in hot bichlorid solution, 1 to 4000. On opening the dura no evidence of hemorrhage was to be seen except a white infiltrate over the speech and lower part of the arm centers. Believing there had been a rupture of the lenticulo-striate artery I cut through the brain to the region of the internal capsule. A large quantity of broken-down brain substance immediately oozed out; so I extended the incision upward and introduced my finger into the cavity, removing two fragments of the clot, each about an inch in length, together with a lot of *débris*. I then irrigated the cavity with sterilized normal salt solution, established drainage with several strands of catgut, stitched the dura and replaced the pieces of skull in a kind of mosaic, carefully suturing the scalp and applying a gauze compress so as to hold them in place; with the usual dressings.

Convalescence was speedy and uneventful. For three days there was a little fever (100 degrees F.) and no improvement was to be seen. But at the end of that time the temperature became normal, all the distressing head symptoms disappeared and then motion began to return slowly in the affected side. In a few weeks the patient was walking around by the aid of a cane with but little difficulty. Motor power has never returned in the hand, but the arm and forearm now have some motion. Speech was not restored. The bladder irritation and obstinate constipation—so prominent before the operation—entirely vanished, the mental symptoms never recurred and the patient regards himself as vastly improved.

The only case upon which I have operated which comes under my third rule was this:

Case 4.—J. P. E., male, age 52, a patient of Dr. Kistler, of Kansas City, I first saw at 4 P.M., on March 31, 1893. I found a hemiplegia of the left side which came on thirty-two hours before, while he was straining at stool; for some hours previously he had complained of vertigo, and had mentioned a "bad feeling" in the head and a heaviness of the left hand and foot two days before, at which time he went to bed with some vomiting—asccribed to biliousness, and for which a cathartic was administered; from this came the straining which caused the bleeding. He had a temperature of 100 degrees F. His mind was not much affected until more than twenty-four hours after the attack, but for eight hours there had been wild delirium and at the time of examination he suddenly became comatose. A severe convulsion would occasionally appear upon the paralyzed side, from which I expected to find a hemorrhage just beneath the membranes. I therefore ordered him to be carried to the German Hospital.

At 9 P.M., coma was complete, so without any anesthetic I opened the scalp and removed a piece of skull two inches by four inches over the motor area. The dura was very tense and pulseless and upon cutting the dura the brain protruded prominently into the opening; at which relief of pressure the patient began to show such signs of returning consciousness as to require a little chloroform. There were no surface indications of hemorrhage, so I cut inward through the parietal convolutions until the greatly distended ventricle was reached. Here there was a large quantity of semi-fluid blood, and broken-down brain tissue, which I removed as gently as possible and then irrigated with hot normal salt solution. As oozing into the ventricle continued persistently a little iodoform gauze was gently packed in the wound and the ventricle and allowed to protrude through the dura. Bulging of the brain was far less marked and after the dura was sutured around the gauze packing, cerebral pulsation was found to have returned. The usual dressings were applied.

At 10 A.M., April 1 the patient died—the attending physician said from "shock." Owing to my departure from the city no autopsy was held, so the source of hemorrhage was never determined.¹

ORIGINAL ARTICLES.

SEVEN CASES OF CEREBRAL SURGERY.

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Believing that cerebral lesions not accompanied by fracture or even trauma represent a large proportion of the cerebral cases requiring relief at the hands of the surgeon, I present the following cases in support of that view:

Case 1.—May 9, 1891, was called to see L. G., age 5 years, who had four days previously sustained an injury by falling fifteen and one-half feet, striking her head on a plank sidewalk. No evidence of fracture of the skull was found at that time or subsequently. She slept eighteen hours in twenty-four, temperature 99.5, pulse 72. Sensation and muscular coordination normal. Appetite was good and bowels regular. Slight mental hebetude. Right side of head and face greatly swollen and discolored. Extravasation of blood under the ocular and palpebral conjunctiva. Left pupil responded to light readily. Swelling prevented inspection of the right pupil. A small swelling was found to the left and slightly behind the bregma.

Diagnosis, intracranial clot. Operation was made as soon as possible, the small swelling to the left of the bregma was cut down upon and a clot turned out

¹ I believe this man would have been saved if the operation had been made a few hours earlier, before the blood broke into the ventricles. That my patient died is no objection to the rule I have given, as a number of cases of progressive hemorrhage have been treated surgically by other operators with brilliant results.

which had formed between the bone and pericranium. Removal of a small disc from the center of this pericranial denudation brought another clot into view, which had formed over the anterior branch of the middle meningeal artery between the dura and anterior border of the parietal bone. Recovery was complete in two weeks without event.

Case 2.—C. B., age 71 years was struck Feb. 22, 1892, by the limb of a tree weighing eighty-five pounds which had fallen forty feet. The blow was received slightly to the right of the median line and in front of the fronto-parietal suture. The scalp wound indicated that the blow glanced slightly backward. I did not see the patient for several days after the injury, at which time the scalp wound had healed. Muscular incoördination marked and memory *nil*. Left patellar tendon reflex was abolished. Owing to dangerous cerebral compression symptoms, and noting no improvement in his mental condition on March 10, 1892, I trephined his right parietal bone beginning at the posterior part of the old scalp wound and extending backward three inches. On opening the dura a large amount of subarachnoid fluid was discharged. No clot was found. There was no laceration of cerebral tissue but arterial and especially venous engorgement was marked. Recovery took place without incident and was complete in three weeks. This patient was entirely relieved from former severe headaches which had occurred every two weeks for many years.

Case 3.—Jan. 18, 1893, I was requested to be present at an autopsy made by Dr. Kinnaman on J. T., aged 9 years, colored, who had died suddenly at his home under suspicious circumstances. Removal of the scalp showed contusion of its under surface, one and one-half inches in diameter, behind the fronto-parietal suture and to the left of the bregma. Removal of the skull cap showed an immense blood clot which extended from vertex to base and covered almost the entire left hemisphere of the cerebrum. The cause was evidently a blow on the vertex at the site of the scalp contusion and probably produced almost instant death. The skull in this case was very thin and possessed great elasticity. No fracture of the skull.

Case 4.—This case I place here out of order in point of time because it is traumatic in origin. Oct. 10, 1895, Peter V., aged 9 years was brought to me with a history of injury received in September, 1894, while in a wagon drawn by a badly frightened horse in a runaway. The nose was broken and driven backward and when I saw the case four months after injury, I found a scar crossing the nose at lower end of nasal bones, well out upon the left cheek, and about an inch to the left of the median line a small sinus discharged pus in considerable quantities. Pus was also being freely discharged from both the lachrymal sacs. The parents said that his nose though raised considerably at the primary dressing, was not its usual height. He was unconscious twenty-four hours after the injury, then appeared to recover completely save the discharge of pus previously mentioned which had been continuous since three weeks following the injury. Within four weeks he begun vomiting in the morning about 4 o'clock and then vomiting occurred at irregular intervals during the day up to the present. Parents noticed that for the past month he has not been as bright intellectually as normal, could not say some words he formerly spoke well, did

not see well, could not grasp anything firmly with the right hand and dragged the right foot. Would fall if he was not steadied when he attempted to walk. Pupils responded pretty well to light but a little sluggishly; convergence was impossible. Eye movements otherwise normal. Temperature normal, pulse 70. Diagnosed cerebral traumatism, with secondary degenerative changes in the left frontal lobe extending well backward near the middle line and towards Brocha's convolution. Trephined the left supra-orbital region. The pulsating dura bulged strongly into the opening. All the membranes were adherent from former inflammatory changes and the cerebral tissue greatly softened. With a cataract knife and small trocar I explored the major part of the anterior left frontal lobe, but found no fluid accumulation of any kind. Some broken-down cerebral tissue was removed, one-half inch opening was left in the dura and large gauze drain introduced. I could find no fracture of the horizontal plate of the frontal bone. Drainage was maintained for three weeks and at least calculation three drachms of broken-down cerebral tissue and old clot was discharged. Improvement in his mental condition was prompt, soon appeared normal, and he was able to speak any word that he had formerly known. He was able to walk without aid of any kind within one week after the operation. Great swelling occurred of the palpebral tissues with eversion of the conjunctiva. At the end of the second week tears were discharged at the old drainage points in the forehead but are now closed. Though the wound was dressed daily no suppuration has taken place.

It is too soon to make a positive declaration of the results in this case. The remnant of an old blood clot which seemed to be the basis of the bond of union between the membranes was almost certainly produced by the original injury, and forces one to the conclusion that early operation would almost surely have saved this boy much of the danger through which he has passed with better prospect of perfect recovery. In each of these cases there was no fracture, and the ages were from 5 to 71 years, yet in each there was a serious if not a fatal lesion. The only rational treatment must be that of removal of the products of trauma, whether that be blood clots, increased accumulations of cerebro-spinal fluid, abscess, or devitalized cerebral tissue. By early operation we may hope to give the damaged brain a chance of restoration by improvement in its circulatory possibilities before permanent impairment of function, paresis, paralysis, epilepsy, idiocy or death of the individual. In Case 3 death was probably instantaneous. In Cases 1 and 2 operated upon, one in four days, the other three weeks, recovery was perfect.

We have no hesitation in saying that all cases of cerebral trauma not accompanied by fracture in which symptoms of compression, dangerous, pronounced and persistent motor or mental disturbance

occur should be operated upon. No age is exempt from traumatic intracranial lesions without fracture, as is shown by my three cases in children and one in a man of 71, as well as a case reported to me by Dr. Gaston of a man 50 years of age who received a blow on the occiput which produced rupture of the middle meningeal artery under the anterior part of the parietal bone which was fatal from secondary inflammatory trouble about the clot. No fracture. The site of the application of the trauma or the course of the branches of the middle meningeal artery will indicate the points to be explored in the absence of localization symptoms. We can see the necessity for a guarded prognosis and can not pronounce our patients positively well till the lapse of many weeks or months, and should keep them under observation so as to detect the first evidence of danger.

Case 5.—E. B., age 36. Epileptic since 14 years of age. Memory and general intelligence greatly impaired. Nystagmus pronounced. General health good. Paretic on left side from infancy, with very little use of the left hand and drags the left foot. Convulsions started in the left side to which they were confined until they became general ten years ago. No history of injury or marked asymmetry of the skull. Jan. 14, 1894, I removed three inches of bone over the fissure of Rolando, and identified the arm and leg centers with brain electrode. Convulsions were defective in development, pale, and widely separated by broad and shallow sulci. Recovery was prompt and apparently complete in two weeks and the relatives thought they noted marked mental improvement but that is to be taken with considerable allowance. He contracted double pneumonia from which he died at the end of one month from the operation. This case was operated upon in the hope that it might lessen the frequency and mitigate the severity of his epileptic attacks and thus, if possible, save what intellect he had.

Case 6.—W. W., age 38. Steamboat raftsmen. Well and exceptionally strong till Oct. 18, 1893, at which time he became suddenly and completely paralyzed in the left arm and leg. He was infected with syphilis eighteen months previously. April 14, 1894, six months after the onset of the paralysis, I diagnosed the cause of the paralysis to be embolic obstruction of the ascending parietal and frontal arteries to the motor area of the right side, and removed three and one-half square inches of bone along the fissure of Rolando. Brain was anemic, pulseless, did not bulge into the opening, and no muscular response could be obtained by the electrodes beyond a general tremor. No abnormal resistance could be detected. Recovery was complete from the operation in three weeks and at the end of six weeks he was able to walk by the aid of a chair, but the gain that was at first promised in the arm was not maintained. His skull was scant one-half inch thick and composed almost entirely of dense compact tissue. He left the city at the end of seven weeks but returned in October, 1894. Nov. 17, 1894, I did a secondary operation on him before the Eastern Iowa District Medical Society, in which I nearly doubled the space from which the bone was removed, being mainly extensions backward from the upper, and forward from the lower end of the Rolandic fissure. Improvement following the secondary operation has not been as marked as that following the first one, and is probably due largely to the lapse of time since the primary lesion and

teaches us another lesson in promptness. He can now walk by the aid of a cane.

This case would seem to indicate that reduction of the cerebral tension to below normal by removal of bone and establishment of drainage, may bring about considerable restoration of function in portions of brain supposed to be damaged beyond the possibility of repair, from embolic obstruction of a terminal artery. At the secondary operation in this case, I learned that the edges of the old opening were beautifully beveled, equally from the outer and inner tables, and that the pericranium and dura were blended to the opposite side, so that the actual gain in cerebral space is represented by one-half the thickness of the bone, less the normal convexity of the part, for the membrane will pass directly across from the bony attachment at one side to that of the other, if it is not carried outward by intracranial pressure. From this, it will be seen that the gain in cerebral space, by removal of the skull, will be relatively greater with a small opening. In this case it was nearly one-fourth inch, for the thickness of the skull was scant one-half inch. This relief of tension may also enable neighboring parts of the brain to take up part of the work of a destroyed or crippled center, as is the case where a center is excised.

Case 7.—Nellie P., age 5 years. Was well until after a fall at the age of 1 year, at which time she could walk and talk some. Following this fall she had nine convulsions in three weeks. Three weeks later she had spasmodic contractions of the entire left side for twelve hours, followed by complete paralysis of the left arm and leg. Twenty days later she had an intense fever accompanied by general convulsions for eight hours, closing with movements only of the left side. She has never spoken since the attack and could not walk again until one year ago. Drags the left leg and does not use the left arm. Now has frequent general epileptic seizures and is idiotic. May 23 did right-sided craniectomy and removed three inches of bone over the fissure of Rolando. Found defective development of the cerebral convolutions. There was no asymmetry of the skull and no evidence of fracture. Though I am convinced that this patient sustained a cerebral injury from the early fall, which prompt and intelligent surgery might have readily recognized and removed, the time for such procedures had gone by. She took the anesthetic badly and died in eight hours.

Early signs of collapse in this case prevented application of electrical tests for the motor centers, and the ultimate result has not lessened my skepticism regarding the justifiability of craniectomy operations in cases of idiocy, even if due to traumatism when there is no asymmetry of the skull, and the history of injury dates back to early life and has been of several years' standing. In the adult we can hardly expect marked improvement in motor disturbances after the lapse of one year with or without operation. In Case 6, paralysis of the arm occurred twelve hours before that of the leg, and would indicate that the ascending frontal and parietal arteries arise by a common trunk from the middle cerebral; the ascending frontal was first plugged and the embolism, probably specific in origin, developed backward so as to involve the ascending parietal in twelve hours and thus produce complete paralysis of the motor area of the opposite side.