Recurrent and multiple suture closures after craniectomy for craniosynostosis

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Six cases of craniosynostosis are reported in which recurrent and multiple closure of cranial sutures occurred after craniectomy and insertion of polyethylene film. In all patients there was closure of a second and sometimes a third suture as well as reclosure of the treated suture. In four children the second operations were done before the age of 18 months; none had increased intracranial pressure preoperatively and three who are living have normal intelligence. In two children, the second operations were not done until after the age of 3 years; both had increased intracranial pressure preoperatively, and both are now mentally retarded.

Key Words: craniosynostosis • craniectomy • sagittal suture closure • coronal suture closure

One aspect of craniosynostosis that has not been investigated in depth is closure of multiple sutures in patients who had previously been operated on for a single closed suture. In 1948, Ingraham, et al., reviewed 50 cases of craniosynostosis; three of these involved secondary multiple suture closures, an incidence of 6%. In 1965, Anderson and Geiger reported an incidence of 2.3% in 204 cases; all five of their patients were less than 18 months old when the second suture closed.

In a review of 178 cases of craniosynostosis seen at the North Carolina Baptist Hospital from 1949 through 1971, we found six cases of secondary suture closure, an incidence of 3.3%. Our experience with these six cases is the subject of this report.

Method

Craniectomy for premature closure of multiple sutures is done in two stages 2 to 4 weeks apart; the technique is illustrated in Fig. 1. The obliterated or fused sutures are excised and the craniectomy edges lined with polyethylene film. Since the osteoblasts in the dura mater are not destroyed, bone formation will continue to occur rapidly. Adherence of the new bone to the surrounding bone will be retarded, but not permanently prevented, by the polyethylene film. Since the new bone is thinner than the surrounding skull, it will be forced outward by brain growth if other cranial sutures become fused. Some authors recommend applying Zenker's solution to the dura mater to destroy the osteoblasts.
Case Reports

Case 1

This 3-month-old boy suffered sagittal craniosynostosis (Fig. 2), and had a head circumference of 41 cm. Sagittal craniectomy was performed. When the patient was 15 months old, skull films revealed that all the cranial sutures had now closed (Fig. 3). The opening spinal fluid pressure on lumbar puncture was 122 mm H₂O. Head circumference was 43 cm. Sagittal, coronal, and lambdoidal craniectomies were performed in two stages, 1 month apart. When he was 18 months old, the patient’s head circumference was 47 cm, and he was walking well but saying only a few words.

Case 2

This little girl was first seen at the age of 12 months because of coronal craniosynostosis and multiple other bone abnormalities. The head circumference was 42 cm; there was no evidence of increased intracranial pressure. By the time she was 32 months old her coronal, sagittal, and lambdoidal sutures were all closed; her head circumference was 43 cm and she now had papilledema. Psychometric testing revealed a Binet score of 50. On roentgenograms, the skull had a beaten-silver appearance and the sella turcica was shown to be eroded. Coronal, sagittal, and lambdoidal craniectomies were done in two stages.

Five years later the head circumference was 48 cm, the sutures were open, and the sella turcica appeared normal. There was no papilledema. The clinical observation indicated that the patient was retarded but no formal psychological testing had been done since she was 32 months old.

Case 3

This baby girl was seen at the age of 7 days because of coronal craniosynostosis. The head circumference was 36 cm. Coronal craniectomy was done the next day. Nine weeks later the coronal suture had reclosed, and the head circumference was 43 cm. Another coronal craniectomy was done. The child did well clinically, but a skull film taken when she was 10 months old showed that all the cranial sutures had now closed; the head circumference had not increased. Sagittal, coronal, and lambdoidal craniectomies were then performed in two stages. Six months
Recurrence of craniosynostosis

later all of the sutures had reclosed. The head circumference was now 45 cm and there was no evidence of increased intracranial pressure. When seen at the age of 9 years, the child had a head circumference of 48 cm; a lumbar puncture revealed an opening pressure of 112 mm H₂O. She was in advanced classes in grammar school.

Fig. 2. Case 1. Anteroposterior (left) and lateral (right) skull films at 3 months showing sagittal craniosynostosis and patent coronal sutures.

Fig. 3. Case 1. Anteroposterior (left) and lateral (right) skull films at 15 months showing refusion of sagittal suture and primary fusion of all other sutures. Note also the beaten-silver appearance of the skull and the elevated portion of new bone over the sagittal suture.
Case 4

This boy was seen at the age of 9 weeks because of coronal craniosynostosis; the head circumference was 36 cm. A coronal craniectomy was done. He did well postoperatively but was slow to walk and talk. By the time he was 22 months old his coronal suture had reclosed and his head circumference was 44 cm. When the patient was 4 years old, skull films showed a beaten-silver appearance and all sutures were closed. The head circumference was 47 cm and he now had papilledema with an opening lumbar puncture pressure of 340 mm H$_2$O. His Binet intelligence test score was 80. Coronal and sagittal craniectomies were done in two stages. At the age of 5 years, his head circumference was 48 cm; he had no papilledema and the sutures were patent.

Case 5

This baby boy was seen at the age of 10 days because of coronal craniosynostosis. His head circumference was not recorded. A coronal craniectomy was performed; however, a skull film taken later when he was 2 months old showed that the lambdoidal suture had closed. A lambdoidal craniectomy was done and the child did well and developed normally. When he was 9 months old, his head circumference was 45 cm. Roentgenograms taken at that time showed that the coronal and sagittal sutures were closed. Coronal and sagittal craniectomies were done in two stages. Postoperatively, he did well and developed normally, but at the age of 3 years there was roentgenographic evidence that all cranial sutures had once more closed. The head circumference was then 53 cm but there was no evidence of increased intracranial pressure. No further craniectomies were done. He was last seen at 5 years of age and was continuing to develop normally.

Case 6

This baby boy was seen when 3 days old because of sagittal craniosynostosis. The head circumference was 36.5 cm. Following sagittal craniectomy he did well. When he was 5 months old, there was roentgenographic evidence that the sagittal, coronal, and lambdoidal sutures had all closed; the skull now had a beaten-silver appearance, and the head circumference was 43.5 cm. Cranietomies of these sutures were done in two stages. The child again did well until 7 months later when skull films showed signs that again the sagittal and coronal sutures were fused. At the start of the craniectomy for these sutures, the child died from a complication related to the anesthesia.

Analysis of Cases

In all six patients there was not only closure of a second and sometimes a third suture, but there was also reclosure of the suture treated initially. The inherent hazards of multiple suture closure include increased intracranial pressure and restriction of brain growth during a phase of its growth that is normally rapid. Four of the children had a two-stage craniectomy for closure of a second or multiple sutures before the age of 18 months. None of these had increased intracranial pressure and the three who are living have normal intelligence. The other two children had two-stage craniectomies for recurrent or multiple suture closures after the age of 3 years. Preoperatively, both had papilledema, elevated cerebrospinal fluid pressure, and digital markings on the skull. Both are now mentally retarded.

Only two patients had a head circumference below the tenth percentile for their age. One is retarded and the other has normal intelligence.

Only one child had a second two-stage craniectomy for closure of a second or multiple sutures. This child died during the operation.

Discussion

Treatment of closure of multiple sutures is based on the fact that skull growth during the first 2 years of life occurs at the suture lines and is influenced by brain growth. Brain weight increased 50% by the age of 2 months, 100% at 6 months, and 200% at 10 months. If the initially treated suture recloses, and a second or third suture also closes during the accelerated phase of brain growth, that growth will be restricted and the intracranial pressure may increase.

Cranietomy for premature closure of multiple cranial sutures is indicated if the infant is less than 18 months old or if he has increased intracranial pressure regardless of age.
Recurrence of craniosynostosis

Postoperatively the patient should be followed clinically and radiographically as an outpatient every 2 months during the first year of life and every 6 months thereafter until he is 6 years old. Recurrent or delayed multiple suture closure may be insidious, and the clinical and radiographic evidence of increased intracranial pressure subtle.

The results are not apt to be good if intracranial pressure is increased when craniectomy is done, or if the operation is delayed until after the child is 18 months old. Alexander, et al., have studied the degree of skull expansion after craniectomy at various ages. Craniectomy done at 7 days of age will produce a 6-cm expansion of the craniectomy edges, at 3 months a 4-cm expansion, and at 6 months a 3-cm expansion. Craniectomy done at 12 months of age will produce little or no expansion.

References

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