CRANIOSTENOSIS
WITH NOTES ON A MODIFIED OPERATION FOR THE BRACHYCEPHALIC FORM
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CRANIOSTENOSIS is the premature synostosis of two or more membranous bones of the cranial vault. Although normally the sutures are apparently closed at the end of the first year because the serrated margins become interlocked, the x-ray examination reveals that the bones are not actually fused. During this period, growth of the skull is feasible because of the existence of the suture spaces. Later the skull growth is only by periosteal apposition and resorption, just as in basal synchondrosis. Ordinarily the brain doubles its weight in the first 7 months of life and triples its weight in 2½ years, completing 80 per cent of its entire growth in the first 3 years of life. For this reason craniostenosis has practical importance when it occurs during the intra-uterine period or first year of life.

Based on anatomical and clinical facts we have suggested the following classification:

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\begin{array}{c}
\text{Incomplete} \\
\text{Complete}
\end{array}
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\begin{array}{c}
\text{Scaphocephaly} \\
\text{Brachycephaly} \\
\text{Oxycephaly}
\end{array}
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\[
\begin{array}{c}
\text{Compensated} \\
\text{Decompensated}
\end{array}
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Premature closure of the sagittal suture results in a long narrow skull (scaphocephaly) and early synostosis of the coronal suture develops a broad, short and high skull (brachycephaly). When premature synostosis affects practically all the sutures the result is a high peaked skull (oxycephaly).

Other changes in the skull may also appear. The anterior fossa becomes short, with its floor oblique, and the orbit becomes shallow, with prominence of the eyes.

Craniostenosis is compensated when a compensatory growth of the skull occurs at the open sutures. Since this is the only evidence of this condition, a markedly abnormal shape of the head results which must be corroborated by the roentgenologic findings. Craniostenosis is decompensated when the

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patient develops chronic increased intracranial pressure, as evidenced by headache, vomiting, mental deterioration and convulsive seizures. Papilledema and optic atrophy with blindness may occur. In these cases an air injection is advisable to rule out a tumor or some other intracranial lesion.

OPERATIVE PROCEDURES

The first attempts at surgical treatment of craniostenosis were made by Krause in Berlin and Eiselsberg in Vienna, performing subtemporal decompression in some cases of decompensated craniostenosis as a palliative measure for relieving the increased intracranial pressure.

The first surgical treatment with curative purposes was done by Lane on August 28, 1888. He removed a strip of bone an inch wide, extending from the anterior to the posterior fontanelle. Then he removed on each side sections of the remaining parietal bones, and as Lane described it, the space after resection resembled a cross, of which the arms were of equal length and breadth. The child (9 months old) lived 14 hours after operation. Death was attributed to the prostrating effect of the triple alcohol-chloroform-ether anesthesia used. A year later he performed the same operation on another infant in whom the space after resection resembled a letter H; the results were better—the child survived and showed some mental improvement. Unfortunately, the 2 patients operated on by Lane were imbecile infants with microcephaly, and consequently the procedure fell into disrepute.

More than 35 years elapsed until Faber and Towne adopted Lane's operation. By this time, as we will see later, it was used as a preventive measure in oxycephaly and allied conditions.

Subtemporal decompressions for oxycephaly were performed in Cushing's clinic at least as early as 1913. One of these patients whose end result is known was operated upon by one of us (G. H.) on July 3, 1916. This was a 9-year-old girl who had decompensated oxycephaly, with bilateral exophthalmos, papilledema and headaches. She has been relieved of her pressure symptoms for more than 20 years.

Operations for craniostenosis prior to 1924 were performed only as palliative measures after increased intracranial pressure had developed and the usual irreparable damage had occurred. Although Messmer, in 1921, advocated extirpation of synostosed sutures, the operation was never performed. It was not until 1924 that Faber and Towne advocated the revival of the Lane-Lannelongue operation to be performed sufficiently early in life to prevent the effects of premature synostosis. In June 1924, they performed a linear craniectomy in a child aged 9 months, who showed a rapidly progressing deformity of the skull due to synostosis of the sagittal and right coronal sutures, with signs of increasing intracranial pressure. Two channels of bone, 1 cm. wide, were removed by means of a transverse scalp incision. The first was longitudinal, extending from the coronal to the lambdoidal suture and to the right of the sagittal suture, and the second extending from one squamoparietal suture to the other, posterior to the coronal sutures.