MODERN APPROACHES TO THE DIAGNOSIS AND SURGICAL TREATMENT OF CRANIOSYNOSTOSIS

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Abstract: Craniosynostosis is a craniofacial anomaly that requires timely diagnosis and surgical intervention to optimize neurological and aesthetic outcomes. Over recent decades, advances in imaging, surgical techniques, and perioperative care have significantly improved patient prognosis. This article discusses current diagnostic strategies, surgical treatment options, and long-term outcomes in children with craniosynostosis.

Keywords: craniosynostosis, 3D CT, endoscopic suturectomy, cranial vault remodeling, distraction osteogenesis, helmet therapy, pediatric craniofacial surgery.

Introduction.

The management of craniosynostosis has evolved from traditional open cranial vault remodeling to minimally invasive endoscopic and distraction-based techniques. The primary goals of treatment are to normalize intracranial volume, correct skull shape, and prevent neurodevelopmental impairment. Multidisciplinary teams, including pediatric neurosurgeons, craniofacial surgeons, anesthesiologists, and geneticists, are essential for optimal care.

Diagnostic Methods.

Early diagnosis relies on careful clinical examination and anthropometric measurements of head circumference and cranial indices. Imaging techniques play a crucial role and include:

- Computed tomography (CT) with 3D reconstruction – the gold standard for confirming suture fusion.
- Magnetic resonance imaging (MRI) – to evaluate associated brain anomalies.
- Ultrasound of cranial sutures – useful in early infancy.

Genetic testing is recommended, particularly in suspected syndromic cases.

Surgical Treatment Options

The selection of surgical technique depends on the patient's age, type of synostosis, and severity of deformity.

1. Endoscopic-assisted suturectomy

   Performed in infants younger than 4–6 months, this minimally invasive approach involves removal of the fused suture through small incisions. Postoperative helmet therapy is required to guide skull reshaping.

2. Open cranial vault remodeling

This traditional technique involves extensive bone reshaping and fixation. It is typically performed after 6–9 months of age and allows immediate correction of severe deformities.

3. Distraction osteogenesis

This method uses gradual mechanical expansion of cranial bones through distractor devices. It is particularly useful in multisuture and syndromic craniosynostosis.

Perioperative Management

Modern anesthesia protocols, blood conservation strategies, and intensive care monitoring have significantly reduced perioperative morbidity and mortality. The use of tranexamic acid, controlled hypotension, and autologous blood transfusion techniques has improved surgical safety.

Outcomes and Prognosis

Long-term outcomes are generally favorable when surgery is performed early. Most children achieve normal or near-normal skull shape and intracranial volume. However, patients with syndromic craniosynostosis may require multiple surgeries and long-term developmental follow-up.

Neurocognitive outcomes depend on the type of synostosis, timing of intervention, and presence of associated anomalies.

Future Perspectives

Emerging technologies, including computer-assisted surgical planning, 3D-printed patient-specific implants, and molecular-targeted therapies, represent promising advances in the management of craniosynostosis.

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