Distraction osteogenesis

Distraction osteogenesis has been used to correct sagittal craniosynostosis in various ways.

Process of osteogenesis is followed at an outpatient clinic, and the expanders are removed 4 to 6 months later after confirming the sufficient ossification. An advantage of this procedure is that maximum skull expansion is possible with minimum regression after distraction osteogenesis in the long term. Limited craniotomy enables limited blood loss. The skin trouble caused by stretching can be avoided. No postoperative helmet is required. A disadvantage is that the procedure leaves a foreign body on the skull for several months and requires additional surgery for removal [1)].

Retrocoronal and prelambdoid craniotomies (Renier's "H" technique)

Originally devised by Dr. Renier which is currently used to treat children with scaphocephaly under 6 months of age at the Craniofacial Unit of Hopital Necker Enfants Malades (French National Referral Center for Faciocraniosynostosis) [2)].

Spring assisted surgery (SAS)

The level of evidence for SAS being an equally efficient surgical method as more extensive cranioplasties for SS is low or very low. The results point out the need for well-designed prospective studies within craniofacial surgery [3)].

Spring assisted cranioplasty and strip craniotomy with postoperative helmet usage are simple minimally invasive surgeries. However, these procedures are only useful in younger patients (generally up to 9 months of age); older children usually undergo total cranial remodeling, which is more stressful.

Sakamoto et al. developed a procedure combining morcellation craniotomy with distraction osteogenesis (MoD) [4)].

Case series

A study aimed at comparing the safety outcomes between conventional bicoronal and direct method in device removal after cranial distraction in the treatment of craniosynostosis. This was a retrospective cohort study of patients treated with distraction osteogenesis to expand intracranial volume in the anteroposterior direction. Preoperative patient demographics, distraction protocols, and perioperative outcomes (operative time, estimated blood loss, intraoperative fluid volume, lowest hematocrit during surgery, transfusion, hospital stay, drain, postoperative complication) were collected and analyzed with the independent samples t-test. Twenty-four patients were included in the study (15 in the conventional and 9 in the direct approach group). The mean duration of surgery and intraoperative fluid volume were significantly shorter (114.56 ± 36.91 min vs. 177.20 ± 47.00 min, $p = 0.003$) and less (241.88 ± 194.07 ml vs. 624.00 ± 524.92 ml, $p = 0.026$), respectively in the direct group than in the conventional. No patients were transfused intraoperatively and admitted to the intensive care unit (ICU) postoperatively in the direct group. The mean intraoperative and total transfusion volumes were significantly greater in the conventional group (p = 0.004, 0.045, respectively). There were no significant differences in other safety outcomes. No postoperative wound complications were reported. The findings of this study indicated that the direct approach for distraction device removal in children with craniosynostosis appears to be safer than the conventional approach owing to the reduced operation time, intraoperative transfusion requirements, and ICU stay [5).]

2017

Fifty-four patients with sagittal synostosis were recruited and assigned to one of three therapeutic groups: group 1, anteroposterior compression with bitemporal expansion (n = 35); group 2, bitemporal expansion (n = 9); and group 3, anteroposterior expansion with bitemporal expansion (n = 10). Distraction procedures were performed while maintaining dural attachment. Four indices-namely cranial index, head circumference, intracranial volume, and neurodevelopmental index (using the Bayley Scales of Infant Development II), were analyzed.

The preoperative cranial index of group 1 (68.51 ± 4.73) differed significantly from those of groups 2 (76.75 ± 2.4; p < 0.05) and 3 (86.8 ± 3.99; p < 0.05). Postoperative cranial index in all groups converged to the mesocephalic cranial index. Preoperative intracranial volume determinations were within the normal range for the majority of participants in groups 1 and 2; however, most fell below -1 SD in group 3 [n = 8 (80 percent)]. Postoperatively, 90 percent of group 3 participants had intracranial volume values within the normal range. The preoperative mental and psychomotor developmental indices of group 3 were significantly lower than those in the other two groups. The postoperative analysis showed significant improvement in these indices in groups 1 and 3 or when all patients were analyzed.

Symmetric sagittal synostosis can be effectively treated with distraction osteogenesis reformation guided by strategic categorization [6)].

2016

Gomi et al., report the results of clinical data of 36 children with craniosynostosis who underwent MCDO between 2005 and 2014 in our institute. This method has the following benefits, such as a high flexibility of reshaping, shorter treatment period and less invasive secondary intervention. We also discuss the other distraction osteogenesis techniques that are used to treat craniosynostosis and compare them with MCDO. The preferred procedure for correction of craniosynostosis may depend on the patient's age, the extent of deformity, and the extent of correction achievable by surgery. We can arrange the combinations of various methods according to the advantage and disadvantage of each technique [7)].

2015

Between June 2002 and May 2013, 32 patients with nonsyndromic sagittal synostosis who had undergone antero-posterior compression with bitemporal expansion were recruited. Circumferential baseline, mid-sagittal, and bicoronal craniotomies were performed in addition to four-quadrant bone flap procedures via distraction with dural attachment. CI, intracranial volume (ICV), head circumference (HC), and neurodevelopmental outcomes using the Bayley Scales of Infant

Development-II (BSID-II) scoring system were analyzed.

Dolichocephalic CI (68.85 ± 3.61) was altered to mesocephalic CI (78.28 ± 3.74) postoperatively. Preoperative ICV and HC determinations were within the normal range for the majority of participants (normal ICV 87.5%, n = 28; normal HC 75%, n = 24). ICV and HC did not show significant changes with postoperative measurements and were maintained within normal ranges. Regarding neurodevelopment, both the mental and psychomotor developmental indices (MDI, PDI) demonstrated significant improvement (MDI, 88.69 ± 17.38 to 96.23 ± 21.05; PDI, 91.38 ± 16.31 to 100 ± 11.51; $p < 0.05$).

Symmetric sagittal synostosis can be treated comprehensively through DO in combination with expansion and compression procedures. ICV and HC measurements were useful for designing surgical and postoperative distraction strategies. Achievement of mesocephalic CI and neurodevelopmental improvement validated morphological and functional effectiveness [8].

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