ONE can organize the myriad techniques for managing sagittal synostosis-induced scaphocephaly in a $2 \times 2$ table according to dynamic and static techniques on one axis and compressive and decompressive procedures on the other, and perhaps even include a third axis for open extensile versus minimal access exposures. The idea of using a dynamic, minimal access decompressive technique is very appealing for a number of reasons, most of all for the opportunity to harness the viscoelastic properties of the infant skull and the powerful functional matrix of the rapidly growing brain in the first few months of life. Therefore, it is exciting to imagine the potential of a simple spring in creating a satisfactory change in cranial configuration and improving craniocerebral disproportion.

Spring-assisted cranioplasty seems to fit the bill quite nicely, although this concept is not new. Claes Lauritzen from Göteborg, Sweden, introduced this technique in 1997 and has shared his extensive experience. Applications of this method have included improvement of hypertelorism in metopic synostosis, correction of brachycephaly in Apert syndrome, working around potentially hazardous anomalous venous drainage, and the correction of nonsynostotic scaphocephaly without cranial osteotomy and ventricular shunt cranial deformity. The workhorse application of spring-assisted cranioplasty has focused on the correction of nonsyndromic sagittal synostosis scaphocephaly.

Opponents of the use of springs in the infant skull cite the lack of control and predictability in bone expansion, the immediate effect of the spring that dissipates over time, the potential for dural and/or venous sinus tears, skin erosion, increased complication rate, and the need for a subsequent surgery for removal. Regardless, the outcomes of surgery speak for themselves, and the popularity of spring-assisted cranioplasty has not abated.

The article by Borghi et al. represents the first notable publication from the Great Ormond Street Hospital for Children (GOSH) group on the use of springs in the management of craniosynostosis. This group has been using the spring-assisted cranioplasty technique since 2008, and this is a welcome opportunity to review the progress they have made in applying the minimally invasive surgery and taking advantage of bone-fluid physiology in the correction of scaphocephaly. The focus of their paper is spring biomechanics and kinematics (a separate manuscript that describes the clinical outcomes in 100 consecutive cases of nonsyndromic scaphocephaly has been accepted for publication). As is often the case, a novel idea that seems to have significant clinical application makes the journey from the bench to the bedside.

A body of work using an animal model has examined the physiological effects of springs on the craniofacial skeleton. Experimental work in the rabbit by Davis and colleagues has demonstrated that cranial springs alter the growth vector of adjacent sutures, cause thickening of cranial sutures and adjacent cranial bone, and cause differential strain patterns on the endo- and ectocranial surfaces. The ability to mould and shape the cranium through the application of spring-derived force is powerful. There is a paucity of literature about the same influences in the human infant.

Therefore, the current study represents a welcome opportunity to assess the biomechanics and kinematics of springs in the management of 60 infants (mean age 5.2 ± 0.9 months) with nonsyndromic sagittal synostosis. The surgical technique involves creating paramedian strip craniectomies and placing 2 springs of various thicknesses across the midline. Spring selection (1.0-, 1.2-, and 1.4-mm thickness springs are available) is arbitrarily based on bone thickness and surgeon expertise. Various combina-
tions of spring thickness are routinely employed. Springs are removed at 3 months, and the spring opening distance is measured on the operating table, at 1 day postoperatively, at 3 weeks postoperatively, and at the time of spring removal. Spring dynamics and kinematics were assessed using a standard mechanical testing device. While the emphasis of this paper is not clinical, the authors describe measuring percentage changes in the cephalic index from preoperatively to the time of the second follow-up at 3 weeks postsurgery.

Several important findings from their paper should be noted. First, compression mechanical testing of the spring types generated force/opening curves that confirmed what many already intuitively know: the tighter the spring is coiled, compressed, or crimped, the greater the force it can generate. Second, as the thickness of the wire increases, so does the force generated across the bone edges in a non-linear fashion. It is interesting to see that the force generated at a 20-mm crimping in the thickest springs (model S14) is almost 4 times greater than the equivalent measure for the thinnest springs (model S10). Older infants with ostensibly thicker bone were noted to require thicker springs, but no data are presented to corroborate this. Interestingly, the springs expand to almost the pre-insertion configuration, and with time (and opening), the force thus generated dissipates. The most intriguing aspect of their study is the suggestion that there is no difference in either the force or the spring opening distance at the second follow-up (3 weeks) as compared with that at removal (3 months) independent of age (and therefore bone thickness). The spring kinematic data show that by 10 days postimplantation, the spring is 98% open and expansion comes to a halt. This would confirm the general impression that the spring effect is rapid and occurs early after insertion. There are no clinical details in their paper to demonstrate whether morphological changes continue to occur in the skull between 10 days postimplantation and the time of spring removal.

Ultimately, the effectiveness of any technique will be based on objective measures, parent and patient satisfaction, and finally public acceptance. Will this child pass the “supermarket test”? There is a paucity of clinical data in this study; no pre- or postoperative details about the “supermarket test”. This will be an important topic for study. The cri de coeur of the International Society of Craniofacial Surgeons as voiced by Paul Tessier—“Pourquoi pas?”—perhaps needs to be revisited and translated into a more conservative and reflective “Devirons nous?”

In summary, the authors are to be congratulated for providing information about their experience in using springs to correct cranial dysmorphism associated with sagittal synostosis and acknowledging the limitations and concerns surrounding this technique. Despite the fact that spring-assisted cranioplasty is entering its 3rd decade of existence, there remains much to understand about this powerful yet simple technique.

It brings to mind a much bigger question when managing this complex group of patients. How much surgery is enough? Where is the balance between level of invasiveness and outcome? Hope continues to spring eternal that this balance will be achieved. For the next generation of craniofacial surgeons, this will be an important topic for study. The cri de coeur of the International Society of Craniofacial Surgeons as voiced by Paul Tessier—“Pourquoi pas?”—perhaps needs to be revisited and translated into a more conservative and reflective “Devirons nous?”

https://thejns.org/doi/abs/10.3171/2017.3.PEDS1725

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