Calcified Cephalohematoma: Classification, Indications for Surgery and Techniques

Chin-Ho Wong, MBBS, MRCS,* Chee-Liam Foo, MBBS, FRCS,* Wan-Tiew Seow, MBBS, FRCS†

Singapore

While calcified cephalohematoma is eminently correctable, a clear description of indications for surgery and surgical techniques are currently lacking in the literature. In this paper we propose a simple classification and an algorithm for the management of cephalohematomas. Three patients were treated for large calcified parietal cephalohematomas. Craniectomy and cranioplasty were performed with excellent outcome. Cranioplasty was performed with the cap radial craniectomy technique in two patients and the flip-over bull's-eye technique in one patient. The literature was reviewed on this entity and an algorithm based on the timing of presentation, extent of calcification and type of calcified cephalohematoma is proposed. Aspiration and compressive dressings can be used for early, incompletely calcified cephalohematomas. Calcified cephalohematoma causing significant distortion of the calvarium requires surgical correction and is classified as Types 1 or 2 depending on the contour of the inner lamella. Type 1, with a normal contoured inner lamella, can be corrected by ostectomy of the outer lamella. Type 2 calcified cephalohematoma has a depressed inner lamella. Elevation of the inner lamella is necessary and the cap radial craniectomy technique can be used. We describe a novel technique, the flip-over bull's-eye techniques as an alternative technique for Type 2 lesions in selected patients. In conclusion, calcified cephalohematomas can safely be treated surgically with excellent outcome. It is hoped that this algorithm will serve as a useful and logical guide in decision making for the management of this condition.

Key Words: Bull's-eye, calcified, ossified, cephalohematoma, classification, techniques, outcome, computed tomography, magnetic resonance imaging, investigation, birth trauma

From the *Department of Plastic and Reconstructive Surgery, and †Division of Neurosurgery, KK Women's and Children's Hospital, Singapore.

Address correspondence and reprint requests to Dr. Chin-Ho Wong, Department of Plastic and Reconstructive Surgery, KK Women's and Children's Hospital, 100 Bukit Timah Road, Singapore 229899, Singapore; E-mail: wchinho@hotmail.com

Cephalohematomais a collection of blood between the skull and the pericranium confined within the borders of cranial sutures. These hematomas, also known as tumor cranii sanguineus,[1] are often caused by trauma associated with instrument assisted vaginal birth and are usually apparent within 24–72 hours after birth. The majority of cephalohematomas spontaneously resorb within one month of life.[2] Beyond this time, calcification of the hematoma occurs as bone is deposited under the lifted pericranium.[3] While the exact incidence is not known, large calcified cephalohematoma is rarely reported in the literature.[2,4,5] This is reflected in the dearth of information on the surgical correction of this problem. Technique for cranioplasty was first described by Kaufman et al.[6] Subsequently, Chung et al[7] reported three cases of surgically treated calcified cephalohematoma using technique similar to that described by Kaufman. To date, the indications for surgery and techniques for reconstruction have not been clearly elucidated. Here we present our experience with the management of this entity and detail our approach and reconstructive techniques used.

Anatomy and Classification of the Calcified Cephalohematoma

Calcified cephalohematoma has inner and outer layers of bone. The inner layer consists of the fetal inner and outer table of intramembranous calvarial bone and the outer layer is made up of subpericranial bone formed after separation of the pericranium for the underlying calvarium. For the purpose of description and to avoid confusion, in this article the former is referred to as the inner lamella and the latter as the outer lamella. We classified calcified cephalohematoma into two types; Types 1 and 2, with the distinguishing feature being the contour of the inner lamella in relation to the surrounding normal cranial vault. Type 1 calcified cephalohematoma has a non-depressed inner lamella with no encroachment into

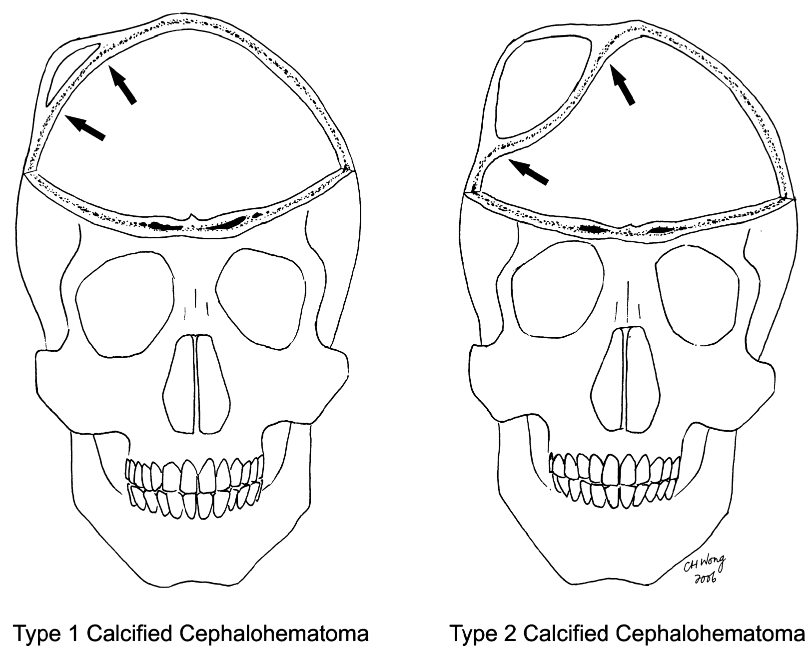

Fig 1 Calcified cephalohematomas were classified as Type 1 or Type 2. Type 1 calcified cephalohematoma has a non-depressed inner lamella with no encroachment into the cranial vault space (arrows). Type 2 has an inner lamella that is depressed into the cranial vault space (arrows).

the cranial vault space while in Type 2, the inner lamella is depressed into the cranial vault space (Fig 1). This classification is important as it determines the appropriate corrective technique and will be discussed later in this article.

Methods and Materials

Three patients were treated at our institution for large calcified cephalohematomas between January, 1998 and December, 2005. Their ages at operative correction were four months, one year, and three years and six months, respectively. The dimensions and locations of the lesion were as shown in Table 1. Indications for surgery were the unacceptable cosmetic deformity and significant distortion and encroachment into the cranial vault space (Type 2 calcified cephalohematoma) in all three patients. All three patients underwent skull roentgenogram and computed tomography (CT) scan prior to surgery as part of their preoperative work-up. Operations were performed by a team comprising plastic and neurosurgeons.

Surgical Technique

Surgical techniques described here are for correction of Type 2 calcified cephalohematomas, where the inner lamella is depressed into the cranial vault. A U-shaped scalp flap based inferiorly on the superficial temporal vessels is raised. The flap is planned 1 cm beyond the palpable elevated margin of the cephalohematoma. The flap is raised at the subgaleal plane followed by reflection of the pericranial flap. The area of excision is planned 1 cm beyond the apparent margins of the calcified cephalohematoma. This is to ensure complete removal of the affected calvarium.

Table 1. Summary of the Age, Size and Location of Calcified Cephalohematomas, Techniques Used and Outcomes of Our Three Patients

Case No	*Age at Operation*	*Associate Anomalies*	*Precipitating Cause*	*Size and Location of the Calcified Cephalohematoma*	*Surgical Technique*	*Outcome*
1	1 y	Nil	Forceps-assisted vaginal delivery	Left parietal, 5 x 6 cm	Cap radial craniectomy technique	6 y, Excellent
2	3 y-6 mo	Nil	Nil	Right parietal, 7 x 6 cm	Flip-over bull's-eye technique	6 mo, Excellent
3	4 mo	Nil	Vacuum-assisted vaginal delivery	Right parietal, 7 x 7 cm	Cap radial craniectomy technique	2 y, Excellent

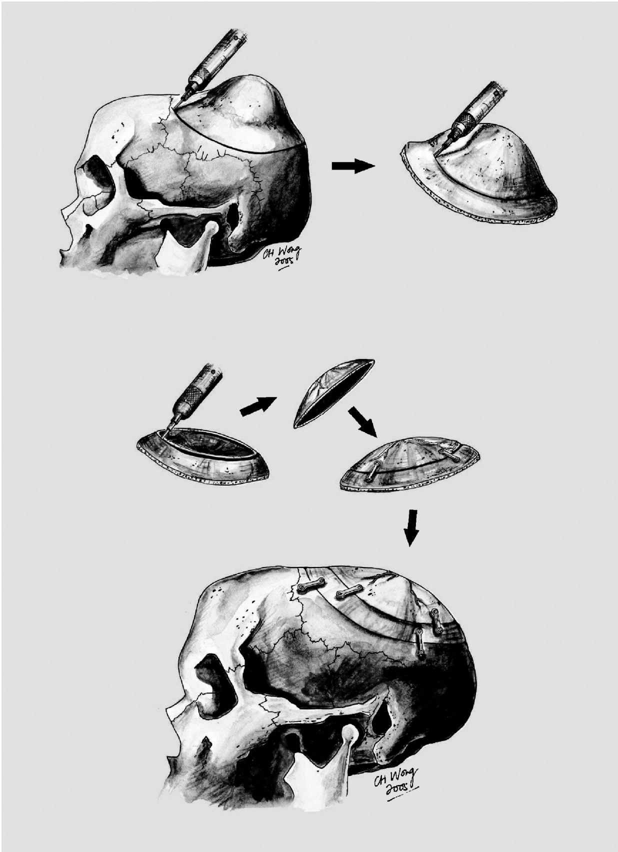

Fig 2 Schematic illustration of the flip-over bull's-eye technique.

The lesion is excised with a high-speed burr and gently lifted of the meninges. Bleeding from meningeal vessels may be encountered and these can be controlled with bipolar cautery.

Cranioplasty Techniques for Type 2 Calcified Cephalohematoma of the Skull

Flip-over Bull's-eye Technique (Reversed Inner Lamella to Outer Lamella Technique)

The calcified cephalohematoma is opened with a high-speed drill and its content excised for histology. The elevated, deformed outer lamella is discarded and the depressed inner lamella is cut around its edges, reversed (flipped-over) and plated onto the non-affected area of the calvarium, giving an impression of a "bull's-eye." The inner meningeal surface of the inner lamella is thus re-orientated to face the outside. The convex inner lamella approximates the convexity of the calvarium and when reversed gives excellent restoration of normal contour (Fig 2).

Cap Radial Craniectomy Technique

The cephalohematoma is excised with a high speed drill, opened and its contents debrided. The inner lamella is discarded. Radial cuts are made on the outer lamella cap to collapse the elevated dome. These triangular fragments are trimmed as necessary to fit the defect and plated with mini-plates to re-create the gentle three-dimensional curvature of the normal skull. Irregular areas can be burred away while excessively large gaps can be filled with bone chips harvested from the excess bone fragments (Fig 3).

The reconstructed calvarium is then secured back onto the skull with mini-plates. Care is taken to ensure complete coverage of the reconstructed calvarial bone graft with the pericranial flap. Meticulous hemostasis is ensured and the wounds closed in layers. Drains are placed and the patient is given a

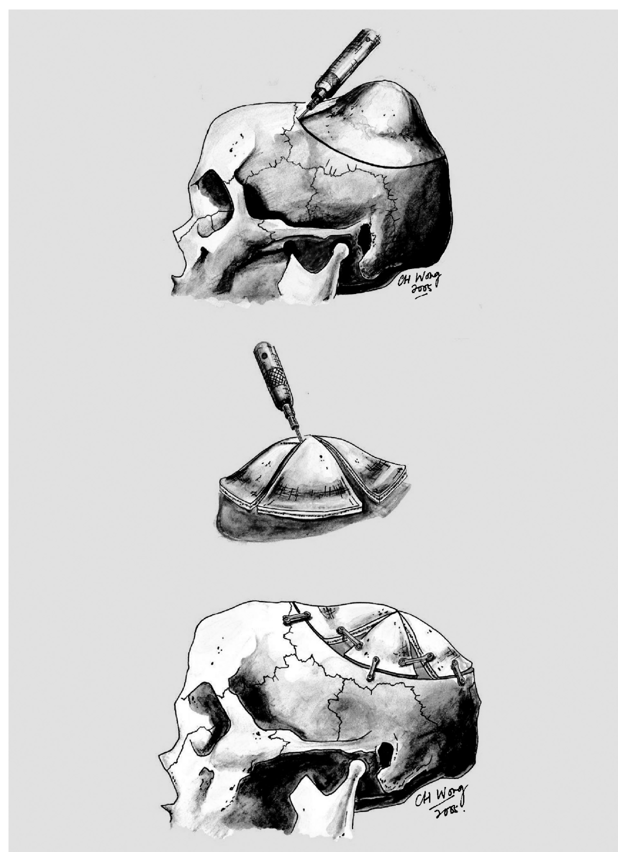

Fig 3 Schematic illustration of the cap radial craniectomy technique.

firm compression head bandage for 24 hours after operation.

Results

All three patients had Type 2 calcified cephalohematoma. Cranioplasty was done with the cap radial craniectomy technique in two patients and with the flip-over bull's-eye technique in one patient. The mean follow-up was 34 months. There were no postoperative complications and the patients were discharged between the third to the fifth postoperative day. All three had excellent contour restoration (Table 1).

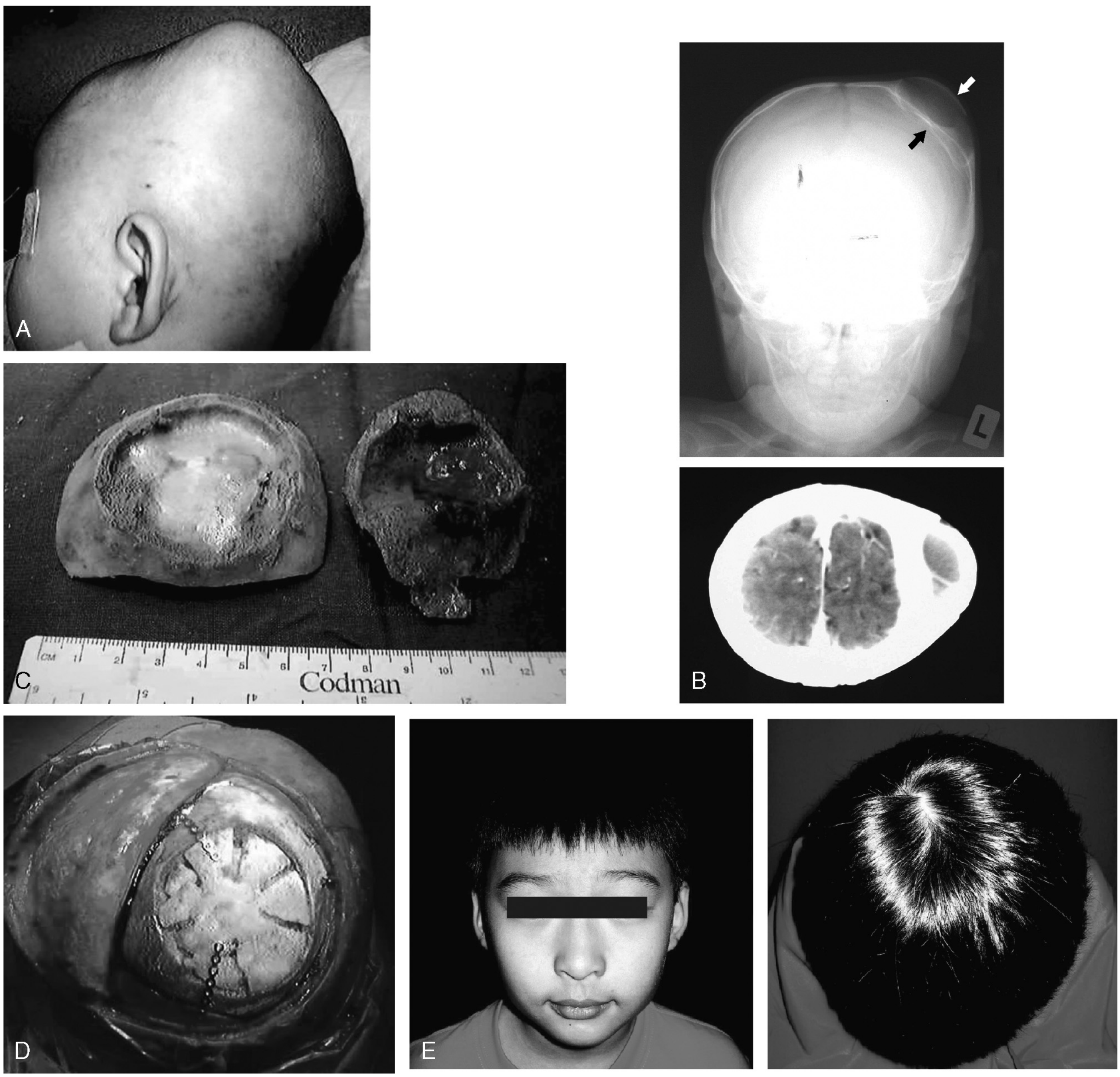

Fig 4 (A) A large parietal calcified cephalohematoma. (B) Roentgenogram (above) and CT scan (below) of the skull showing a type 2 calcified cephalohematoma. (C) The cephalohematoma was excised and opened, revealing an organized hematoma within its core. (D) Radial cuts were made on the outer lamella and the dome contoured to recreate the gentle curvature of the normal calvarium. (E) The patient at six-year follow-up.

CLINICAL REPORTS

Patient 1

A 1-year-old boy presented with a 5 × 6 cm bony lesion in the left parietal region (Fig 4A). The child was delivered vaginally at 40 weeks gestation. At birth, bilateral cephalohematoma was noted. The right cephalohematoma resolved by one month of age while the left persisted and gradually hardened. The child was otherwise healthy. A skull roentgenogram and CT scan demonstrated features consistent with a calcified cephalohematoma (Fig 4B). Surgical excision was performed. The lesion measured 6 × 6 cm in diameter and 3 cm in thickness (Fig 4C). An organized hematoma was seen upon opening the lesion and its contents sent for histology. The outer lamella was used for cranioplasty using the cap radial craniectomy technique and secured with mini-plates and screws (Fig 4D). The reconstructed calvarium was completely covered by the pericranial flap and the wound closed in layers and compressive head dressings applied. Postoperative recovery was uneventful and he was discharged on the fifth postoperative day. Histology showed a dense fibrous membrane with fibrous granulation tissue and hemosiderin containing macrophages, confirming the diagnosis of cephalohematoma. He was well at six-year follow-up with excellent contour of the scalp (Fig 4E).

Patient 2

A three-year, six-month-old girl presented with a hard right parietal swelling (Fig 5A). The swelling was present since birth, firm initially with gradual hardening. It has been static in size for the past three years. She was the mother's third-born and was delivered vaginally at 39 weeks gestation. She was otherwise healthy with normal developmental milestones. The preoperative CT scan was studied and the inner lamella was noted to have a thickness comparable to the normal skull and its contour was in the mirror image of the ideal skull contour. The flip-over bull's-eye technique was thus conceived (Fig 5B). At operation the lesion was excised and its dimensions were 7 × 6 cm in diameter and 3 cm in thickness. Cranioplasty was performed with the flip-over bull's-eye technique as planned with excellent contour restoration. The reconstructed calvarium was completely covered by the pericranial flap and the wound closed in layers and compressive head dressings applied (Fig 5C–G). Histological features were consistent with that of a cephalohematoma. She was discharged on the third postoperative day and was well at six-month follow-up (Fig 5H, I).

DISCUSSION

Cephalohematoma results from trauma during child birth which lifts the scalp including the pericranium off the skull bone, tearing delicate vessels that traverse through the bone into the scalp. The incidence of cephalohematoma has been reported to range from 0.2–3% of all birth.[3,8,9] In a series of 126 patients, Ingram and Hamilton[8] noted the most common site of involvement was the parietal bone (88%). The remaining 12% involved the occipital bone. The majority of cephalohematomas spontaneously resorb by one month of age.[1–3,10] In cases where the hematoma failed to resorb, progressive subpericranial osteogenesis results in a calcified cephalohematoma. The incidence of calcification of cephalohematoma has been reported to occur in 3–5% of all cephalohematomas.[11] If sufficiently large, the hematoma can depress the pliable neonatal skull, causing it to encroach into the cranial vault space as the cephalohematoma expands.

Table 2 gives a summary of the causative and predisposing factors, associations, differential diagnoses and complications of cephalohematomas.[3,6,8,10,12–16] A history of a mass present since birth that is initially firm and fluctuant that gradually hardens is typical of calcifying cephalohematoma.[2] Factors that predisposes to the development of cephalohematoma, such as prolonged, difficult delivery and assisted vaginal delivery, may also be elicited but is not a prerequisite for diagnosis.

Imaging is the main investigation needed for calcifying cephalohematoma. Skull roentgenogram and computed tomography (CT) scan are important to exclude other differential diagnoses[17–19] and for operative planning in the selection of appropriate reconstructive technique. Skull roentgenogram features includes an expansile lesion surrounded by a radio-opaque rim. There may be a variable thinning of the underlying calvarium. CT is the definitive standard for assessment of calcified cephalohematomas. CT features include a uniformly homogenous, hypodense, non-enhancing core encased by bone. CT scan features that should be noted in the selection of technique for reconstruction include: 1) the type of calcified cephalohematoma, i.e., Type 1 versus Type 2; 2) the thickness of the inner and outer lamellas compared with the normal calvarium; and 3) the contour of the inner lamella. For Type 2 calcified cephalohematoma where cranioplasty is needed, the choice of technique is dependent on points 2 and 3. The flip-over bull's-eye technique is suitable only for selected patients. The inner lamellar should be of sufficient thickness and its contour should be approximated the

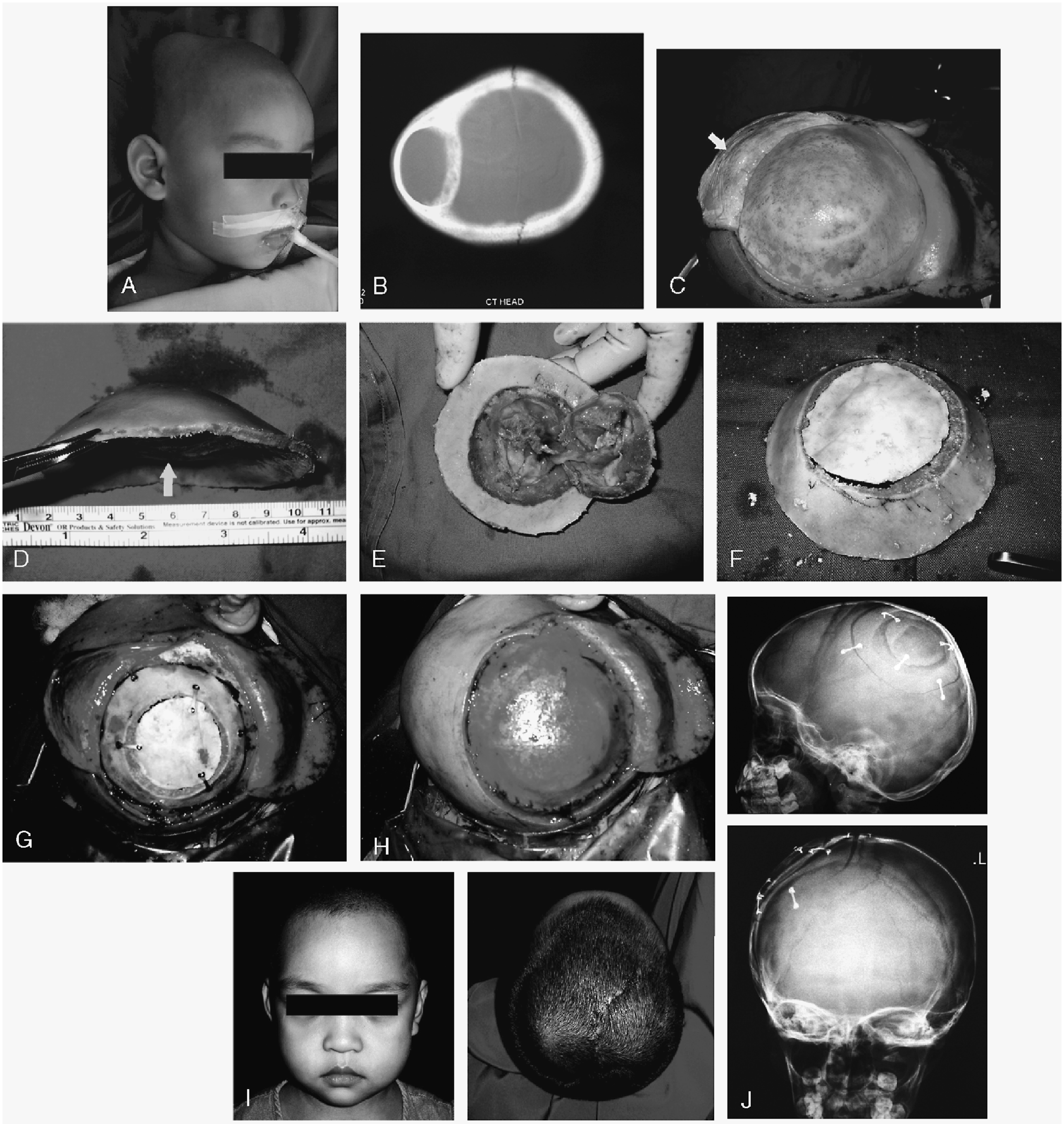

Fig 5 (A) A large calcified cephalohematoma. (B) Preoperative CT scan. (C) The scalp flap was raised at the subgaleal plane and the pericranial flap raised separately (arrow). (D) Type 2 calcified cephalohematoma with the inner lamella encroaching into the cranial vault space (arrow). (E) The calcified cephalohematoma was opened, revealing an organized clot within its core. (F) The inner lamella was excised, flipped-over to reconstruct the calvarium. The meningeal surface of the inner lamella now faced the outside. (G) The reconstructed calvarium is plated back onto the skull, resembling a bull's-eye. (H) The reconstructed calvarium is completely covered by the pericranial flap. (I) Postoperative results with excellent contour restoration. (J) Postoperative skull roentgenogram of the flip-over bull's-eye technique.

mirror image of the ideal skull contour (Fig 6). For irregularly shaped calcified cephalohematomas with a thinned-out inner lamella, the cap radial craniectomy technique would be appropriate as it allows total reshaping of the outer lamella to the desired contour.

If performed, magnetic resonance imaging (MRI) will show a bright (high) signal on the T1-weighted image and on the T2 images demonstrate a predominantly high signal with mild heterogeneity. This is characteristic for the presence of methemoglobin and indicates that the lesion was secondary to hemorrhage rather than an intra-osseus tumor.[17–19] The diagnosis will be evident at operation when the lesion is opened, revealing an organized hematoma within its core. Histological examination should be done as the final confirmation.

Figure 7 shows our suggested algorithm for the management of cephalohematoma. As majority of cephalohematomas resorb within a month of birth, they should be expectantly observed during this period. Aspiration can be attempted for any significantly sized cephalohematoma when it failed to resolved after a month. Early authors such as Cushing have cautioned against aspiration for fear of infection and consequently osteomyelitis.[2,3] This fear is probably unfounded with proper technique and prophylactic antibiotics available today.[1,8,12] This should be done early (before 3–6 months of age) before a significant amount of bone has been laid down by the lifted pericranium. It should be stated however that the rate of sub-pericranium osteogenesis seemed to vary from patient to patient. Firlik and Adelsen[20] reported a case of large chronic cephalohematoma that was observed for three months without any calcification and was successfully aspirated. On the other hand, one of our patients (Case 2) had significant calcification and had developed a thick outer lamella when she presented as early as four months of age. The extent of calcification can be determined clinically by palpating for the firmness/hardness of the cephalohematoma and by CT scan to evaluate the thickness of the outer lamella. Furthermore, the contour of the inner lamella should also be noted on the CT scan. Once the inner lamella is depressed by the cephalohematoma, aspiration alone may not satisfactorily restore skull contour and a craniectomy and cranioplasty may be needed even if aspiration was successful in resolving the cephalohematoma.

Calcification begins with the formation of a ridge around the edges of the hematoma and an eggshell-thin layer under the pericranium. At this stage, the cephalohematoma can be successfully treated by aspiration. Aspiration is performed with a large bore needle under aseptic conditions and prophylactic antibiotic coverage. The thin shell of calcification can be gently crushed and this would be incorporated back into the skull.[2] The ridge around the periphery of the hematoma may remain palpable but will resolve with time. A pressure bandage is applied after aspiration to prevent re-accumulation of the hematoma.

In cases that present late (>3–6 months), the cephalohematoma feels hard and on the CT scan, is completely encased by bone. Surgery is the only effective treatment for these calcified cephalohematoma.[6,7] The indications for surgery for calcified cephalohematoma have not been defined.[6] In the past, surgery for calcified cephalohematomas has been actively avoided for fear of complications associated with intracranial surgery.[2–5] While Tan[3] noted that as the skull grows, the swelling tend to become less conspicuous, many patients with this condition who were treated conservatively had a poor cosmetic outcome.[2] Today, an accepted indication is cosmesis, as this condition can cause significant skull asymmetry and is cosmetically unacceptable. Also, calcified cephalohematoma can potentially cause calvarial growth disturbances. Martinez-Lage et al[21] reported a case of scaphocephaly secondary to a calcified cephalohematoma hindering the growth of the sagittal suture. While there are currently no reported cases of calcified cephalohematoma causing focal neurological

Table 2. Table Summarizing the Causative and Predisposing Factors, Associations, Differential Diagnoses and Complications of Cephalohematomas[3,6,8,10,12–16]

Causative/Predisposing Factors for Cephalohematoma
Difficult, prolonged labor
Trauma associated with assisted vaginal delivery, such as forceps- or vacuum-assisted delivery
Insertion of intra-uterine fetal monitor wire (with a coiled end screwed into the fetal skull)
High birth weight (4 kg)
Primiparous mother (1st pregnancy)
Bleeding disorders such factor VIII deficiency
Conditions associated with cephalohematoma
Skull fracture
Epidural hematoma
Anemia and jaundice
Differential diagnosis
Caput succedaneum (Subcutaneous hematoma)
Subgaleal hematoma
Encephalocele
Tumors such as dermoid, myofibroma or neuroblastoma
Complications of cephalohematoma
Infection, osteomyelitis and sepsis
Calcification of the cephalohematoma causing skull deformity
Complications of calcified cephalohematoma
Craniosynostosis

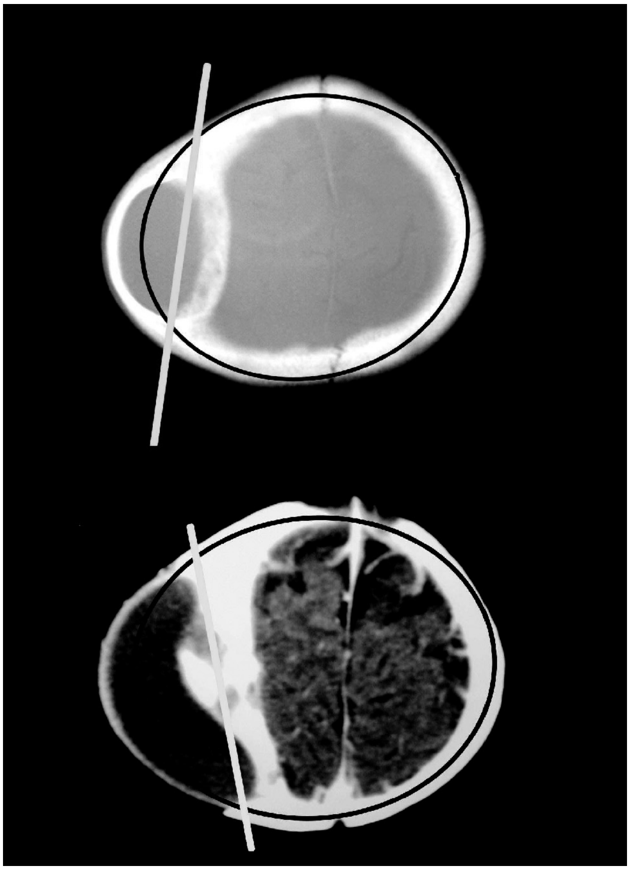

Fig 6 Selection of appropriate surgical technique for calvarium reconstruction for Type 2 calcified cephalohematoma based on preoperative CT scan. The ideal skull contour is marked out in black and an imaginary mirror (white line) drawn at the margins of the calcified cephalohematoma. Top: The inner lamella approximated the mirrow image of the ideal skull contour and when flipped over gave excellent contour restoration. Bottom: The inner lamella is irregularly shaped the flip-over bull's-eye technique would yield a poor result. The cap radial craniectomy technique would be more appropriate.

deficits or disturbances in intracranial pressures, the long-term effects of a calcified mass encroaching into the cranial vault (in Type 2 calcified cephalohematoma) on brain development is unknown. Furthermore, while our experience with surgical correction of calcified cephalohematoma is limited, the safety and efficacy of intracranial surgery for correction of skull asymmetry in other conditions such as craniosynostosis in children have been well documented.[22–24] In our experience, surgery and reconstruction with the techniques described here consistently yield satisfactory results with excellent contour restoration and have a low morbidity. We therefore recommend surgical correction for large calcified cephalohematoma. The optimal timing for surgery however remains uncertain. Because of its rarity, the effects of calcified cephalohematoma on skull growth and facial symmetry are difficult to quantitate. Patients can be operated safely form early infancy onwards. The youngest patient we operated on was four month of age.

When considering surgical correction, the appropriate technique depends on the type of calcified cephalohematoma as described above.[7] In general, Type 1 lesions tend to be smaller calcified lesions with minimal elevation above the skull.[7,11,25] Larger cephalohematomas, as those cases reported here, tend to protrude higher above the skull and at the same time push the pliable inner lamella into the cranial vault and are thus Type 2 lesions. For Type 1 calcified cephalohematoma, the pericranium is opened and the outer lamella is separated from the inner lamella either with a drill bit or an osteotome. The organized hematoma within its core is removed. The inner lamella is smoothed with a burr and bleeding is stopped with bone wax. It is not necessary to enter the cranial cavity.[7,11,25] For Type 2 calcified cephalohematoma however, a craniectomy and cranioplasty is necessary to elevate the inner lamella to restore normal skull contour and intracranial volume.[7] Two techniques are available to achieve this and these were described above. The selection of surgical technique for calvarial reconstruction between the flip-over bull's-eye technique and the cap radial craniectomy technique depends on the preoperative evaluation of CT scans and intraoperative findings. CT scan serves as a useful guide (Fig 6). The ultimate decision should be made intraoperatively after confirming the thickness, robustness and contour of the inner and outer lamellas. If the thickness and convexity of the inner lamella is satisfactory, the flip-over bull's-eye technique is an excellent reconstructive option. The cap radial craniectomy technique can be used with excellent result in cases that do not fulfill these criteria.

The advantages and disadvantages of these two techniques are as shown in Table 3. The advantages of the flip-over bull's-eye technique include its simplicity and the strength of the reconstruction as the inner lamella is left intact as a single piece. Also, in properly selected patients, it gives excellent contour restorations. The cap radial craniectomy technique, originally described by Kaufman et al[6] in 1993, has the main advantage in its versatility. It can be used even for severely deformed skull, as long as adequate good quality bone is available. The disadvantage is that this is relatively more time consuming, requires a lot more contouring and implants and may be weaker structurally when compared with the former technique.[6,7]

An interesting recent innovation for treatment of calcifying cephalohematoma with calvarial molding-helmet was reported by Petersen et al.[26] The calvaria in a child three to nine months of age is malleable and, therefore, quite easy to shape. The authors presented two cases of partially calcified cephalohematoma (their patients presented at three and four months, respectively) and showed excellent cosmetic result with the molding-helmet technique. However, while molding undoubtedly improve contour, its limitations should be recognized. First, as the author stated, molding is only effective partially calcified cephalohematoma and probably would yield poor results in completely calcified cephalohematoma as those reported in this paper. Second, while molding is effective in reshaping the skull, this process may push the inner lamella of the cephalohematoma further into the cranial vault, potentially converting a Type 1 into a Type 2 lesion. As stated, the effect of this on the developing brain is unknown. Thirdly, after a brief

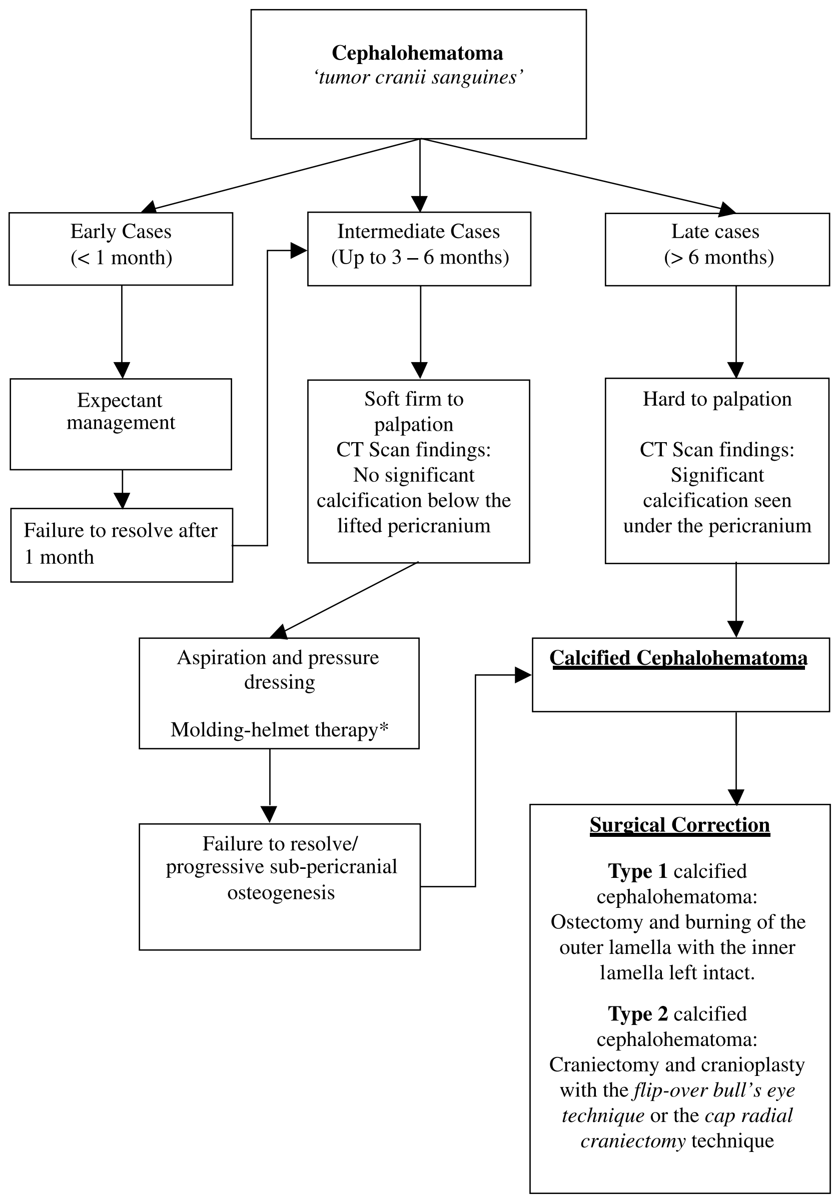

Fig 7 An algorithm for the management of cephalohematomas. *The role of molding-helmet therapy is yet to be defined and its routine use is not recommended. It can be combined with aspiration to reduce recurrence and to achieve a better shape post-aspiration.

Table 3. Advantages and Disadvantages of the Cap Radial Craniectomy Technique and the Flip-Over Bull's-eye Technique

Surgical Techniques for Correction of Type 2 Calcified Cephalohematoma	*Advantages*	*Disadvantages*
Cap radial craniectomy technique	Can be used for severely deformed skull as long as adequate good quality bone is present	Requires a lot more contouring Structurally weaker
Flip-over bull's-eye technique	Simple Good contour restoration in selected patients Structurally stronger	Can only be used in selected cases. Patients in whom the inner lamella contour does not correspond to the calvarial contour and patients in whom the inner lamella is too thin are not suitable candidates for this technique.

Both techniques have a role and complement each other in the surgical management of calcified cephalohematomas.

follow-up (three and five months, respectively), therapy was stopped. The risk of recurrence as the brain continues to grow, especially in the first two years of life, is unknown. Finally, it was unclear why the authors did not attempt aspiration prior to commencing molding-helmet therapy, since these were minimally or partially calcified cephalohematomas.[2] Perhaps the combination of aspiration and molding-helmet would give a better outcome in this subgroup of patients. Further experience is therefore needed define the role of molding therapy in the management of calcified cephalohematoma before its use can be recommended.

Conclusion

Calcification is not an infrequent complication of cephalohematomas. Awareness and a clear treatment protocol are important for an optimal outcome. As noted by Morgan, we should move away from the traditional approach of absolute conservatism to one of active intervention once it is apparent that the cephalohematoma will not spontaneously resorb and subpericranial osteogenesis is evident.[2,3] Early aspiration and pressure dressings may prophylactically reduce the incidence of calcified cephalohematoma. Surgical options depend on the type of calcified cephalohematoma and an excellent outcome can be achieved with appropriately selected technique.

The authors thank Ms. Ee-Wee Ho for her help with the figures in this manuscript.

References

1. Chorobski J, Davis L. Cyst formations of the skull. Surg Gynecol Obstet 1934;58:12
2. Morgan JE. Calcification in cephalhematomata of the newborn infant. Am J Obstet Gynecol 1944;48:702
3. Tan KL. Cephalohematoma. Aust N Z J Obstet Gynaecol 1970;10:101
4. Kastendieck H. Zur frage der verknochering von cephalhamatoma. Zentralbl F Gynak 1939;2507:35–52
5. Ottow Von B. Vollige ossification eines kephalohamatoma beim saugling mit dadurch bedingter bleibender schadelformation. Zentralbl F Gynak 1937;1478:18–35
6. Kaufman HH, Hochberg J, Anderson RP, et al. Treatment of calcified cephalohematoma. Neurosurgery 1993;32:1037–1039
7. Chung HY, Chung JY, Lee DG, et al. Surgical treatment of ossified cephalohematoma. J Craniofacial Surg 2004;15:774–779
8. Ingram MD Jr, Hamilton WM. Cephalohematoma in the newborn. Radiology 1950;55:503
9. Silverman FN, Byrd CR, Fitz CR. The Skull: Traumatic Lesions, 9th ed. St. Louis, Mo: Mosby, 1993
10. Hartley JB, Burnett CWF. An enquiry into the causation and characteristics of cephalohematomata. Br J radiol 1944;17:33–41
11. Bruce DA. Cephalohematoma and subgaleal hematoma. In: Wilkins RH, Rengachary SS, eds. Neurosurgery, 2nd edition, vol 2. New York: McGraw-Hill, 2739–2740
12. Negishi H, Lee Y, Itoh K, et al. Nonsurgical management of epidural hematoma in neonates. Pediatr Neurol 1989;5: 253–256
13. Kendall N, Woloshin H. Cephalohematoma associated with fracture of the skull. J Pediatr 1952;41:125–132
14. Zelson C, Lee SJ, Pearl M. The incidence of skull fractures underlying cephalohematomas in new born infants. J Pediatr 1974;85:371–373
15. Listinsky JL, Wood BP, Ekholm SE. Parietal osteomyelitis and epidural abscess: a delayed complication of fetal monitoring. Pediatr Radiol 1986;16:150–151
16. Overturf GD, Balfour G. Osteomyelitis and sepsis: severe complications of fetal monitoring. Pediatrics 1975;55:253–256
17. Huvos AG. Bone Tumors: Diagnosis, Treatment and Prognosis. Philadelphia, Pa: WB Saunders Company, 1979
18. Mirra JM. Bone Tumors: Clinical, Radiological and Pathological Correlations. Philadelphia, Pa: Lea and Febiger, 1989
19. Thomas JE, Baker HL Jr. Assessment of roentgenographic lucencies of the skull: a systematic approach. Neurology 1975; 25:99–106
20. Firlik KS, Adelson PD. Large chronic cephalohematoma without calcification. Pediatr Neurosurg 1999;30:39–42
21. Martinez-Lage JF, Esteban JA, Martinez Perez M, et al. Craniostenosis secondary to calcified subperiosteal hematoma: case report. Neurosurgery 1984;15:703
22. Panchal J, Uttchin V. Management of craniosynostosis. Plast Reconstr Surg 2003;111:2032–2048
23. Fearon JA, Yu J, Bartlett SP, et al. Infections in craniofacial surgery: a combined report of 567 procedures from two centres. Plast Reconstr Surg 1997;100:862
24. David DJ, Cooter RD. Craniofacial infection in 10 years of transcranial surgery. Plast Reconstr Surg 1987;80:213
25. Fuch HE. Benign tumors of the skull, including fibrous dysplasia. In: Winn HR, ed. Youmans neurological surgery, 5th ed, vol 3. Philadelphia: WB Saunders, 3717–3718
26. Petersen JD, Becker DB, Fundakowski CE, et al. A novel management for calcifying cephalohematoma. Plast Reconstr Surg 2004;113:1404–1409