**Turk Neurosurg** 36(4):553-560, 2026
**DOI:** 10.5137/1019-5149.JTN.49815-25.2

*Original Investigation*
Pediatrics

Received: 10.09.2025
Accepted: 16.11.2025
Published Online: 24.07.2026

# Early and Effective Surgical Treatment of Ossified Cephalohematoma Using a Simple Technique

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## ABSTRACT

**AIM:** To retrospectively analyze infants treated with early surgical management using the simple excision technique and discusses the outcomes in light of the existing literature.

**MATERIAL and METHODS:** Ten infants with OCH who underwent surgery were included in this study. The following parameters were recorded: age, sex, mode of delivery (normal vaginal delivery, cesarean section, vacuum extraction, or forceps delivery), presence of hematologic disorders or bleeding diathesis, comorbidities or anomalies, lesion localization, lesion size, duration of surgery and anesthesia, estimated blood loss, need for transfusion, postoperative complications, neurological findings, presence of additional pathologies, classification type, duration of hospital stay, and postoperative follow-up period.

**RESULTS:** The mean age of the 10 infants was 3.7 months, with a male-to-female ratio of 9:1. The OCH was located in the occipital region in one patient, the parietal region in eight patients, and bilaterally in the parietal region in one female infant. The lesion size ranged from 37 to 90 mm. The duration of surgery ranged from 40 to 80 min, while anesthesia lasted between 70 and 120 min. The mean intraoperative blood loss was 30 mL. All patients were discharged within an average of 2 days. According to Wang's classification, all cases were categorized as Type 1. The follow-up period ranged from 1 to 66 months.

**CONCLUSION:** Initial management of cephalohematoma should involve careful monitoring. However, when ossification occurs, early neurosurgical intervention is advisable. Early surgical treatment of OCH using the simple excision technique is a safe, effective, and minimally invasive approach associated with short operative time, minimal blood loss, and excellent cosmetic and functional outcomes. Therefore, early surgical management should be considered the preferred treatment option for OCH.

**KEYWORDS:** Cephalhematoma, Ossifying cephalhematoma, Birth trauma, Calvarial ossification

## INTRODUCTION

Cephalohematoma is the collection of blood behind the scalp, specifically in the subperiosteal area (Figure 1) (9). It is caused by the buildup of blood between the bone and the periosteum as a result of several unfavorable occurrences or interventions during birth. Postnatal cephalohematoma affects 0.4%–2.5% of all live births. It is more common in first pregnancies, heavier newborns, those with cephalopelvic disproportion, and following assisted births with forceps or vacuum extractors (2,3,6,13). It is more common in male babies than in females, but the explanation for this is uncertain (11). However, this could be explained by the fact that male infants are often larger.

Cephalohematomas may be single or numerous. The lesions are not hazardous and normally resolve spontaneously within a month. Subperiosteal blood is rarely resorbed, and osteo-

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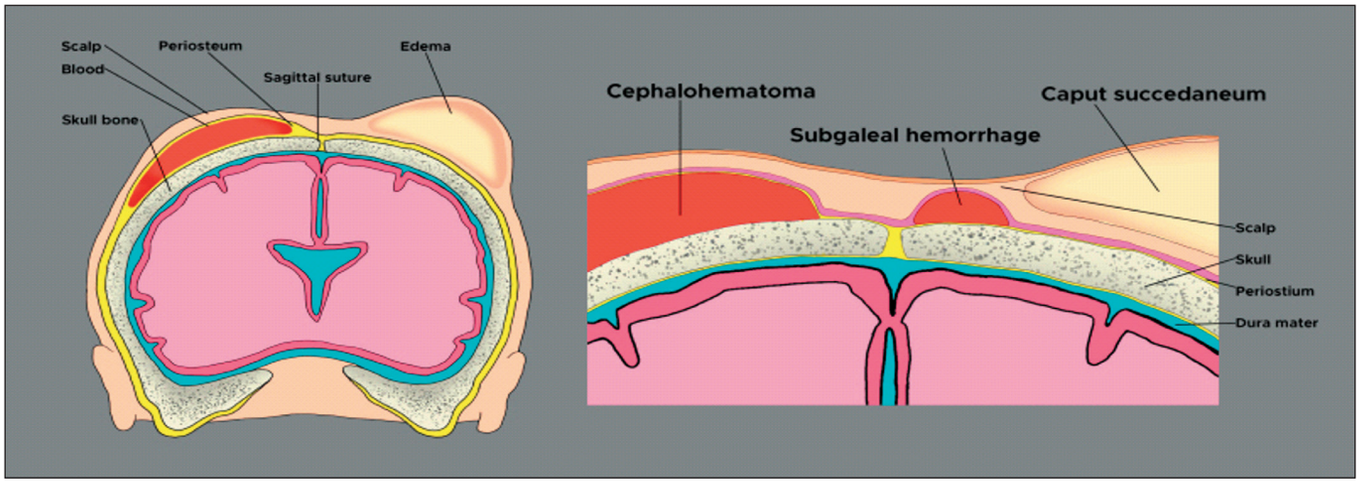


**Figure 1:** Cephalohematoma. Illustration depicting cephalohematoma, subgaleal hemorrhage, and caput succedaneum. The illustration (left) shows the scalp, skull, periosteum, dura mater, edema, sagittal suture, and edema. Contributed by C Rowe (Copyright © 2025, StatPearls Publishing LLC, used under the express permission statement stated in the publication) (9).

genesis at the hematoma's perimeter begins within the first month (3,8,14). The incidence of cephalic ossification is unclear; however, it is extremely uncommon (3).

Ossified cephalic hematoma (OCH) can result in significant calvarial asymmetry and cosmetic abnormalities. It can cause calvarial enlargement and compress the brain by pressing on the true bone with hematoma compression (2,13). In some cases, surgical intervention is required. The majority of procedures performed in the literature comprise complex and limited case reports in which cranioplasty repair techniques are used with excision of OCH and in place autograft (3,13).

This article presents a series of 10 cases that were successfully treated with early use of a simple and effective surgery using the technique of "simple excision and reattachment of periosteum by laying it on the bone." Despite the limited number of cases in our study, it is the third largest series in the literature with long-term results from the same surgeon who performed this surgical procedure.

## MATERIAL and METHODS

The study comprised ten instances of OCH treated surgically by the same surgeon (NSB) in two different tertiary-referral institutions from 2019 and 2025. All of these had the simple OCH excision and reattachment of the periosteum by laying it on the bone technique as a surgical procedure, which is detailed below.

The patient's families provided a detailed anamnesis of their birth and postnatal periods as well as their publishing agreement. The size of the OCH was next calculated using 3D computed tomography (CT), followed by surgical planning (Figure 2). Cases having an OCH area of 3 cm or more in diameter and 1 cm or more in height were considered for surgery. Smaller OCH instances were omitted from surgery.

All patients received general anesthesia, and there were no perioperative difficulties; they were all monitored in the inpatient ward during the postoperative period. None of the patients needed blood transfusions. All patients were discharged after 1 to 3 days of hospitalization and follow-up, which included normal medical care. Patients were followed up in the first week, first month, and third month (Figure 3), except for six patients conducted during the previous year, 1 yr after discharge. In addition, post-3- to 5-yr follow-ups were acquired for four individuals who underwent early surgery. The anamnesis acquired from the patient's parents included information such as age, gender, birth type (typical vaginal delivery, vacuum or forceps use, or section), hematological disease, bleeding diathesis, the existence of comorbidities, and abnormalities. Furthermore, localization, size, operation time, duration of anesthesia, amount of blood loss, need for transfusion, presence of complications, neurological examination, presence of additional pathology, OCH classification type, hospital stay, and postoperative follow-up durations were documented (Table I).

### Surgical Technique

The patient was positioned supine on the operating table, general anesthesia was delivered, and the side of the cranium was operated on because the OCH was on top, with the head turned to the opposite side. If the OCH was bilateral, the head was neutrally positioned in the midline, and the surgery was initiated by turning the head to the opposite side in sequence. A curvilinear incision is created around the whole OCH. The skin flap containing the epicranial aponeurosis is peeled away from the periosteum and elevated. The periosteum is meticulously separated as a single piece from the OCH within the width of the skin incision and reflected on the skin flap. A hole is bored from the apex of the OCH using a high-speed drill, revealing the ossified shell and the original calvarial bone underneath. The ossified shell is removed with a rongeur or Kerrison punch up to the edges, where it emerges from the

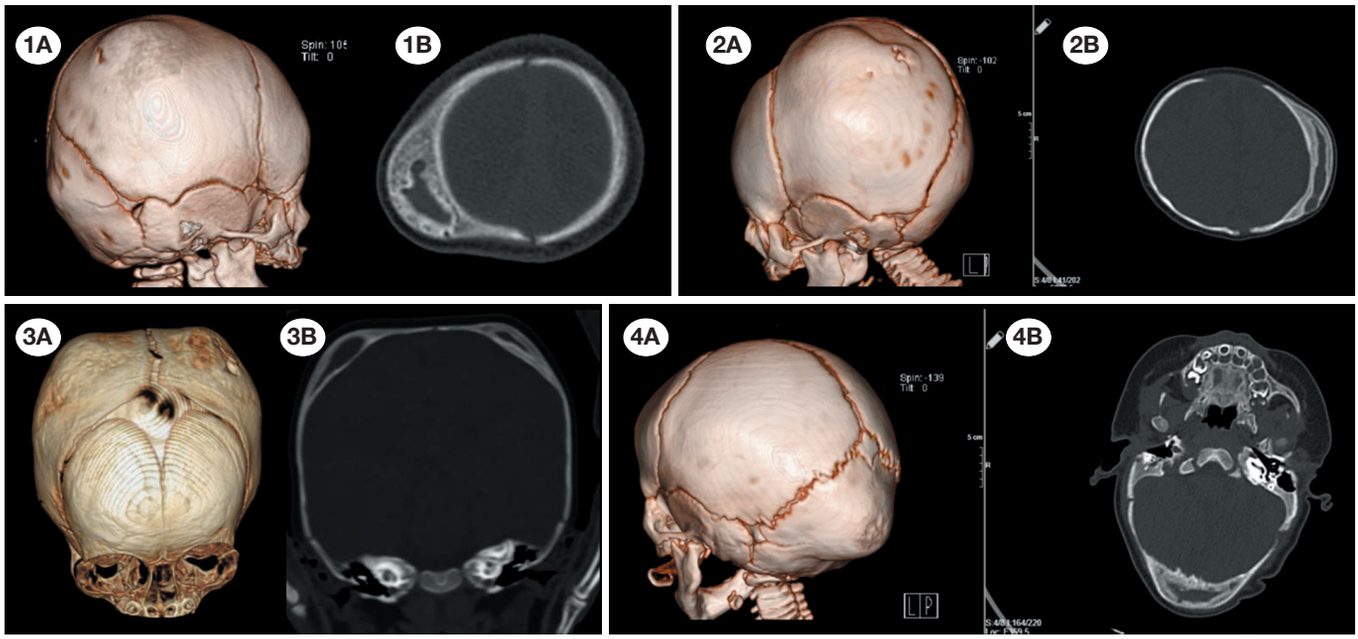


**Figure 2:** 3D and axial computed tomography images of the cases. **1A-B** Right, **2A-B** left, **3A-B** bilateral and **4A-B** occipital ossified cephalic hematoma.

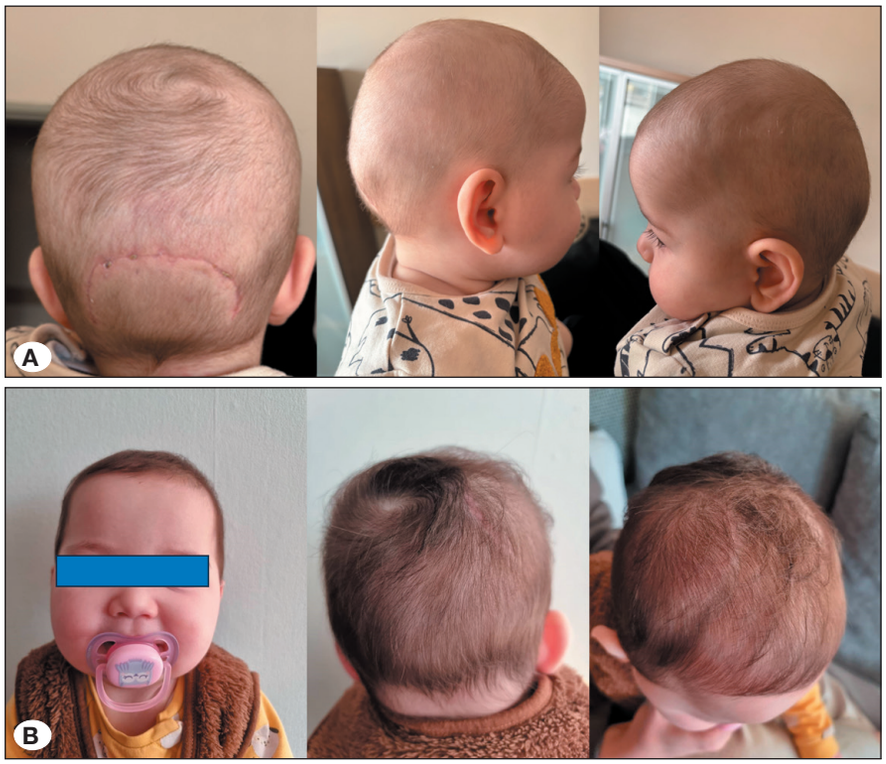


**Figure 3:** Postoperative first month control of occipital OCH case **(A)**, postoperative 3rd-month control of bilateral parietal OCH case **(B)**.

calvarium. Curettage and aspiration are used to empty the old, compacted hematoma. Trimming with a high-speed drill flattens the protrusions and imperfections on the original calvarial bone, which is thin and uneven. As a result, a smooth contour is achieved without stepping outside the calvarium. Minimal bone hemorrhages are sealed with little particles of bone wax. The periosteum, which has been carefully peeled off in one piece, is then applied to the smooth and nonbleeding calvarium, and primary closure is completed. After bleeding management is required, a drain is inserted, and the skin is closed. All patients are given prophylactic perioperative and early postoperative antibiotherapy (Figures 4 and 5).

**Table I:** Patient Assessment Chart

| | Case 1 | Case 2 | Case 3 | Case 4 | Case 5 | Case 6 | Case 7 | Case 8 | Case 9 | Case 10 |
|---|---|---|---|---|---|---|---|---|---|---|
| Age (month) | 2 | 4 | 4 | 4 | 4 | 4 | 3 | 4 | 4 | 4 |
| Gender | M | M | M | M | F | M | M | M | M | M |
| OCH localization | L<br>P | R<br>P | R<br>P | R<br>P | L / R<br>P | R<br>P | R<br>P | <br>O | L<br>P | R<br>P |
| OCH diameter (mm) | 72 | 84 | 60 | 57 | 37 / 55 | 38 | 55 | 67 | 90 | 54 |
| Operation time (minute) | 40 | 60 | 60 | 65 | 80 | 50 | 60 | 50 | 75 | 50 |
| Anesthesia time (minute) | 70 | 90 | 120 | 100 | 120 | 90 | 90 | 100 | 110 | 90 |
| Blood loss (ml) | 20 | 30 | 25 | 35 | 40 | 30 | 25 | 30 | 30 | 20 |
| Blood Transfusion(ml) | No | No | No | No | No | No | No | No | No | No |
| Complication | No | No | No | No | No | No | No | No | No | No |
| Length of stay (day) | 2 | 3 | 1 | 2 | 1 | 2 | 2 | 2 | 1 | 2 |
| Type of birth | NVD | NVD | NVD | NVD | NVD | NVD | NVD | NVD | NVD | NVD |
| Hematological disease | No | No | No | No | No | No | No | No | No | No |
| Neurological examination | N | N | N | N | N | N | N | N | N | N |
| OCH Type | Type 1 | Type 1 | Type 1 | Type 1 | Type 1 | Type 1 | Type 1 | Type 1 | Type 1 | Type 1 |
| Follow-up period (month) | 66 | 55 | 44 | 38 | 12 | 10 | 6 | 5 | 4 | 1 |
| Additional pathology | No | No | No | No | No | No | No | No | ES | No |

***M:** Male, **F:** female, **P:** parietal, **O:** occipital, **NVD:** normal vaginal delivery, **ES:** esophageal stricture, **N:** normal, **R:** right, **L:** left.*

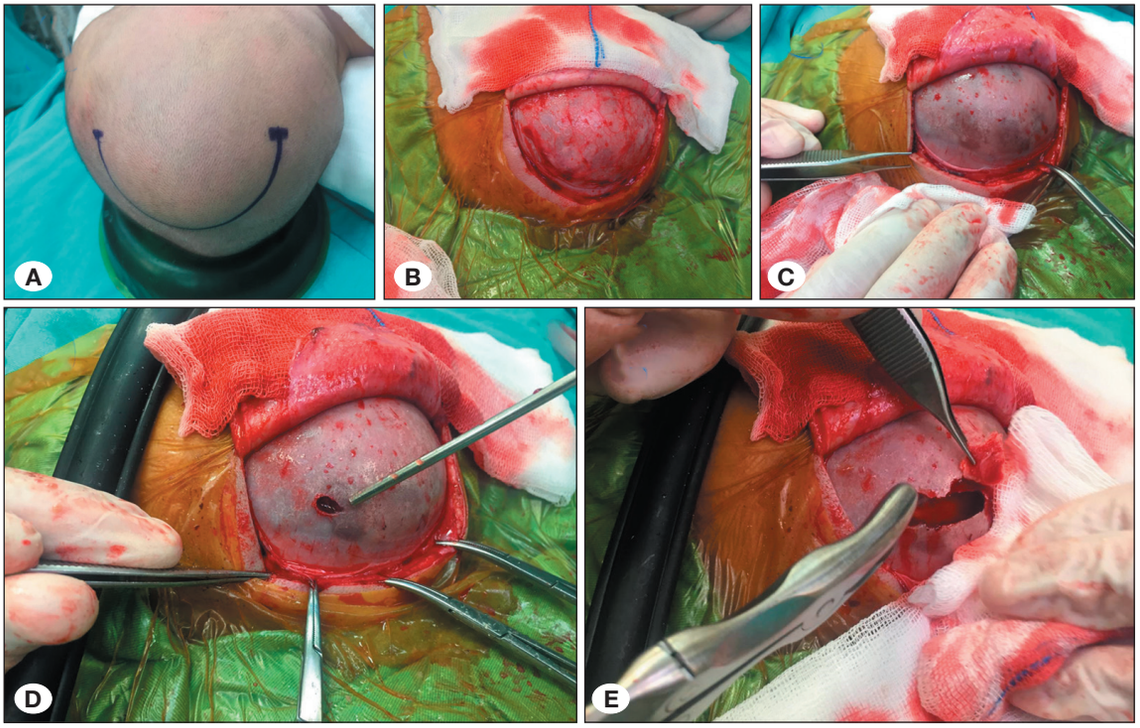


**Figure 4: A)** Marking the skin incision, **B)** incision of the skin and periosteum, **C)** view of the ossified cephalic hematoma (OCH) following periosteal elevation, **D)** drilling a burr hole on the OCH, **E)** excision of the OCH following enlargement of the burr hole using a rongeur.

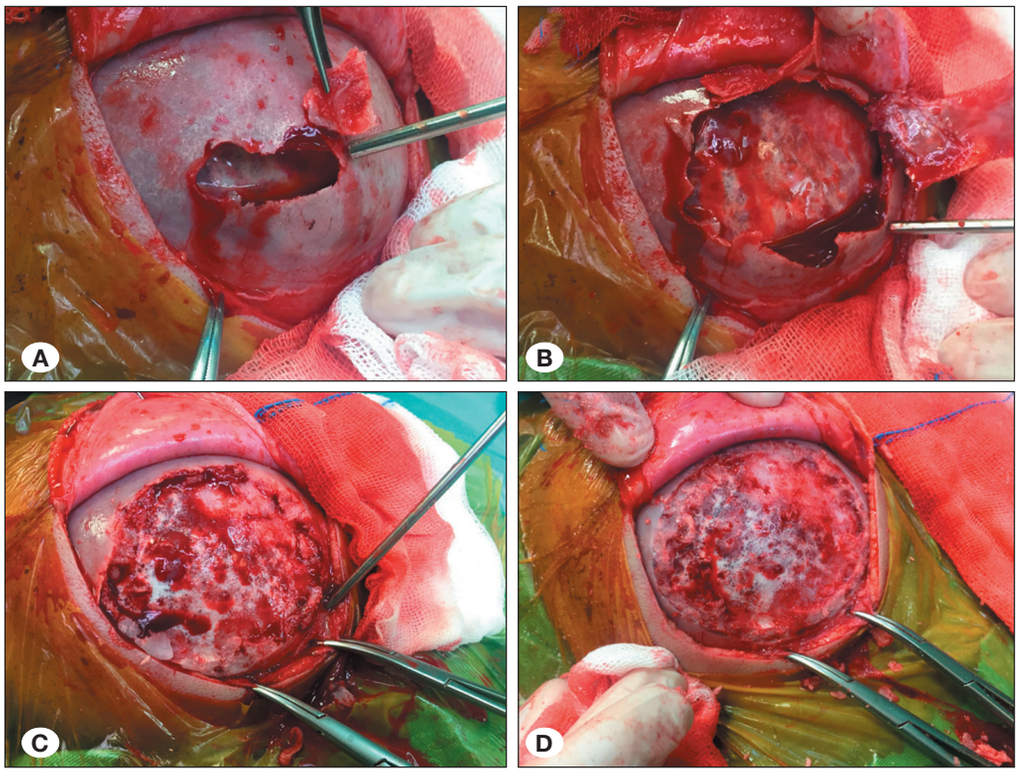


**Figure 5: A)** Blood products within the ossified cephalic hematoma (OCH), **B)** excision of the OCH and aspiration of blood components, **C)** excision of the OCH down to the true boundaries of the calvarial bone, showing thinning and irregularities on the underlying bone, **D)** the appearance of the stepped and irregular bone margins after removal.

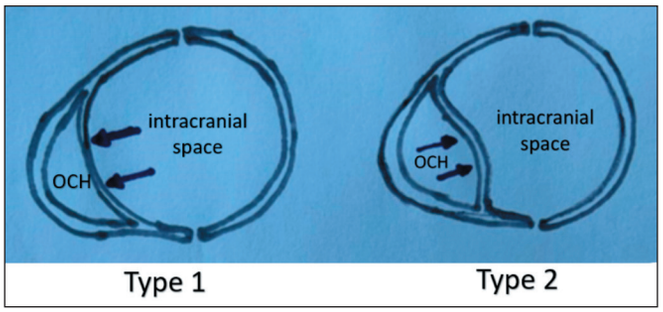


**Figure 6:** Wong classification; if the original calvarial bone under the ossified cephalic hematoma (OCH) retains its normal convex contour, it is classified as Type 1 (arrows); if it becomes depressed and concave, exerting pressure on the intracranial region, it is classified as Type 2 (arrows).

## RESULTS

The average age of the 10 infants in our study was 3.7 months (range: 2–4 months), and the male-to-female ratio of 9:1. OCH was found in the parietal region in nine, with six having right-sided involvement, two having left-sided involvement, the only female having bilateral parietal involvement, and one having occipital involvement. The OCH diameters range from 37 to 90 mm, with an average of 61 mm. The longest operative time was 80 min in the bilateral case, whereas unilateral procedures ranged from 40 and 75 min (average: 60 min). Anesthesia lasted from 70 to 120 min, with an average of around 100 min. Surgical blood loss varied between 20 and 40 mL, and no patient required a transfusion. There were no surgical or postoperative problems, and all patients were discharged from the hospital after an average of 2 days. It was found that all patients were born through normal vaginal delivery, with no birth trauma or the use of assisted delivery equipment such as vacuum or forceps. All patients had normal neurologic tests, and no hematologic illness was detected. Only one patient had an esophageal stricture diagnosed as an extra pathology. Laboratory testing, including a complete blood count and coagulation investigations, was within normal ranges. Cranial CT scans revealed that all patients were classified as Type 1 by Wong's (Figure 6). The infants' postoperative follow-up lengths ranged from 1 to 66 months (Figure 7), with an average follow-up period of 25 months (Table I).

## DISCUSSION

Cephalohematomas are typically found in the parietal region and less frequently in the occipital region, but they can occur on any cranial bone. Unlike caput succedaneum and subgaleal hematomas, cephalohematomas are subperiosteal blood collections that are bordered by suture lines and do not cross the midline (5-9). In 5%–20% of cases, the cephalohematoma may be caused by a linear skull fracture. Intracranial damage is also rarely infrequent (6).

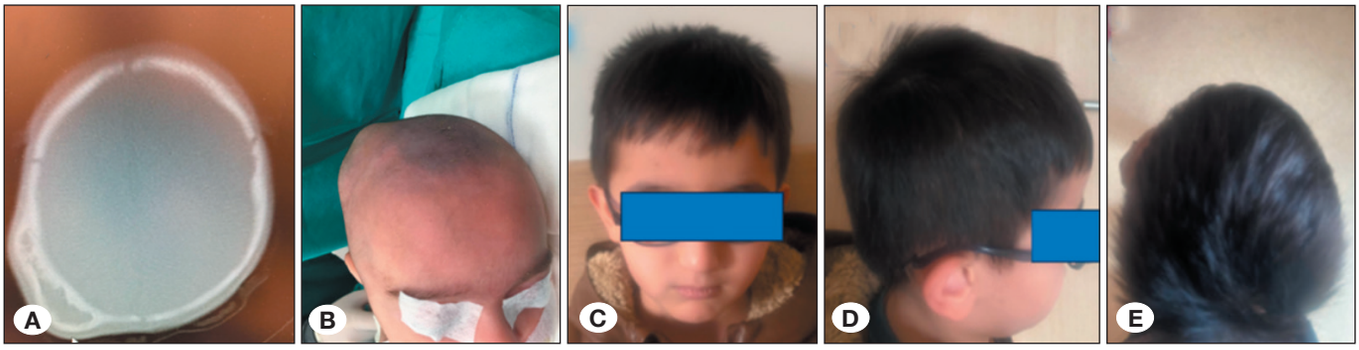


**Figure 7:** Right parietal ossified cephalic hematoma (OCH) belonging to the same patient; **A)** axial CT image, **B)** perioperative photograph, patient at 4-month-old, **C-E)** view from the front, right side, and vertex at the age 5 years.

The specific process of cephalic hematoma development after labor is unknown; however, it is assumed to be an injury induced by the strong and recurrent compression effect of the mother's pelvic bone on the bones of the baby's head, particularly the parietal bones. During birth, contractions and shearing cause bleeding of the diploic arteries into the subperiosteal layer (11). This mechanism also explains why cephalohematomas are more commonly found in the parietal bones. 90% of the patients in our series had a lesion in the parietal region, which is consistent with the literature. The literature reports a 10% rate of bilateral occurrence, and our series included only one female patient with bilateral OCH. One patient has been diagnosed with occipital OCH. This condition is compatible with occipital OCH, the second most common kind reported in the literature.

Cephalohematoma is treated and managed mostly by close monitoring and observation. Because clotted blood resorbs slowly, the enlargement of a cephalohematoma can last for weeks. A calcified cephalohematoma is characterized by a swelling over one or more bones that has been present since birth, initially soft and fluctuant, until firming up. It may be unilateral or bilateral. Cranial sutures establish the limits of cephalohematomas (5,9,13).

Resorption in cephalohematomas is often predicted to occur by the end of the first month or within 4–6 weeks at most (6). If resorption does not occur at this time, the cephalohematoma undergoes ossification, moving from the periphery to the center and producing a firmer calvarial bulge. A microscopic histopathological study of this surgically removed eggshell-like mass revealed dense, fibrous connective tissue with well-formed mature bone trabeculae. Hematopoietic tissue can be found in bone marrow voids surrounded by mature trabeculae. Cytokines and growth factors in the hematoma and osteogenic progenitor cells in the periosteum are hypothesized to contribute to the ossification process. These findings show that in cephalohematoma, rather than simple calcification, apparent ossification occurs beneath the periosteum and above the previous hematoma (6,8,14). Based on these findings, a more drastic surgical approach to ossified hematomas is advocated over a conservative approach (14). However, it should be highlighted that the osteogenesis in the subpericranium differs among patients (13).

A cranial CT scan (3D if possible) is recommended for patients whose cephalic hematoma does not resolve within 6 weeks. CT not only confirms the diagnosis but also eliminates other pathologies in the differential diagnosis (such as subgaleal hematoma, caput succedaneum, leptomeningeal cyst, or cranial meningocele). It also allows for the calculation of the lesions in all three dimensions, which helps to understand the status of the brain parenchyma and plan surgery (5,6,13). Cranial MRI was not required in any of our patients because the diagnosis was made using the 3D Cranial CT and standard anamnestic information.

Cranial CT reveals a double-contour bone picture in the OCH region, which contains soft tissue density. The OCH hardens, forming a clearly defined outer and inner layer of bone around the lesion (3,13). The infant's calvarium forms the inner layer of the OCH, whereas the outer layer is made up of ossified subpericranial bone from the elevated pericranium (6,13). The contour of the inner layer of the OCH might follow the convex curve of the skull or become concave, compressing the intracranial region. Wong categorizes OCHs into two kinds. According to Wong's classification, if the original calvarial bone beneath the OCH retains its normal contour, it is categorized as Type 1, and if it becomes depressed and concave, creating intracranial pressure, it is classified as Type 2 (Figure 6) (13). Every instance in our study was classified as Type 1. As a result, basic excision surgery and periosteum fixation by laying it over the afflicted calvarium were sufficient.

There has been a controversy about whether to treat cephalohematoma conservatively or with early surgical intervention. Some writers documented spontaneous resorption not just in the early phase, but even in instances of OCH followed up for 1 yr or more, and thus suggested cautious treatment. Daglioglu et al. described two cases of calcified cephalic hematoma, which resolved spontaneously after 10 and 16 months (4). They advocated conservative therapy and follow-up. In another case report, Yoon described spontaneous OCH resorption in a 9-month-old infant (15). Üçer et al. reported an ossification rate of approximately 10% in their series of 94 cases of cephalic hematoma >50 mm in size and suggested that these cases were completely or partially resorbed after 1 yr of follow-up, implying that early intervention in the routine treatment of these cases was unnecessary (11).

However, simply seeing OCH cases raises the mental, psychological, and financial on families load on families due to the stress produced by the unpredictable outcome of resorption and the necessity for recurrent hospital visits (6,14). Furthermore, many physicians believe that early intervention, such as puncture drainage or surgical procedures, may be required to correct cosmetic deformities, confirm the diagnosis, prevent restricted brain growth, lower the risk of elevated intracranial pressure, and avoid secondary craniosynostosis (2,6,8,13,14).

Although some publications recommend against puncturing cephalic hematomas due to the risk of infection and late-onset anemia (5,6,9), others report successful treatment without infection by performing single or multiple punctures for the hematoma in the early stages. In a research by Brichtová, 109 out of 123 cephalohematoma patients with nonossified lesions received repeated serial punctures (1–7 times), resulting in permanent remission without the need for additional surgical intervention, and no infections were reported. In the remaining 14 cases, he reported that the cephalohematomas had ossified and required neurosurgical surgery (2). Blanc et al. performed cephalic hematoma evacuation by puncture with local anesthetic under operating room setting in 68 newborns in the early postnatal period (between 15 and 30 days) and found the treatment safe (1). There were no complications noted during or after the procedure. Indeed, attitudes toward puncture treatment have shifted in recent years. Some authors believe that following aseptic principles and conducting early punctures in large infant cephalohematomas can help prevent infection (14). Additionally, cephalohematomas can be linked to hyperbilirubinemia and cerebral bleeding. It has been proposed that puncture drainage of a cephalohematoma may aid in relieving intracranial problems (14).

However, once ossification occurs in a cephalohematoma, puncture is no longer an option. In terms of open surgical interventions to be conducted in these circumstances, the literature contains few surgical series, most of which were undertaken in the late period and included large craniotomies and cranioplasty surgeries. There are reports that in surgeries conducted in the latter phases, when ossification has advanced over months or years, more sophisticated, prolonged, and relatively significant blood loss procedures, such as craniotomy, craniectomy, and cranioplasty, are needed (3,5,6,10,13).

Chung et al. performed a craniotomy and cranioplasty operation in two of their three instances with calvarial bone depression and reported effective repair (3). Wong et al. presented three examples of Type 2 OCH in their publication and explained the cranioplasty surgical procedure method (13). According to an article containing a large series in which Ulma et al. published their 25 yr of experience, surgery was performed in 30 cases with an average age of 8.6 months out of 72 cephalohematoma patients included in the study, and 70% of these patients required bone grafts, and 26.7% required blood transfusions (10).

Despite these late cranioplasty surgeries, Jang et al. described for the first time in 2007 the early “simple excision and periosteal reattachment” technique in a 3-month-old case (7), which we also used in our cases, and concluded that complex cranioplasty surgeries may be unnecessary in OCH cases. In 14 of Brichtová’s 123 cases of OCH (2), he performed a surgery consisting of simple excision of the ossified layer with neurosurgical intervention at an early period of 1–3 months and closure of the periosteum and skin in three layers after calvarial correction with a high-speed drill, with excellent long-term outcomes. Among these articles, Jang et al.’s study is the most similar to our strategy (7), and the first to detail a 3-month case treated using our manner. Brichtová’s series is especially noteworthy because it is the second largest, with 14 cases treated using a similar procedure with outstanding results. In 2025, Xi et al. published the largest series in the recent decade, performing a single puncture and aspiration in 83% of 75 nonossifying cephalohematoma patients and treating 98 OCH cases with the same neurosurgical surgery without cranioplasty (14). Our series, albeit being limited to 10 patients, is the third largest after these investigations and employs the identical surgical method described in the literature. Our experience and findings support the previous three authors’ conclusions. Furthermore, the authors state that neonatal cephalohematoma puncture and aspiration is a safe and effective way to prevent ossification. They also urge early neurosurgical intervention for OCH as it is less technically demanding and reduces the risk of severe surgical trauma (14). Furthermore, postponing surgery may result in resorption, thinning, and irregularity of the original calvarial bone forming the inner layer, increasing compression on the brain parenchyma. This condition, which may demand more sophisticated and lengthy cranioplasty procedures, also raises the possibility of surgical consequences such as dural and parenchymal injury. Vigo et al. described the example of an 11-year-old female who had a chronic ossified OSH that resulted in skull malformation and delayed electroencephalography (EEG). The female underwent surgical removal of her OSH for aesthetic reasons. The EEG abnormalities were resolved following surgery, supporting the theory that there is a link with “brain compression” from the OSH. OSH-related skull malformation necessitates a delayed follow-up period (12).

For these reasons, early surgical intervention is encouraged as it prevents the need for cranioplasty and other difficult surgeries, improves cosmetic outcomes, and is simpler and safer. Our experience fits this perspective (2,14).

Dural injury might arise with the repair of patients’ thinning original calvarial bone surface. Infection and unexpected bleeding are two possible complications. There were no difficulties in our series. However, the small number of cases limits statistically significant findings. Increasing the number of cases may increase the risk of problems.

## CONCLUSION

When a cephalohematoma is diagnosed, the patient should be closely monitored for the first month. However, if ossification occurs, early neurosurgical intervention should be considered. This method is easier in the early stages and provides good cosmetic outcomes without the need for complex surgical procedures such as craniotomy and cranioplasty. Early surgical treatment of OCH with the described method is a

straightforward, safe, and successful procedure with a short operating time and little blood loss. As a result, OCH patients should have a more drastic therapy strategy and early surgical interventions.

**Declarations**

**Funding:** This research did not receive any specific grant from funding agencies in the public, not-for-profit, or commercial sectors.

**Availability of data and materials:** The data that support the findings of this study are not publicly available due to [reason why data are not public; their containing information that could compromise the privacy of research participants] but are available from [the corresponding author upon reasonable request]

**Disclosure:** The authors declare that there are no conflicts of interest related to this study.

**Ethics approval and consent to participate:** This study was performed by the Declaration of Helsinki. This human study was approved by the ethics committee of the Kanuni Sultan Suleyman Training and Research Hospital (Document No: 2025.03.73, Date: 13 March 2025).

**AUTHORSHIP CONTRIBUTION**

Study conception and design: NSB, AO, AT

Data collection: NSB, AT, EC, ES, LA, SD, IB, SC

Analysis and interpretation of results: NSB, AO, AT

Draft manuscript preparation: NSB, IB

Critical revision of the article: NSB, AO, IB

Other (study supervision, fundings, materials, etc...): NSB, AT, EC, ES, LA, SD, SC

All authors (NSB, AO, AT, EC, ES, LA, SD, IB, SC) reviewed the results and approved the final version of the manuscript.

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