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CT IMAGING OF CALVARIAL LUMPS & BUMPS

KEYWORDS: Calvarium, Lumps & Bumps, CT.

Sandeep Mahajan
Associate Professor, Department of Radiodiagnosis, Indira Gandhi Govt. Medical College, CA Road, Nagpur

Aishwarya Damodaran
Assistant Professor, Department of Radiodiagnosis, Indira Gandhi Govt. Medical College, CA Road, Nagpur

Bhavana Sonawane
HOD, Department of Radiodiagnosis, Govt. Medical College and superspeciality hospital, Nagpur.

ABSTRACT **INTRODUCTION**: Calvarial lesion frequently manifest as lumps& bumps with or without associated pain and often pose a diagnostic dilemma. These lesions can be difficult to image as evaluation confounded by their small size. Clinical information is no doubt a key factor in the process of reaching a reasonable diagnosis. **OBJECTIVE**: To find the exact localization of site and extent of the lesion by MDCT and to characterize the lesions by CT so as to reach the diagnosis or to narrow down the differentials. **METHODOLOGY**: In this cross sectional retrospective study, we illustrate the value of cross-sectional imaging techniques using computed tomography (CT) in evaluating these lesions. **RESULTS:** The most common lesions encountered in our centre were post traumatic hematomas and their complications such as chronic calcification and lepto-meningeal cyst formation /growing fracture, miscellaneous lesions like dermoid cysts and fibrous dysplasia, tumours both malignancy and metastasis, benign tumours such as osteoma, osseous hemangioma sebaceous cysts and hemangioendothelioma. Traumatic lesions were the most encountered as our hospital has a well functional and reputed super specialty neurosurgery unit.

INTRODUCTION:

Lumps and bumps on the head are a common presenting complaint and often a source of concern for patients although they are often asymptomatic and incidentally discovered.(1) Clinical suspicion is based on localized pain or the finding of a visible or palpable mass or defect. The differential diagnosis for the examining physician is broad, and radiologic evaluation is often requested. A wide spectrum of congenital lesions and acquired lesions are commonly encountered. Nowadays CT is the initial screening modality of choice. With computed tomography ,the nature of the lesion whether lytic or sclerotic ,presence of calcific foci ,the density of the tissue and the presence or absence of inner and outer table destruction can be evaluated (3)(5).Currently multi detector computed tomography (MDCT) is another very useful tool when it comes to better characterization of these lesions

In this cross sectional retrospective study paper, we discuss and illustrate the radiological features of various calvarial lumps on computed tomography to characterize these lesions.

AIM & OBJECTIVES:

- Exact localization of site and extent of the lesion by MDCT.
- To characterize the lesions by CT so as to reach the diagnosis or to narrow down the differentials

MATERIALS & METHODS:

This study is intended to provide a basic framework for the differentials of calvarial lesions illustrated by the cases found at or referred to our hospital over the last year.

We reviewed the CT of 32 patients with calvarial lesions of all ages and both sexes referred to the Department of Radiology G.M.C. & S.S.H. during the period of Sep 2014 to Sep 2016. The CT were done on 128 slice Toshiba Acquillion scanner using thin-section CT (1 mm thickness with 0.6 mm interval) with volume data with and without the intravenous administration of contrast material. Depending on the location of the lesion, coronal or sagittal reformatted images along with SSD were then obtained to display the lesion and its anatomic relationships with adjacent structures. Such thin-section imaging has become a routine with the rapid scanning and reformation capabilities of the latest generation of multislice scanners.

Fine needle aspiration cytology (FNAC), Biopsy or excisional biopsy of post operative specimen were performed in 28% of cases, and benign lesions are meticulously subject to follow-up without any biopsy.

Inclusion Criteria:

- Patients of all ages and either sex having calvaial swelling on CT examination.

Exclusion Criteria:

- Patients lost to follow up before definitive diagnosis.

Study Design:

- Retrospective cross sectional study.

Study Place &Duration:

- Department of Radiodiagnosis Government Medical College & Superspeciality Hospital, Nagpur.
- Duration September 2015 to September 2016.

OBSERVATIONS & RESULTS:

The most common lesions we encountered in our centre were post traumatic hematomas and their complications such as chronic calcification and lepto-meningeal cyst formation /growing fracture, miscellaneous lesions like dermoid cysts and fibrous dysplasia, tumours both malignancy and metastasis, benign tumours such as osteoma, , osseous hemangioma sebaceous cysts and hemangioendothelioma. The most frequent calvarial tumors multiple myeloma were not referred to our hospital and hence are not featured in this study. Traumatic lesions were the most encountered as our hospital has a well functional and reputed super specialty neurosurgery unit.

INCIDENCE OF LESIONS DIAGNOSIS WISE

SR.NO.	CATEGORY	DIAGNOSIS		NO. OF CASES
1	Trauma	Hematoma	Fresh	12
			Old Calcified	1
2	Infection	Osteomyelitis		3
3	Congenital	Encephalocele		2
		Fibrous Dysplasia		2
4	Tumors	Benign	Osteoma	1

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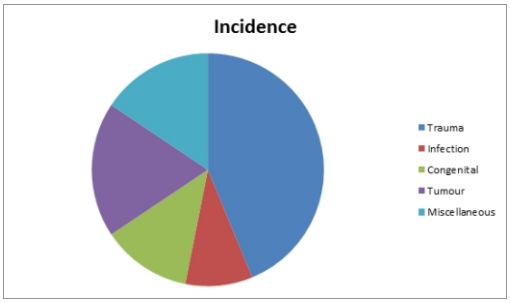
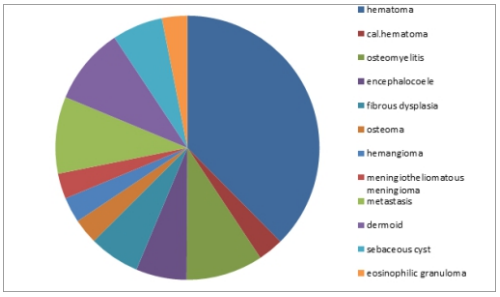
			Hemangioma	1
			Meningiomatous Meningioma	1
			Eosinophlic granuloma	1
		Malignant	Metastasis	3
5	Miscellaneous	Dermoid		3
		Sebaceous Cyst		2
TOTAL				32



In our study we don't have any case of Lymphomatous malformations, AV-Malformation, Nasal Glioma, Neurofibroma, Metastatic Neuroblstoma, Rhabdomyosarcoma, Fibrosarcoma or Multiple Myeloma. The reason being less number of pediatric patients and more of a trauma work because of functional Neurosugery department in our hospital.



LESION LOCALIZATION AND EXTENSIONS

LESIONS	ORIGIN WISE LOCATIONS	EXTENSIONS
Hematomas	Extracalvarial	No
Osteomyelitis	Extracalvarial	Calvarium
Encephalocele	Intracranial	Extracalvarial
Fibrous Dysplasia	Calvarial	No
Osteoma	Calvarial	No
Hemangioma	Calvarial	No
Meningiomatous Meningioma	Calvarial	Extracalvarial & Intracranial
Metastasis	Calvarial	Extracalvarial & Intracranial
Dermoid	Extracalvarial	No
Sebaceous Cyst	Extracalvarial	No
Eosinophilic granuloma	Extracalvarial	No

CONCLUSIONS:

- MDCT is good imaging modality capable of exact localization of site, origin and extensions of the lesion
- MDCT is capable of characterizing the lesions so as to reach the diagnosis and to narrow the list of differential diagnosis.

DISCUSSION:

The calvarium is a bony case that surrounds the brain parenchyma formed by frontal, parietal and occipital bones along with a small contribution from the temporal bones, anatomically divided into an outer and inner table of cortical bone between which is the diploe which contains bone marrow. Focal lesions of the calvarium originate either from its bony elements or secondary to its invasion from the overlying skin or brain parenchyma within(6).

This article illustrates the value of cross-sectional imaging techniques by CT in evaluating a calvarial lesion. We also reviewed the literature and described the characteristic imaging appearances of the most common calvarial lesions, in order to provide information that can lead to a specific radiological diagnosis or to limit the differential diagnosis.

Lesions of the calvarium may be classified as malignant and benign depending on their biological activity ,or as congenital, infective ,or traumatic and miscellaneous as in this study. Primary neoplasms of the calvarium account for 0.8% of all bone tumors. Benign lesions are more common than primary malignancies, but the precise prevalence of each has not been defined because biopsy is not performed on many benign lesions. Radiological evaluation of a patient who presents with a calvarial lesion often requires cross-sectional imaging by computed tomography (CT). Multidetector CT(MDCT), with multiplanar reformatted images, is the most accurate method for evaluating bone destruction, the involvement of the skull tables and diploe, and mineralized tumor matrix. CT is also useful in guiding biopsy to diagnose these lesions. . In many cases, biopsy is warranted in order to diagnose, but some bioptic material may not be histologically representative of the whole lesion, thus clinical-radiological-pathologic correlation is essential in order to make a more accurate diagnosis.(7)

Post Traumatic Extracalvarial Hematomas are the most common swelling as a result of direct or indirect (counter-coupe) trauma. In neonates the cephalhematomas are most commonly found in occipito-parietal regions during normal labor. Most of them will resolve over a period of time with conservative approach but sometimes the untreated chronic hematomas may calcify. In our study we found similar case of chronic calcified hematoma having 1 Yr follow up CT.

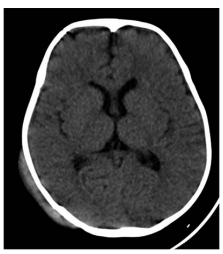


Fig : NECT axial image showing post traumatic extracalvarial scalp acute hematoma in right parieto-occipital region.

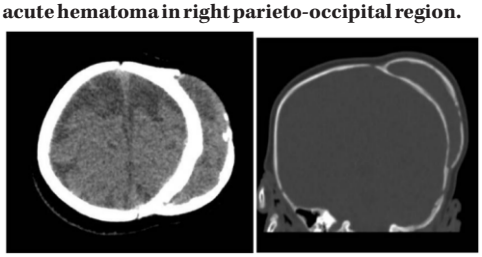


Fig : (A- NECT axial Soft tissue & B-Coronal MPR Bone window) showing well defined extracalvarial swelling with peripheral rim calcification in left high parietal region s/o Old calcified hematoma.

Osteomyelitis of skull bone & scalp abscess are post infective lesions. The infection can be acquired due to direct penetrating injury; post-operative and hematogenous source as in rheumatic heart disease patients or sickle cell disease patients. The scalp abscess can be secondary to underlying bone osteomyelitis or direct soft tissue infection or spread from the mastoid / ear infections.

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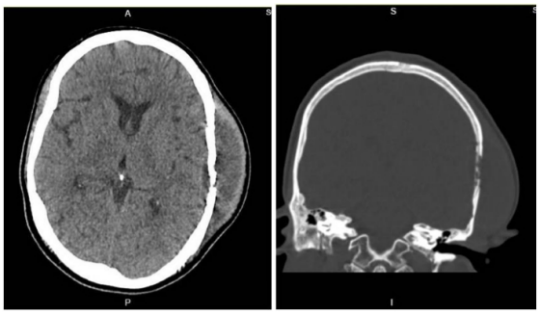

Fig : (A- NECT axial B-Coronal MPR bone window images) showing left parietal bone osteomyelitis with overlying extracalvarial abscess formation.

Encephaloceles

Intracranial tissue that herniates through a defect in the cranium results in an encephalocele. Such lesions are called meningoceles when they contain only meninges and meningoencephaloceles if brain tissue is included in the herniated tissue. They occur in one of every 4,000 live births and are most commonly occipital in location (75% of cases); lesions are frontoethmoidal in 15% of cases and basal in 10%(1). There are often significant associated intracranial anomalies. Occipital encephaloceles may be associated with Chiari or Dandy-Walker malformations and callosal or migrational anomalies. Frontoethmoidal lesions are not typically associated with these types of anomalies. Frontoethmoidal encephaloceles are also known as sincipital encephaloceles and are subdivided into nasofrontal, nasoethmoidal, and naso-orbital types. These encephaloceles are more common in South and Southeast Asian populations. They are found projecting along the nasal bridge between the nasofrontal sutures into the glabella (nasofrontal region), under the nasal bones and above the nasal septum (nasoethmoidal region), or along the medial orbit at the level of the frontal process of the maxilla and the ethmoid-lacrimal bone junction (naso-orbital region)(8). Frontoethmoidal encephaloceles manifest as a clinically visible mass along the nose. The intracranial root of most frontoethmoidal encephaloceles lies at the foramen cecum, a small ostium located at the bottom of a small depression anterior to the crista galli and formed by the closure of the frontal and ethmoid bones. Basal encephaloceles are internal and are not generally externally visible, although they may manifest as a lump or bump in the oropharynx or nasopharynx. Basal encephaloceles include transethmoidal, sphenoethmoidal, transsphenoidal, and frontosphenoidal varieties. Transsphenoidal and transethmoidal encephaloceles are the most common varieties, although they themselves are very rare. The former project through a defect in the floor of the sella and into the nasal cavity, whereas the latter project through a midline or cribriform plate defect into the nasal cavity. Transsphenoidal encephaloceles may be associated with a cleft palate and may also project into the oral cavity. A transsphenoidal encephalocele splays the sphenoid bone, displacing the cavernous sinus laterally, and is positioned anterior to the dorsum sella. Important structures such as the pituitary gland, hypothalamus, optic nerves and chiasm, and anterior third ventricle are typically involved in transsphenoidal encephaloceles. Affected children may present with nasal obstruction(1).

Surgery is the treatment used for encephaloceles. High-resolution CT may also be used to display the bone anatomy, but the intracranial connection is best defined with MR imaging. The extent of cerebral tissue in an encephalocele is also better defined with MR imaging, which aids in prognosis and surgical planning. Association with intracranial anomalies is variable, and some children may have normal clinical outcomes with no associated intracranial anomalies(1).

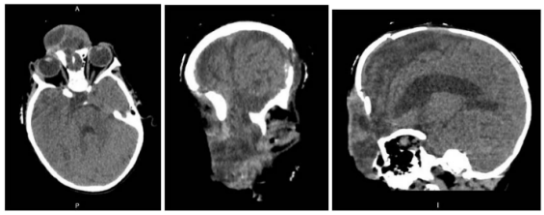

Fig : (A- NECT axial B-coronal & C-Sagital MPR Soft tissue window images) showing frontoethmoidal encephalocele.

Fibrous Dysplasia

Fibrous dysplasia is most frequently seen in childhood and adolescence. The skull is involved in both the monostotic and polyostotic form of the disease. The most common type has a ground-glass appearance with well-defined margins. There is expansion of the diploe with bulging of the outer table and thinning of the inner table, which characteristically does not protrude inwardly(7). Thickening and increased density of the normal bone is present at the margins. The second most common type is the diffusely sclerotic form, mostly found in the skull base. The rarest form is a cystic lytic lesion surrounded by bony sclerosis. (9)

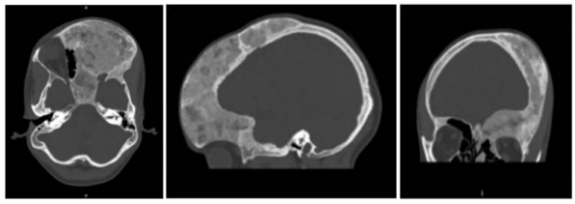

Fig : (A-Axial, B-Sagital MPR & C-Coronal MPR Bone window images) Showing expansile bony swelling with typical ground-glass appearance involving left sided frontal, sphenoid & orbital bones s/o Fibrous Dysplasia.

Osteoma

Osteomas are the most common benign tumors of the calvaria. When symptomatic, they often appear as a painless swelling. On CT, osteomas are dense, smooth, well-demarcated lesions that commonly arise from the outer table. Inner table osteomas can be misdiagnosed as wholly ossified meningiomas. Unlike meningiomas, osteomas show signal void and an absence of soft-tissue component on all MR imaging sequences (9).

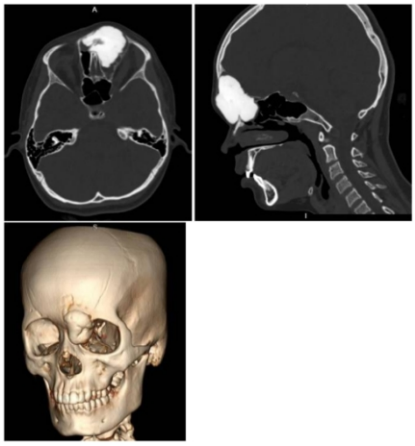

Fig : (A- NECT axial B-Sagital MPR bone window & C- coronal SSD images) showing left fronto-ethmoidal large densely sclerotic lesion s/o Osteoma.

Hemangioma

Hemangiomas can present clinically as palpable masses or can be incidentally detected. These lesions are usually well-defined and radiolucent, with an inner reticulation that has a sunburst or

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honeycomb appearance. Compared with radiography, CT better depicts the radiating trabecular pattern resulting from simultaneous destruction and re- modeling of bony architecture. Periosteal reaction may be seen, but it is uncommon (9).

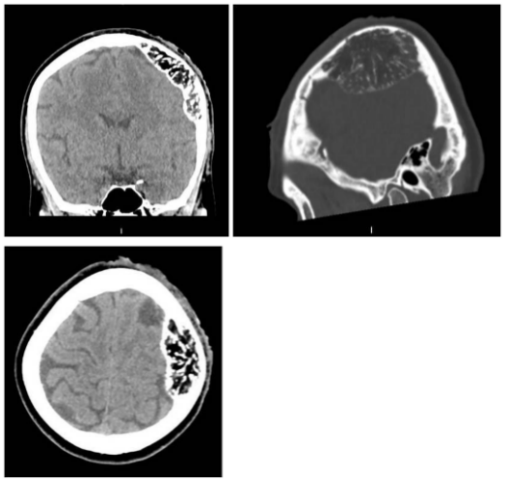

Fig : (A- NECT axial & coronal Soft tissue & B-Sagital MPR Bone window) showing typical sunburst appearance of calvarial swelling in left high parietal region s/o Hemangioma.

Meningioma

Meningiomas are the most common non glial intracranial tumors and typically produce localized hyperostosis of adjacent bone in 4.5-44% of cases. An osteoblastic reaction is commonly seen; less commonly, mixed blastic and lytic reactions are present . Hyperostosis appears on CT as a whorl-shaped inhomogeneous area with local disappearance of the bone laminar architecture. In addition to showing the dural, or carpet like, tumor. Purely lytic reactions are extremely rare and are more aggressive. Primary intraosseous meningioma is also uncommon and has imaging features similar to those of intracranial meningioma (10).

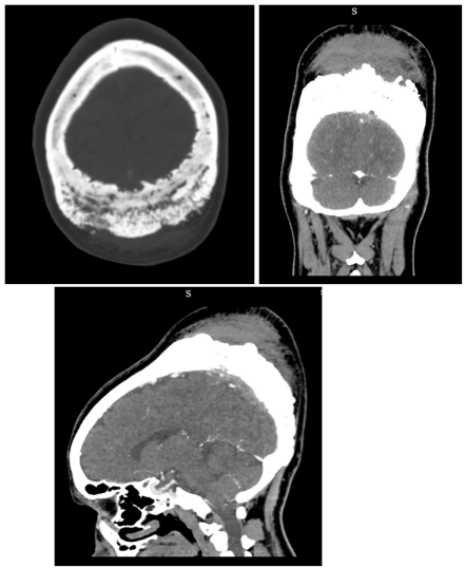

Fig : (A- NECT axial bone window B-Coronal soft tissue MPR & C-Sagital MPR venography images) showing destructive lesion involving both tables of skull vault and predominently extracalvarial & minimal intracranial soft tissue component s/o meningotheliomatous meningioma.

Metastasis

Most multiple abnormal radiolucencies in the calvaria after the fifth decade of life are carcinoma metastases. These lesions are almost exclusively lytic, with ragged margins or permeative destruction. Exceptions to this rule include prostate and breast tumors, which often show osteoblastic reaction (but with less hyperostosis than meningiomas (9). Characteristically, a soft-tissue mass can be discovered.

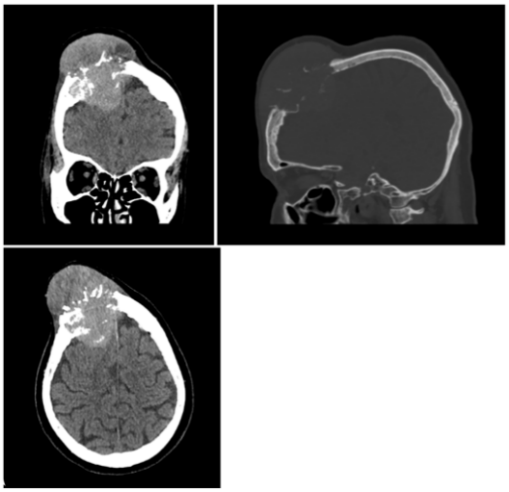

Fig : (A- NECT axial B-Coronal soft tissue window & C-Sagital MPR bone window images) showing destructive soft tissue lesion with extracalvarial and intracranial extra-axial extension of soft tissue s/o metastasis of known carcinoma lung.

Epidermoid and Dermoid Cyst

Epidermal inclusion cysts are mainly located around the midline, but any bone in the cranial vault can be involved. Pressure erosion causes remodeling and expansion of the outer and inner tables. The lesion is typically lytic and oval-shaped with a clearly sclerotic margin. Calcification inside a dermoid cyst represents saponification (9).

Dermoid cysts contain elements of dermal and epidermal origin. These cysts are pre- dominantly located periorbitally and in the posterior fontanel or occipital midline, with or without including the dermal sinus. Dermoid tumors are the largest group of pediatric tumors with intracranial extension (9).

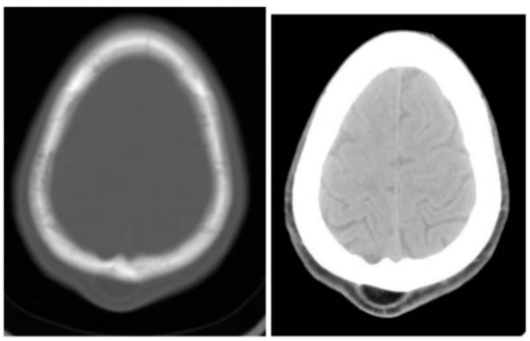

Fig : NECT axial images showing well defined fat density (-120 HU) hypodense cystic lesion in posterior midline extracalvarial scalp s/o Dermoid cyst

Sebaceous cysts also called as epidermal inclusion cyst, are common cutaneous lesions that represent proliferation of squamous epithelium within a confined space in the dermis or subdermis. Epidermal cysts are either found incidentally or present as a firm non-tender lump. If they rupture a local inflammatory response to the necrotic debris released can mimic infection. Although they can be found anywhere, they are typically located on the scalp, face, neck, trunk, and back. Rarely they can be seen within bones representing an intraosseous epidermoid cyst(11).

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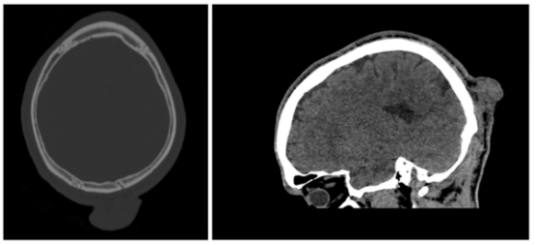

Fig : (A- NECT axial bone window B-Sagital MPR soft tissue window images) showing extracalvarial soft tissue swelling with normal underlying bone s/o Sebaceous cyst.

Multiple radiolucencies with well-defined borders but without reactive sclerosis are characteristic of **multiple myeloma.** The diagnosis of multiple myeloma should be strongly suspected when skeletal lesions are seen at other sites. Rarely, a focal lesion may be due to a plasmacytoma. These lesions have marked enhancement of the soft-tissue component after contrast agent administration (9). Not seen in our study.

Eosinophilic Granuloma (Langerhans' Cell Histiocytosis)

The localized form of Langerhans' cell histiocytosis occurs almost exclusively in children and young adults; at clinical presentation, patients can be asymptomatic or have a palpable soft-tissue mass. The lesions are oval or round isolated lytic lesions that begin in the diplo and involve the full thickness of the calvarium . The margins appear circumscribed, and the edges may be beveled. Bony sequestrum is very characteristic , but periosteal reactions are rarely encountered(9). Not seen in our study.

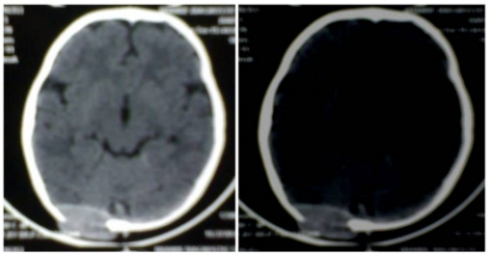

Fig : NECT axial images in an 2 Year old male showing destructive lesion with Soft tissue component on either side of bone and the beveled bony edges. FNAC proven Eosinophilic Granuloma.

In our study we didn't have any cases of, Lymphangiomatous malformations. AV-Malformation, Nasal Glioma, Neurofibroma, Metastatic Neurobalstoma, Rhabdomyosarcoma, Fibrosarcoma or Multiple Myeloma. The reason being less number of pediatric patients and more of a trauma work because of functional Neurosugery department in our hospital.

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