Review Article

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Partial facial hemihypertrophy: A case report and review of literature

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ABSTRACT

Hypertrophy of the facial region is rare developmental malformation. The aim of this study is to report a case of partial facial hemihypertrophy describing its clinical features and debatable heterogeneity of etiologies, along with the review of literature to supplement to its current knowledge in English literature. PubMed search was done from 1986 to 2018, using the terms "Partial facial hemi-hypertrophy" or "Facial hemi-hypertrophy" or "Facial Gigantism" and 95 articles were identified. After manual reviewing and screening, 27 results were included in the analysis. Men are more commonly affected than women, with right side showing more involvement than the left side. Both hard and soft tissues are involved on the affected site. Reconstructive surgeries are usually planned after cessation of physiological growth. It includes orthognathic surgeries or osteotomies. Multiple soft tissue debulking procedures may be performed including excision of excess subcutaneous tissue and masticatory muscles, face-lift surgeries, lip reduction surgery, or parotidectomy. No malignant transformation has been reported in literature. The great variation of asymmetries caused by facial hemihypertrophies requires a combination and variety of sequential treatment procedures to gain adequate functional and cosmetic results. Hence, treatment of such malformation varies radically.

Key words: Facial deformity, facial gigantism, facial hemihypertrophy, hemihypertrophy, partial facial hemihypertrophy

INTRODUCTION

Hypertrophy of the facial region is rare developmental malformation. Hypertrophy has been defined by Dorland as organ enlargement or overgrowth, as a whole or in part, caused by increase in constituent cells size.[1] However, overgrowth limited to unilateral part of the body was called as hemihypertrophy and should involve both skeletal and soft tissues. It was observed that all the structures do not enlarge to the same extent.[2] Embryologically, structures derived from first branchial cleft or from nasal processes are usually involved in hypertrophy. Male dominance (M:F ratio: 3:2) is usually reported, but an equal distribution is seen between the sides involved. Various etiologies have been put forward, but no specific mechanism has been discovered for the same. Management of this deformity shows much variation owing to its numerous types of involvement. The purpose of this article is to represent a case report of partial facial hemihypertrophy along with its review of literature to add to its current knowledge.

CASE PRESENTATION

A 17-year-old female patient presented to our department with the complaint of facial asymmetry since birth which has been increasing with time [Figure 1]. Birth of the patient was by normal delivery. The parents had visited various hospitals for management of the same, but no intervention was done. Medical and family history was unremarkable. There is no history of trauma or any other systemic illness. Serum chemistry gave normal results.

On extraoral examination, there was gross asymmetry with prominent swelling on the left side of the face with following extensions: superiorly, a horizontal line

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joining the left infraorbital margin to the left upper lobe of the ear; inferiorly, a horizontal line along the lower border of mandible; medially, a vertical line extending from medial canthus of the left eye through the left corner of the lip to the lower border of the mandible; and laterally, a vertical line passing parallel along the posterior border of mandible.

Skin over the swelling appeared normal except for presence of light brown pigmentation over the skin in front of the left ear and also over anterior neck region as depicted in Figures 2a, b and 3. Ramal height was increased with respect to the left side leading to bowing of the left angle of the mandible and deviation of the chin to the right side. Bony outgrowth was evident with respect to the left infraorbital region and left malar prominence. The left ear appeared enlarged as compared to right side. On palpation, swelling was soft in consistency, nontender, nonflunctuant, and noncompressible in nature. No paresthesia was evident.

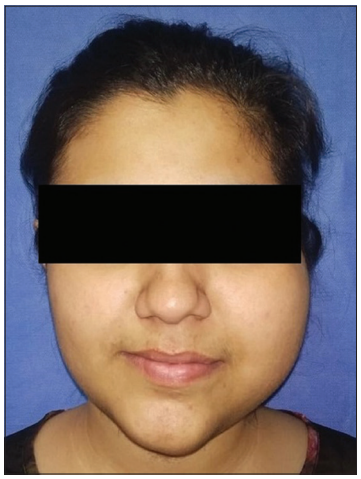


Figure 1: Preoperative facial profile depicting left facial asymmetry

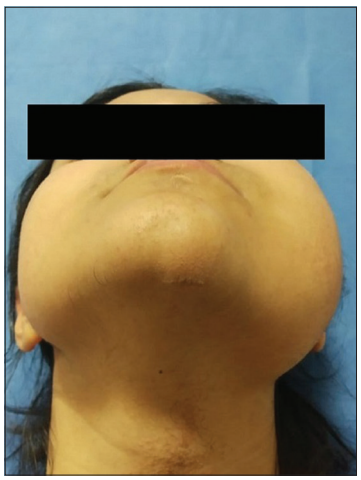


Figure 3: Extraoral examination revealed light brown pigmentation over the anterior neck region

On intraoral examination, mouth opening was within normal limit. Occlusion was satisfactory with mild open bite with respect to the anterior teeth as depicted in Figure 4a and b. Size of the maxillary and mandibular molars along with the alveolar ridges appeared enlarged with respect to the affected side. Canting of the occlusal plane was observed to be downward toward the left.

Radiographic investigation included orthopantomogram and posteroanterior cephalogram, which revealed left condylar enlargement along with widening of the left inferior alveolar canal as depicted in Figures 5 and 6. Furthermore, macrodontia was seen with respect to the left maxillary and mandibular molars along with the enlarged roots with respect to the same teeth. Noncontrast computed tomography confirmed bony overgrowth with respect to the left infraorbital region, left ramal, and left zygoma area. Furthermore, disproportionate enlargement of soft tissues on the affected side was visible on computed tomogram suggestive of increased fatty tissue [Figure 7a-c].

The history of the patient along with physical findings, X-ray examinations, and photograph leads to the final diagnosis of partial facial hemihypertrophy. Laser depigmentation was attempted twice for the skin lesion at the age of 15 years, but to no effect.

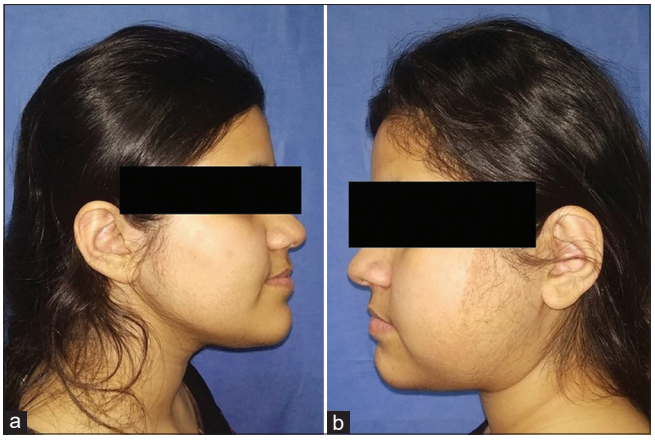


Figure 2: (a and b) Extraoral examination revealed light brown pigmentation over the skin in front of the left ear

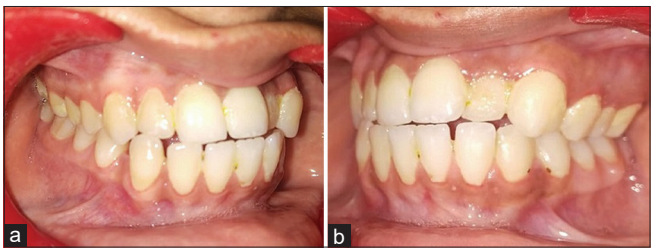


Figure 4: (a and b) Intraoral examination revealed mild anterior open bite with satisfactory occlusion

Left condylectomy was done through the left preauricular approach along with shaving of excess bone with respect to the left zygoma and left infraorbital region through intraoral maxillary left vestibular approach. Furthermore, shaving of the bony overgrowth with respect to the left angle and left lower border of the mandible was done through intraoral crown's incision and vestibular approach under general anesthesia.

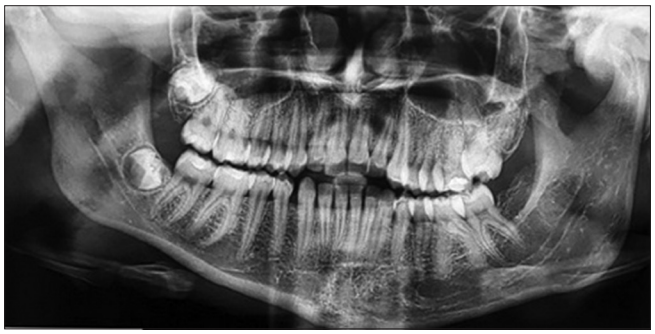


Figure 5: Preoperative orthopantomogram revealed left condylar enlargement along with widening of the left inferior alveolar canal. Also, macrodontia was seen with respect to left maxillary and mandibular molars along with the enlarged roots with respect to the same teeth

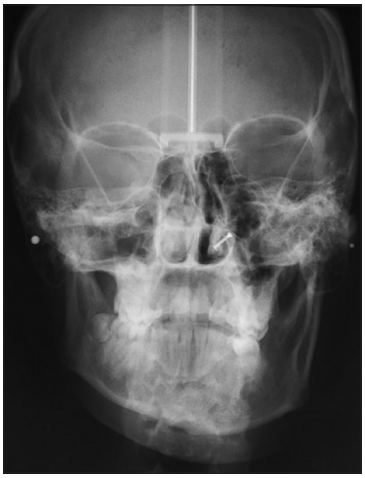


Figure 6: Preoperative posteroanterior cephalogram depicting left condylar enlargement leading to enlarged left vertical height

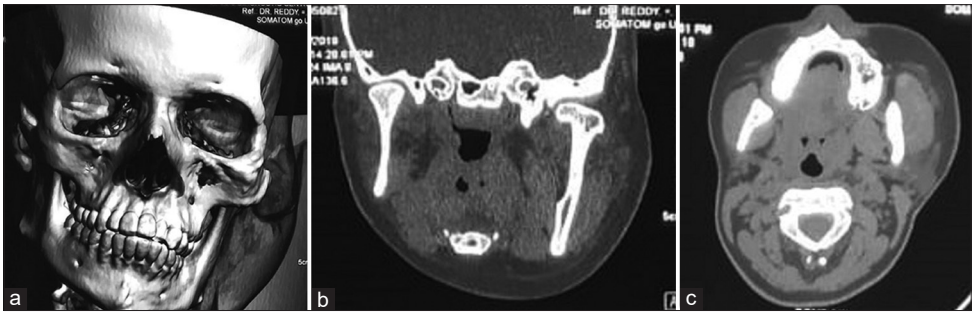
Follow-up of 6 months shows much reduced facial deformity as depicted in Figure 8a-c.

Literature review

In the English language literature, PubMed search was done with the following terms "Partial facial hemihypertrophy" or "Facial hemihypertrophy" or "Facial Gigantism," which yielded 27 results after manual reviewing and screening. Single case reports are 21, case series/multiple case reports are 3, and literature reviews published till date are 3. Adding the present case increases the number of case reports to 22. Of the above-mentioned case reports, 6 were associated with congenital facial hemihypertrophy; 4 were associated with epidermal nevus syndrome; 2 each were associated with lipomatosis, nevus sebaceous syndrome, proteus syndrome, and Klippel–Trenaunay–Weber syndrome; and 1 each was associated with acromegaly, cerebellar hemangioblastoma, and plexiform neurofibromatosis. All the three case series/multiple case reports were associated with neurofibromatosis. Of the literature review, two were based on congenital facial hemihypertrophy and one was associated with epidermal nevus syndrome.

According to Lee *et al.*, only 9 cases were reported of partial facial hemihypertrophy till 2001 as it is seen rare as compared to its true form.[3] According to Bruce B. Horswell, over 240 cases of facial and body hemihypertrophy have been reported.[4] 96 cases were cited by Ringrose, in which other parts of the body were also involved along with the face.[5] Face was the only region involved in 5 cases, whereas in 18 cases, facial region was not involved. Till 1965, over 150 cases were reported, which majorly showed facial involvement.[6,7]

Facial hemihypertrophy was first described by Meckel in 1822 and was reported first by Kottmeier and Wagner in 1839.[8] Hemifacial hyperplasia was first reported by Friedreich in 1863.[9] Its prevalence is reported to be 1:86000 live births according to hospital records



Figures 7: (a-c) Preoperative noncontrast computed tomography showing bony overgrowth with respect to the left infraorbital region, left ramal, and left zygoma area, along with left condylar enlargement. Also, disproportionate enlargement of soft tissues on the affected side can be appreciated

Figures 8: (a-c) Postoperative facial profile depicting corrected facial deformit

of the US.[10] Men are more commonly affected than women, with right side showing more involvement than the left side but in some reports women being affected twice commonly as men.[5] Equal distribution has been reported by Rowe.[11] It affects Caucasians more commonly than Afro-caribbean.[12]

Hemifacial microsomia is a malformation present since birth. It is differentiated from hypertrophy as it has certain typical features such as vertebral anomalies, middle ear malformations, skin tags, and epibulbar dermoids. On the contrary, hemifacial atrophy does not present itself since birth and leads to gross deformity of face.

Development of the enlargement is seen at a rate proportional or faster than the uninvolved side. It is usually observed that condition stabilizes once skeletal maturation occurs and adolescence stage ends.

Alveolar processes are seen to be thicker and wider, along with palatal widening, and occasionally exostoses are formed on maxillary and mandibular ridges.[13] Premature tooth formation is seen which often remains unerupted and creates space in dentition on the side which is affected. Sometimes, deciduous teeth are shed prematurely which are replaced by permanent teeth rapidly. Short roots are also quite common in these teeth. Hypercementosis of tooth roots has also been reported by Kogon *et al*.[14]

Abnormally large teeth are seen due to the hyperproductivity of the dental lamina. The most commonly affected teeth in order are canine, first premolar, second premolar, and first molar.[15] Congenitally missing teeth have also been reported by several authors. According to Stafne and Lovestedt, the form and size of teeth are determined congenitally and not modified later.[12]

Histological features as studied by Pagenstecher showed larger and coarser features.[11] Venous supply is seen to be heavy, and thicker hairs are observed. Fibrous connective tissue seems to be increased along with increased number of cells and skin appendages.[2,6] Variation of the color and texture of the scalp hair has also been reported.[16] Sebaceous and sweat gland secretions are found to be excessive on the affected side. Overgrowth of the tongue is observed, especially in the anterior part with enlarged papillae. Buccal mucosa if involved appears to hang in folds as reviewed by Miles. Uvula, tonsils, and lips may also involve.[13] Pigmentation is seen over the involved skin.[17] Ipsilateral muscles of mastication and parotid gland may show an increased mass.[18] Urban and Roland have reported myohyperplasia as a dominant feature in hemifacial hypertrophy.[6] Due to muscle fiber hyperplasia, the nerve might fail to develop to its normal function and hence can lead to paresthesia.[19] Facial paralysis has been reported in hemihypertrophy by Haicken.[20] Nasal obstruction has also been observed due to nasal mucosa hypertrophy and turbinates enlargement on the side affected. The pupil and ear on the involved side might be seen enlarged.

Various reviews have described abnormalities with respect to skeleton including clubfoot, macrodactyly, syndactyly, scoliosis, and posterior auditory canal exostosis associated with facial hemihypertrophy. Occasionally, association with hepatoblastoma and abdominal tumors such as Wilms' tumor (nephroblastoma) and adrenal cortical carcinoma has also been observed.[21] A case of upper airway obstruction has been reported in hemihypertrophy by Sculerati and Jacobs due to nasopharyngeal enlargement. Some cases show association with medullary sponge kidney, hypospadias, and cryptorchidism.[6] In rare cases, mental deficiency is also noticed among

facial hypertrophy cases along with involvement of central nervous system in the form of epilepsy and strabismus.[22]

Gorlin and Meskin suggested that it is essential to consider and rule out malformations mimicking the lesion such as fibro-osseous lesions (Paget's disease and fibrous dysplasia; as no soft tissue is involved and serum calcium changes are observed), hemangioma, malformation of lymphatics (usually are bilateral and involve different parts of body), and malignant sarcomas such as osteosarcoma and chondrosarcoma.[6] Hence, examination of such patients should be carried out frequently for early identification of early disorders.[23] As per literature, combination of three-dimensional reconstruction via noncontrast computed tomography and volume-rendering system gives a detailed evaluation of the musculoskeletal system.[24]

Much of the variation is seen for the management of this condition as are their types of involvement. The method of treatment is dictated by the severity and site of involvement along with cosmetic considerations. Precise measurement of the asymmetries in all dimensions should be done by a prosopometer as suggested by Lawoyin.[25]

Initially, emotional support is required during developmental years. Involved tissue requires careful assessment for proper planning. Only routine radiographs may not be sufficient and hence require computed tomography scans for the determination of volume of tissue involved. In case hemihypertrophy involves the other parts of the body, abdominal examination should be carried out via ultrasonography to rule out any changes.[26] Pfister *et al*. reported renal medullary changes in two cases, though it is a rare manifestation in childhood.[27]

Treatment is generally recommended when cosmetic correction is required.[28] Both hard and soft tissue corrections might be required in true hemifacial hypertrophy. Cases of slight mandibular hemihypertrophy might show open bite and perhaps require only a dental appliance to correct it in the form of fixed or removable appliance. Some have used overlay appliance or quadrant restorations for the same. However, various surgical techniques have been used for the treatment of unilateral bony hypertrophy of mandible.

An alveolectomy can be performed in case of edentulous patient with enlargement of mandibular body in inferior and superior aspect. Reconstructive surgeries are usually planned after cessation of physiological growth. It includes various orthognathic surgeries or osteotomies including sliding genioplasties. A type of mandibular resection is the treatment of choice if enlargement is observed in body or ramal length. In case of condylar enlargement, condylectomy can be performed. Surgical enlargement of stenosed ear canal was also done in some cases of progressive hearing loss.[4]

Hemihypertrophy involving soft tissues requires its reduction. It may require multiple soft tissue debulking procedures being performed both intra- and extraorally, including excision of excess subcutaneous tissue and masticatory muscles and face-lift surgeries.[18,25] Some also undergo lip reduction surgery.[4] A superficial parotidectomy has also been performed when preserving facial nerve to reduce the soft tissue bulk.[4] Stripping of nasal mucosa, septoplasty, and turbinectomy is done in case of patients with respect to nasal obstruction.[4] Malignant transformation of this malformation has not been reported in English literature.[29]

DISCUSSION

Overgrowth of the tissues of the head and face shows multiple asymmetric variations. A rare congenital malformation showing marked unilateral overdevelopment has been described by various names such as facial hemihypertrophy, hemimacrosomia, partial or unilateral/partial gigantism, and hemifacial hyperplasia. According to Horswell *et al.*, term hemihypertrophy consists of pooled group of nondifferentiable genetic and nongenetic conditions with autosomal dominant mode of inheritance.[4] Stafne *et al*. were of the view that when all the systems including neural, vascular, skeletal, and muscular are included in overgrowth, it is called total hypertrophy. If the overgrowth involves limited areas such as trunk, head, and extremities, it is referred to as segmental hypertrophy.[29] It is seen in rare instances that parts of both sides are involved which is called crossed hemihypertrophy.[30]

Hemihypertrophy was classified into three types by Rowe[11] in 1962 as follows:

1. Complex hemihypertrophy, in which the entire half of the body is involved
2. Simple hemihypertrophy, in which one or both limbs are affected
3. Hemifacial hypertrophy.

He further classified hemifacial hypertrophy into true and partial. The criteria for true hemifacial hypertrophy given by Rowe (modified from Roubier) are as follows:

1. Enlargement of the viscerocranium unilaterally with the following boundaries: frontal bone superiorly (eye not included), lower border of the mandible inferiorly, facial midline medially, and ear/pinna laterally
2. All the tissues within the area to be enlarged: teeth, bone, and soft tissue.

If all the tissues do not show enlargement to the same extent or are limited to one structure, it has been called as partial hemifacial hypertrophy. Pollock *et al.* (1970) opined inadequacy of the term hemihypertrophy because they suggested that significance of cell number is greater than cell volume, and therefore they proposed the term hemihyperplasia.[13] Hemifacial lipomatosis can also present as a variant of hemifacial hyperplasia.[31] Hemifacial myohyperplasia has been described as a separate entity where hyperplasia of the facial muscles is seen predominantly.[32]

There exists etiological heterogeneity as various mechanisms have been implicated for the same. It includes biochemical, endocrine disorders, embryonic, vascular, and lymphatic malformations.[33-35] Facial hemihypertrophy has been seen associated with one of the neurocutaneous disorders such as nevus unius lateris, in which tan-brown lesions are seen along the cutaneous nerve distribution, which may include facial region, neck, chest, back, abdomen, and thigh region. Origin of the lesion is congenital and may remain the same or increase with age. In a review of 16 patients of epidermal nevus syndrome given by Solomon *et al.*, 9 patients showed facial hemihypertrophy.[36] Horswell *et al.* reported that all cases of Japanese hemihypertrophy are associated with cutaneous lesions.[4] Furthermore, it has been associated with Klippel–Trenaunay osteoangiohypertrophy which affects one half of facial region; it was suggested by Bregsma that it might be due to increased vascular supply secondary to abnormal vascular supply. Furthermore, in plexiform type of neurofibromatosis, soft tissue and bone of one side of the face shows gross enlargement. Other syndromes which have been seen associated with this malformation include Beckwith–Wiedemann syndrome and Proteus syndrome.[25]

Some report hereditary factor and an abnormal chromosomal mechanism as a contributory factor in its mechanism.[36] Rudolph and Norvold reported a case in which a familial tendency was observed.[37] Cases have been reported of patients with positive family history though characteristically it is usually of sporadic occurrence.[38] According to Indurkar *et al.*, facial hemihypertrophy can occur secondary to lesion of the bone such as fibrous osteopathies or disorders of condylar overgrowth.[7]

The two most important contributing concepts explaining hemihypertrophy are of Gesell's and Russell's. The anomaly has been considered as embryonal by both these investigators. According to Russell, pathology of placenta is most likely responsible for this type of anomaly. He asserts that several teratogenic and environmental factors during the intrauterine period (e.g., rubella syndrome) alter the ongoing development resulting in limb and facial deformities. Gesell's concept indicated atypical and incomplete form of twinning as the etiology. According to Newman, bilateral doubling was considered as a form of twinning, and that everyone of us can be considered as a pair of twins morphologically since we have been derived from single zygote in case of identical (monozygotic twins), as compared to derivation of two individuals from single ovum as seen in of identical (monozygomatic) twins.

Stockard opined that any deformity during development is due to reduction in oxidation rate which retards its development, and that it can be induced by lowering of temperature.[39] On the contrary, a review by Noe and Berman proposed that mitochondrial damage to the egg postfertilization can lead to over-regeneration leading to hemifacial hyperplasia.[40] Neural crest cells hyperplasia has been reviewed as a basis of this malformation by Pollock and colleagues.[13] Yashimoto *et al.* opined that osteoblast DNA synthesis of the affected side was stimulated by the basic fibroblast growth factor.

Although alteration in prenatal environment leads to retarded embryonal growth, it fails to explain the associated hyperplasia. Three distinct ages are observed in patients with complete hemihypertrophy-chronologic age and physiologic ages for both the sides (affected and nonaffected). Haring and Lewis summarized in their review that all congenital malformations cannot be explained by inhibition of growth. It was observed that there is sparse research involving these mechanisms and that growth hormone injection or carbon dioxide administration to pregnant females produces defects of growth acceleration. Hence, no specific mechanism has been discovered for the discussed malformation.

CONCLUSION

Facial hemihypertrophy in a true sense should involve unilateral enlargement of all the tissues, but it is extremely rare. It may, however, involve mandible, zygoma, and soft tissues as this case report has shown.

The great variation of asymmetries caused by facial hemihypertrophies requires a combination and variety of sequential treatment procedures to gain adequate functional and cosmetic results.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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