# Cleidocranial dysplasia – A review

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## Abstract

Cleidocranial dysplasia is a autosomal dominant inherited disorder, and it is the primary disorder of the bone. When the clinicians' suspect this syndrome, they check for the presence of clavicles. In the literature, yet several other features are reported. Several researches including Chromosomal studies and dermatoglyphics are carried out, for the prevention and management strategies'. This review illustrates the etiology, clinical features, oral features, radiological features and management of cleidocranial dysplasia.

**Keywords:** Cleidocranial dysplasia (CCD), Supernumerary teeth, clavicle aplasia

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## Introduction

Cleidocranial dysplasia was first described in a patient with congenital absence of clavicle in 1765 by Martin. Marie and Sainton coined the term cleidocranial dysostosis in 1898, although descriptions of the disorder can be traced back to the 1760s. The term dysostosis means defective ossification or defect in the normal ossification of fetal cartilages (Gr. osteon - bone). In dysostoses the distribution follows a defect in ectodermal or mesenchymal tissues. Rarely are all bones involved. As derived from the Greek, dysplasia refers to abnormality of development or "ill formed" (Gr. plassein - to form); in pathology it means alteration in size, shape, and organization of adult cells.[1]

## Etiology

Cleidocranial dysplasia is a dominant, inherited autosomal bone disorder with a wide range of expressivities, primarily affecting bones undergoing intramembranous ossification. The CCD gene has been mapped to chromosome *6 p21* within a region containing the *CBFA1* gene, a member of the Runt family of transcription factors, which controls differentiation of precursor cells into osteoblasts. It is thus essential for membranous as well as endochondral bone formation, which may be related to delayed ossification of the skull, teeth, pelvis and extremities in CCD. The genotype–phenotype correlations in mutational studies of the *RUNX2* domain show a variable clinical spectrum, suggesting that skeletal growth and dental development could be related to the type of changes in the *RUNX2* activity.[2]

## Clinical features: (Table 1)

### *Face and general appearance:*

The appearance is generally pathognomonic. Affected individuals are usually short, with males averaging 156.6 to 168.8 cm and females 144.6 to 148.5 cm. The skull is brachycephalic, with pronounced frontal and parietal bossing, and the maxilla and zygomas are hypoplastic; thus, the face appears small. The nose is broad at the base, with the bridge depressed. There is hypertelorism. The neck appears long, and the shoulders are narrow and droop markedly and the occipital bone above the inion. Secondary centers of ossification appear in the suture lines, and many wormian bones are formed. In extreme cases, the parietal bones are not present at birth. The cranial base has short sagittal diameter. Mandibular length is increased and the maxilla is short vertically. The foramen magnum, which is large, often exhibits defects in the posterior wall. Paranasal sinuses and mastoids are often underdeveloped or absent.[3]

### *Bones:*

The clavicles are the first bone to ossify and/or commonly affected, being either hypoplastic or aplastic. Complete absence of the clavicles occurs in about 10% of cases and usually only the acromial end is absent. When there is unilateral absence, it is usually in the right clavicle.[4] Complete or partial absence of clavicular calcification, with associated muscle defects, results in hypermobility of the shoulders, allowing for variable levels of approximation in an anterior plane. Other bones also may be affected, including the long bones, vertebral column, pelvis, and bones of the hands and feet. Hemivertebrae and posterior wedging of the thoracic vertebrae may contribute to the development of kyphoscoliosis and pulmonary complications.[5]

Other findings include scoliosis, vertebral anomalies, spina bifida occulta, a wide pubic symphyseal space with a "chef's hat" appearance of the femoral head, long second metacarpals and short tapering distal phalanges on both hands. 3D computed tomography of the cranium in patients with CCD is beneficial because it clearly delineates the open fontanelle, unlike the anteroposterior view in which the opened fontanelle is superimposed on the occipital bone.[6]

***Oro-Dental findings:***

The formation and eruption of deciduous teeth is normal. However, significant problems are observed on the permanent dentition that is demonstrated by delayed eruption of permanent teeth. It is known that extraction of deciduous teeth does not promote eruption of permanent teeth. Rushton and others studied teeth microscopically and observed that roots lacked a layer of cellular cementum. Fleischer-Peters suggested that the greater than normal bone density of the jaws might inhibit tooth eruption. Rushton and Hitchin attributed noneruption of teeth to failure of bone to resorb.[3] Usually, the first molars and the mandibular incisors erupt normally. The delayed eruption of the maxillary central incisors is usually the cause for seeking treatment.[7]

A case report in which ground section and a decalcified section of an extracted deciduous first molar demonstrated complete absence of cellular cementum, paucity of acellular cementum, and disorganized dentinal tubules. Biochemical analysis revealed a decreased serum alkaline phosphatase level with a normal phosphate level.[6]

In addition, large number of unerupted supernumerary teeth often mimics a premolar. As many as 63 unerupted supernumerary teeth have been documented in one patient. Reason for the formation of multiple supernumerary teeth is still unknown.[1] Radiographically appearance of supernumerary teeth is common in the area of the maxillary incisors as well as in the areas of the maxillary and mandibular canines and premolars. The presence of supernumerary teeth not only obstructs eruption and produces impaction of permanent successor teeth but also leads to morphological dysplasias of the crowns and more commonly the roots of the permanent teeth due to deficiency of sufficient space for proper development. Sometimes congenital absence of some teeth is also observed. An important finding during clinical examination that may significantly contribute to the timely diagnosis of the syndrome is the presence of spacing among the mandibular permanent incisors and the eruption of the second permanent molars while the rest of the dentition is still deciduous.[7]

Other findings include narrow ascending ramus, a slender and pointed coronoid process, coarse trabeculation of the mandible, cyst formation especially dentigerous cyst[5] with supernumerary teeth mainly in the premolar region.[6] A case series depicted that cephalometric features displayed increased Y axis and marked increase in the Frankfort's Mandibular Angle (FMA). These irregular changes resulted in mandibular rotation (Y axis-FH), ramus inclination – FH and the mandibular plane (FH) being forwarded with a clockwise rotation, causing a mandiblular protrusion.[8]

***Other findings:***

Conduction hearing impediment has been described. Although mental development is usually normal, several patients with mild delay have been reported.[3] Temporal arachnoid cyst was also found to be associated with CCD.[9]

***Dermatoglyphics:***

A study on 3 patients assessed dermatoglyphic patters in which total ridge count (TRC) and bilateral arch patterns were examined. The dermatoglyphic findings of these CCD patients with respect to the TRC were found to be lower than the normal study population. The cases exhibited varied arch patterns and different sequence types. There was a predominance of Loop pattern in all the cases. One of the case illustrated Loop pattern in all the fingers. The other arch patterns were Composite and Target whorl concentric circles. It depicts an association of the dermatoglyphics and CCD.[8]

**Management:**

Management for the patient with CCD is quite challenging. The earlier the treatment is initiated; the better is the prognosis. Comprehensive dental and craniofacial management involves the team work of radiologists, pedodontists, oral maxillofacial surgeons, prosthodontists and orthodontists to achieve better facial aesthetics.[4]

Treatment of CCD includes dental procedures to address the affects of retention of deciduous dentition, presence of supernumerary teeth, noneruption of the permanent dentition along with related malocclusion and periodontal conditions accompanying them. When root length of the normal permanent teeth has reached about one- third of its final length, the overlying supernumerary teeth should be removed, together with overlying bone and primary

teeth. In regions where no supernumerary teeth are formed, eruption may also be improved by removal of the primary teeth and surgical exposure of the underlying permanent teeth. Simply the extraction of primary teeth to promote eruption of the permanent successors has been found to be unsuccessful. Hence, orthodontic extrusion of the impacted teeth is also required.[10]

The use of implants in a patient with CCD to support a removable overdenture has been documented.[11] Other suggested treatment include removal of only the erupted teeth and use of a removable prosthesis to minimize alveolar bone loss. The process is usually carried out in stages, as teeth that are guided into their ideal position in the arch can subsequently serve as vertical stops to maintain the vertical dimension while the next group of unerupted teeth is exposed and bonded. Following alignment of all permanent teeth, any underlying skeletal discrepancy (most commonly a Class III skeletal malocclusion) can be corrected through orthognathic surgery after completion of growth.[12]

Through this review it clearly explains that CCD is a cosmetic syndrome. It requires multispecialty dental approach. Early prognosis is mandatory as dentigerous cysts are reported in these cases due to impacted teeth. Further, psychological counseling to these patients are essential due to cosmetic problem.

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| CLINICAL | RADIOLOGICAL | DENTAL |
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Table 1 : **Cleidocranial dysplasia Features**

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| Skull is brachycephalic, frontal and parietal bossing, maxilla and zygomatic arch are hypoplastic, wormian bones,large foramen magnum with defect in walls | Complete or partial absence of clavicular calcification | Delayed eruption of permanent teeth |
| Paranasal sinuses and mastoids are underdeveloped are absent | Scoliosis | Formation and eruption of deciduous teeth normal |
| Hypertelorism | Vertebral anomalies | Complete absence of cellular cementum, paucity of acellular cementum |
| Broad nose, depressed nasal bridge | Spina bifida occulta, | Increased density of jaws |
| Neck appears long | wide pubic symphyseal space | Disorganized dentinal tubules |
| Shoulders are narrow and drooping | "chef's hat" appearance of the femoral head, | Unerupted supernumerary teeth often mimics a premolar |
| Clavicles are hypoplastic or aplastic | Long second metacarpals | Spacing among the mandibular permanent incisors and the eruption of the second permanent molars while the rest of the dentition is still deciduous |
| Hypermobility of shoulders | Short tapering distal phalanges | Narrow acending ramus |
| Kyphoscoliosis and pulmonary complications | Open fontanelle | Slender, pointed coronoid process |
| Conduction hearing impediment | | Coarse trabeculation |
| Total ridge count was lower | | Dentigerous cyst |
| Predominance of Loop pattern | | Increased Y axis and FMA in cephalometrics |