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Diagnosis and Management of Cleidocranial dysplasia: A case Report

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Abstract

Cleidocranial dysplasia (CCD) is an uncommon hereditary condition characterized by a range of skeletal and dental irregularities, primarily caused by mutations in the RUNX2 gene. This case report details a 19-year-old female patient who visited the Department of Oral and Maxillofacial Surgery with complaints of multiple supernumerary teeth and retained deciduous teeth. The patient exhibited several hallmark features of CCD, including frontal bossing, an underdeveloped maxilla, a concave head shape, a flattened malar region, short stature with a bell-shaped chest, and sloping shoulders. The clinical presentation and treatment plan, which involved a phased approach combining surgical and orthodontic procedures, are discussed. Virtual surgical planning played a critical role in Surgically Assisted Rapid Palatal Expansion (SARPE). The positive outcome of this case emphasizes the importance of a multidisciplinary strategy in treating CCD and suggests the need for further exploration into standardized treatment protocols for this rare disorder

Introduction

Cleidocranial dysplasia (CCD) is a rare genetic disorder, affecting approximately one in a million individuals globally. [1] It follows an autosomal dominant inheritance pattern and is caused by mutations in the RUNX2 gene. RUNX2, also known as runt-related transcription factor 2, is vital for the development and maintenance of the skeletal system, as it regulates the differentiation of mesenchymal cells into osteoblasts. Additionally, this gene acts as a transcription factor, activating the expression of several other genes critical for skeletal growth. [2] Mutations in RUNX2 disrupt normal skeletal and dental development, leading to features such as open fontanelles, delayed cranial suture closure, and the presence of Wormian bones. [3] Other key characteristics include underdeveloped clavicles and short stature. In the oral cavity, common findings include delayed shedding of primary teeth, supernumerary teeth, delayed eruption of permanent teeth, a protruding mandible, and a high-arched or cleft palate

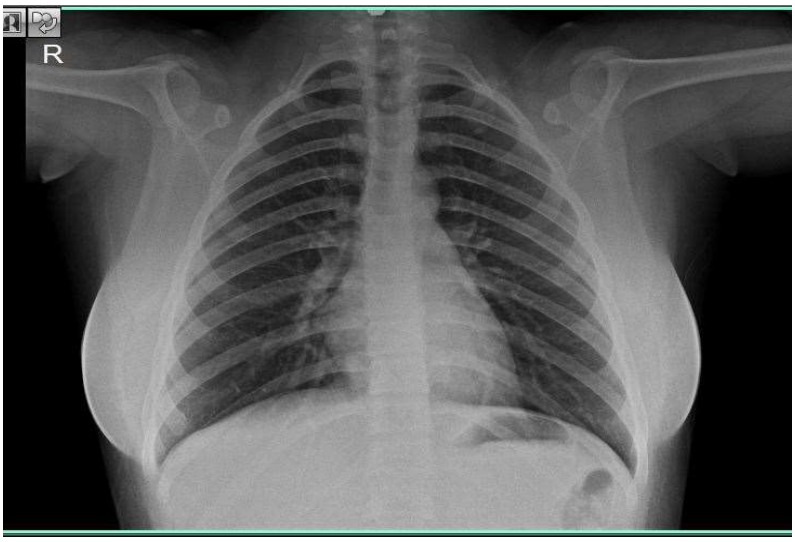
CASE DESCRIPTION

A 19-year-old female patient presented to the dental clinic with concerns about missing upper front teeth since birth. She had previously visited several dental clinics for issues related to missing and misaligned teeth and had a history of abnormal growth patterns since childhood. The patient did not report any pain or speech difficulties.

During the general examination, the patient exhibited short stature (4 feet 5 inches), sloping shoulders, and disproportionately short forearms and legs. The extra-oral assessment revealed a brachycephalic head shape, prominent frontal bossing, a hypoplastic maxilla, and a concave facial profile. Additional findings included a depressed nasal bridge, a short midface, and hypertelorism.

Figure 1 a, b: Body showing abnormally short stature and sloping shoulders with abnormal face shape

Figure 2: Radiograph showing absent Clavivles



Intra-oral examination showed unerupted permanent maxillary anterior teeth and multiple retained deciduous teeth. Radiographic imaging, including an orthopantomogram and CBCT, was performed. The CBCT revealed an open metopic suture and patent fontanelles. Bilateral hypoplasia of the maxilla and rudimentary zygomatic arches were also identified, alongside the presence of seven retained deciduous teeth and five supernumerary teeth, which contributed to the impaction and non-eruption of seven permanent teeth. A PA chest X-ray showed a bell-shaped thorax with congenital absence of the clavicles.

Figure 3: 3-Dimensional CT scan showing Metopic Suture

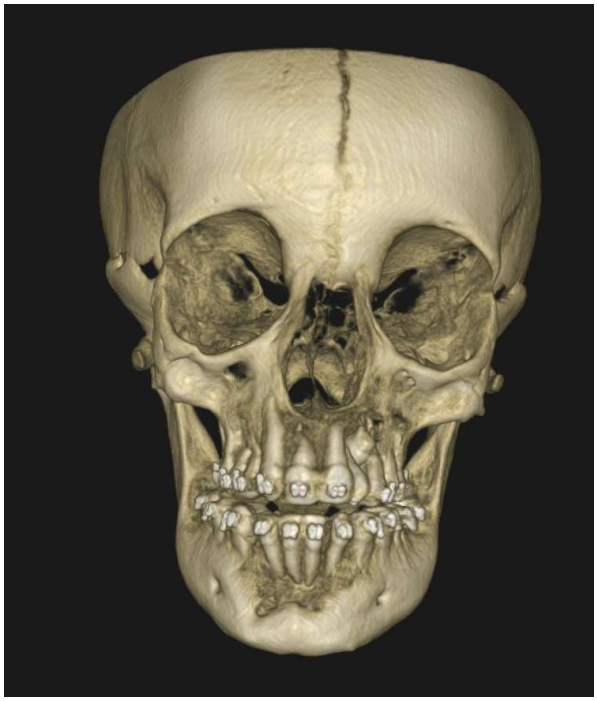
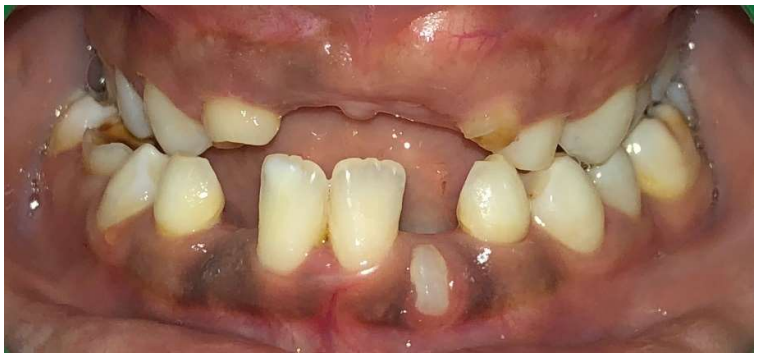


Figure 4: Intra-oral Pre-operative photographs



A review of the patient's medical history and pediatric records revealed stunted physical growth but no significant psychosocial developmental issues. Based on clinical findings and the patient's medical history, a provisional diagnosis of cleidocranial dysplasia (CCD) was made.

A comprehensive treatment plan was developed, focusing on the surgical and orthodontic rehabilitation of the patient to restore normal facial structure and dentition. An intra-oral scanner was used to create a virtual diagnostic cast, and a lateral cephalogram was taken. Bilateral Class I molar relationships were observed. Further analysis, including Steiner's analysis, Wits appraisal, and Burstone analysis, confirmed maxillary hypoplasia and a high-arched, narrow palate. The treatment plan was divided into two phases.

Figure 5: Pre-Operative Lateral Cephalogram

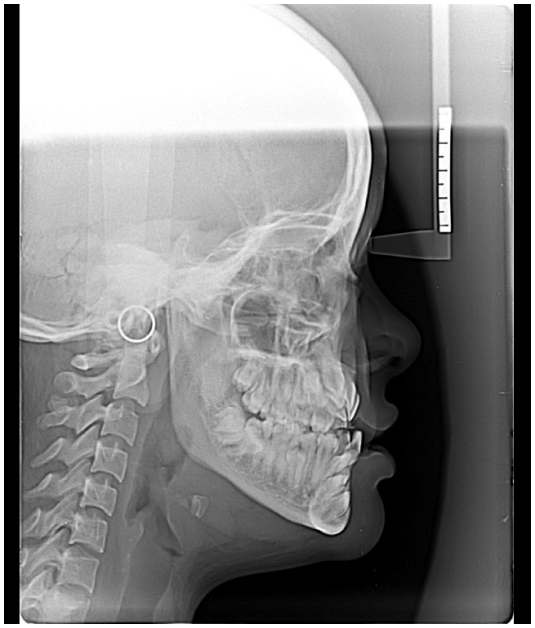
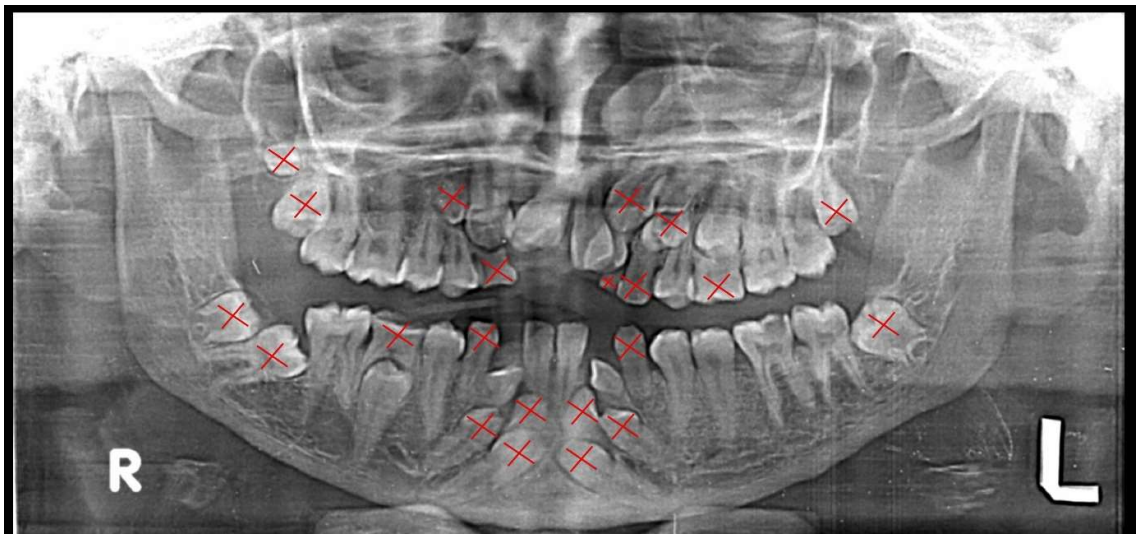


Figure 6: Orthopentamogram with marked teeth for extraction



Phase one involved the extraction of all deciduous and supernumerary teeth under general anesthesia. Additionally, seven impacted teeth were surgically removed, and the maxillary and mandibular permanent anterior teeth were exposed surgically to facilitate orthodontic extrusion. After the procedure, methylcellulose gel and PRP were applied to the extraction sites to promote healing. After two weeks of healing, fixed orthodontic appliances were placed using pre-adjusted edgewise brackets. Orthodontic treatment lasted two years and included the extrusion of the maxillary permanent central and lateral incisors bilaterally, as well as mandibular lateral incisors, the right canine, and the left second premolar. A transpalatal bar was utilized to distalize the molars, creating space for the anterior teeth. The proclination of the mandibular anterior teeth was also corrected. Once the supernumerary teeth were extracted, the midface discrepancy was accurately measured, and the correction was planned using Surgically Assisted Rapid Palatal Expansion (SARPE).

Figure 7 a, b : Intra-operative

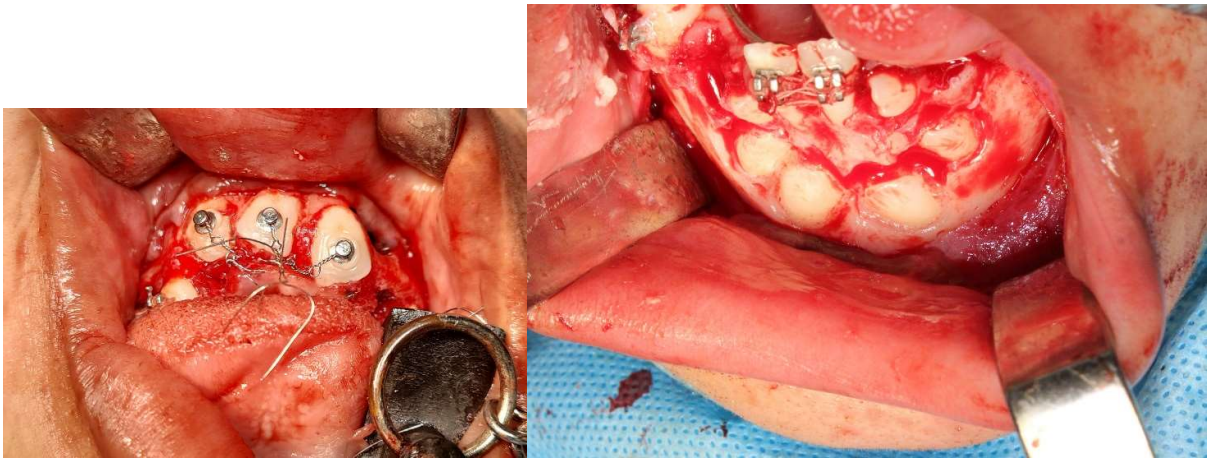


Figure 8: Extracted teeth

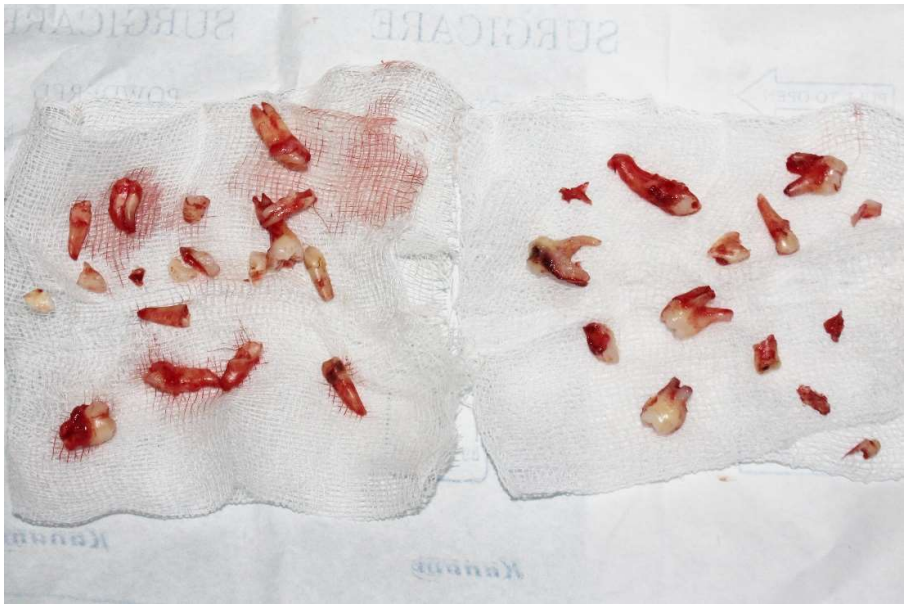
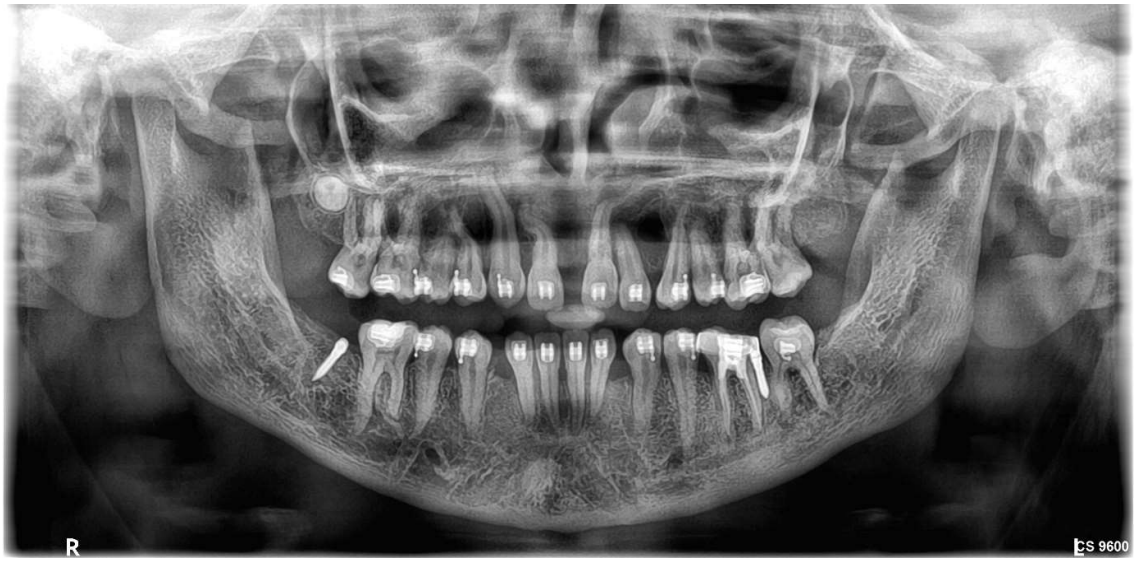


Figure 9: Post-operative Orthopentamogram



SARPE, commonly employed for patients with maxillary deficiencies and narrow, high-arched palates, was planned to address the patient's transverse and vertical deficiencies. Pre-surgical planning involved creating a stereolithographic model of the patient's face using an intra-oral scanner. Virtual mock surgery was performed to ensure precise expansion and correction of the posterior crossbite.

During the SARPE procedure, a labial vestibular incision was made to access the maxilla, followed by a Le Fort I osteotomy and mid-palatal split. Pterygomandibular disjunction was performed, and the maxilla was down-fractured to correct the transverse dimensions. A bonded rapid maxillary expander (RME) with a HYRAX device was activated intraoperatively and post-operatively at 0.5 mm per day to achieve palatal expansion. Once sufficient expansion was achieved, fixed orthodontic treatment continued to close the midline diastema and correct the anteroposterior and transverse malocclusions. Minor occlusal adjustments were made to establish optimal occlusion.

Figure 9 a, b, c: Virtual surgical planning

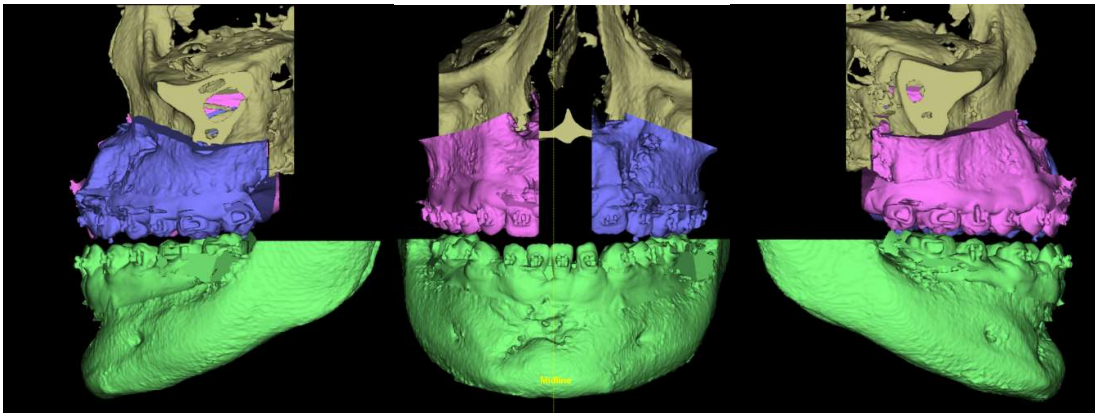


Figure 10 a, b : Intra-operative

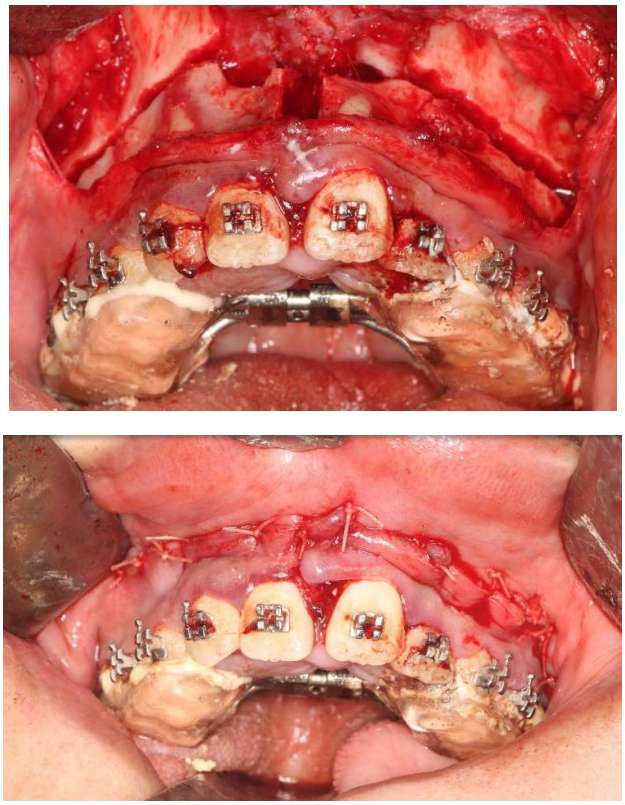
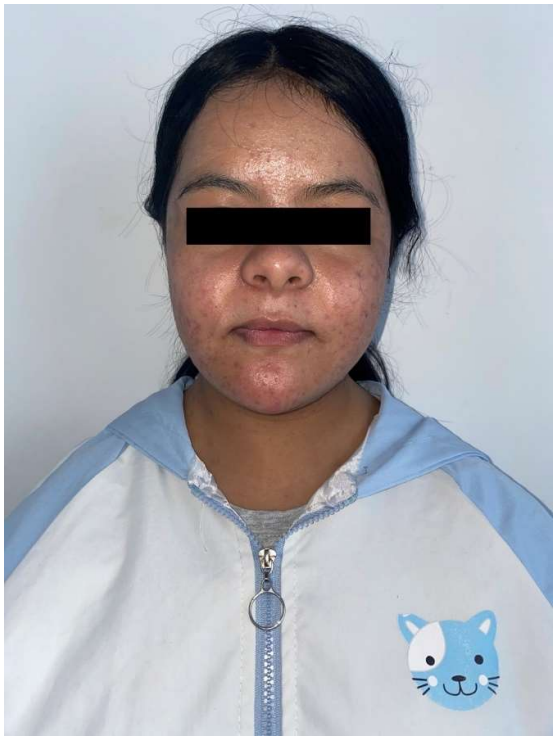
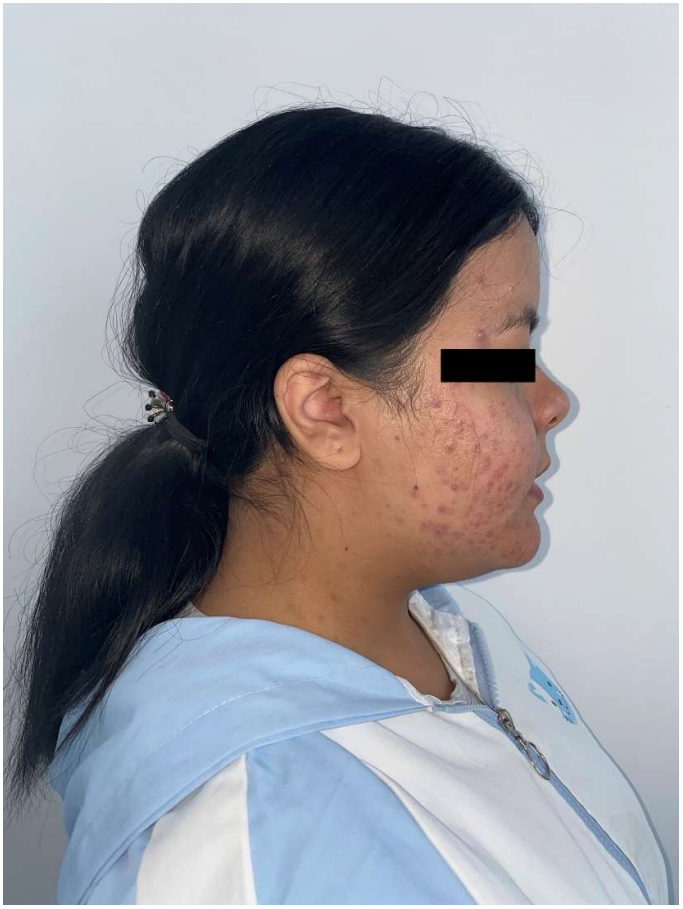


Figure 11 a, b : 2 years follow up review





Over the course of two years, the patient adhered to the treatment plan, resulting in successful outcomes with significant improvement in both dental and facial aesthetics.

DISCUSSION

Cleidocranial dysplasia (CCD) is classified as a congenital skeletal disorder that belongs to the group of osteochondrodysplasias. The primary molecular defect in CCD arises from mutations in the RUNX2 gene, located on chromosome 6p21.1. RUNX2 functions as a key regulator of osteogenesis, guiding the differentiation of mesenchymal cells into osteoblasts, which is fundamental for skeletal formation. [4]

The genetic mutations in CCD vary significantly, ranging from missense mutations to large deletions within the RUNX2 gene. These alterations disturb normal bone formation, leading to the characteristic skeletal anomalies associated with CCD.

Clinically, CCD presents with features such as short stature and a bell-shaped thorax, often detected incidentally in anteroposterior chest X-rays. A distinctive feature is the partial or complete absence of the clavicles, resulting in increased shoulder mobility. Hyper-adduction of the shoulders, enabling the approximation of the shoulders at the midline, is a classic finding. [5,6]

The case discussed here demonstrates many of the hallmark features of CCD and offers a proposed treatment plan. The management of this patient follows well-established protocols and aims to restore both function and aesthetics. Treatment for this syndrome typically involves surgical intervention due to the disruption of normal bone resorption, leading to retained deciduous teeth and delayed eruption of permanent teeth. The presence of supernumerary teeth further complicates the natural eruption process. Therefore, the first step in treatment is often the extraction of supernumerary and retained deciduous teeth, which facilitates the eruption of the permanent teeth. Orthodontic extrusion may be necessary due to the impaired eruptive mechanism. After all the permanent teeth have emerged, orthodontists can accurately assess space requirements and formulate a definitive treatment plan.

Two main treatment protocols are commonly employed for CCD: the Toronto-Melbourne protocol and the Jerusalem protocol. [8,9] The Toronto-Melbourne protocol advocates early intervention, beginning with the sequential extraction of deciduous teeth—front teeth at ages 5 or 6, and posterior teeth at ages 9 or 10—allowing for the natural eruption of permanent teeth. Early extractions enable proper eruption of the permanent dentition. The Jerusalem protocol, in contrast, initiates treatment at a later stage. Permanent teeth are exposed, and traction is applied only after deciduous anterior teeth are removed at ages 10–12 and posterior teeth at age 13.

Due to the patient's age (19), the Toronto-Melbourne protocol was not applicable. The delayed presentation posed a challenge, as the patient had already passed the natural growth phase that could have been beneficial for treatment. Management in such cases requires high patient compliance, as it involves extensive orthodontic therapy, including the continuous use of intermaxillary elastics, frequent visits to a dental hygienist, and diligent oral hygiene. Rapid palatal expansion is typically employed to correct maxillary transverse deficiencies, ideally during a patient's growth phase. However, in older patients, like this one, Surgically Assisted Rapid Palatal Expansion (SARPE) is recommended. Skeletal Class III malocclusion, often seen in CCD, may require a Le Fort I osteotomy, possibly combined with a Bilateral Sagittal Split Osteotomy (BSSO).

In addition to surgical considerations, managing CCD patients poses unique challenges for anesthetists, particularly when mid-face deficiency and hormonal factors are involved. Mid-face hypoplasia in CCD can complicate airway management, as retrusion of the maxilla may limit mouth opening, making intubation more difficult. Additionally, cervical spine anomalies, though rare, may necessitate careful positioning to prevent spinal injury during intubation. However, no such complications were encountered in this patient.

Before proceeding with surgery, a comprehensive preoperative evaluation was performed to check for growth hormone deficiencies and possible thyroid abnormalities. Some studies have indicated that individuals with CCD may experience growth hormone deficiency, affecting their physical development. In such cases, preoperative hormone therapy may be necessary. [7] In this patient, however, growth hormone and thyroid-stimulating hormone (TSH) levels were within normal ranges, eliminating the need for hormonal intervention.

Another important anesthetic consideration is the altered shape of the rib cage, which may compromise lung function and increase the risk of hypoxia during general anesthesia.

Despite the psychological challenges often associated with prolonged orthodontic treatment in syndromic patients, especially young adults, this patient exhibited strong self-esteem, particularly after achieving favorable treatment outcomes. Nonetheless, the extended treatment duration could impact her overall quality of life during the active treatment phase, raising questions about the long-term psychosocial and economic benefits. Further research is needed to explore the cost-benefit balance of such treatments. Careful interdisciplinary planning and a commitment to minimizing the burden of care are essential, with patient selection being a key factor in successful outcomes.

References:

1. Machol K, Mendoza-Londono R, Lee B. Cleidocranial Dysplasia Spectrum Disorder. 2006 Jan 3 [updated 2023 Apr 13]. In: Adam MP, Feldman J, Mirzaa GM, Pagon RA, Wallace SE, Bean LJH, Gripp KW, Amemiya A, editors. GeneReviews® [Internet]. Seattle (WA): University of Washington, Seattle; 1993–2023. PMID: 20301686.
2. Otto F, Kanegane H, Mundlos S. Mutations in the RUNX2 gene in patients with cleidocranial dysplasia. Hum Mutat. 2002 Mar;19(3):209-16. doi: 10.1002/humu.10043. PMID: 11857736.
3. Farrow E, Nicot R, Wiss A, Laborde A, Ferri J. Cleidocranial Dysplasia: A Review of Clinical, Radiological, Genetic Implications and a Guidelines Proposal. J Craniofac Surg. 2018 Mar;29(2):382-389. doi: 10.1097/SCS.0000000000004200. PMID: 29189406.
4. Zheng Q, Sebald E, Zhou G, Chen Y, Wilcox W, Lee B, Krakow D. Dysregulation of chondrogenesis in human cleidocranial dysplasia. Am J Hum Genet. 2005 Aug;77(2):305-12. doi: 10.1086/432261. Epub 2005 Jun 10. PMID: 15952089; PMCID: PMC1224532.
5. Bharti K, Goswami M. Cleidocranial dysplasia: A report of two cases with brief review. Intractable Rare Dis Res. 2016 May;5(2):117-20. doi: 10.5582/irdr.2016.01022. PMID: 27195196; PMCID: PMC4869578.
6. Adhikari A, Shrestha S, Bhattarai P, Khanal S, Lamichhane R, Balayar R, Panta S, Marasini K. Cleidocranial dysplasia-A case report of incidentally found and lately diagnosed disorder. Clin Case Rep. 2022 Oct 8;10(10):e6440.

doi: 10.1002/ccr3.6440. Erratum in: Clin Case Rep. 2022 Dec 13;10(12):e6732. PMID: 36245444; PMCID: PMC9547988.

7. Takaki N, Mori J, Matsuo S, Osamura T, Michigami T. Cleidocranial dysplasia with growth hormone deficiency: a case report. BMC Pediatr. 2020 Jan 16;20(1):19. doi: 10.1186/s12887-020-1914-8. PMID: 31948427; PMCID: PMC6966812.
8. Becker A, Shteyer A, Bimstein E, Lustmann J. Cleidocranial dysplasia: Part 2--Treatment protocol for the orthodontic and surgical modality. Am J Orthod Dentofacial Orthop. 1997 Feb;111(2):173-83. doi: 10.1016/s0889-5406(97)70213-0. PMID: 9057617.
9. Zhu Y, Zou Y, Yu Q, Sun H, Mou S, Xu S, Zhu M. Combined surgical-orthodontic treatment of patients with cleidocranial dysplasia: case report and review of the literature. Orphanet J Rare Dis. 2018 Dec 4;13(1):217. doi: 10.1186/s13023-018-0959-3. PMID: 30514338; PMCID: PMC6280340.