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Why was the concordance rate of imaging and clinical diagnosis in cemento-osseous dysplasia low? A retrospective study of 55 cases

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Abstract

Objective The World Health Organization (WHO) recommends that cemento-osseous dysplasia (COD) be diagnosed based on imaging findings, avoiding biopsy when possible. This study aimed to evaluate the concordance between imaging and clinical diagnoses in 55 COD patients, and to identify key clinical and radiographic features that may help prevent unnecessary biopsy or inappropriate treatment.

Methods Between September 1, 2017, and August 31, 2018, 55 patients diagnosed with COD were randomly selected from the imaging database of West China Hospital of Stomatology. Two radiologists reviewed all cases to assess correlations between COD variants and clinical symptoms, identify common misdiagnoses, and examine subsequent treatment decisions.

Results The cohort showed a strong female predominance (female: male = 48:7). The concordance rate between imaging and clinical diagnoses was only 1.8% (1/55); the remaining 98.2% were either misdiagnosed or overlooked clinically. Most lesions were incidentally discovered on radiographs (65%), while others were associated with tooth pain (18%), facial swelling (9%), tooth mobility (5%), or abscess (2%). A statistically significant difference was found between symptomatic and asymptomatic groups across COD variants (Fisher's Exact Test, $P < 0.05$; Cramer's $V = 0.45$, 95% CI: 0.28–0.67). Among 27 clinically overlooked cases, only one was correctly diagnosed. Misdiagnoses included tooth-related diseases ($n = 10$), tumors or cysts ($n = 6$), osteomyelitis ($n = 3$), bone islands ($n = 1$), and mixed diagnoses ($n = 7$). No significant differences were observed in COD variants, treatment duration, or the number of clinical visits and departments among the misdiagnosed cases. The only correctly diagnosed patient received surgical curettage. Twenty-two patients received no treatment. Others underwent root canal therapy, extraction, curettage, or combinations thereof. Some patients also received dental implants or orthodontic treatment.

Conclusion Cemento-osseous dysplasia (COD), a type of non-neoplastic fibro-osseous lesion of the jaw, is frequently misdiagnosed in clinical practice. These diagnostic errors often lead to unnecessary interventions and complications.

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Enhanced clinician training in radiographic interpretation—particularly the use of cone-beam computed tomography (CBCT)—is essential for enhancing diagnostic accuracy and guiding appropriate management.

Keywords Cemento-osseous dysplasia, Fibrous dysplasia of bone, Radiological examination

Introduction

Benign fibro-osseous lesions are a group of disorders with overlapping histopathological features, making accurate diagnosis challenging [1]. Cemento-osseous dysplasia (COD) is among the most common types in this category. In COD, normal bone is replaced by fibrous connective tissue, followed by the gradual deposition of immature bone that becomes sclerotic over time [2]. COD is likely the most frequently encountered fibro-osseous lesion in dental practice. However, its classification and diagnosis have long been debated. The World Health Organization (WHO) has updated the classification of COD several times. In its 2017 revision, COD was formally divided into three subtypes: periapical (PCOD), focal (FocCOD), and florid (FCOD) [3–6].

The histopathological features of fibro-osseous lesions are often overlapping and difficult to distinguish [7–9]. As a result, histology alone provides limited value in diagnosing COD. Clinically, COD is usually asymptomatic and is often discovered incidentally during routine dental radiographs [10]. Due to the risk of secondary infection, biopsy is generally discouraged, and radiographic evaluation is considered sufficient for diagnosis [11]. The WHO also advises that biopsy should be avoided whenever possible when diagnosing COD [6]. However, general dentists often lack adequate awareness of COD, which contributes to frequent misdiagnoses and underdiagnoses [10, 12, 13]. Alsufyani et al. compared the diagnostic accuracy of general practitioners (GPs) and oral and maxillofacial radiologists (RGs). Their study showed that RGs were significantly more accurate in identifying COD, highlighting the importance of imaging expertise [14].

Accurate identification of radiographic features is crucial to avoid unnecessary biopsies, particularly in asymptomatic cases [6]. Inadequate understanding among clinicians can result in inappropriate treatment and clinical complications [15]. Despite existing literature on COD imaging, limited studies comprehensively assess diagnostic concordance and its clinical consequences, especially when integrating cone-beam computed tomography (CBCT) evaluation and analyzing subsequent treatment decisions for complex procedures.

We hypothesize that concordance between clinical and radiographic diagnoses of COD is low, particularly across its different variants. We also propose that specific radiological features may help predict clinical symptoms. The dataset is derived from our robust clinical database. Additionally, it aims to add new clinical insights for

managing COD in patients requiring dental implants or orthodontic treatment.

Methods

The study was approved by the Institutional Review Board of West China Hospital of Stomatology, Sichuan University (WCHSIRB-D-2022-344). On average, the Department of Oral Medical Imaging receives approximately 200,000 patient visits annually. Since September 2017, the institutional imaging database has collected over one million records. To ensure a sufficient follow-up period, we reviewed 180,961 imaging records obtained between September 1, 2017, and August 31, 2018, and identified 556 cases of fibro-osseous lesions. Of these, 500 were diagnosed as cemento-osseous dysplasia (COD). All COD cases were confirmed by consensus between two experienced oral and maxillofacial radiologists.

Each included case had at least a panoramic radiograph or a cone-beam computed tomography (CBCT) scan to ensure full visualization of the maxilla and mandible. When there were diagnostic inconsistencies among periapical, panoramic, and CBCT images, findings from all modalities were reviewed together. CBCT was used as the reference standard because of its superior diagnostic accuracy.

The imaging diagnosis of COD was based on the following radiographic features:

- *Location*: The lesion is typically located near the apex of a tooth.
- *Shape*: The shape varies from round or oval to irregular.
- *Internal Density*: This depends on the stage of the lesion—radiolucent in early stages, mixed radiolucent and radiopaque in intermediate stages, and predominantly radiopaque in mature stages (Fig. 1).
- *Margins*: Lesions usually have well-defined borders with a surrounding radiolucent rim, although this may be less distinct in mature stages.
- *Effects on Surrounding Structures*: These may include loss of the lamina dura and jaw expansion, especially in larger lesions.

COD cases were classified into three variants: periapical, focal, and florid. Periapical COD typically appears in the anterior mandible and is often bilaterally symmetrical. Focal COD usually involves a single site and is associated

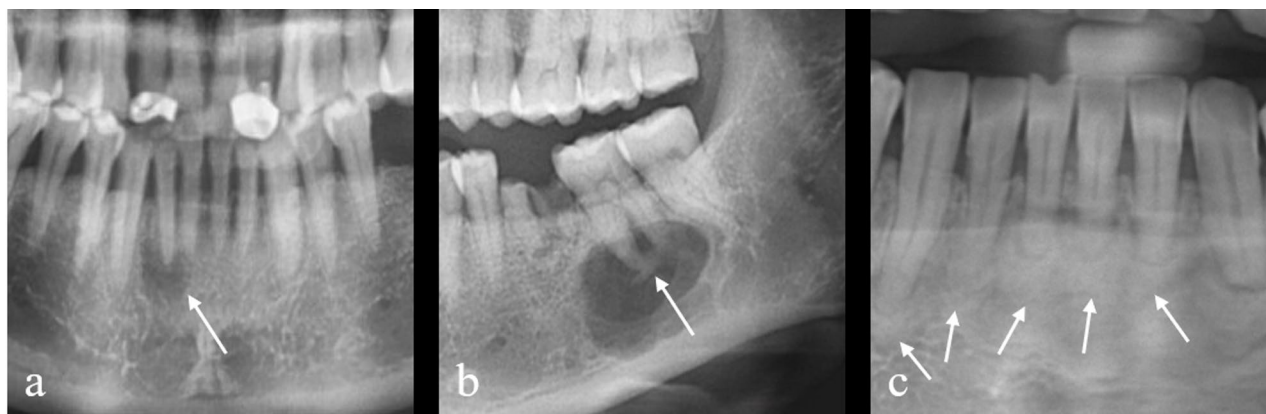


Fig. 1 Radiographic progression of cemento-osseous dysplasia (COD) through its three classic stages. **a** Early stage: A well-defined radiolucent lesion is visible in the periapical area of the mandibular premolar region (arrow). At this stage, the lesion is often mistaken for a periapical cyst or granuloma due to its radiolucency and proximity to the tooth apex. There is no significant bone expansion or sclerotic change, which makes early diagnosis challenging without vitality testing and clinical correlation. **b** Mixed stage: The lesion shows a combination of radiolucent and radiopaque components (arrow), representing intermediate maturation. The central calcified deposits begin to form within the fibrous stroma. **c** Mature stage: The lesion demonstrates a predominantly radiopaque appearance (arrows) with minimal surrounding radiolucency. This stage is characterized by dense mineralized tissue. Borders are usually well-defined, and the lesion is generally asymptomatic

with one tooth. Florid COD is characterized by multiple lesions affecting both jaws and several quadrants (Fig. 2).

Two board-certified oral and maxillofacial radiologists independently interpreted the imaging data. The interobserver agreement was strong, with a Cohen's kappa of 0.78 (95% CI: 0.70–0.86, $P < 0.001$) for overall COD diagnosis, and 0.81 (95% CI: 0.75–0.87, $P < 0.001$) for variants of COD. To reduce bias, both radiologists were blinded to the initial clinical impression diagnoses. Any disagreements were resolved through discussion to reach a final consensus. Sample size was determined using power analysis, assuming a medium effect size (Cohen's $w = 0.4$), power = 0.80, and $\alpha = 0.05$. A minimum of 50 cases was required. Accounting for a potential 10% exclusion rate due to poor image quality, the final target sample size was set at 55. Later clinical and imaging data were collected, including presenting symptoms, clinical impression diagnoses, COD variants, and treatment decisions. The Federation Dentaire Internationale (FDI) tooth numbering system was used for standardization.

Statistical analysis

Fisher's Exact Test was used to assess differences in gender, age, and COD variants between symptomatic and asymptomatic groups. The association between COD variants and clinical symptoms was assessed using Cramer's V. Clinical data across impression diagnosis groups were compared using independent t-tests or one-way ANOVA, depending on data distribution. Treatment patterns were summarized using descriptive statistics. All statistical analyses were performed using IBM SPSS Statistics version 21.0 (SPSS Inc., Chicago, IL, USA). A P-value of less than 0.05 was considered statistically significant.

Results

Among the 55 patients with COD, there was a clear female predominance, with 48 females and 7 males. The majority of cases occurred in middle-aged individuals. Specifically, 51% of patients were between 30 and 59 years old. Younger patients under 30 accounted for 17%. The remaining 32% were aged 60 to 79, with equal distribution between the 60–69 and 70–79 age groups (16% each). The average age was 52.7 years.

Of the 55 patients, 36 (65%) were asymptomatic. In these cases, the lesions were discovered incidentally through radiographs, either by the clinician or the radiologist. Among symptomatic patients, the most common complaints were tooth pain (18%), facial swelling (9%), tooth mobility (5%), and abscess formation (2%).

We compared patients based on the presence or absence of clinical symptoms. There were no statistically significant differences in gender or age between the two groups. However, Fisher's Exact Test showed a significant association between COD imaging variants and symptom presentation ($P < 0.05$). The strength of this association was moderate, with a Cramer's V of 0.45 (95% CI: 0.28–0.67). Adjusted residual analysis revealed that periapical COD (PCOD) was more likely to be asymptomatic (residual = ± 2.4). Focal COD (FocCOD) accounted for 47% of all cases but showed no significant correlation with symptoms (residual = ± 1.1). Florid COD (FCOD), on the other hand, was more likely to be symptomatic (residual = ± 3.0) (Table 1).

Only 1 out of 55 cases (1.8%) was correctly diagnosed clinically. This resulted in a combined missed and misdiagnosis rate of 98.2%. Among the misdiagnosed cases ($n = 27$), the most common clinical impressions were: dental-related conditions ($n = 10$), tumors or cysts ($n = 6$),

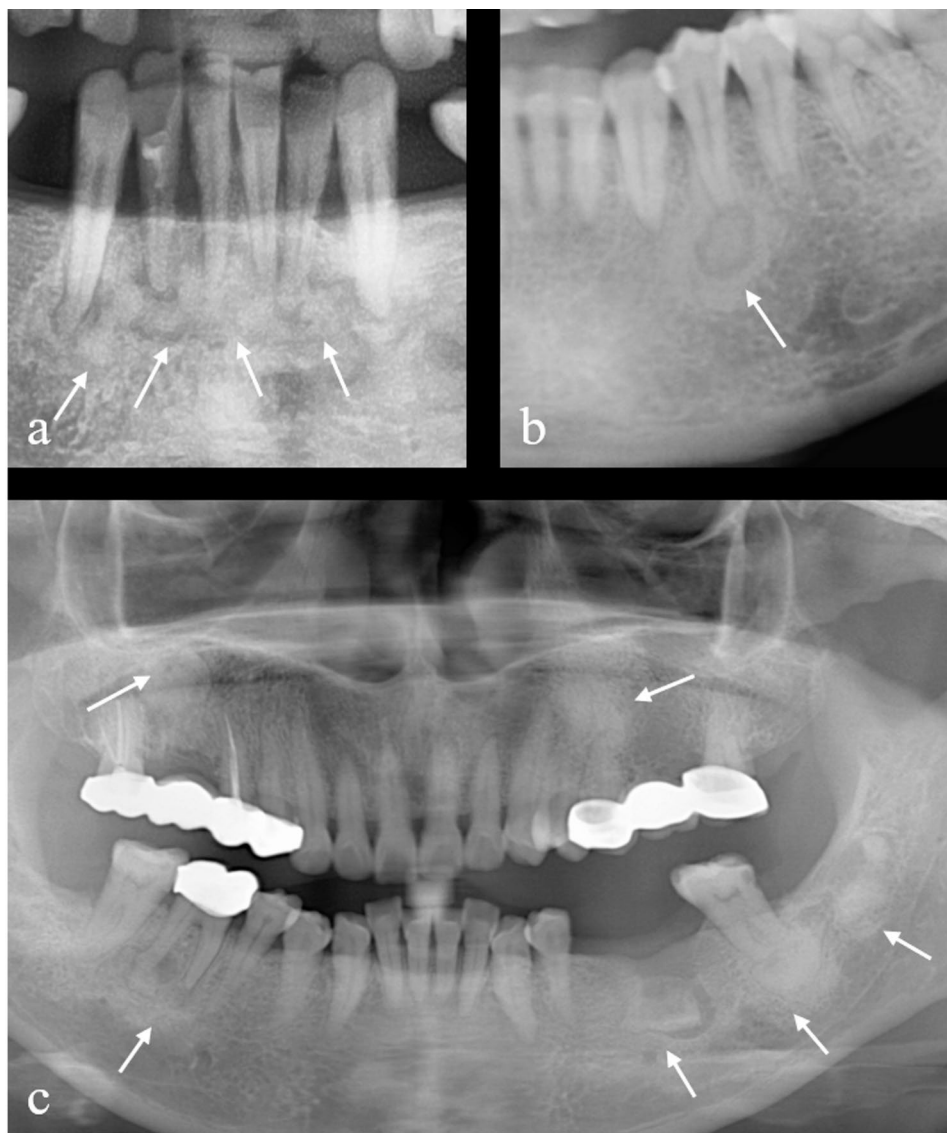


Fig. 2 Radiographic presentation of the three major variants of cemento-osseous dysplasia (COD). **a** Periapical COD: This variant is typically localized to the periapical region of the mandibular anterior teeth (arrows). It often presents as bilaterally symmetrical radiolucent to radiopaque lesions in vital teeth. In the early stages, lesions may mimic apical periodontitis, leading to potential misdiagnosis and unnecessary endodontic treatment. As the lesion matures, radiopaque material becomes more prominent, helping distinguish it from inflammatory pathology. **b** Focal COD: This form usually appears in the posterior mandible, involving a single site or tooth (arrow). Radiographically, it evolves from a well-circumscribed radiolucent lesion to a mixed or predominantly radiopaque mass. Its limited extent and solitary nature help differentiate it from florid COD. **c** Florid COD: This variant is characterized by multifocal, bilateral lesions involving two or more quadrants of the jaws (arrows), most commonly the posterior mandible and maxilla. The lesions may range from radiolucent to radiopaque. The widespread, symmetrical distribution is a hallmark of florid COD

osteomyelitis ($n=3$), bone islands ($n=1$), and mixed pathologies ($n=7$). Only one case was accurately identified as COD before radiographic evaluation. There were no statistically significant differences between the diagnostic impression groups in terms of gender, age, treatment duration, number of follow-up visits, number of referral departments, or COD subtypes ($P>0.05$). (Table 2)

Regarding treatment, 49% of patients ($n=27$) were clinically missed and later diagnosed with COD through

radiographic evaluation by radiologists during retrospective analysis. Among these, four patients had planned or requested dental implants. Two received implants in areas distant from the COD lesions, and both cases were successful (Fig. 3). The other two had implants placed near COD-affected regions. One was successful, while the other failed, likely due to compromised bone quality (Figs. 4 and 5). Another 27 patients were retrospectively found to have been misdiagnosed before COD was confirmed radiographically. Among them, four patients were

Table 1 Patient demographics

Variables	Asymptomatic	Symptomatic	P value
Gender			0.722
Male	n=5	n=2	
Female	n=31	n=17	
Age	49.6±13.5	58.8±12.4	0.971
COD variant			0.003
PCOD ^a	n=9 (2.4) ^d	n=0 (-2.4)	
FocCOD ^b	n=19 (1.1)	n=7 (-1.1)	
FCOD ^c	n=8 (-3.0)	n=12 (3.0)	

a: PCOD: Periapical cemento-osseous dysplasia; b: FocCOD: Focal cemento-osseous dysplasia; c: FCOD: Florid cemento-osseous dysplasia; d: Adjusted residuals appear in parentheses below observe frequencies

referred to other clinics and subsequently lost to follow-up. In total, 16% of patients (n=9) underwent single-modality treatments, including tooth extraction (n=4), root canal therapy (n=2), surgical curettage (n=2), and cleaning and scaling (n=1). An additional 22% (n=12) received multi-modality treatments. Among them, six patients had both tooth extraction and curettage (Fig. 6), three received root canal therapy followed by extraction, and the remaining three underwent extraction combined with other treatments. Two patients had additional treatment needs—one required a dental implant, and the other underwent orthodontic intervention (Fig. 7). Only one case was accurately diagnosed as COD by both the referring dentist and the radiologist. This patient was treated with tooth extraction and curettage (Tables 3 and 4).

Discussion

Diagnostic concordance findings

A key contribution of our study is its diagnostic approach based solely on radiological criteria, without relying on biopsy. This reflects real-world clinical practice, where asymptomatic COD typically does not require invasive

procedures. Our findings highlight a significant and persistent gap in diagnostic accuracy. Among 55 patients in our retrospective analysis, only one case was correctly identified by both the referring clinician and the radiologist. The other 54 cases were either misdiagnosed or completely overlooked.

This result supports earlier findings by Alsufyani et al. [14], who reported that oral radiologists correctly diagnosed COD in 79.3% of cases, compared to only 38.7% accuracy among general practitioners. These discrepancies emphasize the importance of radiologic expertise in identifying COD. Notably, 65% of cases in our study were discovered incidentally during routine imaging, consistent with previous studies showing that COD is often asymptomatic [2, 7, 16]. Given this, the WHO’s recommendation to diagnose COD clinically and radiographically—without biopsy in most cases [6]—is both practical and essential to avoid unnecessary interventions.

Radiographic vs. clinical gaps

Despite the characteristic radiographic features of COD—such as a radiolucent rim, mixed internal densities, cementum-like opacities, and loss of lamina dura—these signs are often misinterpreted. In our study, tooth-related conditions were the most common source of diagnostic errors. Unlike periapical periodontitis, which usually involves a clearly diseased tooth and may show root canal calcification, COD often presents as multifocal and affects vital teeth. In early radiolucent stages, pulp vitality testing is critical. A vital tooth should prompt suspicion of COD rather than infection. Thus, careful evaluation of periapical calcification and pulp status can aid in differentiation. The second most frequent misdiagnosis involved jaw cysts or tumors. These lesions differ in location, internal density, and radiographic appearance. For example, cemento-ossifying fibroma (COF) shares histologic features with florid COD (FCOD), such as fibrous tissue and cementum-like

Table 2 Mistaken identity in Cemento-osseous dysplasia

Variables	Tooth-related disease	Tumor or Cyst	Osteomyelitis	Bone island	Two or more kinds of diseases above	COD	P value
Gender							0.149
Male	n=0	n=0	n=0	n=0	n=3	n=0	
Female	n=10	n=6	n=3	n=1	n=4	n=1	
Age	65.1±12.4	46.3±13.2	59.3±22.1	69	57.6±6.9	40	0.089
Duration of treatment(days)	335.6±493.4	486.8±989.3	600.0±65.6	1	256.3±270.2	150	0.904
number of follow-up visits	7.8±7.6	4.7±2.4	9.3±5.7	1	5.1±2.1	8	0.604
number of referral departments	2.4±0.8	2.0±1.3	2.7±1.5	1	1.9±0.9	3	0.582
COD variants							0.755
PCOD ^a	n=1	n=1	n=0	n=0	n=0	n=0	
FocCOD ^b	n=5	n=1	n=0	n=0	n=3	n=0	
FCOD ^c	n=4	n=4	n=3	n=1	n=4	n=1	

a: PCOD: Periapical cemento-osseous dysplasia; b: FocCOD: Focal cemento-osseous dysplasia; c: FCOD: Florid cemento-osseous dysplasia

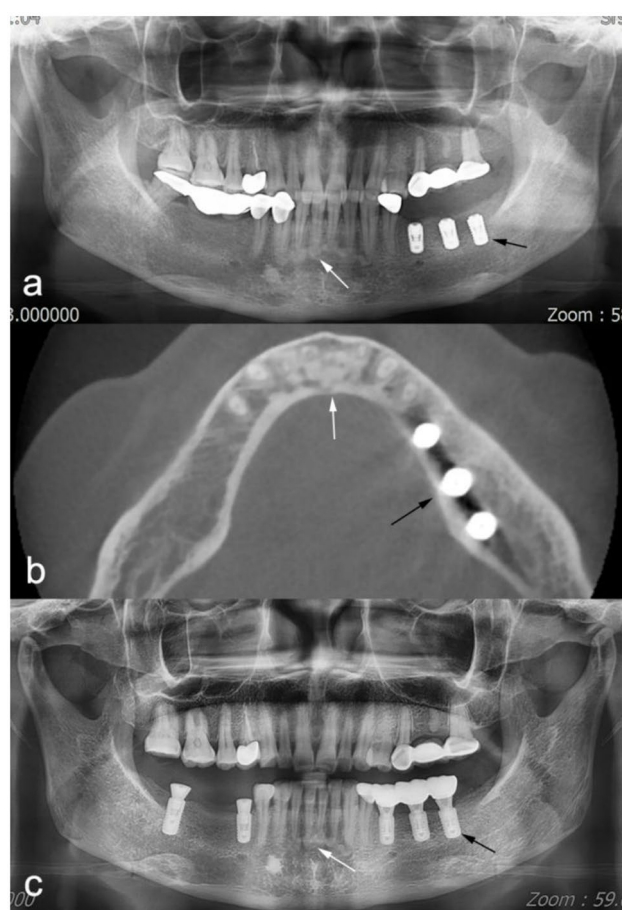


Fig. 3 The successful implant case in areas far from COD. **a** After #35–#37 dental implants placement (black arrow), PCOD was found in the lower anterior region (white arrow). **b** Half a years later, CBCT image showed more details of the PCOD (white arrow) and dental implants (black arrow). **c** Two years later, no significant resorption of the alveolar bone was observed near the implants (black arrow). The PCOD did not show any significant changes (white arrow)

material, but COF typically presents as a well-defined, unilocular, expansile lesion with cortical thinning and varied internal density [17]. It also tends to show more buccolingual expansion than COD [18, 19]. We also encountered a case initially misdiagnosed as osteoblastoma, later confirmed as COD through combined radiographic and pathological evaluation. Osteoblastoma generally affects the mandibular first molar, shows a uniform internal density, and presents with significant jaw expansion and clinical symptoms [10]. Odontomas can also be confused with COD. However, they characteristically show multiple small, high-density, tooth-like structures—unlike the amorphous opacities seen in COD [17]. Chronic osteomyelitis is another frequent misdiagnosis, especially when COD becomes secondarily infected. In such cases, anti-inflammatory treatment may help differentiate the two. Periapical COD may resemble a dense bone island, but the presence of a surrounding

radiolucent halo can assist in diagnosis. In some cases, dense materials remain in the jaw with a peripheral low-density margin visible on reconstruction. A patient's treatment history may also help distinguish COD from other lesions.

Several factors contribute to the frequent misdiagnosis of cemento-osseous dysplasia (COD), particularly when it is confused with other dental pathologies. One of the primary challenges lies in the radiographic ambiguity of early-stage COD. Initial lesions typically appear as periapical radiolucencies, closely mimicking inflammatory odontogenic conditions such as periapical granulomas or radicular cysts [20]. Conventional 2D imaging modalities often fail to capture the subtle sclerotic changes that emerge as COD matures, which leads to a high risk of interpretive errors [21]. The diagnostic challenge is further compounded by secondary infection, which can induce inflammatory changes indistinguishable from primary osteomyelitis or infected cystic lesions. This is especially problematic in florid COD (FCOD), where infected foci may display trabecular destruction, periosteal reactions, and a mixed radiolucent-radiopaque appearance—features that closely resemble suppurative osteomyelitis. These diagnostic overlaps emphasize the limitations of relying solely on radiographic morphology, particularly in cases involving infection or complex presentations. Another significant source of diagnostic error stems from clinical context bias. For instance, a history of tooth infection, trauma, or recent extractions may prompt clinicians to prematurely assume a diagnosis of periapical disease or osteomyelitis. However, COD often progresses slowly and remains asymptomatic, making clinical differentiation difficult without the aid of advanced imaging techniques, such as CBCT, which can reveal more definitive architectural features [22]. A comprehensive diagnostic approach that incorporates radiographic progression, symptomatology, and patient history is therefore essential to distinguish COD from other jaw pathologies.

Clinical consequences

For asymptomatic patients—particularly those with periapical or focal COD—no active intervention is typically required. Regular clinical and radiographic follow-up is generally sufficient [22]. In contrast, symptomatic patients, especially those with florid COD, may require treatment if they present with infection, pain, or nerve involvement. In such cases, surgical curettage, tooth extraction, or antibiotic therapy may be necessary. If the lesion develops into an abscess or progresses to osteomyelitis, more aggressive management may be indicated [23]. Some authors advise against tooth extraction in FCOD cases due to the risk of poor socket healing and sequestrum formation, which can complicate recovery

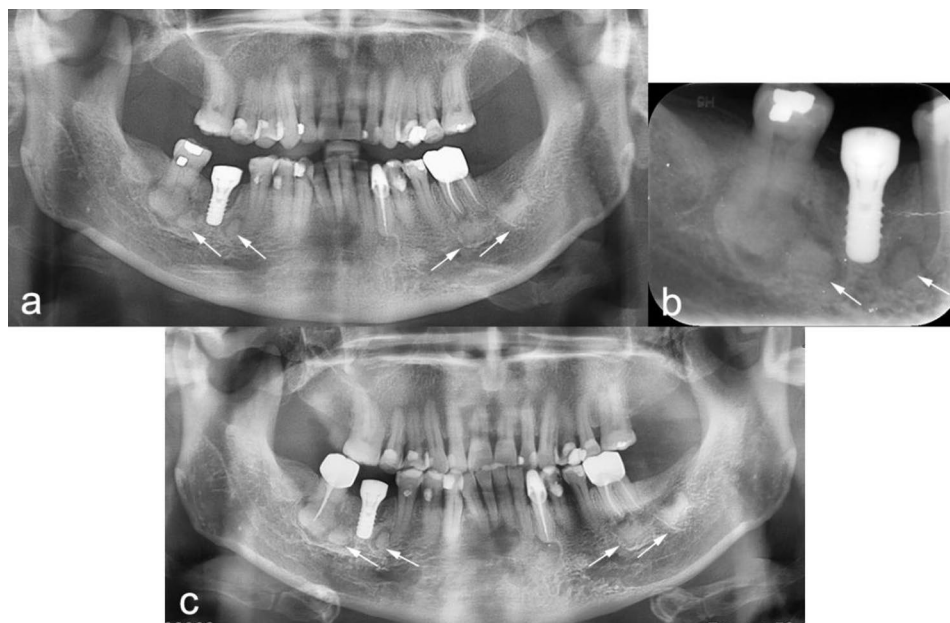


Fig. 4 The successful implant case near the COD areas. **a, b** Dental implant was implanted in #46. FCOD was found in the apical areas of the premolar and molar in the mandible (White arrows). **c** After 4 months, no significant bone resorption was found around implant. The FCOD did not show any significant changes (white arrows)

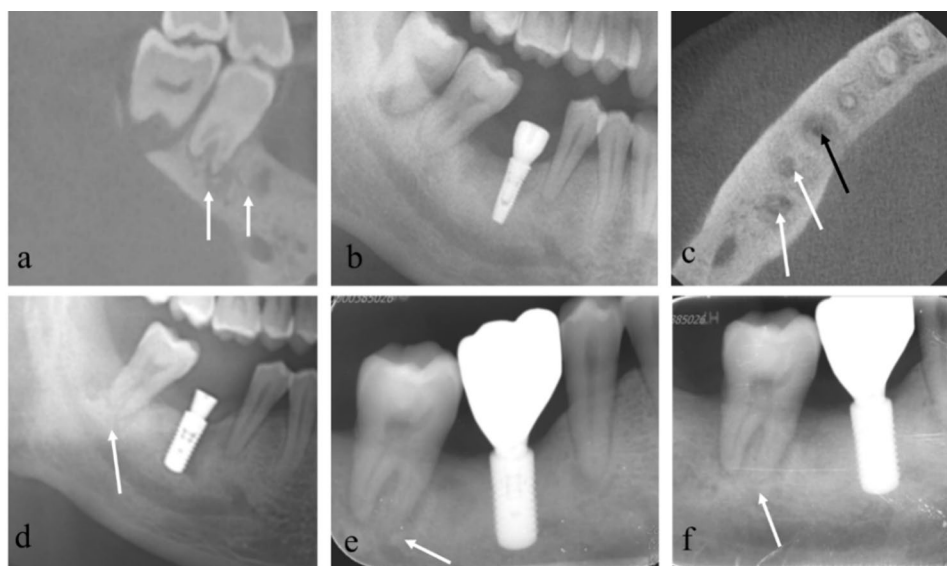


Fig. 5 The failed implant case near the COD areas. **a** Preoperative CBCT image showed that #46 teeth missed and COD was in the periapical region of the molar (white arrows). **b** Implant was placed. The COD could not be observed clearly in the panorama. **c** The CBCT image showed the remaining implant socket (black arrow) and COD (white arrows) after the implant was lost three years later. **d** COD could be seen in the panorama (white arrow) when another implant was replaced. **e** The COD was also observed in the periapical film (white arrow), 8 months after implant replacement. **f** No significant resorption of alveolar bone was discovered. The COD had been calcified and matured (white arrow) one year later

[18]. In our study, one patient presented with swelling and pain one month after tooth #48 was extracted at another hospital. The patient had experienced recurrent occlusal pain for two years and was initially misdiagnosed with osteoblastoma. This led to the extraction of tooth #47 and surgical curettage. A two-year panoramic

follow-up showed satisfactory bone healing in the area of teeth #47 and #48. Most other patients who underwent extractions did not return for further treatment. This may be because COD lesions are usually small and confined to the apical region. During extraction, the lesion might have been removed incidentally during socket

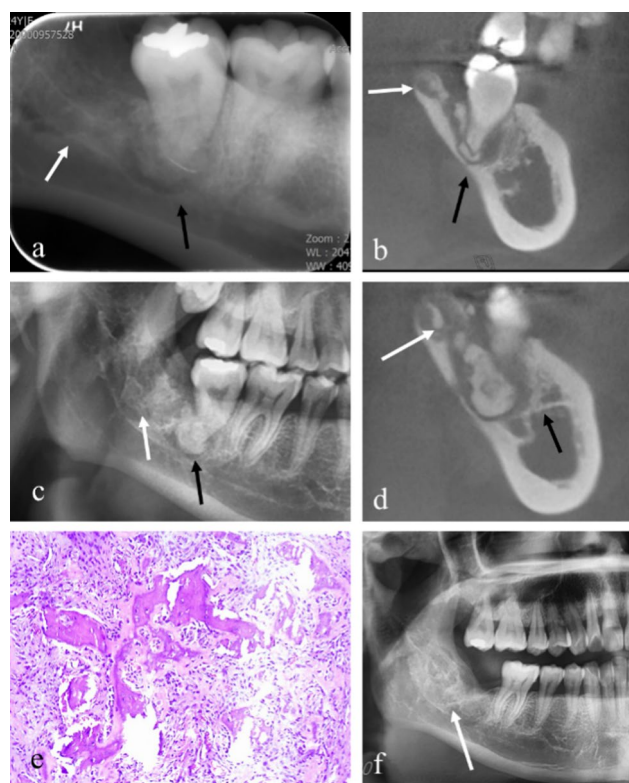


Fig. 6 The COD case treated by tooth extraction and curettage. **a** Periapical film showed that the remaining alveolar fossa of #48 was visible. The clinician just focused on the alveolar fossa of the #48 teeth (white arrow), and did not mention the periapical high-density mass of the #47 (black arrow). **b** CBCT image suggested high-density mass in the periapical area of the #47 (black arrow) and #48 socket (white arrow). The clinical diagnosis was periapical lesions 4 months later. **c** A panoramic radiograph revealed poor bone repair in 48 in the alveolar fossa (white arrow) and a low-density line encircling the periapical margin of the apical high-density mass of #47 (black arrow) one month later. **d** Approximately 2 years later, CBCT image revealed a high-density mass in the alveolar fossa of the remaining #48 (white arrow), in addition to the periapical area of tooth #47 (black arrow), and the low-density line encircling them. The clinical diagnosis of osteoblastoma was made, and 47 extraction and curettage were executed in the hospital. **e** Postoperative pathology revealed that fibro-osseous lesion in the apical region of #47. Combined with a radiographic image, COD was diagnosed in the apical region. **f** After 2 years, the panoramic review showed there was a good bone recovery in the #47 and #48 areas (white arrow)

debridement. In such cases, the lesion could be mistaken for granulation tissue and therefore not documented in the clinical records.

Patients with COD often have multiple clinical needs, including requests for dental implants or orthodontic treatment. These interventions require careful planning because COD lesions generally have reduced vascularity and poor healing capacity, which can complicate surgical procedures [24–28]. One major concern is the placement of implants in areas affected by COD. Traditionally, such placement was considered contraindicated. However, recent evidence suggests that implant therapy may

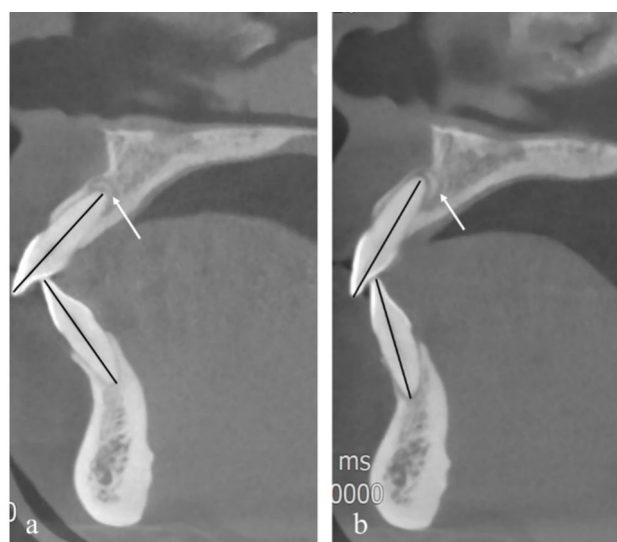


Fig. 7 The COD case with orthodontic treatment. **a** The orthodontic CBCT image revealed a high-density mass and transmitted encircling line of COD located in the apical region of #21 before orthodontic treatment (white arrow), which was clinically misdiagnosed as an odontoma. **b** After 2 years of orthodontic treatment, #21 was internalized (black line) and the COD was located on the palatal side of the root (white arrow)

still be feasible under certain conditions. For example, one case reported successful implant function for 15 years in a patient with mature-stage focal COD (FocCOD) and no complications [29]. On the other hand, some reports have documented implant failure due to chronic osteomyelitis in COD-involved bone [24, 26]. In our study, five patients received dental implants. Four were cases where COD was missed clinically, and one was misdiagnosed. Two patients received implants in areas anatomically distant from the COD lesions, both of which were successful. Among the three patients with implants placed near the lesions, two were successful, and one failed. In the successful cases, follow-up imaging showed stable alveolar bone and no lesion progression. In the failed case, the implant did not achieve osseointegration and was eventually removed due to swelling and pain, consistent with previous findings by Shin et al. [24]. Evidence from systematic reviews supports the cautious use of implants in COD-affected regions, with an overall success rate of around 79.3%. Success is more likely in FocCOD and mature-stage lesions, while failures are mostly linked to implants placed directly within florid COD (FCOD) lesions [30, 31]. These findings underscore the importance of thorough preoperative assessment. Key recommendations for optimizing implant outcomes in COD include: Avoid placing implants directly within COD tissue, especially in FCOD; Use CBCT imaging to assess the boundaries and extent of lesions; Consider histological staging in complex or uncertain cases; Ensure long-term follow-up to monitor implant integration and lesion stability.

Table 3 The treatments in these cases with cemento-osseous dysplasia

Misdiagnosis		Misdiagnosis		Confirmed diagnosis	
Untreated	Other treatment needs	Lost follow up	Single treatment	Multiple treatments	Other treatment needs
22	Dental implant Orthodontic treatment	4 4 1	tooth extraction cleaning and scraping root canal treatment curettage	4 1 2 2	tooth extraction + root canal treatment tooth extraction + anti-inflammatory treatment tooth extraction + curettage tooth extraction + cleaning and scraping tooth extraction + biopsy
Sums		27			1

Table 4 COD implant treatment summary

No.	Clinical Diagnosis	Implant Site Relation to COD	Implant Outcome
1	Missed	Far from COD	Successful
2	Missed	Far from COD	Successful
3	Missed	Near COD	Successful
4	Missed	Near COD	Failed
5	Misdiagnosed	Near COD	Successful

Orthodontic treatment in patients with COD remains controversial due to the lesion’s biological nature and limited regenerative capacity. One published case reported successful treatment without extractions, but the authors emphasized that if extractions are not possible, the feasibility of tooth movement should be reconsidered [32]. Other researchers have warned about the risk of bacterial contamination from procedures like mini-implant placement. Moreover, tooth movement may be limited by the disorganized and mineralized structure of the affected bone [25]. In our study, two patients underwent orthodontic treatment. One case was still under observation and had not completed treatment. In the other, a high-density mass was noted in the apical region of the upper anterior teeth on orthodontic radiographs. It was initially misdiagnosed as an odontoma. Retrospective review revealed that the lesion involved tooth #21 and was present before orthodontic treatment. After two years, treatment was completed, and the imaging showed mesial movement of tooth #21, with the lesion shifting to the palatal side of the root. As Consolaro et al. [27] noted, florid COD (FLCOD) presents with densely mineralized, disorganized fibro-cementum tissue that lacks adequate vascularization and cellular turnover. These conditions are not favorable for bone remodeling under orthodontic force. While isolated cases may show success [33], there is currently no strong scientific evidence from controlled studies supporting routine orthodontic intervention in COD-affected areas.

Implications for training and practice

The high missed and misdiagnosis rate of 98.2% in COD highlights the urgent need for better clinical awareness and diagnostic accuracy. Based on our findings, we recommend a stepwise diagnostic protocol that begins with clinical examination and panoramic radiography. For detailed assessment, cone-beam computed tomography (CBCT) should be prioritized due to its high resolution and three-dimensional visualization.

Our results showed no significant differences in how dentists diagnosed or treated the three COD subtypes—periapical, focal, and florid. This suggests a general lack of understanding of COD’s clinical and radiographic features among practitioners. However, a significant correlation was found between COD subtype and symptom

presence: periapical COD (PCOD) was more likely to be asymptomatic, while florid COD (FCOD) was more commonly associated with clinical symptoms. This moderate correlation may serve as a useful diagnostic clue in practice.

Other factors—including gender, age, treatment duration, follow-up visits, number of departments consulted, and COD variant—showed no statistical difference among patients with varying initial clinical diagnoses. This reinforces the widespread diagnostic inconsistency and underlines the need for improved training.

Management of COD should be conservative. Asymptomatic lesions generally require only regular radiographic monitoring. Symptomatic cases may need targeted treatment such as antibiotics or surgical curettage. Complex procedures like dental implants or orthodontic treatment should be approached with caution. Due to impaired healing and reduced bone remodeling in COD-affected areas, individualized evaluation and long-term follow-up are essential.

This study has several limitations. First, as a retrospective study from a single institution, the findings may have limited generalizability, although the hospital is a major regional center for oral diseases. Second, the relatively small sample size reduced the statistical power for some subgroup analyses, such as comparisons between different misdiagnosis groups. Third, the study did not evaluate diagnostic variability among general dentists, which may contribute to the high rate of misdiagnosis. Additionally, the retrospective design introduces a risk of information bias. To improve the reliability and applicability of these findings, future multicenter, prospective studies using standardized CBCT protocols are recommended.

Conclusion

This study demonstrates a combined missed and misdiagnosis rate of 98.2% for COD and underscores the necessity of CBCT-based imaging interpretation and improved training for general dentists.

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Authors' contributions

Yijun Li and Yunhao Zheng contributed equally to this work. YL: Conceptualization, data curation, formal Analysis, investigation, validation, visualization, writing – original draft; YZ: Conceptualization, data curation, software, visualization, writing – review & editing; BT: Resources, supervision; YS: Resources, supervision; JR: Resources, supervision; Meng You: Funding acquisition, resources, supervision; LL: Conceptualization, data curation, formal Analysis, funding acquisition, methodology, project administration, resources, supervision, writing – review & editing. All authors reviewed the manuscript.

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Data availability

The datasets used and/or analyzed during the current study available from the corresponding author on reasonable request.

Declarations

Ethics approval and consent to participate

The study was approved by the Institution Review Board of the West China Hospital of Stomatology, Sichuan University (WCHSIRB-D-2022-344). Informed consent was obtained from all individual participants included in the study.

Consent for publication

Patients signed informed consent regarding publishing their data and photographs.

Competing interests

The authors declare no competing interests.

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