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Evaluation of Unilateral Transmigration of Cuspid Tooth in Mandibular Arch using 3D Imaging

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Abstract

Transmigration, where an impacted tooth crosses the midline, is a rare anomaly occurring in less than 1% of cases. Described initially by Nodine and Thoma and later termed by Ando *et al*. in 1964, it is more common in the mandibular arch and linked with malocclusion, impacted teeth, over-retained primary teeth, and supernumerary teeth. This case series examines seven instances of transmigrated mandibular canines using Cone Beam Computed Tomography (CBCT). The evaluated cases included Type I and Type II variations, with canines showing coronal and medio-lateral oblique placements. These placements led to complications such as labial cortex perforation, internal root resorption, and cortical thinning. CBCT was crucial for precise localization and visualization, aiding in accurate diagnosis and treatment planning. Transmigrated canines affected adjacent structures, causing cortical thinning and perforation. The superior imaging of CBCT was essential in identifying root resorption, often missed by traditional radiographs. Early diagnosis through CBCT enhances treatment planning, whether for orthodontic intervention or surgical removal, particularly when symptomatic or associated with other dental anomalies. This case series underscores the need for meticulous evaluation of transmigrated mandibular canines due to their potential impact on adjacent teeth and structures. The enhanced diagnostic capabilities of CBCT facilitate accurate assessment and improved treatment outcomes. Early detection and regular monitoring are crucial to prevent complications and maintain dental health. This study highlights the importance of CBCT in managing transmigrated canines and calls for increased clinician awareness for timely intervention.

Keywords: CBCT, Cuspid, Impacted, Malocclusion, Panoramic Radiograph, Transmigration.

Introduction

Impacted tooth crossing the midline is called Transmigration which is a rare developmental anomaly with an occurrence of less than 1%. Nodine (1943) & Thoma (1952) found that impacted teeth crossing midline in cadaver mandibles of old civilization sera & in patients respectively (1). Transmigration word was first used by Ando *et al* in 1964 (2). Tarsitano *et al* in 1971, defined transmigration as the phenomenon of an impacted tooth crossing the center or midline of the maxillary arch or mandibular arch (3). Javid in 1985 defined transmigration as more than half of the tooth had passed through the midline of the arch (4). Joshi in 2001 felt that the frequency of a canine to cross the midline of the arch is more essential as compared to distance traveled (5). Transmigration can be unilateral or bilateral or it can be observed in the mandibular arch. Mupparapu classified unilateral transmigration of mandibular canines (6). Transmigrated teeth can be associated with malocclusion, impacted teeth, over-retained primary teeth, and supernumerary teeth (7-9) A transmigration can be explained genetically or in embryological stage (10, 11) other obstruction factors are: blockage of eruption pathways by supernumerary teeth or odontomes (7, 11), developmental cysts (12, 10) peg shape lateral incisor (11), crowding or spacing; premature loss of deciduous tooth or over-retained deciduous cuspid. Anatomically, transmigration can be due to lack of path of least resistance, lack of guidance, abnormal tooth positioning and bone density variations. Cone Beam Computed Tomography (CBCT) has been considered a more effective diagnostic tool since it may help to determine the exact position or location of the

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impacted canines more accurately and to give more details about adjacent root or tooth structure relation with impacted tooth (12). The advantage of using 3D radiographic imaging, such as CBCT, helps in evaluating root resorption. Root resorption diagnosis has been increased after 3D imaging, it may detect early or mild resorption in the apical third (13). In type IV transmigration the impacted canine is located below the apices of the posterior teeth. To avoid the sensory dysfunction or paresthesia due to mental nerve injury during surgery it is crucial to know the exact location of the mental foramen, which is generally present between mandibular premolars (14). This article mentions about 7 different cases of transmigrated canines and their relationship with adjacent structures diagnosed through CBCT.

Methodology

Study Design

This case series was designed to evaluate seven instances of transmigrated mandibular canines using Cone Beam Computed Tomography (CBCT). The study was conducted at the School of Dental Sciences, with all cases collected over a period of 2 years. Patients who required and / or consented to undergo CBCT imaging as part of their orthodontic treatment planning or due to impacted teeth were considered for inclusion.

Patient Selection

Patients included in this study were those diagnosed with transmigrated mandibular canines. Selection criteria involved:

- Patients of any age and gender.
- Presence of at least one transmigrated mandibular canine confirmed by initial radiographic examination through panoramic radiography.
- Consent to undergo CBCT imaging for further evaluation.

Imaging Technique

CBCT scans were performed using a CS9300 Carestream Select, adhering to standard protocols for mandibular imaging. Scans were conducted at settings optimal for detailed visualization of dental structures, with the following parameters:

- Field of view (FOV): 5 x 5, 5 x 10.
- Voxel size: 90µm to 150µm.
- Exposure settings: 90kVp to 120kVp, 8mA and exposure time 12 seconds.
- Imaging software: CS Imaging Software.

Data Collection: Each patient's CBCT scans were analyzed to determine:

- The type of transmigration (Type I or Type II).
- The exact position of the transmigrated canine (coronal and medio-lateral oblique placements).
- Associated complications such as labial cortex perforation, internal root resorption, and cortical thinning.
- Impacts on adjacent dental structures and overall mandibular morphology.

Evaluation Parameters

Localization and Positioning

The exact position of the transmigrated canines was noted, and their spatial relationship with adjacent teeth and structures was documented.

Pathological Changes

Observations included any pathological changes such as root resorption, cortex perforation, and thinning.

Clinical Correlation

Symptoms and clinical findings associated with the transmigrated canines were recorded, including any history of malocclusion, impacted teeth, over-retained primary teeth, or supernumerary teeth.

Data Analysis

The collected data was analyzed descriptively. Each case was reviewed to determine the extent of transmigration and associated complications. The role of CBCT in providing detailed diagnostic information was assessed, and the findings were correlated with clinical observations.

Results

Case Report 1

CBCT of impacted right mandibular canine 43 shows transmigration of type I according to Murrapau classification. The tooth is obliquely placed superoinferiorly in the coronal plane with the coronal portion near the labial cortex and is perforating it. The tooth is labially placed with respect to 31, 32, 41. Coronal portion (cusp tip) of 43 is indenting the radicular middle third of 31, 41. Impacted tooth reveals normal radicular and pulpal morphology with normal follicular space around it. Diffuse radiolucency present w.r.t 43 at the pulp chamber suggestive of internal root resorption. No retained deciduous precursor is present. No evidence of root resorption of 32, 31, 41 seen (as shown in Figures 1A, 1B, 1C).

Case Report 2

CBCT of impacted right mandibular canine 43 shows transmigration of type I according to Murrapau classification. The tooth is obliquely placed medio-laterally in the coronal plane with the coronal portion near the labial cortex and cusp tip is perforating the labial cortex. Radicular portion is placed inferiorly and is oriented lingually. The tooth is inferiorly placed with respect to 44, 83, 42, 41. Ill-defined coronal radiolucency seen wrt impacted 43 involving enamel, dentin and pulp suggestive of internal resorption / pulpitis, apical 1/3rd of 43 reveals no dilacerations. Over retained deciduous 83 is present without physiologic root resorption (as shown in Figures 2A, 2B, 2C).

Case Report 3

CBCT of impacted right mandibular canine 43 shows transmigration of type I according to Murrapau classification. The tooth is obliquely placed medio-laterally in the coronal plane with the coronal portion near the labial cortex and cusp tip perforating the labial cortex. Radicular portion is placed horizontally and inferiorly and is causing indentation and thinning of the labial cortex without any perforation. The tooth is inferiorly placed with respect to 32, 31, 41, 42, 43, 44. Impacted tooth reveals normal radicular and pulpal morphology with normal follicular space (as shown in Figures 3A, 3B, 3C).

Case Report 4

CBCT of impacted left mandibular canine 33 shows transmigration of type I according to Murrapau classification. The tooth is obliquely placed superoinferiorly in the coronal plane with the coronal portion near the labial cortex and is perforating it. Radicular portion is vertically placed and is oriented lingually and is indenting the lingual cortex. However, there is no perforation of the lingual cortex. The tooth is labially placed w.r.t 41, 42, 31, 32. Impacted tooth reveals normal radicular and pulpal morphology with normal follicular space. Apical 1/3rd of 33 shows no dilacerations (as shown in Figures 4A, 4B, 4C).

Case Report 5

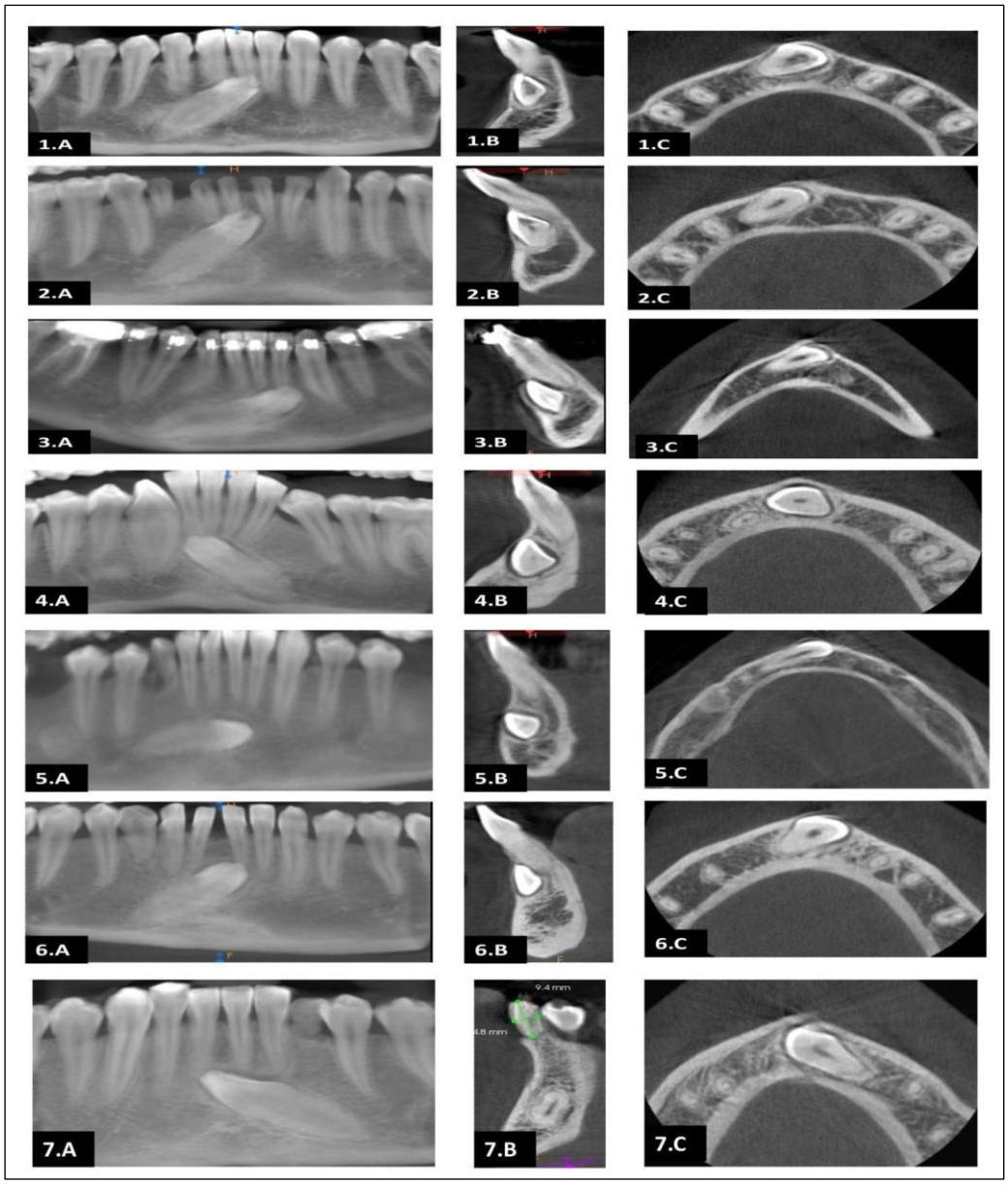
CBCT of impacted right mandibular canine 43 shows transmigration of type II according to Murrapau classification. The crown is noted in the apical alveolus inferior to the apices of 31, 32, 41, and the radicular portion is noted in the apical alveolus inferior to the apices of 42, 83. The horizontal impacted tooth is placed obliquely in the mandible with crown and root oriented labially. The crown is causing thinning and perforation of the adjoining mandibular labial cortex. Retained deciduous precursor - 83 is present. There is no contact of impacted tooth with root apices of 31, 32, 41, 42 (as shown in Figures 5A, 5B, 5C).

Case Report 6

CBCT of impacted right mandibular canine 43 shows transmigration of type I according to Murrapau classification. The tooth is obliquely placed superoinferiorly in the coronal plane with the coronal portion near the labial cortex and is perforating it. Radicular portion is obliquely placed without causing indentation or perforation of the labial / lingual cortex. The tooth is labially placed with respect to 31, 41. Coronal portion (cusp tip) of 43 is indenting the radicular apical 1/3rd of 31. No evidence of surface resorption. Evidence of retained deciduous precursor is present w.r.t 83 (as shown in Figures 6A, 6B, 6C).

Case Report 7

CBCT of impacted left mandibular canine 33 shows transmigration of type I according to Murrapau classification. The tooth is obliquely placed medio-laterally in the coronal plane with the coronal portion near the labial cortex and cusp tip causing thinning & perforation of the labial cortex. Radicular portion is placed inferiorly and is oriented obliquely towards the lingual cortex. Radicular portion is not having any contact with the lower border of the mandible. The tooth is inferiorly placed w.r.t 41, 31, 32, 73, 34. There is point contact of cusp tip of 33 with facial aspect of apical 1/3rd radicular portion of 41, no root resorption observed w.r.t 41. Impacted tooth reveals normal radicular and pulpal morphology with normal follicular space. Over retained deciduous 73 is present without physiologic root resorption (as shown in Figures 7A, 7B, 7C).



Figures 1-7: (A) Panoramic Reconstructed View (B) Cross Sectional Images (C) Axial slices

Discussion

Early diagnosis of transmigrated canines help to make treatment plans either for orthodontic treatment by surgical exposure of canine or to remove it surgically if it is associated with any symptoms. Unilateral transmigration of the mandibular canine is more frequently observed on the left side than on the right side. Prevalence of transmigration is very less. In this case series 7 CBCT of transmigrated canines were evaluated. The incidence of transmigrated canines is lower in males as compared to females. In our case series transmigration is seen in males as compared to females in the age group of 30 to 45 years. Most common transmigration in our case series was Type I followed by type II and retained deciduous teeth were seen in 4 out of 7 cases. Unilateral transmigration of mandibular canine is more frequently found as compared to bilateral transmigration (15) Axial inclination criteria proposed by Joshi (16) can help predict the likelihood of canine impaction and transmigration. Canines found at an angle between 25°-30° of the midsagittal plane have a higher chance for impaction, but they do not tend to cross the midline. Canines within 30°–50° of the midsagittal plane tend to cross the midline and canines at an angle more than 50°, almost always transmigrate (17). Among 4 cases out of our 7 cases, the angle between 30°–50° and 3 cases showed more than 50° (as shown in Table 1). Formation of dentigerous cyst associated with impacted 43, 33

and retained deciduous 73, 83 was also seen. Transmigration of the mandibular canine rarely occurs. Most commonly it is an incidental finding of panoramic radiograph. Early diagnosis helps in better treatment plan for esthetic, surrounding tissues and dentition, resulting in better treatment outcome. If an impacted tooth is symptomless, it can be left untreated. In these cases, radiographs should be obtained periodically to see any kind of pathology, cystic change or changes associated with surrounding structures.

Table 1: Variable Patterns of Transmigration of Canine on CBCT Imaging

S.No.	Age/ Gender	Trans migrated tooth	Transmigration Type	Retained deciduous precursors	Cortical thinning	Root resorption of adjacent teeth	Length of the tooth	Angulation
1	24/F	43	I	Absent	Coronal portion perforating labial cortex	No	23.3mm X 6.5mm	39°
2	25/M	43	I	Present	cusp tip is perforating the labial cortex	No	25.9mm X 5.5mm	41°
3	25/M	43	I	Absent	cusp tip is perforating the labial cortex	No	25.5mm X 8.3mm	64°
4	17/M	33	I	Absent	Coronal portion near the labial cortex and is perforating it. Radicular portion indenting the lingual cortex.	No	23.1mm X 6.9mm	42°
5	14/F	43	II	Present	Crown is causing thinning and perforation of labial cortex	No	22.3mm X 6.7mm	83°
6	21/F	43	I	Present	Coronal portion near the labial cortex and is perforating it.	No	23.6mm X 6.8mm	46°
7	19/M	33	I	Present	cusp tip is causing thinning & perforation of the labial cortex	No	26.6mm X 5.9mm	54°

CBCT is to be used to see the transmigrated tooth associated with cyst, displacement of surrounding teeth or resorption of the roots. Transmigrated canines of varying lengths and angulations were commonly observed perforating or thinning the labial cortex. CBCT is recognized as the best method to evaluate impacted teeth. Use of CBCT is indicated when panoramic radiograph does not provide better information or images regarding surrounding structures, CBCT provides 3D image of canines, and their association with surrounding structure or any abnormality or deformity associated with that impacted teeth (18). On a regular basis transmigration is evaluated in panoramic radiographs as it is the most commonly used extraoral radiograph. If sufficient information is not evaluated by panoramic radiograph, then only CBCT is prescribed. Mupparapu's classification for unilateral transmigration of mandibular cuspid has been described in Table 2.

Table 2: Mupparapu's Classification for Unilateral Transmigration of Mandibular Cuspid

Type 1	The cuspid is mesio-angularly impacted across the midline either labial or lingual to anterior teeth, and the crown portion of the tooth passing the midline.
Type 2	The cuspid is horizontally impacted near the lower border of the mandible below the apices of the anterior teeth.
Type 3	The cuspid erupting either right or left of the other side.
Type 4	The cuspid is horizontally impacted near the inferior border of the mandible below the apices of posterior teeth on the other side.
Type 5	The canine is vertically impacted in the midline along the long axis of the tooth crossing the midline irrespective of eruption status.

Conclusion

In conclusion, this case series emphasizes the importance of early and precise diagnosis of transmigrated mandibular canines using Cone Beam Computed Tomography (CBCT). Transmigration, while rare, poses significant risks to adjacent dental structures, leading to complications such as cortical thinning, labial cortex perforation, and internal root resorption. CBCT proved invaluable in detecting these pathologies, often missed by traditional imaging techniques, and provided detailed insights for effective treatment planning, whether orthodontic or surgical. By demonstrating the diverse presentations of transmigrated canines, this study underscores the need for heightened clinician awareness and careful monitoring to prevent further complications. By focusing on unilateral transmigration, we aimed to establish a foundation for further research, which could later explore bilateral cases in more depth. The utilization of CBCT ensures better diagnostic accuracy and treatment outcomes, ultimately contributing to improved patient care in cases of transmigrated canines.

Abbreviation

CBCT: Cone Beam Computed Tomography.

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Author Contributions

Kushdeep Kumar Gupta: Conceptualization, Methodology, Data Collection, and Writing - Original Draft, Hemant Sawhney: Data Analysis, Visualization, Writing - Review and Editing, Mohd Faisal: Supervision, Project Administration, Writing - Review and Editing. Athira Sasikumar: Data Analysis, Writing Review. Ritik Kashwani: Data Collection, Writing - Original Draft and Submitting to Journal.

Conflict of Interest

The authors declare no conflict of interest related to this study.

Ethics Approval

Ethical clearance for this study was obtained from the Institutional Ethics Committee of the School of Medical Science and Research and Sharda Hospital, Sharda University (Ref. No. SU/SMS&R/70-Z/2024/07).

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