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Surgical and Orthodontic Management of Impacted Maxillary Central Incisor Associated with Supernumerary Tooth

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ABSTRACT

Impaction refers to the complete or partial failure of a tooth to erupt beyond the typical age of eruption . In mixed dentition, permanent tooth impaction is uncommon; nonetheless, central incisor impaction is typically identified when the tooth fails to emerge
Impaction of maxillary central incisors is frequent in dental practice. However its management is challenging because of its importance in aesthetics. Supernumerary teeth are the most common dental anomaly that can cause impaction of adjacent teeth, crowding, rotation and displacement of teeth. We report a case of 10,5 year old male with an impacted supernumerary tooth in the maxillary anterior region, which was interfering with the eruption of the permanent, left central incisor. The impacted supernumerary tooth was surgically removed. With the application of an orthodontic traction, impacted left maxillary central incisor was brought down to its proper position in the dental arch.

Keywords: Impacted Incisor, Orthodontic Traction and Supernumerary, mesiodens, impaction, surgical exposure, orthodontic force

I. INTRODUCTION

An impacted tooth refers to a tooth which is completely or partially unerupted and is positioned against another tooth, bone or soft tissue, so that it's further eruption is unlikely, described according to its anatomical position. Among impacted teeth, maxillary third molars is commonly

impacted tooth followed by maxillary canine and central incisor impaction is rare, accounting for around 0.06%–0.2% of all cases. [1-5]

Central incisor impaction can be associated with a range of causative factors,such as presence of supernumerary tooth,root dilaceration, fusion of tooth roots, disruptions in the normal eruption mechanisms, presence of tumour & cysts (Fig.1 A-F), Syndrome (Fig.2 A-F), or underlying systemic conditions such ashormonal imbalances, vitamin deficiencies, or genetic predisposition (Fig.3 A-F).[4-7] Supernumerary teeth are considered as the main cause for the impaction of maxillary central incisors with an incidence rate of upto 56-60%. The absence of a central incisor interferes with facial aesthetics and has negative impact on self-esteem, functionality, and social interactions .Therefore, it is crucial to diagnose andmanage it at an early stage.[1-7]

Orthodontists often face a dilemma while deciding whether to extract the impacted tooth or guide it into its correct position.Spontaneous eruption of impacted maxillary incisors occursin

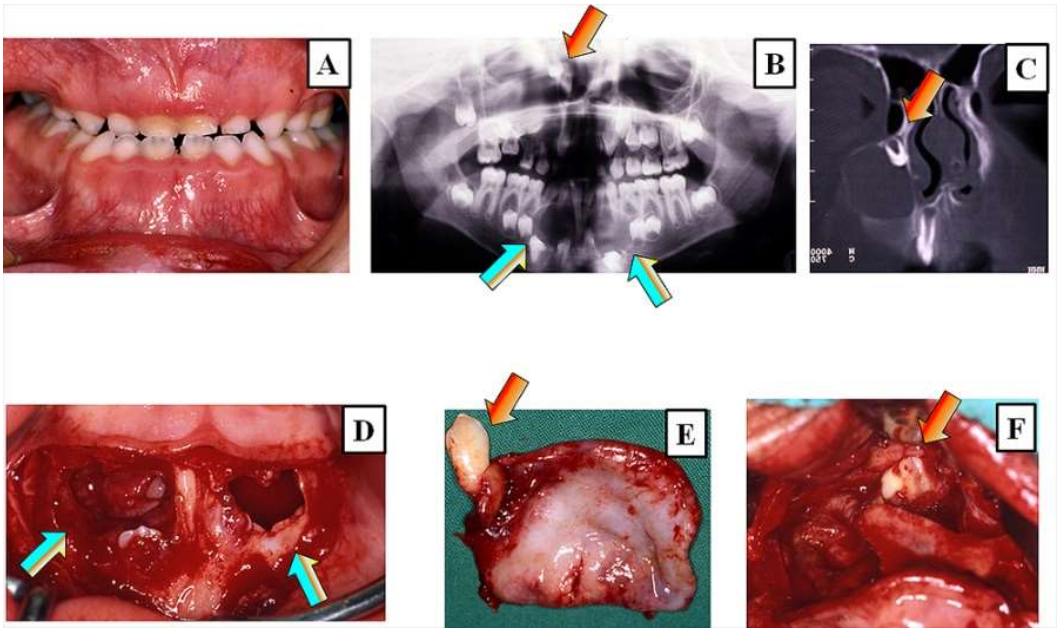

FIG 1 A-F: A 7-year-old patient with extremely large cysts in the maxilla and mandible.
A: Intraoral photos – No abnormalities detected.
B: Panoramic radiograph – The red and blue arrows indicate the cysts.
C: CT scan – Shows the size of the cyst and how it has displaced the canine and the eye cranially.
D: Surgical opening of the cysts – Partial removal of the cyst while preserving the permanent teeth in the mandible.
E, F: Total removal of the cyst along with the displaced tooth in the maxilla.

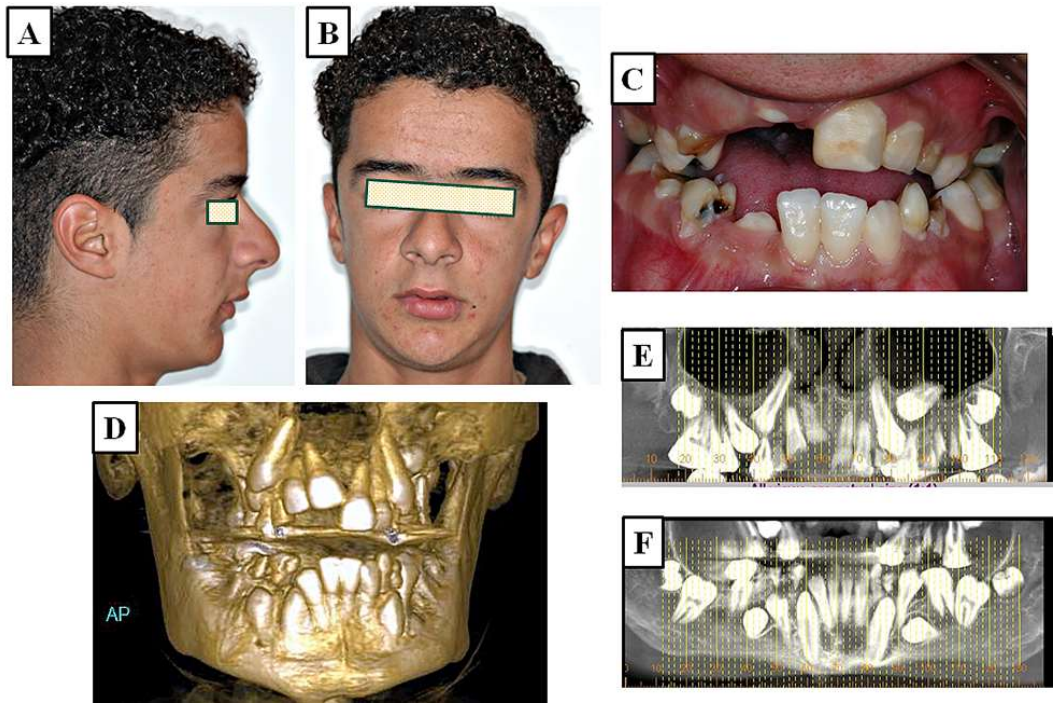

FIG. 2 A-F: A 15-year-old patient with the rare genetic syndrome Cleidocranial Dysplasia (CCD), simple type.
A, B: Extraoral images – Do not show the typical profile of patients with this syndrome.
C: Intraoral photo – Shows the absence of several permanent teeth for his age.
D-F: CT scans – Clearly indicate multiple displacements in both jaws

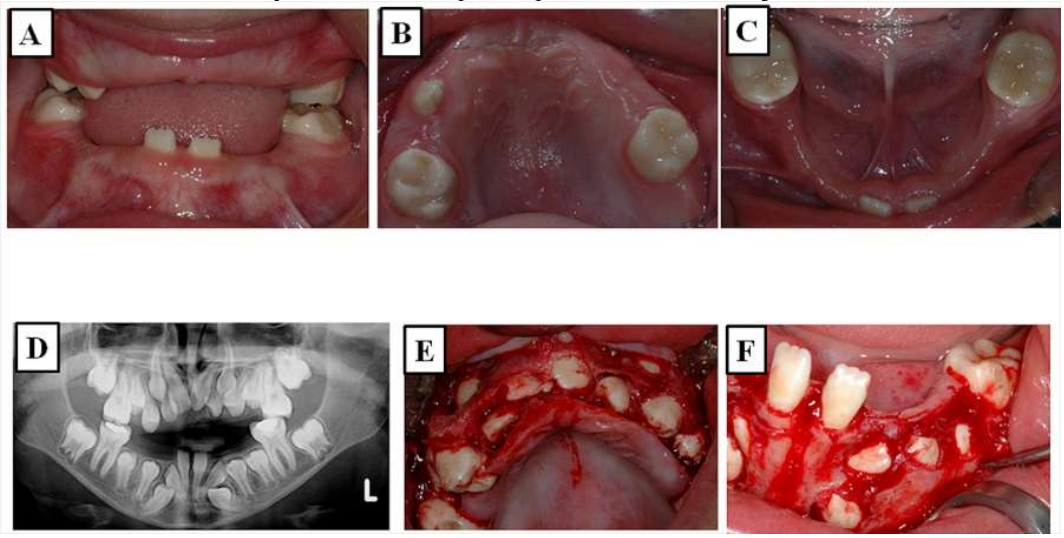

FIG. 3 A-F: A 14-year-old female patient with multiple displacements and impactions in both jaws; a genetic predisposition is present in the family.
A-C: Intraoral images show only six teeth in the oral cavity.
D: Panoramic radiograph displays multiple displacements in both jaws.
E, F: Surgical exposure of the displaced teeth in both jaws.

54-76% of cases when supernumerary tooth is removed and there is enough space in the dental arch.In cases where the central incisor is ankylosed to the surrounding bone, positioned unfavourably, or severely curved, extraction is usually recommended.[1-7]
We reported a case of an impacted supernumerary tooth in the maxillary anterior region, interfering

with the eruption of the permanent left central incisor. Combined surgical and orthodontic approachis employed, to bring the impacted left maxillary central incisor into its proper position in the dental arch.

CASE REPORT

Medical History and Diagnosis

The patient is 10.5 years old, healthy, with no previous illnesses, allergies, or medications. The parents noticed that the central incisor had not erupted and that the space for the tooth appeared restricted. The initial situation is documented in Figures 4 A-H.

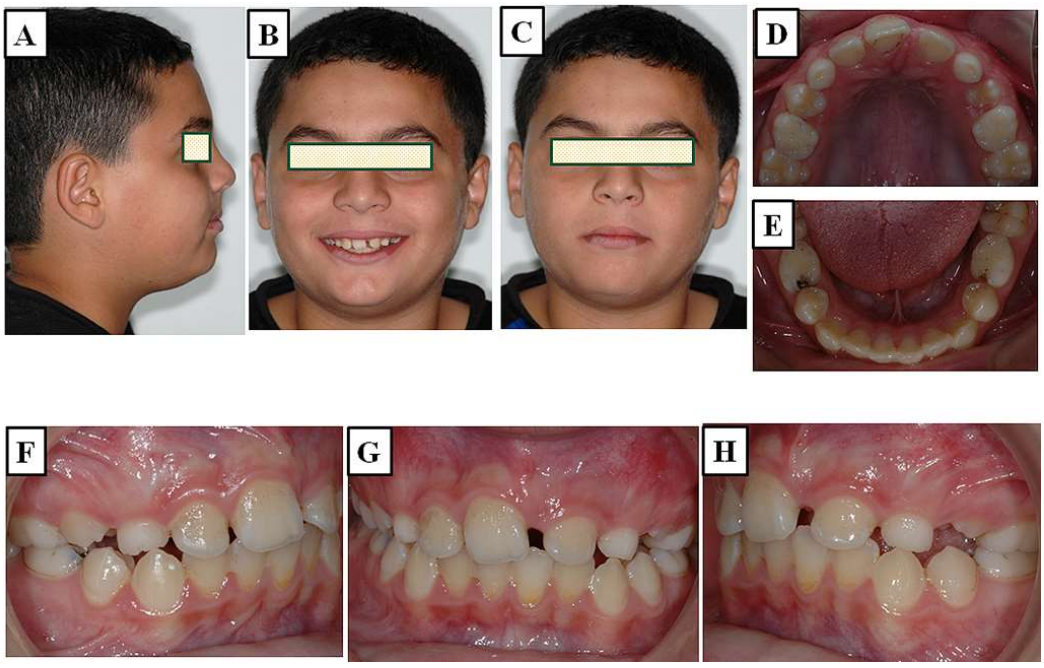

FIG. 4 A-H: A 10.5-year-old patient with a displaced and impacted central incisor and a mesiodens in the same region.
A-C: Extraoral images.
D-H: Intraoral images – Show a Class I occlusion. Tooth 21 has not erupted compared to tooth 11. The space for tooth 21 is narrowed due to the tilting of the adjacent teeth 11 and 22.

The orthopantomogram, maxillary radiograph, and cephalometric images (Fig. 5 A-C) revealed the presence of a supernumerary tooth in the region of tooth 21 and a displaced, impacted central incisor. Tooth 21 has an unfavorable angulation and is in close spatial proximity to the roots of the adjacent lateral incisors. Radiologically, no root resorption of the neighboring teeth was detected. Additional information regarding the position of the displaced tooth was provided by the lateral cephalometric image, which was analyzed along with general cephalometric parameters (Fig. 5 C). A space analysis indicated insufficient room for the positioning of tooth 21. Additionally, an Angle Class I occlusion was diagnosed.
After a thorough analysis of all records and calculation of the required space for the displaced tooth, the treatment strategy was determined.

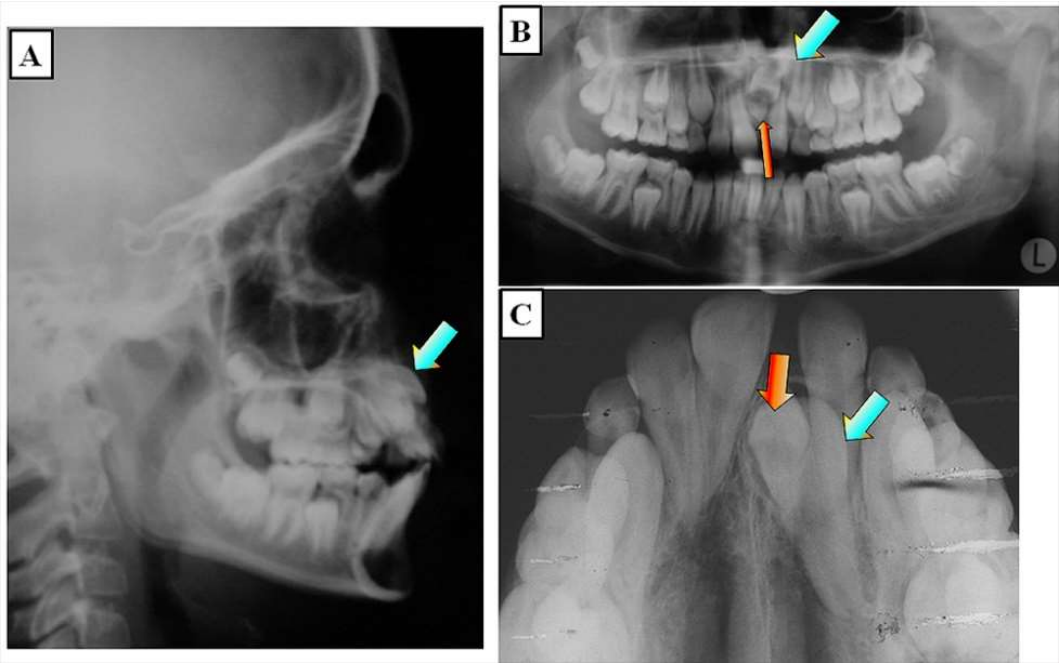

FIG. 5 A-C: The radiographic images show the displaced and impacted tooth 21 (blue arrow) and the supernumerary tooth in the same region (red arrow).

Therapeutic Goals and Treatment Planning

The following goals were established to ensure optimal functionality, aesthetics, and stability of the dentition:

1. **Extraction of the supernumerary tooth in the region of 21:** Integration of the displaced tooth 21 to restore the natural tooth row.
2. **Establishing a stable and functional occlusion:** Ensuring a neutral bite with physiological sagittal and vertical overbite and a correct, natural condyle position.
3. **Improvement of dental aesthetics:** Optimizing tooth position and alignment for a harmonious appearance.
4. **Improvement of gingival aesthetics:** Designing a healthy and aesthetically pleasing gum line.
5. **Long-term stability of treatment outcomes:** Ensuring sustainable maintenance of the achieved improvements.

These objectives form the foundation for an individualized treatment plan that comprehensively addresses both functional and aesthetic aspects.

Therapeutic Approach

The treatment of displaced canines involves several coordinated phases to achieve optimal outcomes in function, aesthetics, and stability:

I. Integration of Multiband Appliance

In this initial phase, a multiband appliance is used to create space for the displaced tooth, preparing it for later alignment.

II. Surgical Extraction of the Mesiodens and Exposure of the Displaced Tooth

Surgical exposure is performed to access the displaced and impacted tooth for orthodontic treatment, setting the stage for further procedures.

III. Alignment of the Displaced Tooth Using Attached Appliance and Multiband System

Following exposure, tooth 21 is aligned using the integrated multiband appliance and auxiliary

tools. This precise tool enables gradual yet controlled tooth movement.

IV. Finishing and Occlusion Stabilization

In this phase, tooth alignment is finalized, and optimal occlusion is achieved and stabilized, forming the basis for a functionally and aesthetically successful treatment outcome.

V. Retention

The retention phase follows to secure the achieved results. Bonded retainers and retention devices are used to stabilize the new tooth position long-term.

Management of Surgical Exposure

Surgical exposure of displaced teeth is a critical step to achieve satisfactory periodontal and aesthetic outcomes. The choice of method depends on the specific position of the displaced tooth. Overly aggressive procedures or ignoring biomechanical and biological principles can damage adjacent teeth or lead to poor periodontal conditions.

The orthodontist's presence during surgery allows better assessment of the impacted tooth's position and its relationship to adjacent teeth. This information is crucial for planning biomechanical forces (Smith et al., 2019).

There are two established methods for surgical exposure of displaced teeth: closed and open elongation (Fig. 6). Both are described in detail below.

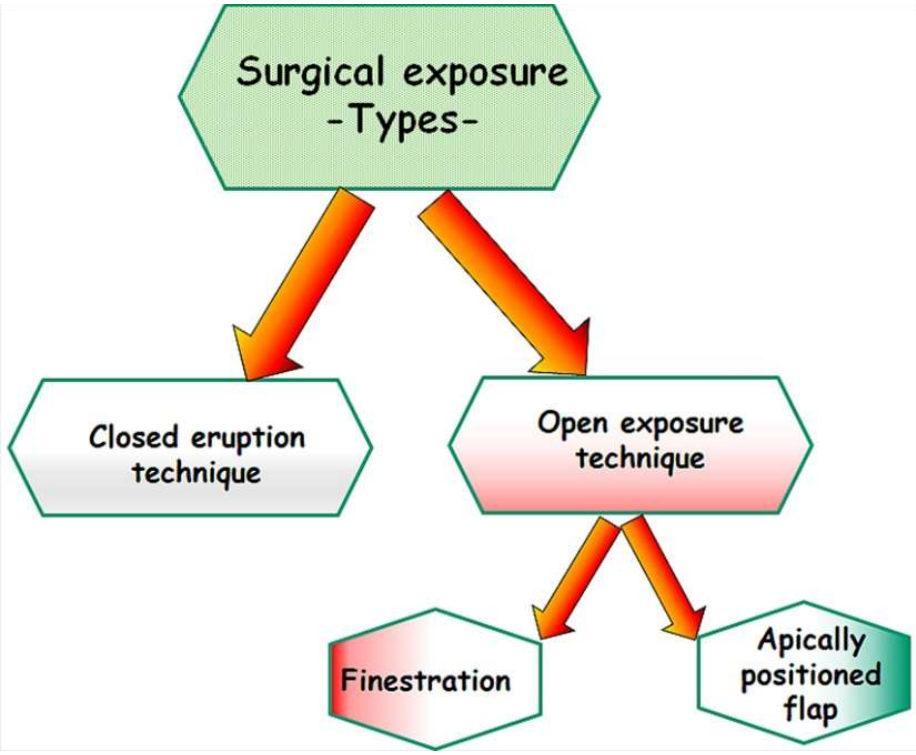

FIG. 6: Schematic representation of the surgical exposure of impacted teeth.

1. Closed Elongation

A mucoperiosteal flap is incised and mobilized. Bone is removed to expose the crown portion of the impacted tooth. An attachment is bonded and secured with resin. The flap is repositioned to cover the surgical site, with a chain extending a few millimeters from the suture area at the intended eruption point (Fig. 7 A-F Fig. 8 A-F)

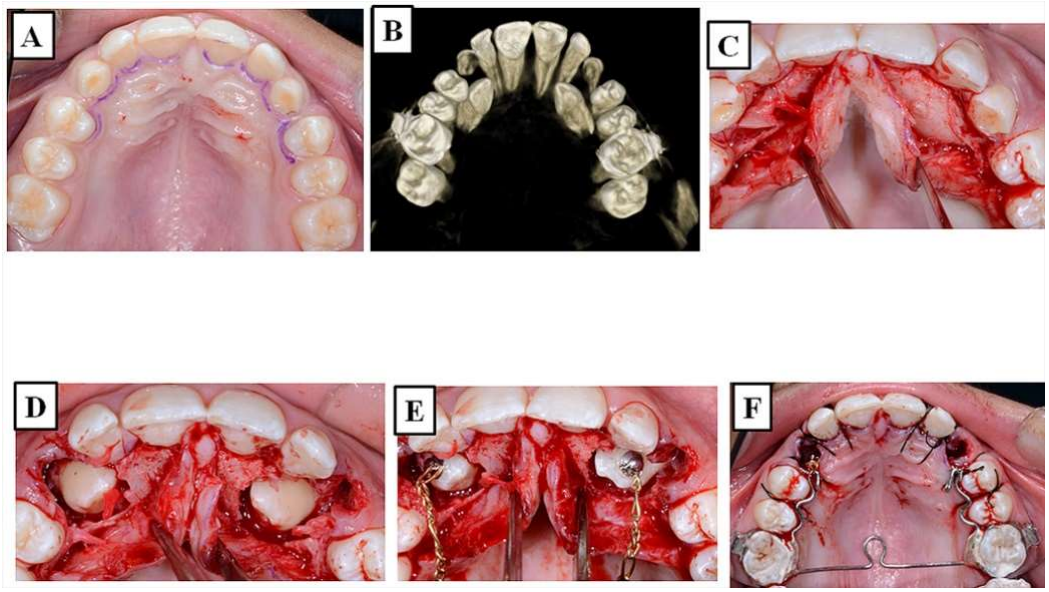

FIG. 7 A-F: Palatal displacement of teeth 13 and 23 with persistence of the primary canines 53 and 63. A closed eruption technique with a marginal incision was performed for the surgical exposure and attachment fixation of the displaced teeth.

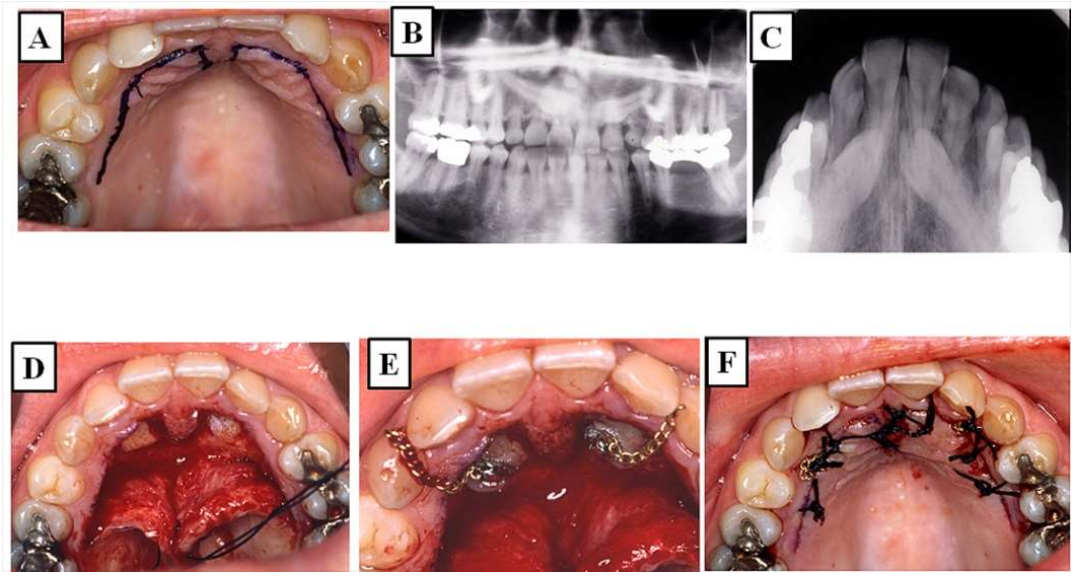

FIG. 8 A-F: Palatal displacement of teeth 13 and 23 with persistence of the primary canines 53 and 63. A closed eruption technique with a paramarginal incision was performed for the surgical exposure and attachment fixation of the displaced teeth

2. Open Elongation (Apically Positioned Flap, Windowing)

A trapezoidal mucosal flap is created, and the mucosa is dissected incisally, leaving the periosteum intact (split-flap technique). The flap is then mobilized apically. Bone, periosteum, and follicular tissue are removed to expose the labial surface of the tooth. The flap is fixed 2-3 mm incisal to the enamel-cementum junction with integrated keratinized gingiva .

The appropriate method depends on the patient's specific condition. While the closed method offers a minimally invasive option, the open elongation is suitable for cases requiring full crown exposure. Both approaches require precise surgical technique and close collaboration with the

orthodontist for long-term functional and aesthetic success.

Exposure of Displaced Teeth

After obtaining the traction device for the displaced tooth 21, a surgical procedure was initiated for the extraction of the mesiodens and the exposure of the impacted tooth. A closed eruption technique was used for this purpose(Fig. 9 A-E).

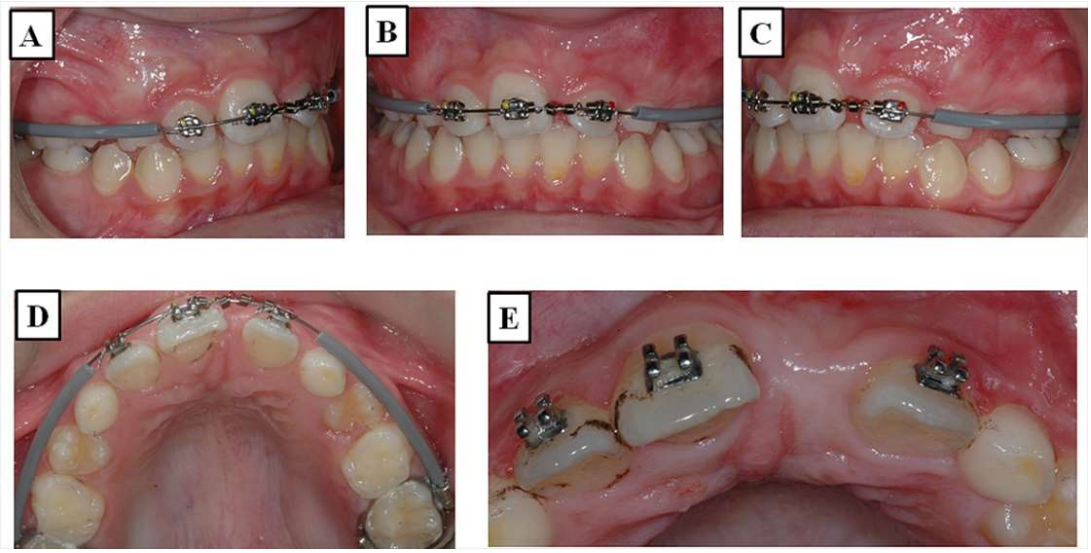

FIG. A-E: Intraoral images with the multibracket appliance, including a coil spring used for space opening for the displaced tooth 21.
A-D: Beginning of space opening.
E: The space for the displaced tooth 21 was sufficiently opened before surgical exposure

Surgical exposure requires an interdisciplinary approach, with careful selection of techniques and materials and close collaboration between surgeons and orthodontists to ensure treatment success. The surgical exposure of displaced teeth can be performed through either a marginal or paramarginal incision. The paramarginal technique is preferred due to better healing through mucosal adaptation.

After raising the mucoperiosteal flap, the mesiodens was extracted, and the impacted tooth was simultaneously exposed. Minimal bone removal is performed to expose the crown for attachment fixation (Figures 11b, 12d). Excessive bone drilling should be avoided to minimize bone loss . Keeping the enamel-cementum junction intact minimizes bone loss . In cases of deep impaction, the “tunneling” technique maintains a bony bridge through which the attachment chain passes to guide eruption (Fig. 10A-C, Fig. 11 A-C).

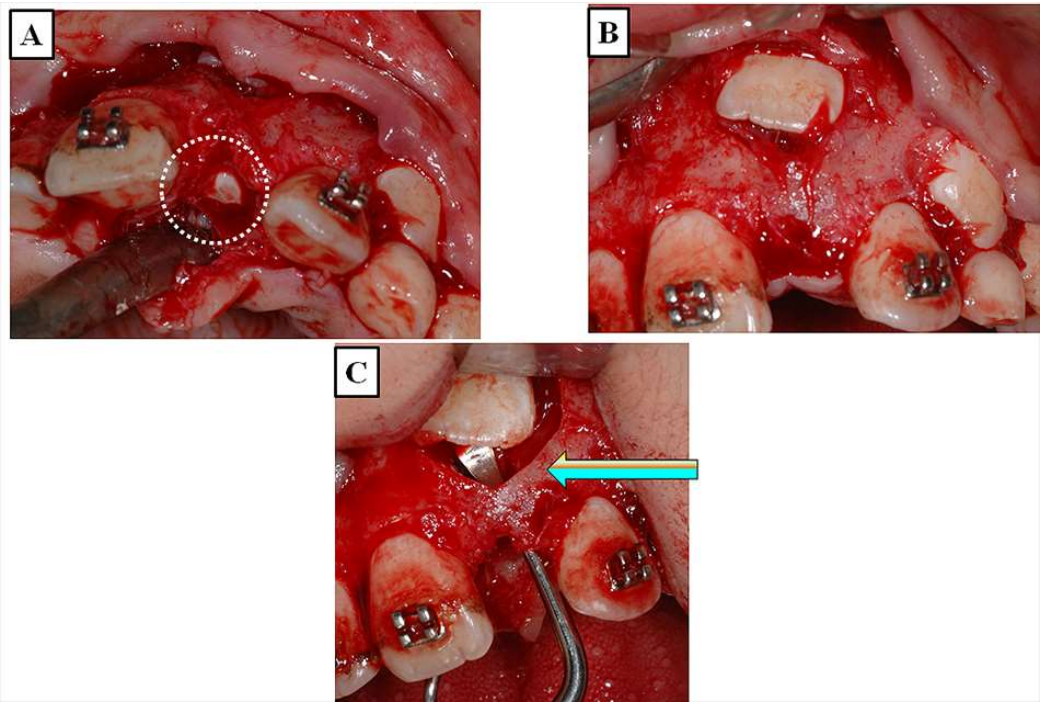

FIG. 10 A-C: Surgical removal of the supernumerary tooth and exposure of the impacted tooth 21
A, B: Elevated mucoperiosteal flap providing access to the mesiodens and the crown of the displaced tooth 21 from the labial side.
C: Tunneling of the overlying bone for attachment fixation.

Bonding Techniques and Attachment Fixation

The acid-etch technique without prior enamel polishing is the most reliable bonding method, improving composite adhesion (38, 41). Careful rinsing and drying of the tooth surface after phosphoric acid application is critical to avoid gingival necrosis and ensure stable fixation.
Effective attachments include the eyelet and gold button with chain. Titanium buttons with laser-treated surfaces offer improved adhesion (Fig. 11 A-C).

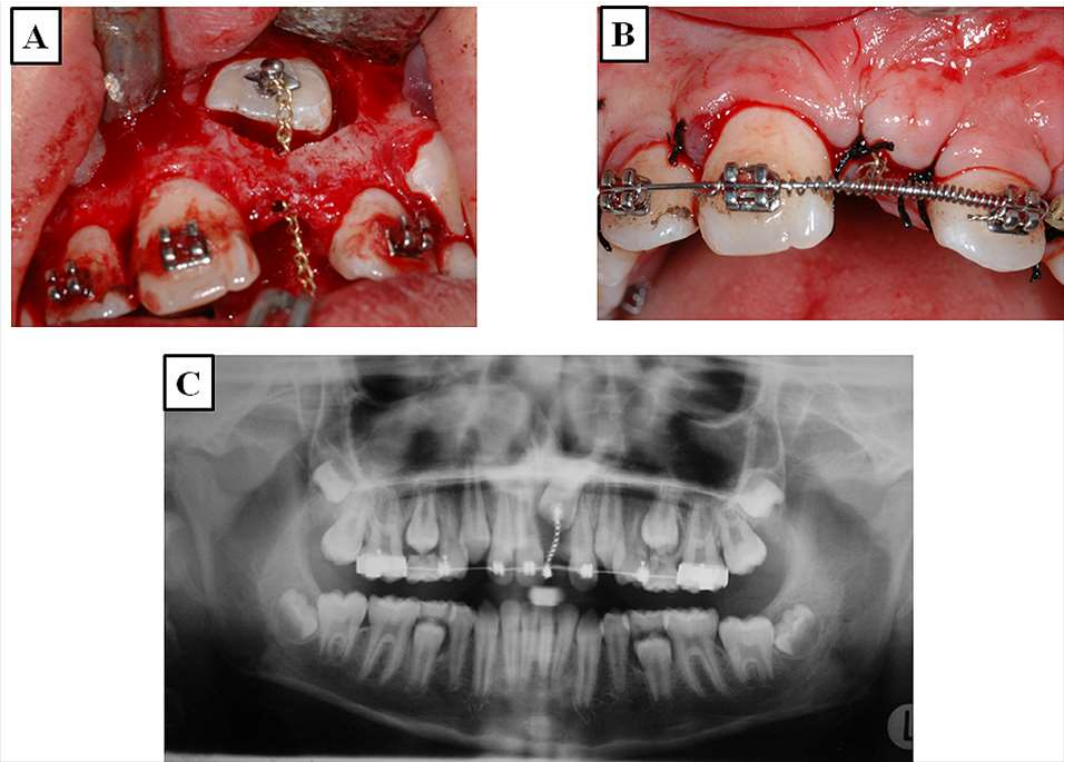

FIG. 11 A-C:
A: A Fixed gold chain through the prepared tunnel.
B: Repositioned and sutured flap. The bonded attachment on tooth 21 was connected to the archwire with gentle traction to facilitate tooth movement.
C: Radiograph showing the fixed attachment on the displaced tooth 21.

Placement and Postoperative Care

Attachments should be placed near the tooth tip to facilitate access. Binding agents enhance attachment adhesion. After surgery, the area is rinsed and sutured (Fig. 11 A-C).
If left exposed, complications such as soft tissue overgrowth or plaque accumulation can occur, leading to secondary infections .

Orthodontic Integration

The chain should be positioned to avoid soft tissue trauma. A maxillary splint can be used if necessary. The impacted tooth is moved into position using appropriate appliances under the mucosa.
For displaced front teeth, closed elongation is typically preferred, while fenestration suffices when the tooth lies just beneath the mucosa (Fig. 12 A-H, Fig.13 A, B).

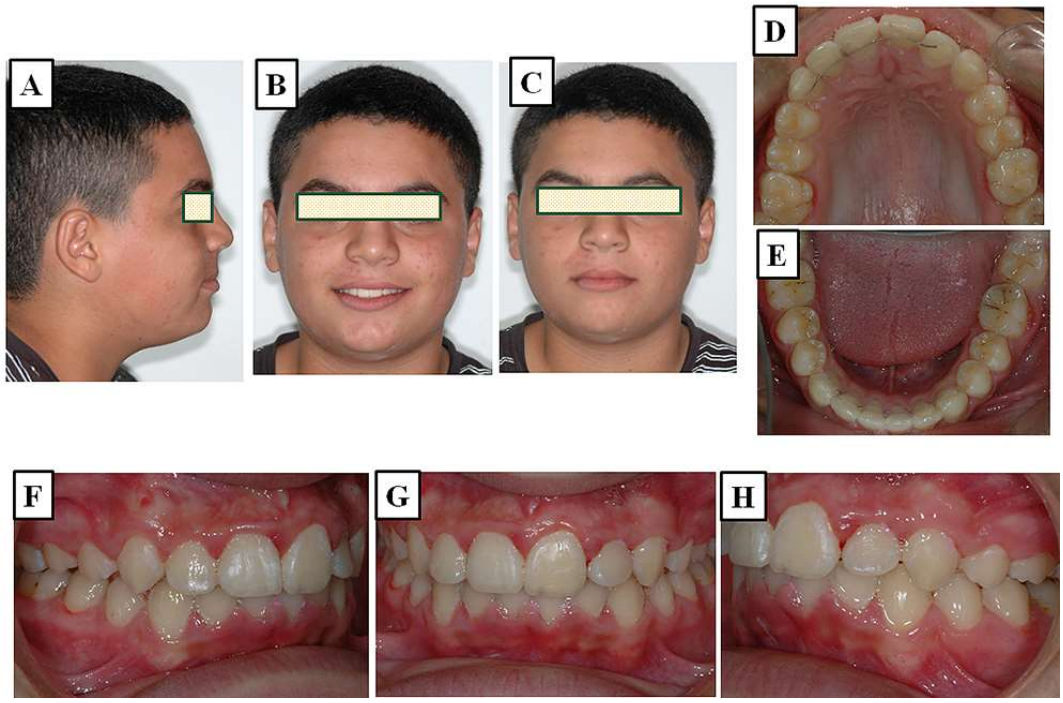

FIG. 12 A-H: Intraoral and extraoral situation after the completion of treatment, with tooth 21 properly aligned in the dental arch.

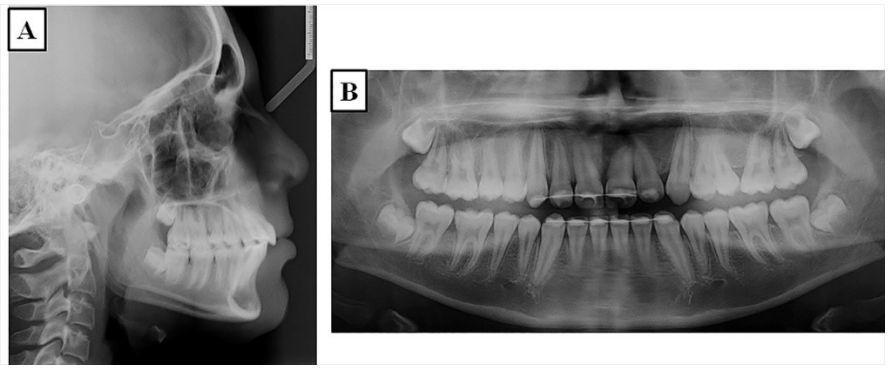

FIG. 13 A, B: Radiographs after the completion of treatment

Follow Up

The patient was advised for a follow up every month to monitor the spontaneous eruption of 21. The central incisor began to spontaneously erupt after a three-month period of follow-up

Discussion

An impacted tooth refers to a tooth that is unable or delayed in its ability to erupt into its intended functional position.[8] One of the most frequent adverse effects of having supernumerary teeth in the anterior region of maxilla is incomplete eruption of maxillary incisors [7-9]. Several theories have been suggested to explain the etiology of supernumerary teeth, including the hyperactivity of dental lamina, phylogenetic theory, and dichotomy of tooth bud.[7- 11]

There are different ways to manage impaction caused by supernumerary teeth. These methods include removing the supernumerary teeth or tooth only, removing both the supernumerary teeth

and the bone covering the impacted teeth, or making an incision in the fibrous tissue over the alveolar ridge to encourage eruption. These methods may be used with or without orthodontic traction. [1,7,11,12](Fig.14)

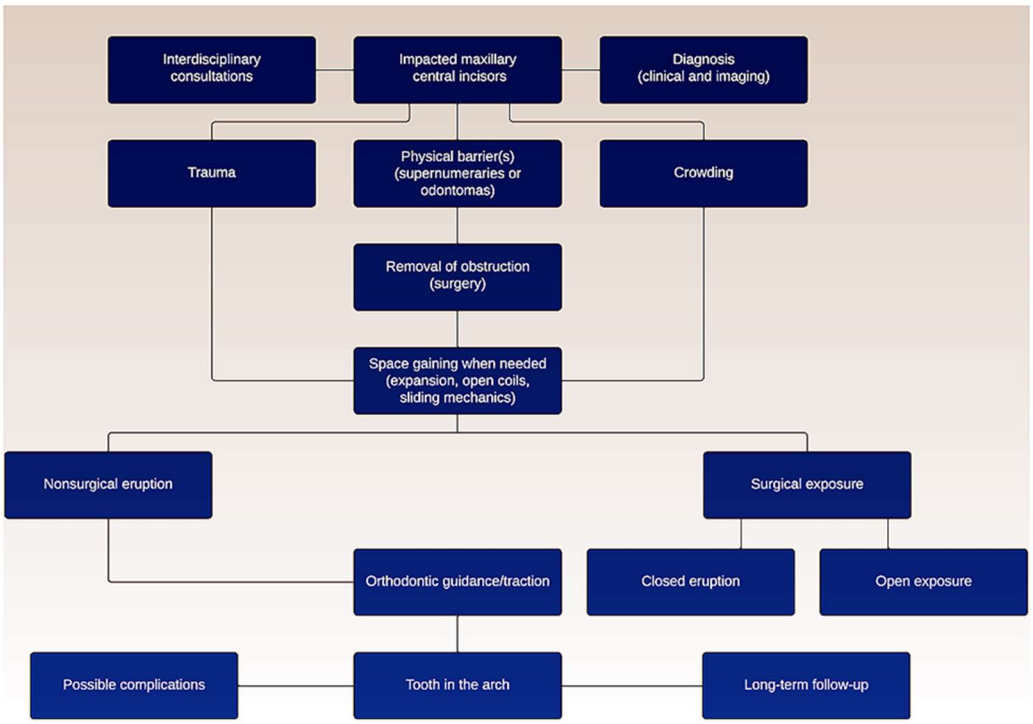

FIG. 14: different ways to manage impaction caused by supernumerary teeth

Delaying orthodontic and surgical intervention is not advisable as it can lead to challenges in aligning teeth within the arch. There are different surgical methods available for uncovering impacted teeth prior to orthodontic treatment .
Becker outlines three surgical techniques for exposing impacted teeth:
1. Circular excision of the oral mucosa above the impacted tooth.[1,7]
2. Repositioning the raised flap to include the attached gingiva covering the impacted tooth.[1,7]
3. Closed eruption technique: raising the flap, including the attached gingiva, and then replacing it entirely in its original position after bonding an attachment to the impacted tooth.[1`,13]

Methods of management of crowding or impaction due to supernumerary are; remove super-numerary teeth or tooth only, remove supernumerary teeth and bone
overlying impacted teeth, incision of fibrous tissue over the alveolar ridge to promote the eruption with or without orthodontic traction Surgical exposures of impacted
incisors or surgical repositioning have been used to bring impacted teeth into occlusion.**[**8,9,14**]** The disadvantage of the combined surgical/orthodontic therapy is required a longer treatment period and some complication including ankylosis, non-vital pulps and root resorptions may be encountered. When an extensive amount of bone is removed or an open approach method is used to expose the impacted teeth, surgically, periodontal complicationcan be occurred such as gingival recession, delay in periodontal healing, gingivitis, bone loss and decrease in the width of keratinized gingiva.[15-18]

Following a careful clinical examination, it is imperative to use a complementary means of diagnosis. In all clinical cases presented, panoramic radiography and lateral tele radiography were important methods for studying the impacted MCI and general orthodontics.[1,7,19]

With all the requisite information, it is possible to establish a diagnosis and elaborate a treatment plan. Once complete, the symbiosis of several medical specialties may be necessary. In response to the situation, several treatment options are available .[1,7,20]

Lin [10] successfully treated a patient with an impacted dilacerated maxillary central incisor and pointed out that the success rate of an impacted dilacerated tooth depends on the degree of dilaceration, the position of the tooth, and the amount of root formation.

The treatment approach of impacted maxillary teeth requires the cooperation of dental specialties such as orthodontics, oral surgery, and prosthodontics. The current treatment modality, instead of extraction, is to have surgical crown exposure with the placement of an auxiliary, followed by orthodontic positioning of the tooth.[20-26]
The surgical exposure for orthodontic guidance of impacted tooth must be well planned to prevent any harmful effects on the periodontium. The impacted incisor was erupted by using the closed-eruption technique [19-23]. It was suggested that labially impacted teeth might have a thinner plate of bone and therefore are at greater risk for attachment loss if uncovered with an apically positioned flap [19]. Vermette [27] compared these 2 surgical procedures and showed negative esthetic effects such as increased clinical crown length and gingival scarring with the apically positioned flap technique than the closed-eruption technique [12-20].

Mitchell and Bennet [19] in 1992 classified the distance of the unerupted permanent tooth from the occlusal plane as: near, vertical displacement within coronal 1/3 root of adjacent teeth, horizontal displacement < ½ tooth width; mid, vertical displacement within middle 1/3 root of adjacent tooth, horizontal displacement > ½ tooth width but <1 tooth width; far**,** greater displacement.
In this report we have done the extraction the supernumerary teeth (three) followed by removal of the overlying bone and surgical repositioning of the incisors.[28] The patient was advised to not to disturbed the surgical filed very often until adequate soft tissue andbony healing occurs, other wise the repositioned incisor may get displaced. Twenty-one erupted normally as the root was not completed during the time of surgery and obstacles (superneumamary teeth) was removed from its path of eruption.[29,30] Orthodontic extrusion for 11 was carried out as it failed to erupt. As it lack the eruptive forces because the root of the right central incisor was almost completed at the time of surgery and the tooth was repositioned in the arch. At last incisor alignment achieved with the help of a NiTi wire. In the presentcase the duration of treatment was around 18 monthsm and the aligned maxillary incisor remained vital and responded normally to percussion and mobility and sensitivity testing.[31-33]

Every case should be analyzed individually to develop the proper treatment plan. Mutidisplinary team approach should be utilized to ensure successful outcome of the treatment. Early diagnosis of the presence and removal of supernumerary teeth is essential. Maxillary permanent left incisor was successfully positioned in the maxillary arch by surgical exposure and orthodontic traction, which showed good stability.[33,34]

For the treatment, it depends on the type and location of the supernumerary teeth and on its potential effect on the adjacent hard and soft tissue structures. The majority of delayed permanent incisors erupt spontaneously if sufficient space is created at the time of removal of the supernumerary tooth and maintenance of postoperative space is needed [1,7,25]. However, if there is no space for a delayed tooth, we must re-establish it by orthodontic treatment.[25]

CONCLUSION

Successful management of anterior impacted maxillary tooth can be challenging in a clinical practice. Proper diagnosis concerning the exact localization of the impacted tooth, an appropriate surgical technique, and a light orthodontic force system can be an effective approach to successfully bring the tooth into occlusion. The closed-eruption technique provided an esthetically pleasing result in this patient.

CONTRIBUTION OF AUTHORS;

Research concept- Dr. A . Watted ,Dr. N. Watted ,**Research design**-Dr. Abu-Hussein M . , Dr. N. Ghannam , Dr. M . Abu Yunis, **Supervision**- Dr. Abu-Hussein M. , Dr. N. Watted, **Materials**- - Dr. Abu-Hussein M.Dr. N. Ghannam , Dr. M . Abu Yunis **Data collection**-Dr. N. Ghannam , Dr. M . Abu Yunis
Data analysis and Interpretation- Dr. A . Watted ,Dr. N. Watted ,**Literature search**-Dr . , Abu-Hussein M .
Critical review- Dr. A . Watted , Dr. N. Watted Dr. N. Ghannam Dr. M . Abu Yunis **, Article editing**-Dr . Abu-Hussein M, Dr. N. Watted, Dr. A . Watted ,**Final approval**- Dr. N. Watted , Dr. Abu-Hussein M.

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Conflict of Interest
The authors declare they have no conflict of interest.

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