

Management of unerupted maxillary incisors

Omar Yaqoob
Julian O'Neill
Terry Gregg

Joe Noar
Martyn Cobourne
David Morris

Introduction

Missing and unerupted maxillary incisors can have a major impact on dental and facial aesthetics and were considered to be the most unattractive deviant occlusal trait in one American study.¹ There are very few studies reporting any functional problems associated with missing anterior teeth although some speech difficulties have been reported, particularly with the 's' sound.²⁻⁴ As missing upper incisors are regarded as unattractive this may have an effect on self-esteem and general social interaction and it is important to detect and manage the problem as early as possible.⁵

This guideline has been based on current evidence and should be continually developed as further evidence is made available. In the current literature, there are no controlled trials, 23 retrospective case studies reporting on 12 to 213 cases, 4 epidemiological studies reporting on 41 to 48,550 individuals, 52 case reports and 23 articles portraying clinical techniques, overviews and personal impressions.

1. DIAGNOSIS AND MANAGEMENT

1.1 Definition

Delayed eruption of maxillary incisors requires monitoring or intervention when:

- > there is eruption of contralateral teeth that occurred greater than six months previously;
- > both central incisors remain unerupted and the lower incisors have erupted greater than one year

- previously; or
- > there is deviation from the normal sequence of eruption (eg lateral incisors erupting prior to the central incisor).

1.2 Causes of delayed eruption

Delayed eruption can be classified into two causative groups.⁶

1.2.1 Hereditary

Supernumerary teeth, cleft lip and palate, cleidocranial dysostosis, odontomes, abnormal tooth/tissue ratio, generalised retarded eruption, gingival fibromatosis.

1.2.2 Environmental

Trauma, early extraction or loss of deciduous teeth (with or without space loss), retained deciduous teeth, cystic formation, endocrine abnormalities, bone disease.

2. INCIDENCE/PREVALENCE

The incidence of unerupted maxillary central incisor in the 5–12 year-old age group has been reported as 0.13%.⁷ In a referred population to regional hospitals the prevalence has been estimated as 2.6%.⁸

3. DETECTION OF CAUSES OF FAILURE OF ERUPTION

Dental and medical history:

A detailed dental and medical history should be obtained to determine possible hereditary or environmental factors, which may be contributory to the delay in eruption.

4. EXAMINATION

An intra-oral examination should be undertaken to identify the presence of deciduous teeth retained beyond their normal exfoliation dates. Buccal or palatal swellings should be noted as well as the availability of suitable space for the eruption of the incisors (9mm for a central and 7mm for a lateral incisor).⁹

Radiographs should be taken. A dental panoramic tomography and anterior occlusal radiograph can be taken for general assessment purposes. For detailed assessment of position it has been shown that the use of a horizontal parallax technique is better than vertical.¹⁰ For more accurate assessment of root and crown morphology, periapical radiographs should be taken using the long cone technique.^{11,12}

More recently, cone beam computed tomography technology has become available for imaging the maxillofacial region and this can be used for the localisation of impacted teeth, including incisors. This technique allows accurate localisation of the impacted tooth and visualisation of associated structures. However, it is associated with a higher overall effective dose than conventional radiography and currently there are no official guidelines or formal selection criteria with regard to its use in the UK.¹²

5. MANAGEMENT PRINCIPLES

5.1 Remove retained deciduous tooth

Any retained deciduous tooth should be extracted if there is no other obvious causative factor or if the permanent incisor is close to eruption.

5.2 Create and maintain sufficient mesial and distal space

Seventy-five per cent of incisors erupt spontaneously after space creation. Of these, 55% will align spontaneously while the rest will require some form of orthodontic alignment.^{13,14}

5.3 Physical obstruction

The presence of a supernumerary tooth or odontome does not necessarily cause delayed eruption of incisors.¹⁵ In the premaxillary region, where there is a failure of eruption of the permanent incisors, the effects of supernumerary teeth have been reported variably at 28% and 38%.^{15,16} Tuberculate supernumerary teeth are more likely to cause an obstruction than conical supernumerary teeth (1 in 5 compared to 1 in 1).¹⁷ In addition, one-third of compound odontomes and one-half of complex odontomes prevent eruption of teeth (compound odontomes are four times more common than complex odontomes).¹⁸ Odontomes are most common in Caucasian populations, where they account for over 65% of all odontogenic tumours. In general, odontomes occur more often in the permanent dentition and are very rarely associated with the primary teeth.¹⁹ It is felt that, in general, if there is an obstruction it should be removed as the early removal of the causative factor preventing eruption of the incisor improves the prognosis.²⁰

In 54 to 78% of cases in which supernumerary teeth overlie the incisor, removal of the supernumerary will result in the permanent incisor erupting spontaneously within an average time of 16 months,^{21,22} provided there is enough space.²³ The incisor may also be exposed at the same time as the removal of the supernumerary tooth as this will help aid the path of eruption.²⁴ Maxillary incisors that fail to erupt due to the presence of supernumerary teeth have a better prognosis than unerupted incisors with fewer common aetiologies.¹⁶

There are a number of different approaches:

5.3.1 Exposure

A minimal approach can be employed in which a small window is created if the permanent incisor is close to the surface, the attached gingiva is wide and there is extensive preservation possible at the gingival margin.²⁵ Otherwise, palatal or buccal mucosal flaps should be raised to reveal the tooth. In the case of a buccal flap, as much attached gingiva as possible

should be preserved using an apically positioned flap.²⁵ The exposure may need to be maintained using a non-eugenol based periodontal dressing.²⁶ Whitehead's varnish pack may cause discoloration of the underlying tooth.¹⁴ The short-term use of a chlorhexidine mouthwash should be prescribed to reduce gingival inflammation.²⁷

5.3.2 Closed eruption technique

A flap is raised and a bracket attached to a gold chain, steel ligature,^{28,29} magnet³⁰ or elastomeric material is bonded to the tooth followed by replacement of the palatal flap. Orthodontic traction should then be applied.^{31,32} The bracket should be bonded palatally so that early buccal fenestration does not occur in order to avoid an unfavourable gingival contour. Placement of a customised bracket bonded to the incisal tip has been described to reduce the risk of fenestration.³³

Traction in a forwards and downwards direction may cause the tooth to erupt in too high a gingival position and is not recommended. Therefore, in order to avoid exposure of the unerupted tooth into a high gingival position, it is necessary to apply traction carefully. The final position of the gingival margin is technique-sensitive. It is important not to remove the gingivae and surrounding tissues during exposure of the impacted incisor. Two weeks after surgical exposure, orthodontic traction may be started.³⁴⁻³⁶

5.4 Unfavourable root formation

Dilaceration can occur in both primary and permanent dentitions. This malformation can occur in permanent incisors as a result of trauma to primary predecessors whose apices lie close to the permanent tooth germ. The prevalence of traumatic injuries to the primary dentition ranges from 11 to 30%.¹⁹

A study of 41 dilacerated unerupted maxillary central incisors revealed that 7% were associated with cysts or supernumerary teeth, 22% resulted from trauma to the deciduous predecessor and the remaining 71% were developmental in nature.³⁷ The dilacerated incisor may be brought into the line of the arch by exposure and closed technique.^{38,39} Elective root filling and apicectomy may

be undertaken where there is unfavourable labial root dilaceration. If the malformation is severe, the incisor may have to be removed.

5.5 Incisor removal

If a permanent incisor has to be removed (for example, if it is ankylosed) space can be maintained initially with a fixed or removable prosthesis.⁴⁰ An implant may then be considered as a long-term solution.⁴¹⁻⁴³ However, prolonged space maintenance can lead to significant alveolar bone loss in the affected region, making later implant placement more difficult. An alternative strategy, particularly in the younger child, is to allow spontaneous space closure in the labial segment and then to open up space with fixed appliances prior to definitive restoration in the permanent dentition.⁴⁴

5.6 Ankylosed maxillary incisors

Severe intrusion and infection of the primary incisors or traumatic avulsion of the permanent incisors can cause ankylosis of permanent incisors.

5.6.1 The following treatment options are available:

- > Extraction of the ankylosed incisor followed by reimplantation in an ideal position; or extraction followed by orthodontic space closure with lateral incisor as surrogate.
- > Extraction followed by placement of an osseointegrated implant if the patient has completed growth.
- > Prosthetic replacement or augmentation.
- > Osteotomy of the dentoalveolar segment with immediate repositioning.⁴⁰

5.6.2 Osteotomy of the segment and repositioning of the dentoalveolar structures is a feasible option in some cases.

Distraction osteogenesis of ankylosed maxillary incisors with subsequent orthodontic adjustment has been reported.⁴⁵⁻⁴⁷ Growth of the patient is of special concern because of the risk of vertical relapse.

5.7 Autotransplantation

Autotransplantation of developing premolars to replace missing maxillary incisors has been documented 'to provide physiologically sound results'.⁴⁸ The most commonly selected tooth for transplantation is the lower second premolar. This has been documented to produce successful outcomes.^{48,49}

The main advantage is physiological as the process involves placement of the patient's own vital tooth, with preserved periodontium, followed by some morphological alteration by reshaping.⁵⁰⁻⁵³

6. DISCUSSION

The occurrence of unerupted maxillary incisors can be associated with hereditary and environmental factors. However, the relevant importance of these different factors is not known. For example, the presence of supernumerary teeth does not necessarily mean that the incisor will be prevented from eruption.⁵⁴

Often the position of the impacted incisor (ie distance from alveolar crest, rotation, angulation and inclination) determines the surgical procedure used. One study of 30 patients suggested that the closed technique resulted in a more aesthetically pleasing gingiva than the apically repositioned flap.

However, there was no significant difference between the techniques regarding periodontal attachment. In contrast, superior results have been reported in terms of gingival, periodontal and pulp status using the closed eruption technique in comparison with the apically repositioned flap.²⁵

The timing of intervention has been suggested as being important, with several studies suggesting that the younger the age, the quicker the tooth erupts.⁵⁵ However, other studies have suggested that age of intervention has no effect. To some extent the differences can be explained by the small mean time difference of about three months in eruption, inadequate sample sizes and unmatched age groups.

SUMMARY AND RECOMMENDATIONS

1. Children up to nine years with incomplete root development of permanent incisor:
 - > Remove obstruction.
 - > Do not uncover bone from unerupted incisor – maintain integrity of follicle.
 - > Create space if required.
 - > Monitor eruption for 18 months – 80% erupt spontaneously
 - > If exposure required then expose minimally to eliminate soft tissue obstruction. If tooth is still high, expose and bond bracket.
 - > For best aesthetics:
 - i. avoid excision of attached gingivae; and
 - ii. avoid apically repositioned flaps.
2. Children above nine years with complete or nearly complete apex:
 - > Remove obstruction.
 - > Create space if required.
 - > If permanent incisor high then monitor eruption for 12 months.
 - > If tooth still unerupted at 12 months, expose and bond bracket as required.
3. If permanent incisor is impacted:
 - > Expose and bond bracket at first operation.
4. Children referred late (over 10 years):
 - > Remove obstruction, expose and bond bracket at first operation.

References

1. Cons NC, Jenny J, Kohout FJ. *DAI: the dental aesthetic index*. Iowa: College of Dentistry, University of Iowa; 1986.
2. Snow K. Articulatory Proficiency in Relation to Certain Dental Abnormalities. *Journal of Speech and Hearing Disorders* 1961; **26**: 209–12.
3. Bankson NW, Byrne MC. The Relationship

- Between Missing Teeth and Selected Consonant Sounds. *Journal of Speech and Hearing Disorders* 1962; **27**: 341–48.
4. Weinberg B. A cephalometric study of normal and defective –s- articulation and variations in incisor dentition. *J Speech Hear Res* 1968; **11**: 288–300.
 5. Shaw WC, O'Brien KD, Richmond S, Brook P. Quality control in orthodontics: risk/benefit considerations. *Br Dent J* 1991; **170**: 33–37.
 6. Hitchen AD. The impacted maxillary incisor. *Dent Pract Dent Rec* 1970; **20**: 423–33.
 7. Mac Phee CG. The incidence of erupted supernumerary teeth in consecutive series of 4000 school children. *Br Dent J* 1935; **58**: 59–60.
 8. Di Biase DD. Midline supernumeraries and eruption of maxillary central incisors. *Transactions of the BSSO* 1968–1969; 83–88.
 9. Moyers RE, van der Linden FP, Riolo ML, McNamara Jr JA. *Standards of human occlusal development*. Ann Arbor, Michigan: Centre for Human Growth and Development, University of Michigan; 1976.
 10. Armstrong C, Johnston C, Burden D, Stevenson M. Localizing ectopic maxillary canines – horizontal or vertical parallax? *Eur J Orthod* 2003; **25**: 585–89.
 11. Brook AH. Dental anomalies of number, form and size: their prevalence in British schoolchildren. *J Int Assoc Dent Child* 1974; **5**: 37–53.
 12. Isaacson KG, Thom AR, Horner K, Whaites E. *Orthodontic radiographs – guidelines*, 3rd edn. London: British Orthodontic Society; 2008.
 13. Di Biase DD. The effects of variations in tooth morphology and position on eruption. *Dent Pract Dent Rec* 1971; **22**: 95–108.
 14. Munns D. Unerupted uncisors. *Br J Orthod* 1981; **8**: 39–42.
 15. Leyland L, Batra P, Wong F, Llewelyn R. A retrospective evaluation of the eruption of impacted permanent incisors after extraction of supernumerary teeth. *J Clin Pediatr Dent* 2006; **30**: 225–31.
 16. Betts A, Camilleri G. A review of 47 cases of unerupted maxillary incisors. *Int J Paediatr Dent* 1999; **9**: 285–92.
 17. Foster TD, Taylor GS. Characteristics of supernumerary teeth in the upper central incisor region. *Dent Pract Dent Rec* 1969; **20**: 8–12.
 18. Katz RW. An analysis of compound and complex odontomas. *ASDC J Dent Child* 1989; **56**: 445–49.
 19. Yeung K, Cheung R, Tsang M. Compound odontoma associated with an unerupted and dilacerated maxillary primary central incisor in a young patient. *Int J Paediatr Dent* 2003; **13**: 208–12.
 20. Kajiyama K, Kai H. Esthetic management of an unerupted maxillary central incisor with a closed eruption technique. *Am J Orthod and Dentofacial Orthop* 2000; **118**: 224–28.
 21. Mitchell L, Bennett TG. Supernumerary teeth causing delayed eruption – a retrospective study. *Br J Orthod* 1992; **19**: 41–46.
 22. Witsenberg B, Boering G. Eruption of impacted permanent incisors after removal of supernumerary teeth. *Int J Oral Surg* 1981; **10**: 423–31.
 23. Bryan RA, Cole BO, Welbury RR. Retrospective analysis of factors influencing the eruption of delayed permanent incisors after supernumerary tooth removal. *Eur J Paediatr Dent* 2005; **6**: 84–89.
 24. Ashkenazi M, Greenberg BP, Chodik G, Rakocz M. Postoperative prognosis of unerupted teeth after removal of supernumerary teeth or odontomas. *Am J Orthod Dentofacial Orthop* 2007; **131**: 614–19.
 25. Vermette ME, Kokich VG, Kennedy DB. Uncovering labially impacted teeth: apically positioned flap and closed-eruption techniques. *Angle Orthod* 1995; **65**: 23–32.
 26. Jorkjend L, Skoglund LA. Effect of non-eugenol and eugenol-containing periodontal dressings on the incidence and severity of pain after periodontal soft tissue surgery. *J Clin Periodontol* 1990; **17**: 341–44.
 27. Sanz M, Newman MG, Anderson L *et al*. Clinical enhancement of post-peripodotal surgical therapy by a 0.12% chlorhexidine gluconate mouthrinse. *J Periodontol* 1989; **60**: 570–76.
 28. Becker A, Shpack N, Shteyer A. Attachment bonding to impacted teeth at the time of surgical exposure. *Eur J Orthod* 1996; **18**: 457–63.
 29. Oliver RG, Hardy P. Practical and theoretical

- aspects of a method of orthodontic traction to unerupted teeth illustrated by three cases. *Br J Orthod* 1986; **13**: 229–36.
30. Sandler PJ, Meghji S, Murray AM *et al.* Magnets and orthodontics. *Br J Orthod* 1989; **16**: 243–49.
31. Proffit W. *Contemporary Orthodontics*. St Louis: Mosby; 1992.
32. Foley J. Surgical removal of supernumerary teeth and the fate of incisor eruption. *Eur J Paediatr Dent* 2004; **5**: 35–40.
33. Noar JH, Gaukroger MJ. Customized metal coping for elastic traction of an ectopic maxillary central incisor. *J Clin Orthod* 2000; **34**: 585–89.
34. Uematsu S, Uematsu T, Furusawa K *et al.* Orthodontic treatment of an impacted dilacerated maxillary central incisor combined with surgical exposure and apicoectomy. *Angle Orthod* 2004; **74**: 132–36.
35. Becker A, Brin I, Ben-Bassat Y *et al.* Closed-eruption surgical technique for impacted maxillary incisors: a postorthodontic periodontal evaluation. *Am J Orthod Dentofacial Orthop* 2002; **122**: 9–14.
36. Bayram M, Ozer M, Sener I. Bilaterally impacted maxillary central incisors: surgical exposure and orthodontic treatment: a case report. *J Contemp Dent Pract* 2006, **7**: 98–105.
37. Stewart DJ. Dilacerate unerupted maxillary central incisors. *Br Dent J* 1978; **145**: 229–33.
38. Nashashibi IA. Orthodontic movement of a palatally displaced, dilacerated, unerupted maxillary central incisor. *J Pedod* 1986; **11**: 83–90.
39. Sandler PJ, Reed RT. Treatment of a dilacerated incisor. *J Clin Orthod* 1988; **22**: 374–76.
40. Asher C, Lewis DH. The integration of orthodontic and restorative procedures in cases with missing maxillary incisors. *Br Dent J* 1986; **160**: 241–45.
41. Lewis DH, Eldridge DJ. Orthodontic/restorative interface. *Dent Update* 1992; **19**: 195–96, 198–99.
42. Henry PJ, Laney WR, Jemt T *et al.* Osseointegrated implants for single-tooth replacement: a prospective 5-year multicenter study. *Int J Oral Maxillofac Implants* 1996; **11**: 450–55.
43. Kristensen L. Autotransplantation of human premolars. A clinical and radiological study of 100 teeth. *Int J Oral Surg* 1985; **14**: 200–13.
44. Kokich VG, Crabill KE. Managing the patient with missing or malformed maxillary central incisors. *Am J Orthod Dentofacial Orthop* 2006; **129** (4 Suppl): S55–63.
45. Medeiros PJ, Bezerra AR. Treatment of an ankylosed central incisor by single tooth dento-osseous osteotomy. *Am J Orthod Dentofacial Orthop* 1997; **112**: 496–501.
46. Huck L, Korbmacher H, Niemeyer K, Kahl-Nieke B. Distraction osteogenesis of ankylosed front teeth with subsequent orthodontic fine adjustment. *J Orofac Orthop* 2006; **67**: 297–307.
47. Isaacson RJ, Strauss RA, Bridges-Poquis A *et al.* Moving an ankylosed central incisor using orthodontics, surgery and distraction osteogenesis. *Angle Orthod* 2001; **71**: 411–18.
48. Czochrowska EM, Stenvik A, Zachrisson BU. The esthetic outcome of autotransplanted premolars replacing maxillary incisors. *Dent Traumatol* 2002; **18**: 237–45.
49. Czochrowska EM, Stenvik A, Album B, Zachrisson BU. Autotransplantation of premolars to replace maxillary incisors: a comparison with natural incisors. *Am J Orthod Dentofacial Orthop* 2000; **118**: 592–600.
50. Frenken JW, Baart JA, Jovanovic A. Autotransplantation of premolars. A retrospective study. *Int J Oral Maxillofac Surg* 1998; **27**: 181–85.
51. Kalwitzki M, Ney T, Göz G. Transplantation of a lower bicuspid after traumatic loss of three upper incisors. *J Orofac Orthop* 2003; **64**: 57–66.
52. Glassman SD. Autogenic tooth transplantation in the treatment of malocclusion. *Dent Clin North Am* 1981; **25**: 109–116.
53. Nethander G. Autogenous free tooth transplantation by the two-stage operation technique. An analysis of treatment factors. *Acta Odontol Scand* 1998; **56**: 110–15.
54. Stafne EC. Supernumerary upper central incisors. *Dental Cosmos* 1931; **73**: 976–80.
55. Brin I, Zilberman Y, Azaz B. The unerupted maxillary central incisor: review of its etiology and treatment. *ASDC J Dent Child* 1982; **49**: 352–56.

Articles read

Agnihotri A, Marwah N, Dutta S. Dilacerated unerupted central incisor: A case report. *J Indian Soc Pedod Prev Dent* 2006; **24**: 152–54.

Andreasen JO, Ravn JJ. The effect of traumatic injuries to primary teeth on their permanent successors. II. A clinical and radiological follow-up study of 213 teeth. *Scand J Dent Res* 1971; **79**: 284–94.

Andreasen JO, Sundström B, Ravn JJ. The effect of traumatic injuries to primary teeth on their permanent successors. I. A clinical and histological study of 117 injured permanent teeth. *Scand J Dent Res* 1971; **79**: 219–83.

Anke B. Eruption problems with maxillary incisors – a case report. *Quintessence Int (Berl)* 1971; **6**: 61–62.

Asaumi JI, Shibata Y, Yanagi Y *et al.* Radiographic examination of mesiodens and their associated complications. *Dentomaxillofac Radiol* 2004; **33**: 125–27.

Bishara SE. Treatment of unerupted incisors. *Am J Orthod* 1971; **59**: 443–47.

Bodenham RS. The treatment and prognosis of unerupted maxillary incisors associated with the presence of supernumerary teeth. *Br Dent J* 1967; **123**: 173–77.

Bondemark L, Kurol J, Larsson A. Long-term effects of orthodontic magnets on human buccal mucosa – a clinical, histological and immunohistochemical study. *Eur J Orthod* 1998; **20**: 211–18.

Boyd RL. Clinical assessment of injuries in orthodontic movement of impacted teeth. II. Surgical recommendations. *Am J Orthod* 1984; **86**: 407–18.

Cangialosi TJ. Management of a maxillary central incisor impacted by a supernumerary tooth. *J Am Dent Assoc* 1982; **105**: 812–14.

Cerny R. Treatment of an “ankylosed” upper central incisor in the mixed dentition. *Aust Orthodont J* 2000; **16**: 104–7.

Cheshire PD, Griffiths GS, Griffiths BM, Newman HN. Evaluation of the healing response following placement of Coe-pak and an experimental pack after periodontal flap surgery. *J Clin Periodontol* 1996; **23**: 188–93.

Chohayeb AA. Dilaceration of permanent upper lateral incisors: frequency, direction, and endodontic treatment implication. *Oral Surg Oral Med Oral Pathol* 1983; **55**: 519–20.

Cozza P, Gatto R, Marino A, Mucedero M. Case report: two nasal floor compound odontomas associated with impacted maxillary incisor. *Eur J Paediatr Dent* 2003; **4**: 99–102.

Cozza P, Mucedero M, Ballanti F, De Toffol L. Supernumerary teeth and mental retardation: the importance of early surgical intervention. *Eur J Paediatr Dent* 2006; **7**: 45–49.

Cozza P, Mucedero M, Ballanti F, De Toffol L. A case of an unerupted maxillary central incisor for indirect trauma localised horizontally on the anterior nasal spine. *J Clin Paediatr Dent* 2005; **29**: 201–13.

Crean SJ, Banu B, Coonar H. Modified apically repositioned flap in the treatment of unerupted maxillary central incisors. *Dent Update* 2000; **27**: 137–39.

Dash JK, Sahoo PK, Das S, Mohanty UK. Prevalence of supernumerary teeth in deciduous and mixed dentition. *J Indian Soc Pedod Prev Dent* 2003; **21**: 37–41.

Davies TM, Lewis DH, Gillbe GV. The surgical and orthodontic management of unerupted teeth in cleidocranial dysostosis. *Br J Orthod* 1987; **14**: 43–47.

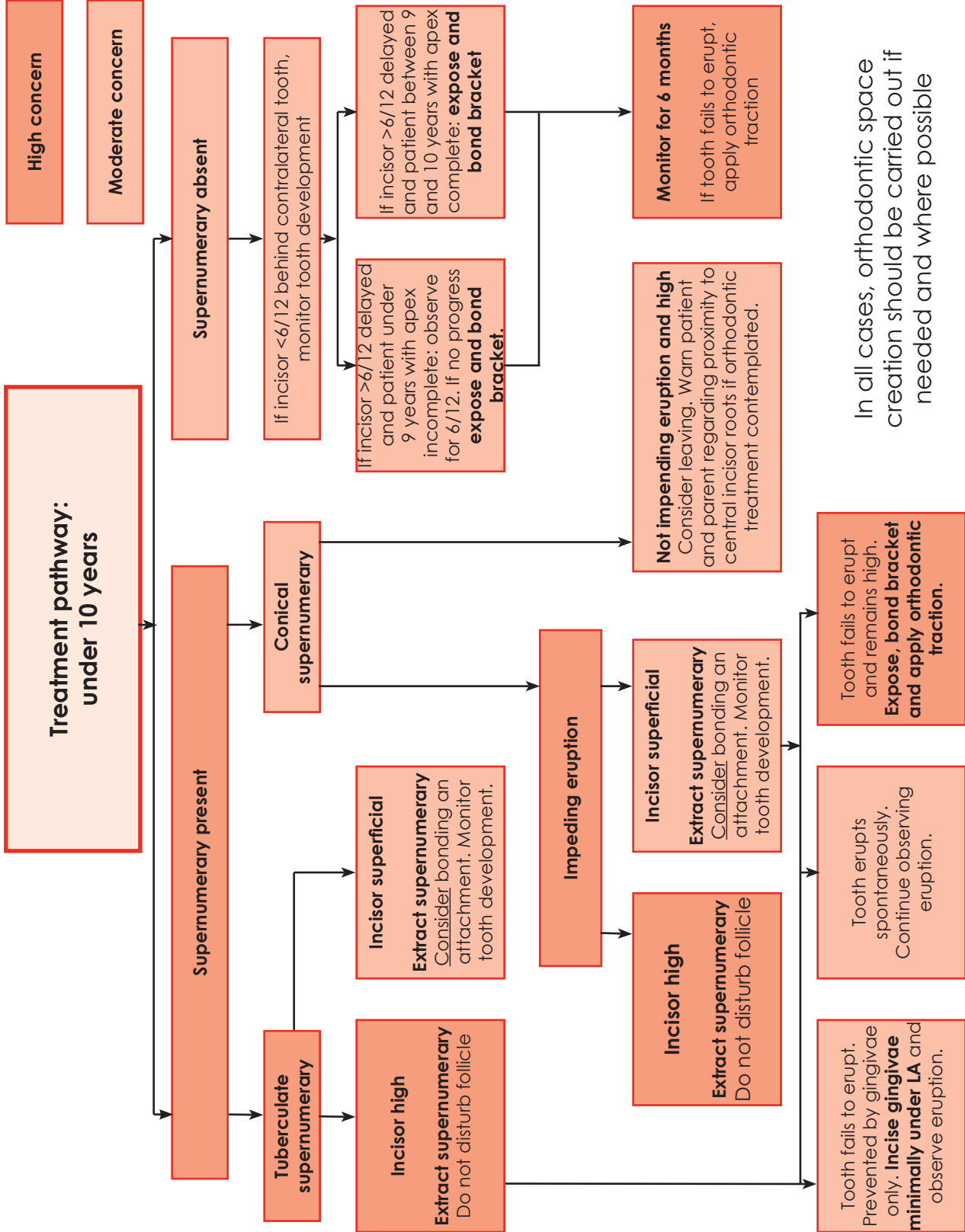
Di Biase DD. Midline supernumeraries and eruption of the maxillary central incisor. *Dent Pract Dent Rec* 1969; **20**: 35–40.

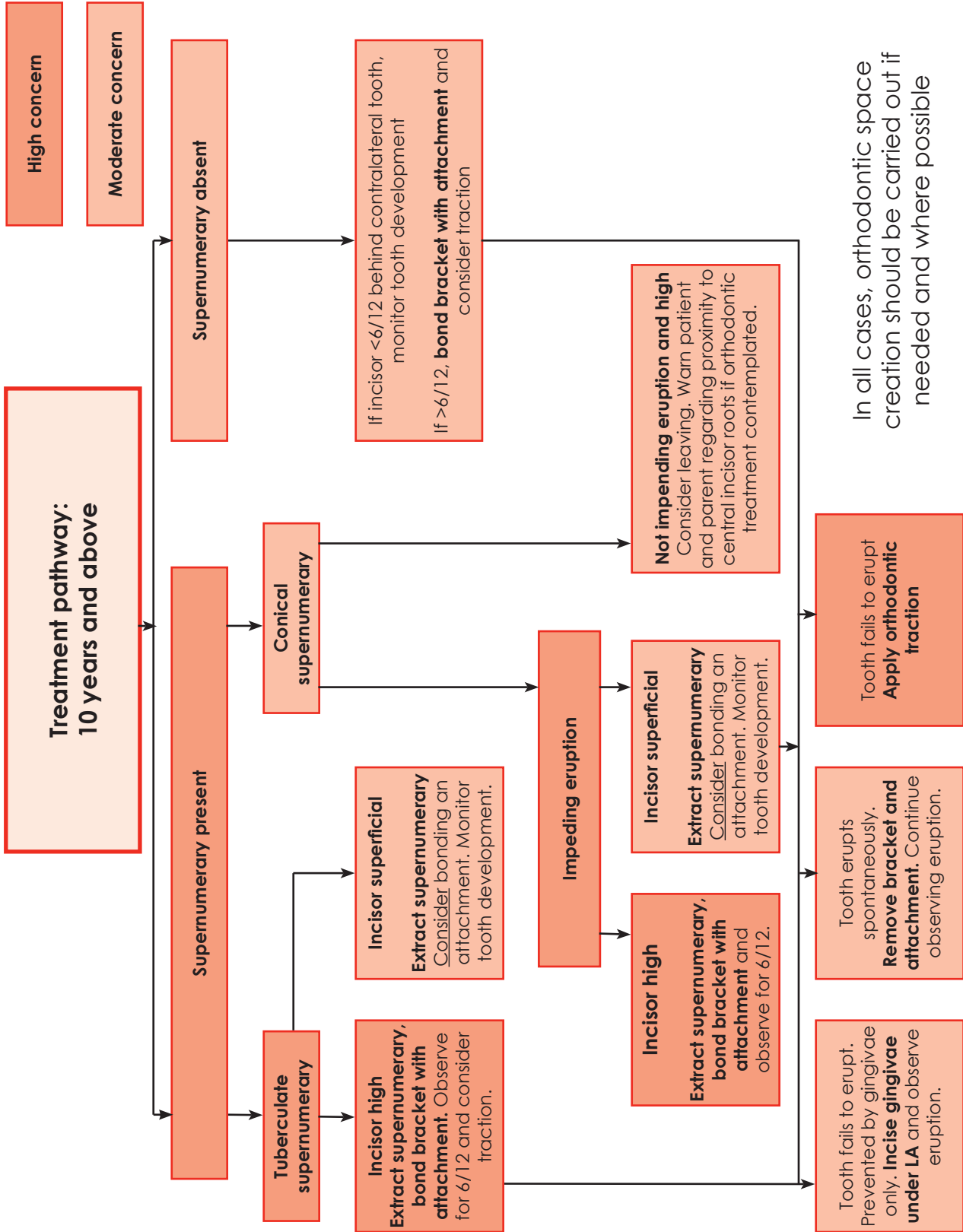
Di Salvo NA. Evaluation of unerupted teeth: orthodontic viewpoint. *J Am Dent Assoc* 1971; **82**: 829–35.

- Duncan WK, Ashrafi MH, Meister F, Pruhs RJ. Management of the nonerupted maxillary anterior tooth. *J Am Dent Assoc* 1983; **106**: 640–44.
- Fujita Y, Takahashi T, Maki K. Orthodontic treatment for an unerupted and severely rotated maxillary central incisor: a case report. *Eur J Paediatr Dent* 2008; **9**: 43–47.
- Gardiner JH. Supernumerary teeth. *Dent Pract* 1961; **12**: 63–73.
- Gatoff AM, Stern M. Surgical and orthodontic management of an unerupted maxillary permanent incisor: report of case. *J Am Dent Assoc* 1974, **89**: 897–99.
- Glenn FB. Case report: twin supernumerary maxillary central incisors, unerupted maxillary central incisors. Early orthodontic treatment in ten-year-old child. *J Gen Orthod* 1994, **5**: 24–27.
- Gregg TA, Kinirons MJ. The effect of the position and orientation of unerupted premaxillary supernumerary teeth on eruption and displacement of permanent incisors. *Int J Paediatr Dent* 1991; **1**: 3–7.
- Grover PS, Lorton L. The incidence of unerupted permanent teeth and related clinical cases. *Oral Surg Oral Med Oral Pathol* 1985; **59**: 420–25.
- Haas R, Mensdorff-Pouilly N, Mailath G, Watzek G. Brånemark single tooth implants: a preliminary report of 76 implants. *J Prosthet Dent* 1995; **73**: 274–79.
- Hall AM. Supernumerary upper anterior teeth. *Br Dent J* 2000; **188**: 642–43.
- Hall WB. The current status of mucogingival problems and their therapy. *J Periodontol* 1981; **52**: 569–75.
- Hovell JH. Some surgical procedures related to orthodontic treatment. *Dent Pract Dent Rec* 1958; **9**: 21–30.
- Howard RD. The unerupted incisor. A study of the postoperative eruptive history of incisors delayed in their eruption by supernumerary teeth. *Dent Pract Dent Rec* 1967; **17**: 332–41.
- Huber KL, Suri L, Taneja P. Eruption disturbances of the maxillary incisors: a literature review. *J Clin Pediatr Dent* 2008; **32**: 221–30.
- Hurlen B, Humerfelt D. Characteristics of premaxillary hyperdontia. A radiographic study. *Acta Odontol Scand* 1985; **43**: 75–81.
- Jacobs SG. Radiographic localization of unerupted maxillary anterior teeth using the vertical tube shift technique: the history and application of the method with some case reports. *Am J Orthod Dentofacial Orthop* 1999; **116**: 415–23.
- Johnson J, Whaites EJ, Sheehy EC. The use of multidirectional cross-sectional tomography for localizing an odontome. *Int J Paediatr Dent* 2007; **17**: 129–33.
- Kapur A, Goyal A, Jaffri S. Management of inverted impacted primary incisors: an unusual case. *J Indian Soc Pedod Prev Dent* 2008; **26**: 26–28.
- Kearns HP. Dilacerated incisors and congenitally displaced incisors: three case reports. *Dent Update* 1998; **25**: 339–42.
- Kirschbaum R. Normal occlusion after extraction of a supernumerary tooth. *J Am Dent Assoc* 1956; **53**: 718.
- Kobayashi H, Taguchi Y, Noda T. Eruption disturbances of maxillary permanent central incisors associated with anomalous adjacent permanent lateral incisors. *Int J Paediatr Dent* 1999; **9**: 277–84.
- Kocadereli I, Ciger S, Cakirer B. Late-forming supernumeraries in the premolar regions. *J Clin Orthod* 1994; **28**: 143–44.
- Kocadereli I, Giray B. Combined surgical and orthodontic treatment of multiple impacted supernumerary teeth in the maxillary anterior region – a patient report. *Kieferorthopaedie* 1996; **10**: 189–92.

- Koch H, Schwartz O, Klausen B. Indications for surgical removal of supernumerary teeth in the premaxilla. *Int J Oral Maxillofac Surg* 1986; **15**: 273–81.
- Kokich VG, Mathews DP. Surgical and orthodontic management of impacted teeth. *Dent Clin North Am* 1993; **37**: 181–204.
- Kolokitha OE, Papadopoulou AK. Impaction and apical root angulation of the maxillary central incisors due to supernumerary teeth: combined surgical and orthodontic treatment. *Am J Orthod and Dentofacial Orthop* 2008; **134**: 153–60.
- Konchak PA, Lanigan DT. The management of impacted maxillary incisors secondary to supernumeraries. *Oral Health* 1985; **75**: 59–61.
- Kuvvetli SS, Seymen F, Gencay K. Management of an unerupted dilacerated maxillary central incisor: a case report. *Dent Traumatol* 2007; **23**: 257–61.
- Levine N. Clinical management of supernumerary teeth. *J Can Dent Assoc* 1961; **28**: 297–303.
- Lundberg M, Wennström JL. Development of gingiva following surgical exposure of a facially positioned unerupted incisor. *J Periodontol* 1988; **59**: 652–55.
- Luten JR Jr. The prevalence of supernumerary teeth in primary and mixed dentitions. *J Dent Child* 1967; **34**: 346–53.
- Mason C, Azam N, Holt RD, Rule DC. A retrospective study of unerupted maxillary incisors associated with supernumerary teeth. *Br J Oral Maxillofac Surg* 2000; **38**: 62–65.
- McBride LJ. Traction – a surgical/orthodontic procedure. *Am J Orthod* 1979; **76**: 287–99.
- McNamara T, Woolfe S, McNamara C. Orthodontic management of a dilacerated maxillary central incisor with an unusual sequela. *J Clin Orthod* 1998; **32**: 293–97.
- Mellville RG, Eloff JP, Farman AG, Nortjé CJ, de V Joubert JJ. Successful treatment of horizontally positioned unerupted permanent central incisors report of a case. *Br J Orthod* 1978; **5**: 213–15.
- Millhon JA, Stafne EC. Incidence of supernumerary and congenitally missing lateral incisor teeth in eighty-one cases of harelip and cleft palate. *American Journal of Orthodontics and Oral Surgery* 1941; **27**: A599–604.
- Minderjahn A. Incidence and clinical differentiation of odontogenic tumours. *J Maxillofac Surg* 1979; **7**: 142–50.
- Nazif MM, Ruffalo RC, Zullo T. Impacted supernumerary teeth: a survey of 50 cases. *J Am Dent Assoc* 1983; **106**: 201–4.
- Nik-Hussein NN. Supernumerary teeth in the premaxillary region: its effects on the eruption and occlusion of the permanent incisors. *Aust Orthod J* 1990; **11**: 247–50.
- Nik-Hussein NN, Boon LC. Dilaceration of unerupted maxillary incisor. *Singapore Dent J* 1986; **11**: 23–25.
- Ochoa Grijalva JF, Kuster CG. Supernumerary teeth removal and orthodontic tooth repositioning: a case report. *J Clin Pediatr Dent* 1993; **17**: 95–98.
- Oliver RG, Hodges CG. Delayed eruption of a maxillary central incisor associated with an odontome: report of case. *ASDC J Dent Child* 1988; **55**: 368–71.
- Ong M, Chew MT. Use of the apically repositioned flap in the management of labially impacted maxillary central incisors. *Singapore Dent J* 2004; **26**: 55–59.
- Primosch RE. Anterior supernumerary teeth – assessment and surgical intervention in children. *Pediatr Dent* 1981; **3**: 204–15.
- Rayson RK, Houston WJ, Howe GL. A surgical approach to the treatment of permanent incisor teeth in infraocclusion – two case reports. *Br J Orthod* 1974; **1**: 237–39.

- Sandler JP. An attractive solution to unerupted teeth. *Am J Orthod Dentofacial Orthop* 1991; **100**: 489–93.
- Sandler PH, Fearn J. Unerupted incisors: a case report illustrating an attractive solution. *J Int Assoc Dent Child* 1990; **20**: 22–25.
- Schön F. Supernumerary incisors in uniovular twins and their treatment by means of electrosurgery. *Quintessence Int Dent Dig* 1974; **5**: 13–18.
- Shelton J, Owens B, Schuman N. Compound odontoma associated with an impacted permanent central incisor. *J Tenn Dent Assoc* 1997; **77**: 46–48.
- Shulman ER, Corio RL. Delayed eruption associated with an odontoma. *ASDC J Dent Child* 1987; **54**: 205–7.
- Smahel Z, Tomanová M, Mullerová Z. Position of upper permanent central incisors prior to eruption in unilateral cleft lip and palate. *Cleft Palate Craniofac J* 1996; **33**: 219–24.
- Stafne EC. Original Communications: Supernumerary teeth. *Dental Cosmos* 1932; **74**: 653–59.
- Stanford HG, Mueller BH. A technique of management of the unerupted maxillary incisor. *Gen Dent* 1977; **25**: 36–37.
- Stones HH. *Oral and Dental Diseases*. 3rd edn. Edinburgh: Livingstone; 1954.
- Tay F, Pang A, Yuen S. Unerupted maxillary anterior supernumerary teeth: report of 204 cases. *ASDC J Dent Child* 1984; **51**: 289–94.
- Tinn CA. Excess, deficiency and gemination in the deciduous and permanent dentition of school children. *Br Dent J* 1940; **68**: 236–38.
- Turgut MD, Tekçiçek M, Canoglu H. An unusual developmental disturbance of an unerupted permanent incisor due to trauma to its predecessor – a case report. *Dent Traumatol* 2006; **22**: 283–86.
- Varnarsdall R, Corn H. Soft tissue management of labially positioned unerupted teeth. *Am J Orthod* 1977; **72**: 53–64.
- Wennström JL. Regeneration of gingiva following surgical excision. A clinical study. *J Clin Periodontol* 1983; **10**: 287–97.
-





- High concern
- Moderate concern
- Treatment pathway

Investigation of unerupted central incisor

