

## Introduction

Supernumerary teeth (ST) are additional teeth to the normal series. They can occur in almost any region of the dental arch but, are most commonly seen in the maxilla and can present unilaterally or bilaterally (Liu, 2007; Schulze, 1970). There is a gender predilection with a higher prevalence seen in males compared with females (Kinirons, 1982). The aetiology of ST is not fully understood; however, it is accepted there is a strong genetic component with there being a high occurrence within members of the same family (Fleming et al., 2010).

ST can appear as a single tooth or as multiple teeth, occasionally appearing in clusters. A single supernumerary is most commonly seen in 76–86% of cases, double supernumeraries are less frequent at 12–23% and multiple supernumeraries with no associated syndrome or disease are rare, accounting for less than 1% of cases (Rajab and Hamdan, 2002). Multiple ST are often associated with syndromes such as Gardner syndrome, Ehlers-Danlos syndrome or Cleidocranial Dysplasia and therefore it is prudent that a thorough medical history is taken and if necessary, a referral to an appropriate medical professional made. ST have the potential to cause delayed eruption, displacement of teeth, root resorption and cyst formation. As a result, timely management is imperative (Paduano et al., 2016).

ST can be classified according to chronology, location and morphology (Meade, 2020, Parolia et al., 2011, Yassaei et al., 2013). Chronologically, ST can develop prior to deciduous teeth formation, concurrent to permanent teeth development or form after the permanent dentition has been established (Yassaei et al., 2013). The location may be classified as being mesiodens, para-premolar, para-molar or disto-molar (Figure 1) (Parolia et al., 2011). The morphology of ST can be categorised as either conical, tuberculate, supplemental or odontome (compound or complex) (Figure 2) (Meade, 2020).

Late forming supernumerary teeth (LFST) are additional supernumerary teeth which develop after the eruption of the permanent dentition. LFST are most commonly found in the premolar region (Paduano et al., 2016, Shah et al., 2008). However, there are limited studies relating to the prevalence and aetiology of LFST. It is not routine practice to screen for late forming teeth during treatment and little is known regarding the timing of their development (Breckon and Jones, 1991). The following five cases describe medically fit, non-syndromic patients who developed LFST.

## Case 1

### *Summary and radiographic assessment*

Case 1 was a 9 year old male who presented with a Class I incisor relationship on a Class 1 skeletal base complicated by delayed eruption of the upper central incisor teeth. A dental panoramic tomogram (DPT) and an upper standard occlusal (USO) taken at age 9 years demonstrated two unerupted tuberculate supernumerary teeth impacting eruption of the UR1 and UL1 (Figure 3). He underwent a general anaesthetic (GA) for surgical removal of the two ST at 10 years of age and exposure and bonding with gold chain of the UR1 and UL1. A DPT

taken at 11 years old, for comprehensive treatment planning, showed LFST in the lower right and left premolar regions (Figure 3).

#### *Management and impact upon orthodontic treatment*

Following discussion of the options, the patient opted for removal of the LFST which meant undergoing a second GA. Following removal, the patient proceeded with orthodontic treatment and is currently in upper and lower fixed appliances.

### Case 2

#### *Summary and radiographic assessment*

Case 2 was a 7 year old male who presented with a Class II Division 1 incisor relationship on a Class 1 skeletal base with unerupted upper central incisor teeth. An USO taken at the age of 7 years, showed two supernumeraries in the pre-maxilla impeding the eruption of the UR1 and UL1 (Figure 4, image of reduced quality). At the age of 7, the ST were surgically removed and a DPT taken at the age of 8 years showed unerupted UR1, UL1 (Figure 4, image of reduced quality). At the age of 9 years, the UR1 and UL1 failed to erupt spontaneously and were therefore surgically exposed and bonded with gold chains. The patient was provided with an upper removable appliance to align the upper central incisors.

At the age of 11 years, a DPT was taken for comprehensive treatment planning and showed LFST in the LR4 and LL45 regions with delayed eruption of underlying premolar teeth (Figure 4). The patient subsequently underwent surgical removal of LFST in the LR4 and LL45 region, exposure and bonding of both the LL4 and LL5 and placement of a lower fixed appliance. Due to delays caused by the Covid-19 pandemic, the patient was seen at age 13 for a DPT prior to placing upper fixed appliances and LFST in UL45 and LR9 regions were noted.

#### *Management and impact upon orthodontic treatment*

The patient was given the option to remove their LFST surgically or to monitor them periodically. The patient chose to remove the additional LFST (LR9 and in the UL45 area), which were subsequently removed under GA. The patient decided to accept their remaining malocclusion and not proceed with upper fixed appliance treatment.

### Case 3

#### *Summary and radiographic assessment*

Case 3 was an 11 year old female who presented with a Class III malocclusion on a mild Class 3 skeletal base with moderate crowding in the lower arch. A DPT taken at 11 years of age showed multiple ST in the mandible (Figure 5). A Cone Beam Computed Tomograph (CBCT) scan was subsequently taken due to the number of supernumerary teeth identified on plain film images. It confirmed the presence of two ST in the LR2 region, two in the LL2 region and two ST in the lower left quadrant, one mesial and one distal to the LL5 (Figure 5). Between

the DPT and the CBCT being undertaken, this patient also had a root canal treatment completed on the UL1 due to an avulsion injury.

There was a positive family history of multiple ST with both the patient's mother and brother having additional teeth. A letter was written to the general medical practitioner (GMP) to investigate for other medical conditions/syndromes associated with ST teeth, none were identified.

Delays in care due to the Covid-19 pandemic meant the patient was reviewed at 14 years old, at which point, two supernumeraries had erupted lingual to the LL2, LR2 (Figure 5). These were subsequently removed by the Paediatric Dentistry team. A panoramic radiograph taken at 14 years showed additional LFST in LR4 region, LR9 and in the maxilla (UR9, UL9) (Figure 5).

#### *Management and impact upon orthodontic treatment*

Regarding orthodontic treatment for the upper arch, the options given were to accept or to treat the malocclusion with fixed appliances and for the lower arch, to remove the ST and LFST followed by fixed appliances or to accept. The patient opted for upper fixed appliances in the upper arch and no treatment in the lower.

## CASE 4

#### *Summary and radiographic assessment*

Case 4 was a 7 year old male who presented with a Class I incisor relationship on a Class 1 skeletal base complicated by unerupted upper central incisors. A DPT and USO when the patient was aged 7 years showed two ST teeth impeding the eruption of the UR1, UL1 (Figure 6, the DPT is of reduced quality). Removal of the ST and exposure and bonding of UR1, UL1 was completed under GA at 8 years old. The patient was treated with an upper removable appliance to aid eruption of the upper central incisors. At the age of 13, a further DPT was taken which showed multiple additional supernumerary teeth and was supplemented with a CBCT due to the number of supernumerary teeth observed. The CBCT showed a total of five LFST: one apical to UR4, another apical to UL4-UL5, two adjacent to the LR5 and one mesial to the LL5 (Figure 6).

#### *Management and impact upon orthodontic treatment*

The options to remove or monitor the LFST were discussed with the patient and parent who opted to monitor the LFST. Regarding orthodontic treatment, the patient was offered upper fixed appliances (as the LFST in the UR4 and UL45 area were deemed sufficiently clear of the adjacent roots) with lower sectional fixed appliances (bypassing the lower premolar teeth to avoid iatrogenic damage) or to accept. The patient opted for upper fixed appliances with lower sectional fixed appliances.

## CASE 5

### *Summary and radiographic assessment*

Case 5 was a 10 year old boy who presented with a Class II Division 2 incisor relationship on a mild Class 2 skeletal base complicated by an unerupted UL1. A DPT and USO, taken at the age of 10, showed two ST in the upper anterior area, one had erupted adjacent the UL2 and the other was inferior to the UL1 and causing its impaction (Figure 7). A CBCT also taken at the age of 10, to assess the morphology of the unerupted and impacted UL1, confirmed the presence of two ST in the anterior maxilla (Figure 7). The plan involved removal of the two ST and expose and bonding of the UL1. Delays in care due to the COVID-19 pandemic meant a DPT taken at the age of 12 years prior, to his surgery, identified a late forming supernumerary tooth between the roots of the LR5 and LR6 (Figure 7).

### *Management and impact upon orthodontic treatment*

Regarding the LFST in the lower right quadrant, the options were given to monitor or to remove the tooth surgically, the patient and parent opted to monitor. The patient is planned to have upper fixed appliances only to allow traction of the UL1.

## Discussion

The physiological calcification of teeth in the permanent dentition is typically completed by 10 years of age. In the five cases presented, the age range in identifying LFST was between 11-15 years, which is later than the expected age for calcification in the permanent dentition (Table 1). LFST typically develop between 10-15 years, an important time as comprehensive orthodontic treatment is typically undertaken during this period (Bozkurt et al., 2015, Paduano et al., 2016, Yassaei et al., 2013,).

Radiographic assessment is essential in detecting LFST, as it provides valuable information about the presence, position, and morphology of supernumerary teeth. Appropriate imaging can also determine the relationship between supernumerary teeth and adjacent structures, such as roots and neighbouring teeth (Meade, 2020). The importance of careful radiographic interpretation cannot be underestimated, for example in Case 1, the ST in the lower left premolar region formally identified in the DPT taken at age 11, can be visualised in the DPT at age 9 (Figure 3). A CBCT may have been beneficial in this case as the LFST was not easily identifiable in the DPT at age 9. With regards to the assessment of ST, there is no strong evidence to support the use of CBCT as the first choice of imaging modality but it may be indicated when conventional intraoral radiography does not supply adequate information (SEDENTEXCT, 2012). CBCT scans provide a clear three-dimensional view of teeth and associated structures, however they are associated with a greater overall effective dose than conventional radiography, having been linked with an increased risk of haematological malignancies (Bosch de Basea Gomez et al., 2023, SEDENTEXCT, 2012; Yaqoob at al., 2022). Cases 3, 4 and 5 all had CBCT scans taken, which were helpful in accurately locating the ST and adjacent structures. While not illustrated in this case series, three dimensional information obtained from a CBCT can also result in changes to clinical decision making (Meade, 2020).

The most common reason for failure of eruption of central incisor teeth is the presence of supernumerary teeth, which typically occurs between the ages of 7 and 9 (Yaqoob et al., 2022). Interestingly, the majority of the cases discussed in this paper initially presented with ST impeding the normal eruption of upper incisors (Case 1, 2, 4 and 5). Treatment of cases 1, 2 and 5 was in line with the Royal College of Surgeons of England guidance on the management of unerupted incisors (Yaqoob et al., 2022). In Case 2, the upper central incisors failed to erupt and were subsequently exposed and bonded. A recent systematic review and meta-analysis found the use of orthodontic measures and removal of supernumerary teeth might be associated with greater odds of successful eruption than removal of the supernumerary alone. However, the certainty of this was low to very low (Seehra et al., 2023). Interestingly, Case 4 had the ST removed and the UR1, UL1 exposed and bonded with gold chain attachments at the age of 8 and it could be argued that this may not have been indicated.

Multiple and late forming supernumerary teeth may be suggestive of an underlying medical condition (Meade, 2020). While rare, consideration should be given to referring patients to the appropriate medical specialist for screening of conditions or syndromes associated with ST. This was carried out in Case 3 and should be considered in all cases where there are multiple late forming supernumerary teeth.

LFST are associated with several complications as described earlier and can even have implications during orthodontic treatment, such as delayed space closure (Breckon and Jones, 1991; Paduano et al., 2016). Patients should therefore be made aware of the possible complications that ST can cause during the consent process (Shah et al., 2008). LFST are typically diagnosed incidentally during radiographic examination, either pre-treatment, during treatment or near the end of treatment (Paduano et al., 2016). However, in cases where space closure appears unexpectedly prolonged, the possibility of LFST should be considered (Breckon and Jones, 1991).

There is no universally accepted management approach for LFST and treatment should be undertaken on a case-by-case basis, taking into consideration the specific findings and needs of the individual patient (Bozkurt et al., 2015). Typically, the management is either to monitor or remove the teeth (Paduano et al., 2016). An alternative plan for Case 3, 4 and 5, may have involved removal of all LFST followed by comprehensive orthodontics but the surgical risks would have been increased. A number of factors need to be considered when deciding whether to monitor or surgically remove the LFST. This can include the morphology or the location of the ST, the potential damage to surrounding structures by leaving or removing the LFST as well as the orthodontic treatment plan (Paduano et al., 2016). Due to the unpredictable nature of LFST, patients can be subjected to multiple general anaesthetics and it is therefore imperative that patients and their guardians are fully informed of the risks of recurring ST.

## Conclusion

While LFST are not commonly seen, when detected they can have a significant impact upon orthodontic management. It is not routine practice to screen for ST during active orthodontic treatment, however clinicians should be vigilant for LFST in patients where ST have previously been observed.

## Acknowledgements

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## References

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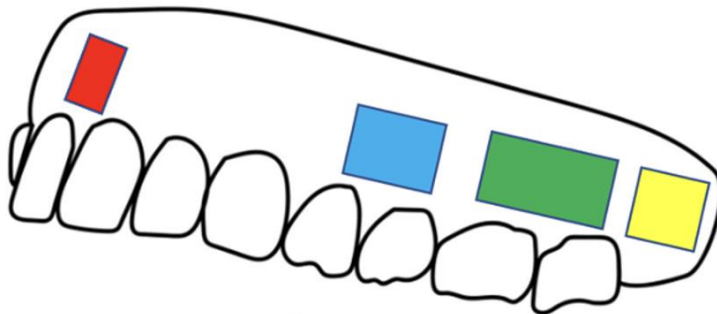


**Table 1. Chronological age of LFST diagnosed.**

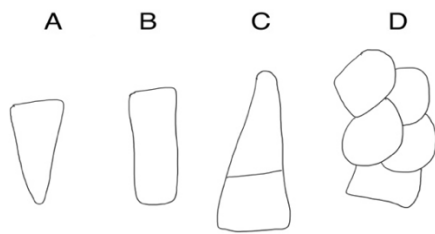
Age	Supernumerary Diagnosed	First LFST Diagnosed	Additional LFST Diagnosed
Case 1	9	11	
Case 2	7	11	13
Case 3	11	14	
Case 4	7	13	
Case 5	10	12	

**Figure 1. Classification of supernumerary teeth by location**

Red: mesiodens  
Blue: para-premolar  
Green: para-molar  
Yellow: disto-molar



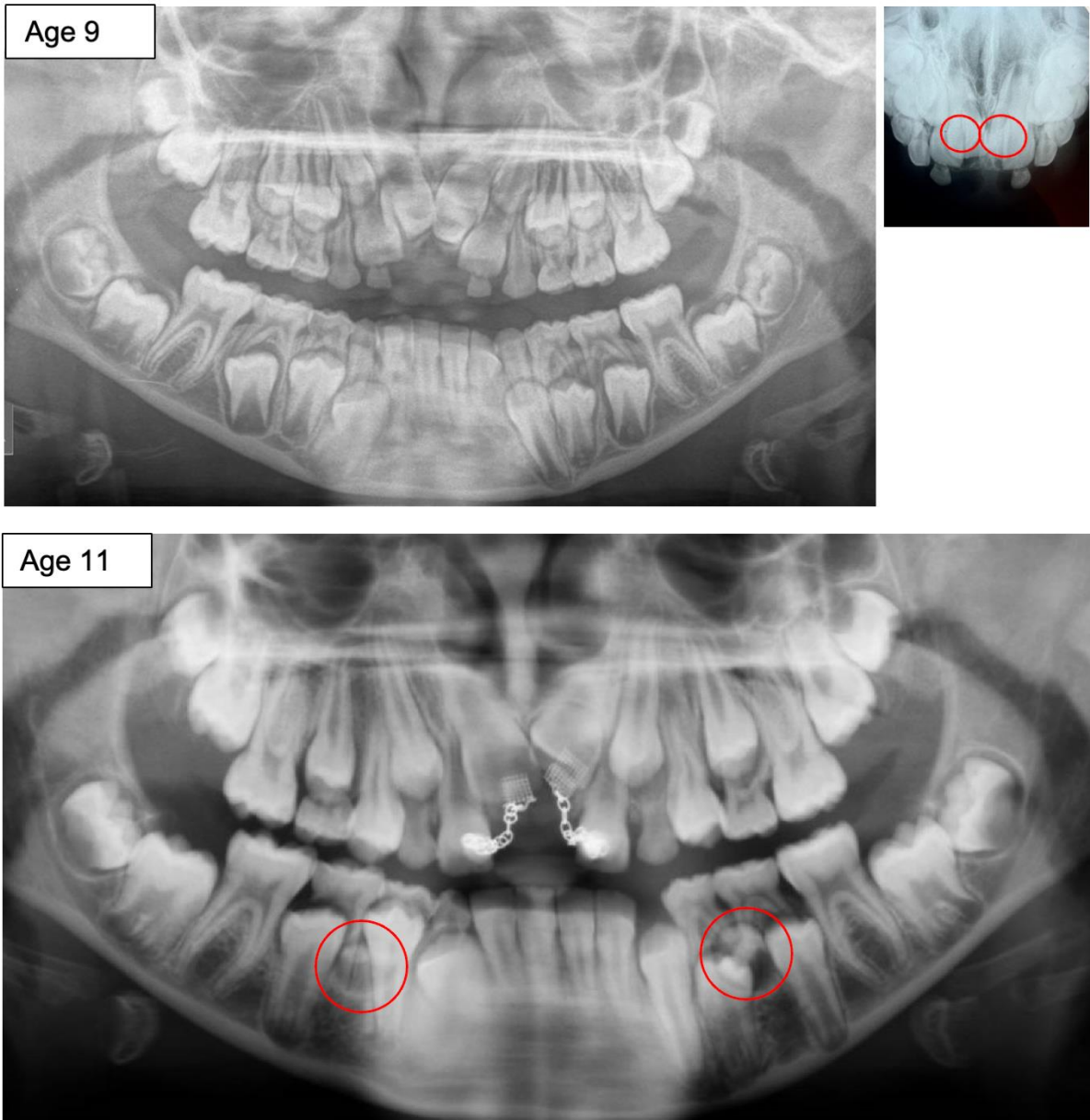
**Figure 2. Classification of supernumerary teeth by morphology**



- A. Conical
- B. Tuberculate
- C. Supplemental
- D. Odontome

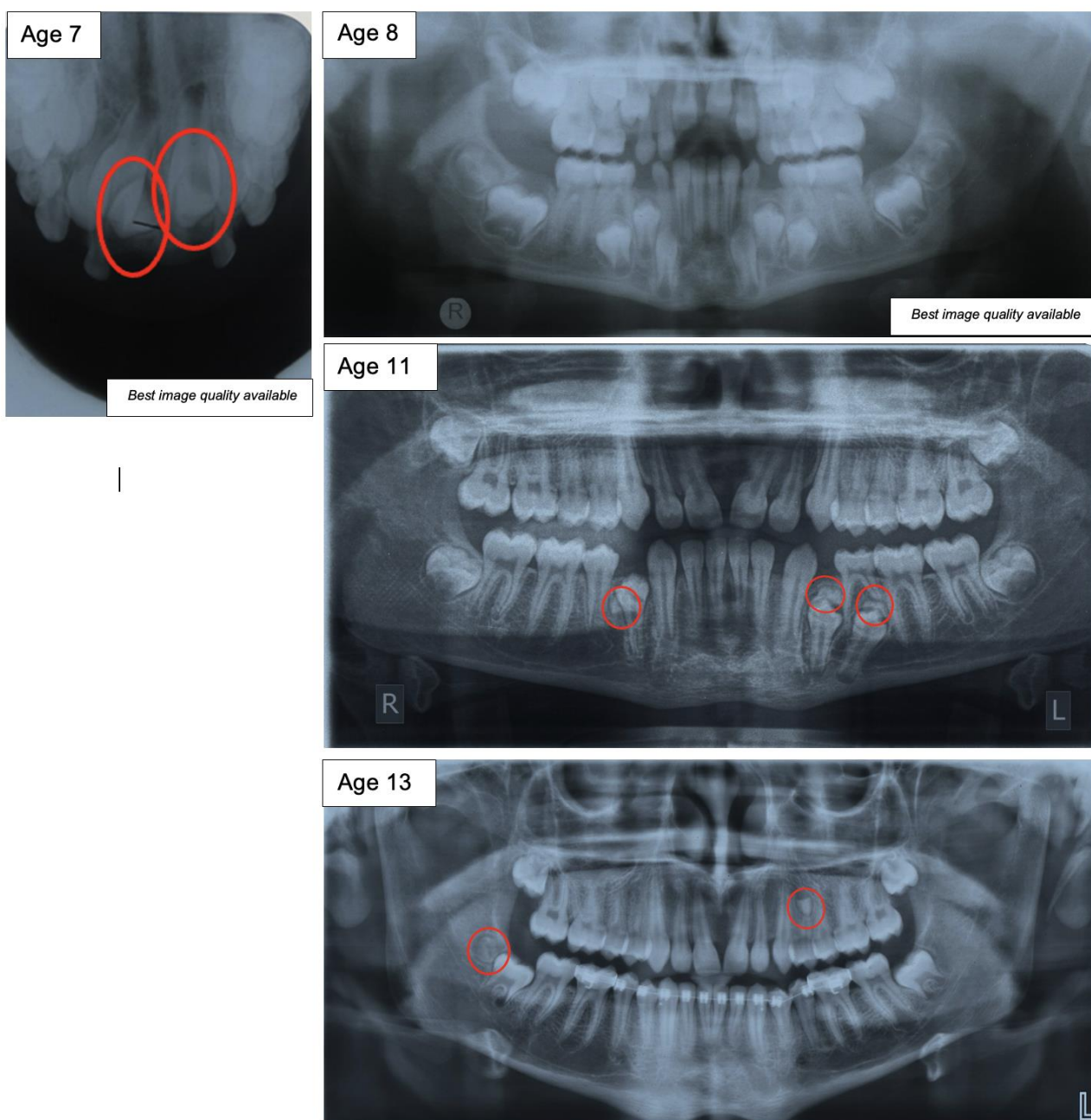
Case 1

Figure 3 (Case 1): Radiographs highlighting the supernumerary teeth at age 9 and 11 years of age



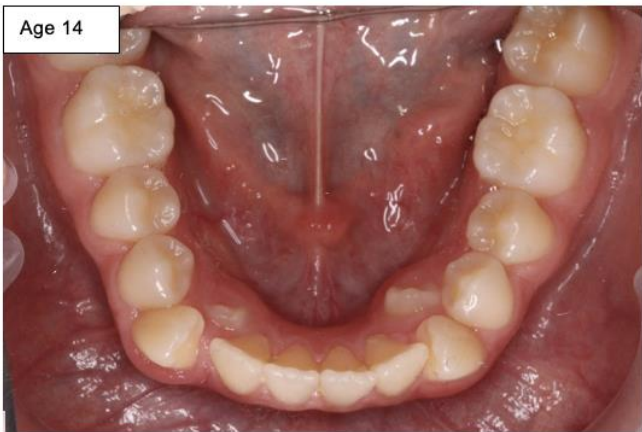
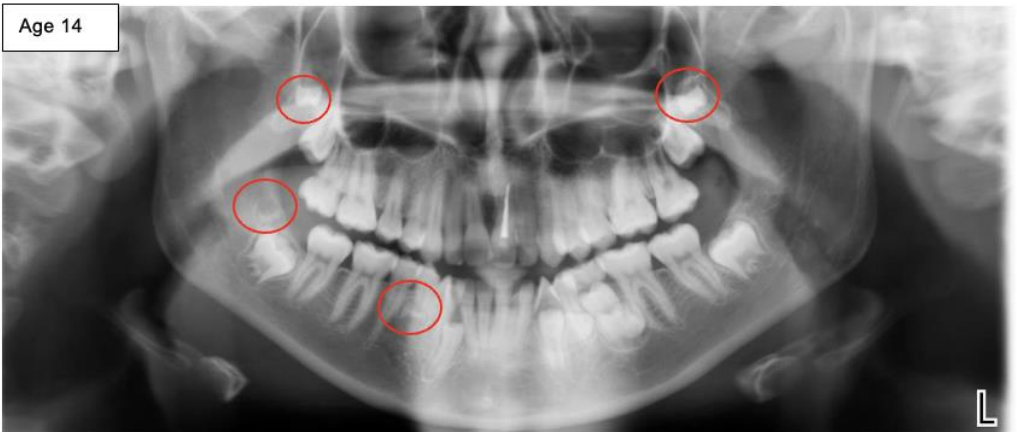
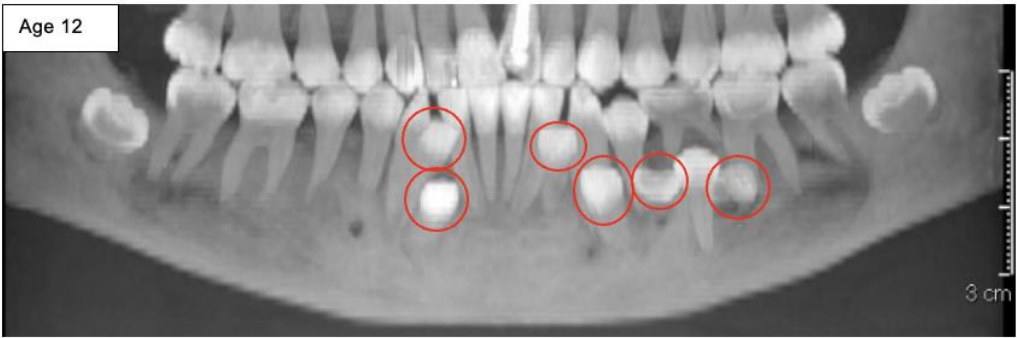
## Case 2

Figure 4 (Case 2): Radiographs highlighting the supernumerary teeth at ages 7, 11 and 13 years of age.



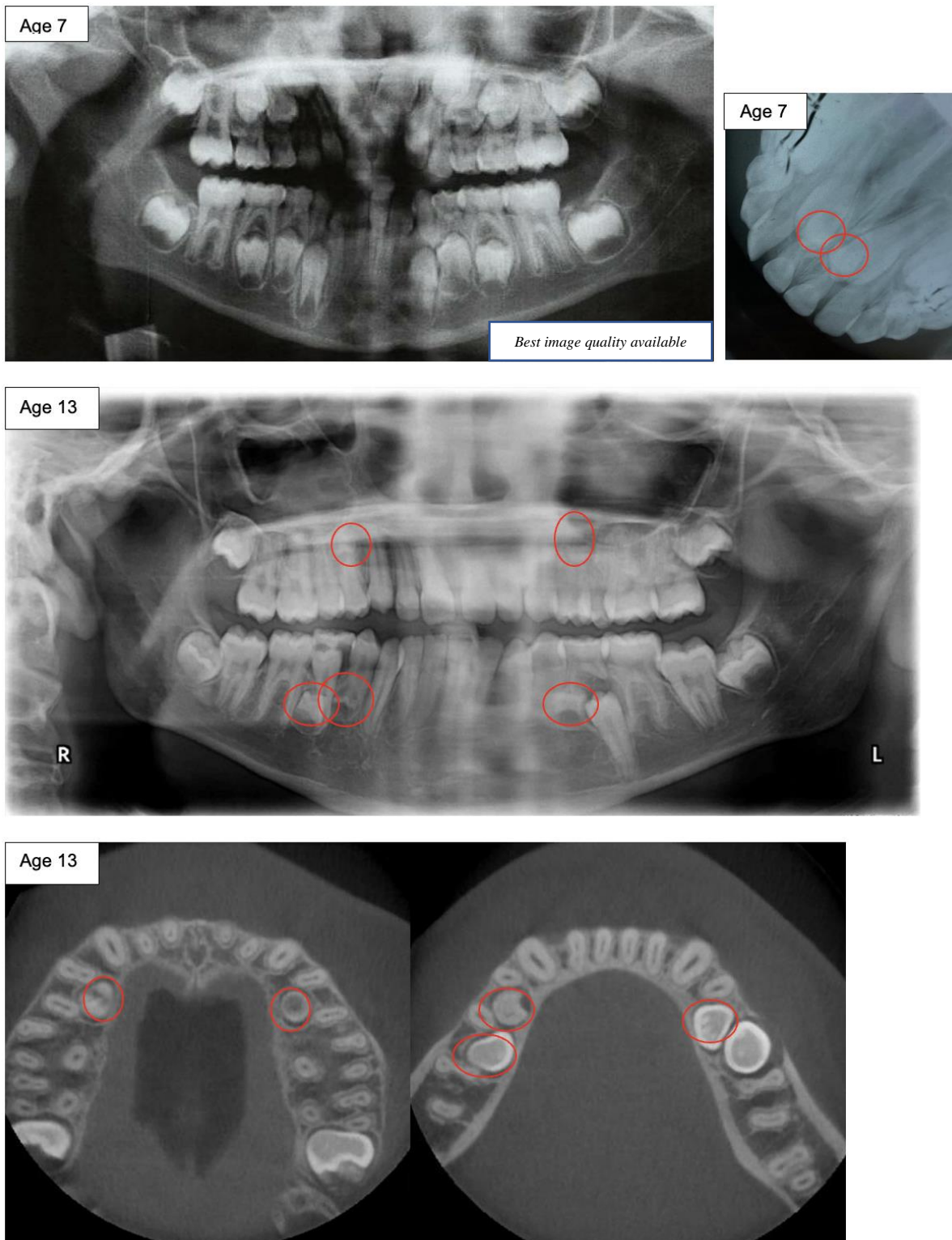
### Case 3

Figure 5 (Case 3): Radiographs highlighting the supernumerary teeth at ages 11, 12 and 14 years of age and an intra-oral photograph of erupted supernumerary teeth.



Case 4

Figure 6 (Case 4): Radiographs highlighting the supernumerary teeth at ages 7 and 13 years of age.



Case 5

Figure 7 (Case 5): Radiographs highlighting the supernumerary teeth at ages 10 and 12 years of age.

