Simple example of that would be the early detection of impacted canines. If this problem was spotted early in life and the child was referred accordingly to the specialist then a simple space management or deciduous tooth extraction and/or slight expansion could save the child a major surgical exposure procedure and a gold chain placement in the future. This is in addition to a lengthy orthodontic treatment which could be associated, in some cases, with considerable side effects such as tooth decay, gingivitis and gums enlargements, blunt root tips, decalcification marks, halitosis and many others.

In this article, we are aiming at shedding some light on a number of common features of Malocclusion that is necessary to be observed and detected early in the early/mixed dentition stages in order to help avoiding complex treatments later on in life.

These developmental anomalies can affect both the primary and the permanent dentitions and their etiological factors are complex and very often are of a genetic, environmental and multifactorial origin.

Few examples of such anomalies are listed below and it would be very beneficial if detected by the GDP in the early years of life.

## Early loss of primary teeth

This is usually the result of extraction of the primary tooth due to caries or trauma and it can have direct or indirect implications on the developing occlusion. The severity of such effects could be related to many factors such as:

- **Age:** the younger the patient, the more crowding potential later on in life.
- **Existing Crowding:** The more crowding potential is there, the more space loss will occur.
- **Tooth Type:** Usually primary incisors loss have minimal effect while primary canines' loss can lead to a center-line shift. The primary 1$^{st}$ molars' loss can lead as well, to some center-line shift and premolar displacement while the loss of the 2$^{nd}$ primary molars may have a direct effect on the position of the 1$^{st}$ permanent molar and might lead to its mesial drifting and to the impaction of the 2$^{nd}$ premolar and bite disturbances.

## Balancing extractions

The removal of a tooth from the opposite side of the same dental arch to maintain arch symmetry and hence, to preserve the centerline from shifting.

## Compensating extractions

The removal of a tooth from the opposite dental arch but from the same quadrant to maintain the buccal occlusion and minimize disturbances.

Both balancing and compensating extractions aim to preserve dental arch symmetry during development [1]. No extraction should be performed unless x-rays are taken beforehand that confirmed the presence, position and normal formation of the successor teeth. This is in accordance with the Royal College of Surgeons of England National Clinical Guidelines (2002). Those guidelines could be summarized as follows [2]:

- No need for balancing or compensating extraction in case of primary incisor loss
- Balancing extraction is advisable in case of the unilateral loss of a primary canine but not the compensating extraction for the healthy opposite primary teeth.

- Balancing extraction is advisable in case of the unilateral loss of the 1st primary molar but not the compensating extraction for the healthy opposite primary teeth.
- No balancing extraction is required for the early loss of the 2nd primary molars but space maintainer should be considered. No compensating extraction for the healthy opposite primary teeth is required.

## Space maintenance

In general, the natural teeth are the best space maintainers. Dentists should do their best always to preserve primary teeth until the time of their natural exfoliation. In case of the inevitable primary tooth lose, then the space should be maintained as soon as possible to prevent drifting of the neighbor teeth, bite disturbance and the potential displacement or impaction of the successor tooth (Figure 1).

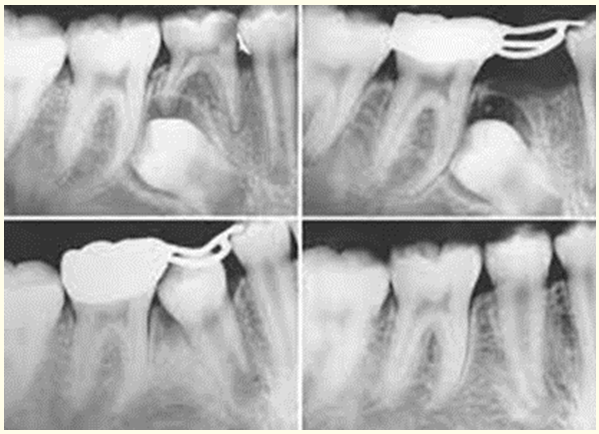


***Figure 1:*** *The eruption of the 2nd permanent mandibular premolar after maintaining the needed space by using a space maintainer in the area immediately after the extraction of the 2nd primary mandibular molar due to dental decay.*

## Prolonged retention of primary teeth

Considerable variations in the timing of primary tooth exfoliation exist among children and similar is the case regarding the subsequent eruption of the permanent successors.

Prolonged exfoliation of primary teeth is usually multifactorial and this could include crowding, ectopic position, impaction or even agenesis of the permanent successors.

In some cases, permanent teeth struggle to erupt and fail to resorb the roots of the overlaying primary teeth hence the child is encouraged to wobble them out or advised to seek the help of the GDP for their extraction. X-rays should always be taken and space analysis should be formalized before taking any decision in such cases.

Retained deciduous teeth due to agenesis of their successors, especially the 2nd primary molars, could be left in situ for many years [3] if their roots are strong and they are kept caries free, so that they maintain the space naturally and maintain the alveolar bone to facilitate any future dental implant treatments (Figure 2).

***Figure 2:*** *A retained 2nd Primary Mandibular Molar Associated with a congenitally absent lower right 2nd mandibular premolar. The tooth is of good roots, not infra-occluded and not decayed hence its long term prognosis could be considered as positive. Another example of retained primary incisors wile permanent incisors area struggling to erupt lingually.*

## Ankylosis and infra-occlusion

When the periodontal ligament is lost and direct fusion occurs between the root dentine and the surrounding alveolar bone, the tooth could be classified as being ankylosed. Ankylosis can be found in 9% of children and most often affects the primary molars [4] and its origin is still not fully understood.

The primary ankylosed tooth is usually suspected in the growing child due to its submerged appearance or its infra-occlusion position in relation to the occlusal plane (Figure 3).

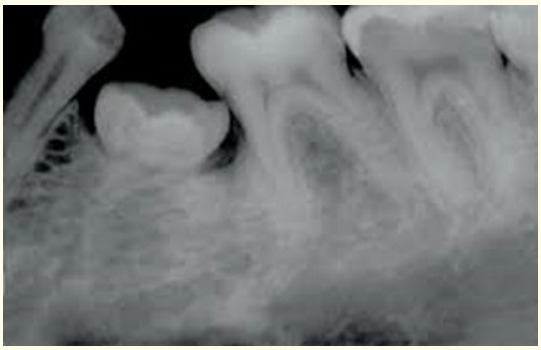


***Figure 3:*** *Infra-occluded and ankylosed Primary 2nd mandibular molar. Bite disturbance, submerging position and the absence of the lamina dura are few signs of ankylosis.*

Ankylosis as well could affect permanent dentition and mainly could be seen in association with the maxillary central incisors and often it is due to replacement resorption process after traumatic injuries that include intrusion and avulsion injuries.

### Missing teeth

Hypodontial could be used as a generic term to describe developmental tooth absence however, to be more specific, one could divide this relatively common anomaly of tooth agenesis into: [5,6]

- Hypodontia: When 1-6 teeth are absent, excluding 3rd molars
- Oligodontia: When more than 6 teeth are absent, excluding 3rd molars.
- Anodontial: When all teeth are absent in one or both dentitions.

A number of dental anomalies were found to be associated with Hypodontia and Oligodontia, such as, generalized reduction in crown and root size, conical crown shape, enamel hypoplasia, prolonged retention of primary teeth, infra-occlusion of primary teeth, impactions, ectopic eruption, lack of alveolar bone, increased overbite, and transpositions.

Although Hypodontia could be found as an isolated trait, inherited forms of Hypodontia could follow autosomal dominant, autosomal recessive, or autosomal sex-linked patterns hence it could be associated with many Syndromes such as: Down Syndrome (most common), Ectodermal Dysplasias, Anhidrotic Ectodermal Dysplasia, Ehlers-Danlos, Incontinentia Pigmenti, Reiger, Limb Mammary, Ellis-Van Creveld, Witkop and others.

Treatment in general is based on the following terms:

- Open space for future replacement
- Close the space with orthodontics
- Re-distribute the space for future restorative or prosthodontic work

In severe cases, complex and multidisciplinary treatments in specialist centers could be needed (Figure 4).

***Figure 4:*** *Multidisciplinary treatment is required when many teeth are congenitally absent and the remaining teeth are deformed, or of short roots or of poor long term prognosis.*

## Supernumerary teeth

These teeth are usually present in addition to the normal complement and can be found in both the primary (almost 1%) and in the permanent dentition (almost 4% and twice as common in males than females and more common in the Maxilla) [7].

Although supernumerary teeth could be fond as isolated traits, they could form a part of many syndromes such as the Cleft Lip and Palate, Cleido-cranial Dysplasia, Ellis-Van Creveld, Gardner, Incontenetia Pigmenti and others.

Supernumerary teeth could be classified according to their morphology and location. The most common presentations could include:

- Conical supernumeraries: small peg-shaped teeth with normal root formation. If found in the anterior maxilla mainly between the upper incisors could be called Mesiodens (Figure 5). In the molar region they could be called paramolars but if they were distal to the 3rd molar then could be called disto-molars.

***Figure 5:*** *Conical Supernumerary (Mesiodense) in between the upper primary incisors.*

- Tuberculate supernumeraries: multi-cusped coronal part and underdeveloped roots. They are usually found palatal to the maxillary permanent incisors.
- Supplemental supernumeraries: (Figure 6). Duplication of a tooth within a series mainly at the end of the series and they are commonly found in the primary dentition stage. Look like extra normal teeth.

***Figure 6:*** *Duplication of the mandibular premolar leading to crowding in the area.*

- Odontomes: Developmental malformations with enamel and dentinal parts. Could be compound in the anterior jaw or Complex in the posterior parts of the jaws.

Many supernumerary teeth are found by chance on routine x-rays, those asymptomatic supernumeraries could be left in situ and monitored regularly; but many others will have risks, problems and symptoms associated with them.

Most common problems associated with supernumerary teeth that require their removal could include:

- Crowding and rotations
- Failure of tooth eruption and impactions
- Spacing and diastemas
- Cystic formation.

### Abnormalities in tooth shape, size and eruption

The etiology of this variation (than normal ranges) is not certain yet but there is definitely a genetic background associated with them. A number of systemic conditions are usually associated with delayed eruption of both dentitions but mainly permanent teeth. Local factors, however, are the main cause of any eruption disturbance in children [8]. A time interval of up to 1-2 years of the average norm could be allowed before any concerns are raised.

- Megadontia (1%): Enlarged crown, or root or the whole tooth, is often symmetrical, and found in the maxillary permanent incisor region and the mandibular 2nd premolar areas.
- Microdontia (2.5%): Smaller than average crown, root or the whole tooth, could be unilateral and it could affect the whole dentition or just individual teeth. Maxillary permanent lateral incisors are the most common to have microdontia anomalies (Figure 7).

***Figure 7:*** *Microdontia anomalies usually affect the maxillary lateral incisors and commonly called Peg-shaped laterals.*

- Double Teeth: This is often associated with Megadontia and could vary from a simple coronal notching of a slightly enlarged tooth to an almost complete separation of two normally formed teeth. This could be due to Gemenation (developmental separation of a single tooth germ) or due to Fusion (two adjacent tooth germs fuse together and commonly seen in primary dentition of the anterior mandible area). (Figure 8).

***Figure 8:*** *Example of Megadontia (Double Teeth).*

- Evaginated and Invaginated teeth: These could vary considerably from an external enamel-covered projection/s on the surface of the tooth (Evagination) to an enamel-lined cavities mainly on the coronal part of the tooth (Ivagneation) which could vary from simple pit to a major groove that can deform the shape of the tooth. The interest in Dense Evaginatus has also increased with the introduction of a procedure called "Regenerative Endodontics". [9].

- Extra cusps: Such as Carabelli's cusp which is seen in almost 60% of the cases on the mesiopalatal line of the maxillary 1st permanent molar. Or as Talon Cusp which is occasionally seen on the palatal aspect of the Maxillary upper incisors (Figure 9).

***Figure 9:*** *Examples of Extra cusps such as the Carabelli cups of the upper first permanent molar and the Talon cups of the upper incisor.*

- Dilacerations: This could range from a mild to a severe abnormalities in the angulation between the crown and the root of a permanent tooth mainly and most cases it does affect the Maxillary permanent incisors. Trauma to their primary predecessors could be one of the thought etiological factors (Figure 10).

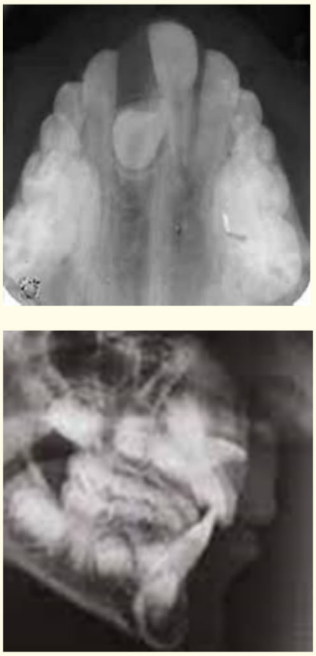


***Figure 10:*** *Examples of Dilacerated upper permanent incisors on an upper occlusal x-ray and a cephalometric one.*

- Taurodont (2.5 - 5%): in such cases, the pulp chamber of the permanent tooth mainly is enlarged due to the apical migration of the furcation area. These cases could be seen in isolation or as part of other conditions such as in Down syndrome or Amylogenesis Imperfects.
- Un-erupted Permanent Maxillary Canine (2%): The Maxillary permanent canine could be deviated from its path of eruption in a palatal (85%) or buccal/within the line of the arch (15%). Buccal impaction is usually associated with Crowding while the palatal one could be considered as a true ectopic incident. [10].
- Maxillary permanent canines should be palpable in the buccal sulcus by the age 10 - 11 years, if not then further investigations including x-rays should be considered to roll out their potential impaction or agenesis. Other signs could be as well, a palatal bulge, a firm primary canine, peg shaped or microdontia of the related upper Maxillary lateral incisor/s etc.

***Figure 11:*** *Impacted upper maxillary canines associated with short of space for eruption and iatrogenic resorption of the upper left lateral incisor root.*

Few theories were speculated in this relation [11], few of which are:

- Long path of eruption, as the developmental position of the Maxillary canines begins high
- A genetic susceptibility. This was based on the association between the Maxillary canines' impaction and other dental anomalies, familial tendency and female predilection.
- Maxillary lateral incisor root guidance of eruption. This was based on the association between the impaction and the definitive or absence related to Maxillary lateral incisors.
- Firmly retained Maxillary primary canine/s that can obstruct the normal canine eruption.
- As the Maxillary canine erupts often after the 1st premolar the available space for it could be at a premium.

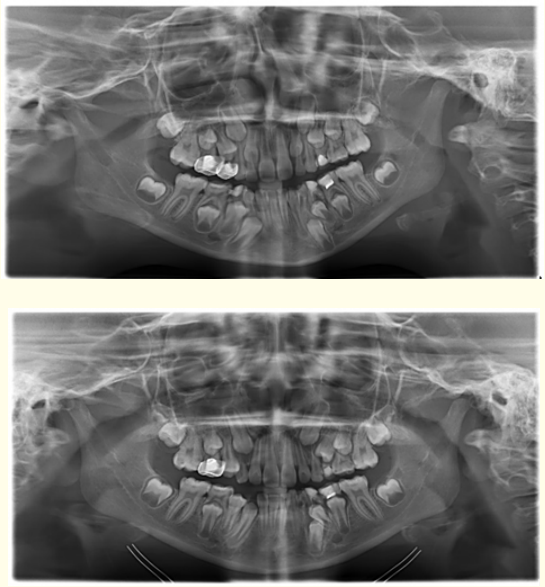
Many clinical and radiographical factors play an important role in finalizing the decision making process. The radiographically tests including the parallax technique usually evaluate the position of the canine in all 3 planes of space such as: Bucco-palatal relation to the

dental arch, height or distance to the occlusal plane, Severity of the angulation relative to the mid-sagittal plane and the distance from the mid-sagittal plane.

Other factors could include the remaining growth, the age of the patient and the amount of crowding etc. in relation to finalizing the decision to extract the retained primary canine to help the potentially impacted canine to improve its path of eruption, extract the related 1st premolar to create an eruption path for the potentially impacted canine, use a headgear or mini screws to create enough space for the canine eruption, surgical exposure with or without a gold chain traction (which is in most cases is the ideal option) (Figure 12) or even the extraction of the impacted canine or its Auto-transplantation. In some occasions, impacted canine could be left in situ (but monitored routinely) if it was not closely associated to the roots of the neighboring teeth, not associated with any pathological changes, no potential residual growth associated root resorption risk, etc.

***Figure 12:*** *Fixed Orthodontic Appliances are usually used for the traction of the impacted maxillary canines post their surgical exposure.*

- Un-erupted Permanent Mandibular Canine: This is less common compared to the Maxillary canine and it is usually related to crowding (Figure 13). Semi vertical ones can be treated successfully after creating enough room for them but the horizontal ones or significantly displaced ones are better extracted or auto-transplanted.



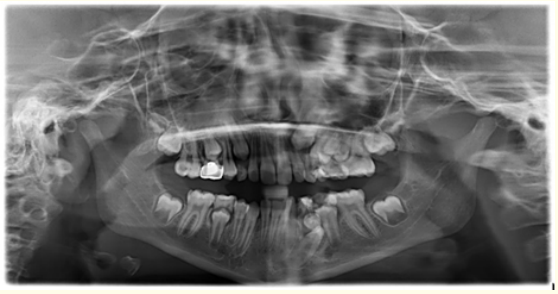


***Figure 13:*** *Radiological evidence showing how local crowding can play an important role in the impaction of the developing lower permanent canines.*

- Un-erupted Permanent Maxillary Incisor: (Figure 14). If the contralateral Maxillary incisor or the lateral incisors are erupted before the incisor in question by more than 6 months then a radiographic investigation should be done in order to confirm the presence of that tooth, the available space for its eruption, or any local factors that might be affecting its eruption such as dilacerations, supernumerary teeth presence such as odontoids or the tuberculate form supernumeraries. Treatment in simple term could vary from just the removal of the supernumerary tooth/teeth, or exposure of the impacted incisor, a gold chain attachment and traction or even removal of the dilacerations was severe as the root apex will penetrate the buccal plate when the crown is aligned etc [12].

***Figure 14:*** *Examples of absent or un-erupted permanent upper maxillary incisors that were discovered and referred late by the GDP and all permanent teeth have already erupted. This should have been spotted when the patient is about 8-9 years of age (like in the last picture).*

- Un-erupted Permanent Molars: Impacted third molars are rarely indicated to be treated orthodontically hence surgical intervention is the best choice in most cases. While the impaction of the first permanent molars against the 2nd primary molars (4%) of the second permanent molars against 1st or 3rd molars (2%) may require orthodontic intervention in most cases and often associated with dentigerous cysts (Figure 15), crowding or even genetic predisposing factors.

***Figure 15:*** *Un-erupted mandibular permanent first molar due to a large dentigerous cyst.*

Sometimes the extraction of the 2nd primary molar or even grinding the distal part of it and occasionally using orthodontic separators to guide the eruption of the 1st permanent molar suffice. While in other less common cases, surgical exposure associated with an orthodontic traction might be required. For the 2nd permanent molar impaction cases, most probably the extraction of the associated 3rd molar and orthodontic traction of them with or without the help of mini-implants for anchorage support might be required. In very rare occasions, practitioner would be forced to extract the impacted 2nd permanent molar but this will often result in the least favorable outcome.

- Primary Failure of Eruption of Permanent Teeth: This is a very rare incidence and usually not associated with any obvious systemic, pathological or environmental reason. Recently, some genetic connection was suggested especially with the autosomal dominant mutations in the PTH1R gene [13,14]. Most of these teeth end up with extraction and the remaining space is either closed by orthodontics or restored with a prosthodontic replacement. Occasionally, segmental osteotomy could be used to move the tooth with its surrounding bone to the ideal or near position and some coronal build up to adjust the final occlusion would be needed [15].

- Transpositions: This could be intentional such as the complete positional interchange of two adjacent teeth via orthodontic forces or could be developmental such as the eruption of the tooth in the position normally occupied by a non-adjacent tooth (0.33%). The multifactorial mechanisms [16] speculated for these mostly genetic-in-origin transpositions could vary from:

- The positional interchange of the adjacent developing tooth buds (most probably the upper canine and 1$^{st}$ premolar or the lower canine and the lateral incisor).

- Retention of the primary teeth.

- Tooth agenesis

- Down Syndrome

- Alteration of tooth eruption paths and associated peg-shaped lateral incisors

- Trauma.

The early detection of the transposition which usually affects females and is unilateral in most cases, could save the patient a lengthy treatment in the future. The early interceptive extraction of the overlying primary tooth may help in these cases (if the transposition of the tooth buds is not fully established yet) otherwise orthodontic treatment will be needed aiming at correcting the order of the affected teeth unless other decision was made to either accept the transposed order or extract one of the affected teeth (Figure 16).

***Figure 16:*** *Upper right permanent canine and upper right first premolar transposition.*

- Maxillary Midline Diastema: This could be a normal developmental phenomena especially in the Ugly-Duckling stage and usually it does improve following the eruption of the permanent canine teeth unless it was associated with other conditions, few of which are:

- Spaced dentition
- A prominent labial frenum
- Congenital absence or peg-shaped Maxillary lateral incisors
- Midline supernumerary
- Flared out upper incisors especially when associated with habits such as digit or dummy sucking.
- Presence of pathology.

The management of the midline diastema is usually dependent upon the underlying causes [17]. Removal of supernumeraries, obstructions, pathology usually improve the situation. Braces might still be needed to close the gaps and sometimes to leave some gaps around to allow the restorative buildup of diminished teeth, if present.

Many suggestions existed in relation to the best timing of the removal of the prominent labial frenum (that blanches when pulling the lip up (Figure 17) and associated with a notched inter-maxillary segment on the x-rays). The authors are in favor of the delayed frenectomy until maxillary canines have erupted and until orthodontic closure of the diastema has been completed. Permanent retainers would be advisable in such cases due to the high relapse incidence.

***Figure 17:*** *Example of a prominent labial frenum that blanches when pulling the lip up.*

## Early loss of permanent teeth

### Early loss of 1st permanent molars

The most common reason for the extraction of the permanent molars is usually due to caries and very rarely due to other conditions such as Molar-Incisor Hypo-mineralization that affects usually the first permanent molar.

The decision to extract the first permanent molar is not the ideal choice in most cases and it usually creates a large space at a distance from those sites where it is required to relieve incisor crowding, create space for canine's eruption or even reducing increased overjet.

That decision might depend on a number of factors that includes but not limited to:

- Age of the patient and the stage of the dental development
- The amount and the site of crowding and the type of Malocclusion
- The general oral health status of the mouth and other teeth present with very poor prognosis
- Patient compliance
- The presence of the related 3rd molar.

As a general rule, if the case is anchorage demanding, better to try to delay the extraction of the 1st molars until the 2nd molars are erupted and then they could be used to retract the anterior teeth into the extraction site with or without additional anchorage support measures (as required). If the plan is to allow the 2nd molar to replace the extracted 1st molar then try to extract at the optimal time (i.e. the 2nd molar roots approximately half-formed and with evidence of early dentine calcification within the bifurcation) and one should expect end results to be better in the Maxilla than the Mandible, in general.

### Early loss of permanent central incisor

Traumatic loss of the Maxillary central incisor (3%) is usually unilaterally (Figure 18) and happens to boys who have increased overjet [18]. Immediate re-implantation is the best choice available so that the tooth will serve as a space maintenance and the alveolar bone will be preserved until it fails. A partial denture would be the second options of choice as most temporary fixed bridges have many problems with some children. Orthodontics can play a role in maintaining the space mainly for future permanent bridges or dental implants etc.

***Figure 18:*** *Unilateral loss of upper left central incisor due to trauma. Orthodontics aligned the teeth and maintained the space a future implant in the site.*

If the loss is bilaterally then orthodontics can reduce the overjet by trying to partially close the gaps and then restorative/prosthodontic techniques could be utilized to make them match the missing central incisors and reshape the canines too.

### Undesirable habits

Many habits and oral dysfunctions could have devastating effect on the occlusion such as Digit or Dummy Sucking, Lower Lip Sucking, Tongue Thrusts, night grinding, mouth breathing, Nail biting and many others [19]. Multiple devices with various degrees of success have been developed and practitioners can modify most of them to fit the specific requirements of each patient (Figure 19).

***Figure 19:*** *Examples of Anterior open bites due to thumb sucking and tongue thrust and examples of tongue cribs and habit breaker devices.*

The most common habit that dentists usually encounter with their young patients (under 10 years of age) is the persistent and prolonged digit sucking habit with its associated features such as:

- Proclination and possible gaps between the upper front teeth
- Possible retroclination of the lower front teeth
- Possible Asymmetrical anterior open bite
- Posterior cross bites
- Increased lower face height and many others.
- Anterior open bite that should be treated Orthopaedically and/or Orthodontically in order to avoid orthognathic interferences in the future [20].

## Crowding problems in the mixed dentition

There is a wide variation between children in the amount of crowding in the mixed dentition stage, as well as the manifestation and the early signs of such crowding. The relative difference in size (mainly mesio-distal dimension) between the primary and permanent teeth as well as the variation in the growth spurt and widening of the jaws could play an important role in the presence of various levels of anterior and posterior dental arch crowding. All this, make it difficult to accurately predict the amount of crowding the child will have in the full permanent dentition stage almost impossible. So many ways were suggested in this aspect, but none has the merit of being 100% accurate in predicting the actual amount of crowding although they can help practitioners to predict the crowding to be mild, moderate or severe at the best.

This usually helps practitioners to decide whether they need to plan ahead and follow one of the following strategies in dealing with crowding in the mixed dentition stage:

Arch expansion, serial extraction or space maintenance.

In general, the long-term stability of arch expansion (using fixed or removable appliances) is not proven and cannot be accurately predicted. Expansion, therefore, better be utilized in cases with cross-bites (Figure 20), abnormally narrow dental arches, or in severe crowding cases where multiple teeth are feared to be impacted in one single quadrant or more.

***Figure 20:*** *Rapid Maxillary Expander is used in the mixed dentition stage to expand the upper arch and correct the Cross-bites and create more room for the eruption of the permanent teeth.*

Serial extraction was proposed in the middle of the 20th century in order to help achieve aligned dentition without the need for orthodontic appliances. This is usually done in cases with good oral hygiene, full complement of teeth and without significant sagittal discrepancy.

- Upon eruption of the lateral incisors, the primary canines would be extracted. This will help aligning the anterior teeth as they have enough space by then.
- Almost a year later, the primary 1st molars would be extracted. This will encourage the eruption of the 1st premolars ahead of the permanent canines.
- Those 1st premolars would be extracted to allow enough room for the erupting permanent canines to erupt into alignment with the dental arches.

Due to the trauma associated with the extraction of almost 12 teeth in a child and other side effects, the popularity of the serial extraction is fading by time however, the interceptive extraction of the primary canines is still popular in several cases such as:

- When the lateral incisors are severely crowded or erupting into cross-bites.
- When the labial segment teeth suffer from a considerable gingival recession.
- When there are signs of possible impaction of the permanent canines.

Space maintenance aims in general on preventing the teeth to drift mesially and tilt or reduce the available space which was created when a primary tooth was lost or extracted. This is usually useful in preventing the 1st permanent molars from moving mesially and allow space for the 2nd premolar to erupt. Space maintainers usually allow the anterior dentition to benefit from the small Leeway space that is usually created by the difference in size between the premolars and the primary molars in the dental arch [21].

So many types of space maintainers were recommended but the most useful ones in general are the trans-palatal arches or Nance buttons for the Maxilla and the lingual arch for the Mandible (Figure 21).

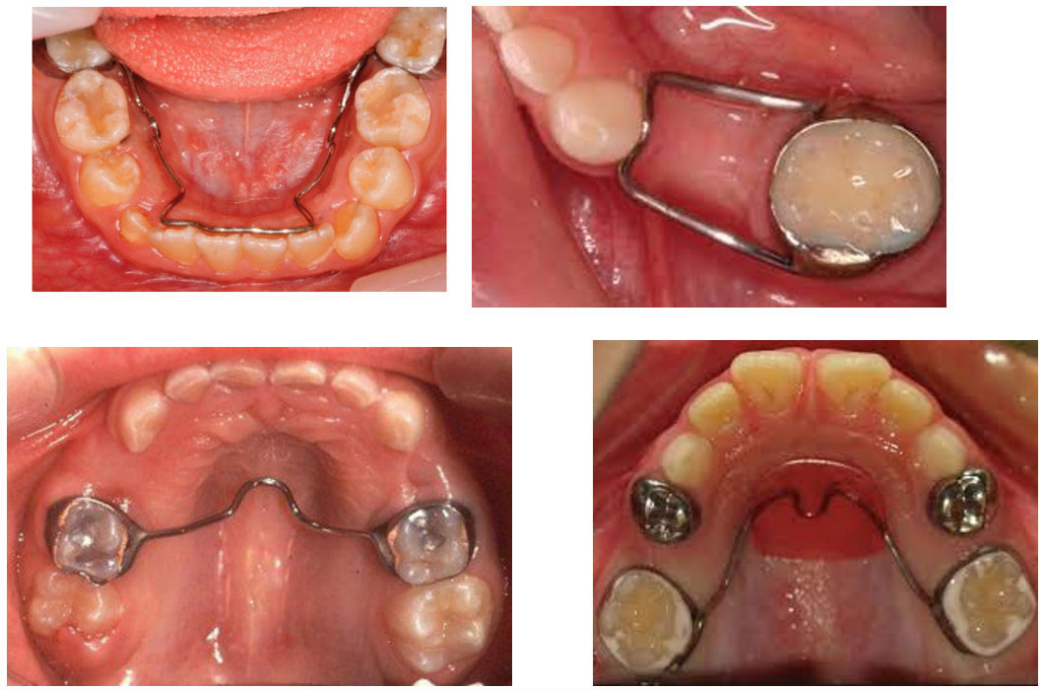


***Figure 21:*** *Various types of space maintainers exist. Some of them to maintain the space for a single tooth while others for multiple teeth.*

## Skeletal problems in the mixed dentition stage

A variety of skeletal problems might be spotted developing in the early years of life, but the decision of treatment would usually depend on many factors such as:

- Hereditary,
- Growth patterns,
- The best time to treat in order to reduce the treatment time and guarantee maximum cooperation,
- Achieving good results in a single orthodontic treatment,
- The possibility to avoid or minimize the need for surgical interference in the future among others.

In General, the treatment during the adolescent growth spurt period yields the quickest and best results. Most treatment should be aimed to coincide with it unless there is a major need to start treatment earlier such as due to trauma in severe increased overjet cases, major anterior cross-bite among others [18], (Figure 22).

***Figure 22:*** *Increased overjet in a young child that require immediate attention and treatment due to the high incidence of trauma to the upper labial segment teeth in such cases. Usually Functional Appliance would be considered to modify the growth direction and reduce the need for extractions.*

For Class II cases, usually functional appliances work best in correcting the increased overjet and overbite and for expanding the narrow arches and creating some localized spaces for erupting permanent teeth that are struggling to erupt due to shortage of the available space (Figure 23).

***Figure 23:*** *A removable Twin Blocks appliance forcing the jaws to be on one level and helping expanding the upper arch, reducing both the over jet and the over bite and preparing on many cases for phase II treatments using fixed orthodontic appliances.*

Proclined incisors could be retracted with a retraction labial bow. Headgear could be added to stabilize upper molars or to retract the incisors too. If fixed appliances are planned, then quad- or tri- helix could help in correcting the x-bites and expanding the dental arch and help correct the molars' relationship indirectly too (Figure 24).

***Figure 24:*** *Quad-helix expander to help correcting a cross-bite and expanding the Maxilla and creating more room for the permanent teeth to erupt into.*

For Class III cases, it is very important for these cases to be assessed carefully if they are treatable at that stage or better to be left a bit longer to have a combined orthodontic and orthognathic surgery interface [22].

Mild to moderate cases, for example, when the skeletal base is Class I or mild Class III, with limited compensation, with average or reduced lower face height, with forward displacement and still can bite edge to edge (Figure 25).

***Figure 25:*** *Mild and moderate Class III cases in which the patient can still get edge to edge bite, usually benefit from a simple course of early Orthodontic treatment.*

These cases can benefit from early treatment especially for correcting the anterior cross-bites [23] using removable appliances with posterior bite planes and palatal springs. Midline expansion screws could be added to help transverse relationship correction (Figure 26).

***Figure 26:*** *Upper removable appliances can be used with palatal springs to push the anterior teeth over the bite and correct the early anterior cross-bites. Many modifications exist and a midline expander screw could be added and flat posterior bite plane is usually needed to open the bite and free the teeth in cross-bite to facilitate their movement.*

Fixed appliances such as 2x4 appliance (4x brackets and 2 bands on molars and GIC blocks to open the bite) could be used as well if more than tipping movements are required to fix the developing anterior cross-bite (Figure 27).

***Figure 27:*** *Sectional Fixed Appliance (2x 4 Appliance) is usually used to correct the developing anterior cross bites.*

Functional appliances in Class III cases (such as Frankel III and Twin Blocks III) are not as popular as those for Class II cases and patients usually report them to be bulky, difficult to wear, and prone to breakages.

Protraction headgear, on the other hand, could be considered the ideal approach for patients who suffer from a Maxillary Hypoplasia (Figure 28). If accompanied with rapid maxillary expansion, greater forward displacement of the maxilla could be achieved in some cases in the preadolescent period. Success is less usually in cases with vertical growth pattern, mandibular prognathism and in older patients.

***Figure 28:*** *Example of a simple protraction headgear to help correcting the developing Class III malocclusion due to Maxillary Hypoplasia.*

With the development of mini (screws/ plates) in orthodontics, the envelope of correcting Class II and Class III cases have been expanded and now more cases (at different ages) could be treated using those bone-anchorage (screws/ plates) and intra oral or extra oral elastics with encouraging degrees of success (Figure 29) [24].

***Figure 29:*** *An Example of using TADs (temporary anchorage devices – mini (screws/ plates) to correct anterior cross-bites in a growing child with intra-oral elastics.*

## Conclusion

Spotting the developing abnormalities in the early and mixed dentition stages and referring the patient to the specialist for an advice or even simple interceptive treatment could save the patient plenty of complex modalities of possible invasive treatments that could involve major surgeries in the years to come (Figure 30) [25,26].

***Figure 30:*** *An Example of the delayed referral. This referral should have been done like 6 - 7 years earlier!.*

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