Mixed dentition stage

It begins at about age of 6 years with the eruption of the first permanent molars, followed soon thereafter by the permanent incisors, table (1). Generally, females precede males in the eruption timing by an average of 5 months. During the mixed dentition, both deciduous and permanent teeth are present. The mixed dentition stage can be divided into three periods:

- First transitional period (6-8.5 yrs), in which the eruption of permanent 1st molars and incisors occur.
- Inter-transitional period (8.5-10 yrs).
- Second transitional period (10-12 yrs) include the eruption of canines, premolars and 2nd molars.

**Eruption Sequence**

In the maxillary arch, 18 different sequences were noted. The most frequent sequence was (6-1-2-4-5-3-7-8). In the mandibular arch, 17 eruption sequences were observed. The most common sequence was found to be (6-1-2-3-4-5-7-8). It was found that the combination of the above sequences (most frequently seen), produced the highest percentage of Class I occlusions. The sequence of eruption of the permanent teeth can play an important role when considering a serial extraction procedure. A change in the sequence of eruption is a much more reliable sign of a disturbance in normal development than a generalized delay or acceleration.

<table>
<thead>
<tr>
<th>Tooth</th>
<th>Calcification begins (months)</th>
<th>Eruption (years)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Maxillary</td>
<td>Mandibular</td>
</tr>
<tr>
<td>Central</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Lateral</td>
<td>10-12</td>
<td>3</td>
</tr>
<tr>
<td>Canine</td>
<td>4-5</td>
<td>4-5</td>
</tr>
<tr>
<td>1st premolar</td>
<td>18-21</td>
<td>21-24</td>
</tr>
<tr>
<td>2nd premolar</td>
<td>24-27</td>
<td>27-30</td>
</tr>
<tr>
<td>1st molar</td>
<td>Around birth</td>
<td>Around birth</td>
</tr>
<tr>
<td>2nd molar</td>
<td>27-33</td>
<td>27-33</td>
</tr>
<tr>
<td>3rd molar</td>
<td>8 yrs</td>
<td>9 yrs</td>
</tr>
</tbody>
</table>
The more a tooth deviates from its expected position in the sequence, the greater the likelihood of some sort of problem. For example, a delay in eruption of mandibular canines to age 14 is within normal variation if the second premolars are also delayed, but if the second premolars have erupted at age 12 and the canines have not, something is probably wrong.

There is asymmetries in eruption between the right and left sides of arch. The normal variation is only a few months, however, as a rule, if a permanent tooth on one side erupts but its counterpart on the other does not within 6 months, a radiograph should be taken to investigate the cause of the problem.

**First transitional period**

**Eruption of Permanent First Molars**

First permanent molars erupt at about dental age 6. The initial occlusal relationship of the first permanent molars is directly influenced by the deciduous second molar position. If these teeth are flush in the terminal plane then the first permanent molars assume a cusp-to-cusp relationship when they erupt. In order to establish a class I molar relationship, some mesial movement of the mandibular first permanent molar will be required. This is achieved by the following mechanisms:

- The mesial shift, early and late.
- Mandibular growth.

**Early mesial shift**

In the arch with the physiological spaces, the eruptive force of the permanent molars will move the primary molar mesially, so that close the space distal to the primary canines (primate spaces), thus allowing lower permanent molars to shift mesially into Class I relationship.
Orthodontics ....................................................... Development of Occlusion.

(Leeway Space). As the leeway space is greater in the mandible (1.7mm per side) than that in the maxilla (0.9 mm per side), the mandibular molars tend to migrate slightly more mesially than the maxillary molar, making the initial “terminal flush plane” relationship, now into a Class I relationship.

**Mandibular Growth**

In general, both the maxilla and mandible grow downward and forward, but during this developmental stage the mandible grows relatively more forward than the maxilla. Differential growth of the mandible relative to the maxilla is also an important contributor to the molar transition, particularly in the transition from an end-to-end to a Class I molar relationship.

Flush terminal plane, it is more challenging diagnostic cases. Of these cases, 56% developed into a Class I molar relationship and 44% developed into an end-to-end (class II) if the growth pattern is not favorable.

In distal step relationship, the molar relationship in permanent molar more likely develops into a class II relationship, and this condition will not self-corrected with time.

In mesial step relationship, it is quite possible to progress to a half-cusp Class III during the molar transition and proceed further to a full Class III relationship with continued mandibular growth. Nevertheless, if differential mandibular growth no longer occurs, the mesial step relationship at an early age may simple become a CL.I relationship later.

It is necessary to periodically evaluate the changes in the occlusal relationship, particularly in distal step occlusion, in young patient to initiate the treatment when the adverse relationship of molars is developed.
**Eruption of permanent incisors**

Permanent incisors develop lingual to the primary incisors. They are located in (zigzag) fashion and the lateral usually trapped by the centrals and canines. Anyhow if the incisors deflected from their path of eruption, they will erupted lingual to the deciduous. Since the upper lateral incisors situated palatal to the centrals, so they may be influenced by the malocclusion more than the centrals. If there is no enough space in dental arch for all the incisors, most of the available space is occupied at the eruption of centrals, when laterals erupt later, they may erupt in a rotated or in crossbite condition.

The collective mesiodistal dimensions of the permanent incisor tooth crowns are larger than their deciduous predecessors by approximately (6 mm) in the mandible and (8 mm) in the maxilla. The difference between the amount of space needed for the incisors and the amount available for them is called the *Incisor Liability*. Because of the incisor liability, a normal child will go through a transitory stage of incisor irregularity, especially in the mandible, at age 8 to 9 even if there will eventually be enough room to accommodate all the permanent teeth in good alignment.

The increased space requirement for well-aligned permanent incisor teeth is gained from the following:
- Interdental physiologic spacing in the primary incisor region.
- A slight increase in the inter-canine arch width by growth occurs with the eruption of incisors and canines.
- Labial positioning of the permanent incisors to the primary incisors. The primary incisors tend to stand upright. As the permanent incisors replace them, these teeth lean slightly forward (proclined), which arranges them along the arc of a larger circle.
• Deciduous canines being moved distally as the incisors erupt. By the eruption of permanent incisors, the lower deciduous canines, and by their contact push the upper canines, not only in outward but also move slightly in distal direction, increasing the intercanine width.

**Physiological spacing (ugly duckling) stage**

Around the age of 8 yrs, midline diastema is commonly seen in the upper arch, which is usually misinterpreted as a malocclusion. This variation of normal development is not very esthetic and is referred to as "Ugly duckling stage". This phenomenon occurs due to a lateral pressure applied by the erupting canines on the developing roots of lateral incisors which in turn press the roots of centrals causing a lateral flaring of their crowns, and producing a midline diastema. As the canines erupt, the pressure is transferred from the apical region of the maxillary incisors toward their crown, improving their inclination and usually closing the midline diastema.

**Inter-transitional period**

After the completion of eruption of 1st molars and incisors, there is a silent period extend from 8.5 to 10 years of age, during which there is no teeth eruption or exfoliation, except a little changes in occlusion. The teeth present are:

\[
\begin{array}{c|c}
6EDC21 & 12CDE6 \\
\hline
6EDC21 & 12CDE6
\end{array}
\]
**Second transitional period**

**Eruption of premolars, canines and second molars**

Further development of the dentition is characterized by eruption of the premolar and canine teeth, between the incisors at the front of the arch and the first molars at the back. In contrast to the incisor dentition, the combined mesiodistal length of the deciduous canine and molar teeth is greater than that of the permanent canine and premolars, an excess known as the leeway space. Eruption of these teeth normally takes place between the ages of 10 and 12 years, generally:

- In the mandible, the canine erupts ahead of the first premolar and this is followed by the second premolar.
- In the maxilla, the first premolar usually erupts first, followed by the second premolar and then the canine.

The consequences of these eruption patterns are that the mandibular second premolar and maxillary canine teeth are the most vulnerable for potential crowding. For the canines to develop normally, it should firstly directed mesially until it touch the apical part of the lateral incisor root, then it directs into a coronal and lateral direction till reaches the occlusal level.

Undoubtedly, the larger the leeway space present within each quadrant, the more potential space there will be for eruption of the permanent canine and premolar teeth. However, if earlier alignment of the permanent incisor dentition has utilized any space within the deciduous canine regions, this will now be at the expense of that available for the permanent canines.

The crowding of canines is common particularly in the maxillary arch, so that it could be erupted in buccal direction or be impacted if it directed palatally. This usually occurs in maxilla where the permanent canine develops
in a high position (under the orbit), so it has a long tortuous path of eruption. It often depends on the presence and shape of root of permanent lateral incisors as guide for normal eruption. Moreover, the canine appears late in the dental arch, following the premolars eruption.

In addition, if substantial forward movement of the first permanent molar has occurred, particularly in the mandibular arch, during establishment of the molar relationship or following the early loss of deciduous second molars, there will be a less space for permanent canine and premolar teeth to erupt uncrowded. In this scenario it is often the mandibular second premolar that becomes crowded and erupted in lingual direction or it may be impacted under the 1st molar.

The final part of this phase of dental development occurs with eruption of the second permanent molars, usually at around 12 years of age. Eruption of these teeth is often associated with some reduction in arch length, which manifests as increased crowding, particularly of the lower incisors.

If the second permanent molars erupt precociously before the premolar teeth, in the lower jaw especially, as their path of eruption is directed mesially and occlusally, this can result in a considerable arch length reduction and crowding of the second premolar tooth. Occasionally, there is a lack of space in the posterior regions of the maxillary and mandibular dental arches and the second molars can become impacted.
Summary:

We can summarize the timing of permanent teeth eruption in following table:

<table>
<thead>
<tr>
<th>Eruption time (years)</th>
<th>6-7</th>
<th>7-8</th>
<th>8-9</th>
<th>10-11</th>
<th>10.5-11.5</th>
<th>11-12</th>
<th>12-13</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maxillary tooth no.</td>
<td>6</td>
<td>1</td>
<td>2</td>
<td>4</td>
<td>5</td>
<td>3</td>
<td>7</td>
</tr>
<tr>
<td>Mandibular tooth no.</td>
<td>1 &amp; 6</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>7</td>
<td></td>
</tr>
</tbody>
</table>