PREVENTIVE ERUPTION GUIDANCE -- PREVENTIVE OCCLUSAL DEVELOPMENT

Analysis and Diagnosis of Occlusion:

The ideal child of 5 y ears of age that probably has the best chance of developing an ideal occlusion and facial appearance by 18 years of age is if the overjet is from 2 to 3 mm (overjet - Bjork, 1953 AJO [p. 30] decreases 0.7 mm between 12 and 20 years), the overbite is about 1.00 mm (increases 1.75 mm to 9 years and does not have a significant change thereafter), there is 2.5 to 3.0 mm of interincisal space in the lower arch and the mandibular incisors are of average size (male central incisor 4.08 mm, female 3.98 mm, male lateral incisor 4.75 mm, female 4.63 mm) or slightly larger; the anterior vertical face height (NMe) is normal (male 97.3 mm, female 93.1 mm); the lower vertical face height (ANS-Me) is normal (male 57.7 mm, female 54.1 mm); and the facial soft tissue profile fits into the corresponding 5 year old template. This 5 year old ideal certainly does not guarantee an 18 year old ideal since there are many uncontrolled factors that can easily change the pattern of development, but there are a number of factors that show some degree of constancy.

It is more difficult to predict occlusion prior to the transition from deciduous to mixed dentition than after the eight incisors are in place. The correlations are higher for canine arch width changes, spacing/crowding, overbite and overjet once the anterior dentition is somewhat fixed after 8½ years of age. On the other hand, it becomes more difficult to correct these problems once they have been allowed to develop than preventing them from occurring to begin with (during this transition period). For example, overbite is one of the most difficult to correct among the various problems of occlusion once the teeth are "fully" erupted into the excessive vertical position. The Occlus-o-Guide® appliance requires 2 to 4 hours of exercise each day to gain from 0.4 to 0.84 mm per month correction depending on whether the overbite is less or more than 5.24 mm initially, while fixed appliances correct it at the rate of 0.14 mm per month. On the other hand, the same Occlus-o-Guide® appliance worn one hour passively while sleeping each night will effectively stop further eruption of the incisors once they reach the proper

overbite level at an earlier age. They will stay in this position if the overjet is also of proper proportions (1 - 3 mm). If the overjet is excessive, however, the overbite will continue to develop when the appliance is removed. Therefore, it is important to correct the overjet as well as the overbite to ensure the greatest amount of retention.

Since prevention before the problem develops is considerably easier and less costly than treatment afterwards, unnecessary prevention of a problem that would have self-corrected is not as critical as unnecessary treatment of a self-correcting problem at a later time. It is important, however, to avoid preventive measures that, if done unnecessarily, will increase the complexity of a developing problem. The avoidance of these problems will be discussed alter and most involve recognizing abnormal growth tendencies to that certain restricting occlusal tendencies are not removed that might encourage the abnormal situation from becoming worse. Examples are the preventive elimination of a developing overbite in a potential Class III growing mandible, or to prevent the over-eruption of maxillary permanent incisors in a child with an unusually vertically-shortened maxilla (small ANS upper incisor distance), or to prevent an overbite from occurring in an excessively short vertical lower anterior face height patient, where later functional correction of the developed overbite would help to lengthen the abnormally small face height (ANS-Me). Most of the principles of avoidance involve abnormal growth tendencies which are easily recognized at the 5 to 6 year age group.

The high majority of children who present "normal" (within ± 2 S.D.) measurements of facial dimensions are candidates of preventive measures provided they have deep overbites, excessive overjets, potential crowding, gummy smiles and TMJ disc problems. The most difficult of these attributes to analyze is the potential crowding since a great deal of change occurs during the transition of the deciduous to permanent dentition. A working knowledge of these developmental tendencies during this period is essential and to be able to foresee certain changes that will normally be happening for most children at this young age.

Developmental Changes in the Mandibular Arch:

One year preceding the eruption of the permanent mandibular central incisor, (5 - 6 years of age), the deciduous canine-to-canine distance begins to expand, probably from the forceful eruption of the crowns of these teeth in the tissues forcing the canines apart. The actual dimensional increase at this time is 0.69 mm in the male and 0.67 in the female. Also closely related to this expansion is the presence or absence of spaces. There is little relation of the presence of spaces between the deciduous teeth and the percentage relation of deciduous to permanent crown sizes of incisors (Max - M = -0.31 male, M = +0.05 female, Mand. - -0.17 male, -0.15 female). In other words, if spaces exist it does not necessarily mean there will be either large or small permanent teeth present. One important relation that is significant is that when the percentage ratio of the combined diameters of the lower deciduous to permanent teeth are compared to the available space at 16 to 18 years of age, the correlations are quite high (male r = +09.94, female 4 = 0.84) (p. 134). This means that the available space at a young age is related to the degree of straightness or crowding at a later age. Most children with interdental spacing of the deciduous teeth, according to Barme, however, end up with good alignment while in those cases without such deciduous spacing (43%) end up with crowded permanent incisors (Barme, p. 20). The average interdental space between the mandibular deciduous canines prior to the eruption of the lower permanent central (6 years) was 2.46 mm in the male and 1.42 mm in the female according to Moorrees, while during the previous year (5 years) it was 2.37 mm in the male and 2.47 mm in the female. It is negligible in the premolar area from age 3 until the exfoliation of the deciduous molars in both sexes.

It is therefore essential to consider both the size of the unerupted permanent incisors and the available arch size between the deciduous canines, particularly in the mandible. Rarely is there sufficient room for completely straight permanent incisors when there is no space between deciduous incisors even though there is an average of 2.1 mm (in both male and female) expansion in this area from the forceful eruption of the centrals and laterals (Moorrees). Fortunately, there is a tooth diameter difference between the two deciduous molars and canines and their permanent replacements (premolars and canines) of 5.1 mm (male) and 484 (female) in the mandible and 2.6 mm (male) and 2.92 mm (female) in the maxilla. The mandible is the least manipulative arch orthodontically and is most limiting in the diagnosis and is the most frequently crowded. Fortunately, there is a consistent pattern in the mandible where a 4 mm excess tooth

mass in the deciduous posterior segment (canine and deciduous molars) exists over the corresponding permanent teeth that will replace them beginning at about 11 years in the male and 10 years in the female. It is possible to utilize this extra room in preventing a malocclusion from developing at an early age (6½ to 7 years, prior to the eruption of the lower laterals) by simply stripping away 2 mm of enamel on each side or a total of 4 mm in whole arch. This is done by mesial and distal stripping of deciduous canine (1 mm from the mesial and 1 mm from the distal), or one can strip partially from the mesial of the first deciduous molar if the deciduous canine enamel is quite thin and does not allow a full 2 mm stripping on that tooth alone. There is thus 4 mm of extra space at this age that can easily be utilized in the lower arch by not allowing the first permanent molars from migrating mesially as the second permanent molars erupt past the cement-enamel junction of the distal surface of the first molars at about 12 years of age. The loss of the deciduous molars (especially the first deciduous molars) and canines are not usually associated with the mesial migration of the first molar as much as the mesially-erupting second permanent molar. The lower first permanent molar usually retains its distal position while the deciduous canines and first deciduous molars exfoliate and are replaced by the permanent canines and premolars. If the second permanent molar erupts early, these excess tooth mass spaces usually close up early and therefore the placement of a bumper or a lingual holding arch is indicated if the spaces begin to close. Fortunately, the second molar is slow to erupt in most cases and this procedure is usually not necessary. This extra 4 mm of tooth mass difference between deciduous and permanent posterior teeth is one of the primary reasons for early treatment because if one prevents the mesial migration of the first permanent molar, its position seems clinically to be more stable than in those cases where one distal drives the molar after it is has been fully erupted for more than 6 months. This difference is probably due to the rapid development of adult collagenous fibers after the permanent tooth erupts which tends to return the tooth to its original position relative to the adjacent teeth after it is orthodontically moved.

In analyzing a young child's mandibular arch anytime prior to the loss of the deciduous molars, there is an extra 4 mm (2 mm per side) of space to aid in the correction of crowding. It is important to use this space, preferably as the lower permanent lateral incisor erupts (5 to 7½

years of age) or at least before the first molar has forced its way mesially in the arch to close these helpful spaces. Usually, if the molar can be distalized within 6 months after it is fully erupted, the creation of extra space will still be successful probably since full adult collagenous fiber formation is not complete at this stage.

Early treatment is easily accomplished especially for the prevention of overbite development and to encourage optimal eruption of the permanent incisors. To guide the permanent incisors during eruption is to encourage them to assume a correct position labio-lingually and rotationally so that they force their way directly into their proper positions in the arch form. In this way they are encouraged to widen the arch (within the curvature of the arch and not necessarily in the canine-to-canine straight line distance). This occurs optimally probably when these permanent incisors force their way into the arch form without significant breaks in their contact areas since they are considerably larger than their deciduous predecessors. In fact, according to Moorrees the male permanent lower central incisor is an average of 1.34 mm (or 32.8%) larger than the corresponding deciduous tooth, while the male permanent lateral incisor is 1.21 mm (or 25.5%) larger than its deciduous counterpart. The female permanent central is 1.27 mm (31.9%) larger and the lateral is 1.15 mm (24.8%) larger than the same deciduous teeth. This accounts for a total average incisor difference if 5.1 mm in the male and 4.84 mm in the female between permanent and deciduous teeth with an average of 1.52 mm interincisal deciduous space in the male and 1.02 mm space in the female. There is also mean arch circumference expansion of 2.1 mm that occurs during the eruption process. This leaves a negative available space in the male of 1.48 mm. and in the female of 1.72 mm between the deciduous and permanent incisor dentition.

Frequently, when the lower incisors erupt, they are in a lingual position to the deciduous teeth. Sometimes they will naturally migrate labially, but often they will not. In this position they cannot exert the lateral force that can give maximum lateral arch expansion. This is particularly true of the permanent lateral incisors. At times they will erupt rotated and with the development of adult collagenous fibers will remain this way. The expected expansion of 2.1 mm might not be as pronounced as it would be if the teeth were encouraged to erupt into a channel that duplicates the normal arch form. If the permanent erupting teeth are labio-lingually

misplaced or rotated, it is important to encourage them to assume an ideal eruption path in order to maximize the expansion that can occur from normal eruption forces. This expansion has been observed by Baume and also involves some labial positioning as well of about mm in the lower arch. He also found that cases without interdental deciduous spacing experienced more eruption expansion than those cases having spaces. Also, those cases having deciduous interdental spacing had larger canine-to-canine widths than those cases without spaces. In fact, children having interdental spaces had a mandibular canine-to-canine dimension 1.5 mm larger than those cases without such spaces. Moorrees, on the other hand, did not find an association between the canine-to-canine dimension or the presence or absence of interdental spaces to the ultimate condition of crowding at 16 to 18 years of age. It is important to depend more on an arch length analysis from the mesial of one canine to the same on the other canine along the arch circumference in comparison to the sizes of the permanent incisors rather than a simple measurement of the canine-to-canine straight line distance or simply the presence of interdental spacing. Moorrees also found no association with interdental spacing to the ratio of sizes of teeth, therefore, indicating that spaces may be present rather independently of the relative sizes of the deciduous or permanent teeth. It must be stated that the widening of the arch is closely associated with the eruption of the permanent teeth since Moorrees indicated the greatest bi-canine widening between 6 and 8 years of age occurs earlier in the female than in the male. The greatest mandibular bi-canine expansion was 4.3 mm in the male and 4.0 mm in the female in sample sizes of 40 and 38 respectively. IN fact, Moorrees showed that the bi-canine dimension began its expansion prior to the appearance of the mandibular permanent centrals, giving 33% (about 1 mm) of the total expansion in the male (5 to 6.5 years) and 25% (about 0.5 mm) in the female (5 to 6.5 years). After 8 years of age, very little change was evident in the bi-canine dimension up to 18 years of age. It would therefore be advisable that if an appliance was inserted in a child prior to the eruption of the permanent central incisors, expansion in the bi-canine area should be at least 1 to 2.5 mm larger than the existing dimension when treatment is started by 5 years of age and this increase in dimension should be greatest in the year preceding eruption (5½ to 6½ years in the male and 5 to 6 years in the female),m the maximum bi-canine width increases reported by Moorrees from 5 to 6 years of age prior to the eruption of the central incisors in the male was 2.3 mm and in the female was 2.1 mm (in a sample size of 26 and 33 respectively). After the centrals make their appearance until the laterals make their appearance

(1/3 crown height showing above tissue) from 6½ to 7½ years in the male 1.5 mm (50% of total) bi-canine expansion occurs and from 6 to 7½ years in the female 1.0 mm (50%) occurs. There is some further expansion of 0.5 mm for 6 months after the laterals have appeared with 1/3 crown showing from 7½ to 8 years of age in both the male (17%) and the female (25%). Therefore, when an appliance is worn by the patient during these periods of eruption, namely (a) prior to the eruption of the centrals, (b) from the time the centrals make their appearance until the laterals first appear, and (c) after the laterals first appear for the following 6 months. Period (a) lasts until about 6½ years old in the male and is represented by a 1.0 mm expansion bi-canine distance (33%) and .068 mm arch circumference enlargement from mesial canine to mesial canine (32.3%). IN the female it is represented by 0.5 mm in bi-canine expansion (25%) and 1.79 mm arch circumference increase (85.6%). Period (b) lasts from 6½ to 7½ years of age in the male with 1.5 mm bi-canine expansion (50%) and 1.42 mm arch circumference increase (67.6%). In the female from 6 to 7½ years of age the bi-canine expansion is 1.0 mm (50%) and the arch circumference increase is 0.3 mm (14.3%). Period (c) in the male from 7½ to 8 years of age the bi-canine expansion is 0.5 mm (17%) and the arch circumference increase is 0. In the female from 7½ to 8 years, the bi-canine expansion is also 0.5 mm (25%) and the arch circumference change is also 0. These figures are relatively unimportant other than that the total arch circumference increase of about 2.1 mm during the two first periods and that the bi-canine distance also increases between 2 and 3 mm (female and male) between periods (a) and (c).

Using an appliance is a little like being just ahead of the crest of a wave when surfing. The natural increasing dimensions have to be compensated for in the appliance in order to take advantage of these increases. When using a Nite-Guide® preventive eruption guidance appliance, the size has to be increased as the teeth begin their eruption. This appliance increases in 0.8 mm increments across the lower incisal segment for each one-half size difference. Therefore, for a 2.1 mm arch circumference increase, three one-half size increases should be made during this period. If greater increases are desired than this when there is a greater shortage of tooth mass than 2 mm, the size increases are made in greater loops such as a full size or a double size jump. For example, if the deciduous dentition requires a 1½C size, one might start instead with a #2C. Within a few months when the arch matches the #2C size, the size is increased as the lower centrals erupt to a full #3C size. As the laterals are almost ready to erupt,

a #4C is inserted. Therefore, an increase of 4.9 mm instead of 2 mm has been accomplished for the successful eruption of the potentially crowded lower incisors. In this last example, just as the laterals are ready to make their appearance, the deciduous canines are stripped about 2 to 4 mm (1 to 2 mm per side) depending on how much additional space is required. The bi-canine width increases are automatically compensated for in the increased manufactured sizes of the Nite-Guide® appliance.

Following the eruptive appearance of the lateral incisors, for about 6 months there is a slight increase of the bi-canine distance (7½ to 8 years of age) of about 0.5 mm and then the distance remains relatively constant to 18 years of age. The appliance that will fit the adult incisors will have a canine-to-canine dimension predicated on an adult dimension. Therefore, once the permanent incisors have completed erupted, the same appliance can be used off and on until about 12 years of age, although the normal retention time usually is only about 6 months after full eruption. This normally corresponds with adult collagenous fiber formation of these teeth. The appliance can be used as a safeguard during an eruptive resting period from 8 until about 10½ years in the female and 11 years of age in the female when the premolars and permanent canines begin to erupt. At this stage the appliance can be used at night only (passively without biting forces) to guide the remaining permanent teeth into place if necessary. No further retention is usually necessary at this stage.

A general description of dental eruptive development has been described together with a technique of eruption guidance consistent with these accepted principles. The mandible, as stated previously, is probably the most important of the two arches, however, it is also important to appreciate what is going on in the maxilla and how it affects the preventive eruption in this arch as well.

Developmental Changes in the Maxillary Arch:

The maxilla goes through similar changes as the mandible with a few notable exceptions, namely:

(a) The ratio of deciduous tooth widths to permanent widths is not quite as advantageous

in the maxilla. The permanent incisors are 7.1 mm larger in the male and 6.4 mm larger in the female (the mandible is 5.1 mm and 4.84 mm respectively). The total of the deciduous canine and deciduous molars are 1.3 mm larger per side in the male and 1.46 mm per side in the female (the mandible male is 2.33 mm and the female is 2.67 mm larger per side than the permanent teeth).

(b) There is greater expansion in the maxillary incisal arch circumference than in the mandible during eruption of the permanent incisors, being 2.93 mm in the male (5 to 8½ years of age) and 3.17 mm in the female (t to 8 years of age). In the mandible it is 2.1 mm for both male and female (5 to 8 years of age).

(c) There are generally slightly greater increases in the canine-to-canine straight line distance in the maxilla than mandible and it usually continues over a longer period of

time, being 2.37 mm in the male (5 to 8 years of age) and 2.89 mm in the female (5 to 8 years of age). In the male it is 1.64 mm to 13 years of age and .83 mm in the female 8 to 13 years of age. In the mandible it is 2.93 mm (5 to 8 years with no significant increase after 8 years), and 2.88 mm in the female (5 to 8 years of age with 2.3 mm increase from 8 to 13 years of age).

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