

An evaluation of the criteria used to determine arch perimeter problems

Study Group 1*

The dynamics of transition from primary to permanent dentition requires the pediatric dentist to constantly evaluate the changing dental space requirements of the growing child. Numerous criteria have been proposed to aid in this evaluation process. It was the assignment of this workshop to examine and evaluate each of these criteria.

The first criterion examined by this workshop, and perhaps the most commonly used tool by the

pediatric dentist in evaluating arch perimeter problems, was arch length analysis. This falls into two major categories: (1) the direct analysis; and (2) the regression analysis. The direct analysis utilizes radiographs and enlargement factors to obtain an accurate measurement of the developing canines and premolars. The Hixon-Oldfather and modified Hixon-Oldfather analyses have been shown to most accurately predict arch length requirements. The regression analyses are based on tooth sizes of erupted teeth (i.e., permanent incisors) and then regressed to the correlation between the mesiodistal dimensions of the canines and premolars. While these analyses are somewhat less accurate, they offer the advantage of an easy, rapid assessment of arch length

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requirements without need for radiographs. In the mixed dentition accuracy to within 3 mm seems more than adequate as borderline cases will probably be treated initially by the nonextraction method. Most participants felt these regression analyses were adequate.

The second criterion discussed was the Bolton analysis of tooth size discrepancies. Since this analysis relies on the mesiodistal dimensions of the permanent maxillary and mandibular 6 anterior teeth or all permanent incisors, canines, premolars, and first molars, it was felt to have limited value in the mixed dentition. However, the Bolton analysis should be useful for correction of discrepancies in the full permanent dentition addressed by the pediatric dentist.

Perhaps the most important diagnostic criterion was consideration of facial profile. It was felt that minor crowding, relapse, and some periodontal concerns play secondary roles to obtaining a good profile. Profile evaluation should include consideration of not only the lower face, but also future growth of the nose and chin. In addition, racial, ethnic, and familial characteristics must influence the desired treatment objectives.

Arch perimeter problems also may be compounded by early loss of over-retained primary teeth and by eruption patterns of permanent teeth. Ankylosed primary teeth may act as excellent space maintainers, but they must be monitored to prevent adverse sequelae, such as mesial tipping of first permanent molars, supra-eruption of the opposing teeth, or retarding the eruption of underlying succedaneous teeth.

The effects of various habits on arch perimeter problems have not been studied adequately to provide any definitive conclusions. Likewise, while arch forms are well related to facial types, their influence on arch perimeter is not well known. It is felt that all preformed arch wires should be individualized to prevent the unwanted arch expansion which may contribute to relapse.

Leveling the Curve of Spee may contribute to arch perimeter problems as this procedure consumes arch length. Conversely, a deepening of the curve by allowing supra-eruption of the mandibular incisors in primary canine extraction cases should be avoided through the judicious use of appliances such as lingual arch.

In summary, the pediatric dentist must consider numerous criteria in evaluating arch perimeter problems. While many of these criteria have a good scientific basis, others tend to be more empiric in nature. Consequently, the dentition of the growing child requires constant monitoring and reassessment. Treatment decisions may require modification to accommodate any changes observed.

Conclusions

1. Arch length analyses that are accurate within 3 mm are considered adequate for evaluation of arch perimeter problems in the mixed dentition.
2. Facial profile of the child is of primary importance in the management of arch perimeter problems. Consideration must be given to future nose and chin growth.
3. The effect of habits on arch perimeter problems is not well understood and requires additional study.
4. Leveling the Curve of Spee consumes arch length and thus must be considered a factor in arch perimeter management.

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The value of leeway space and its management

Study Group 2*

The term "leeway space," first used by Dr. Hays N. Nance (1947), refers to the difference between the total mesiodistal dimension of the primary canine, first and second molars, and the permanent canine, first and second premolars. This excess space can be maintained and utilized to relieve some or all of an arch length discrepancy which is initially evident with the eruption of the permanent anterior teeth during the early mixed dentition. This workshop explored the value of the leeway space, when and how to utilize it, and, most importantly, how to integrate it into a total plan for managing an arch length discrepancy.

Pediatric dentists often observe crowding in the anterior region during the early mixed dentition stage. This early crowding of the permanent dentition can cause or be associated with periodontal problems such as soft tissue dehiscences or, in more extreme examples, bony defects when crowding forces teeth off the bony base. In addition, ideal oral hygiene is more difficult to maintain and cosmetic considerations often become important as well. Management of the crowding during the early mixed dentition stage often depends on the amount of the leeway space which will become available as the primary canines and first and second primary molars are lost. Although no scientific evidence is available, many clinicians believe that early relief of this crowding facilitates the ultimate occlusal therapy and may also make the resulting occlusion more ideal and more retentive.

Management of this early crowding of the permanent dentition can involve disking the primary canines or, in the more extreme cases, extraction of the primary canines or first primary molars. This intervention encourages the permanent lateral incisors to spontaneously move distally. Extracting primary canines is often referred to as the beginning of "serial extraction." To many clinicians this term also means the eventual extraction of permanent teeth. However, extraction of primary canines does *not necessarily* lead to the extraction of permanent premolars or molars

(second); therefore, the term needs to be defined clearly or eliminated. Workshop participants considered a new definition of serial extraction: "The selective removal of primary teeth to facilitate eruption and resolve crowding of the permanent dentition, not necessarily resulting in the extraction of permanent teeth." The term "serial eruption" or "sequential space management" might better describe this early occlusal therapy than "serial extraction."

When the primary mandibular canines are extracted, placement of a mandibular lingual holding arch may be indicated. In Class II division II malocclusions, deep bites, cases with hypertonic musculature, and/or poor facial profile, the use of a lingual holding arch is recommended strongly in order to prevent lingual tipping of the incisors. This "lingual collapse" will decrease arch length, increase the overbite, and often worsen the profile. In other malocclusions associated with crowding and early extraction of mandibular primary canines, use of the lingual arch may still be elected to ensure that lingual collapse does not occur.

The lingual arch can be placed on the first permanent molars or alternatively on the second primary molars. Placing a lingual holding arch on the second primary molars has the advantage of decreasing the time the permanent teeth are banded; however, an additional lingual arch may have to be placed on the permanent molars just prior to exfoliation of the second primary molars to prevent the loss of the leeway space. One should consider both the expense of these appliances and perhaps "patient burn-out" by having additional appliance therapy. Some clinicians feel that if a lingual arch is not known to be definitely needed, it is best to leave it out and place it only if lingual collapse begins. Slight lingual collapse, it is contended, can be corrected later with occlusal therapy. However, other clinicians feel that this approach is "mismanagement of space."

Maintenance of the leeway space in the late mixed dentition by placing a lower lingual holding arch and disking the mesial surfaces of or extracting the second primary molars will allow the first premolars and permanent canines to erupt in a slightly distal direction. In most instances disking of the primary teeth is preferable to extraction.

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A major factor in the management of leeway space is the necessity of making a full orthodontic diagnosis at this early age. Many clinicians believe that one needs to project the long-range occlusal therapy. To accomplish this projection full diagnostic records need to be completed and analyzed prior to initiating treatment for this early crowding. These records should include, but not necessarily be limited to, a cephalometric analysis, soft tissue (both facial and periodontal) analysis, occlusal and space analysis. These records are necessary to analyze facial profile, degree of crowding and the necessity of its early relief, depth of the Curve of Spee, the position of the lower incisors, the probability of lingual collapse if canines are extracted, and how the leeway space can best be utilized. There is no good "cookbook" approach and only through an individual analysis can a rational, comprehensive treatment plan for early occlusal treatment be initiated. Thus, the measurement and management of the leeway space is only one facet in comprehensive occlusal therapy. Pediatric dentists should be competent in all these analyses so that they can properly manage early malocclusion with arch length discrepancies. If they are not well versed in occlusal diagnosis, close consultation with those who will ultimately manage their patients' malocclusion is recommended. In this way, early treatment will be consistent with later treatment philosophies and mechanics.

Conclusions

1. Use of the leeway space is a valued modality in managing arch length discrepancies.
2. Management of permanent incisal crowding during the early mixed dentition should be considered.
3. Sequential disking and/or extraction of primary canines and molars can help to relieve anterior

crowding by transposing the crowding to the posterior segment where leeway space is available.

4. Placement of a lower lingual holding arch can help to maintain leeway space and, in certain occlusions, prevent lingual tipping of the mandibular incisors after early extraction of primary mandibular canines.
5. A thorough dental and facial analysis should be considered prior to early intervention of arch length discrepancies.

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The effects of eruption guidance and serial extraction on arch development

Study Group 3*

Effectively assisting arch development through selectively disking or extracting primary teeth is controversial. Proper treatment planning must be based upon a complete understanding of dental arch growth and development. In addition, early treatment must be based on a thorough diagnosis of the developing malocclusion. This can be done only by obtaining complete and appropriate records. Pediatric dentists must therefore be familiar with the classic articles on growth and development of the orofacial and craniofacial complex.

One of the most common and challenging occlusal problems occurs at approximately age 6 to 7 with the exchange of the primary and permanent incisors. Due to incisor liability and tooth size to arch length discrepancies, it is not uncommon to find crowding in the incisal area. An unresolved dilemma is how much crowding is acceptable and/or appropriate. Clinical experience and thorough evaluation can help determine the proper diagnosis and, thus, a rational treatment approach. No standardization of record taking exists at this time and the implications of this for treatment options are not clear. Classic treatment has included passive supervision, primary tooth disking or extractions, and placement of space maintainers to hold incisal position and maintain arch length.

Passive supervision is not always the most conservative treatment. Untreated occlusal disharmonies can lead to periodontal problems, cosmetic problems, and trauma to malposed teeth. These problems or others may necessitate correction by active intervention.

Disking (reproximation) of the mesial or distal surfaces of the primary canines can relieve mild to moderate crowding of permanent incisors. The alignment of the incisors will improve spontaneously by drifting distally into the canine spaces. There is a limit to the amount of space that can be gained from disk-

ing and extractions may be necessary to relieve severe crowding.

Severe crowding in the anterior incisor region must be addressed during the mixed dentition. Midline discrepancies, deep overbites, inadequate oral hygiene, and periodontal problems are definitive indications for interceptive treatment. In these situations, one must consider extraction of the primary canines at the appropriate dental age.

According to Moorrees (1965), eruption of the lateral incisors results in some increase in intercanine width. There is some controversy, however, as to whether this lateral expansion of growth in the canine area is diminished when one prematurely extracts primary canines to decrease crowding. In addition, bone tends to atrophy at the extraction site which may also decrease arch length. This possible loss of bony growth has prevented many clinicians from recommending extraction of primary canines, which may, in addition, lead to the extraction of permanent teeth, i.e., "serial extraction." Extraction of the primary canines usually will lead to extraction of additional primary teeth, but does *not necessarily* lead to extraction of permanent teeth if one manages the remaining space properly. A lingual holding arch is indicated when a decrease in arch length is likely. Until further studies document other alternatives, it is better to be safe and place a space maintainer when primary canines are extracted.

In summary, there are multiple methods for guiding the erupting dentition. Further studies are needed to evaluate the effect of guiding the erupting dentition, not only the effect on the final treatment, but also on arch development and the entire craniofacial complex. These studies should address guiding the erupting teeth, relating the dynamic forces of function to retention, and the esthetic development of the face.

Conclusions

1. Pediatric dentists must be familiar with the growth and development of the orofacial and craniofacial complex.
2. Complete and appropriate records must be taken

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- to diagnose and treatment plan developing malocclusion.
3. Eruption guidance in a developing arch length discrepancy can consist of passive supervision, diskling or extraction of primary teeth, and placement of space maintainers.
 4. Early treatment of permanent incisal crowding often is indicated to minimize the detrimental effects of this crowding.
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The effects of eruption guidance and serial extraction on facial development

Study Group 4*

The possibility of the clinician influencing facial development through various treatment modalities has been suggested by several studies. Rapid palatal expansion, headgear therapy, and functional appliances may all directly affect facial development. However, the effects of eruption guidance and serial extraction on facial development remains to be explored.

The area of the face below the forehead may be subdivided into 3 regions: an upper region which is dominated by the nose; a middle region which is composed of the maxilla, maxillary and mandibular dentitions and their supporting alveolus; and a lower region composed of the mandible which is dominated by the chin. The overlying soft tissue drape is determined by the underlying bony contours and the position of the anterior teeth. A pleasing facial profile results from a harmonious relationship between these tissues.

Facial development in the upper and lower regions would seem to occur independently of orthodontic (nonorthopedic) therapy. However, orthodontic treatment may positively or negatively influence the final facial profile. An excellent example of such a treatment modality is serial extraction. Classically, the indications for serial extraction include: (1) severe crowding often manifested by ectopic eruption of the permanent lateral incisors, and (2) mesial positioning of the permanent second molars thus limiting arch perimeter gain through distalization. In addition, several skeletal criteria also should be considered in contemplating serial extraction. For example, individuals with a flat mandibular plane and short anterior facial height often have profiles which may suffer from serial extraction, as the extraction spaces may be rather difficult to close. Retrusive lip positions and a prominent nose and chin may contraindicate serial extraction since permanent tooth removal may have deleterious effects on the profile.

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Serial extraction, as defined by this workshop, implies that sequential extraction of selected primary teeth ultimately leads to the extraction of permanent teeth in the transitional dentition. Consequently, the decision to remove permanent teeth via serial extraction can be made anywhere from 1 to several years prior to the adolescent growth spurt. Obviously, the further the patient is from this growth spurt the more the clinician depends on his or her ability to predict growth of the upper and lower face so that an acceptable profile can be achieved. Serial extraction in an individual who later shows considerable chin and nose development can have disastrous effects on facial esthetics.

Several analyses have been proposed to aid the clinician in predicting facial growth. Even the most sophisticated of these analyses is based on pooled data, applying mean growth rates, mean directions of growth, and mean treatment effects on facial growth to an individual patient. The clinician must be cautious in utilizing these data, as an individual patient may lie well outside these means.

In summary, treatment should be governed by a continual evaluation process that involves obtaining a good data base, with serial records and careful monitoring. Serial extraction should be limited to those individuals in which a predicted result is highly likely; otherwise the choice of delaying extraction of permanent teeth through guidance of eruption is preferred.

Conclusions

1. A good data base and serial records are essential to good treatment planning in serial extraction.
2. Factors such as sex, mandibular plane, soft tissue drape, and position and eruption pattern of the permanent teeth all play an important role in developing an appropriate treatment plan.
3. Growth prediction analyses must be used with caution, as these analyses are developed from pooled data and may not apply to a specific patient.
4. Serial extraction should not be instituted unless a predictable result of its effects on facial profile can be made.

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