SPECIAL report

The effects of eruption guidance and serial extraction on the developing dentition

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Clinical practice is a balance of our collective experience and intuitive clinical experimentation, an evolving process which shapes our philosophy of treatment. Modifications of our methods and techniques can and should result from the range of treatment success and failure experienced, providing we are willing to examine our results and are willing to learn from these treatment experiences.

For more than 30 years the faculty and graduate students in the Department of Orthodontics at the University of Washington diligently collected diagnostic records of more than 500 patients who a decade or more prior had completed orthodontic treatment. Evaluation of satisfactory and unsatisfactory treatment has tested our theories, personal biases, and clinical convictions. The purpose of this article is to summarize the results of research on arch length problems and to discuss clinical implications.

Inadequate Arch Length

Late Premolar Extraction

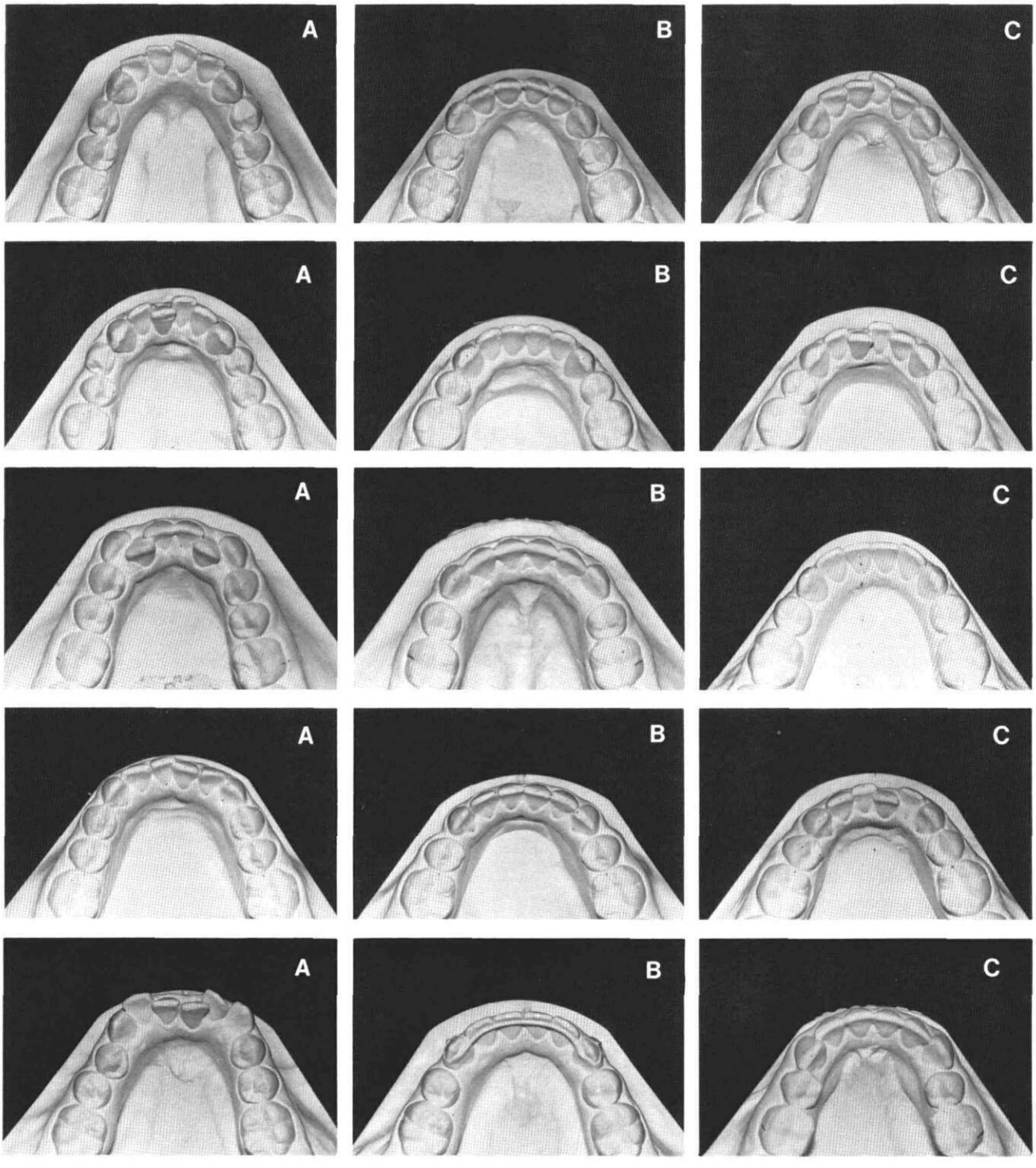
Methods and Materials. Patients were treated with standard edgewise orthodontic appliances following first premolar extraction in the permanent dentition (N = 65). Retention followed for an average 2-year period. Records were obtained pretreatment, at the end of active treatment, and a minimum of 10 years following removal of retainers (Little et al. 1981; Shields et al. 1985).

Results.

1. Long-term alignment was variable and unpredictable.
2. No descriptive characteristics such as Angle class, length of retention, age at the initiation of treatment, or gender, and no measured variable such as initial or end of active treatment alignment, overbite, overjet, arch width, or arch length, were of value in predicting the long-term result.
3. Arch width and length typically decreased following retention and crowding increased. This occurred in spite of treatment maintenance of initial intercanine width, treatment expansion, or constriction.
4. Success at maintaining satisfactory mandibular anterior alignment was less than 30% with nearly 20% showing marked crowding many years after removal of retainers.
5. Cephalometric data before and at the end of active treatment were of little value in predicting future success or failure.
6. Combinations of pre- and posttreatment cephalometric parameters such as incisor position and facial growth, were poor predictors of long-term mandibular arch irregularity.
7. Postretention changes of cephalometric parameters failed to explain postretention crowding.
8. In general, there were few associations of value between cephalometric parameters and dental cast measurements.
9. The process of arch length and arch width reduction with concomitant crowding continued well into the 20–30 year span and apparently beyond, but the rate of these changes seemed to diminish.

Serial Premolar Extraction

Methods and Materials. First premolars were extracted in the mixed dentition followed by a stage of physiologic drift. Standard edgewise orthodontic appliance treatment plus retention was accomplished as with the previous sample. Records were obtained pretreatment, at the end of active treatment, and a minimum of 10 years following removal of retainers (N = 30).



FIGS 1–5. Cases treated by first premolar extraction and edgewise orthodontics plus retention: A. pretreatment, B. end of active treatment, C. postretention.

Results.

1. Crowding typically improved following extraction during the observation stage prior to active treatment.
2. Long-term alignment was variable and unpredictable.
3. Serial extraction cases were no better than late extraction cases at the postretention stage.
4. No descriptive or measured variables were of value in predicting the long-term result.
5. Arch width and length typically decreased after retention while crowding increased.
6. Success at maintaining satisfactory alignment was less than 30%, a result very similar to the late extraction cases.
7. Cephalometric measurements pre- and posttreatment, the facial growth amount and direction during treatment, and superimposition data were of no value in predicting the long-term result.

Nonextraction Treatment – Mixed Dentition Arch Length Increase

Methods and Materials. Patients in which the mandibular arch length was enlarged in the mixed dentition by various means (active lingual arch, edgewise banded therapy, lip bumper, etc.) were observed into adult years (N = 25). Records were obtained preexpansion, at the end of active treatment, and at a minimum of 10 years postretention.

Results.

1. Anteroposterior and/or transverse expansion typically returned to pretreatment dimensions. Most patients (21 of 25) showed an arch length and arch width measurement less than the pretreatment value at the postretention stage.
2. Very few expanded arches had acceptable long-term alignment. In fact, this sample showed greater relapse than all other samples examined.

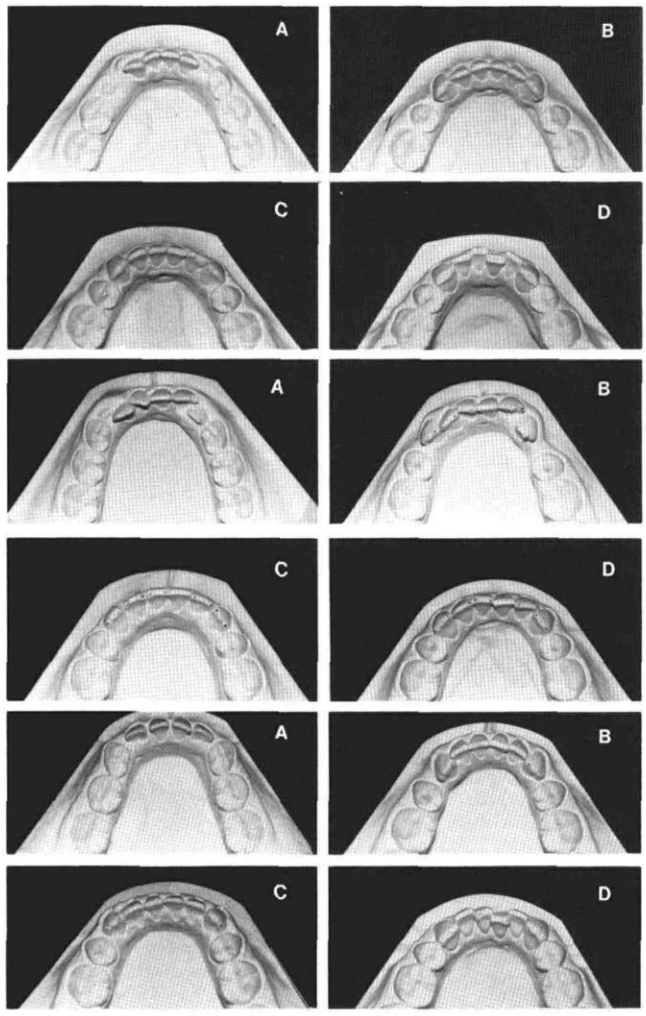
Excess Arch Length

Nonextraction Treatment – Generalized Spacing

Methods and Materials. Patients with generalized arch spacing were treated with standard edgewise orthodontic appliances plus retention (N = 30). Records were obtained as described previously.

Results.

1. Long-term alignment was typically quite good. A few patients showed mild crowding and a very small per cent demonstrated varying degrees of unsatisfactory anterior malalignment.

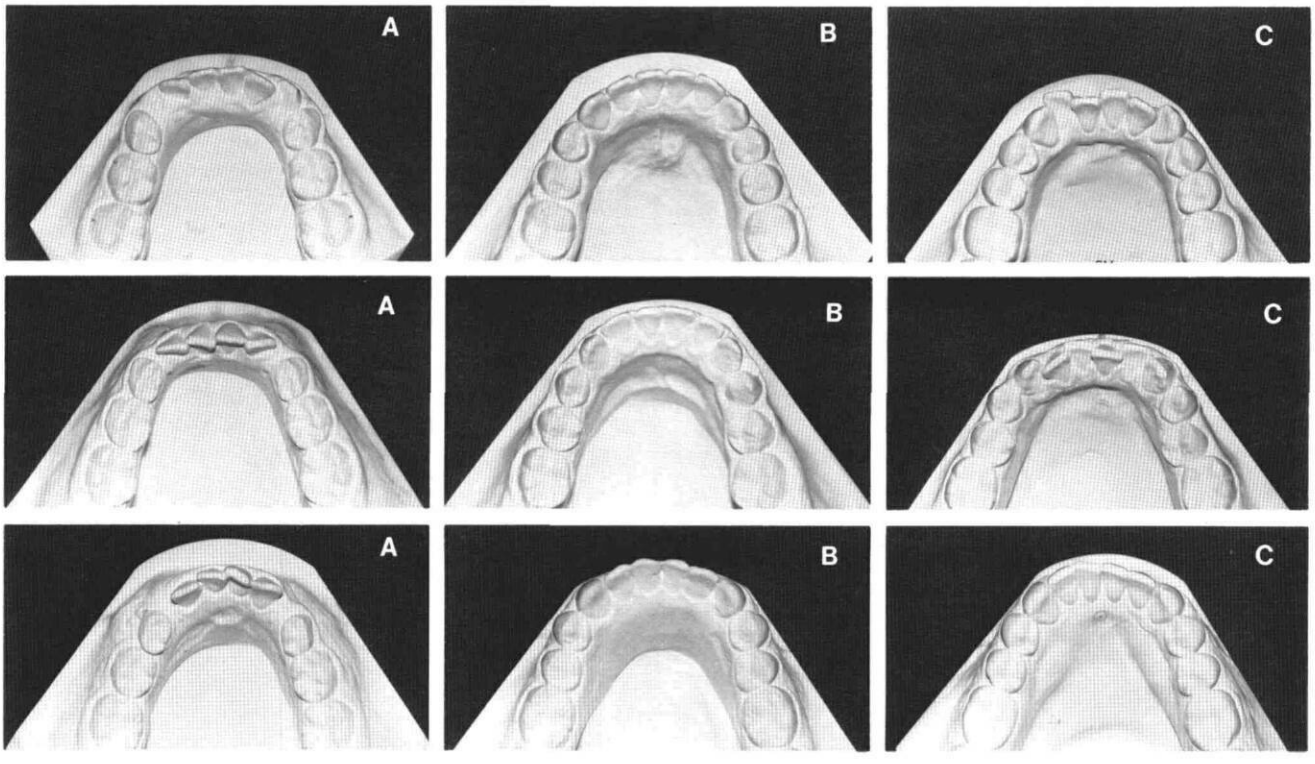


FIGS 6–8. Cases treated by first bicuspid serial extraction followed by edgewise orthodontics and retention: A. preextraction, B. after physiologic drift, C. end of active treatment, D. postretention.

2. Mandibular arch spacing remaining at the conclusion of active treatment typically closed in later years although there were some exceptions. Maxillary spacing was more variable long-term, with the midline diastema the most common area of space recurrence.
3. Arch width and length typically decreased after retention.

Nontreated Normals

Methods and Materials. Untreated "normals", that is, Angle Class I individuals with clinically "good" occlusion, were observed from the mixed dentition into early adulthood (N = 65). Orthodontic casts and



FIGS 9–11. Cases treated by non-extraction expansion in the mixed dentition: A. pretreatment, B. end of active treatment, C. postretention.

cephalometric headfilms were evaluated in the mixed dentition, early permanent dentition, and early adulthood (Sinclair and Little 1983, 1985).

Results.

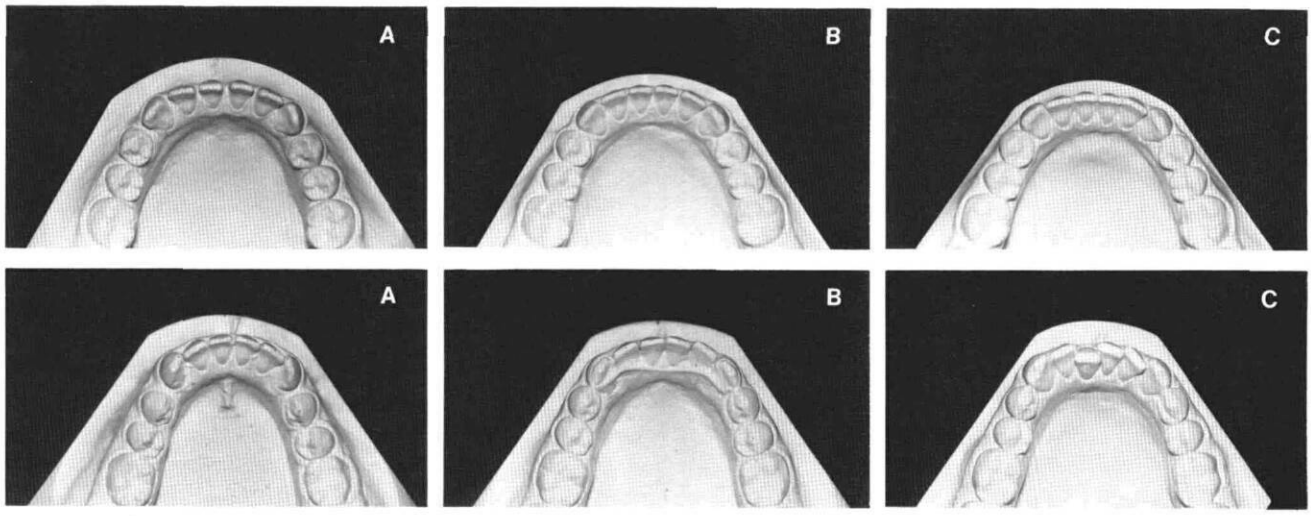
1. There was a consistent trend toward a decrease in arch length from the mixed dentition into early adulthood.
2. There were small decreases in intercanine width, the most significant change occurring in females from age 13 to 20.
3. Intermolar width, in general, remained very stable with some degree of sexual dimorphism present. Males showed insignificant increases while the females showed a small but significant decrease from age 12 to 20.
4. Overjet and overbite typically increased from 9 to 13 years, then decreased from 13 to 20 years, resulting in minimal overall changes.
5. Incisor irregularity increased from age 13 to 20, females exhibiting more incisor irregularity than males at the adult stage.
6. Changes in individual dental variables could not be correlated to other measured parameters. No associations or predictors of clinical value were found.
7. No correlation or predictors of clinical value were found between the cephalometric parameters evaluated and dental cast parameters.

Clinical Implications

Premolar Extraction

Removal of premolars to permit alignment of teeth has been a standard procedure for decades and continues as the most common treatment utilized in patients with crowded arches. In spite of achieving suggested and accepted cephalometric norms, and in spite of adhering to usual clinical standards or arch form, overbite, etc., the long-term maintenance of acceptable results is disappointing, with only 30% of the patients demonstrating acceptable long-term results.

Arch length and width typically reduce with age and long-term records show the trend continuing at least into the 30s and 40s age bracket. Narrowing of incisors or supracrestal fiberotomies as treatment measures do not seem to yield improved results (Gil-



FIGS 12–13. Generalized spacing cases treated non-extraction: A. pretreatment, B. end of active treatment, C. postretention.

more and Little 1984). Long-term periodic retention or permanent retention seem to be the only preventive measures giving consistent, acceptable results.

Serial Extraction

Although crowding is usually reduced during the mixed and early permanent dentition stages following serial extraction, long-term evaluation shows results no better than extracting after the premolars have fully erupted. Serial extraction still makes clinical sense to reduce the severity of the crowding pattern, to speed the follow-up orthodontic treatment, and to prevent erupting teeth from being blocked out of the band of attached gingiva.

Again, long-term periodic retention or permanent retention seem to be the options that would ensure future success at maintaining the corrected result.

Generalized Spacing

The most ideal long-term results were in this category but unpredictable degrees of crowding occasionally occurred. Continuing observation of these patients beyond the typical retention stage is indicated, just as continuing recall and observation is warranted and prudent in all other types of malocclusion.

Expansion

Anterior-posterior and/or lateral increase in mandibular arches usually fails; the dental arch typically returns to the pretreatment size and shape. Most arches eventually reduced to a dimension less than the pretreatment size. Permanent or long-term retention seems mandatory for arches treated by this regimen.

Guidance of eruption in the mixed dentition by judicious narrowing of primary teeth, use of space maintenance devices, and primary extractions when needed can often result in a conservative treatment plan avoiding premolar extraction. The issue relates to preserving arch length as opposed to expansion or "development" of the arches. Research indicates that treatment enlargement of the overall arch dimension typically relapses with crowding the result. Preservation of arch dimension seems to be more appropriate and puts the patient less "at risk" than increasing the arch dimension. Passive mandibular lingual arches, Nance-type maxillary lingual arches, and fixed orthodontic appliances utilized in the mixed dentition can often alter the course of a potentially crowded arch and should be advocated when facial/skeletal features dictate a "nonextraction" approach in the permanent dentition.

Summary

Over time, decreasing mandibular dental arch dimensions in both treated and untreated malocclusions appears to be a normal physiologic phenomenon. The degree of arch length reduction, constriction, and resultant crowding is quite variable and unpredictable; however, several clinical guidelines are suggested:

1. Treat to ideal standards of perfection obtaining the best possible occlusion, oral health, and function.
2. Avoid expansion of the lower arch unless mandated by facial profile concerns or to harmonize the occlusion with maxillary palatal expansion accomplished for crossbite correction or unusual narrowness.
3. Use the patient's pretreatment arch form as a guide to arch shape.
4. Retain the arch form long-term and continue to monitor patient response into and through adult life.
5. Obtain the highest quality pre- and posttreatment records and continue to utilize them to assess patient progress.

Gilmore C, Little RM: Mandibular incisor dimensions and crowding. Am J Orthod 86:493-502, 1984.

Little RM, Wallen T, Riedel R: Stability and relapse of mandibular anterior alignment. First premolar extraction cases treated by traditional edgewise orthodontics. Am J Orthod 80:349-65, 1981.

Little R, Riedel R, Artun J: An evaluation of changes in dentitions during a ten to twenty year postretention period. Am J Orthod, in press.

Little R, Riedel R, Engst D: Stability and relapse of mandibular anterior alignment. Serial extraction cases treated by traditional edgewise orthodontics. Am J Orthod, in press.

Little R, Riedel R, Stein A: Increasing mandibular arch length in the mixed dentition. A postretention investigation. Am J Orthod, in press.

Little R, Riedel R: Mandibular arch spacing—a postretention study of stability and relapse. Am J Orthod, in press.

Shields T, Little RM, Chapko M: Stability and relapse of mandibular anterior alignment: a cephalometric appraisal of first-premolar-extraction cases treated by traditional edgewise orthodontics. Am J Orthod 87:27-38, 1985.

Sinclair P, Little RM: Maturation of untreated normal occlusions. Am J Orthod 83:114-23, 1983.