The Question of Extractions in Orthodontia

By Murray C Meikle

Biological Foundations of Orthodontics and Dentofacial Orthopaedics

Seminar 15

2013

NUS National University of Singapore

UNIVERSITY of OTAGO

SAPERE AUDE

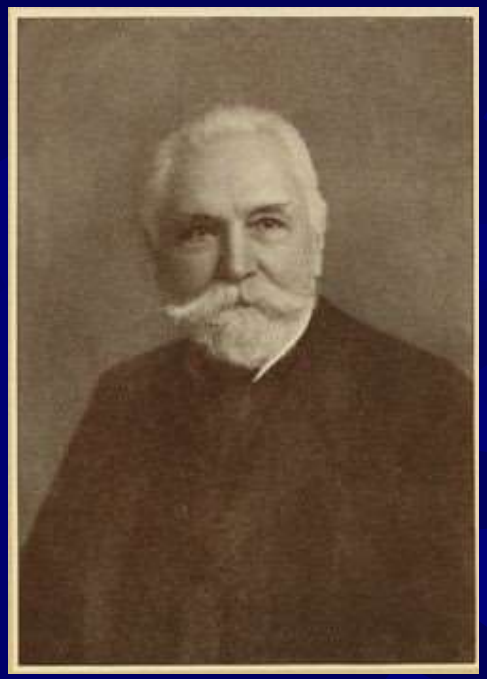
Te Whare Wānanga o Otāgo

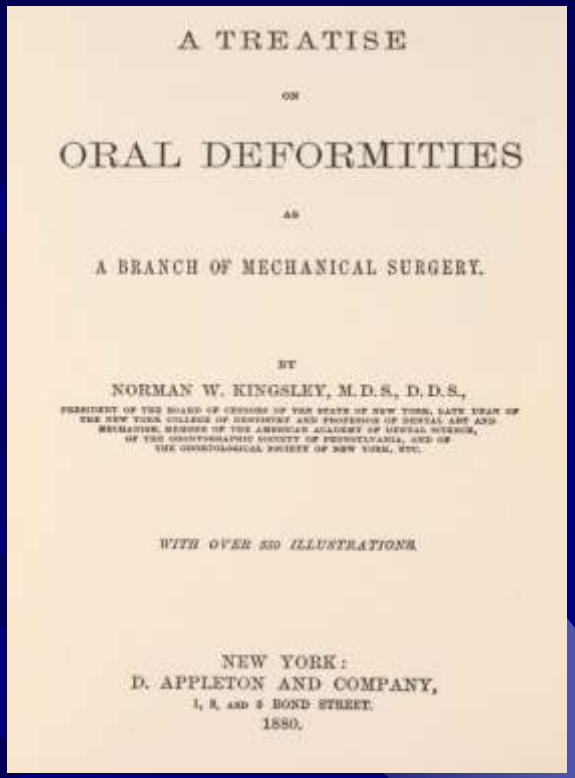
Orthodontia or orthdontics

- The title of this seminar is taken from Calvin Case's presentation at the "Extraction Debate" of 1911, of which more later, orthodontia being the chosen name of the specialty at the time, where much as today the centre of orthodontic theory and practice was the USA.
- However, Sir James Murray, lexicographer and foundation editor of the Oxford English Dictionary, on visiting his dentist and seeing the word orthodontia in a journal (interesting waiting room literature), pointed out the linguistic solecism of having a word constructed from two Greek words with a Latin suffix, and suggested that an ending in C would be more appropriate.
- Arguably the most important diagnostic decision one has to make in an orthodontic treatment plan is whether or not to extract teeth. It has been a controversial topic since the emergence of orthodontics as a specialty. If you have to defend extractions to your patients and/or the press, it is essential to be aware of the historical background and the arguments both for and against.

Norman W Kingsley

Norman William Kingsley
MDS, DDS (1829–1913)
circa 1900.





A TREATISE

ON

ORAL DEFORMITIES

AS

A BRANCH OF MECHANICAL SURGERY.

BY

NORMAN W. KINGSLEY, M.D.S., D.D.S.,

WITH OVER 350 ILLUSTRATIONS.

NEW YORK:
D. APPLETON AND COMPANY,
1, 3, AND 5 BOND STREET.
1880.

- In the first modern textbook of orthodontics by Norman Kingsley, the pros and cons of extractions are discussed at some length.
- “It requires a profounder knowledge than most of us possess to decide always upon the wisdom of extraction, and when such a conviction is settled the judgement may be equally at a loss to the choice of teeth to be removed… There are so many considerations to be taken into account that it is hardly possible to lay down any rule of universal application” (pp. 43).
- It would be difficult to summarise the dilemma facing the clinician better.

Edward H Angle and the ‘New School’

Edward Hartley Angle DDS, MD, DSc (1855–1930), age 43 years, 1898, St Louis, Missouri.

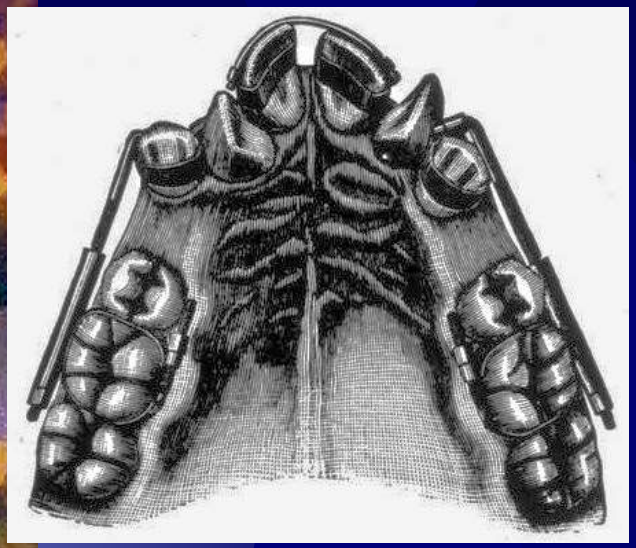
- Reasoned debate regarding the extraction of teeth was suppressed with emergence of Edward Angle as the dominant figure in orthodontics.
- Angle believed that … “It is that the best balance, the best harmony, the best proportions of the mouth in its relations to the other features require that there shall be *the full complement of teeth, and that each tooth shall be made to occupy its normal position – normal occlusion*.” (pp.63; the italics are Angle’s).
- He also went on to say … “It is gratifying to note that this fallacious teaching and pernicious practice are rapidly passing and will doubtless soon become mere matters of history.”
- Angle EH (1907). *Treatment of Malocclusion of the Teeth*. *Angle’s System*. 7th edition, The SS White Dental Manufacturing Company, Philadelphia, Pennsylvania.

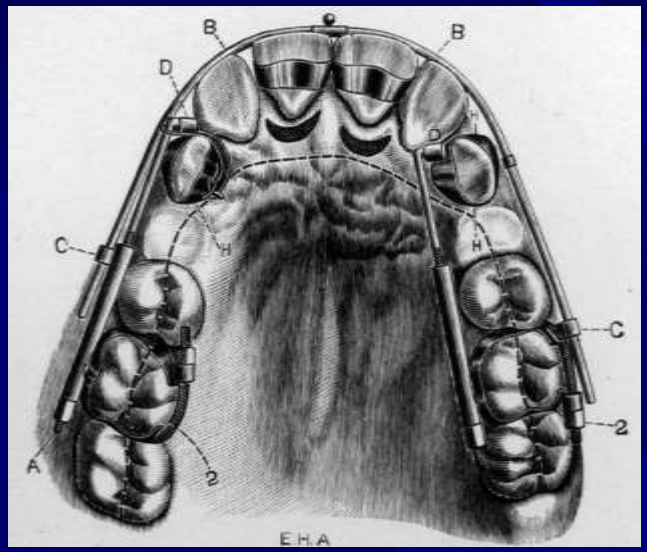
Old Glory – *Secretum apertum*

From Angle EH (1907). *Treatment of Malocclusion of the Teeth*. *Angle's System*. Seventh edition, The SS White Dental Manufacturing Company, Philadelphia, Pennsylvania.

- To represent the ideal of normal occlusion which should be the aim of treatment, Angle used a Native American skull with a perfect set of teeth known as Old Glory (labelled *Secretum Apertum* – the secret revealed) that had been discovered in Illinois. The skull was owned by Dr Richard Summa.
- Interestingly, the skulls used to illustrate normal occlusion in the textbooks of the day usually showed the morphological characteristics of bimaxillary protrusion. They were unlikely to be representative of the ethnic background of the majority of the patients of European origin undergoing orthodontic treatment at the time.

Why non-extraction?

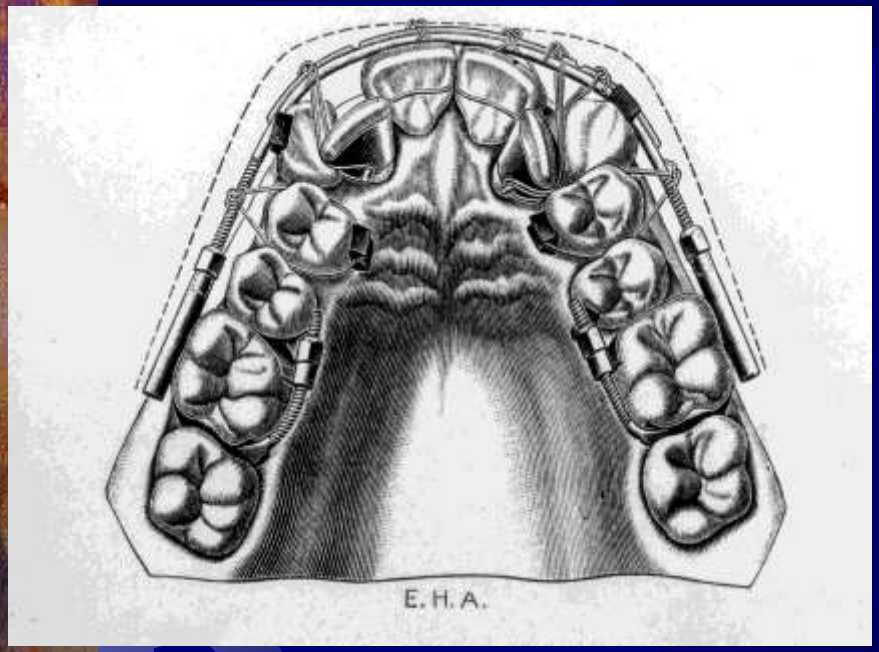


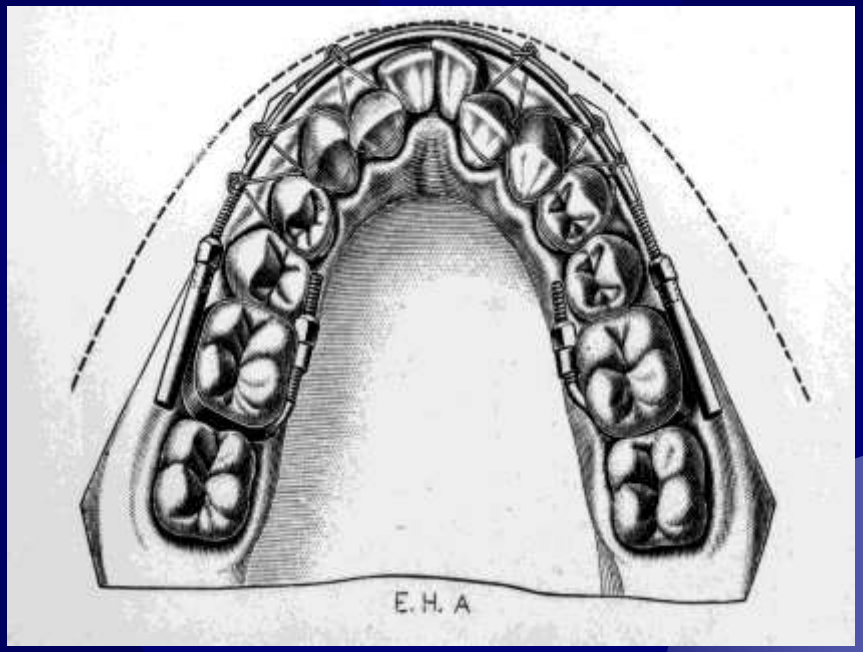


These illustrations are Figs. 632 and 650 respectively from Angle (1907).

- Although all the case histories in Angle's seventh edition of 1907 involved non-extraction treatment, the appendix contains several engravings from previous editions illustrating appliances used to treat cases in which premolars had been extracted.
- One can speculate why Angle abandoned extractions, but looking at the appliances available at the time it is not hard to guess. Closing extraction spaces with the crude regulating appliances available must have been technically difficult if not impossible. Such appliances could only tip teeth; uprighting and/or torque were not possible. It was easier to just round out the arches.

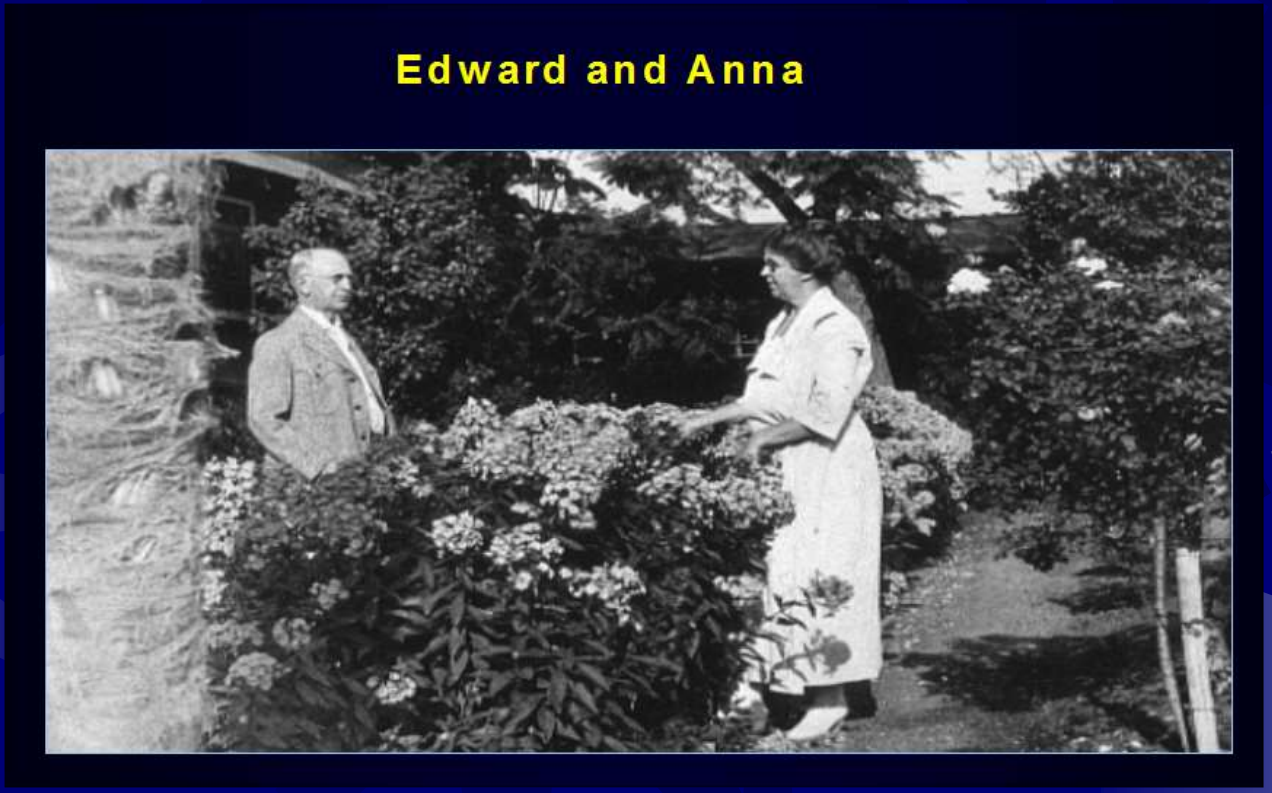
Non-extraction appliances





- Appliances designed to correct crowding in a non-extraction case. Expansion was provided by the ribbed expansion arch (so-called E arch) held in position by clamp bands on the first molars. Notches were cut in the arches to prevent slipping of the ligature wires used to apply traction to the displaced teeth.
- From Angle (1907). *Treatment of Malocclusion of the Teeth*.

Angle's angst



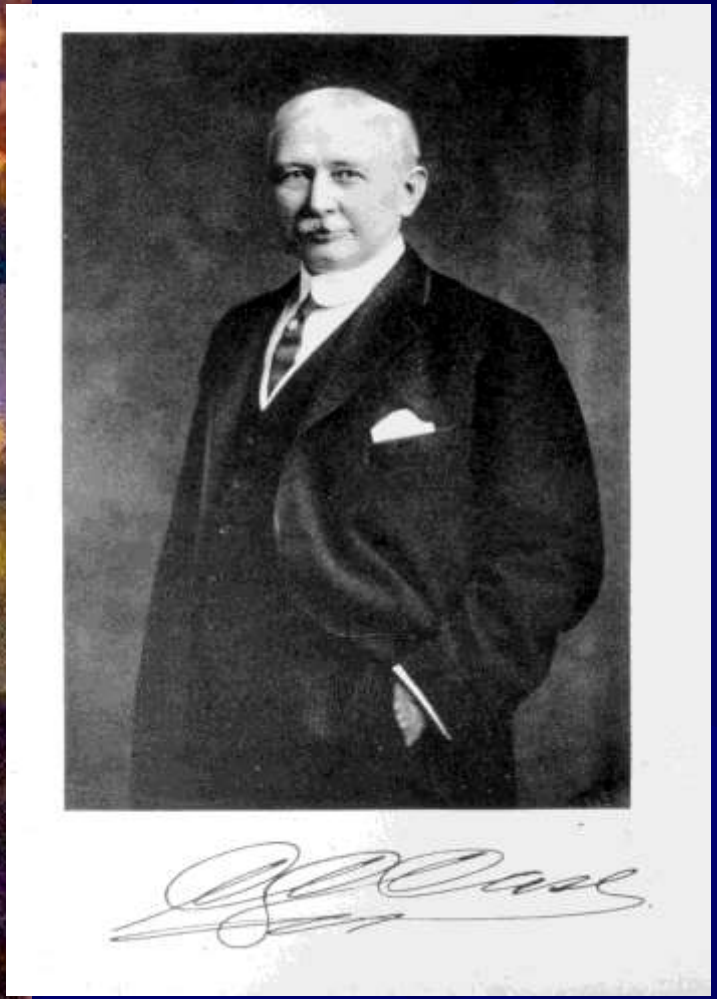
- Angle also had a personal reason for denouncing extractions. He had apparently removed two upper first premolars from his wife Anna in 1905, and couldn't keep the spaces closed! According to Curtis (2000) he felt he had ruined both her smile and facial profile.

- Curtis EK (2000). *Orthodontics at 2000*. American Association of Orthodontists, St. Louis, Missouri.

Basis of the ‘full complement’ theory

- During the early decades of the 20th century most orthodontic therapy continued to be based on the nonextraction philosophy of Angle. Many of Angle’s students became teachers in dental schools and leading members of the profession; as a consequence the doctrine of the full complement of teeth was widely taught.
- The Angle School ridiculed claims that heredity was one of the causes of malocclusion. They considered malocclusion to be the consequence of inadequate bone growth which could be stimulated by the alignment of the teeth – a rather liberal interpretation of Wolff’s law.
- The ‘scientific’ rationale for nonextraction was the research of Oppenheim and the Law of Bone Transformation discussed earlier in which bone was formed on both the labial and lingual alveolar bone of a tipped tooth (Seminar 13). Furthermore, the stimulating effects of orthodontic tooth movement and the establishment of normal occlusion if started young enough would cause the jaws to grow. In other words, malocclusion could be treated without extracting teeth by growing bone.

Calvin Case and the ‘Rational School’



Frontispiece from Case C S (1921). *A Practical Treatise on the Technics and Principles of Dental Orthopedia and Prosthetic Correction of Cleft Palate*.

- Some of Angle’s contemporaries, however, maintained that this concept was a fiction and unrealistic in practice.
- Calvin Suveril Case DDS, MD (1847–1923) representing the ‘Rational School’ was another influential figure of the time and the leading critic of Angle’s rigid proclamation that no teeth should ever be extracted. He adopted a more reasoned view and concluded from the statistics of his own practice … “there was only about one case in twelve to fifteen in which the question of extraction should ever arise.”
- Since these powerful personalities had their disciples, it is not hard to understand why the topic of extraction was the subject of acrimonious debate at orthodontic society meetings.

Extraction debate of 1911

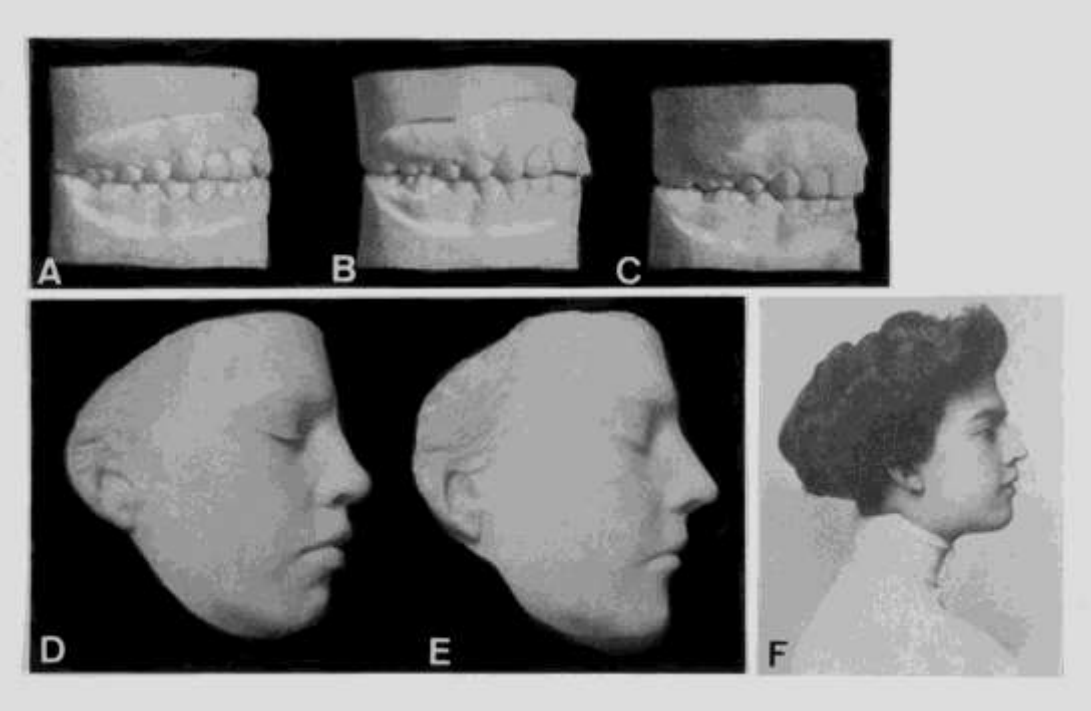
- Martin Dewey who at the time was Professor of Dental Anatomy and Orthodontics at Kansas City Dental College and a clinical instructor on the Angle course, with Angle's encouragement challenged Case to defend his position on extractions. Case's response entitled 'The question of extraction in orthodontia,' together with the subsequent discussion, became known as the extraction debate of 1911.

- Originally published in the *Journal of the National Dental Association* of that year, Case's article and the lively discussion that followed was reprinted serially in the *American Journal of Orthodontics* in 1964.

Case's philosophy

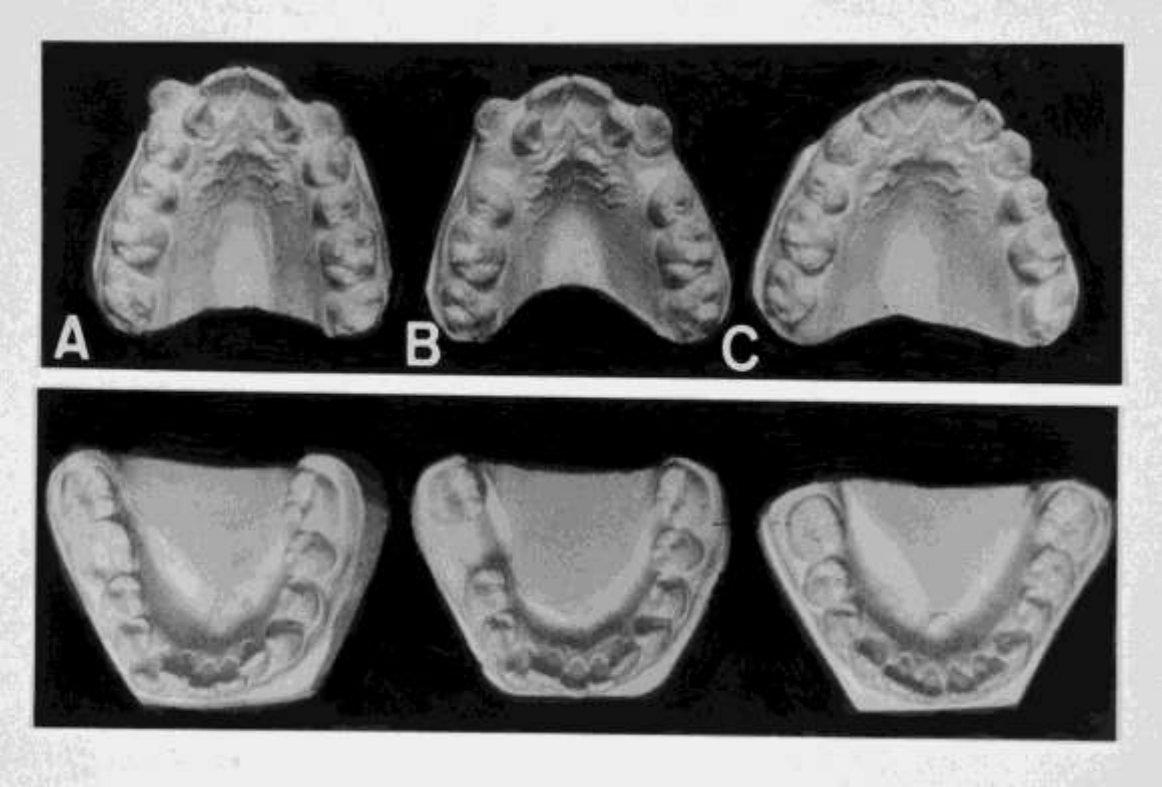
- To Case the question of extraction was intimately bound up with the question of causation. Is malocclusion, for example, due to local causes operating after birth as maintained by the 'New School,' or does it arise, at least in part, from the laws of heredity and other laws that govern the development of plants and animals? Case was a confirmed Darwinian.
- "There is no doubt in the minds of advanced anthropologists that the form, structure, and relation of the bones of the human skull, like those of other bones of the body, were evolved from a being very much lower in the animal scale, through the unwavering laws of heredity, variation, natural selection and influences of environment." (Case, 1911; pp. 682).
- As far as Case was concerned the main indication for extraction was to harmonize facial relations, particularly in cases of bimaxillary protrusion (Slide 13), or where the upper canines had been impacted in cases with a Class II buccal segment relationship (Slide 14).

Treatment of bimaxillary protrusion



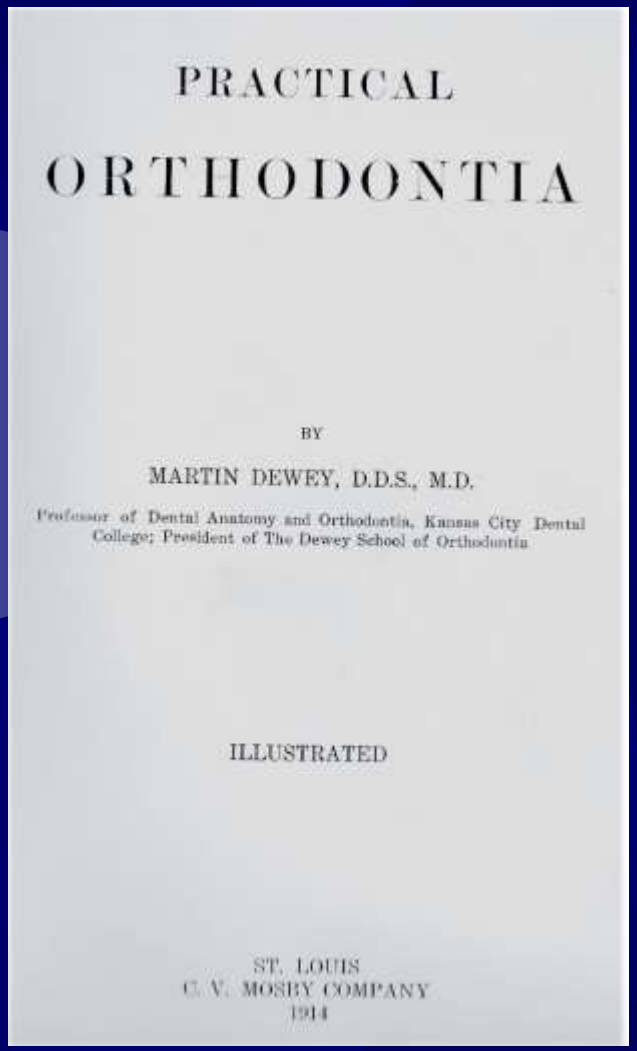
- Records of a patient aged 14 initially treated non-extraction and the teeth placed in normal occlusion. (A) Before treatment. (B) After treatment. (C) After extraction of four first premolars to facilitate correction of the bimaxillary protrusion. (D) Facial cast prior to extraction treatment. (E) Facial cast, and (F) a profile photograph following extraction treatment.
- From Case (1921). *Dental Orthopedia*.

Upper first premolar extractions



- (A) Study models of a patient aged 12 with severe crowding in the upper arch and a heavily decayed lower right first molar treated by Dr Case. (B) Two upper first premolars and the first molar were extracted. (C) The canines were moved distally and intermaxillary elastics used to move the molars mesially.
- From Case (1921). *Dental Orthopedia*.

Martin Dewey's view



PRACTICAL

ORTHODONTIA

BY

MARTIN DEWEY, D.D.S., M.D.

Professor of Dental Anatomy and Orthodontia, Kansas City Dental College; President of The Dewey School of Orthodontia

ILLUSTRATED

ST. LOUIS
C. V. MOSBY COMPANY
1914

- Dewey firmly believed that malocclusion of the teeth was the cause of malformation of the jaws, not the result; the aim therefore was to restore normal occlusion and function and normal growth would follow.
- In *Practical Orthodontia* (1914), he divided the aetiology of malocclusion into general or constitutional causes (diseases such as scarlet fever, measles, rickets, tuberculosis) and local causes (cleft lip and palate, missing teeth, habits and mouth-breathing).

Martin Dewey DDS, MD (1881–1933)

- Dewey dismissed inheritance as an aetiological factor, and believed the occurrence of malocclusion in parents and siblings was because each had experienced exactly the same environment. So-called family traits therefore were … “not the result of transmission of the malocclusion, but the result of acquired conditions which are the same in each individual.”

- With the benefit of hindsight we shouldn’t judge him too harshly; opposition to Darwin’s theory of natural selection to explain evolutionary change was widespread. Lamarckian concepts of the direct action of the environment on organisms to produce inherited changes in structure (the inheritance of acquired characteristics) continued to exist well into the 20th century.

Post-treatment relapse

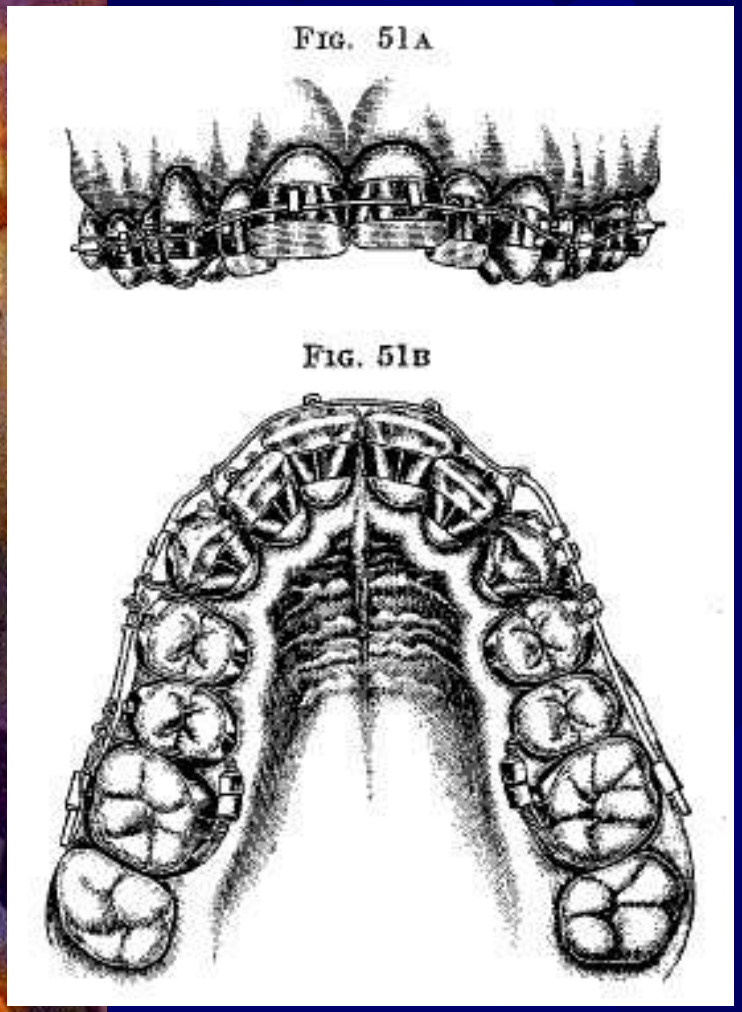
- While few experienced orthodontists did not at some stage resort to the extraction of teeth, not many were prepared to acknowledge the fact publicly – at least not amongst their colleagues. One of the first to comment that the results of orthodontic treatment were frequently disappointing was the Swedish orthodontist Axel Lundström. (Following the discussion of a paper he had presented in the USA, Lundström was complimented by a member of the audience for his courage in exhibiting his failures.)
- In a classic paper read before the British Society for the Study of Orthodontics (BSSO) in 1927, extensively illustrated with treated cases several years out of retention, Lundström challenged many of the prevailing dogmas of the time, including the universality of nonextraction treatment, irrespective of the type of malocclusion (Lundström, 1928a,b). He concluded from the clinical evidence that the effects of orthodontic treatment were confined to tooth movement, thereby pre-dating the findings of the first cephalometric study of orthodontic treatment by Brodie *et al.* (1938) by some ten years.

- Lundström AF (1928a). The responsibility of the operator for relapses after orthodontic treatment executed in full accord with the directions of leading authorities. *The Dental Record* **48**, 315–330.
- Lundström AF (1928b). A few case reports. *The Dental Record* **48**, 331–342.

Axel Lundström and the apical base

- Lundström regarded malocclusion of the teeth as a problem associated with the apical base and stressed the importance of distinguishing the apical base or basal bone from the alveolar bone (Lundström, 1923).
- The size and form of the apical base is independent of the position of the teeth and in the horizontal plane the interface between basal and alveolar bone will coincide with the location of the root apices. Lundström believed the incorporation of bodily moving appliances into the Angle system to bring about the development of bone about the root apices was biologically unsound.
- Malocclusions caused by dentoalveolar disproportion could be corrected by orthodontic methods, but disturbed development of the apical base (a skeletal discrepancy) required an orthopaedic or surgical approach.
- Lundström A F (1923). *Malocclusion of the Teeth Regarded as a Problem in Connection with the Apical Base.* Doctoral dissertation, Karolinska Institute, Stockholm, Sweden. Reprinted (1925), *The International Journal of Orthodontia, Oral Surgery and Radiography* **11**, 591–602; 724–731; 793–812; 933–941; 1022–1042; 1109–1133.

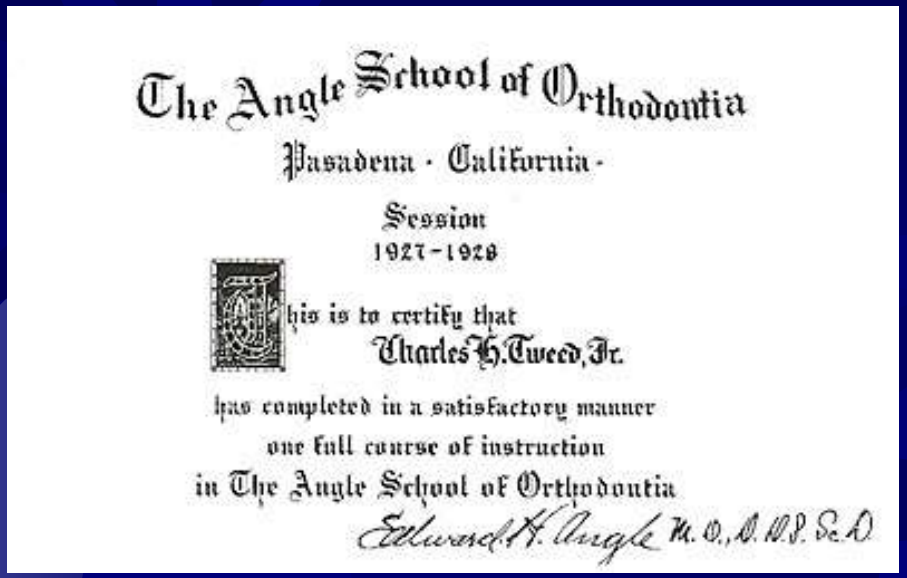
The evolution of fixed appliances



From Angle EH (1929). The latest and best in orthodontic mechanism. *Dental Cosmos* **71**, 409–421 (The fourth of four parts).

- The state-of-the-art nonextraction appliance in 1907 was the E-arch shown earlier. Angle's next development was the Pin-and-Tube designed for moving roots as well as crowns. It was difficult to use (the pins had to be removed and resoldered) and was replaced in 1915 by the Ribbon Arch bracket (used in the Begg technique) that enabled the teeth to slide along the wire.
- In 1928 Angle introduced the Edgewise Arch Mechanism, "the latest and best" in four parts in the *Dental Cosmos.* It *was* a considerable advance because it enabled force to be applied in all three planes of space.
- It is ironic that by inventing the Edgewise appliance with 3-D control of tooth movement, Angle unwittingly provided the means to treat extraction cases to a high standard.

Post-retention relapse: Charles Tweed



The Angle School of Orthodontia

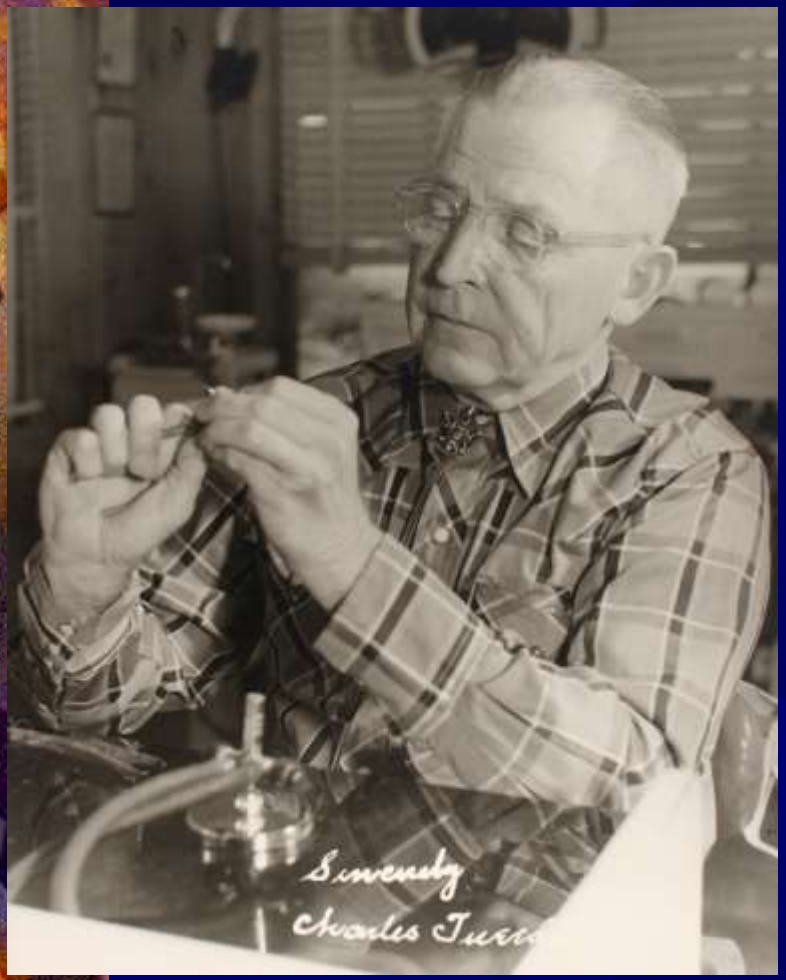
Pasadena · California ·

Session
1927–1928

This is to certify that
Charles H. Tweed, Jr.
has completed in a satisfactory manner
one full course of instruction
in The Angle School of Orthodontia

Edward H. Angle M. D., D. M. S. Sc. D

- Charles Tweed was a member of the last class of 5 students at the Angle School of Orthodontia, held in Berkeley, California. He field tested the Edgewise Appliance, and assisted Angle in completing the article that had been in draft form since 1925, published in *The Dental Cosmos* in December 1928, and February, March and April 1929.
- In his practice in Tucson, Arizona, Tweed followed the Angle philosophy of treatment for six and a half years. He then recalled 70% of all the patients he had treated and divided them into successes and failures. To his amazement he found that of those patients who had been out of retention for 2–5 years, he regarded his success rate at less than 20%.



Charles Henry Tweed DDS (1895–1970)

- After analyzing his cases, Tweed found a correlation between facial balance and the position of the mandibular incisors with respect to basal bone. He concluded that successful treatment depended on positioning the mandibular incisor teeth over basal bone, and to achieve this he had begun to extract first premolars.
- By 1940 he had records of 100 patients, treated first without extractions and then retreated with extractions. He put these patient records on display at an American Association of Orthodontists (AAO) meeting. The results were impressive.
- However, his iconoclastic extraction philosophy did not go down well with his colleagues in the Angle Society, which by this time had acquired some of the hallmarks of a cult.

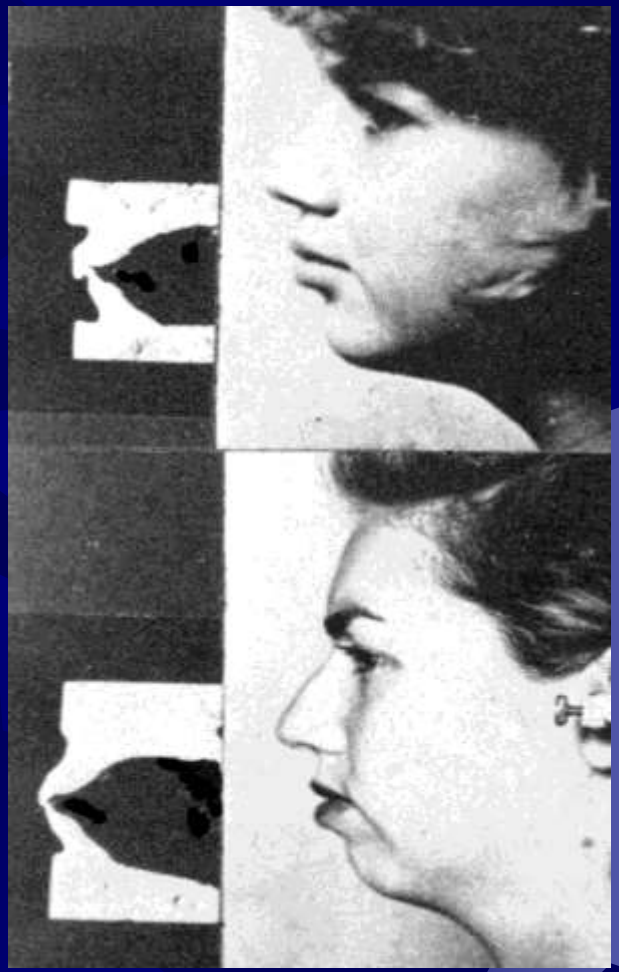
The Extraction Panel of 1944

- Tweed's extraction philosophy coupled with his demonstrable clinical ability and the evidence of his treated cases (Tweed's standard reply to critics was 'put your plaster on the table'), eventually made an impact, gaining many supporters, to such an extent that in April 1944, the debate known as the 'Extraction Panel' was held in Chicago during the annual meeting of the American Association of Orthodontics. It is interesting to observe that while World War II raged on, orthodontists were still quarrelling about whether teeth should be extracted in the treatment of a crowded dentition.

- Essayists who participated were Charles Tweed, Milo Hellman, George Grieve and Allan Brodie, with George Hahn acting as moderator (Hahn, 1944). Their contributions were subsequently published in the *American Journal of Orthodontics and Oral Surgery* of the same year.

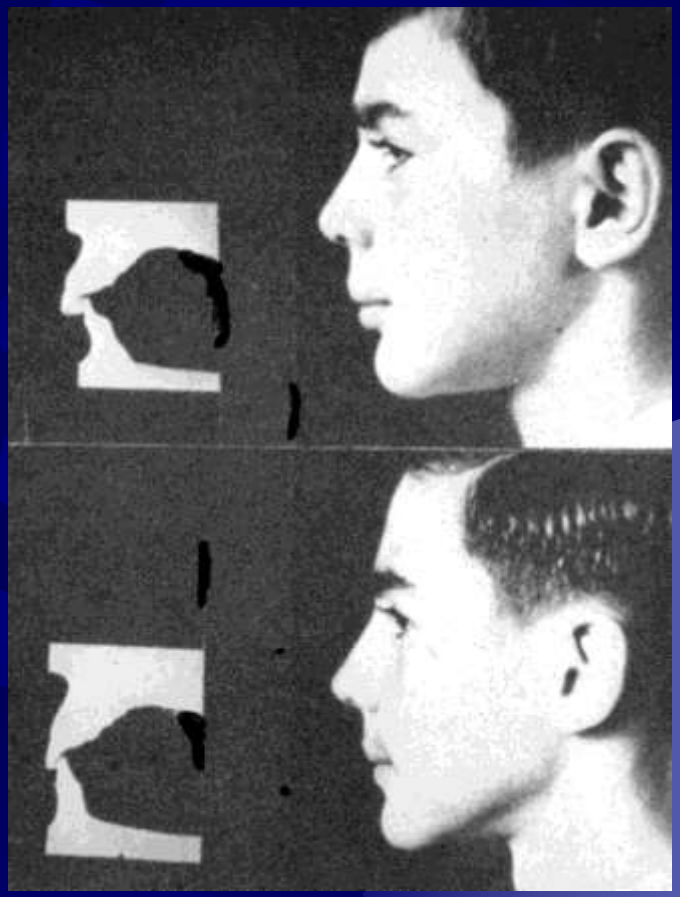
Tweed: analysis of failures

- Analysis of his treated cases clearly demonstrated to Tweed that as a rule, failures in treatment were caused by a failure to correct what he called perverted axial inclinations, and establish normal relationships of the teeth to their basal bone.
- The figure shows an improperly treated case comparing the inclinations of the mandibular incisors before and after orthodontic treatment. Alignment of the teeth (proclination) plus thirteen years of function have not produced any obvious benefit to either the dentition or facial aesthetics.
- From Tweed (1944). Indications for the extraction of teeth in orthodontic procedure. *American Journal of Orthodontics and Oral Surgery* **30**, 405–428.

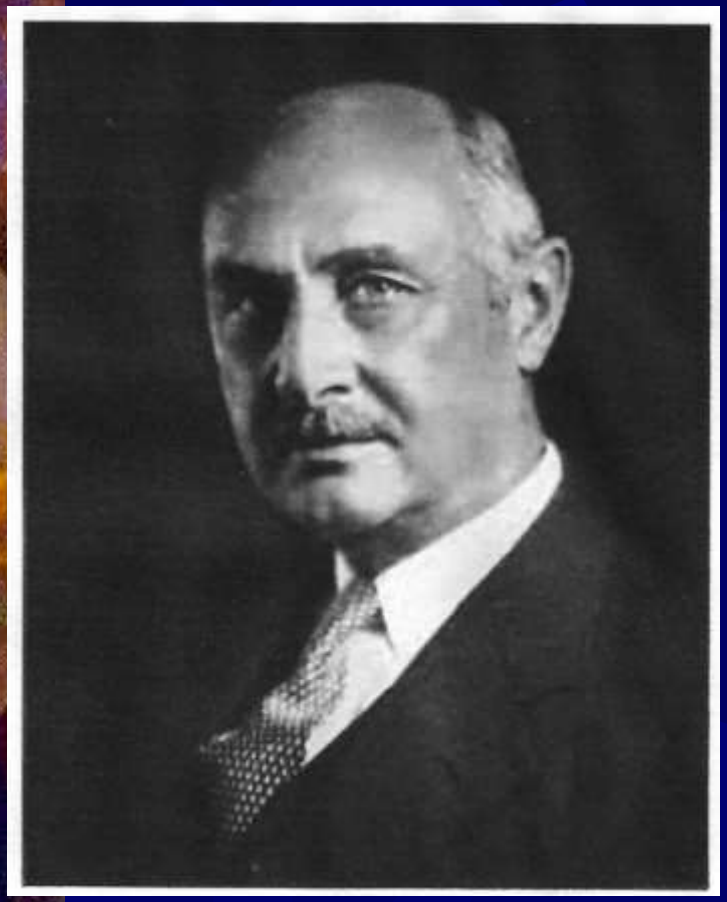


Tweed: indications for extraction

- Tweed had come to the conclusion that the key to a stable occlusion was the incisor–mandibular plane angle (this had been shown by Margolis (1943) to be on average 90±5 degrees), a measurement that later became incorporated into the Tweed diagnostic triangle (See Seminar on cephalometrics), which became the conceptual basis of the Tweed Technique.
- The extraction of four first premolars and the correct positioning of the mandibular incisors was indicated in this case because of the discrepancy between tooth position and basal bone.
- From Tweed (1944). Indications for the extraction of teeth in orthodontic procedure. *American Journal of Orthodontics and Oral Surgery* **30**, 405–428.



Hellman's contribution



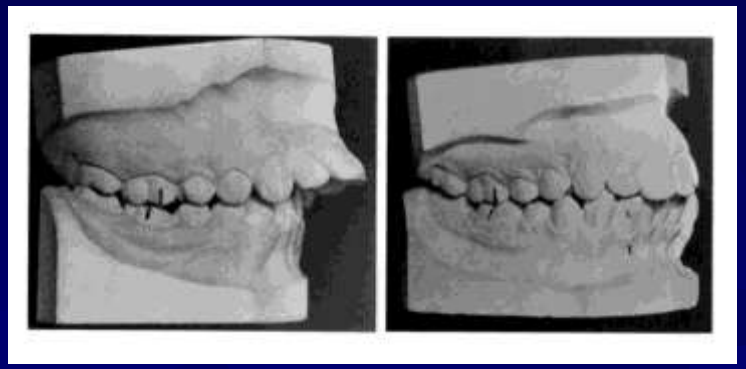
Milo Hellman DDS (1872–1947)

The Milo Hellman Award for Research was established by the AAO in 1958.

- Milo Hellman was an academic heavyweight; a distinguished academic, clinician and anthropologist. He served as a Professor at NYU and Columbia; a somewhat patrician figure held in some awe by his clinical colleagues.
- He adopted a rather patronizing tone towards Tweed branding him a clinician, holding unsound, unscientific views …"when he ventures to demonstrate as much wisdom with the support of so little exact knowledge."
- Despite being unable to resist having a dig at Tweed, Hellman's clinical experience had been similar. He even mentions an anecdote in which he asked Angle what had become of the case shown in the next slide.
- Hellman M (1944). Fundamental principles and expedient compromises in orthodontic procedures. *American Journal of Orthodontics and Oral Surgery* **30**, 429–436.

“It went back”

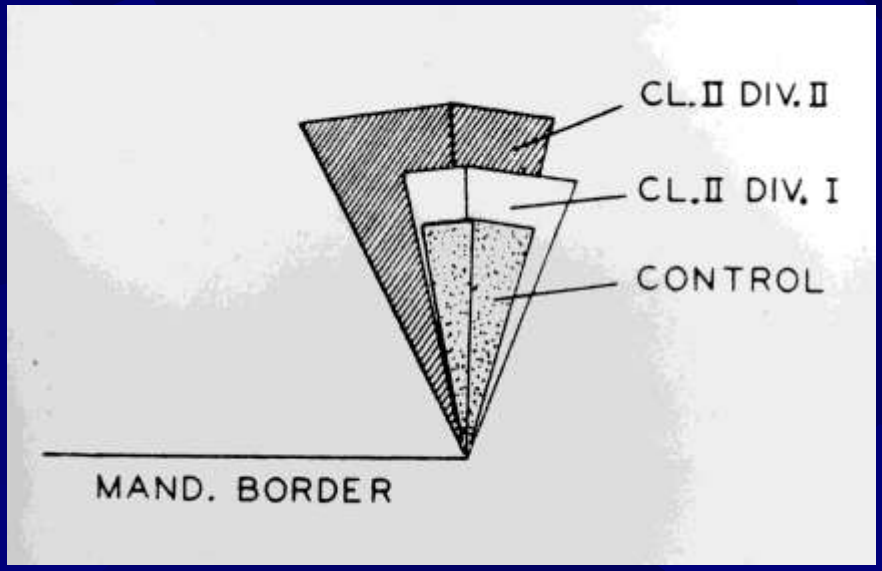
- Class II division 1 malocclusion treated by Angle. He points out that treating such a case by the extraction of upper first premolars and retracting the incisors and canines is now regarded as obsolete by all orthodontists of the new school.
- Photographs of the patient: Figs. 501 to 508 on pages 494–498 of *Treatment of Malocclusion of the Teeth* (1907).
- When asked by Hellman what happened to the case, Angle replied … “ it went back.”



Brodie's critique–I

- Brodie was critical of Tweed's concept of uprighting teeth over basal bone with emphasis on the lower incisors.
- In his opinion, orthodontic treatment had a limited effect on facial aesthetics and the extraction problem reduced itself to a single consideration. 'Is there enough bone to hold the teeth in a normal and stable position following treatment?'
- He also echoed Hellman's sentiment … "Are we justified in extracting two premolars…whose combined diameters measure 13–14 mm in order to gain 1–2 mm of space?"
- Alan Gibson Brodie DDS, MS, PhD (1897–1976).

Brodie's critique–II



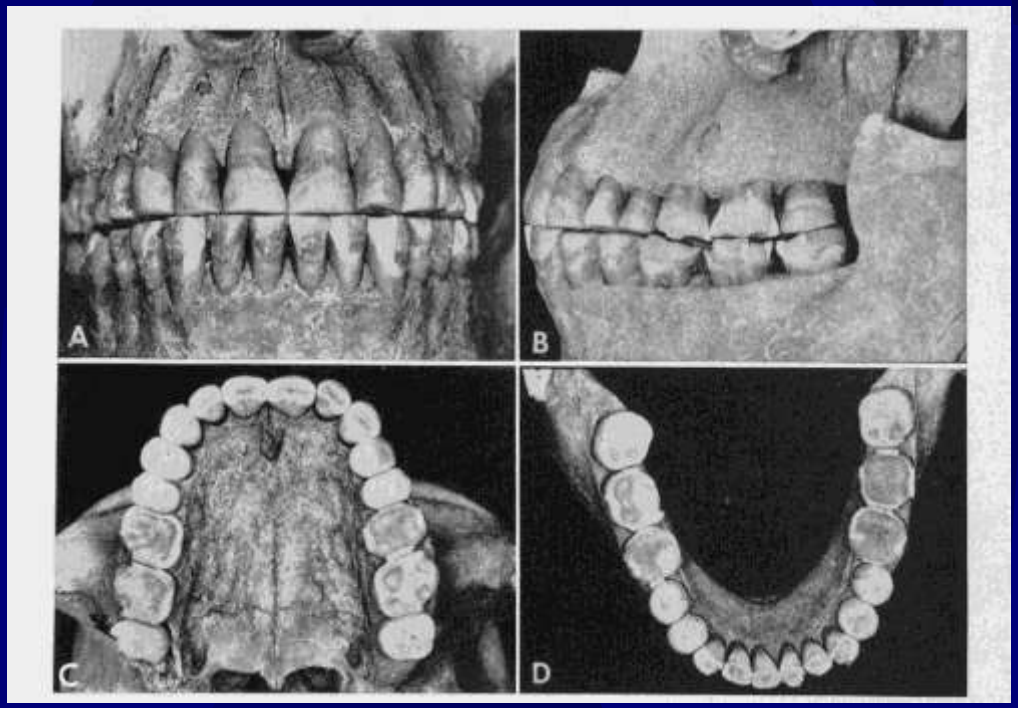
- This figure was used by Brodie to criticize Tweed's concept of uprighting teeth over basal bone, and the fallacy of applying mean values to individual patients. The large range in the lower incisor angle makes the use of a mean of 90º an unsatisfactory basis for treatment planning.
- The axial inclination of the lower incisors, like any other anatomical feature varies greatly and is just as much a part of the individual's pattern as other details of his/her physiognomy.
- Brodie A G (1944). Does scientific investigation support the extraction of teeth in orthodontic therapy? *American Journal of Orthodontics and Oral Surgery* 30, 444–460.

Percy Raymond Begg

AO, BDSc, DDSc (1898–1983)

- Another student of the Angle School of Orthodontia who abandoned nonextraction treatment was Raymond Begg from Adelaide, South Australia.
- Begg had made an extensive study of Australian aboriginal skulls including tooth wear; the food of Stone Age man was hard, coarse, fibrous and gritty leading to extensive occlusal and interproximal wear throughout life.
- He adopted Stone Age man's attritional occlusion as the basis of his philosophy of orthodontic treatment, regarding it as the anatomically and functionally correct occlusion.

Stone Age man's dentition

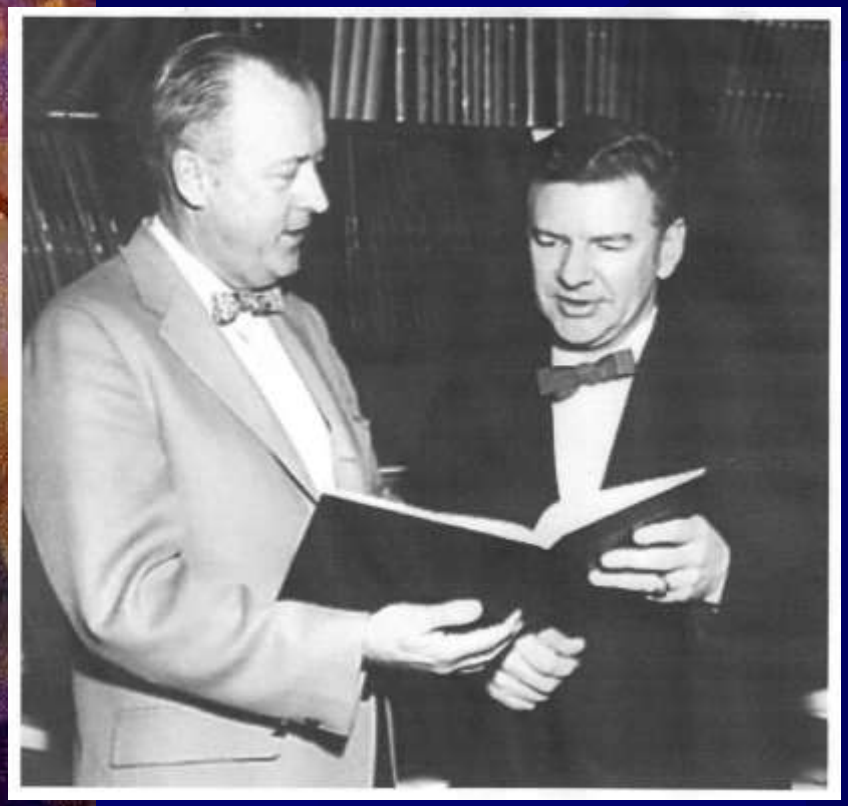


- Begg argued that since the lengths of Stone Age man's dental arches were continually reduced throughout life by tooth wear, orthodontists had a well-founded scientific precedent for reducing arch length by extracting teeth.
- The extraction of four first premolars therefore became an integral part of the philosophy of Begg treatment.
- From Begg PR (1965). *Begg Orthodontic Theory and Practice*. WB Saunders, Philadelphia, Pennsylvania.

Extractions and treatment stability

- The problem with the nonextraction–extraction debate was the arguments were largely personality driven and anecdotal, and to some extent still are. Both sides lacked the objective documentation of post-retention results necessary to prove their point of view.
- The aim of premolar extractions was to effectively treat patients with arch length discrepancies and bimaxillary protrusion, the rationale being to ensure post-treatment stability and the improvement of facial aesthetics.
- However, while Tweed, Begg and others were key figures in establishing extraction therapy as a respectable clinical practice during the 1950s, they failed to address the next logical question
- What was the evidence base for this? Were premolar extraction cases more stable after retention, or were they also subject to relapse? As it turned out, the assumption that the extraction of four first premolars resulted in a more stable occlusion proved to be unfounded.

Relapse following premolar extractions



Alton Wallace Moore DDS, MS (1916–2007) and Richard Anthony Riedel DDS, MSD (1922–1994)

- Numerous studies of changes in dental arch relationships and crowding following retention have been reported. However, probably the best known come from the University of Washington in Seattle.
- The post-retention assessment of orthodontic treatment has formed an important part of the clinical research undertaken in the Department of Orthodontics for more than 50 years.
- Starting with MSD theses in the 1950s, a large treatment database has been established including cases more than 10–20 years out of retention. Much of this work has been published and makes for interesting reading.

Stability of lower incisors – I

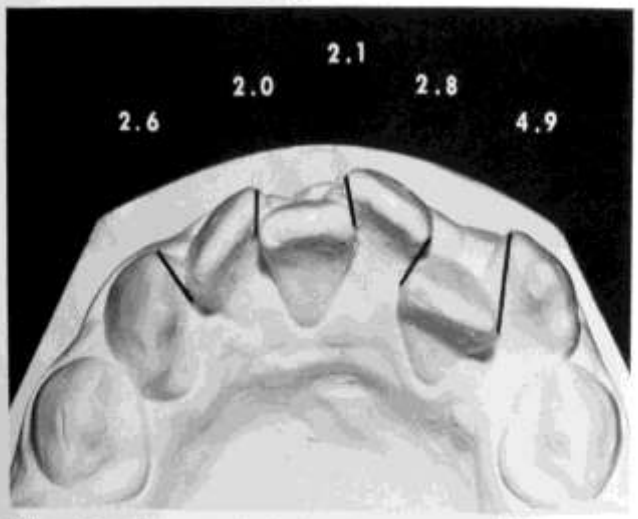


Fig. 1. Technique involves measuring the linear distance from anatomic contact point to adjacent anatomic contact point of mandibular anterior teeth, the sum of five measurements representing the Irregularity Index.

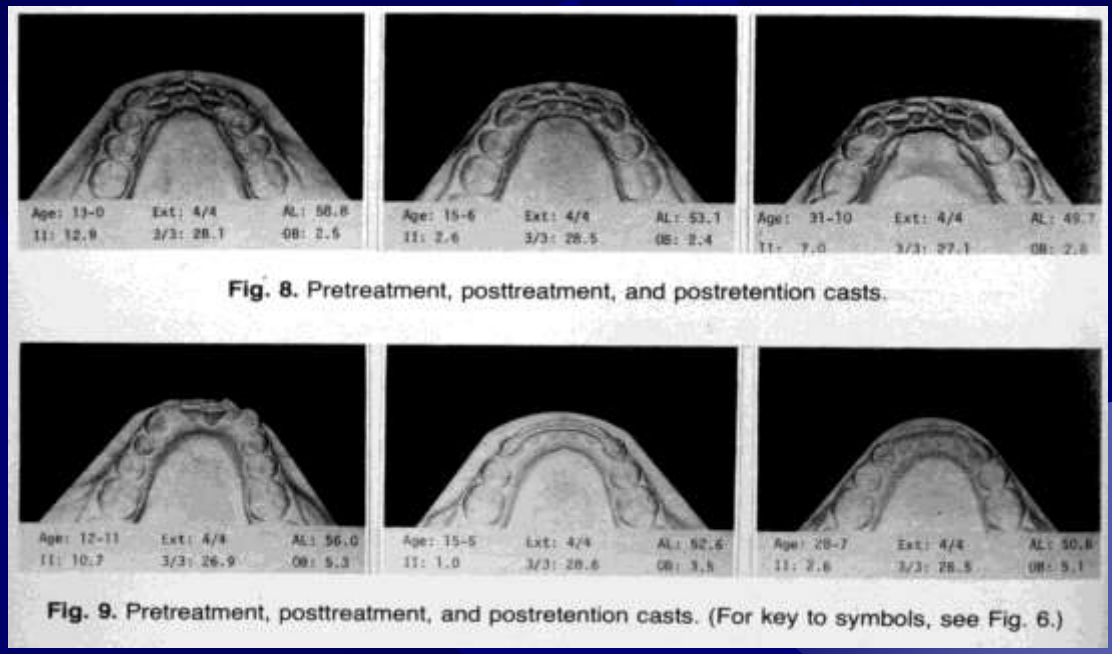


Fig. 8. Pretreatment, posttreatment, and postretention casts.

Fig. 9. Pretreatment, posttreatment, and postretention casts. (For key to symbols, see Fig. 6.)

- University of Washington data: Pre-treatment, post-treatment and post-retention study models of two first premolar extraction cases.
- Fig 8: there has been a return of crowding and in a pattern almost identical to the pre-treatment arrangement of the teeth. Fig. 9: the incisors have remained well aligned.

- Little RM (1975).The irregularity index: a quantitative score of mandibular anterior alignment. *American Journal of Orthodontics* **68**, 554–563.
- Little RM, Wallen TR, Riedel RA (1981). Stability and relapse of mandibular anterior alignment–first premolar extraction cases treated by traditional edgewise orthodontics. *American Journal of Orthodontics* **80**, 349–365.

Stability of lower incisors –II

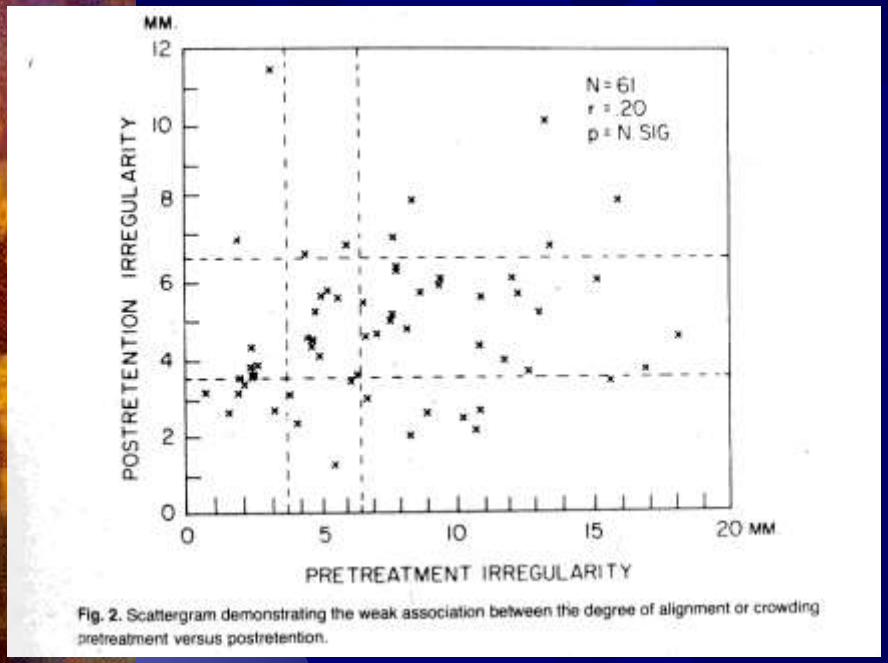


Fig. 2. Scattergram demonstrating the weak association between the degree of alignment or crowding pretreatment versus postretention.

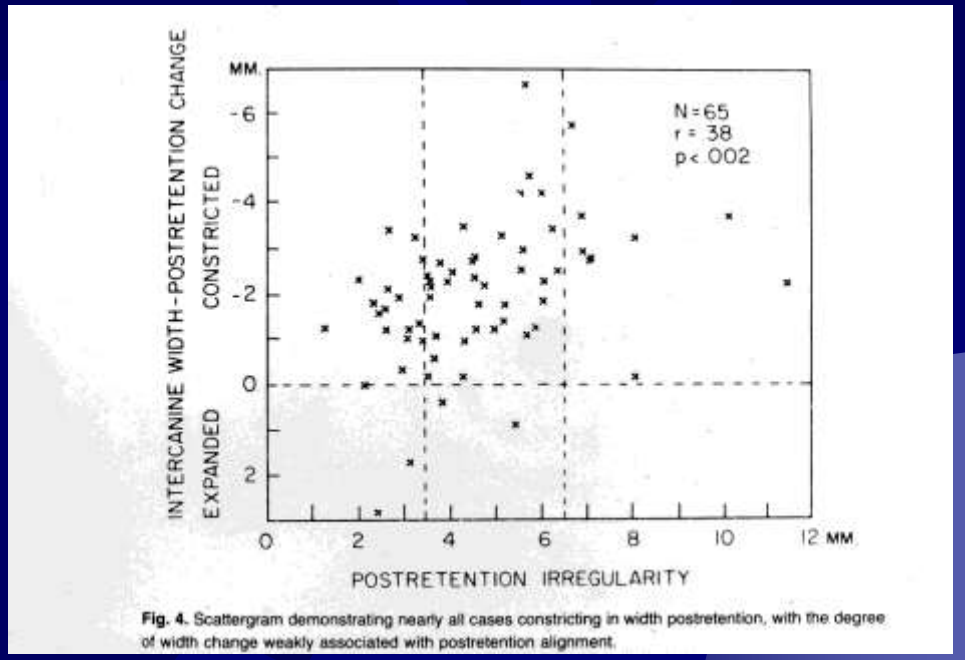


Fig. 4. Scattergram demonstrating nearly all cases constricting in width postretention, with the degree of width change weakly associated with postretention alignment.

- Left: Scattergram showing the weak association between pre- and post-retention irregularity of the lower incisors. Initial crowding was a very poor predictor of long-term irregularity, the correlation coefficient being only 0.20.
- Right: With only 5 exceptions, intercanine width decreased post-retention, with most constricting more than 2 mm.
- Little RM, Wallen TR, Riedel RA (1981). Stability and relapse of mandibular anterior alignment–first premolar extraction cases treated by traditional edgewise orthodontics. *American Journal of Orthodontics* **80**, 349–365.

Long-term stability–Illinois data

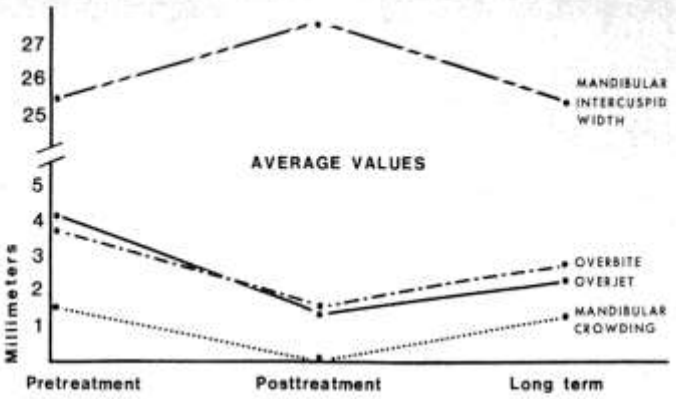


Fig. 1 Mean values for mandibular intercuspid width, overbite, overjet and mandibular crowding for 45 non-extraction cases before treatment and short and long-term posttreatment. Standard deviations for all values were higher than the mean changes. See Tables 2-4.

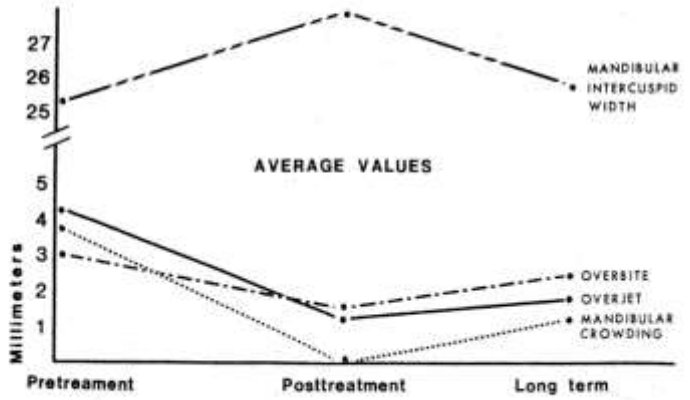


Fig. 2 Mean values for mandibular intercuspid width, overbite, overjet and mandibular crowding for 27 extraction cases before treatment and short and long-term posttreatment. Standard deviations for all values were higher than the mean changes. See Tables 2-4.

- In a study from the University of Illinois, the long-term stability of orthodontic treatment was evaluated in 96 patients who had received treatment 12–35 years previously.
- A. Mean values for mandibular intercanine width, overbite, overjet and mandibular crowding for 45 non-extraction cases.
- B. Mean values for 27 extraction cases. The results are remarkably similar and standard deviations in both groups were higher than the mean changes.
- Uhde MD, Sadowsky C, Begole EA (1983). Long term stability of dental relationships after orthodontic treatment. *The Angle Orthodontist* **53**, 240–252.

The A-Pog line

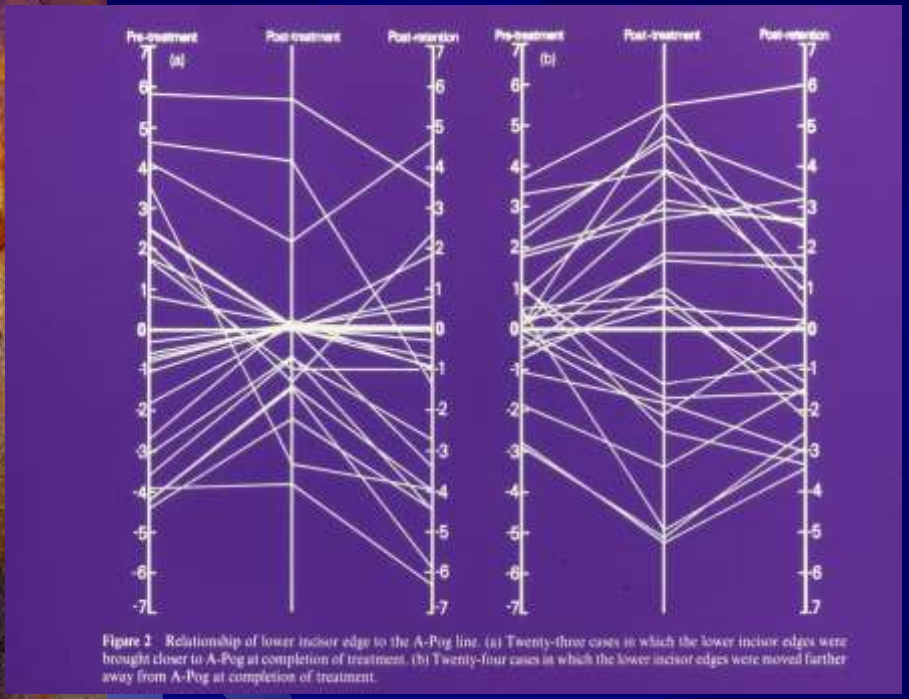


Figure 2 Relationship of lower incisor edge to the A-Pog line. (a) Twenty-three cases in which the lower incisor edges were brought closer to A-Pog at completion of treatment. (b) Twenty-four cases in which the lower incisor edges were moved further away from A-Pog at completion of treatment.

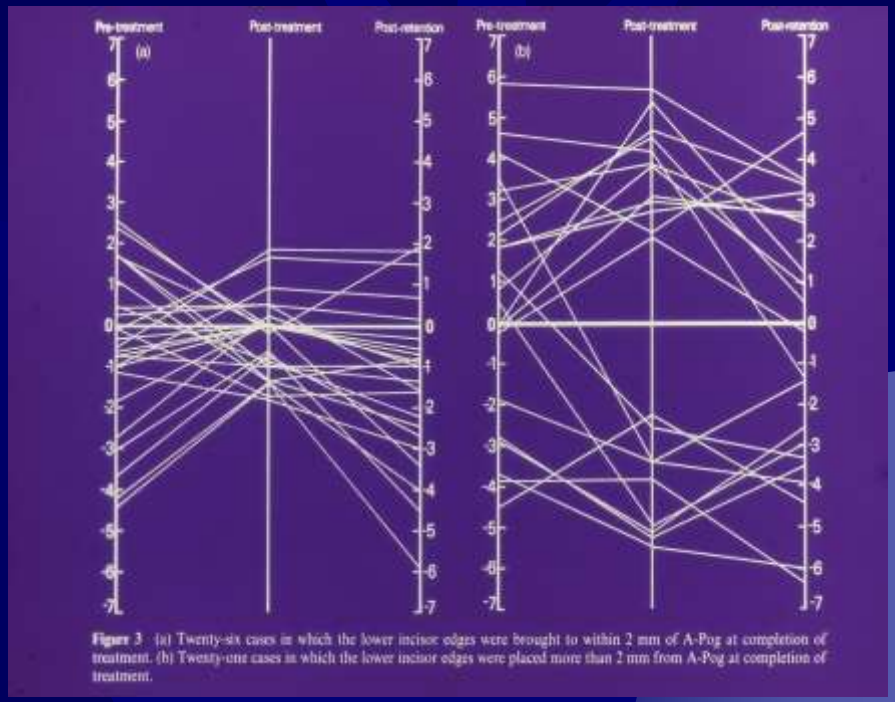


Figure 3 (a) Twenty-six cases in which the lower incisor edges were brought to within 2 mm of A-Pog at completion of treatment. (b) Twenty-one cases in which the lower incisor edges were placed more than 2 mm from A-Pog at completion of treatment.

- These figures are designed to show that in the majority of cases following cessation of retention, the lower incisors moved back toward their original position, although the extent to which this occurred was highly variable.
- Even when there was very little change during treatment there could be substantial alteration subsequently.
- Houston WJB, Edler R (1990). Long-term stability of the lower labial segment relative to the A-Pog line. *European Journal of Orthodontics* **12**, 302–310.

Factors influencing the extraction decision

- Life was much simpler when crowding equalled extractions. Unfortunately, in patients with mild crowding there are no clear diagnostic criteria to show whether extraction is the correct choice or *vice versa*. Certainty has been replaced by doubt.
- The decisions that orthodontists use clinically on a daily basis are determined by their training and by personal experience acquired from many years of practice. As a consequence, orthodontists have different policies on extraction. In an orthodontic training programme with several clinical instructors this can present difficulties for trainees in assessing borderline extraction cases.
- Which brings us to the question. Given that extraction therapy does not guarantee post-treatment stability, under what circumstances should teeth be extracted?

Lower incisor position

- As a general rule the treatment plan should be designed around the existing position of the lower incisor teeth and is based on the findings of Litowitz (1948) and Mills (1967, 1968), that any significant amount of labial or lingual movement was likely to relapse; the lower incisors appear to lie within a very narrow zone of stability. Many patients, particularly those with Class I crowding can be treated without significantly altering the labiolingual position of the lower incisors. There are, however, some exceptions to this rule which include:

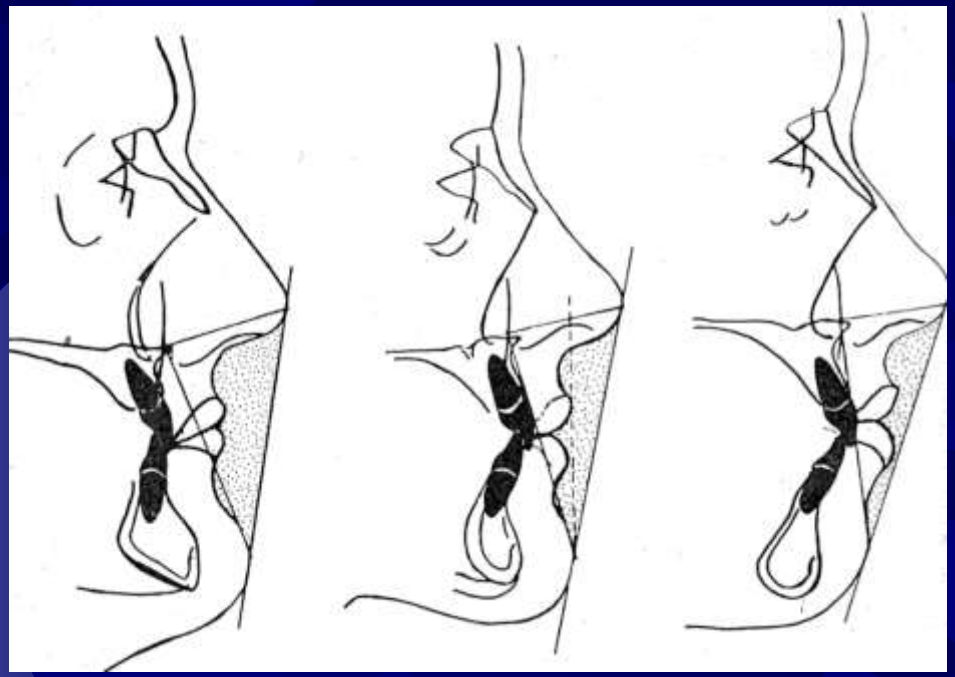
- Class II division 1 and division 2 malocclusions.
- Where there has been a thumb or finger sucking habit.
- The reduction of a bimaxillary protrusion.
- Decompensation in surgical cases.

- Litowitz R (1948). A study of the movements of certain teeth during and following orthodontic treatment. *The Angle Orthodontist* **18**, 113–131.
- Mills JRE (1968). The stability of the lower labial segment. *Dental Practitioner and Dental Record* **18**, 293–306.

Lower arch crowding

- A number of arch length analyses based on measurements of study models and periapical radiographs have been proposed (Nance 1947; Hixon and Oldfather 1958). However, probably the most practical way to estimate crowding is to use Little's irregularity index (See Slide 33 above). Although not without criticism (by measuring tooth displacement it tends to overestimate the amount of crowding) its great merit is simplicity; visual observation and some mental arithmetic are usually sufficient to reach an informed decision.
- Mild crowding (0–4mm). Since the available data shows that the extraction of premolars does not obviate post-retention relapse, where the crowding is mild, interproximal stripping may be the treatment of choice.
- Moderate crowding(4–6mm). First premolars are the teeth of choice, although over the past few years there has been a trend towards the extraction of second premolars. This does not, however, lead to greater post-retention stability (Reynolds and Little, 1991).

The facial profile–Ricketts' E line

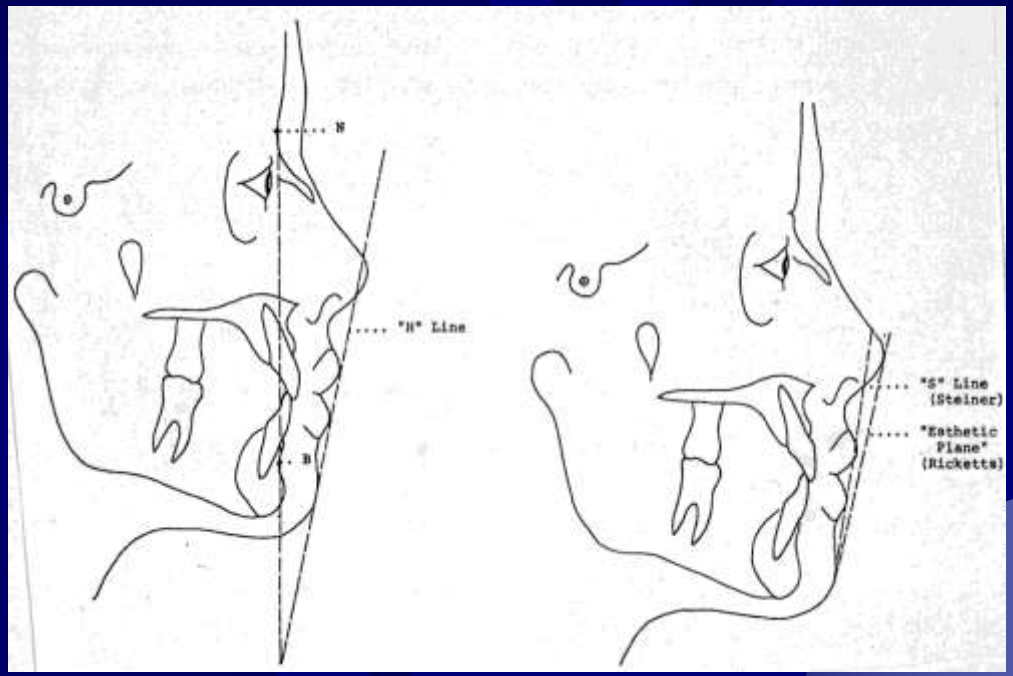


Ricketts RM (1957). Planning treatment on the basis of the facial pattern and an estimate of its growth. *The Angle Orthodontist* **27**, 14–37.

- Many attempts have been made to determine what constitutes the ideal profile; the early cephalometric studies of Downs (1948) and Riedel (1950) used hard tissue measurements. Soft tissue measurements became important to assess the effects of treatment on the facial profile.
- Ricketts in addition to using the facial angle and the angle of convexity introduced what he called the Esthetic plane. He found that in childhood the lips lie just ahead of the line and progressively retrude until in adulthood they lie 4 mm behind it (on average).

Holdaway and Steiner profile assessments

Angelle PL (1973). A cephalometric study of the soft tissue changes during and after orthodontic treatment. *Transactions of the European Orthodontic Society*, 267–280.



- Left: Holdaway (1983) described the use of a plane from the upper lip to the chin point – the H line. The angle formed between this line and the line NB he termed the H angle.
- Right: The lip analysis of Steiner is based on a line bisecting the S-shaped curve between the tip of the nose and extended to soft tissue pogonion; ideally the lips should lie on this line.

Changes in facial profile

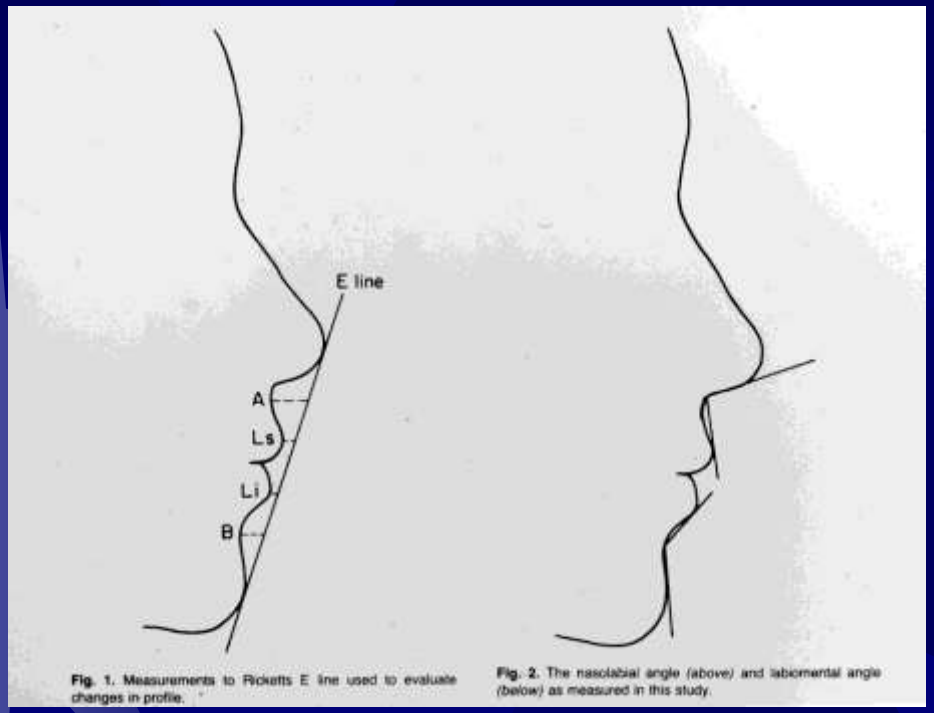


Fig. 1. Measurements to Ricketts E line used to evaluate changes in profile.

Fig. 2. The nasolabial angle (above) and labiomental angle (below) as measured in this study.

From Drobocky OB, Smith RJ (1989). Chenges in facial profile during orthodontic treatment with extraction of four first premolars. *American Journal of Orthodontics and Dentofacial Orthopedics* **95**, 220–230.

- Measurements used by Drobocky and Smith (1989) to assess the effects of the extraction of four first premolars and orthodontic treatment on the facial profile. Profile changes were compared to normal or “ideal” facial aesthetics
- Extraction of four first premolars did not result in a dished-in profile. 80–90 percent of patients had soft-tissue measurements suggesting the profile was improved by treatment or remained satisfactory.

Facial profile: extraction v nonextraction

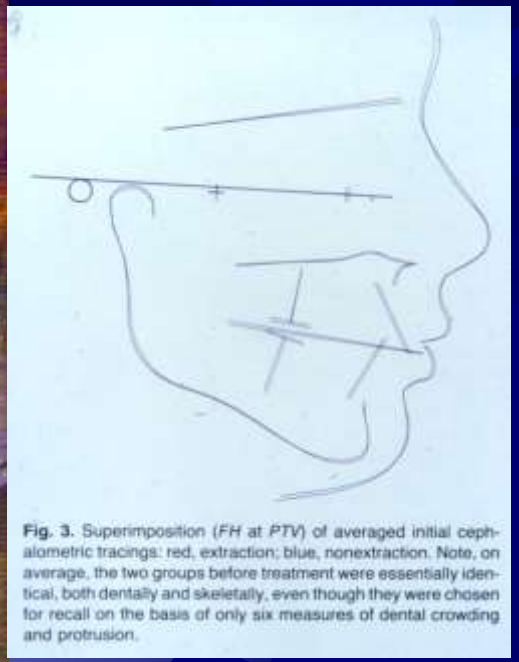


Fig. 3. Superimposition (*FH* at *PTV*) of averaged initial cephalometric tracings: red, extraction; blue, nonextraction. Note, on average, the two groups before treatment were essentially identical, both dentally and skeletally, even though they were chosen for recall on the basis of only six measures of dental crowding and protrusion.

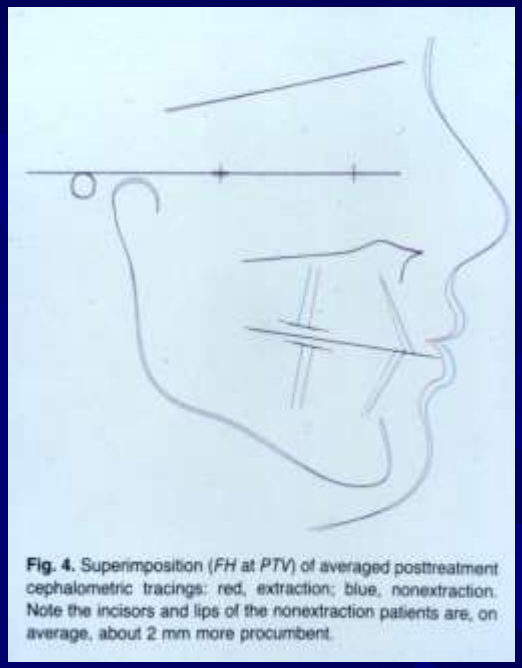


Fig. 4. Superimposition (*FH* at *PTV*) of averaged posttreatment cephalometric tracings: red, extraction; blue, nonextraction. Note the incisors and lips of the nonextraction patients are, on average, about 2 mm more procumbent.

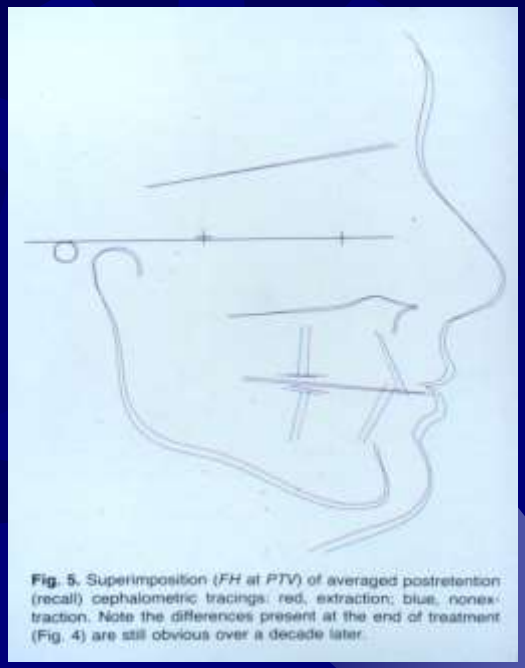
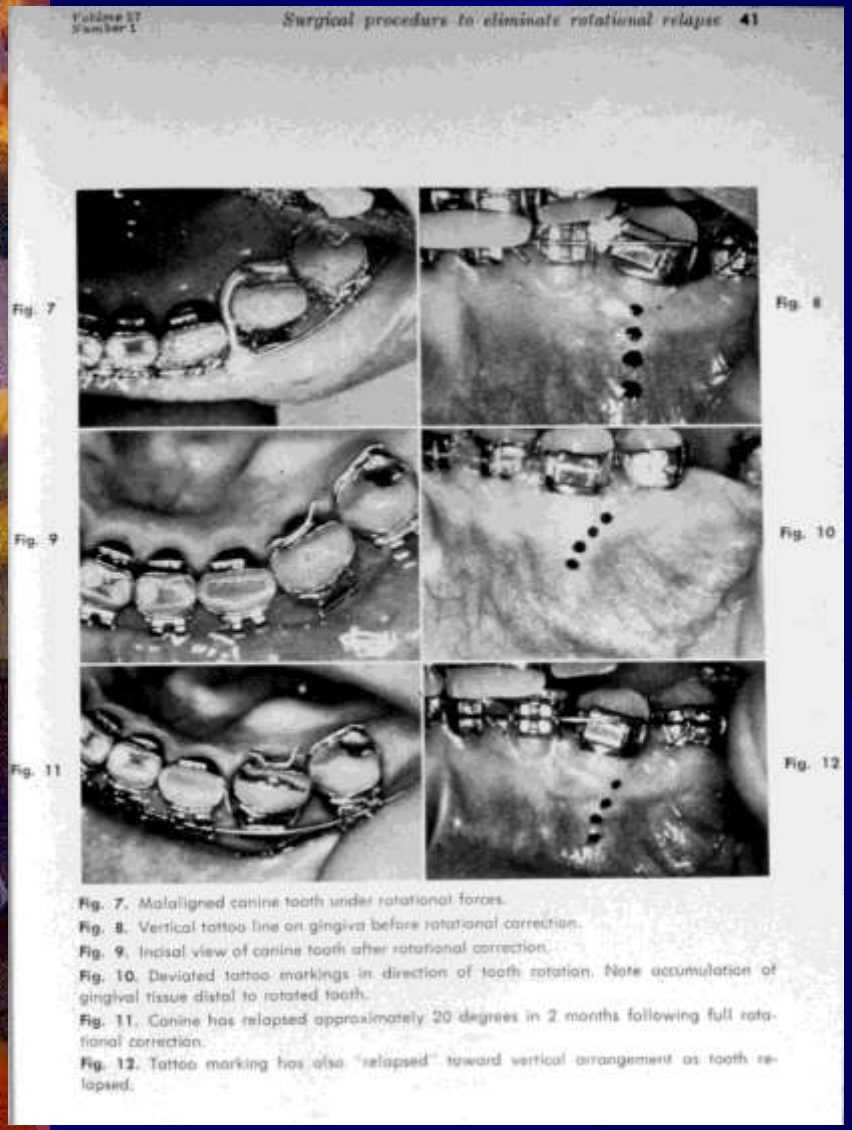


Fig. 5. Superimposition (*FH* at *PTV*) of averaged postretention (recall) cephalometric tracings: red, extraction; blue, nonextraction. Note the differences present at the end of treatment (Fig. 4) are still obvious over a decade later.

- Superimpositions showing: (Left) Average pre-treatment tracings (red, extraction; blue, non-extraction) the two groups are essentially identical.
- (Middle) Average post-treatment tracings. The lips and incisors of the non-extraction patients are on average about 2 mm more procumbent; (Right) Average post-retention (recall) tracings. The differences present at the end of treatment are still apparent.
- Paquette DE, Beattie JR, Johnston LE (1992). A long-term comparison of nonextraction and premolar extraction edgewise therapy in “borderline” Class II patients. *American Journal of Orthodontics and Dentofacial Orthopedics* **102**, 1–14.

Rotational relapse: pericision


Volume 57
Number 1

Surgical procedure to eliminate rotational relapse 41

Fig. 7

Fig. 8

Fig. 9

Fig. 10

Fig. 11

Fig. 12

Fig. 7. Malaligned canine tooth under rotational forces.
Fig. 8. Vertical tattoo line on gingiva before rotational correction.
Fig. 9. Incisal view of canine tooth after rotational correction.
Fig. 10. Deviated tattoo markings in direction of tooth rotation. Note accumulation of gingival tissue distal to rotated tooth.
Fig. 11. Canine has relapsed approximately 20 degrees in 2 months following full rotational correction.
Fig. 12. Tattoo marking has also "relapsed" toward vertical arrangement as tooth relapsed.

- Rotations are the tooth movement most likely to relapse, no matter how long the tooth is retained or over-rotated (often recommended but hardly every carried out). Edwards established the importance of the surgical procedure of pericision or fiberotomy to eliminate rotational relapse.
- Fig 8: Vertical tattoo line on the gingival tissues adjacent to a rotated canine prior to rotation. Following alignment the tattoo has turned in the direction of tooth movement (Fig. 10).
- In Figs. 11 and 12 the canine has been allowed to relapse; the tattoo has also relapsed.
- Edwards JG (1970). A surgical procedure to eliminate rotational relapse. *American Journal of Orthodontics* **57**, 35–46.

Interproximal stripping and fiberotomy

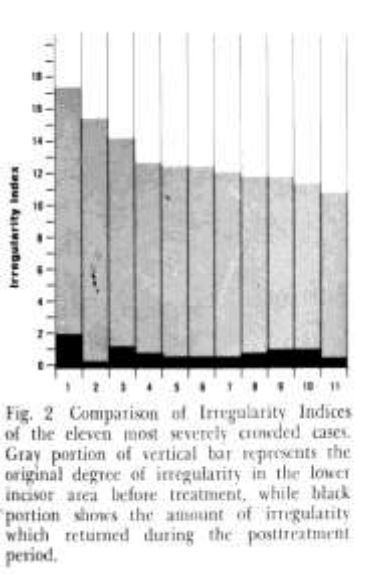


Fig. 2 Comparison of Irregularity Indices of the eleven most severely crowded cases. Gray portion of vertical bar represents the original degree of irregularity in the lower incisor area before treatment, while black portion shows the amount of irregularity which returned during the posttreatment period.

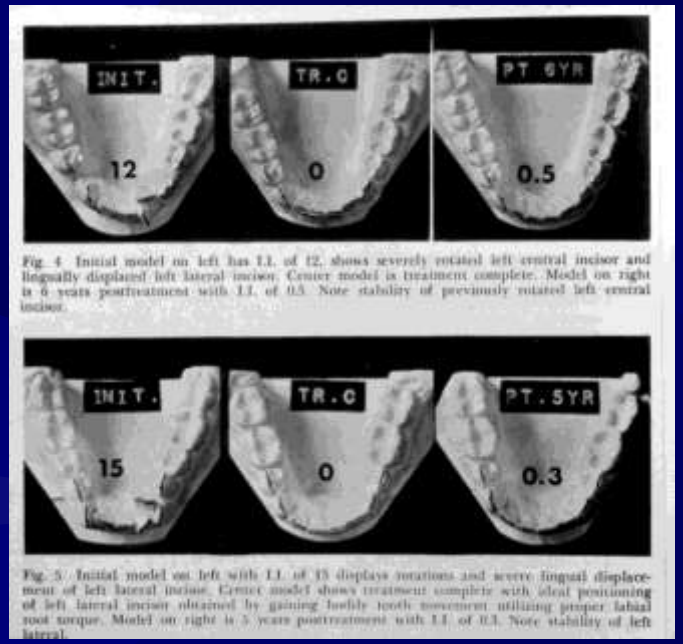


Fig. 4 Initial model on left has I.I. of 12, shows severely rotated left central incisor and lingually displaced left lateral incisor. Center model is treatment complete. Model on right is 6 years posttreatment with I.I. of 0.5. Note stability of previously rotated left central incisor.

Fig. 5 Initial model on left with I.I. of 15 displays rotations and severe lingual displacement of left lateral incisor. Center model shows treatment complete with ideal positioning of left lateral incisor obtained by gaining freely tooth movement utilizing proper labial root torque. Model on right is 5 years posttreatment with I.I. of 0.3. Note stability of left lateral.

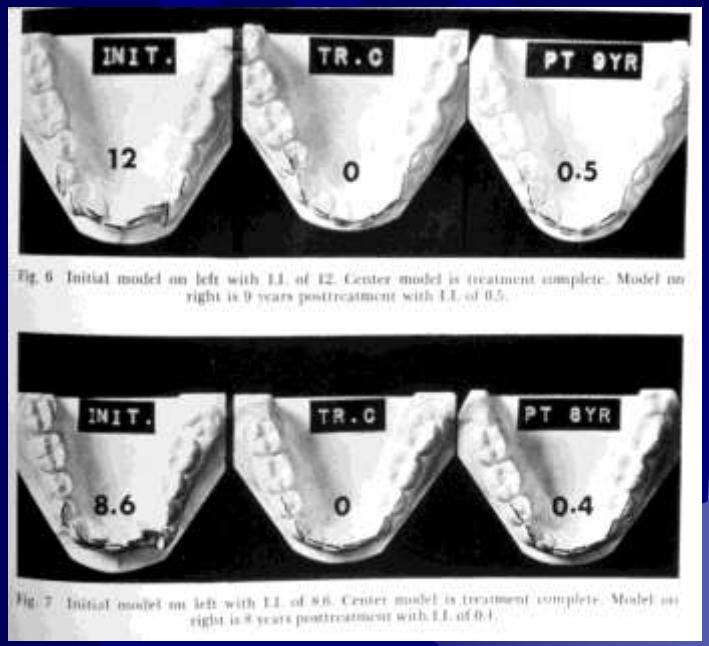


Fig. 6 Initial model on left with I.I. of 12. Center model is treatment complete. Model on right is 9 years posttreatment with I.I. of 0.5.

Fig. 7 Initial model on left with I.I. of 8.6. Center model is treatment complete. Model on right is 8 years posttreatment with I.I. of 0.4.

- Some of the cases used to illustrate the effects of interproximal fiberotomy and stripping on the stability of the lower labial segment. The mean MD/FL index at the start of treatment for the mandibular lateral incisors was 99.1 ± 6.78%, reduced by stripping to 92.7 ± 6.64%.
- The corresponding figures for the central incisors were 96.4 ± 13.5% and 91.0 ± 6.7%.
- From Boese (1980b). Fiberotomy and reproximation without lower retention, 9 years in retrospect: Part II. *The Angle Orthodontist* **50**, 169–178.

Incisor dimensions and crowding–I

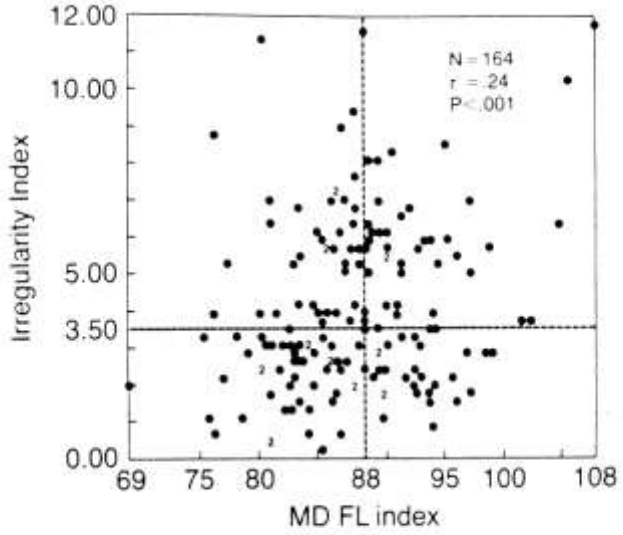


Fig. 3. Scattergram demonstrating the weak association between the mandibular central incisor MD FL index and the irregularity index.

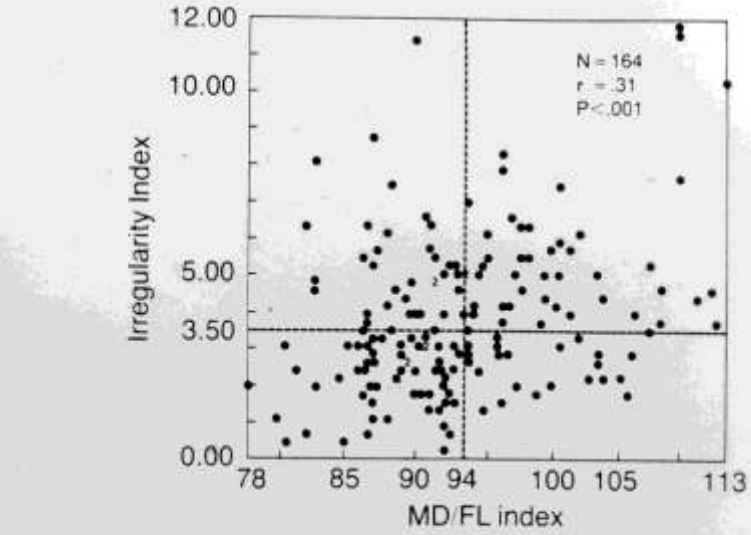
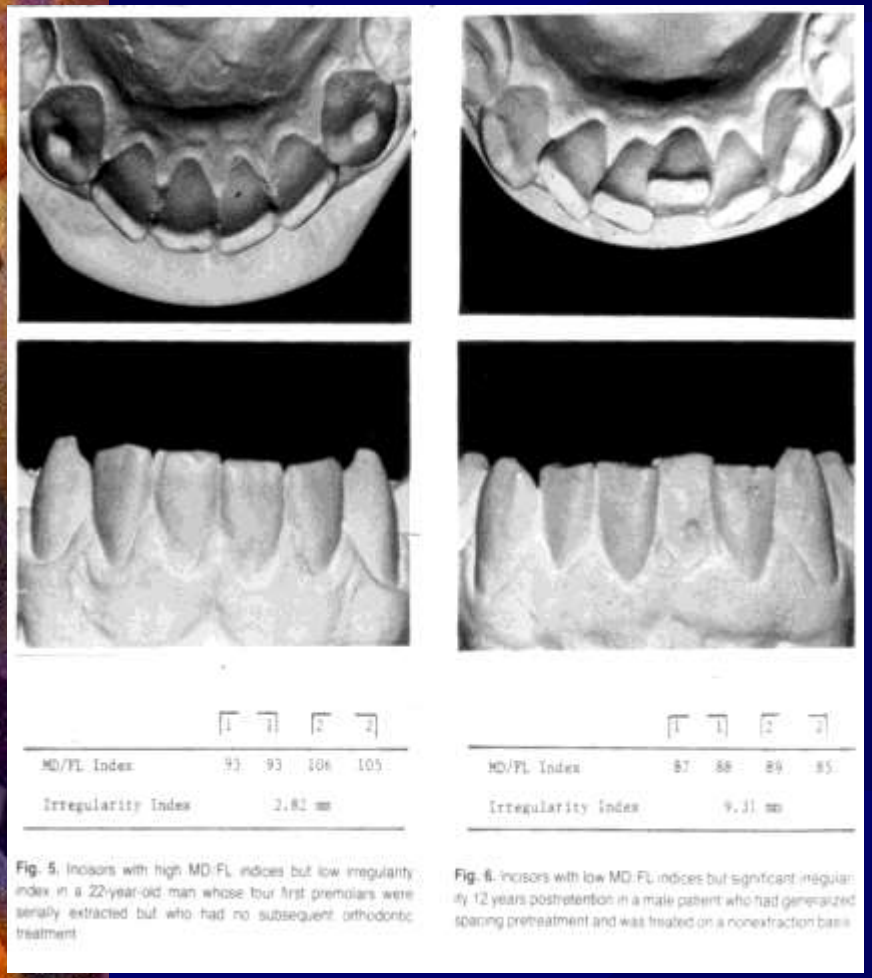


Fig. 4. Scattergram demonstrating the weak association between the mandibular lateral incisor MD/FL index and the irregularity index.

- An evaluation of 164 treated orthodontic cases 10 years out of retention showed only a weak association between the MD/FL index and stability of alignment of lower incisors in the long term.
- While there was a weak tendency for narrower incisors to be associated with better alignment in some cases, narrower MD widths of mandibular incisors did not by themselves ensure long-term stability.
- From Gilmore CA, Little RM (1984). Mandibular incisor dimensions and crowding. *American Journal of Orthodontics* **86**, 493–502.

Incisor dimensions and crowding–II



	1	1	2	2
MD/FL Index	93	93	106	105
Irregularity Index		2.82 mm		

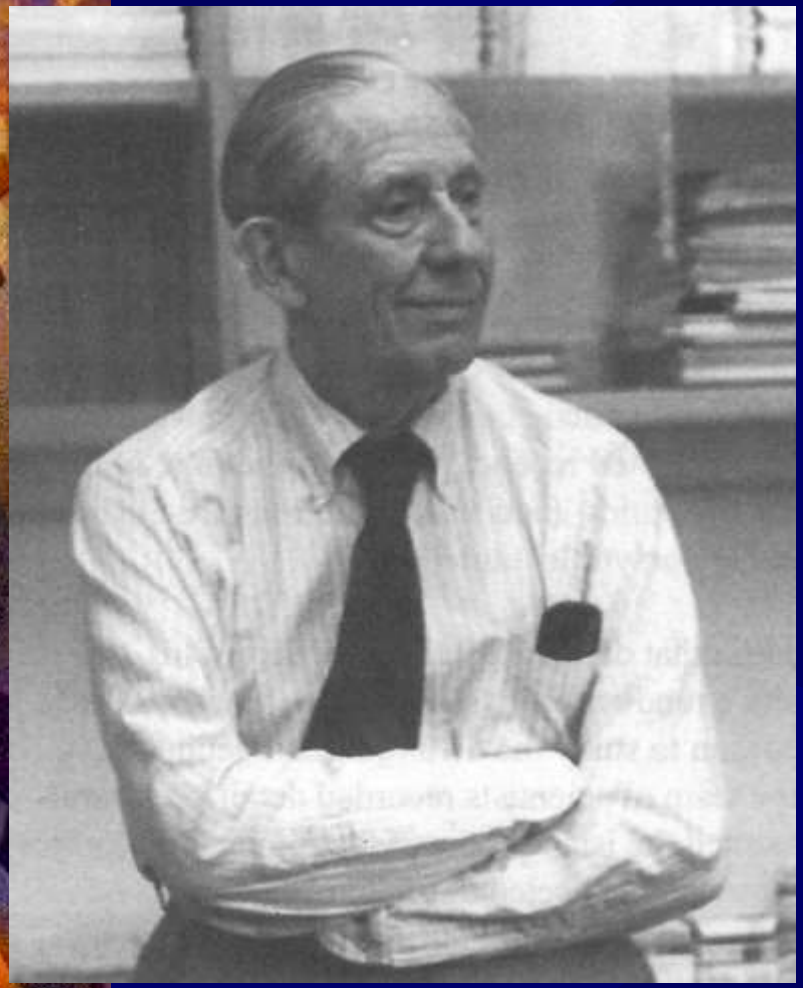
Fig. 5. Incisors with high MD:FL indices but low irregularity index in a 22-year-old man whose four first premolars were serially extracted but who had no subsequent orthodontic treatment

	1	1	2	2
MD/FL Index	87	88	89	85
Irregularity Index		9.31 mm		

Fig. 6. Incisors with low MD:FL indices but significant irregularity 12 years postretention in a male patient who had generalized spacing pretreatment and was treated on a nonextraction basis

- While there is a tendency for incisors with greater MD dimensions to be associated with crowding, the association is weak.
- Reduction of the widths of lower incisors to fit a specific range cannot be guaranteed to produce a stable alignment as illustrated in these two cases.
- However, there is some evidence to suggest that reduction in tooth widths by interproximal stripping, in combination with interproximal fiberotomy, can enhance lower incisor stability (Boese, 1980).
- From Gilmore and Little (1972). *American Journal of Orthodontics* **86**, 493–502.

Age changes in the dental arches



Coenraad Frans August Moorrees DDS (1916–2003)

- Age changes in the size and form of the maxillary and mandibular dental arches have been widely investigated, with several published series based on longitudinal material.
- The best known work on the subject is *The Dentition of the Growing Child : A Longitudinal Study of Dental Development Between 3 and 18 Years of Age* (1959). It was based on two groups of children: (1) the Stuart series from the Harvard Growth Study of 59 boys and 73 girls measured from birth to 18 years, and (2) the Stucklen series from Wilmington, Delaware, which comprised 25 boys and 27 girls studied from 5–6 to 16–18 years of age.

Changes in arch length

- Average dental arch length was found by Moorrees (1959) to be smaller at 18 years than at age 3 in both males and females. The reduction was greater in the mandibular than maxillary arch and occurred mainly between 4 and 6 years of age and between 10 and 14 years.
- The first decrease can be explained by the disappearance of the spaces between the deciduous teeth; the second follows replacement of the deciduous molars by the smaller premolars and closure of the leeway space.
- The later implant studies of Björk (1963), showed that uprighting of the lower incisors also contributed to the decrease in arch length in many individuals, particularly those with marked horizontal mandibular growth. The obvious clinical manifestation of these changes is lower incisor crowding, an important cause of post-retention relapse.
- There was considerable variation around the mean or average values for arch length. Some children showed an increase and others a decrease, irrespective of the direction or amount of the mean change at each age level. Moorrees suggested that it was therefore hazardous to accept the average annual change as a guide to predict individual growth patterns in arch length.

Changes in arch width

- In the mandible the average distance between the canines increased continuously after 5 years of age to a maximum at 10 years in males and 9 years in females, followed by small decreases with eruption of the permanent canines.
- Little change occurred after 12 years of age. The distance between the mandibular first permanent molars increased gradually, apart from an appreciable increase at 13 years in boys and at 11 years in girls.
- In the maxillary arch, between the ages of eruption of the deciduous canines and permanent molars to age 18 years, the intercanine dimension increased by 5 mm and the intermolar dimension by 4 mm.

Summary

- The literature on the extraction debate reminds one of the remark attributed to Wallace Sayre, a political scientist at Columbia University, who claimed the intensity of academic squabbles was a function of the triviality of the issue being discussed. “In any dispute the intensity of feeling is inversely proportional to the value of the issues at stake.”
- There is also more than a hint of hubris about the early practitioners of orthodontics to have imagined that after moving teeth to new positions in the oral cavity they would remain undisturbed. Not helped by a sense of superiority amongst the graduates of the Angle School as members of an exclusive club and custodians of the true faith. As Charles Tweed was to find out, woe betide any apostates.
- It’s difficult to avoid the conclusion the reason Angle became a firm advocate of nonextraction treatment was the absence of an orthodontic appliance that could do more than just tip teeth.
- In other words, the limited mechanics made nonextraction treatment a virtue out of a necessity. And if Curtis (2000) was correct, extracting two premolars from his wife and failing to keep the spaces closed, provided an everyday reminder, and a powerful motive for Angle to invent an appliance that could.

- The result after many years of trial and error was Angle's supreme gift to the specialty of orthodontics – the Edgewise Arch System of the late 1920s. The irony of course was that in doing so, he unwittingly undermined his own dogmatic nonextraction philosophy by inventing an appliance that could be used to treat extraction cases to a high standard, as Tweed and other orthodontists were soon to demonstrate.

- Teeth are not embedded in concrete; the oral cavity is a living biological system subject to adjustment like any other part of the human body. The dynamics of occlusion are such that crowding of the lower incisors is a normal feature of the dentition in the late teens, regardless of whether the patient has had orthodontic treatment.

- Patients should be told that if they wish their teeth to remain in their present alignment, it will be necessary to wear retainers for an indefinite period. That is why I favour removable retainers that can be worn as frequently as the patient decides; after all they know more about what their teeth do than anyone else.