

The Edgewise Sequential Directional Force Technology

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<前言>

筆者有幸，受邀參加中山校友會8月30日在臺大醫學院所舉辦之矯正系列演講，講題是“Clinical Treatment of class II malocclusion with Tweed Technique”，此次演講在矯正學會新上任理事長曾應魁醫師及矯正專家曾振文醫師的高知名度號召下，乃有近150名左右的牙科同好報名參加，可見在一陣Implant的風潮中，矯正熱度並未因而稍有退卻，尤其在演講當天，適逢寶莉颱風來襲，風雨交加，卻仍有百餘人不懼狂風陣雨，來共襄盛舉，好學之精神，實令人敬佩。

唯中山校友會梁榮洲會長有感於仍有多位已報名者或因受阻於風雨，或因交通不便而未克參加，乃令筆者在校友會刊中做一份精簡之報告，以償未參加者，因此筆者斗膽提筆，在有限的篇幅及緊迫的時間下，將此次講題中主要的一部分，即由Dr. Merrifield所提出而目前為Tweed foundation所廣為推行的“The edgewise sequential directional force technology”做一份摘要性的敘述，並舉一臨床病例來說明，雖此一病例並非盡善美，但謹希望能藉由此機會與讀者

們一起切磋共勉，更希望先進同好給予指正。

I. Diagnosis and treatment planning

任何矯正治療之開始，首要之工作乃是治療目標的設定。因此診斷與治療計劃之擬定是矯正治療中不可或缺且是必要的工作。

A. Total dentition space analysis (圖一)

傳統的Tweed method主要是以下顎前牙區的Arch length discrepancy和Tweed Triangle的Ceph correction來做為診斷上的主要依據，再依其total discrepancy的多寡決定拔牙與否，而Dr. Merrifield則根據其多年的臨床經驗，重新整理出一套新而實用的空間鑑別診斷原則，將下顎齒列空間是否足夠，分成前、中、後三個齒列區來個別計算，算出其差距，再依Dr. Merrifield所設定的“Differential Diagnostic guideline”來做為臨床上是否須要拔牙或應拔除那幾顆牙齒的參考標準。其分析法簡述如下：

1. Anterior Denture area

- ①分別量出下顎前面六顆牙齒(321 | 123)的required space和available space，以求得

(圖一)

TOTAL DENTITION SPACE ANALYSIS

A. Anterior denture area

a) Teeth width		_____
b) Available space		_____
c) Tooth arch disc		_____
d) Headfilm correction		_____
e) Soft Tissue Modification		_____
		Deficit _____ Surplus _____

B. Mid-arch denture area

a) Teeth width		_____
b) Available space		_____
c) Tooth arch disc		_____
d) Curve of spee		_____
		Deficit _____ Surplus _____

C. Posterior denture area

a) Teeth width		_____
b) Available space		_____
c) Tooth arch disc		_____
d) Estimated increase		_____
		Deficit _____ Surplus _____
DENTURE TOTAL		Deficit _____ Surplus _____

其tooth size discrepancy。

②利用Tweed Triangle, 求得Headfilm correction所須的值(圖二)

此數值乃代表將下顎門齒uprighting到所設定的治療目標位置時, 所需要的齒列空間。

FMA 21° ~ 29° FMIA = 68°

FMA ≥ 30° FMIA = 65°

FMA ≤ 20° IMPA ≤ 92°

Ceph. Correction = 0.8 × The FMA difference

③Soft tissue correction (圖三)

除了牙齒和顎骨的改正外, 軟組織的差異, 亦同時應加以考慮。Dr. Merrifield利用"Z angle"來評估顏面美觀程度, 當FMIA是68°時, Z angle應該是78±3°, 同時Z angle亦隨著FMIA的變動而成比例的改變, 其方法如下:

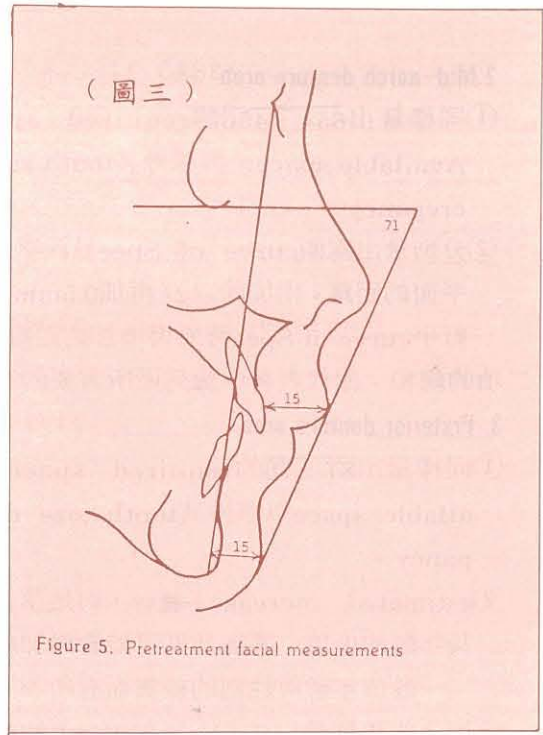
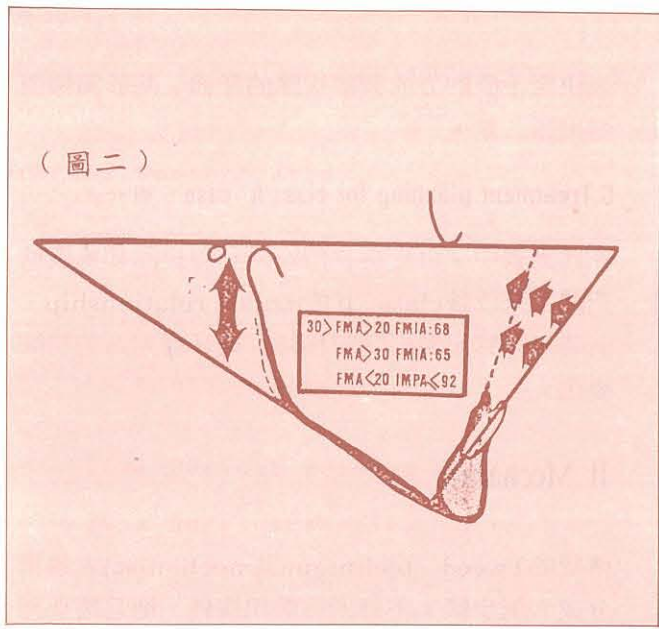
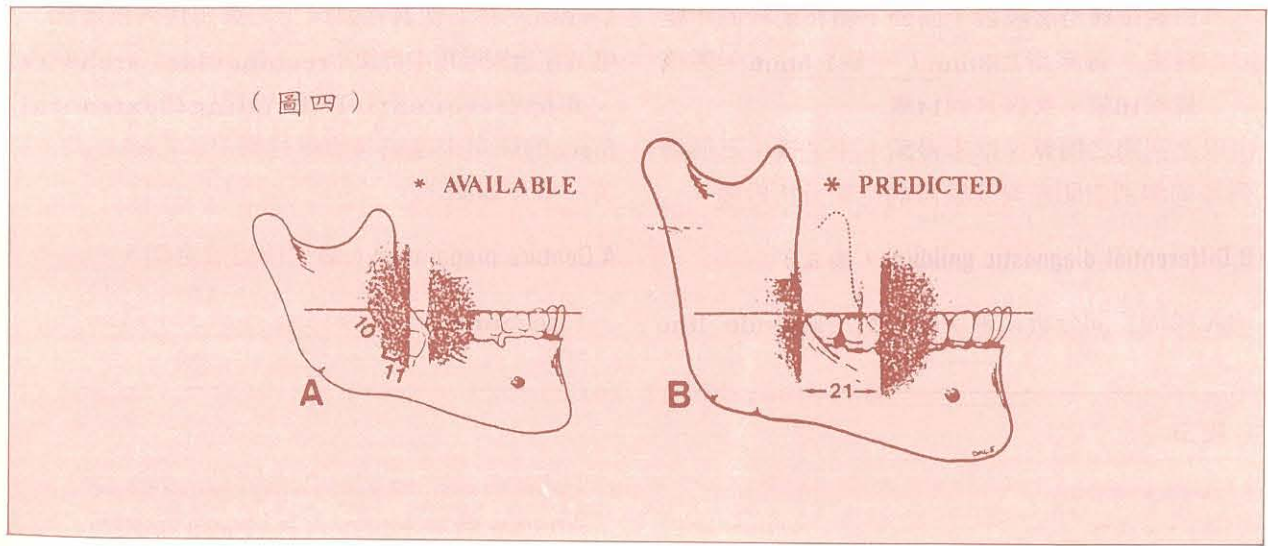


Figure 5. Pretreatment facial measurements



- (i)先決定治療前的“Z angle”的角度
- (ii)再將Ceph. correction時需要的角度加入Z angle中
 - a.如二者相加的和大於80°時，下顎門齒的位置可依需要而modification, IMPA約92°。
 - b.如二者相加的小於75°時，則下顎需要更多的直立。

- ①Upper lip thickness > total chin thickness 則 (lip thickness - chin thickness) × 2 = space required
 - ②Upper lip thickness ≤ total chin thickness 則不需要Soft tissue modification。
- 由①、②、③三項的總和，即代表著前牙區的空間在矯正治療目標的擬定時是否足夠。

2. Mid-arch denture area

- ①同樣量出 $\overline{654}$ | $\overline{456}$ 的required space和 Available space, 再求得其tooth size discrepancy。
 - ②分別量出兩側curve of Spee最深處到咬合平面的距離, 相加除以2, 再加0.5mm, 此即打平curve of Spee時所需增加的距離。
- 二項的總和, 即代表著中齒列區所需要的空間。

3. Prsterior denture area

- ①同樣量出 $\overline{87}$ | $\overline{78}$ 的required space和available space以求得其tooth size discrepancy。
- ②estimated increase (圖四) 則是預估在成長年齡的小孩, 其後牙區可能會增加的距離, 一般依年齡與性別的差異而有所不同, 臨床上的預估是以Ceph tracing上的第一大臼齒後緣沿著咬合平面到下顎枝前緣的距離為主。每年增加3mm (一側1.5mm) 男孩長到16歲、女孩長到14歲。

由以上空間之換算, 以求得前、中、後, 三個齒列區的個別空間差異及整體的空間分析數值。

B. Differential diagnostic gnildline (圖五)

由A.項的空間分析結果, 即可利用此guide line

來決定治療的方向與該拔除的牙齒, 基於篇幅僅列出頭二款。

C. Treatment planning for class II case (圖六)

在此圖表中, 可告訴我們如何利用拔除牙齒後的空間, 來改善class II的molar relationship, 同時可計算出當 $\overline{6}$ | $\overline{6}$ 前移時, 後牙齒列區的空間變化。

II. Mechanics

傳統的Tweed technique其mechanism大致可分成六個步驟, 不但過程繁鎖複雜, 而且需要彎上幾十組的archwire, 而Dr. Merrifield所改良的新Tweed technique, 其mechanism大致只分成四個步驟, 所需更換之archwire也只要5~6組左右, 使其在臨床上之實用性大為增加, 唯其在治療過程中均使用rectangular archwire, 再配合sequential banding和extraoral force的使用來達成其治療目標。

其一般步驟如下:

A. Denture preparation (齒列位置設定期)

1. leveling

(圖五)

I. ANTERIOR DEFICITS:

	Non-Extraction
A. + to -2 MM.	EXTRACT: $\frac{8}{8} \quad \quad \frac{8}{8}$
B. 3 MM to 5 MM without crowding.	EXTRACT: $\frac{5}{5} \quad \quad \frac{5}{5}$
C. 3 MM to 5 MM with crowding.	EXTRACT: $\frac{4}{5} \quad \quad \frac{4}{5}$
D. 5 MM to 7 MM with less than 3 MM anterior crowding.	EXTRACT: $\frac{4}{4} \quad \quad \frac{4}{4}$
E. 5 MM to 7 MM with more than 3 MM anterior crowding.	EXTRACT: $\frac{4}{4} \quad \quad \frac{4}{4}$
F. 7 MM to 15 MM anterior deficit.	EXTRACT: $\frac{4}{4} \quad \quad \frac{4}{4}$
G. 16 MM and above.	EXTRACT: $\frac{X}{X} \quad \frac{4}{4} \quad \quad \frac{4}{4} \quad \frac{X}{X}$

II. MID-ARCH DEFICITS: The anterior deficits override mid-arch deficits so the 1st determination is a decision on I above.

C & D include mid-arch decisions.

A. + to 3 MM

B. 3 MM to 5 MM without crowding EXTRACT: $\frac{8}{8} \quad | \quad \frac{8}{8}$

C. 3 MM to 5 MM with Class II molar. EXTRACT: $\frac{4}{5} \quad | \quad \frac{4}{5}$

D. 5 MM to 7 MM with upper anterior protrusion. EXTRACT: $\frac{4}{5} \quad | \quad \frac{4}{5}$

E. 5 MM to 7 MM. EXTRACT: $\frac{5}{5} \quad | \quad \frac{5}{5}$

F. 8 MM to 15 MM. EXTRACT: $\frac{PX}{PX} \quad \frac{4}{5} \quad | \quad \frac{4}{5} \quad \frac{X?}{X?}$

G. Over 15 MM. EXTRACT: $\frac{X}{X} \quad \frac{4}{5} \quad | \quad \frac{4}{5} \quad \frac{X}{X}$

(圖六)

TREATMENT PLANNING FOR CLASS II CASES

Anterior Denture Area	Deficit _____ Surplus _____
Mid-Arch Denture Area	Deficit _____ Surplus _____
Total (Anterior-Mid Arch)	Deficit _____ Surplus _____
Extraction Space	Deficit _____ Surplus _____

If a Deficit remains go to A

If a Surplus remains go to B

A- 1. When all the extraction space has been used to correct the Anterior and Mid-Arch deficit, the remaining deficit is absolute for the Anterior and Mid-Arch, and dictates:

- a. A compromise of results, or
- b. A resolution in the mandibular posterior area.

2. The Class II correction must be done in the maxillary arch.

Class II Correction _____

- a. Anchorage is critical.
- b. Posterior discrepancy is absolute.
- c. So, any posterior discrepancy must be eliminated for Anchorage Preparation.
- d. A maxillary molar needs to be removed and the choice is made using the Diagnostic Guidelines.

B- It means the lower molars can be moved forward the amount of the extraction space left over.

Carry Over Surplus _____

Class II Correction _____

Deficit _____ Surplus _____

- a. The remaining deficit must be corrected in the maxillary posterior area, so anchorage and Class II mechanics must be considered.
- b. The mesial molar movement is added to the posterior denture area as a surplus.
- c. With the use of Diagnostic Guidelines, a maxillary molar is usually removed.

Posterior Denture Area Extraction Space _____ Deficit _____ Surplus _____

Mesial Movement of 616 Deficit _____ Surplus _____

- Class II Correction
- a. 5mm if the Class II is on one side.
 - b. 10mm if the Class II is on both sides.

- 2.individual tooth alignment
- 3.Cuspid retraction
- 4.terminal molar anchorage preparation

B.Denture correction (齒列改正期)

- 1.Maxillary
 - ①anterior retraction
 - ②space close
 - ③initial posterior denture positioning
- 2.mandibular
 - ①lower incisor positioning
 - ②space close
 - ③anchorage preparation
 - ④root paralleling and alignment

C.Denture completion (齒列完成期)

- 1.final space close
- 2.final positioning and alignment
- 3.cusp seating
- 4.Esthetic arrangement of anterior segments
- 5.Achievement of overtreatment objectives
- 6.progressive appliance removal

D.Denture Recovery (齒列恢復期)

為了讓讀者們能更清楚的了解到整個治療的過程，筆者引用了Dr. Merrifield在Tweed foundation的Journal中文章的圖表來加以說明：

- 1.sequential banding $\bar{7}$ 、 $\bar{5}$ 、 $\bar{3}$ 、 $\bar{1}$ ，先分別量出 $\bar{7}$ 、 $\bar{5}$ 的前傾角度
- 2.維持 15° 的 effective tip 來 upright $\bar{7}$ ，同時使用 H.P.H.G 來 retract $\bar{3}$ 和 level $\bar{5}$
3. Tip back 在第三次約診時，才 band $\bar{6}$ ，同時繼續 Tipback $\bar{7}$ 和 retract $\bar{3}$
- 4.第一階段完成時，所有的牙齒均已上環套，拔牙空間均已關閉而 $\bar{7}$ 則 Tip back 15°
- 5.上顎同樣做 Sequential banding，同時分別量

出後牙的前傾角度

6. $\bar{7}$ 維持 10° 的 effective tip，同時使用 H.P.H.G. 來 retract $\bar{3}$
- 7.第二次約診時 band $\bar{6}$ ，同時繼續 retract $\bar{3}$
- 8.第一階段完成時，所有拔牙空間均已關閉，而後牙區則維持 slight curve of Spee
- 9.開始第二個階段，denture correction 使用 Vertical loop 和 H.P.H.G. 來 retract 門牙和關閉所有的空間
- 10.空間關閉完成
- 11.上顎第二階段亦同樣的使用 Vertical loop 和 H.P.H.G. 來關閉空間
- 12.空間關閉完成
- 13.下顎開始 10-2 anchorage preparation，先做 10-2-6， 10° Tip back $\bar{6}$ ，同時使用 H.P.H.G.
- 14.10-2-6 完成
- 15.做 10-2-5 anchorage preparation
- 16.10-2-5 完成
- 17.上頰維持著 Curve of Spee
- 18.當白齒關係是 Class I 或稍微 end-on 時，則使用 H.P.H.G. + class II Elastics 和 Up & down Elastics 來達成 overtreated class I occlusion
- 19.若白齒關係是 Class II 時，則依 ANB 的角度大小，及病人合作的程度來決定是否再拔牙以達白齒關係的改善
- 20.利用 bulbous loop 和 sliding jig 外加 H.P.H.G. + class II Elastics 及 up & down Elastics 來達成 class I occlusion
- 21.第三階段則做些微的調整以利 cusp seating 和 detailing the treatment
- 22.overcorrection 以達到 Tweed occlusion
- 23.最後一階段則是 Recovery stage 在矯正器去除後，讓牙齒自己 settle 下來，以維持一功能性咬合

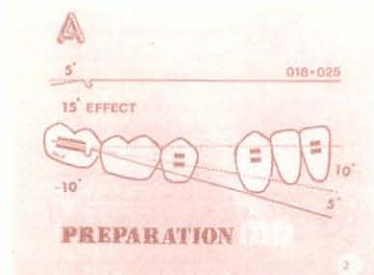


Figure 1 The mesial inclination of the molar adds to the effect of the bend in the archwire. Ten degrees of mesial inclination combined with 5° tip in the wire produces a 15° effect.

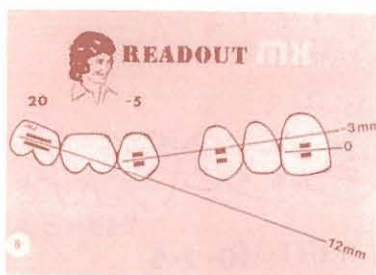


Figure 5 A readout of the maxillary teeth shows the axial inclination of the terminal molars and the second bicuspids.

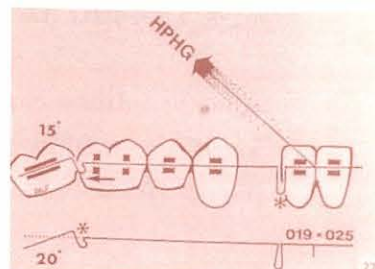


Figure 9 The force system for anterior retraction. Note the adjustment of the tie back stop for proper compensation of the tipped terminal molar.

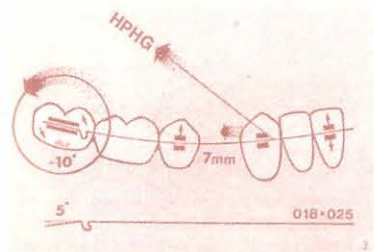


Figure 2 Activation of the 0.018" x 0.025" edgewise archwire with the high-pull headgear produces sequential force on the terminal molar, second bicuspid and the cuspid. It supports the central incisors.

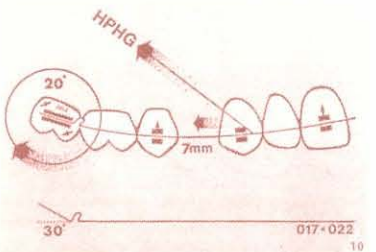


Figure 6 The high-pull headgear, applied against the cuspid, retracts the cuspid, restrains the incisors, helps upright the second bicuspid and activates the tip on the second molar.

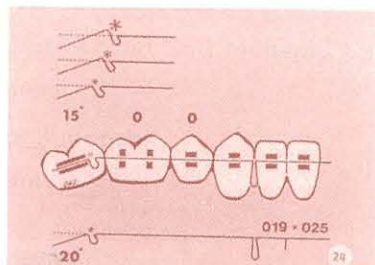


Figure 10 The necessary adjustments to the bent-in-loop stops are detailed during retraction of the anterior teeth.

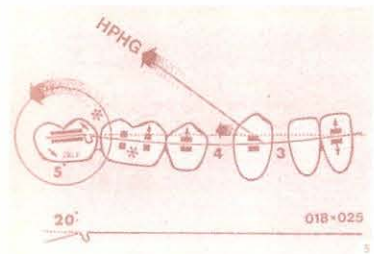


Figure 3 An increase in the terminal molar tip of 10° in the archwire will produce 5° of distal tip in the molars and an additional one and one-half millimeters of distal movement of the cuspid in one month. The first molars can now be easily banded.

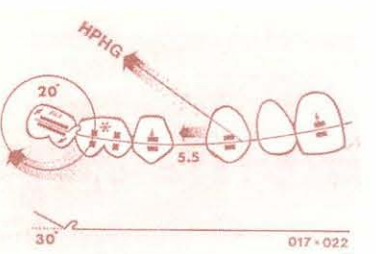


Figure 7 The result of one month of this force system should produce one and one-half millimeters of distal movement of the cuspid, leveling in the bicuspid areas, and slight spacing between the first and second molars as the second molars tip distally. The first molars are now banded.

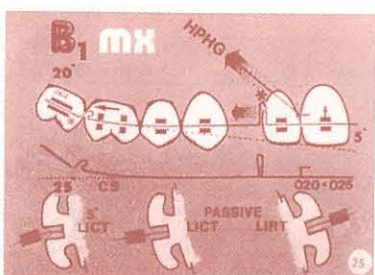


Figure 11 The maxillary archwire and force system for maxillary denture correction.

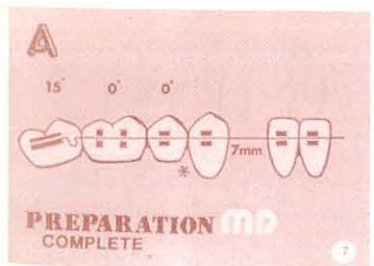


Figure 4 The lateral incisors are banded, all posterior teeth are ligated together and the distal force on the molar further tips these teeth as the cuspid retract. The lower arch should be level with all teeth in bracket engagement and the terminal molars tipped distally to 15°.

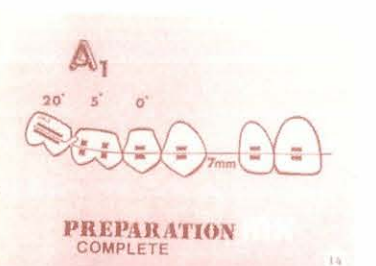


Figure 8 Completion of maxillary denture preparation. The cuspid are fully retracted, the mid-arch has a slight curve of Spee, and the second molars are in at least their original axial inclination.

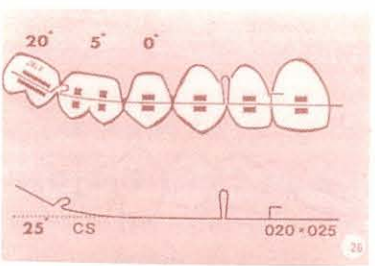


Figure 12 At this stage of denture correction, the spaces are closed. The teeth should be positioned as shown.



Figure 13 The second step of the mandibular ten-two anchorage preparation 10° of tip in the first molar areas. 10-2-6.

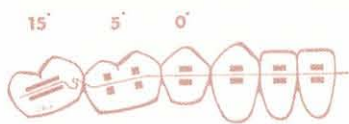


Figure 14 Readout values after the first molars are prepared.

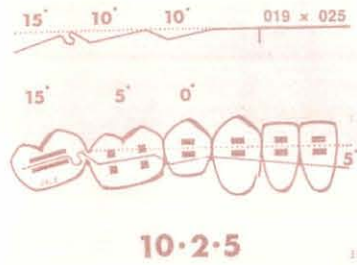


Figure 15 The mandibular archwire adjusted for the third step of ten-two anchorage preparation. 10-2-5.

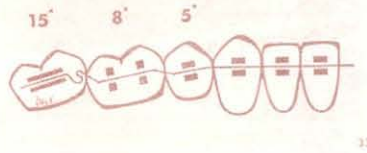


Figure 16 Readout values following the completion of mandibular anchorage preparation with the ten-two system.

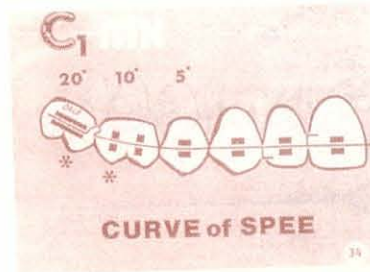


Figure 17 Maxillary posterior denture inclinations are confirmed by a readout. The values shown are ideal.

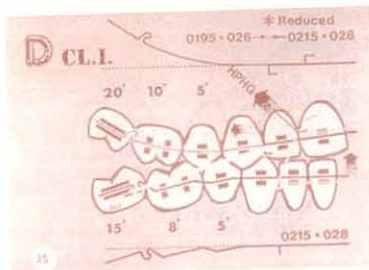


Figure 18 Directional force system for occlusal adjustment of Class I or slightly end-on occlusions.

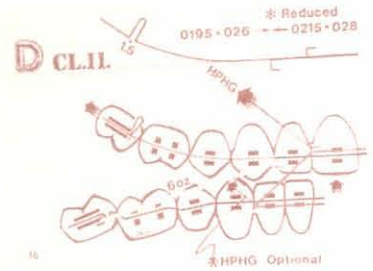


Figure 19 The Class II sequential directional force system adjustment #1.

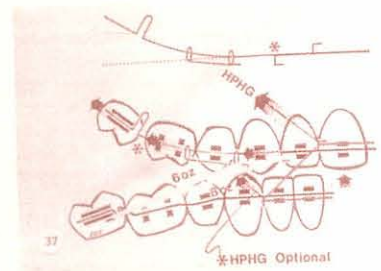


Figure 20 The Class II sequential directional force system adjustment #2. Note the utilization of two elastics on each side.

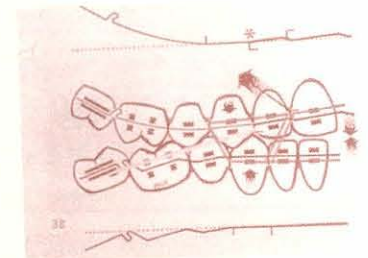


Figure 21 The final archwires for cusp seating and detailing the treatment.



Figure 22 Ideal overtreatment at the time of band removal. Note the cuspid and bicuspid occlusion and incisal relation.

III. 病例報告

Class II Division I, Bimaxillary protrusion, treated with $\frac{44}{44}$ extraction

PATIENT DIAGNOSTIC DATA SHEET

1. CEPHALOMETRIC DATA

- FMA.....27°
- IMPA.....98°
- FMIA.....55°
- SNA.....93°
- SNB.....86°
- ANB.....7°
- Z ANGLE.....69°
- UPPZR LIP.....10mm
- TOTAL CHIN.....11mm
- FACIAL HEIGHT.....69mm

2. TOTAL DENTITION SPACE ANALYSIS

- A. Anterior denture area
 - (1) Required
 - a. tooth width.....37mm
 - b. headfilm correctim.....10.4mm
 - c. Soft tissue modification.....0
 - (2) Available.....37mm
 - Deficit 10.4mm
- B. Midaarch denture area
 - (1) Required
 - a. tooth width.....54mm
 - b. curve of Spee.....2mm
 - (2) Available.....54mm
 - Deficit 2mm
- C. Posterior denture area
 - (1) Required.....42mm
 - (2) Available
 - a. presently available.....20mm
 - b. estimated increase.....6mm
 - Deficit 16mm

DENTURE TOTAL DEFICIT 28.4mm

- D. Extraction space
 - (1) 1st bicuspid width.....15mm
 - (2) 3rd molar width.....21mm
 - TOTAL 36mm

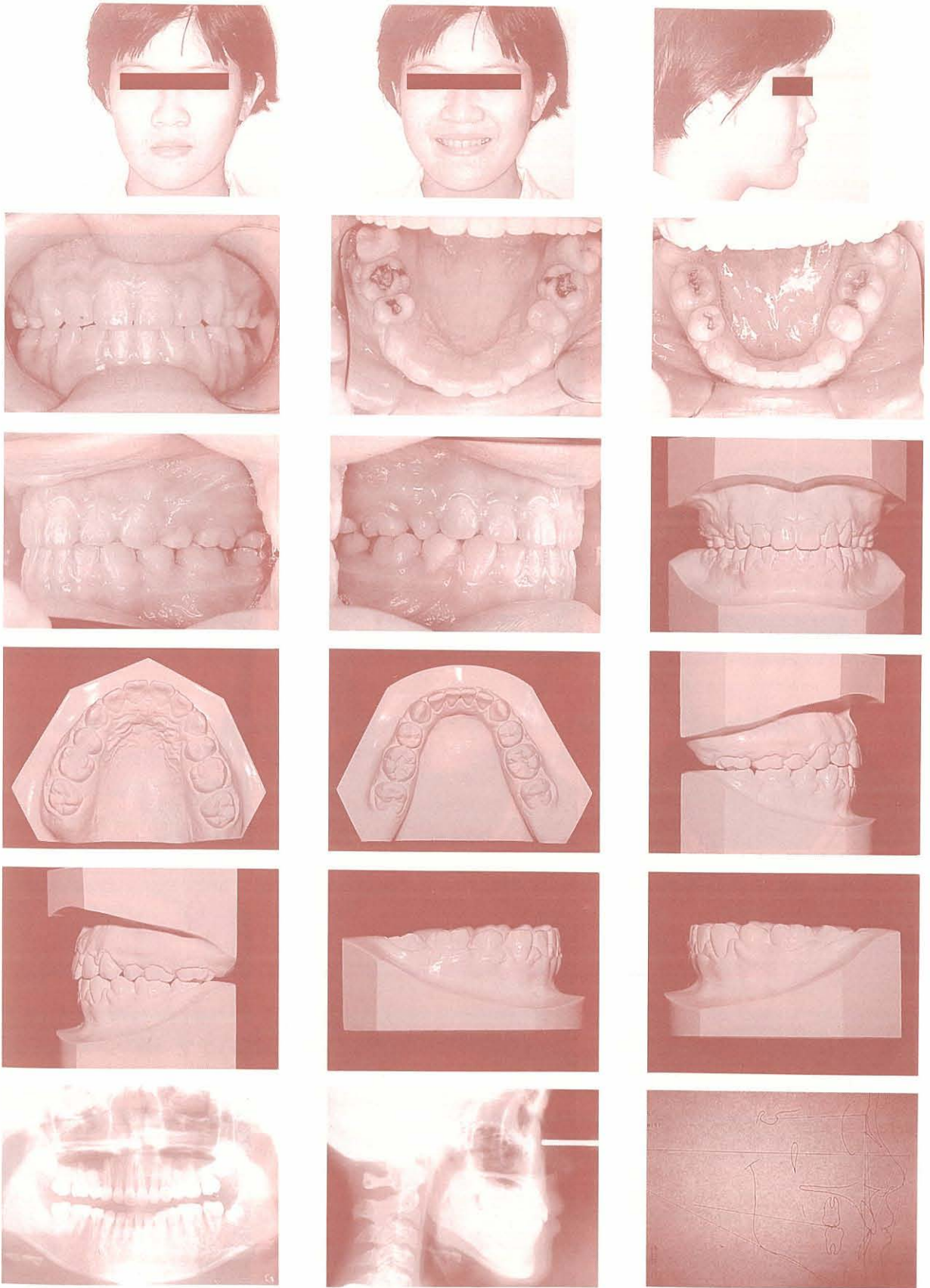
3. OTHER DATA

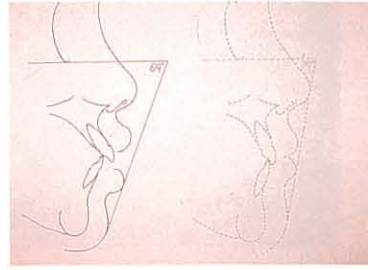
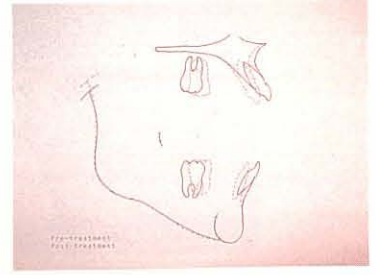
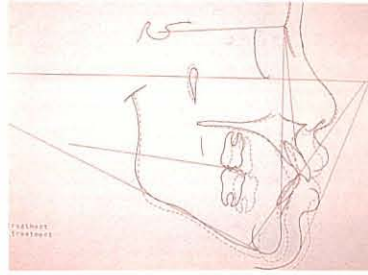
- (1) Class II Division 1 malocclusion with 2mm curve of Spee and bimaxillary protruding, lip incompetence.
- (2) Impaction of upper left 2nd bicuspid
- (3) Female Chinese
- (4) Age: 12 years 3 months
- (一) pre-treatment 治療前
 - (1) photo
 - (2) model
 - (3) Panorex
 - (4) Ceph & tracing
- (二) Post-treatment 治療後
 - (1) photo
 - (2) model
 - (3) panorex
 - (4) Ceph & tracing
- (三) Before and after Cephalometric superimposition
- (四) Recovery stage 恢復期
 - (1) photo
 - (2) model

<後記>

臨床上，針對不同的矯正病例，依其病因，咬合分類、病人的生長條件與合作程度等等因素而有不同的診斷與治療方式。Dr. Merrifield所提出的整套technology則仍保存著Tweed philosophy的一貫傳統精神，重視anchorage preparation， overcorrection的理念，講究空間分析及鑑別診斷，注重顏面美觀的改善，以達stable

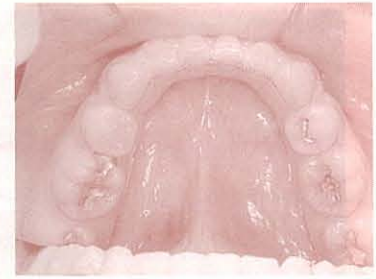


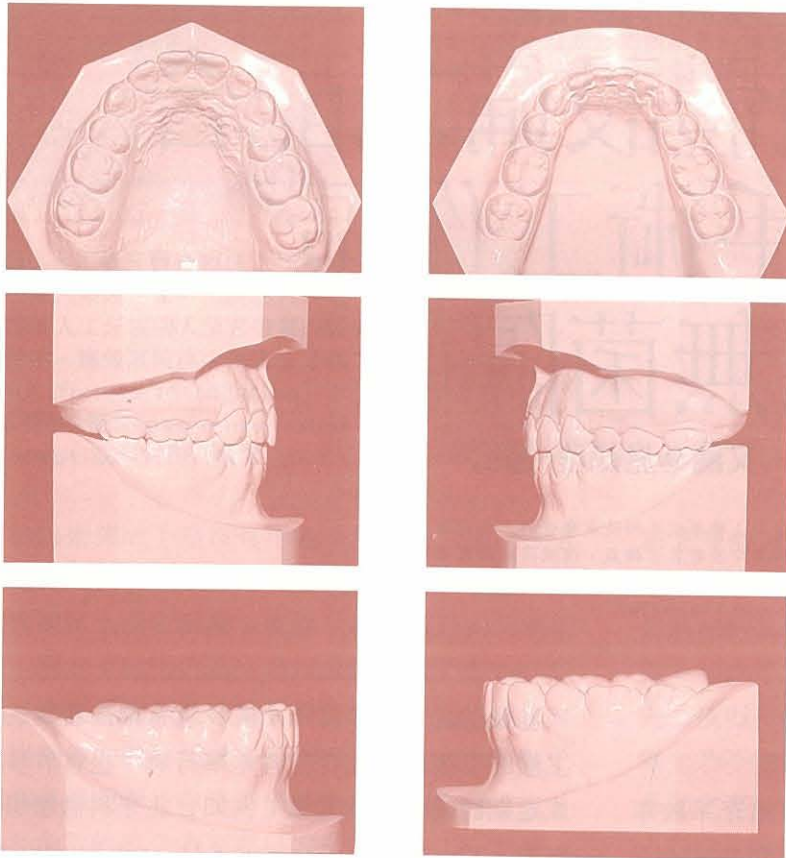




P. J. CHUNG

cephalometric	mm	pre-Tx	POST-TREAT
SNA	88°	55°	69°
SNB	81°	25°	25°
SNPA	81°	30°	44°
SNB1	83°	93°	90°
SNB2	80°	66°	82°
SNB3	3°	7°	3°
SNB PLANG	10.14	7°	7°
2 ANGLE	74°	63°	79°
UPPER LIP		10	11
ORAL CHIN		11	13
FACIAL HEIGHT		88.88	89
NO - NO	DRG 2	R	-2





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 • 華品牙醫診所矯正主治醫師

， esthetics， health， function 的四大目標。唯其在診斷與 technique 上仍太偏重於個別牙齒的空間移動，而對於整個矯正治療過程中扮演著重要角色的顎骨生長，仍欠缺一分完整而有效的評估與預測，這或許是美中不足之處，不過就整個治療的 mechanism 而言，實可稱的上是嚴密

而完整，它對於一個矯正的學習者，提供了良好的思維方向。

最後感謝中山校友會及梁會長給我這個篇幅報告的機會，同時也利用這個機會感謝我的矯正入門老師周固猷醫師，及多年來，在臨床上給我個人許多指導的林祥健醫師及滕起民醫師。

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