The Level Anchorage Orthodontic System

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去年11月21-22日南加州大學齒顎矯正研究所教授Dr. Root應LAS聯誼會及馬偕醫院牙科部之邀來臺講授Level Anchorage矯正系統。由於課程精簡實用，聯誼會特編撰摘要供讀者進一步了解，對於已聽過課程的同仁則可溫故知新。

由於同仁反應頗佳，聯誼會已與馬偕醫院牙科部著手安排LAS進階課程於本年度10月底舉行，屆時歡迎各位讀者蒞臨指教。

本文承蒙Dr. Root審校，中華牙醫學會出版委員會王天美教授多方襄助，賴海元教授鼓勵得以完成，聯誼會在此謹致由衷的謝意。

The Level Anchorage System of edgewise orthodontic treatment is a blending of the new and old. The new consists of deformation resistant preformed arch wire (Fig. 1) in combination with accurate preadjusted brackets and cast tubes that provide tip,torque, inset,offset and rotational control (Fig. 2 & Table 1). The old consists of time honored precepts that state the human changes very slowly.

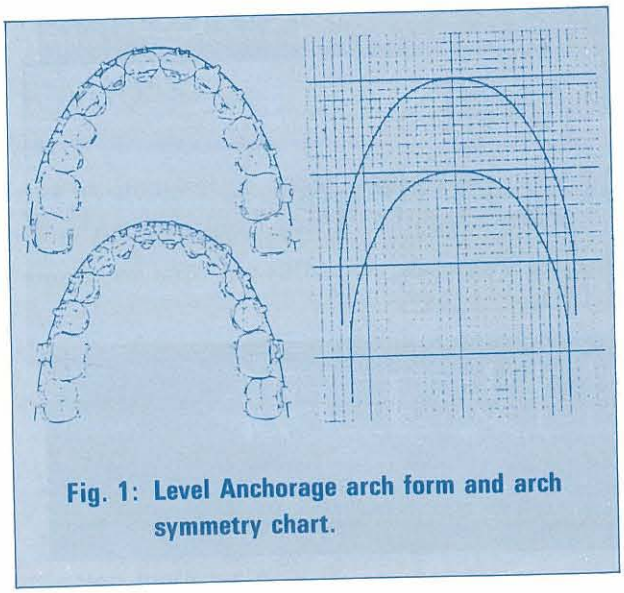


Fig. 1: Level Anchorage arch form and arch symmetry chart.

Generalized orthodontic goals of proper function, stability and pleasing esthetics are universally accepted. Function should be based on gnathological concepts. Stability means that when treatment is complete, the teeth do not relapse but stay in their new position. Esthetics is a subjective term that means the teeth and face are pleasing to the eyes of the beholder.

Correction of the malocclusion must take place within critical anatomical limits (Boundaries of the denture) if a stable end result is to be achieved.

Boundaries of the denture according to the Level Anchorage system:

1. "B" point is the anterior boundary for the lower anterior roots. Gingival recession on the labial occurs if these roots are moved bodily forward. If lower anterior roots are moved lingually, "B" point follows. Once "B" point has been retracted, it can not be brought forward again.

2. Lower arch width. Original lower canine width, providing the canines are not blocked out labially or lingually, can not be expanded without compromising stability.

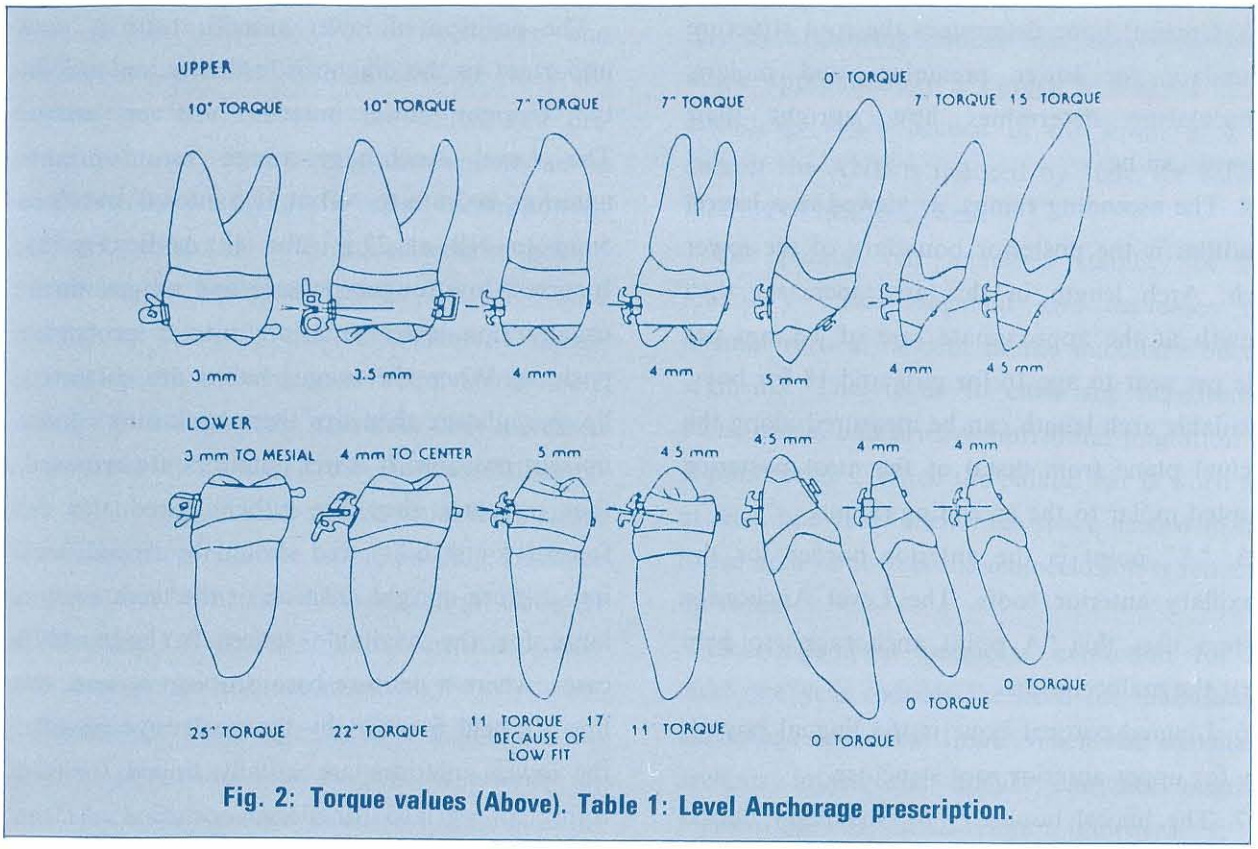


Fig. 2: Torque values (Above). Table 1: Level Anchorage prescription.

Tooth	First Order	Second Order	Third Order
$\underline{1}$	Medium Thick	4° Mesial Crown	15° Labial Crown
$\underline{2}$	Thick	7° Mesial Crown	7° Labial Crown
$\underline{3}$	Thin	6° Mesial Crown	0° Labial Crown
$\underline{4}$	Thin	0°	7° Lingual Crown
$\underline{5}$	Thin	0°	7° Lingual Crown
$\underline{6}$	15°	0°	10° Lingual Crown
$\underline{7}$	10°	15° Distal Crown	10° Lingual Crown
$\overline{1}$	Thick	2° Mesial Crown	0°
$\overline{2}$	Thick	2° Mesial Crown	0°
$\overline{3}$	Thin	6° Mesial Crown	0°
$\overline{4}$	Thin	4° Mesial Crown	11° Lingual Crown
$\overline{5}$	Thin	Regular: 4° D.C. / Major: 6° D.C.	11° Lingual Crown Same as 17° Lingual Crown Because of low fit
$\overline{6}$	10°	6° D.C.	10° D.C. 22° Lingual Crown
$\overline{7}$	10°	10° D.C.	15° D.C. 25° Lingual Crown

3. Cortical bone determines the root structure boundary for lower premolars and molars. Musculature determines how upright their crowns can be.

4. The ascending ramus, as viewed in a lateral headfilm is the posterior boundary of the lower arch. Arch length in this area increases thru growth at the approximate rate of 1 ½ mm per side per year to age 16 for girls and 18 for boys. Available arch length can be measured along the occlual plane from distal of the most posterior erupted molar to the ascending ramus.

5. "A" point is the anterior border for the maxillary anterior roots. The Level Anchorage system uses this "A point anchorage" to help treat the malocclusion.

6. Lingual cortical bone is the lingual boundary for upper anterior root structure.

7. The buccal boundary for maxillary buccal teeth is based on proper function with the mandibular teeth. Widening of the mid palatal suture does provide some expansion of the maxillary arch, but it is generally limited to correct function with the lower arch.

8. The maxillary tuberosity is the posterior boundary of the maxillae. This area increases in length approximately 1 ½ mm per side per year to age 16 for girls and 18 for boys.

The position of lower anterior teeth is very important to the diagnosis, esthetics and stability. "Upright" lower anteriors are very stable. The Level Anchorage range for "upright" anteriors is 3mm to NB at 17 ½ ° for 0° ANB to 5mm to NB at 22 ½ ° for 4° ANB (Fig. 3). Incorrect low tongue posture and tongue thrust usually tips lower anteriors into a protrusive position. When the tongue habits are corrected, lip musculature then tips them back into a more upright position. If lower anteriors are crowded, that indicates they are either tipped too far foward for stability and should be tipped back into a more upright position or the teeth are too large for the available space. In large ANB cases, where a denture base problem is seen, the lips are held forward by the protrusive maxilla, the lower anteriors are usually tipped forward trying to get into functional occlusion. As the upper anteriors are retraced and the ANB angle is reduced, lip pressure increases on the lower anteriors. These teeth then tip back from lip pressure as they attempt to maintain proper function.

The concept of tooth anchorage:

There are two generalized types of anchorage

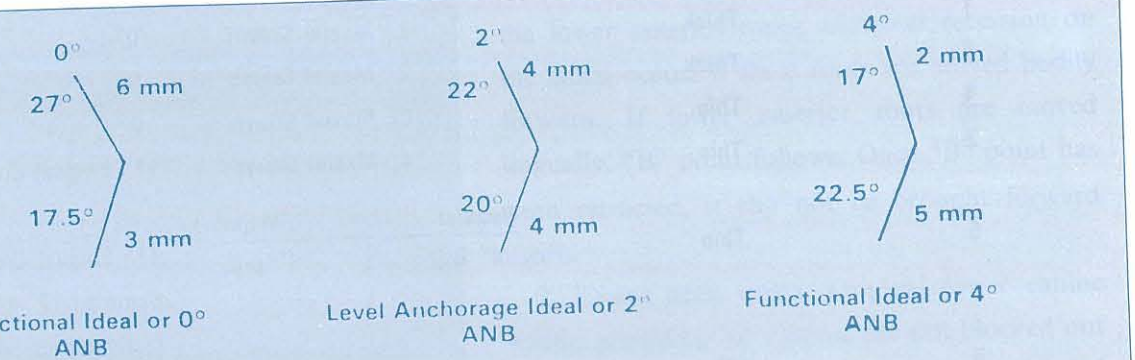


Fig. 3: The positions of "Upright" lower anteriors for 0° ANB; 2° ANB and 4° ANB.

used in orthodontics: Tooth anchorage and anchorage savers. Tooth anchorage may be defined as "Resistance to movement and distance to move". Resistance to movement can be increased by changing the axial inclination of anchor teeth so that when pulled against they do not move as easily as before. Extrusion and tipping are relatively easy movements. Depression and bodily movement are relatively difficult. Tooth anchorage can therefore be increased (Prepared) by changing the mesioaxial inclination of the buccal teeth to distoaxial inclination, thus increasing resistace to mesial pull. Distance to move can be increased by extraction. Class III elastics that tip the lower buccal crowns distally also increase the distance to move.

Anchorage savers are those orthodontic adjunctive procedures that reduce the amount of tooth anchorage needed to correct the malocclusion. For examples: (1)Using a headgear and a palatal bar (2) Delaying extraction of the maxillary premolars till later in treatment, (3) Lip bumpers and (4) Musculature pattern of low mandibular angle cases.

High pull facebow headgear to the maxillary first molars or high pull J hook headgear attached to the maxillary anterior area with 1 pound pressure on each side, worn 12 hours per day by a growing patient will reduce the ANB angle approximately 1° every 6 months. Thus anchorage space needed in the lower arch to correct the ANB is reduced by 1mm for each 6 months of headgear wear.

The palatal bar increases stability of the maxillary buccal segment and decreases the normal vertical descent of the maxillary buccal segments. This tends to close the mandibular plane angle, and a more horizontal migration of B point occurs. When the palatal bar is worn for at least one year, anchorage space needed in the lower arch to correct the malocclusion is reduced by 1mm.

Delaying upper premolar extraction for at least one year reduces the need for mandibular anchorage space by 1mm. When the maxillary arch is intact, the molars can not migrate forward thus the molar relation improves.

Class III elastics worn 24 hours per day to the inital mandibular arch wire will level the curve of Spee at a rate of 1mm per month. If space is available distal to the mandibular second molars, the buccal segments will continue to tip distally $\frac{1}{2}$ mm per side per month. Anchorage space created by Class III elastics is therefore 1 mm per month for up to 6 months. After that, the second molars will usually start burying

Extractions	+Value	−Value	Space to Save
$\frac{4\|4}{4\|4}$	15	3	+3+ANB change(＃5) −＃s 6,7,8, and 13
$\frac{5\|5}{4\|4}$	15	4	+4+ANB change(＃5) −＃s 6,7,8, and 13
$\frac{4\|4}{5\|5}$	15	5	+4+ANB change(＃5) −＃s 6,7,8, and 13
$\frac{5\|5}{5\|5}$	15	7	+6+ANB change(＃5) −＃s 6,7,8, and 13
$\frac{6\|6}{8\|8}$	7	—	— — —
$\frac{4\|4}{}$ only	4	—	— — —
$\frac{5\|5}{}$ only	3	—	— — —

under soft tissue.

The anchorage values available when various teeth are extracted or missing and anchorage space to save during Step 3.

Measuring anchorage requirements:

The severity of the malocclusion is quantified as a function of seven clinical variables:

1. Depth of curve of Spee.
2. Lower arch discrepency: Crowding or spacing.
3. Space needed to upright lower anteriors.
4. Anchorage needed to retract lower canines.
5. Anchorage needed to correct ANB.
6. Additional anchorage needed if mandibular plan angle is high.
7. Anchorage needed to retract upper anteriors in extraction cases.

Anchorage requirements are considered negative values. Anchorage available is considered a positive value. A treatment plan is then reached by balancing the negative anchorage requirements against the positive anchorage available.

The ideal goal of 2° ANB angle is usually chosen if the malocclusion is not too severe. When the original ANB is low or tends toward a Class III malocclusion, the 0° ANB goal is chosen. When the original ANB is 7° to 10° the 4° ANB goal is usually used. The difficulty of the orthodontic case is directly related to how much change the orthodontist intends to achieve. Choose the goal that is best for the patient and is attainable (Fig. 4).

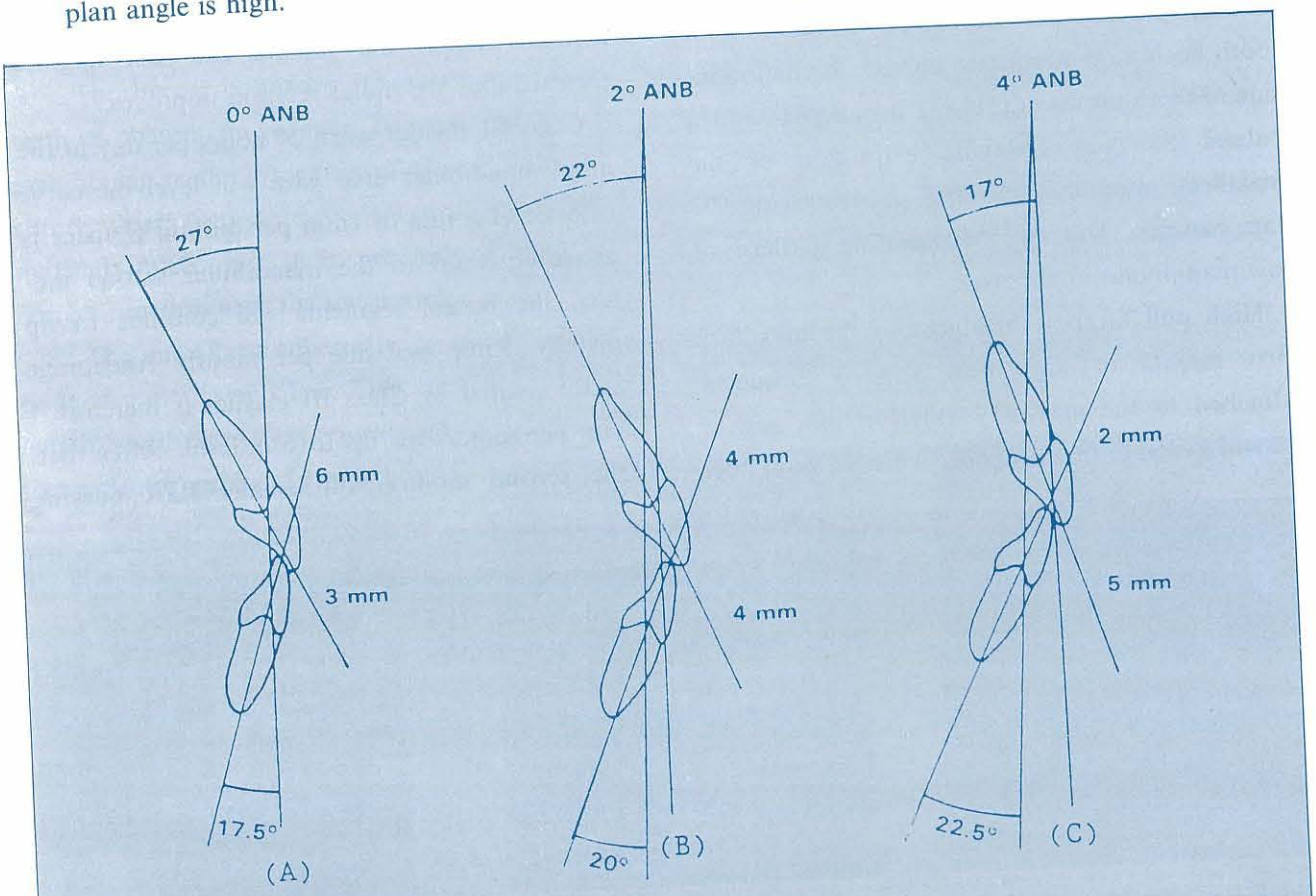


Fig. 4: The ideal goal range.

In the Level Anchorage system, most patients are treated using the following basic steps:

1. The upper arch is stabilized for anchorage.
2. Anchorage is prepared in the lower buccal segments.
3. If the malocclusion required premolar extraction, the lower canines are then retracted.
4. The lower anteriors are banded and tipped upright.
5. The lower arch is stabilized, and the molar relation corrected if needed.
6. Space closure is completed in the upper arch.
7. The case is detailed, finished, and retained.

The measurable malocclusion problems are recorded in the treatment plan chevron representing headfilm land marks (Fig. 5), then in the negative column of the analysis chart, representing anchorage required (Fig. 6; [−]), and the anchorage available in the positive column (**Fig. 6**; [+]).

Charting the anchorage problem:

Line 1.

Depth of curve of Spee in mm (−): Measured from buccal groove of lower second molar–lower anteriors to occlusal plane of premolars. Use average depth of both sides. It takes 1mm of arch length to level each mm of curve.

Line 2.

MM discrepency (−) or space (+) in lower arch: Estimate the amount of lower arch crowding or spacing. Crowding goes in the negative column, spacing in the plus column. It take the same amount of arch length to provide space for crowding.

Line 3.

MM to upright the lower anteriors: Subtract the goal from the problem position and multiply by two. Do not multiply if only one or two anteriors are tipped forward. Now add the first 3 lines to make a tentative decision on whether the case is a premolar extraction case or not.

Line 4.

Molar anchorage loss: After lower premolars are extracted the canines must be retracted to relieve crowding and permit anterior teeth to tip back to the goal position. While retracting the lower canines, the buccal segments move forward one–sixth the amount then canines retract. Add lines 2 and 3 and divide by 6 to determine molar anchorage loss.

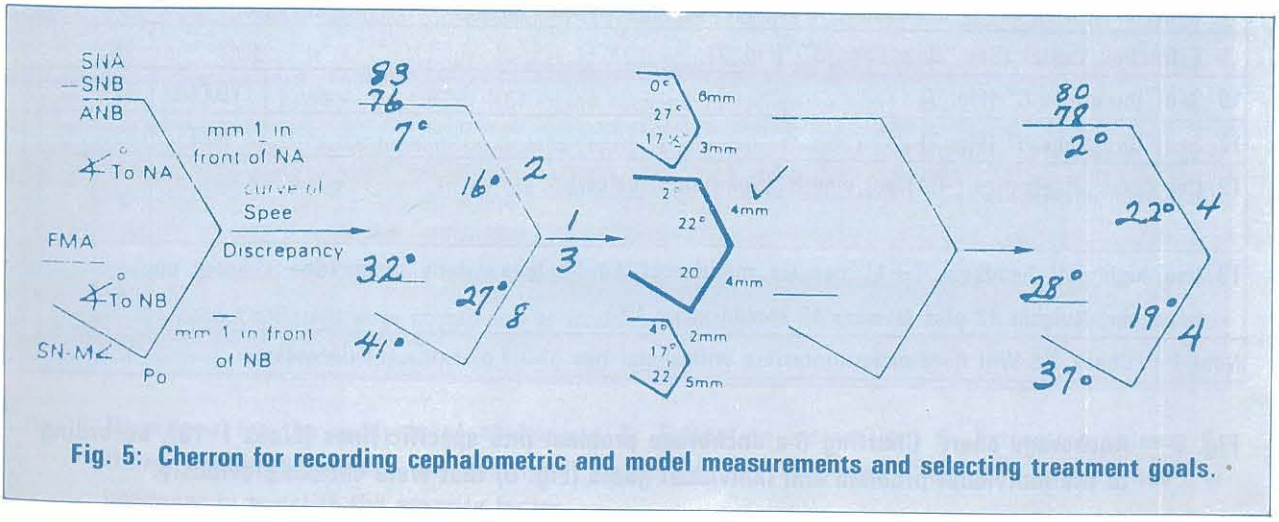


Fig. 5: Cherron for recording cephalometric and model measurements and selecting treatment goals.

Line 5.

ANB change: There is major or regular distal crown tip for the mandibular buccal teeth for Class II elastics to correct the ANB. Regular: The second premolar 4°, first molar 6°, second molar 10° of distal crown tip. Major: The second premolar 6°, first molar 10°, second molar 15° of distal crown tip (Fig. 8). If major anchorage is used it will take 1mm space in the lower buccal segments to reduce 1° of ANB, it will take 1½ mm when regular anchorage is used. The choice of regular or major anchorage depedns on the severity of the malocclusion. Use major anchorage if ANB change is large or if lines 1 thru 4 add up to 11 or more. Use regular anchorage if Class III type or low ANB.

Line 6.

Mandibular plane angle: If FMA is 8° higher than average the case will take 1mm of additional anchorage. Muscles of mastication are not as effective, anterior bite tends to open, mandible tends to rotate downward and direction of chin growth is more vertical. If the FMA is 8° lower than average the case has equivalent to 1mm of available anchorage. The muscles of mastication are strong and effective, anterior bite tends to close, mandible tends to rotate upward and the direction of chin growth is more horizontal. The value may be changed ½ mm for each additionnal 4°.

CHARTING THE ANCHORAGE PROBLEM		+	−
1 Depth of curve of Spee in mm(−)			1
2 MM discrepancy (−) or space (+)in lower arch			3
3 MM to upright $\overline{1}$ SUBTRACT GOAL FROM PROBLEM AND MULTIPLY×2			8
4 Add Line 2 and Line 3 Divide by 6 for molar anchorage loss while retracting $\overline{3\|3}$(−)			2
5 ANB change 1½mm per degree for regular anchorage(−) 1mm per degree for major anchorage(−)			R 5 / M
6 Mandibular plane 8° high (−1) 8° low (+1) (Now see directions A)(Fig.7)		1	
7 Use palate bar (+1) if used at least one year			
8 Delay extraction of $\underline{4\|4}$ until ready to retract upper anteriors(+1)		15	3
9 Extraction Values (See "Directions B") (Fig. 7)	TOTAL	17	22
10 See "Directions C" (Fig. 7)	NET		5
11 See "Directions C" (Fig. 7)			
12 Use Class III elastics (+1) per month (See note 1 below)		3	
13 Use high-pull headgear (+1) per six months of 10–12 hours daily wear (See chapter on headgear) Number 12 plus Number 13 should equal NET.		2	
Note 1 : Check $\overline{8\|8}$ Will third molars interfere with distal tips of $\overline{7\|7}$? Extract if necessary.			

Fig. 6 : Anchorage chart. Charting the anchorage problem into specific lines (Lines 1–13), according to the individual problem and individual goals (Fig. 5) that were chosen previously.

Direction A: Here is a summary of extraction suggestion. If lines 1 thru 6 add up to −9 to −11, consider extracting $\underline{4|4}$ and $\overline{5|5}$ or $\underline{5|5}$ and $\overline{4|4}$. The choice between these two would be based on the molar relation. If Class I or Class III tendency, use former; if Class II type use latter suggestion. If total is −12 or greater, extract $\underline{4|4}$ and $\overline{4|4}$ (Fig. 7). Record extraction values on line 9.

Line 7.

Use palatal bar: Available anchorage is increased by 1 if palatal bar is used at least one year. Vertical control by the palatal bar will encourage more horizontal migration of the chin. It also resists mesial migration and rotation of the upper first molars. Add 1 to the + column on line 7.

DIRECTIONS

A. Add Lines 1 thru 6 to Evaluate Problem

1 if total is (−4) or less probably treat nonextraction (Example : gain +4 by use of Class III elastics for four months) May extract $\overline{8|8}$

2 If total is (−5) to (−7) consider extraction of $\underline{4|4}$ only, or extraction of $\frac{7|7}{8|8}$ plus use of Class III elastics and headgear Example Gain +7 with 4 months use of Class III elastics and 18 months of headgear wear

3 If total is (−7) to (−8) consider extraction of $\frac{5|5}{5|5}$ Extraction of $\underline{6|6}$ is equal to (+7) anchorage units

4 If total is (−9) to (−11) consider extraction of $\frac{4|4}{5|5}$ or $\frac{5|5}{4|4}$

5 If total is (−12) or greatet extract $\frac{4|4}{4|4}$

B. Record Extraction Values on Line 9

$\frac{4|4}{4|4} = (+15)(-3)$ $\frac{5|5}{4|4} = (+15)(-4)$ $\frac{4|4}{5|5} = (+15)(-5)$

$\frac{5|5}{5|5} = (+15)(-7)$ $\underline{6|6} = (+7)$ $\underline{4|4} = (+4)$ $\underline{5|5} = (+3)$

C. Try to equalize TOTAL figures by :

1 Add (+1) for use of palate bar at least one year (Line 7)

2 Add (+1) for delay of $\underline{4|4}$ extraction (Line 8)

3 Use "Major" Anchorage (−1) degree of ANB change (Line 5)
"Regular" Anchorage is (−1) per degree of ANB change (Line 5)

D. Subtract TOTAL (+and) for NET if NET figure remains−negative :

1 Use Class III elastics the number of months figure is negative (+1) per month (See Note)

2 Use high−pull headgear (+1) per six months of 10−12 hours daily wear. (See chapter on headgear)

3 In extreme cases if ANB is 8 ° or higher
consider extraction of $\underline{6|6}$ if $\underline{6|6}$ extracted treatment Step 5b is notnecessary
Do not extract $\underline{6|6}$ until atfer completion of treatment Step 6
Add one year treatment time to close first molar space.

fig. 7 Directions for the analysis of anchorage. A: Extraction instruction; B: Extraction values; C: Using anchorage savors for additional anchorage; D: Prescribe Class III elastics and / or headgear to equalize the severity factor.

Line 8.

Delay extraction of 4/4: Add 1 anchorage unit if the upper premolar extraction is delayed until the lower arch is ready for Class II elastics.

Line 11.

Net: Subtract line 10 TOTAL (+and −) for NET. Any negative value here is known as the severity factor. Class III elastics (Line 12) and high-pull headgear (Line 13) should balance the severity factor.

Line 12.

Class III elastics: Class III elastics if worn with the initial lower arch will increase lower arch length $\frac{1}{2}$ mm per side per month up to six months. If additional Class III's are necessary they are effective during lower anterior retraction (Step 4).

Line 13.

High-pull headgear: Either facebow or "J" hook will decrease the ANB approximately 1° for every six months of 10 to 12 hours daily wear. Lines 12 and 13 should add up to the severity value. Usually lines 12 and 13 are the same value or line 12 is given 1 higher value. Example: If the severity value is −7, wear Class III's four months and headgear 18 months (3 anchorage units). The ANB angle reduces approximately 1° every six months, do not wear upper headgear longer than desired ANB change. If the ANB is low, but crowding is high, use more Class III's and less headgear. If the ANB is high and the crowding is low (Large Class II) use less Class III's and more headgear. Cases with severity factor of 0 to −4 are fairly easy to treat. −7 to −8 are difficult to treat. −10, super cooperation is required. Consider either changing the goal, or extract upper first molars (+7 extraction value).

The reason that a severity factor of −10 is near the limit of a successful treatment is that six months of Class III elastics and two years of headgear is about all the cooperation we can expect from most patients.

An example of how to treat a difficult Class II division I four premolar extraction case where the analysis chart calls for pallatal bar, delaying extraction of upper premolars, Class III elastics and headgear. Treatment steps, arch changes,

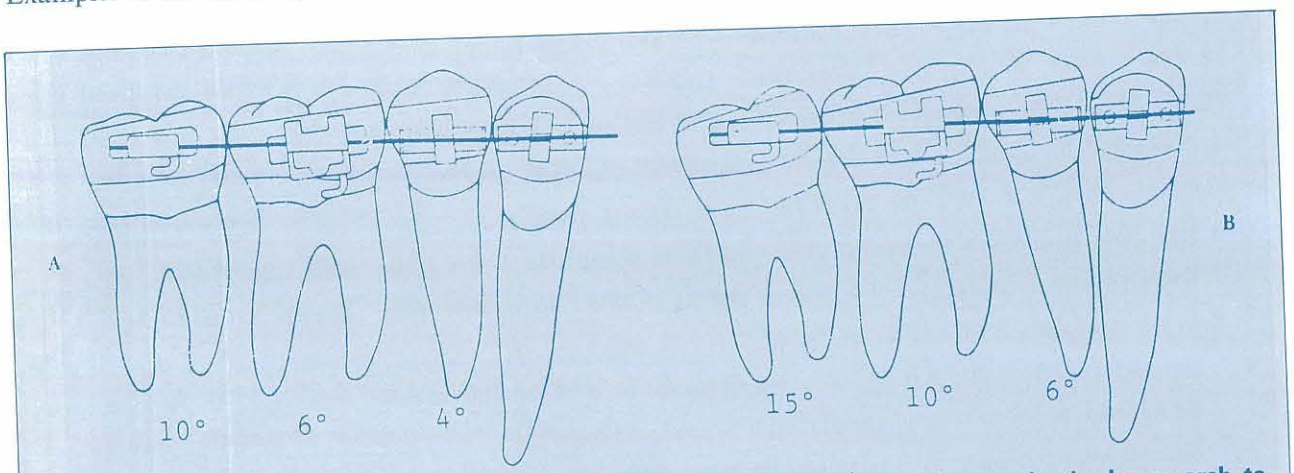
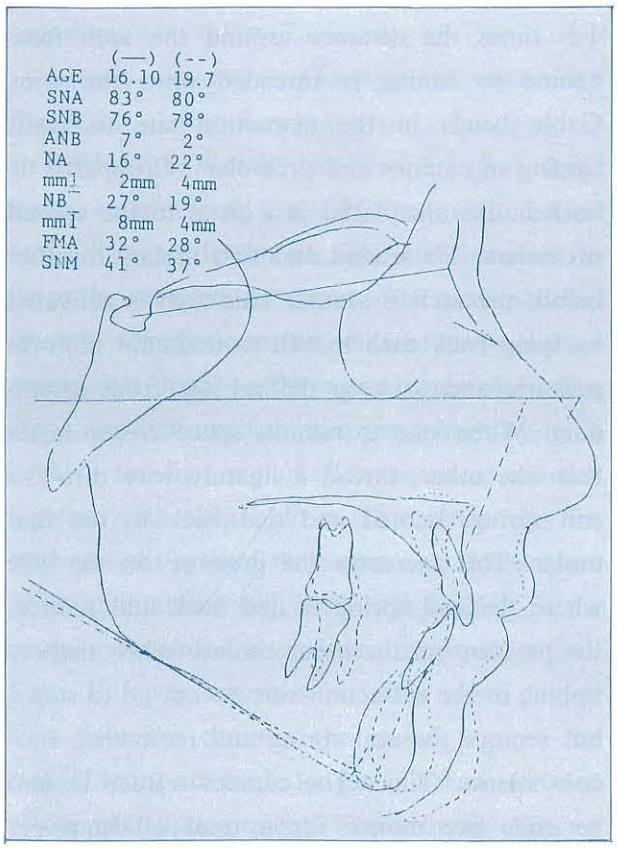


Fig. 8: A. Regular anchorage; B. Major anchorage. It will takes 1 $\frac{1}{2}$ mm of space in the lower arch to reduce 1° of ANB if Regular anchorage is used. It only takes 1mm of anchorage space in the lower arch to reduce 1° of ANB if Major anchorage is used (using Class II elastics).

time for each step and the self check for each step are discussed here.

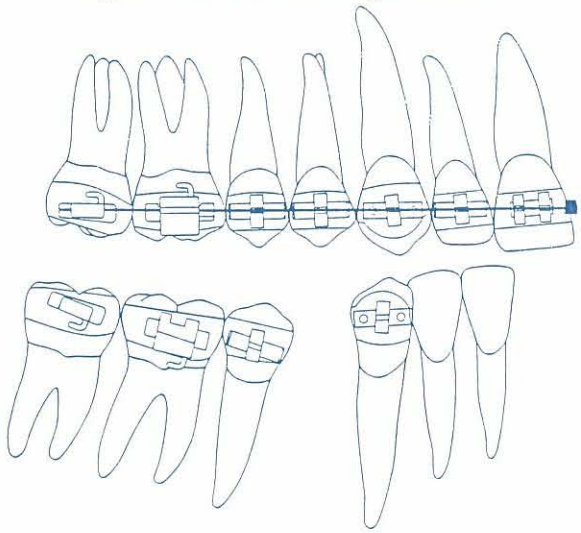


Cephalometric tracing, superpositioning on cranial base. Changes before and after orthodontic treatment. Shows no vertical facial growth but continued mandibular length increase. The mandible has rotated closed and B point has moved foreward, SNB increased 2°. The maxillary anteriors depressed as did the maxillary molars. (This is the case used in all illustrations throughout this paper).

Step 1.

Stabilize the upper arch. First arch: .018 x .018 Nitinol is highly recommended for it provides torque control from first arch yet is small enough to tie into most rotations. Attach a rectangular crimpable stop between centrals so arch does not slide. Bypass teeth that are blocked out of the arch. Time: One to two months. Second arch: .017 x .025 Nitinol. This size arch provides positive torque control of the upper anteriors and "A" point anchorage can be used. Example: if canines are partially blocked out, an open coil spring between the lateral and first premolar will slide the buccal segment distally. A high pull facebow headgear will help this action. Time: One to two months, but longer if high canines are brought into alignment. Third arch: .018 x .025 steel. Omega loops mesial of the second molars provide resiliency for final second molar movement. Make distal leg of the omega shorter if depression is needed. Start palatal bar and headgear. Total time for step 1 is three to five months. Self-check for step one: Rotations are corrected, arch is level, torque is controlled because arch is seated completely into brackets.

Step 1 — After
Upper Arch: .017 x .025 Rectangular Nitinol

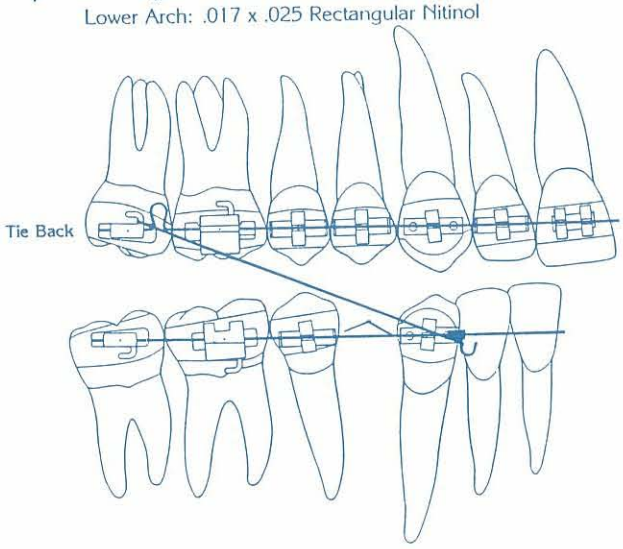


Step 2.

Level the lower buccal segment. Lower premolars have been extracted and the lower teeth were banded except lower anteriors. First arch: .

018 x .018 Nitinol with Class III crimpable hooks mesial to the canines. Start heavy 5/16, 6–8 oz. Class III elastics when headgear is worn, light 5/16, 2–3 oz. when headgear is not worn. The upper arch is now tied back. Time: one month. Second arch: .017 x .025 Nitinol with crimpable Class III hooks. A gable bend is usually placed in the extraction site to allow the leveling action to work faster. Time: Two months. Third arch: .017 x .024 (.018 x 0.25 reduced) steel to level the buccal segments. An omega loop mesial of the second molar tube for added resiliency and final anchorage preparation. Time: One to two months. Total time for step 2 is three to five months. This time can also be estimated by the curve of Spee because the curve will level at the rate of 1mm per month, or months of Class III wear needed as previously determined. Class III elastics worn during step 2 provide additional arch length at the rate of $\frac{1}{2}$ mm per side per month for up to six months. Steps 1 and 2 are done simultaneously, if Class III elastics are not needed. Self-check for step 2 is when anchorage has been prepared as seen by level buccal segments, roots in the extraction site converge and rotations are corrected.

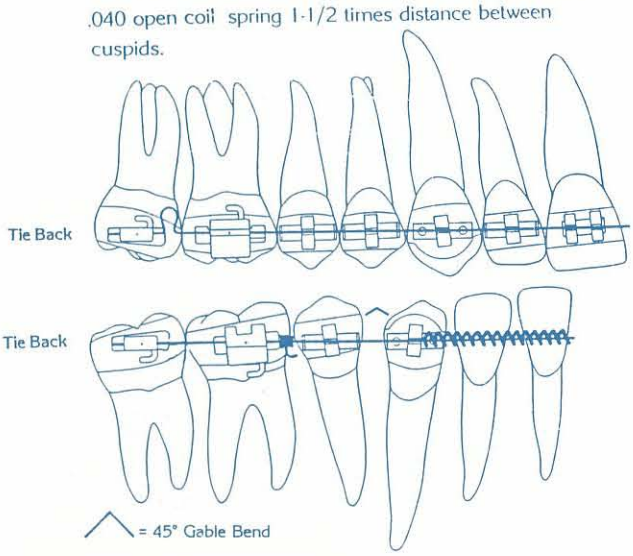
Step 2 — During
Lower Arch: .017 x .025 Rectangular Nitinol



Step 3.

Retraction of lower canines. .017 x .025 Nitinol. A section of .10 x .40 open coil spring $1\frac{1}{2}$ times the distance around the arch from canine to canine is threaded onto the wire. Gable bends in the extraction site to resist tipping of canines and premolars. Crimpable tie back hooks are placed just distal to the second premolars. Tie second and first molars together before the arch is seated. This arch is activated by tying back each month to maintain uniform pressure and to keep the canines from expanding. When one extraction space closes faster than the other, thread a ligature wire thru the coil spring, knoted and tied back to the first molar. This increases the pressure on the side where the coil spring is tied back and reduces the pressure on the other canine. When there is tipping in the extraction site, do not go to step 4 but remove the coil spring and reestablish root convergence. Time: The canines retract $1\frac{1}{2}$ mm per side per month for a total of 3mm per month, Add lines 2 (crowding) and 3 (MM to upright $\overline{21/12}$ to their goal position) to determine the distance canines need to be retracted.

Step 3 — Before
Lower Arch: .017 x .025 Rectangular Nitinol with .010 x .040 open coil spring 1-1/2 times distance between cuspids.



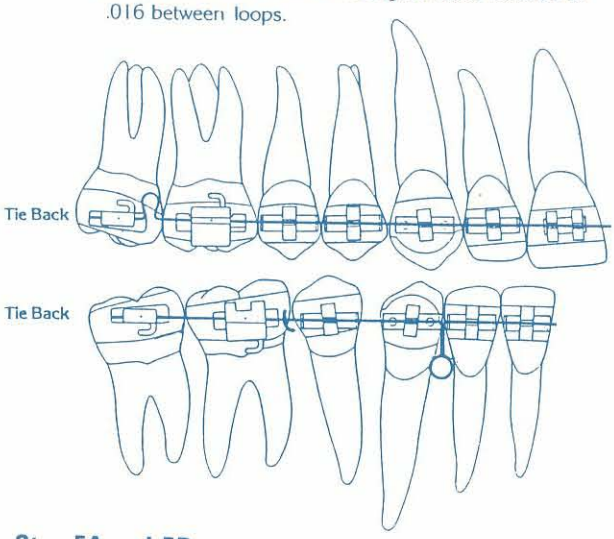
Divide by 3 for the number of months. Self-check: Save enough anchorage space to correct the ANB and to retract the upper anteriors.

Step 4.

Tipping the lower anteriors upright. Band lower anteriors. .018 x .025 steel with vertical loops distal to the laterals. The arch between the loops is rounded to about .016 and polished smooth. Omega loops or soldered tie backs are placed just distal to the second premolars. The loops are each opeded 1mm per month by tying back to the first molars. The anteriors are tied together with alastic chain. This action tips the teeth upright around their apex and closes space while maintaining full anchorage control in the buccal segments. Extraction space does not close. If lower anteriors are at a much higher level than the canines, the mesial legs of the vertical loops are made longer and then releveled at the next appointment. For extreme cases of anterior elongation and for leveling the entire lower arch an .016 x .016 utility arch can be used, while using .018 x .025 steel sectional arches in the buccal segments to maintain anchorage. If the lower anteriors are badly rotated, an .017 x .025 Nitinol can be used for a short time before the vertical loop arch is started. Time for Step 4: Refer to line 3 (MM to upright $\overline{21/12}$) to see how far lower anteriors need to be tipped back. The vertival loops are each opened 1mm per month (Total of 2mm). Divide line 3 by 2 for number of months. Step 4 is an excellent time to wear additional Class III elastics if needed. Self-check: Take a headfilm when anterior space is closed. $\overline{1}$ should be in goal position. If more tipping is needed, restart Class III's. If $\overline{1}$ back too far, the full size Step 5 anchorage arch will correct the problem.

Step 4 — After

Lower Arch: .018 x .025 Rectangular Steel reduced to .016 between loops.



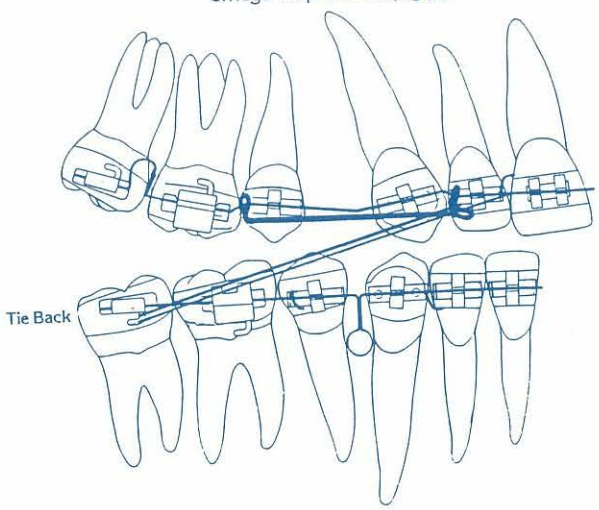
Step 5A and 5B.

Stabilize the lower arch and correct the Class II molar relationship if necessary. 5A is to stabilize the lower arch with an .018 x .025 steel anchorage arch with vertical loops in the extraction spaces. Vertical elastic hooks are soldered mesial to the canines. Soldered tie backs are placed distal to the second premolars. Bent in omega loops distal to the first molars may be used for resiliency and second molar adjustment. This can be considered a working arch for releveling and minor adjustments until ready for Class II elastics. The vertical loops are not activated until the second molars show mobility from Class II elastic wear. The vertical loops, when activated are tied back to the first molars. Upper premolars are now extracted. Time for 5A is one month.

Step 5B.

Is the correction of the Class II molar relation. By 5A, most cases have either a Class I or super Class I molar relationship and proceed with Step 6. Some high ANB cases and full

Step 5 (Option B) — Before
Upper Arch: .017 x .025 Rectangular Steel with large omega loop and sliding jig.

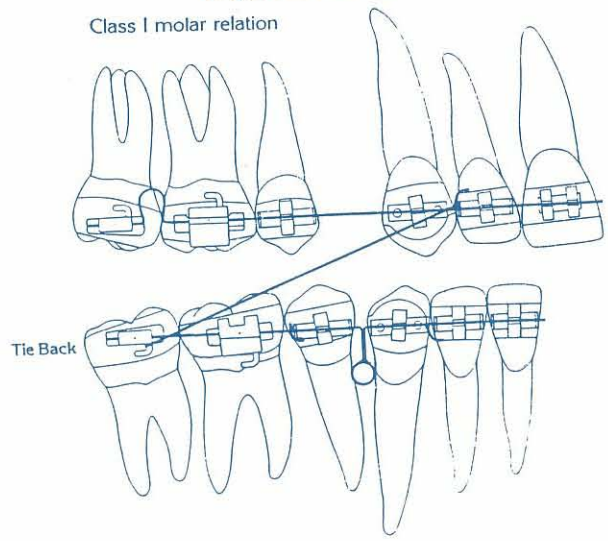


Class II malocclusions still have a Class II molar relation. If there is space on the tuberosity for distal tipping of the upper buccal segments, remove the palatal bar, construct an .017 x .024 steel arch with tip back bends in the buccal segments. Sliding jigs rest against the mesial of the first molars with the elastic hook mesial to the canine. Large omega loops flush against second molar. Solder Class II hooks gingivally ust distal of the laterals. Solder headgear hooks incisally distal to the centrals if a "J" hook headgear is to be worn. The omega loops are opened so there is an additional 15° tip on the second molars. Two heavy 5/16, 6 oz. elastics are worn on each side. One from the lower second molar Class II hook to the sliding jig. The other from the lower second or first molar to the soldered Class II hook. The large resilient omega loops tip the upper second molars up and away from the first molar. The sliding jig slides the first molar up and back while periodontal fibers pull the second premolar back also. The second class II elastic attached to the arch thru the soldered hook, moves the entire arch distally and tends to keep spaces closed. The Class II action has a tendency of lifting the lower posterior and depressing the lower anterior areas of the arch. Anterior vertical elastics prevent this from happening and reinforce the lower buccal anchorage. A 5/16 heavy, 6 oz. elastic is worn in a square from the Class II hooks in the upper down to the Class III hooks in the lower.

When double Class II elastics (12 oz. on each side) are worn 24 hours per day, the lower second molars become mobile. Activate the vertical loops $\frac{1}{2}$ mm per month on each side only if the lower second molars are mobile to thumb pressure. If the molar relation has not corrected in two months and the patient has been wearing elastics, remove the upper arch and increase the tip backs. A full Class II molar relation will correct in three months.

If there is not enough tuberosity space for distal tipping of the second molars and anchorage space is closed in the lower arch and good third molars are present, then the extraction of the upper second molars to correct the Class II molar relation is preferred.

Step 5 — After
Upper Arch: .018 x .025 Rectangular Steel with large omega loop.
Lower Arch: .018 x .025 Rectangular Steel with vertical loop in extraction site.

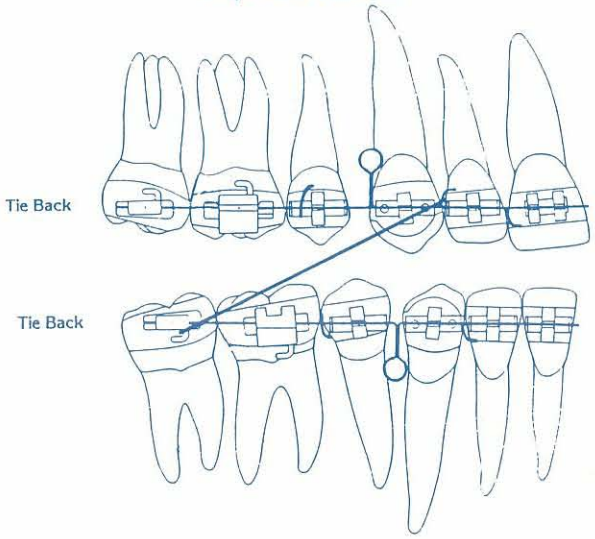


The upper second molars are not extracted until after Step 6 because the anchorage of these teeth should be used to help retract the upper anteriors. When upper second molars are extracted, a 4mm Class II molar relationship will correct in three months with .017 x .024 steel arch and tip backs. The tip backs are increased each month. If the severity factor on Line 11 is −10 or larger plus inadequate tuberosity space; lower anchorage space has been used up and good third molars are present, then the extraction of the upper first molars is sometimes necessary. The anchorage saved by 6/6 extraction is equal to 7 mm of anchorage space. When the malocclusion is so severe that an ideal goal can not be reached, either the goal is modified to a fuller less stable end result or surgery may be indicated. The self check for Step 5 is a Class I or super Class I molar relation.

Step 6.

Retracting upper anteriors. If tip back bends were not needed in the previous arch, an .017 x .025 Nitinol arch is used to retract the upper anteriors. Class II crimp on hooks mesial to the canines, the upper first and second molars are tied together. A .010 x .030 closed coil spring, 2/3 the distance from Class II hook to first molar is stretched from the first molar hook to the Class II hook. A gable bend is placed in the extraction site. If the molar relation is Class I, then Class II elastics are needed to maintain the Class I relationship. The upper molars will come forward without Class II wear. Do not activate the lower arch unless the lower second molars are mobile. If the molar relation is super Class I or Class III, do not wear Class II elastics until the molar relation is ideal. The upper extraction space closes at the rate of 1 $\frac{1}{2}$ mm per side per month. Time: Five to six months. Tipping in the extraction site starts to occur after five to six months. Large ANB cases require longer than six months to retract the anteriors so then switch to a steel vertical loop arch. Be sure use palatal bar during step 6.

Step 6 (Option) — Before
Upper Arch: .018 x .025 Rectangular Steel with vertical loop in extraction site.

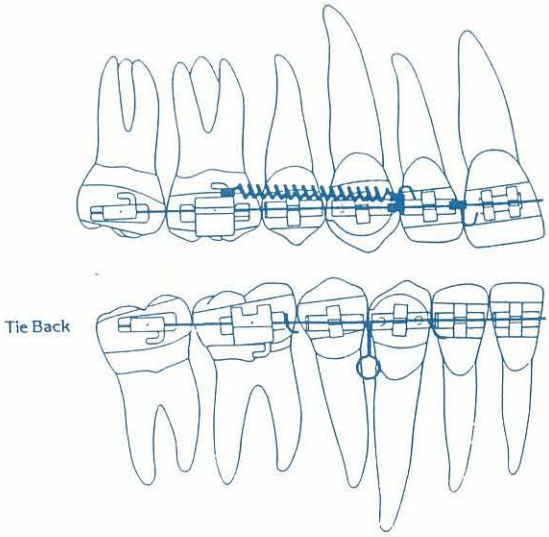


Step 6.

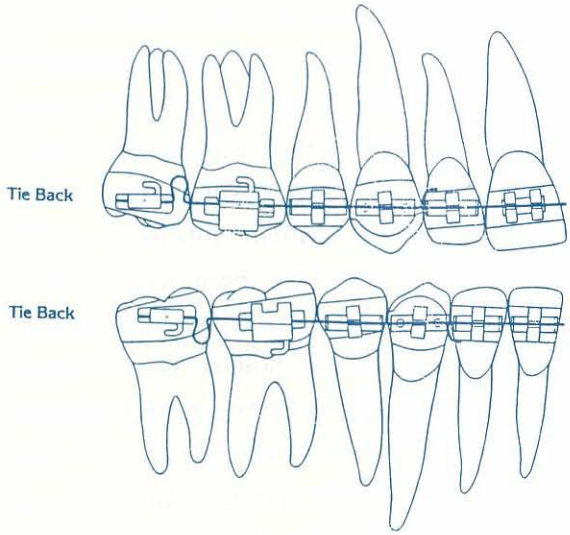
Option arch. If tip backs were used during Step 5B, than a steel vertical loop arch is used to close the upper extraction site. Vertical loops are bent in distal to the canines. Identical tip backs as in the Step 5B arch are bent to maintain the Class I molar relation. Soldered tie backs are placed just distal to the second premolars. The first and second molars are tied together. Space usually occurs between the upper molars during Step 5B.

An alastic chain from the second molar lingual hook to the palatal bar not only closes this space but helps retract the rest of the arch using the second molar as anchorage. If the molar relation is Class I, Class II elastics are used to maintain this relation. The upper loops are activated 1mm per side per month. Tie the

Step 6 — After
Upper Arch: .017 x .025 Rectangular Nitinol with .010 x .030 closed coil spring 2/3 distance from 6|6 to hooks mesial to 3|3



Step 7 — Finishing
Upper Arch: .018 x .025 Rectangular Steel
Lower Arch: .018 x .025 Rectangular Steel



ligature wires from the first molar hook to the soldered tie back to activate the loop. Time for Step 6 is five to six months if the ANB is to be reduced 3° or less. A 4° reduction takes six to eight months. A 5° reduction takes nine to ten months and a 6° reduction about eleven to twelve months. The self check for Step 6 is that the molar relation is correct and the extraction spaces are closed in both arches.

Step 7.

Finishing. Reduced edgewise arches may be used for this step because strong anchorage is no longer needed. .017 x .024 steel arches are usually used. Vertical loops should be placed in areas where there is space. Torque can be adjusted. Step down bends and vertical elastics are usually used to seat the canines. Be sure that the case demonstrates centric occlusion when the aw closes in hinge relation. The palatal bar is removed during this step then reused for the first two weeks after band removal. Time for this step is three months.

Predictability:

Absolute accuracy could be predicted if every variable were eliminated. The Level Anchorage system attempts to eliminate as many variables as possible. thus treatment with it is highly predictable (**Table 2**). The variables of treatment procedures are eliminated by use of a prescribed treatment plan with specific self-checks for each step. The first, second and third order arch bending and arch form variable has been eliminated by the use of a preadjusted appliance with arches built specifically for the Level Anchorage appliance. Nitinol arches are extremely smooth and resilient, and they have great resistance to deformation. Because of these characteristics, Nitinol provides a uniform force for rotation, leveling, tipping and sliding mechanics. Patient variables are hard to control, but incorrect tongue posture and finger sucking habits are eliminated by the use of spurs. The elastic force variable is controlled by specific elastic size and strength.

Table 2: Treatment variables and their control.

Variable	How controlled
Dynamic forces	
To retract canines	Coil spring(specific size, length)
To retract upper anteriors To close mandibular extraction space	Archwire(specific size, loop diameter, monthly changes in vertical loop opening)
Archwires	Three sizes: Initial 0.018 round Nitinol Working 0.017×0.025 Nitinol Anchorage 0.018×0.025 high spring steel
Degrees of first, second, and third order bends	Preadjusted appliance
Patient	
Habits	
Tongue thrust	Spurs
Thumb sucking, fingersucking	Ruga area spurs
Headgear wear	Analysis chart prescribes time
Elastic wear	Uniform elastic size and force of tie-on calibrated force modules
Orthodontist	Prescribed treatment plan with specific selfcheck intervals

Discussion:

A precise treatment plan can be formulated by use of the analysis chart. Anchorage requirements to reach a predetermined goal are balanced against anchorage available. This analysis promotes a feeling of confidence knowing that the goal can be achieved. Arch bending has been reduced to a minimum because of the preadjusted appliance and arch. Efficiency is improved because routine treatment steps and self checks for each step allow progress to be monitored at a glance (Table 3). The patient and orthodontist know the rate of progress because of the predictable time chart. Parents appreciate the ability of achieving a predetermined goal and like the positive approach that the orthodontist can take when the treatment steps and time sequence have been predetermined.

FOUR PREMOLARS EXTRACTION CASE — TIME

Step 1. 3–5 months after initial arch placement.

Step 2. 1 month per mm curve of Spee or number of months Class III elastics are worn.

Whichever is greater.

Treat Step 1 and Step 2 at the same if Class III elastics are not required for entire time.

Step 3. Canines retract 3mm per month ($\overline{4/4}$). 1 $\frac{1}{2}$ mm per side per month. Canines retract 2mm per month ($\overline{5/5}$). 1mm per side per month.

Add Lines 2 and 3 to obtain distance and divide by 3 ($\overline{4/4}$) or 2 ($\overline{5/5}$) to obtain number of months.

Step 4. Lower anteriors tip back and spaces close at 2mm per month. Refer to Line 3 for mm to upright and divide by 2 to obtain number of months.

Minimum time: 2 months to allow for leveling and rotation correction.

Step 5A. The lower arch is stabilized, one month.

Step 5B. Months to correct 4mm Class II molar (If tuberocity space) wearing 6–8 oz. (5/16 in.) Class II elastics 24 hours per day. Full upper arch with tip backs −5 months. Sliding Jigs to first molars −3 months. Extracting 7/7 −2 months. When anchor molars are mobile, activate lower loops $\frac{1}{2}$ mm per side per month if "Major" anchorage, activate lower loops 3/4mm per side per month if "Regular" anchorage.

Stepp 6. Anteriors close $\frac{1}{2}$ mm per month per side with 4/4 extraction =5–6 months. Anteriors close 1mm per month per side with 5/5 extraction =8 months.

Time for Step 6 is five to six months if the ANB is to be reduced 3° or less. A 4° reduction takes six to eight months. A 5° reduction takes nine to ten months and a 6° reduction about eleven to twelve months.

Step 7. 3 months.

SELF CHECK

Step 1. When upper arch is level and rotations are corrected.

Step 2. When curve of Spee is level. Roots in extraction site converge, and rotations are corrected.

Step 3. Save enough anchorage space to correct molar relation, correct ANB and retract upper anteriors. To determine space to save, add mm ANB change and extraction values.

Step 4. When anterior space is closed. Take headfilm. $\overline{1}$ should be in "Goal" position. Use Class III elastics to loops if additional $\overline{1}$ uprighting is required to reach the goal.

Step 5A. When 6/6 are in solid Class I molar relation.

Step 5B. Study molar relation and anchorage space. Will need prescribed amount for anterior retraction (See self check, Step 3).

Be sure sufficient anchorage space remains to correct the molar relation. If not, consider increasing anchorage or extracting 7/7.

Step 6. When space is closed.

If lower anteriors tip forward, Class III elastics can be used to reset the anchorage (Gain +1 per month).

Step 7. When space is closed, torque and rotations are corrected. Check for function, use gnathological principles.