Answers to…

Asymmetries

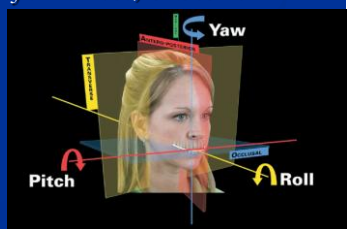
Peter Miles

Gottlieb JCO 1993;27:357-58
(A Farewell to Symmetry)

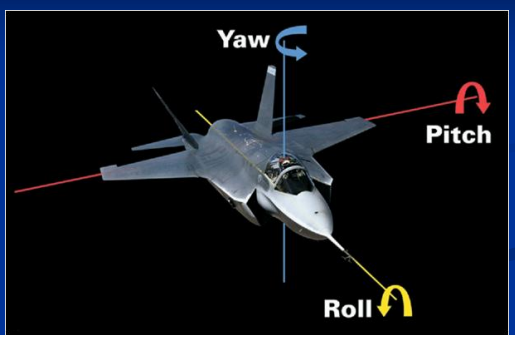
- "It is not surprising that asymmetry may be the rule rather than the exception in the environment in which we work."

Pitch, Roll, Yaw

- Pitch, roll, and yaw: Describing the spatial orientation of dentofacial traits
- Ackerman et al. AJODO 2007;131:305-10



Pitch, Roll, Yaw



Show me the midline!

- Johnston et al. Eur J Orth 1999;21:517-22
- Discrepancies of 2mm or more between the facial and dental midlines will have a negative impact on dentofacial aesthetics.

Midline discrepancies

- Impact of dental asymmetries on the perception of smile esthetics.
- Pinho et al. AJODO 2007;132:748-53.
- Midline shifts were perceived at 1.0 mm by orthodontists and 3.0 mm by prosthodontists
- Laypersons did not notice midline shifts.

Do the public notice it?

- Johnston et al. Eur J Orth 1999;21:517-22

Table 3 Probability of a randomly selected judge detecting a dental to facial midline discrepancy.

Discrepancy (mm)	Probability orthodontists	Probability laypeople
0	0.00	0.00
1	0.26	0.19
2	0.83	0.56
4	1.00	0.93
6	1.00	0.99
8	1.00	0.99

Does an individual notice it?

Tilted anterior teeth

- The effect of axial midline angulation on dental esthetics. Thomas et al.
- Angle Orthod 2003;73(4):359–364.
- The maxillary dental midlines were altered left and right at 5°, 10°, 15°, & 20° from the midline

TABLE 4. Threshold of Acceptable Maxillary Midline Angulation

	Male Subject (°)	Female Subject (°)
Orthodontists	6.6 ± 4.5	6.4 ± 4.0
Laypeople	10.7 ± 6.2	10.0 ± 6.1

Mean acceptable tilt

- Discrepancies of 5° were not statistically significantly different to 0° angulation
- Discrepancies of 10° were unacceptable by 68% of orthodontists and 41% of laypeople.

Tilted midlines

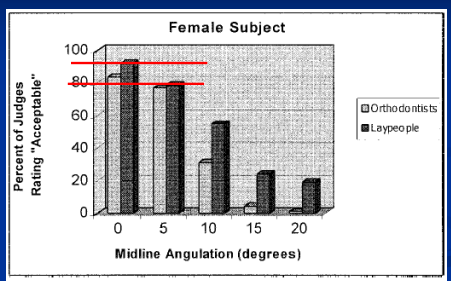


FIGURE 5. Percentage of judges rating each altered image "acceptable"

Tilted midlines

- 10° midline tilt was accepted by 60% of the public but only 30% of orthodontists
- BUT ~10% of the public did not accept even 5° of midline tilt

Importance of midlines

American Validation of the PAR Index, from DeGuzman et al.

Components (and range*)	Raw	Weightings used to measure Malocclusion severity	Treatment difficulty	Combination
1. Upper anterior alignment (0-25)	1	1	1	1
2. Buccal occlusion (0-14)	1	2	2	2
3. Overjet (0-8)	1	5	4	4.5
4. Overbite (0-7)	1	3	3	3
5. Midline discrepancy (0-2)	1	3	4	3.5

* Range values from Richmond et al.

Lesson!

- Don't diagnose/treatment plan from the models
- Patient's don't look at models, they look in the mirror
- If the upper is symmetrical, keep it symmetrical
- If a compromise is necessary keep it where it is least visible

Why was this approach incorrect?

- Alavi et al. AJODO 1988;93:38-46
- Rose et al. AJODO 1994;105:489-495
- Janson et al. AJODO 2001;119:406-418
- Primary factor contributing to most Class II subdivision malocclusions is unilateral distal positioning of the lower molars on the Class II side

Midline discrepancies

- The midline: diagnosis and treatment. Jerrold & Lowenstein. AJODO 1990;97:453-62.
  - A mandibular shift due to a posterior crossbite
  - Lateral mandibular shift without a causative crossbite (resulting from occlusal interferences)
  - Tooth size discrepancies
  - Tipping/drifting of the teeth
  - Arch asymmetries
  - Any combination of the above

Ravi Nanda – Biomechanics & Esthetic Strategies in Clin Orth

- Midline discrepancies should be corrected as early as possible. This allows the remainder of treatment to be completed symmetrically to reduce unilateral vertical forces, skewing of the dental arches, or asymmetric anchorage loss.
- Completing as much of treatment as possible using symmetric mechanics minimises the potential impact of side effects. (2005:199)

Unilateral posterior crossbite

- Unilateral crossbite can result in a slide shift in occlusion and a subdivision malocclusion
- Correct as early as diagnosed
  - Single tooth – cross-elastics
  - Multiple teeth
    - removable appliance
    - quad-helix or rapid palatal expander

Early expansion

Unilateral posterior crossbite (UPXB)

- Brin et al. AJODO 1996;109:173-9. Skeletal and functional effects of treatment for unilateral posterior crossbite.
- Complete, stable correction reports 61-96%
- 24 subjects (9.5 – 10.3 yo) treated for UPXB.
- **Removable** symmetrical expansion plate followed by 6 mths Hawley retainer
- All Class I in first occlusal contact but 15 Class 2 subdivision on closure

Unilateral posterior crossbite

- Final n=22 with models
- 6 months after retention, 1 exhibited a persistent UPXB whereas others 50:50 corrected or edge to edge
- Originally n=20 but lower midline still deviated in n=9 subjects but not due to a functional shift
- Originally n=15 Class 2 subdivision and n=9 after expansion (only 40% corrected)

Unilateral posterior crossbite

- Promozic et al. Angle 2013:83:253-258.
- 3D evaluation of facial asymmetry in association with unilateral functional x-bite .....
- Children with UPXB exhibited a greater facial asymmetry than children without.
- Facial asymmetry was more evident in the older subjects

Chicken and the egg?

- This is not a cause and effect relationship as does the asymmetry cause the crossbite or the crossbite cause the asymmetry?

A longitudinal study of early Tx

- Promozic et al. Eur J Orth 2013;35:7-13
- 3D evaluation of early crossbite correction.....
- 60 patients in the primary dentition (age ~5.3yo)
- 30 with UPXB with 2mm midline deviation
- 30 control normals/ideals
- Treatment resulted in an improved facial symmetry in the lower 1/3 of the face
- Relapse in 26.7% by 30 months

Does it matter if we delay Tx?

- Are there deleterious consequences if treatment is left until later?
- Can the adult molars erupt normally and the deciduous crossbite be left without consequence?
- Is it more cost effective to correct Early vs. Late?

Systematic review on crossbite

- Talapaneni. J Orth 2012;39:279-291
- The association between posterior unilateral crossbite and craniomandibular asymmetry: A systematic review.
- An evidence based conclusion could not be drawn due to the lower quality level of the studies.

Posterior crossbite – Sys Rev

- **Orthodontic treatment for posterior crossbites**
- JE Harrison, D Ashby
- **Authors' conclusions**
- The evidence from the trials reported by Lindner (1989); Thilander (1984) suggests that removal of premature contacts of the baby teeth is effective in preventing a posterior crossbite from being perpetuated to the mixed dentition and adult teeth.
- When grinding alone is not effective, using an upper removable expansion plate to expand the top teeth will decrease the risk of a posterior crossbite from being perpetuated to the permanent dentition.

Functional shifts

- Schiffman and Tuncay review (Clin Orth Res 2001) concluded that 'early correction of a developing crossbite may or may not be beneficial'.
- However the Cochrane Library review stated that early treatment of posterior crossbites by removal of premature contacts appears to prevent them from being passed on to the adult dentition.

Early treatment of crossbites

- Cochrane Library 2001 (Harrison, Ashby)
- When selective grinding alone is not effective, a removable or other expansion device to widen the maxillary arch will reduce the risk of a posterior crossbite being perpetuated.
- However this conclusion was based on only two small studies by Thilander and Lindner .
- What about TMD?

Very early crossbite correction

- Tullberg M. et al.
- Acta Odont Scandinavica 2001;59:280-284.
- Early selective grinding at age 4 vs. Treatment in mixed or early permanent dentition
- No significant differences were found between the early and late groups with regard to signs and symptoms of TMD.

Functional shifts and growth

- Pirttiniemi P. et al. Eur J Orthod 1990;12:408-13
- Treated group had fixed or removable expansion at age 5-8 and reviewed at 11 yo. (N=9)
- Untreated group at age 23 yo. (N=13)
- The degree of asymmetry was found to be twice as great in the untreated as in the treated group.
- Small samples and age difference is a concern as a similar age would have been a better control

What is a Class II subdivision?

- A matter of Class: Interpreting *subdivision* in a malocclusion.
- Siegel MA. AJODO 2002;122:582-6.
- Class II subdivision left – does left refer to the Class I side or the Class II side?
- Only ~65% of orthodontic educators agree on the meaning of subdivision
- 65% stated subdivision refers to Cl 2 side, 24% Cl 1 side, rest unsure or did not teach either

Prevalence of Class II subdivision

- Sheats. Sem Orth 1998;4:138-145
- 22% in a population of orthodontic patients (VCU grad clinic)
- 23% (avg age 14.4) to 30% (avg age 9.3) in mass screening of public school children in Florida

Prevalence of Class II subdivision

- Behbehani. AJODO 2012;34:686-692.
- Prevalence of asymmetric molar and canine relationship.
- Half-step outweighs a full-step asymmetry
- Class II Asymmetric molars = 21.8%
- Class II Asymmetric canines = 36.2%
- No gender difference

Subdivision aetiology

- Alavi et al. Facial and dental arch asymmetries in Class II subdivision malocclusion. AJODO. 1988;93:38–46.
- Rose et al. Mandibular skeletal and dental asymmetry in Class II subdivision malocclusions. AJODO. 1994;105:489–495.
- Janson et al. Three-dimensional evaluation of skeletal and dental asymmetries in Class II subdivision malocclusions. AJODO. 2001;119:406–418.
- Azevedo et al. Evaluation of asymmetries between subjects with Class II subdivision and apparent facial asymmetry and those with normal occlusion. AJODO. 2006;129:376–383.
- Kurt et al. Mandibular Asymmetry in Class II Subdivision Malocclusion. Angle Orthod. 2008:78:32-37.

Class II subdivision

- The mandible in Class II subdivision malocclusions does not exhibit unusual skeletal positioning or skeletal asymmetry.
- No vertical asymmetry in the vertical posterior heights of the mandible
- Therefore the contributing factor of asymmetrical anteroposterior molar relationship on the Class II side is mainly dentoalveolar.

Class II subdivision – G. Janson

- Characteristics of Class II subdivision malocclusions:
- Class II subdivision malocclusions are primarily dentoalveolar
- More frequent deviation of the lower dental midline to the Class II side.

CBCT in Class II subdivisions

- Sanders et al. AJODO 2010;138:542.e1-20
- Skeletal and dental asymmetries in Class II subdivision malocclusions using CBCT.
- 30 Class II subdivision and 30 norms
- Mandibular length and ramus height were shorter on the Class II side and midline deviated to Class II side

CBCT in Class II subdivisions

- Lower molar closer to the ramus on the Cl2 side
- The aetiology of Class II subdivision is primarily due to an asymmetric mandible.
- A mesially positioned maxillary molar and distally positioned mandibular molar on the Class II side are also minor contributing factors.

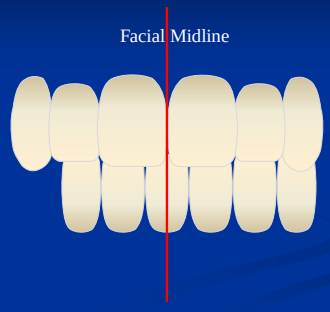
CBCT in Class I vs. Class II

- Sievers, Larson et al. Angle 2012;82:410-417
- Asymmetry assessment using CBCT: Cl1 vs. Cl2
- 70 consecutive subjects meeting the inclusion criteria were assessed by CBCT
- No difference in the amount of asymmetry between Class II and Class I subjects

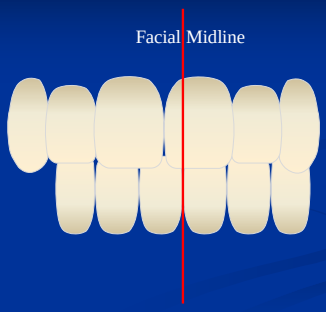
Class II subdivision – G. Janson

- Type 1 – Coincidence of the maxillary dental midline with the facial midline and deviation of the mandibular midline due to distal positioning of Lower 6 on the Class II side.
- Type 2 – Deviation of the maxillary dental midline with the facial midline and coincidence of the mandibular midline due to mesial positioning of the Upper 6 on the Class II side.

Type 1



Type 2



Distribution of Class II subdivisions

- Janson et al. Class II subdivision malocclusion types and evaluation of their asymmetries. AJODO 2007;131:57-66.
- Among the group with Class II subdivision
  - 61.36% has type 1
  - 18.18% has type 2
  - 20.45% has combination

Prevalence of Class II subdivision

- Sheats et al. Sem Orth 1998;4:138-145
- Most common asymmetry trait was mandibular midline deviation from the facial midline
- This occurred in 62% of subjects

Class II subdivision – G. Janson

- Combination type – Take into consideration other malocclusion characteristics to decide whether to treat as Type 1 or 2.
- Examples:
- If there is moderate crowding, incisor protrusion and absence of passive lip seal, choose to treat as Type 1 with 3 premolar extractions.
- If there is absence or slight crowding associated with a good facial profile, choose to treat as Type 2 with 1 premolar extraction **???**
- Or Class II intermaxillary elastics/springs **(Miles)**

Selection of the treatment protocol

- Janson - Protocols for Type 1:
  - Mixed and young permanent dentition:
    - Removable or fixed functional appliances
    - Class II elastics/springs/miniscrews
    - 3-premolar extractions (2 upper/1 lower)
  - Young and adult permanent dentition:
    - Fixed functional appliances (e.g. springs)
    - Class II elastics/miniscrews
    - 3-premolar extractions (2 upper/1 lower)

Type 1 - Class II subdivision

- Janson et al. Class II subdivision treatment success rate with symmetric and asymmetric extraction protocols. AJODO 2003;124:257-264.
- Advantages of Type 1 Class II subdivision malocclusion treatment with 3-premolar extraction over 4-premolar extraction protocols:
- 1- Extraction of 3 premolars shows a better treatment success rate in correcting the maxillary-to-mandibular dental midline deviation compared with 4-premolar-extraction treatment (0.5mm). Simpler mechanics.

Advantages of 3 premolar xtns

- Janson et al. Cephalometric evaluation of symmetric and asymmetric extraction treatment for patients with Class II subdivision malocclusions. AJODO 2007;132:28-35.
- 2- The 3-premolar asymmetric extraction protocol in Class II subdivision malocclusions produces less mandibular incisor and soft-tissue retraction than the 4-premolar extraction protocol.

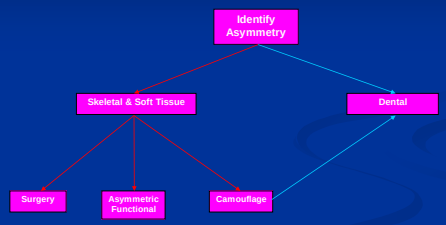
Advantages of 3 premolar xtns

- Janson et al. Dentoskeletal treatment changes in Class II subdivision maloc clusions in submentovertex and posteroanterior radiographs. AJODO 2004;126:451-463.
- 3- The treatment protocols with asymmetric extractions do not induce undesirable dentoskeletal effects in the frontal plane.

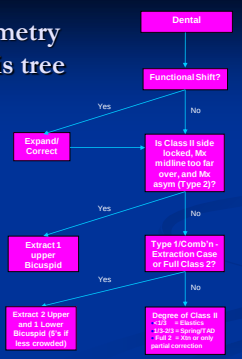
Advantages of 3 premolar xtns

- Janson G et al. Smile attractiveness in patients with Class II subdivision malocclusions treated with different extraction protocols. Eur J Orth 2014;36:1-8.
- 4- Smile attractiveness with asymmetric extractions (1 or 3 teeth) is similar to treatment with symmetric extractions (4 teeth).

Asymmetry analysis tree



Asymmetry analysis tree

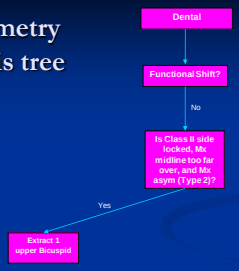


If unsure, delay Xtn

- Discuss delaying any extraction decision until levelling and alignment achieved or until unilateral crossbites corrected as there can be a shift present which disappears once the crossbite is corrected
- Then review as the decision may change once the crossbite is resolved
- Therapeutic diagnosis

Case Assessment cont'd

Asymmetry analysis tree



Step 2 -
Midline position when aligned

Single extraction

17 mths, 12 visits

Single extraction cont'd

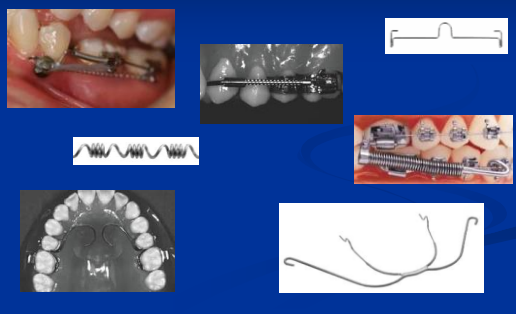
Warn of compromises

- When treating an asymmetry, especially if treating the upper arch asymmetrically, warn the patient of the possibilities of trading one asymmetry (midline) for another (e.g. skewing archform, tilting midline)
- Discuss options to determine what best addresses their goals and minimizes side effects
- Consider treating as a combination case or removing a second premolar and using elastics

Selection of the treatment protocol

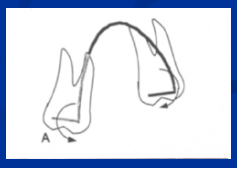
- Janson - Protocols for Type 2:
  - Mixed and young permanent dentition:
    - Asymmetric headgear
    - Distalising appliance
    - 1 upper premolar extraction
  - Young and adult permanent dentition:
    - 1 upper premolar extraction
    - Distalising appliance

Extraction vs. non-extraction approaches



Asymmetric molar tip

- To correct uniarch molar axial asymmetries, a lingual or palatal arch (0.032-inch TMA or 0.032 × 0.032-inch TMA) activation is made to deliver a tip forward moment on the Class I side and a tip-back moment on the Class II side.
- Steenbergen, Nanda
- AJODO 1995;107:618-24



Asymmetric molar rotations

- Rotated molars are frequently seen in the maxillary arch. A mesial-in rotation of one molar often results in an asymmetric molar occlusion.
- To correct this problem, a transpalatal arch is used with equal amounts of antirotation activation.

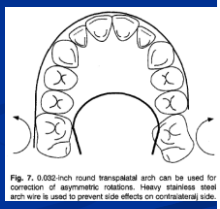


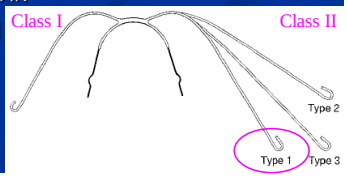
Fig. 7. 0.032-inch round transpalatal arch can be used for correction of asymmetric rotations. Heavy stainless steel arch wire is used to prevent side effects on contralateral side.

Asymmetric molars

- No difference in molar rotation and/or axial inclination
- An asymmetric headgear has the potential to move one molar further distally than the other molar. However, the transverse components of the forces exerted by this appliance can cause undesirable side effects.
- Good patient cooperation (wearing the headgear) is necessary for this approach to succeed.

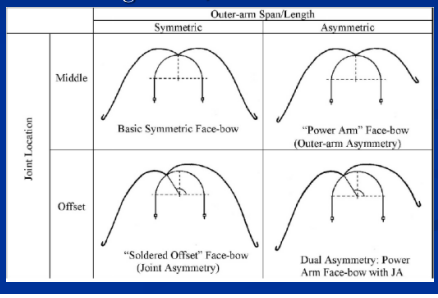
Reducing HG side-effects

- Yoshida et al. 1998;113:558-66.
- The recommended design is the power arm face-bow type 1 as less lateral effect. The outer bow on the Class I side is 25 mm shorter than a long-type face-bow.
- Consider expand inner bow to prevent x-bite

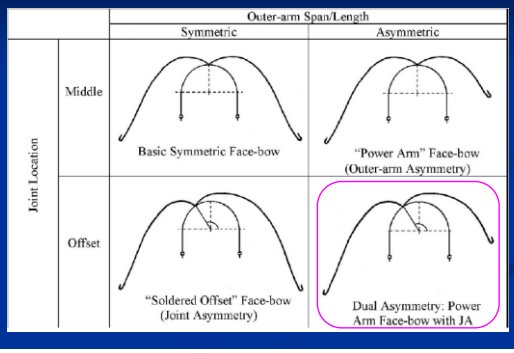


Asymmetric headgear

- Chi et al. Angle 2012;82:682-690.



Asymmetric headgear



Non-extraction methods

- Compliance Reliant
  - Asymmetric elastics
  - Asymmetric headgear/TPA
  - Removable plates (e.g. Cetlin)
- Non-Compliance Reliant
  - Intra-arch Nance anchored appliance (e.g. coil spring, pendulum, Jones Jig, etc.)
  - Inter-arch appliance (e.g. Forsus, Jasper Jumper)
  - Implant anchored mechanics

Nance anchored appliances

- The authors concluded that no more than 2-2.5mm of distal maxillary molar movement could be achieved and the quality of evidence for any method of moving maxillary molars distally was not high.
- Both the Jones Jig and a removable plate achieved distal movement of ~1.2-1.3mm.

J. Orthodontics
2002;29:211-216

Ortho Craniofac Res
2002;5:238-242

TAD anchored sectional

LOMAS or Quattro screw

Elastics

Cross & modified Class II elastics

Possible side effects

- Asymmetric elastics and springs may result in an occlusal cant developing (keep to milder cases, do not overpower the appliance)
- Choose the lesser of two evils – a compromise with some residual overjet or lower midline discrepancy may be more acceptable than a cant or midline discrepancy/tilt in the upper arch

Forsus open bite

Missing/extracted teeth

- Symmetrical occlusions that could potentially end up asymmetrical
  - Inappropriately extracted teeth to relieve crowding
  - Missing teeth
  - Condemned teeth

Protraction of #17

6 mths, 6 visits

21 Months

Class III subdivisions

- A similar strategy of analysis can be used
- If the asymmetry is in the lower arch – extract 1 lower bicuspid or 1 lower incisor
- If the asymmetry is in the upper arch – extract 3 bicuspids or treat as a mixed case with a fixed functional

Prevalence of Class III subdivision

- Behbehani. AJODO 2012;34:686-692.
- Prevalence of asymmetric molar and canine relationship.
- Class III Asymmetric molars = 8.4%
- Class III Asymmetric canines = 6.1%

Summary points

- Assess functional shift – correct early if possible
- If the upper is symmetrical, keep it symmetrical
- Discuss side effects of asymmetric treatment
- Tx plan to address patient values while minimizing potential risks
- If compliance is involved, measure it & if not improving in ~3 months then change tack

Midlines –

maybe it's just a matter of perspective?