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Condylar Hyperplasia

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ABSTRACT

Condylar hyperplasia is a rare pathology of the growth of the mandibular condylar cartilage leading to facial deformation. A bone scan demonstrates the active or inactive character of the condylar hyperplasia and helps guide therapeutic choices. There are two types of condylar hyperplasia, horizontal and vertical growth. Early condylectomy is the treatment of choice for active forms.

KEY WORDS

Unilateral condylar hyperplasia

Bone scan

Facial asymmetry

Condylectomy

INTRODUCTION

Normal growth of the facial bones is generally manifested by a symmetrical face, a balanced dental occlusion and, consequently, by the coordinated development of both mandibular condyles.

Condylar hyperplasia is characterized by hypertrophy of the head and/or the neck of the condyle with hyperactivity of one, but rarely both, of the mandibular condyles.

It is linked to uncontrolled pre-chondroblastic cellular activity at the head and/or neck of the condyle.

Condylar overgrowth manifests itself differently according to whether it is expressed vertically or transversely. Thus one can describe two very different clinical scenarios:

– Condylar hyperplasia with vertical growth;
– Condylar hyperplasia with transverse growth.

Condylar hyperplasia with vertical growth

Dyssymmetry of the lower one-third of the face resulting from condylar hyperplasia presents as excessive vertical height on the affected side, a canting of the mandibular plane of occlusion on the same side

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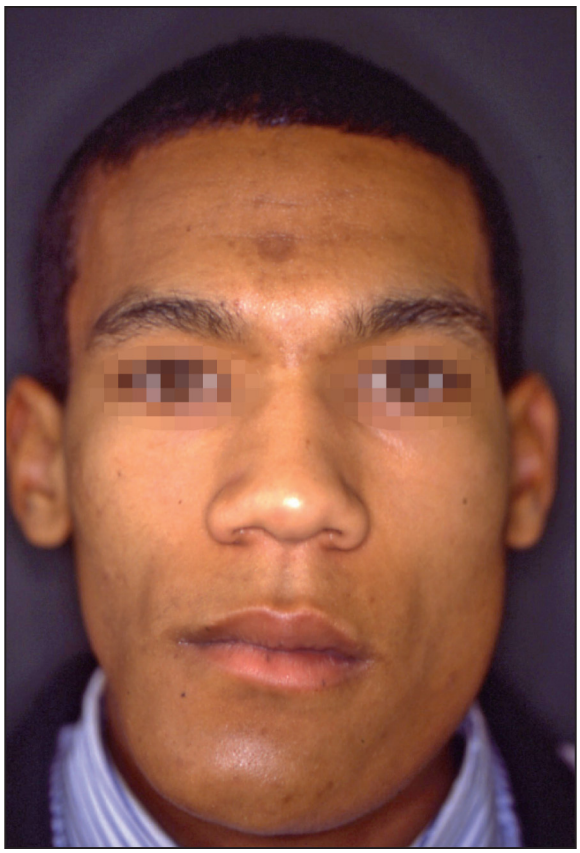


Figure 1
A Facial photograph of a patient presenting with a left-side condylar hyperplasia with mostly vertical growth.

Figure 2
A facial photograph of a patient presenting with left side condylar hyperplasia with mostly transverse growth.

that is responsible for a general infra-occlusion compensated by eruption of the of the affected dento-alveolar sectors[2]. Adaptive alteration of the maxilla is a secondary compensation of the skeletal deformation. In this case of condylar hyperplasia with vertical growth, there is little or no deviation of the chin (Fig. 1).

Condylar hyperplasia with transverse growth

Facial dyssymmetry manifests itself essentially by a lateral shift of the chin. Expression of the chin in vertical hyperplasia is conversely weak to non-existent. Dento-alveolar compensations are more transverse than vertical: the arches are skewed (Fig. 2).

The uniqueness of these deformities rests in their potential to develop often after the end of growth. This characteristic suggests a specific therapeutic treatment plan; in particular it is an indication for interceptive condylectomy. This is why it is important to evaluate the stability or lack of stability of the growth of the

condyle that controls the development of the dysplasia. The questionnaire and patient interview and the anterior photographs contribute to our assessment of this developing condition, but the bone scan represents the key diagnostic element.

- **Condylar growth**

The condylar cap plays an active role in the formation and adaptation of the condyle during all growth. This adaptive potential can extend into the second decade, and for some, throughout life.

The mandibular condyle responds to the lateral pterygoid muscle. In 1979, Charlier, Stutzmann and Petrovic distinguished 2 types of growth centers[3]. In one type, there are the primary growth centers, where growth takes place by division of undifferentiated chondroblasts, among which are found conjunctive cartilages such as the spheno-occipital and spheno-ethmoidal synchondroses, and the nasal septum.

For the other type, the secondary growth centers, are where the adaptive growth occurs by division of young conjunctive cartilage cells. This forms the sutures of the cranial vault and the face.

Only the secondary growth centers are susceptible to being stimulated or inhibited by mechanical factors. Such factors have only a modeling action on the primary growth centers.

- **Arguments in favor of a primary condylar growth center**

Petrovic's research has shown that that pre-chondroblastic activity, as the primary growth center, and therefore growth, responds to hormonal impregnation and possesses its own growth potential.

Arguments in favor of a secondary condylar growth center

In its role as the secondary center of growth, the activity of the condyle adapts to local functional stresses, and according to Moss[9] entails:

– local extrinsic factors, particularly muscular activity of the lateral pterygoids which stimulate pre-chondroblasts causing increased blood levels of somatotropic hormone.
– regional factors such as periodontal proprioception.

The purpose of all of these factors is to fine-tune condylar growth in order to obtain a harmonious maxillo-mandibular skeletal relationship.

In conclusion, Delaire defines the condyle as **mixed or blended growth center**. To a limited extent, the condyle is both a primary growth center, influenced by hormonal factors and genetics, and a principal secondary growth center, influenced by local morphogenic factors, such as the action of peri-condylar muscles[5].

Conversely, the condyle can be considered a primary growth center with a strong capability to adapt to functional stressors.

Is condylar hyperplasia a non-functional deregulator of its own growth?

I – DIAGNOSTIC

1 – 1 – Circumstances of discovery

Condylar hyperplasia is a growth anomaly that in general initially appears between 10 and 30 years, is divided equally between the sexes and shows no ethnic differences[7].

Condylar hyperplasia progresses asymptomatically until 10 or 12 years of age, but often can occur much later. The dyssymmetry generally becomes exaggerated at the onset of puberty, and then usually stabilizes by adulthood. However, it is not uncommon for there to be periods of pre-chondroblastic hyperactivity interspersed with rest periods, persisting beyond puberty sometimes even to 30 or 40 years of age, leading to complications.

This explains why we are interested in early treatment for affected patients.

Figure 3
A facial photograph with a lip expander in place that allows visualization of the skewing of the plane of occlusion to the side of the hypertrophied left condyle with essentially vertical growth. The maxillary arch has adapted by compensatory super-eruption.

1 – 2 – Definitive diagnosis

1.2.1. Clincal exam

1.2.1.1. Condylar hyperplasia with vertical growth

- Extraoral examination
  - Vertical dissymmetry of the lower 1/3 of the face
  - Reduction of the gonial angle, of the labial commissure and the inferior border of the mandible (Fig. 3).
- Intraoral examination
  - Skewing (or tilting) of the plane of occlusion
  - Randomly occurring gap since it is dependent on alveolar compensations and the behavior of the tongue.

1.2.1.2. Condylar hyperplasia with transverse growth

- **Extraoral examination**
  - Lateral chin shift
- **Intraoral examination**
  - Deviation of the inter-incisal midline due to a mandibular shift

Figure 4
Panoramic xray of left side condylar hyperplasia with vertical growth. The maxillary arch has adapted by compensatory super-eruption. The image shows an expansion of the ramus, blunting of the antegonial notch, an increase in the distance from the inferior border of the mandible to the floor of the maxillary sinus.

1.2.2. Additional para-clinical examinations

1.2.2.1 Standard x-rays

These films of the affected side allow us to see (Fig. 4):

– The increase in the volume of the head of the condyle;
– The elongation of the neck of the condyle and sometimes its enlargement/widening.
– At the level of the ascending ramus:
  • Vertical elongation of the sigmoid notch to the angle of the mandible;
  • Disequilibrium of the height between the coronoid process and the condyle;
  • Deepening of the sigmoid notch.
– Angle of the mandible is rounded and lowered;
– At the level of the horizontal ramus:
  • Convexity of the inferior border of the mandible, disappearance of the antegonial notch;
  • Increase of the distance between the apex and the inferior border of the mandible; and between the apex and the dental canal;
– The maxillary quadrant on the affected side: almost constantly lowered because of dento-alveolar compensations that occur during growth.

The Delaire architectural analysis allows us to expose almost

PANORAMIC BASED STUDY GUIDE FOR MANDIBULAR ASYMMETRIES

LAST NAME: HABOURDIN **FIRST NAMES:** MARION BILLET **AGE:** 16Y **SEX:** FEMALE
REFERENCE GROUP: **DATE OF X-RAY:** 04/15/1994 **TREATMENT OPTIONS:**

"MIRROR IMAGE" SYMMETRY

VERTICAL DIRECTION	∆ ∇	∆ ∇
"maxillary molar occlusal" point (oMs)		∆ -3mm
"lower molar occlusal" point (oMi)		∆ -1mm
"Gonion" point		∆ -3mm
TRANSVERSE DIRECTION	◁▷	◁▷
"posterior condyle" point (Cp)		◁ 3mm
"posterior ramus" point (Rp)		▷ 10 mm
"Gonion" point Go (Go)		▷ 11 mm

MEDIAN POINTS ◁ ▷

ENA point (ENA)		1mm
max. incisor inter-apical(mia)		
max. inter-incisor point (is)		2 mm
mand. inter-incisor point (ii)		2 mm
mand. incisor inter-apical point (mia)		4mm
mid-point of Menton (mMe)		2 mm

ramus measurements			
segment condyle D	45 mm	segment condyle G	41mm
segment coronoid D	37 mm	segment coronoid G	36mm
segment angle D	29 mm	segment angle G	33mm
height CsD-GoD	66 mm	height CsG-GoG	63mm
Segment GoD-Me	104mm	segment GoG-Me	112mm

Angles of the posterior borders with vertical

right posterior border	10°	left posterior border	3°

Angles of the lower first molars

46 w/plane of occlusion	116°	36 w/plane of occlusion	116°

N.B: transverse measurements are accurate only when the panoramic x-ray is very symmetrical (not distorted)

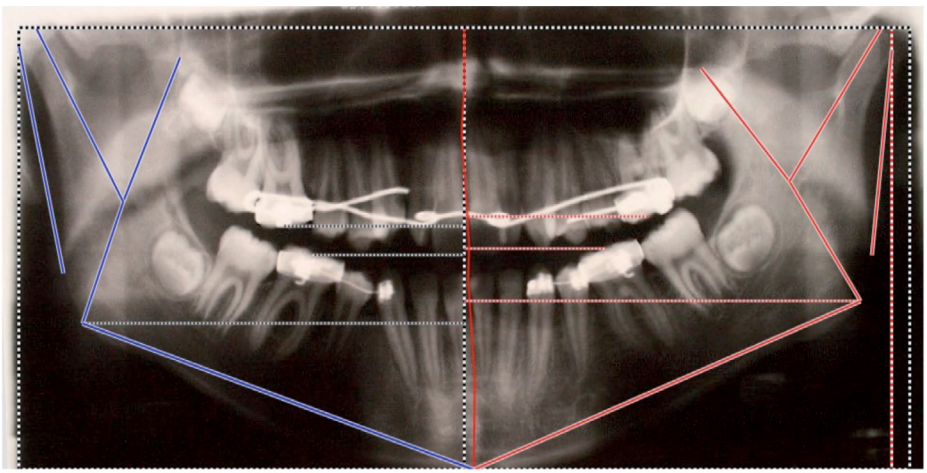


Figure 5
Early *screening of the dyssymmetries using the Delaire Analysis on a dental panoramic x-ray.*

imperceptible dyssymmetries at a young age (Fig. 5). The morphological dyssymmetry is clear;

– The right condyle is 3 mm longer than the left condyle;
– The height of the right ramus is 6 mm more than the left condyle.

But at the level of the teeth, there is very little deviation, a sign that orthodontic treatment would permit compensation at the dento-alveolar level of the facial dyssymmetry (Fig. 6).

– The dyssymmetry increases in numerical value;
– The morphological signs of condylar hyperplasia are more obvious.

The deviation of the maxillary and mandibular interincisal midline relationship is slightly more obvious, but it is, above all, the 2nd order alignment of the mandibular incisors which is noteworthy, demonstrating a significant dento-alvolar compensation.

PANORAMIC BASED STUDY GUIDE FOR MANDIBULAR ASYMMETRIES

LAST NAME: HABOURDIN **FIRST NAMES:** MARION BILLET **AGE:** 14Y 2M **SEX:** FEMALE
REFERENCE GROUP: **DATE OF X-RAY:** 06/19/1992 **TREATMENT OPTIONS:**

"MIRROR IMAGE" SYMMETRY

VERTICAL DIRECTION	∆ ∇	∆ ∇
"maxillary molar occlusal" point (oMs)		∆ -2mm
"lower molar occlusal" point (oMi)		∆ -2mm
"Gonion" point		∆ -5mm
TRANSVERSE DIRECTION	<>	<>
"posterior condyle" point (Cp)		▷ -5mm
"posterior ramus" point (Rp)		▷ 2 mm
"Gonion" point Go (Go)		▷ 4 mm

MEDIAN POINTS

	◁	▷
ENA point (ENA)		
max. incisor inter-apical(mia)	1 mm	
max. inter-incisor point (is)		1 mm
mand. inter-incisor point (ii)		1 mm
mand. incisor inter-apical point (mia)		3 mm
mid-point of Menton (mMe)		3 mm

ramus measurements			
segment condyle D	47 mm	segment condyle G	44mm
segment coronoid D	37 mm	segment coronoid G	36mm
segment angle D	31mm	segment angle G	34mm
height CsD-GoD	71 mm	height CsG-GoG	65mm
Segment GoD-Me	110mm	segment GoG-Me	111mm

Angles of the posterior borders with vertical

right posterior border	12°	left posterior border	6°

Angles of the lower first molars

46 w/plane of occlusion	118°	36 w/plane of occlusion	121°

N.B: transverse measurements are accurate only when the panoramic x-ray is very symmetrical (not distorted).

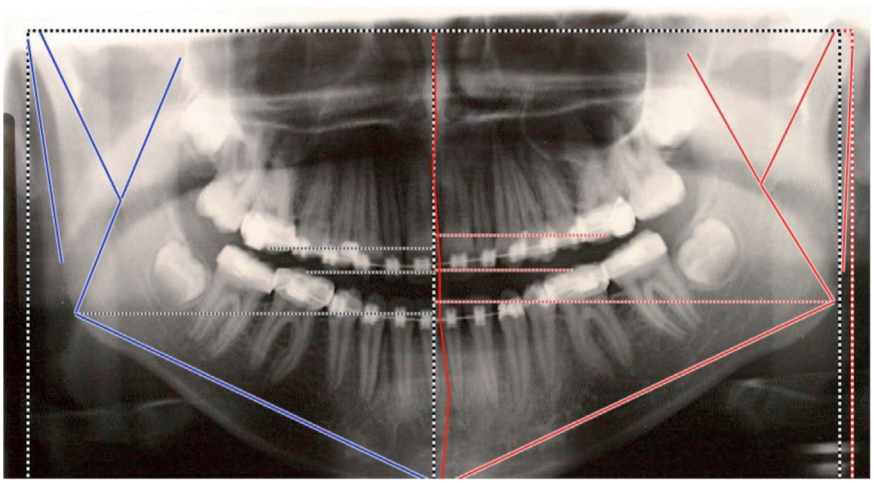


Figure 6

Ongoing follow-up during treatment of the dyssymmetry using the Delaire Analysis of the panoramic x-ray.

This compensation, according to Delaire is the result of orthodontic treatment.

- **Lateral head film**

The lateral head film helps to determine whether or not a dyssymmetry is present (Fig. 7).

We can see:

– The double shadow of the angles of the mandible at the inferior borders with a marked vertical discrepancy;
– The dyssymmetry of the heads of the condyles that is difficult to visualize.

- **Vertical anterior-posterior head film (Fig. 8):**

– Condylar hyperplasia of the head and neck of the condyle;
– A marked lowering of the angle of the mandible and of the inferior border of the mandible;
– An oblique cant of the occlusal plane;

Figure 7
Lateral head film of condylar hyperplasia with vertical growth. The structural analysis is dominated most by the double shadow of the inferior border of the mandible as well as the double shadow of the occlusal plane which accompanies it (much less than in the transverse type).

Figure 8
AP head film of condylar hyperplasia with vertical growth. The structural analysis shows the vertical asymmetry of the angles of the mandible.

– A lowering of the floor of the sinus due to the dento-alveolar compensations.

Transverse shape:

– Deviation of the chin to the side opposite the condylar hyperplasia;
– At times, a compensatory cant of the plane of the mandibular incisors.

• **Basal view (submental)**

– Condylar hyperplasia is difficult to discern;
– Dyssymmetry of the mandibular arch elongated transversely on the affected side.

• **Scanner**

The cuts obtained of the transverse structures with a digital scanner allows a tri-dimensional reconstruction which prove to be useful in order to have a better view of affected condyle and the associated dento-alveolar compensation (Fig. 9).

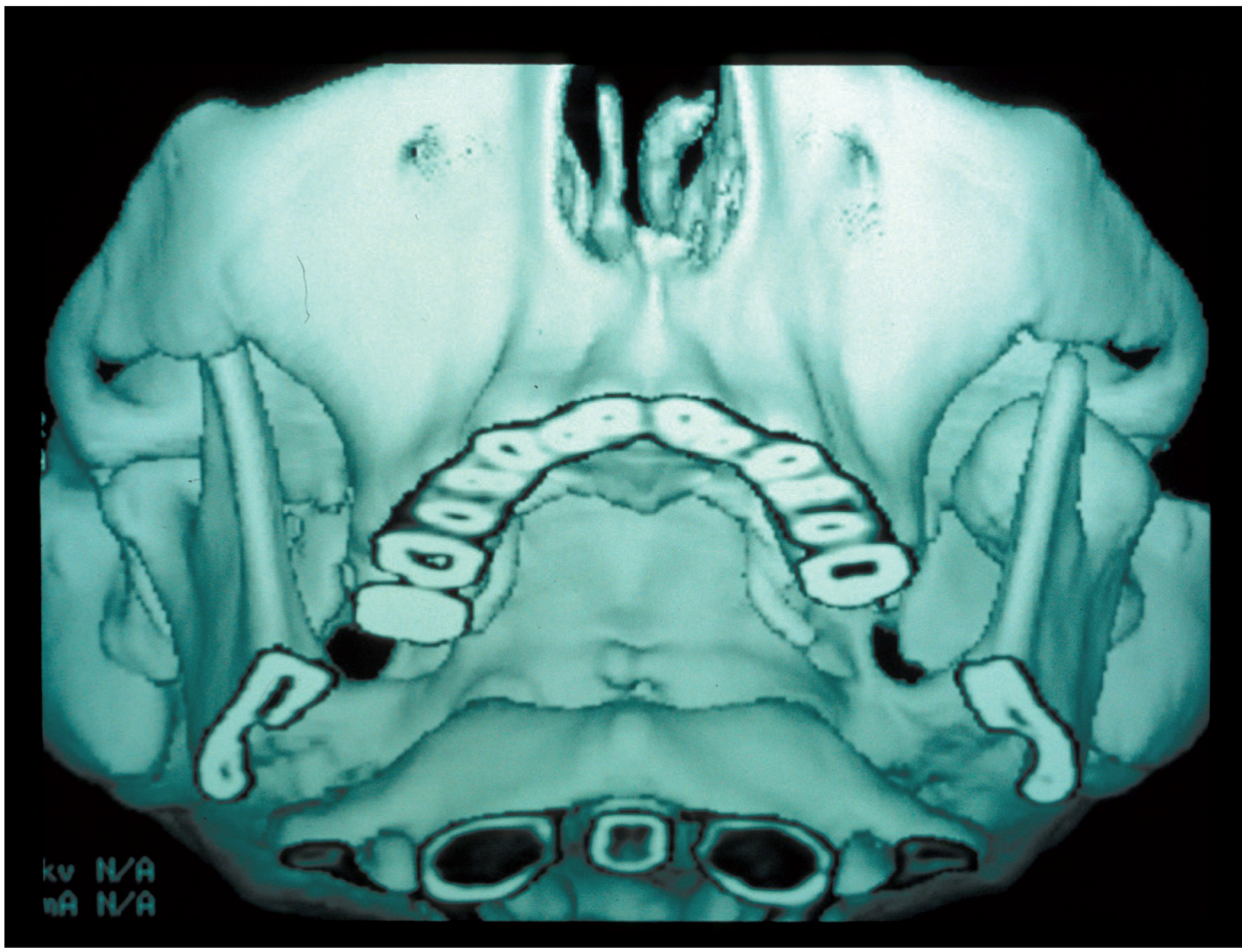


Figure 9
3D reconstruction focused on the hyperplastic left condyle.

However, despite the precision of the examination, it cannot be used to make an accurate diagnosis particularly concerning whether or not there is growth activity of the condylar cartilage.

- MRI

An MRI exam typically performed to examine TMD disorders, does not provide any definitive information in this case where there is no dysfunction of the condylar meniscus.

Information provided by an MRI is insufficient for the establishment of a diagnosis of condylar hyperplasia; therefore it is not indicated.

- Bone scan

It is a functional imaging process.

At the bony level, the bone scan allows us to identify the zones where there are areas of increased osteoblastic metabolic activity (Fig. 10).

Isotope marker uptake confirms the active nature of condylar

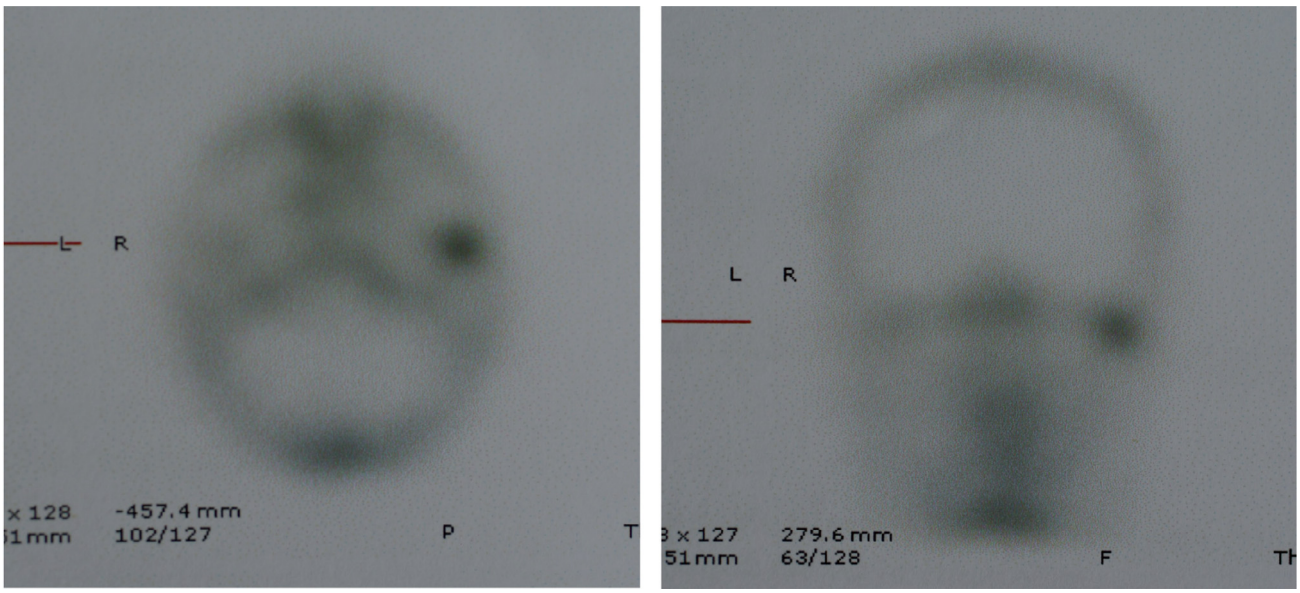


Figure 10
Bone scan: the isotope uptake demonstrates the active nature of the condylar hyperplasia.

hyperplasia and as a consequence determines the treatment plan. However, it is not a predictive factor in determining future growth.

– **Planar bone scanning**

An image acquired with a planar bone scan represents a plane that displays the volume of the distribution of the radioactive material in the part of body being studied. A collimated camera is used to obtain the image.

The spatial relation is mediocre, the size is not accurate, but the interest is focused on the functional aspect and not on pure anatomy.

– **SPECT Tomographic bone scan**

In the case of a tomographic bone scan, image acquisition is produced by causing the camera to move around the part of the body being explored. The image thus obtained is therefore tridimensional, by reconstructing transverse slices from the information acquired from the mobile camera.

The advantage is therefore to improve the resolution of the spatial relation by elimination of adjacent planes that helps to more accurately assess the distribution of the activity of the area. The lesion can be located in the three planes of space.

The SPECT, acronym for *Single Photon Emission Computed Tomography* (in French, Tomographie Computée à Emission de Photon Unique), provides functional information (for example, an acquired bone image augmented by a radioisotope tracer at the level of area of hyperactivity) along with a CT scan supplies corresponding morphologic and anatomic information. Since two modules are tomograms, they both create tri-dimensional images, *i.e.*; a section of the lesions in three planes of space.

Figure 11
Left side underdevelopment contrasted with a normal right side.

1.3 Differential diagnosis

The differential diagnosis arises in moderate or early forms.

- **Functional laterognathias**

– The two condylar heads are of normal size;
– The neck is thinner and longer;
– The ascending ramus does not present with any modifications in size or shape.

- **Unilateral condylar hypoplasia**

Condylar hypoplasia leads, as in condylar hyperplasia, to a mandibular dyssymmetry. However, in cases of condylar hypoplasia, the facial malformation is due to the reduction in the unilateral length of the ramus (Fig. 11, 12).

Such condylar hypoplasia can either be congenital or acquired (traumatic or rheumatic)[11].

- **Mandibular hemi-hypertrophies**

Mandibular hemi-hypertrophies may be either isolated or occur in the overall cohort of total body hemi-hypertrophies.

2. TREATMENT

Determining if condylar growth is active or inactive is necessary in order to choose the appropriate treatment.

– no remaining growth: classic orthognathic surgery;
– growth still active: consider condylectomy at the beginning of treatment.

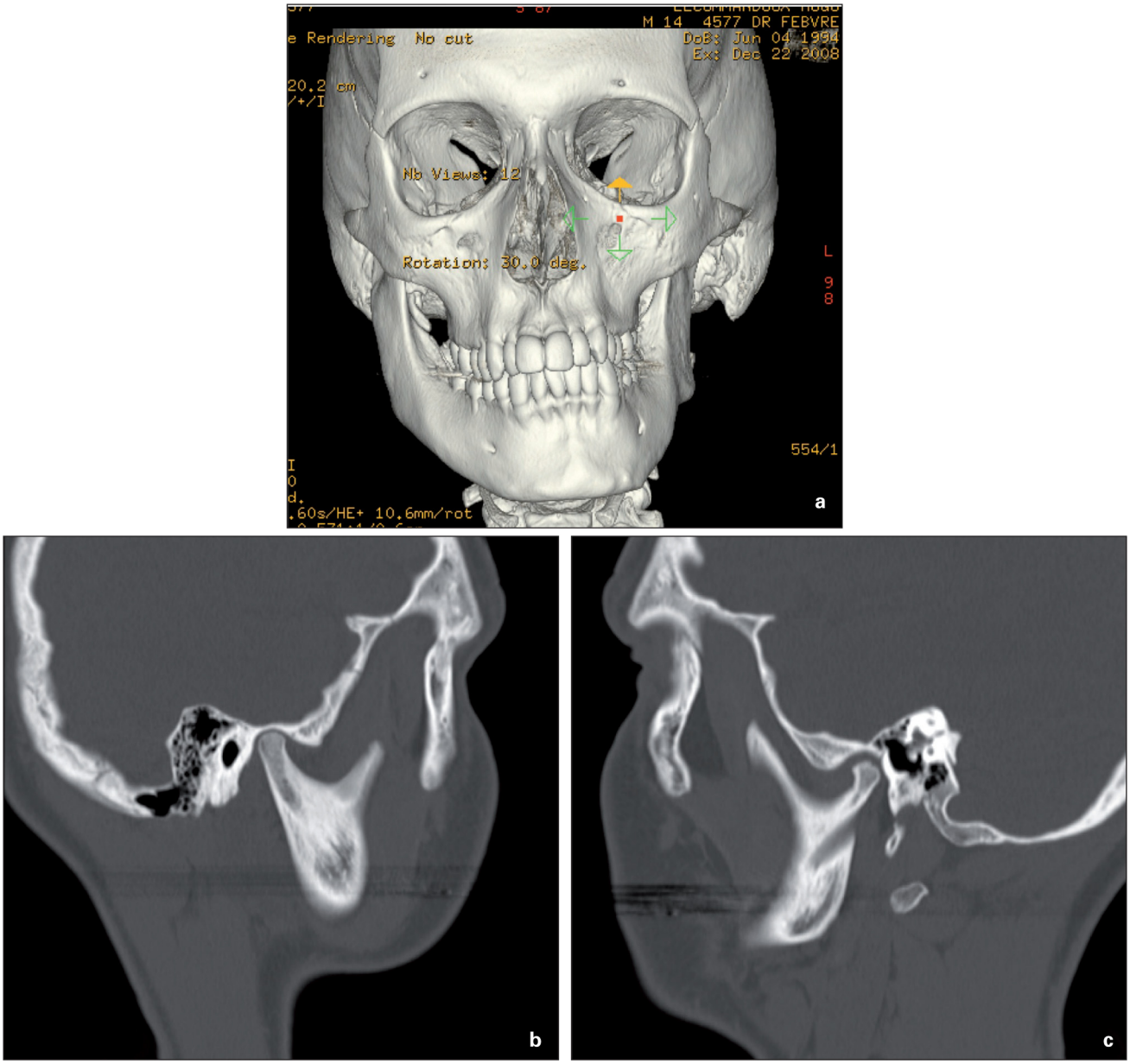
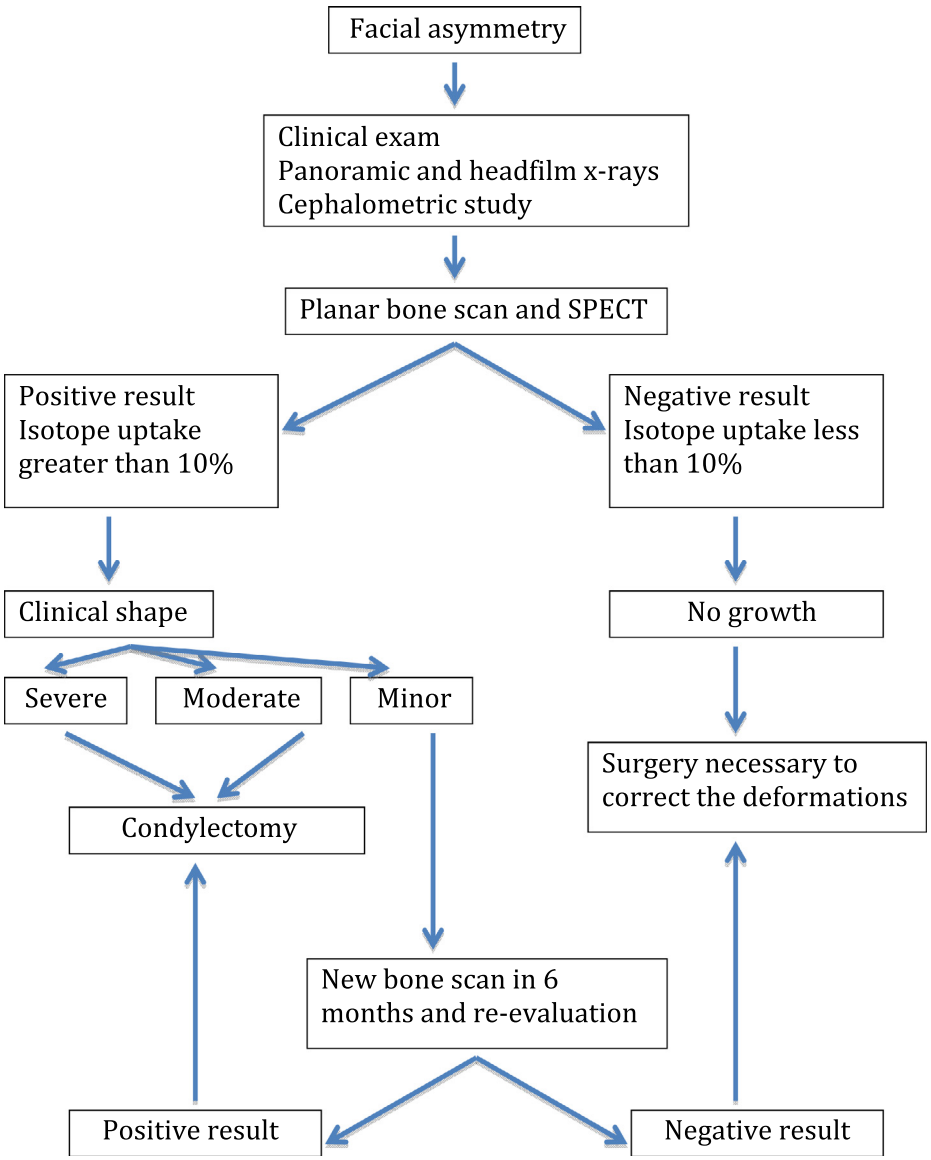


Figure 12

a: The reconstruction from a 3D scanner confirms the skeletal origin of the asymmetry. b&c: the saggital scanner slices show a normal right condyle (b) and a hypoplastic left condyle (c).

In 1999, after bone scans had been almost routinely recommended in cases of condylar hyperplasias[6], Hoder et al. proposed a decision tree summary.

However, according to Delaire, the bone scan is not required in order to make a good therapeutic choice especially in choosing to do a condylectomy.



Classic orthognathic surgical protocol

When the dysplasia is stabilized, there is no need to operate on the condyle. Classic orthognathic surgery at the angles of the mandible allows for the mandible to become symmetrical thus sparing the TMJ without fear of a developmental relapse that will compromise stability. Orthodontic preparation precedes the surgery.

Early condylectomy

In 2009[1], Angiero wrote that in cases where active condylar hyperplasia is proven a condylectomy is necessary (Fig. 13, 14).

We believe it is important to specify the orthognathic protocol for a condylectomy. To begin with, contrary to the classic orthognathic

Figure 13
During the course of orthodontic treatment the appearance of a lateral mandibular shift should make the orthodontist suspect a diagnosis of condylar hyperplasia , which in fact, was confirmed by a bone scan.

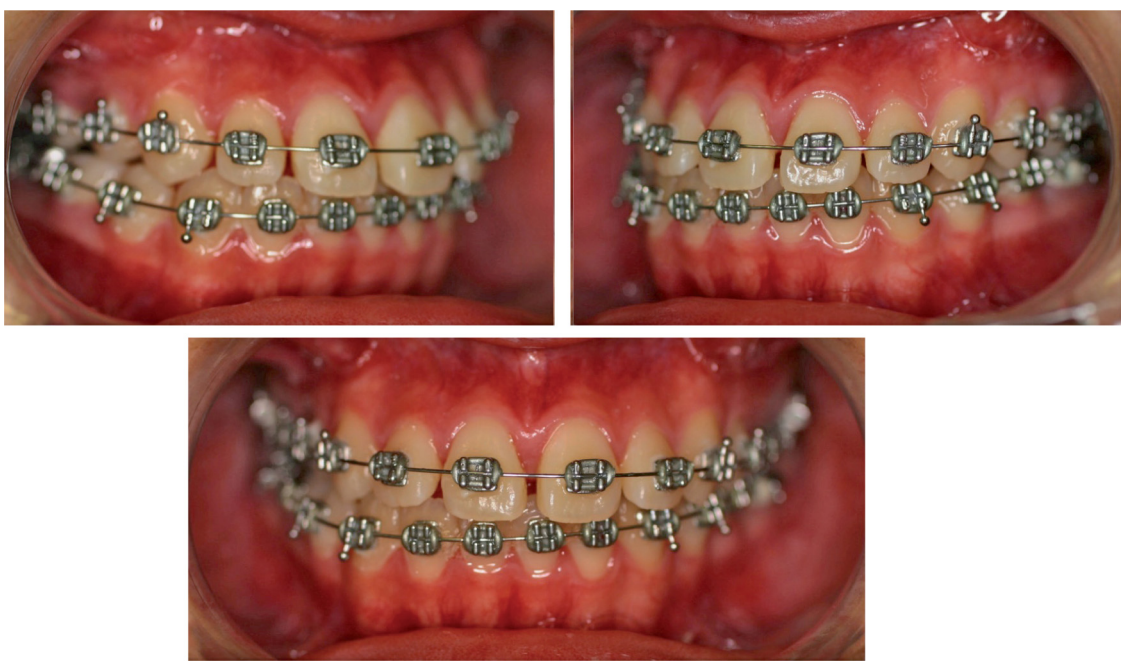


Figure 14
A condylectomy allowed for a re-centering of the mandible (orthodontist : Dr. Daude).

Figure 15
The external site of the condylectomy does not leave a disfiguring scar.

surgical protocol, a condylectomy does not allow precise positioning of the mandible. Secondly, vertical compensations are technically difficult to correct preoperatively. Their persistence creates occlusal interferences that restrict perioperative positioning. In addition, it serves no purpose to decompensate preoperatively by trying to measure the anticipated changes because it is corrected progressively exactly as it is done in cases of condylar fractures (Fig. 15, 16, 17, 18). It is preferable to do this orthodontic treatment in the post-operative phase.

This is very delicate surgery. To begin with, the surgeon must avoid damaging the facial nerve by using a posterior approach on the upper part of the condylar neck.

During the second phase of treatment, the meniscus must be preserved so as to avoid the risk of developing TMD. The occlusal results, notably correction of the

Figure 16
Condylar hyperplasia with transverse growth characterized by a significant deviation of the chin.

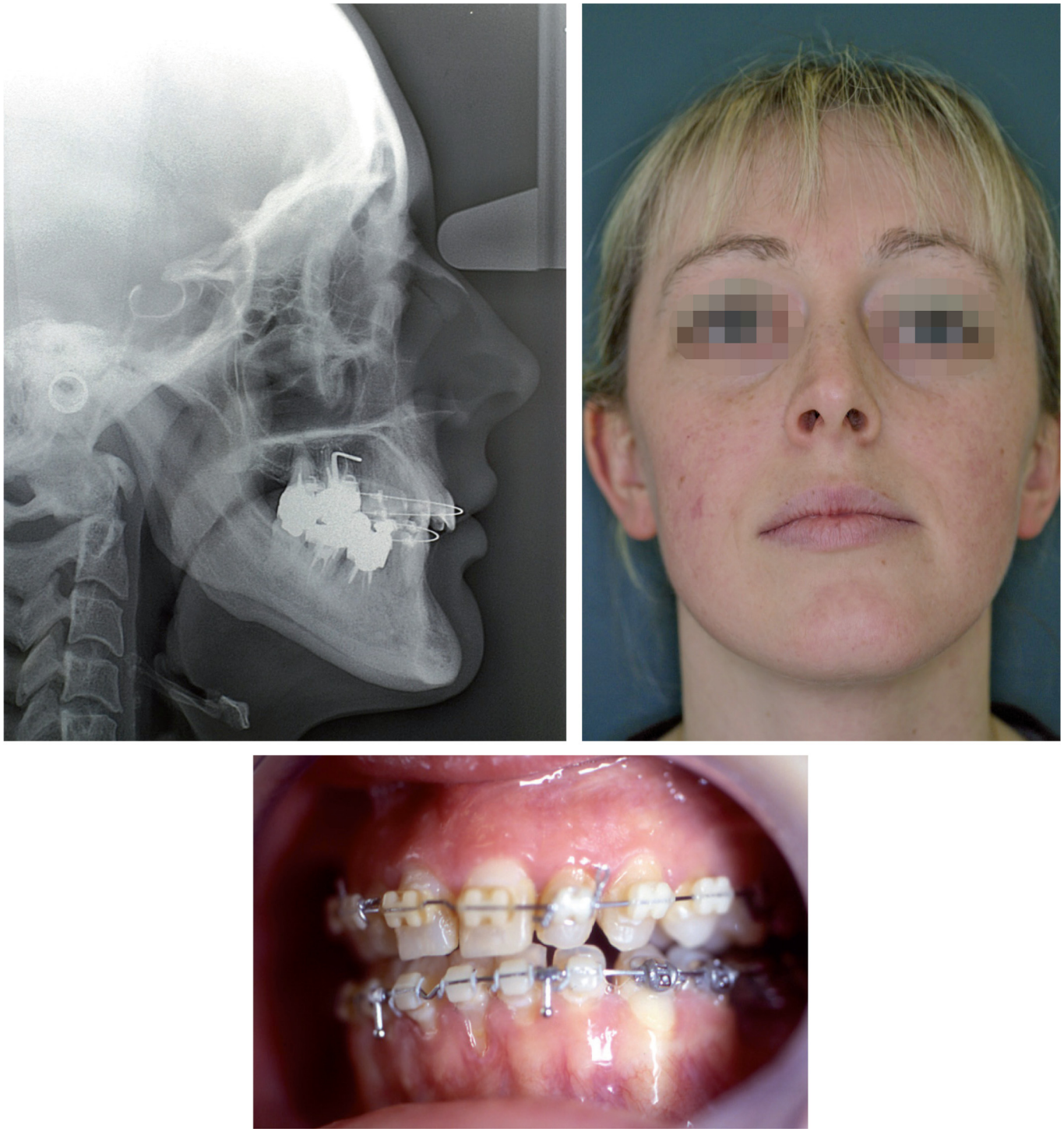


Figure 17
A condylectomy created a good skeletal symmetrical alignment but not sufficient occlusal control with persistent remaining Class 2 (orthodontist Dr Le Trocquer).

Figure 18
A surgical mandibular advancement permitted achievement of an occlusal and skeletal correction.

orientation of the plane of occlusion, are favorable and assure the patient of a stable and functional correction. However there sometimes persists a noticeable asymmetry of the inferior border of the mandible which we think it is advisable to correct at the end of treatment after stabilization of the vertical decompensations.

CONCLUSION

If the condylar hyperplasia is an easy diagnosis to make in severe cases, we must remember to consider it in simple orthodontic cases that increasingly go untreated.

The therapy of early condylectomy avoids development of complex dento-alveolar compensations that are complicated to correct and allows for a treatment based on the etiology of the condition that rarely relapses.

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