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The Aetiology, Diagnosis and Management of Mandibular Asymmetry

Abstract: An understanding of the aetiology of mandibular asymmetry and a thorough methodical diagnostic approach is essential for the appropriate management of patients presenting with dentofacial asymmetry.

The aim of this review article is to describe the developmental, pathological, traumatic and functional causes of mandibular asymmetry, to provide a guide to diagnosis through clinical examination and special investigations and, finally, to outline the management of patients presenting with a mandibular asymmetry, focusing particularly on the treatment of developmental asymmetries.

Clinical Relevance: This article presents a review of the aetiology, diagnosis and management of mandibular asymmetries with a particular focus on developmental asymmetries.

Ortho Update 2008; 1: 44-52

The word symmetry is derived from the Greek word *symmetria* which means 'of like measure'. Symmetry is defined as correspondence in size, shape and relative position of parts on opposite sides of a dividing line or median plane. Asymmetry is described as a lack or absence of symmetry. When applying this to the human face, it illustrates an imbalance or disproportionality between the right and left sides. A degree of asymmetry is normal and acceptable in the average face. It may be caused by a range of factors that affect the underlying skeletal structure or soft tissue drape. However, the importance of early diagnosis and the detection of progressive causative conditions is essential for the management of facial asymmetry. This article will focus on asymmetries of the mandible and on some of the aspects of maxillary asymmetry.

The causes of mandibular asymmetry can be divided into (Table 1):

Causes	Examples
Developmental	Hemimandibular elongation Hemimandibular hyperplasia Hemifacial microsomia Achondroplasia Hemifacial hypertrophy Torticollis Hemifacial atrophy (Parry-Romberg syndrome)
Pathological	Tumours and cysts Infection Condylar resorption
Traumatic	Condylar fractures
Functional	Mandibular displacement

Table 1. Causes of mandibular asymmetries.

- Developmental;
- Pathological;
- Traumatic;
- Functional.

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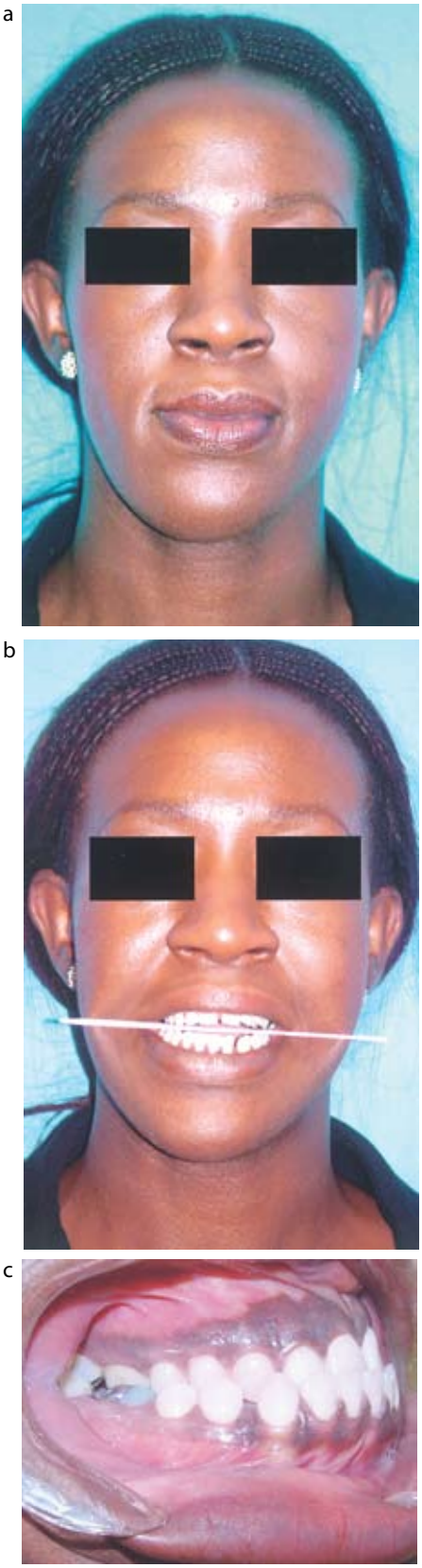

Figure 1. **(a)** Patient presenting with left-sided hemimandibular elongation. Note the chin point deviation to the right, away from the affected side. **(b)** This condition is often associated with minimal compensatory canting of the maxilla. **(c)** The same patient with a crossbite on the unaffected side.

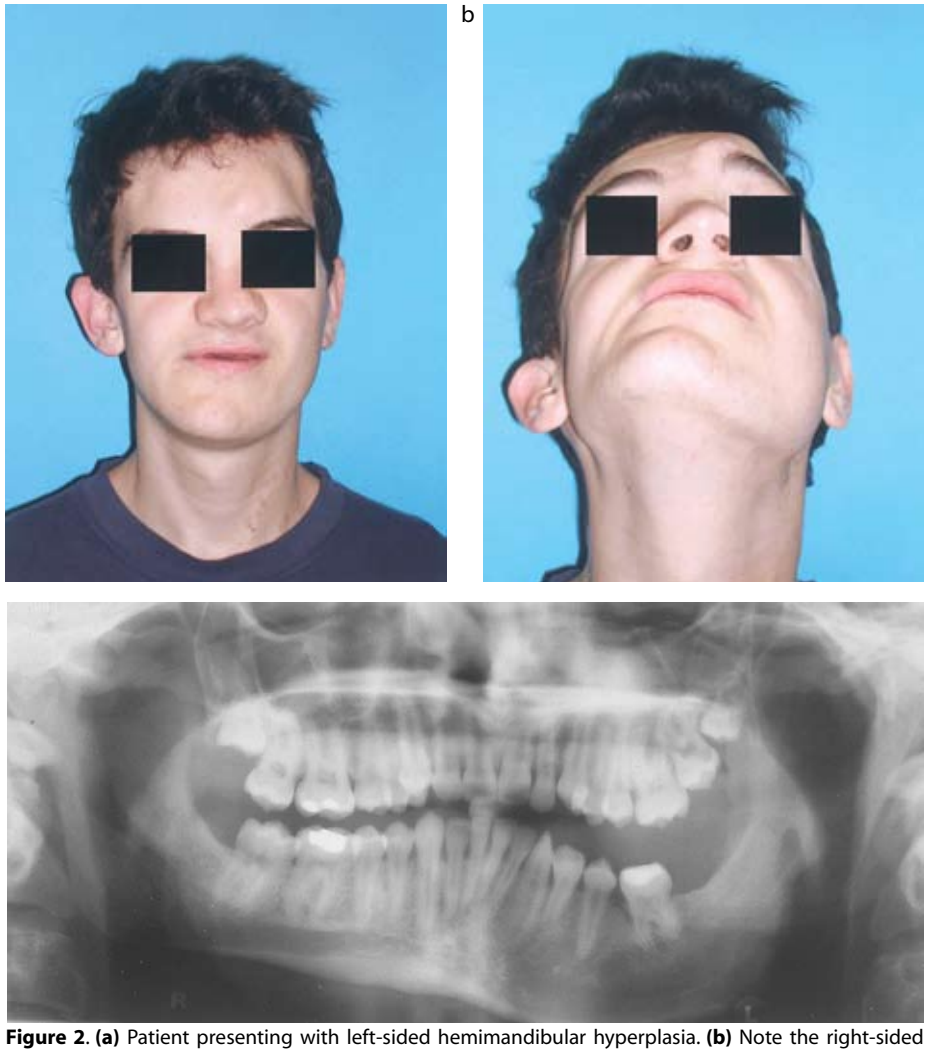

Figure 2. **(a)** Patient presenting with left-sided hemimandibular hyperplasia. **(b)** Note the right-sided chin point deviation which is clearly visible from below. **(c)** An OPG radiograph of the same patient demonstrating increased vertical mandibular growth on the left side, increased alveolar height, a left-sided lateral open bite, and displacement of the inferior dental canal on the left.

Developmental

The conditions, hemimandibular elongation and hemimandibular hyperplasia, were originally described together as condylar hyperplasia. However, the former terms are now used instead to describe these two distinct conditions and have superseded the term condylar hyperplasia.

Hemimandibular elongation

Hemimandibular elongation was first described by Obwegeser and Makek[1] and is a developmental deformity of unknown aetiology affecting the mandible unilaterally. It commonly presents with a progressively increasing transverse displacement of the chin point in young adulthood.

The occlusion follows the displaced skeletal pattern so that the mandibular dental centreline does not coincide with the midfacial line. However, the centreline may be coincident with the chin point. There will also be a crossbite observed on the unaffected side and possibly a scissor bite on the affected side. Since there is such a small vertical component to the abnormal growth, there are typically no lateral open bites of the buccal segments or compensatory transverse canting of the maxillary occlusal plane (Figure 1a, b). Radiographically, there is clear elongation of the affected side of the mandible, principally located in the condylar region and the body of the mandible.

Hemimandibular hyperplasia

Hemimandibular hyperplasia, also described by Obwegeser and Makek,[1] is a three-dimensional developmental enlargement of one side of the mandible including the condyle, condylar neck, ramus

a

b

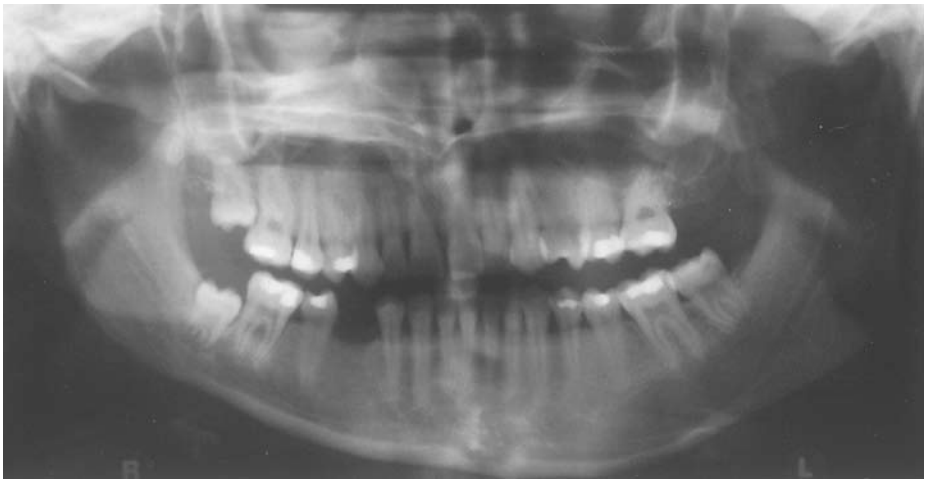

Figure 3. **(a)** Patient presenting with a hybrid form of hemimandibular hyperplasia (left side) and hemimandibular elongation (right side). **(b)** A panoramic radiograph illustrating both the hyperplasia and elongation of the mandible.

and body. It typically only affects one side of the mandible and the enlargement is characterized by abruptly stopping at the midline of the mandibular symphysis. It is distinct from hemimandibular elongation as there is both a horizontal and significant vertical component to the abnormal mandibular growth pattern.

There is an increase in the height of the affected side, giving the face a rotated appearance. The mouth slopes to the affected side but is not restricted in opening. The condition usually commences in puberty and hence the maxillary dentition on the affected side will overerupt to compensate for the excessive vertical mandibular growth, which results in a characteristic transverse cant of the maxillary occlusal plane. The teeth will often remain in occlusion on the affected side. However, if the vertical component of the excessive mandibular growth is rapid, then dental eruption may not keep pace with vertical ramal growth and a lateral open bite will occur on the affected side, particularly if the tongue becomes interposed. The transverse component of the abnormal mandibular growth may result in a mandibular dental midline discrepancy. However, the dental midlines may well remain coincident, albeit with altered angulation of the mandibular incisors (Figure 2a).

Radiographically, a panoramic tomogram will show that the ascending ramus is elongated vertically with enlargement of the condyle. There is also an elongation and thickening of the condylar neck. The angle of the mandible is rounded, whilst the lower border is bowed downwards to a lower level compared to the opposite side. There is an increase in the height of the mandibular body, which appears to increase the distance between the molar roots and the mandibular canal. The unaffected side appears to have a normal height. This growth defect is clearly demarcated by the symphysis (Figure 2b).

Hybrid forms of hemimandibular hyperplasia and hemimandibular elongation exist where patients exhibit features of both conditions (Figure 3a, b). The differences between the two conditions are highlighted in Table 2.

Hemimandibular elongation	Hemimandibular hyperplasia
Unilateral horizontal enlargement of mandible	Unilateral three dimensional enlargement of mandible
Transverse displacement of chin point	Transverse chin displacement maybe minimal. Chin may be rotated
No transverse canting of occlusal plane	Transverse canting of occlusal plane
Normal alveolar bone height above ID canal of affected side	Increased alveolar bone height above ID canal of affected side

Table 2. Differences between hemimandibular elongation and hemimandibular hyperplasia.

Branchial arch	Derivatives
1st	Meckel's cartilage (malleus, anterior ligament of malleus, sphenomandibular ligament), mandible, incus. From the pouch: auditory tube, middle ear cavity, tympanic membrane and external auditory meatus. Maxillary and mandibular divisions of the Trigeminal nerve (V).
2nd	Reichert's cartilage (stapes, styloid process, stylohyoid ligament, lesser cornu and body of the hyoid bone). Facial cranial nerve (VII).

Table 3. Derivatives of the 1st and 2nd branchial arches.

Hemifacial microsomia

Hemifacial microsomia is a congenital disorder that results in a deficiency in the hard and soft tissues on

a

b

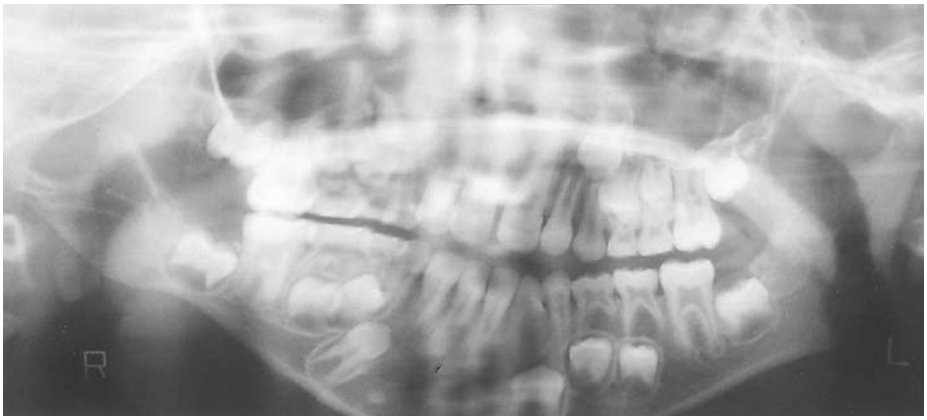

Figure 4. **(a)** Patient presenting with right-sided hemifacial microsomia. Lack of mandibular growth on the right side has resulted in chin displacement to the affected side. **(b)** A panoramic radiograph illustrating the lack of mandibular growth on the right side.

predominantly one side of the face. The condition is thought to be caused by a defect in the proliferation and migration of early embryonic neural crest cells, which results in defects of the 1st and 2nd branchial arch structures (Table 3). However, the 1st arch structures are primarily involved, leading to the underdevelopment of the temporomandibular joint, mandibular ramus, masticatory muscles and the ear. Owing to the reduced size of the masticatory muscles, the facial bones do not mature normally. In severe cases, large portions of the mandible, such as the condyle or ramus, fail to develop. This may result in mandibular asymmetries of varying severity (Figure 4a, b). The occlusion may be affected with crowding and a unilateral crossbite on the affected side. Tooth development can also be disturbed on the affected side and the prevalence of hypodontia is five times more common in these patients than the normal population.[2] Owing to the association of the specific cranial nerves with the branchial arches, varying degrees of nerve palsy may be exhibited.

Hemifacial hypertrophy

Hemifacial hypertrophy is a rare form of overgrowth that may cause asymmetry in the craniofacial structures, including soft and hard tissues. It may also affect the occlusion. The hypothesis for the aetiology of this condition is an asymmetric distribution of neural crest cells.

Intra-uterine pressure during pregnancy and pressure during birth may have effects on the musculoskeletal system of the foetal skull and body. This may lead to muscular torticollis (shortening of the sternocleidomastoid muscle) or postural scoliosis, which can lead to mandibular asymmetries. It should be noted that there can be a significant genetic contribution to this condition.

Hemifacial atrophy (Parry-Romberg syndrome)

This is a rare disorder that is characterized by progressive atrophy of underlying soft tissues and bones on one side of the face. Hemifacial atrophy is a disorder of uncertain aetiology. It is more common on the left side and in females. The facial changes include the tissues around the nose and nasolabial fold and later progresses to the angle of the mouth, eyes, ears and neck. It follows the distribution of the trigeminal nerve. This may be accompanied by hyperpigmentation of the skin, seizures and facial pain. It may also cause muscle and facial bone atrophy. This can lead to the development of a mandibular asymmetry (Figure 5).

Figure 5. Patient presenting with hemifacial atrophy (Parry-Romberg syndrome) of the right side of the face. Note the mandibular growth on the left side resulting in an asymmetry on the right side where the atrophy has occurred.

Pathological

Tumours

Tumours of the orofacial region may affect the soft tissues, salivary glands, nerves and bone. These are commonly asymmetric in presentation, being distinguished from developmental abnormalities by their clinical behaviour and effects. The local effects result from compression, invasion, ulceration or destruction of adjacent structures, which may manifest as changes in nerve sensation, lymph node enlargement or pain.

The ameloblastoma is a common odontogenic tumour that may occur in childhood. It is a locally aggressive benign tumour that develops from the remnants of the odontogenic epithelium and may present in the mandible asymmetrically. It is characterized by a multilocular or honeycomb appearance radiographically in the body and ramus of the mandible.

Tumours rarely develop in the condylar head of the mandible. If they do occur there will be a deviation of the chin point to the unaffected side. Radiographically, there will be unilateral condylar enlargement. Typical examples of tumours include osteochondroma, osteoma or chondrosarcoma.

Cysts and other pathology

Dentigerous cysts, keratocysts and lympho-epithelial cysts have asymmetric presentations in the mandibular region. The condition fibrous dysplasia may also affect the symmetry of the mandible.

Infections

Various infections can present asymmetrically. Examples of those that may cause a mandibular asymmetry include dento-alveolar abscesses and acute parotitis. These are characterized by their rapidity of onset, pain, pyrexia, malaise and associated regional lymph node involvement.

Condylar resorption

There are a number of conditions that may cause resorption of the mandibular condyles. These include juvenile rheumatoid arthritis, post-steroid therapy and orthognathic surgery. Rheumatoid arthritis as a child can affect the temporomandibular joint unilaterally or bilaterally, causing changes in mandibular function and structure. Destruction of the joint and disc can be seen as the condition affects bone and cartilage. If unilateral condylar resorption occurs, then this may result in a mandibular asymmetry. Often, multiple joints within the body are affected, which helps to make the diagnosis.

Condylar resorption following orthognathic surgery can be a cause of skeletal relapse and the mechanisms are poorly understood. The predisposing factors for condylar resorption following orthognathic surgery include pre-operative temporomandibular joint dysfunction, being young and female, and having a high mandibular plane angle with mandibular retrusion.[3] Females may be more commonly affected than males owing to hormonal factors.

Traumatic

Condylar fractures

Trauma to the condylar region during childhood may result in growth arrest and impaired function. However, the majority of cases remain undiagnosed.[4] If growth arrest does occur, this may produce a chin asymmetry towards the side of the affected condyle. The loss of function is usually caused by an ankylosis in the temporomandibular region. This is initiated by the intra-articular bleeding and resulting haematoma formation that follows traumatic episodes in children.

Functional

Mandibular displacements

A buccal crossbite occurs when the buccal cusp of a mandibular molar occludes buccal to the buccal cusp of the corresponding maxillary tooth.

Slight transverse narrowing of the maxilla or associated dentition may result in mandibular to maxillary cusp-to-cusp occlusal interferences, resulting in a lateral displacement of the mandible as the patient tries to achieve maximal intercusption on closure. Some authors have suggested that mandibular growth is restricted on the side of the crossbite and may result in shortening of the ramal height on that side and contribute to the development of a mandibular asymmetry.[5] However, there is not yet any firm evidence to support this theory.

Examination	Diagnostic aids
Extra-oral clinical	Note the position of the midpoint of the chin in relation to the facial midline. If a discrepancy exists, check if there is a transverse cant in the maxillary occlusal plane and note the relationship of lower dental centreline to the midline of the chin.
Intra-oral clinical	Check for dental centreline discrepancies and occurrence of crossbites. If a crossbite exists, check for a mandibular displacement.
Imaging	Radiographs, photographs, CT scan.
Occlusion	Study models or articulated study models with facebow transfers.
Pathology	Biopsies, histopathology, sialography.

Table 4. Examination and diagnostic aids.

Figure 6. Patient illustrating a maxillary cant with the use of a tongue spatula.

Diagnosis

Extra-oral clinical

Examination can reveal asymmetry in three planes of space: vertical, antero-posterior and transverse dimensions. Both skeletal and soft tissue evaluations must be conducted bilaterally to make comparisons. Deviations in the dorsum and tip of the nose, philtrum of the upper lip and chin point need to be established and should be assessed in relation to the facial midline (Table 4).

Asymmetries in the mandible can be established from frontal views. However, inferior and superior views must not be discounted as they can reveal the extent of the asymmetry in relation to the rest of the face. If a mandibular asymmetry exists, it is also important to check for a co-existing cant in the maxillary occlusal plane (Figure 6). A transverse maxillary cant is related to asymmetrical vertical growth of the mandibular rami. On the side of excessive growth, the maxillary teeth continue to erupt to maintain occlusal contact with the opposing mandibular dentition, producing a cant. The significance of a maxillary cant is that this will require correction with surgery if the mandibular asymmetry is to be corrected.

It should be noted that even aesthetically pleasing faces exhibit a degree of skeletal asymmetry with a slight tendency to right-sided dominance.[6] Mandibular asymmetry is demonstrated in growing children between the ages of 7 years and 16 years. This does not always become clinically significant as it may

represent a fluctuation in normal growth.[7,8]

Intra-oral clinical

Dental midlines

The maxillary and mandibular dental midlines should ideally be coincident with the midline of the face. If there is a discrepancy in the mandibular dental midline, it is important to recognize whether it is of skeletal or dental origin. If the mandibular dental midline is coincident with the chin point, then the discrepancy is likely to be skeletal in origin and therefore correction may require an orthognathic approach. If the dental midline is not coincident with the chin point, a dental cause should be considered.

Examination of the upper and lower dental midlines should be carefully undertaken in two different mandibular positions:

- In centric relation (retruded contact position, RCP);
- In centric occlusion (intercuspal position, ICP).

The position of the chin point and mandibular displacements should also be noted during these movements. True mandibular asymmetries will demonstrate similar midline discrepancies in centric relation and centric occlusion. However, lateral functional displacements of the mandible are usually the result of occlusal interferences following initial tooth contacts, and the change in midlines will reflect this. Displacements can occur in the same or opposite direction to the mandibular asymmetry and may work to mask or accentuate the asymmetry.

Occlusion

Occlusion in the vertical plane

Maxillary and mandibular cants can be observed by asking patients to bite on a tongue spatula and comparing this horizontal reference with the inter-pupillary plane, in the absence of vertical orbital dystopia.

Occlusion in the transverse plane

There is often no mandibular displacement associated with true skeletal crossbites. However, if there is a displacement, then the dental midlines can change in the same or opposite direction to the mandibular asymmetry. Dental crossbites can originate from occlusal interferences, which cause the mandible to shift laterally or anteriorly so that the posterior teeth can better interdigitate. A change in dental midlines between centric relation and centric occlusion will become apparent if a lateral mandibular displacement exists. There may also be a shift in the chin point when this occurs.

Serial and reproducible clinical records of the patient, including imaging and study models, are required to determine if an asymmetry is progressive, before the treatment can be considered.

Imaging

Radiographs

The panoramic radiograph allows a comparison of the shape of the mandibular rami and condyles bilaterally. It also provides an overview of the dental and bony structures of the mandible, providing information regarding pathology, the number of teeth and any other hard tissue anomalies. However, owing to the focal trough used in panoramic tomography, there can be distortions in different areas of the image.

Posterior-anterior cephalometric radiographs allow the comparison of left and right hard tissue structures. Distortion and unequal enlargement are minimized. Midlines of the skeletal structures and the dentition can be examined as they are both seen on this projection. However, these radiographs can be misleading as a result of variation in the orientation of the transmeatal axis. It is recommended that these views be taken by clinicians in a specialist care environment. Examination of this radiograph allows the localization of the asymmetry by using a midsagittal reference plane (where there tends to be the most symmetry). There are three methods used to examine this image, including the anatomic approach, the bisection approach and triangulation approach.

Other radiographic views, including the transcranial and transpharyngeal views of the temporomandibular joints, can also be taken to investigate pathology, arthritic disease and trauma to this area.

Photographs

Extra-oral photographs must be taken in frontal view, with profile and three-quarter profile views from both left and right sides in patients with asymmetry. Superior and inferior views of the mandible

a

b

Figure 7. **(a)** A three-dimensional CT scan can be used to assess the underlying skeletal deformity. **(b)** An example of a Technetium isotope scan used to assess the growth activity of skeletal sites. In the example shown there is no increased uptake in the condylar regions.

Functional asymmetry	Orthodontic treatment	Restoration of functional occlusion
	Non-orthodontic treatment	Occlusal adjustment Occlusal splints
Skeletal asymmetry	Orthodontic treatment	Growth modification Orthodontic camouflage
	Surgical treatment	Orthognathic surgery Distraction Osteogenesis Genioplasty Soft tissue surgery
	Pathology	Treat any dental infection or refer to hospital if other pathology

Table 5. Management of mandibular asymmetries.

may also form a useful record. A front view of the patient in occlusion biting on a tongue spatula will give a record of transverse occlusal canting. The intra-oral views will provide important information about the occlusion. These should be taken in centric relation and centric occlusion in cases exhibiting mandibular displacement.

Laser scanning

Optical surface scanning has been used to monitor three-dimensional facial growth.[9] This is a non-invasive technique and the associated software allows the digitization and comparison of images over time. Over 60,000 points are recorded in 10 seconds producing an accuracy of 0.5 mm.[10] Hence, it is possible to examine facial asymmetry quantitatively. Laser scanning has also been used in plastic surgery to study facial asymmetry.[11]

Computed tomography (CT)

CT scanners use X-rays to produce sectional images but the radiographic film is substituted with sensitive gas or crystal detectors. These convert the X-ray beams passed from the patient into digital data. It provides excellent imaging of the hard and soft tissues with more manipulation of the tomographic sections. However, they are both expensive and tend to require high radiation dosage. They can be used for the investigation of pathology, including tumours and temporomandibular joint imaging. Sectional images and 3D reconstructions (Figure 7a) can also be used to study developmental deformities and to locate the position of any bony deformity.

Radioisotope imaging

Radioisotope imaging (Figure 7b) uses radioactive compounds that have an affinity for target tissues. Once they are concentrated in a target tissue, the radiation emissions are detected and imaged using a gamma camera. This allows an investigation of function and structure of the target tissue. Technetium is the most commonly used isotope and is used to image bones and salivary glands. It can be used to investigate tumour pathology, especially in the salivary glands and, more importantly, detect the function and growth in the condylar head. This form of imaging is rarely used nowadays because of the excess radiation exposure and the high number of false positive results.

Stereophotogrammetry

Stereophotogrammetry is a method of acquiring three dimensional images using multiple photographs of the same object taken at different angles. In orthodontics, this can be used to quantify facial morphology and detect changes in growth and development of the face. It can be used to monitor facial asymmetry as it is both non-invasive and reproducible.

Articulated study models

The functional occlusion of a patient can be assessed more accurately with the use of study models that have been articulated with a facebow transfer. It is important to take a jaw registration in centric relation so that any premature contacts or interferences can be detected. This investigation should supplement a detailed clinical examination of the occlusion in static and dynamic function.

Pathological special investigations

If pathology is suspected of causing the asymmetry, the patient should be referred for specialist care. Incisional and excisional biopsies will allow histological diagnosis. This will reveal the nature of the hard or soft tissue pathology, for example, fibro-osseous lesions or tumour-like lesions. Sialography is the radiographic examination of the major salivary glands by introducing a radio-opaque contrast medium into the ductal system. It will allow the detection of the size, nature and origin of a swelling or mass in the area.

Management of mandibular asymmetries

The management of mandibular asymmetries is summarized in Table 5.

Functional asymmetry

Restoration of functional occlusion

Orthodontic treatment can be used to eliminate crossbites that lead to functional displacements of the mandible. Options involve removable or fixed appliances. Upper removable appliances can eliminate a posterior crossbite with the use of a midline expansion screw. Fixed appliance approaches include the use of the quadhelix, rapid maxillary expansion and auxiliary expansion arches used in conjunction with routine bonded appliances.[12]

Occlusal adjustment and occlusal splints

Very minor occlusal adjustments can be made to remove premature contacts that cause mild deviations of the mandible.

Skeletal asymmetry

Figure 8. A hybrid functional appliance allowing differential eruption of the maxillary teeth on the left side to compensate for an occlusal cant.

Figure 9. **(a)** Patient presenting with right-sided mandibular asymmetry. **(b)** The same patient with corrected asymmetry following orthodontics and bimaxillary orthognathic surgery.

Growth modification

In cases where a mandibular asymmetry or deficiency is identified at a young age, growth modification may be attempted. Hybrid functional appliances are specifically tailored to address certain growth processes and development by combining several components.[13] The components may act by the following mechanisms: eruption (biteplanes), linguofacial muscle balance (shields or screens) and mandibular repositioning (construction bites or jaw registrations). It has been suggested that these appliances cause selective dento-alveolar eruption and, to a lesser extent, encourage a degree of normal mandibular growth to occur to compensate for asymmetrical deficiencies in growing patients (Figure 8). However, evidence for this is lacking.

Orthodontic camouflage

If the mandibular skeletal asymmetry is acceptable, and any abnormal growth has ceased, but a dental midline shift still exists, then this may be camouflaged orthodontically. A number of techniques can be used in conjunction with fixed appliances to correct dental midline discrepancies including:

- Asymmetric extraction patterns;
- The use of asymmetric lacebacks;
- Push-pull mechanics;
- Asymmetric elastics.

Surgical treatment

Orthognathic surgery

Mandibular asymmetries that cannot be camouflaged by orthodontics alone will require surgical repositioning of the mandible. This is indicated once abnormal mandibular growth has ceased. Mandibular asymmetries can often lead to a secondary maxillary deformity. When the mandibular asymmetry has a vertical component of growth, the maxilla will compensate in growth and cause a transverse occlusal cant. A Le Fort I osteotomy to reposition the maxilla may be required if an occlusal cant is present. Surgical correction for the mandible usually involves a bilateral sagittal split osteotomy procedure, which carries the risk of damage to the inferior alveolar nerve.

Pre-surgical orthodontics will involve the relief of crowding and alignment of the arches followed by decompensation to unmask the true extent of skeletal discrepancy and allow maximal change with the surgery. There should be no attempt to correct the dental midlines at this stage as the correction will occur mostly with the surgical movements. The mandibular dental midline should be made coincident with the midline of the chin, allowing correction with asymmetric mandibular repositioning at surgery. Post-surgical orthodontics is usually short in duration and mainly consists of detailing the occlusion (Figure 9a, b).

Distraction osteogenesis

Distraction osteogenesis is described as the induction of a callus of bone by osteotomy or corticotomy followed by distraction of proximal and distal ends to increase bone length. It has been used to treat mandibular asymmetries where the mandibular ramus and body are to be lengthened.[14] This is indicated in severe cases of mandibular asymmetry, for example due to hemifacial microsomia or condylar fractures at an early age.

Surgical procedures as adjuncts or alone

The lower border osteotomy (genioplasty) of the mandible can reposition the chin point transversely or vertically in order to address the asymmetry. It is one of the most stable movements compared to managing mandibular asymmetries by other orthognathic movements.[15] When the ramus or body has a degree of asymmetric shaping that is contributing to the overall asymmetry of the mandible, then implants or recontouring of the bone surfaces can be undertaken.

Soft tissue surgery

Excessive muscular contraction (especially the sternocleidomatoid muscle) in torticollis can cause twisting of the head and result in a mandibular asymmetry. The restriction of growth on the affected side can be relieved if the contracted muscles are surgically detached at an early age.[16]

Pathology

If the nature of the mandibular asymmetry is due to a pathological cause, then referral to the appropriate specialty is required for further management unless a dental cause can be identified.

Conclusion

Mandibular asymmetries can have many causes. However, with a detailed clinical examination and further investigations, the correct diagnosis can be made. This is essential as the appropriate management for the patient must address both the patient's concerns as well as the cause. These can range from simple measures to complex multidisciplinary approaches. Some of these can be carried out by the general dental practitioner, whilst others will require a specialist. However, they should aim at an aesthetic and functional result.

Acknowledgements

We are grateful to Mr Steve Jones (Consultant Orthodontist) for providing us with Figure 8 and to Mr Tim Lloyd (Consultant Maxillofacial Surgeon) for

providing us with Figures 6 and 9.

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Cochrane Synopses

INTERSPACE/INTERDENTAL BRUSHES FOR ORAL HYGIENE IN ORTHODONTIC PATIENTS WITH FIXED APPLIANCES

Goh HH. Interspace/interdental brushes for oral hygiene in orthodontic patients with fixed appliances. *Cochrane Database of Systematic Reviews* 2007, Issue 3. Art. No.: CD005410. DOI: 10.1002/14651858. CD005410.pub2.

'Patients with fixed orthodontic braces need to make extra efforts to keep their teeth clean. It has been recommended by dentists and hygienists that special interdental or interspace brushes are required to maintain clean teeth. These special brushes and the braces mean that toothbrushes need replacing more frequently and therefore mean an increase in cost.

There is no evidence to show that this recommendation is supported by clinical investigations.'

ORTHODONTIC TREATMENT FOR PROMINENT UPPER FRONT TEETH IN CHILDREN

Harrison JE, O'Brien KD, Worthington HV. Orthodontic treatment for prominent upper front teeth in children. *Cochrane Database of Systematic Reviews* 2007, Issue 3. Art. No.: CD003452. DOI: 10.1002/14651858. CD003452.pub2.

'Prominent upper front teeth are an important and potentially harmful type of orthodontic problem. This condition develops when the child's permanent teeth erupt and children are often referred to an orthodontist for treatment with dental braces to reduce the prominence of the teeth. If a child is referred at a young age, the orthodontist is faced with the dilemma of whether to treat the patient early or to wait until the child is older and provide treatment in early adolescence.

The evidence suggests that providing orthodontic treatment, for children with prominent upper front teeth, in two stages does not have any advantages over providing treatment in one stage, when the children are in early adolescence.'

REINFORCEMENT OF ANCHORAGE DURING ORTHODONTIC BRACE TREATMENT WITH IMPLANTS OR OTHER SURGICAL METHODS

Skeggs RM, Benson PE, Dyer F. Reinforcement of anchorage during orthodontic brace treatment with implants or other surgical methods. *Cochrane Database of Systematic Reviews* 2007, Issue 3. Art. No.: CD005098. DOI: 10.1002/14651858. CD005098.pub2.

'Anchorage is the resistance to unwanted tooth movement during orthodontic treatment. Control of anchorage is important in treatment planning and often dictates treatment objectives. It has been suggested that more effective anchorage reinforcement may be offered by surgically placed temporary anchorage devices.

There is little evidence to support the use of surgical anchorage systems over conventional means of orthodontic anchorage reinforcement. However there is evidence from one recent trial that showed mid-palatal implants are an acceptable alternative to conventional techniques for reinforcing anchorage.

The review authors were able to find only limited evidence on the use of surgical means of preventing anchorage loss compared with conventional techniques and the data showed equivalence, but not superiority of either type.'