DOI: 10.1051/odfen/2013205

J Dentofacial Anom Orthod 2013;16:305

When anthropological considerations influence our attitude about the chin and orthognathic surgery

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ABSTRACT

The presence of a chin is a specific and unique feature of the human face that is absent from the face of our hominid ancestors and all other primates. A number of anthropologists have studied this anthropomorphic characteristic and elaborated various theories concerning its genesis and anatomical usefulness. Recent research based on the analysis of stress using the finite element method (FEM) seems to establish that the presence of the chin is a biomechanical consequence of skeletal and muscular equilibrium peculiar to the human face. This data is an important addition to our matrix of thoughts that influences our attitude concerning the chin and orthognathic surgery. In particular, whether or not a genioplasty is necessary, and whether it should be performed separately from orthognathic surgery or at the same time.

KEY WORDS

Genioplasty
Chin
Anthopology of the chin
Mentoplasty
Orthogathic surgery

INTRODUCTION

The surgical correction of facial dysplasias is an important and growing multidisciplinary field today. Case management of these dysplasias requires a treatment plan that involves close collaboration between the orthodontist and the maxillofacial

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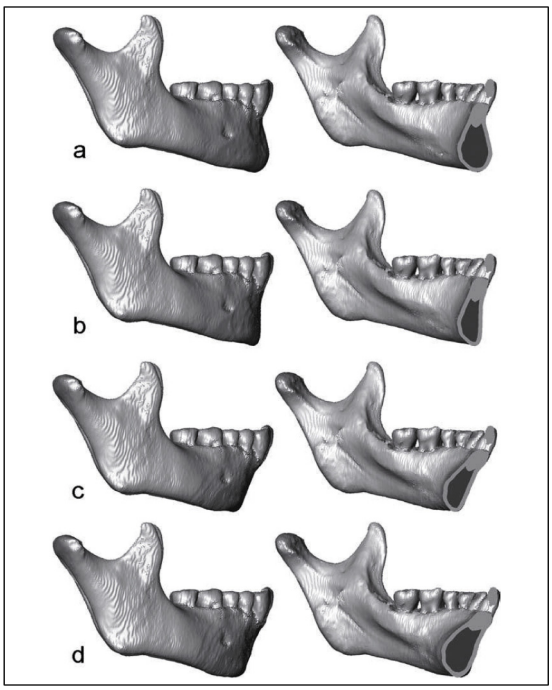
Article received: 02-2013
Accepted for publication: 03-2013



Different shapes of the chin, from the work of Gröning et al.

surgeon. This team, assisted by many practitioners, tries to address a two-fold objective that is both functional and morphological. The chin occupies a unique and important place in the treatment plan both from a morphological and functional perspective.

The chin (the trigonum mentale): whose base corresponds to the inferior border of the mandibule and whose summit reaches the median ridge of the mental symphysis, differentiates a central mammelon: the mental tubercle. The mental protuberance is beneath a depression: the mandibular curves, this protuberance causes the bony part of the chin to jut forward.

The chin is the paleontological criterion of choice to differentiate a modern mandible from a more primitive mandible. The appearance of the chin is still a highly topical issue.

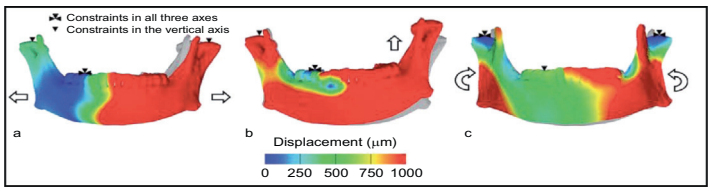
This anthropological view of the chin has provided us with a new way of considering procedures when performing orthognathic surgery.

WHY DO WE HAVE A CHIN?

Different theories

The dental theory concerning the mental protuberance is the result of the appearance and deepening of the mandibular curve occurring at the junction of the two parts of the mandible: the underlying alveolar part and the underlying basal part. The formation of the anterior mandibular curve is made possible due to the lingual inclination of the roots of both the incisors and the canines and also because of the decrease in the length of the dental arch.

According to more current theories (Gröning *et al.*) the presence of the chin is a biomechanical consequence of the skeletal and muscular equilibrium that is unique to the human face. In particular, the stresses generated by masticatory muscles in the course of lateral and vertical movements that take place during the



Stresses from pressure, from Gröning et al.

masticatory cycles seem to play a major role in the development of the chin.

Their conclusion comes as a result of a series of experiments made possible by implementing a powerful mathematical model based on finite elements and thus demonstrating that the appearance of the chin is a logical outcome for the mandible of anatomically modern humans because of the distribution of stresses from the masticatory muscles and occlusal pressures, but also because of the thinning of the skeleton of anatomically modern humans. Additionally, they demonstrated that the absence of the chin can be justified by the same mathematical models that justify cases of disequilibrium due to vertical excess or exaggerated robustness.

GENIOPLASTY: TECHNICAL PRINCIPLES

General considerations

Many techniques are described for performing a genioplasty. We will just provide a description of the standard technique or the current technique most widely used for genioplasty.

A genioplasty can be the only suggested treatment or it can represent one part of the treatment. It can also be the only surgical part of the therapeutic treatment plan of the patient or it can be one stage in a series of surgical procedures.

The indication for a genioplasty can modify the surgical technique and even change the timeframe chosen to perform it.

Treating the mental symphysis

The positioning of the patient must be done rigorously and must adhere to the standard practice of orthognathic surgery. The patient is in the head up position to reduce bleeding. The head is stabilized in a neutral position.

After an injection of Xylocaine with adrenaline also in order to reduce perioperative bleeding, the practitioner begins the intraoral procedure. The incision, in an inverted V shape is made approximately 15 mm from the depth of the vestibule from 33 to 43.

The incision is made through the orbicular oris muscle of the lips then towards the periosteum that it

pierces until stopped by osseous contact.

Next, the surgeon retracts a wide section of the symphysis thus making it possible to locate the mental nerves and to stop at the basal border.

Osteotomy

Marking the incision site as described by Obwegeser in 1957 is still widely used.

The shape, thickness and type of osteotomy will depend entirely on the indication.

The osteotomy must maintain a safe distance of at least five millimeters from the dental roots and from the mental nerves.

The incision site is marked with a round bur and/or piezoelectric device and then completed by using a reciprocating saw or a round bur with a larger diameter.

The angle of the osteotomy is particularly important since it will have a direct impact on the height of the lower third of the face.

The angle can be horizontal or oblique downwards and backwards. It can be single or multiple.

Movements

Various types of movements are possible once the symphysis has been freed and is mobile.

An advancement or forward sliding genioplasty, genioplasty for vertical lengthening or elongation, genioplasty for reduction (an intermediary bone fragment is removed) or impaction are all possibilities offered by this technique. We should also mention the ''tenon and mortise'' genioplasty involving a central osseous plate that guides the advancement. There is also the ''jumping'' genioplasty or overlapping, that consists in completely moving the fragment forward from the remaining symphysis.

A recent variation described by Triaca A. called ''*chin wing*'', allows the surgeon to detach the chin from the lower border of the mandible (from the angle of the mandible on one side to the angle of the mandible on the other side) and makes it possible to additionally modify the position of the chin, to assess (independently from the movement of the dental portion of the mandible that is performed at the same time as a standard mandibular osteotomy) the relief of the line separating the face from the neck. This allows the practitioner to more accurately monitor the shape, the height and the width of the face.

Attaching and closing

Anchorage with steel wires, has been replaced more and more with rigid fixation for osteosynthesis that uses miniplates or compression screws. The preformed and pre-measured miniplates that are in a ''crab shape'' are currently used most of the time.

Next, the closing is achieved in two planes using absorbable sutures for muscle reinsertion that has to be performed with particular care.

A compression bandage is kept in place from 24 to 72 hours.

Other techniques and supplemental procedures

Some supplemental procedures are possible and regularly implemented:

- Procedures for periodontal care: treatment for muscular fragility due to reinsertion of the muscles in a more inferior position on the bulbous portion of the chin. Some mucosal and/or gingivoplasties.
- Bone grafts: placed for the purpose of reinforcing incisor periradicular protection.

Other techniques have been used but they are still provisional:

- Chin prostheses: they are technically easier to use and present minor short-term side effects. However, they are often a source of infection, of secondary movement or osseous erosion in the long term.
- The cutaneous approach: may allow the practitioner to make small cartilaginous and/or bone grafts whose long term reliability and stability remain questionable.
- Bone abrasion: it used to be widely performed, but is now increasingly

Geoffrey's case

associated with ''witch's chin'' that is linked to muscular fat ptosis. This procedure is used only for limited and specific remodeling.

Side effects and complications

In general, the side effects of genioplasty are rather minor. After a 24 hour stay in the hospital, the discomfort is the result of localized edema and especially labio-mental numbness that can last several months.

The main complications are short term bleeding (rarely requiring drainage), secondary movement (very rare since the development of rigid fixation osteosynthesis) and bone resorption in cases of ''*jumping*'' or bone grafts.

However, there is no such thing as a ''simple'' surgical procedure, and the rare serious complications (hematoma of the buccal floor, respiratory problems, etc.) make it essential to carefully consider the indications and the possible alternatives.

The period of patient adjustment to the esthetic modification generally requires more time than expected and in this case, considerable preliminary preparation.

The main ''complication'', if it can truly be considered a complication, is the postoperative dissatisfaction with the result of the procedure: undercorrection, overcorrection, inadequate correction...

Often, the recognition of this ''imperfection'' is delayed and can take place six months after the procedure. This is why we consider the indication for a genioplasty, as well as the timing of the procedure to be essential for determining an optimal treatment plan for the patient.

INDICATIONS

From the very beginning of case management, we have to take into consideration the possible need for an additional surgical procedure for the chin.

The practitioner must have a dual perspective that includes both morphology and function.

The morphological perspective is subjective and the esthetic or standard cephalometric norms should be used with caution. There is certainly a place for a minor receded chin on a female face that can be charming just as a slightly receded chin can appear unsuited for some male faces. Therefore, we think that these norms can serve as a rough and basic framework for determining treatment and must be adapted case by case. What patients feel and what they expect are, in this case, fundamental and one of the difficulties will be to determine as precisely as possible the expectations of the patients and their own capacity to adjust to the change in their appearance.

As for the functional perspective, it includes a number of parameters:

– labial ''competence'' at rest and in motion with the occlusal component (on one hand maxillary and on

the other mandibular) and the mentalis component.
– nasal or mouth breathing with possible obstacles to nasal breathing (cartilaginous and osseous nasal blockage, polyps, tonsils...)
– The tongue position at rest or in motion (swallowing *inter alia*), the volume and morphology of the tongue and the space available for the tongue.
– Mentalis musculature at rest and in motion.
– The possible presence of sleep apnea syndrome.
– The overall posture of the body and in particular a possible cervical protrusion.
– Labial tone and labial volume.

By using this dual morphological and functional perspective, the practitioner can immediately divide the patients into two separate groups:

– A ''caricature'' group whose indication for a genioplasty is immediately evident
– An ''uncertain'' group for whom it difficult to know in advance if the morphological and functional results will be inadequate and if their

In these 2 cases where a genioplasty was initially considered advisable, the choice to delay the decision for 8 months made it possible to more accurately determine the indication.

Natacha's case: no need for a genioplasty,...

...Nathalie's case: performing a genioplasty more suitably adapted to the patient.

condition will not be completely resolved by a treatment plan ''without a genioplasty''

Given the number of parameters involved, the multitude of treatment plans that could be started (maxillary impaction, labioplasties, lingual retraining, improving nasal breathing, etc.) and the impossibility of predicting how the patient will respond to these treatments, we think it would be wise to defer the genioplasty procedure until after orthognathic surgery has taken place.

Even in cases where this procedure turns out to be necessary, the planning and the performing of the genioplasty as well as the results will be more accurate and more satisfying.

DISCUSSION

The matrix of this study takes into account the functional chin that is specific to humans.

– To the extent that the orthognathic surgery can restore this function: we provide the face with the opportunity ''to create its own chin''
– If the functional context is obviously unfavorable: mentoplasty should immediately be planned.

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