Impact of occlusal scheme on peri-implant crestal bone level

Incidence du schéma occlusal sur le niveau crestal péri-implantaire

SUMMARY

The aim of this article is to know if there is a correlation between the occlusal concept applied to the implant prosthesis and the level evolution of the peripheral bone.

A comparative retrospective follow-up study was performed with implants of identical emergence concept, between a witness group, only balanced in canine protected occlusion (CPO), followed for 2 years and a second group of 40 unit implants, or connected by 2, followed for a period ranging from 1 to 8 years and balanced in simulating actual chewing, on the occlusal surfaces of the posterior teeth.

The measures of the vertical bone level evolution are indisputable. The significant level bone augmentation around meticulously functional balanced implants is +1,3mm in average. It shows clearly that the bone transmitted forces are regulated in an optimal stimulation range. This is not the case for implants whose equilibration is limited only to CPO, around which bone loss is observed on the ridge.

KEY WORDS

Occlusion, occlusal trauma, overload, bone, bone level, density, bone loss, balancing, mastication, déglutition, stimulation, bone gain, bone augmentation, infection, chewing, swallowing

MOTS CLÉS

Occlusion, trauma occlusal, surcharge, os, niveau osseux, densité, perte osseuse, équilibration, mastication, déglutition, stimulation, gain osseux, infection

RÉSUMÉ

L’objectif de cet article est de chercher à savoir s’il existe une corrélation entre le concept occlusal appliqué à la prothèse implantaire et l’évolution du niveau osseux périphérique.

Des implants de même concept d’émergence, mais de marques différentes, ont permis de mener une étude rétrospective longitudinale comparative entre un groupe témoin réglé en protection canine suivi pendant 2 ans et une série de 40 implants unaires, ou solidarisés par deux, suivis pendant une période de 1 à 8 ans, équilibrés en simulant et en équilibrant la mastication, sur les faces occlusales des dents postérieures. Les gains de niveaux osseux verticaux, obtenus autour des implants bénéficiant d’un réglage fonctionnel minutieux des dents postérieures et antérieures, sont significatifs (+ 1,3 mm en moyenne). Ils indiquent clairement que les forces transmises par les faces occlusales sont bien régulées, avec un niveau optimal de stimulation osseuse. Cela n’est pas le cas pour le groupe témoin, composé d’implants de même concept dont le réglage se limite à la seule protection canine en latéralité et sur lequel des pertes osseuses sont observées au niveau crestal.
**Introduction**

Compared biomechanics between natural teeth and implants have promoted numerous studies and publications, that broadly validated osseointegration (Adell et al. 1981) and, among others, given rise to new implants design and prosthetic components developments. They also have improved peri-implants tissues procedures, aesthetic results (Saadoun et al.1992, 93, 94, 2003), and developed early or immediate loading on the implants (Le Gall et Le Gall 2006).

One subject is always questioning: how to select the best occlusal scheme to apply on implant prostheses and on natural teeth.

The experimental studies in animal, show that occlusal forces of average intensity, either axial or oblique applied on an implant, result rapidly in bone loss around the neck and the body of implants, all the more important as the intensity of the force is high (Isidor 1997, Miyata et al 2000, 2002).

In the study presented below, the clinical model of occlusal adjustment is different. It aims to set well balanced and coordinated guides and contacts during chewing and swallowing, with controlled occlusal load levels, without any overguiding, or occlusal interference (Le Gall et Lauret 2011). However, previously published studies have used the classic occlusal model, which is questionable (Rinchuse et al 2007) because it does not take into account the real function (Misch and Bidez, 1994) and gives irregular results, because the occlusal balancing is very often incomplete.

The consequences on the peri-implant bone of the application of a functional model based on chewing and swallowing (Lauret and Le Gall 1994, 1996) have not yet been evaluated.

The aim of this article is to briefly describe this functioning model. Then, taking as a reference a control group only balanced in CPO, to evaluate the compared consequences on the peri-implant bone with an another group, balanced in according with the functional model.

**Occlusion and bone loss**

Periodontists, following the Swedish School, showed on the natural teeth that the bone loss was of infectious origin and largely depended on the response of the host, and under these conditions the role of occlusion was reduced to that of cofactor of periodontal diseases.

Classically, Schools of occlusion, assumed that bone loss could also be of occlusal origin alone, but without never succeed to prove it.

But for implants, several publications have shown that:
- Infection can be responsible for peri-implant bone loss
- Mechanical overload, is the only etiology of the fracture of components or implants.
- They also have shown that occlusal overload can be alone responsible for bone loss (Misch et al 2005).

**Bone response to mechanical load**

Applying low forces on the bone, from 50 to 150 microstrains (micropascals) causing a slight deformation, (from 0,005 to 0,15%), stimulates bone healing, and provokes its remodeling (Cowin et al 1991, Frost 2004).

However, the application of medium intensity forces from 1500 to 4000 microstrains, causing 0.15% to 0.40% strain (on hip implants, in orthodontics and in implantology) can result in bone loss, even in the absence of germs (Chiba et al 1993; Frost, 2004).

The transition threshold from stimulation to resorption seems pretty brutal, because the forces are directly applied and amplified by the absence of damping of the ligament. Further studies should be conducted on this threshold effect, to better define the limits, whether they are individualized and whether or not they evolve over time in the same patient.

More significant forces, from 10000 to 20000 microstrains (1 to 2% of bending), can provoke fractures of the peri-implant trabecular bone , and shows a direct correlation between occlusal trauma and bone loss (Misch et al. 2005).

Overpassing this level, fractures of implants and/or components can be seen (Kohavi 1993, Gyllenram 1994), depending of the type of bone, the grade of titanium, the implant design, its diameter and the selected abutment.
In these conditions and taking into account implant specificities, how to balance occlusal faces of implants prostheses, to avoid medium and high strengths and to maintain, if feasible, the occlusal strengths in the values of bone stimulation?

**Implant specificities**

Osseointegration of implants have, at least, two major biomechanical consequences:

- The lack of periodontal mechanoreceptors, reduce interferences perception, and thus the CNS ability to install avoidance mechanisms (Jacobs, Van Stenbergh 1991; Hammerle et al 1995).

- The absence of ligament considerably reduces the mobility of implants, compared to that of natural teeth, and amplifies the malocclusions that are badly perceived by the patients and not avoided (Sekine et al.1986, Gyllenram 1994).

- Clinical mobility of the neighboring teeth and opposite is a key factor (Le Gall et Lauret 2002). If their mobility is reduced, their equilibration during chewing and swallowing will be similar to the adjacent natural teeth (fig.1-3). By cons, if their mobility is important, the risk of uncontrolled overloading of implants will be very high, and will impose:

  - a specific balancing of single implants

  - or in case of extended restoration, the obligation to realize an extensive rigid connexion, in order to reduce the mobility of the whole, to better balance it (Le Gall et Saadoun 2004, Le Gall et Lauret 2002,2011, Le Gall 2013).

During this period, classical implants with external hexagonal connection, show a bone loss at the neck (Adell et al. 1981, 1986). While other designs of implants show various reorganizations, either in loss or in bone gain (Zechnier et al. 2004; Karousis et al. 2004, Le Gall 2011). In fact:

- Roots and cortical bone have the same modulus of elasticity (called Young’s modulus; Kittel 1998), whereas titanium, depending of the grade, is 5 to 10 times higher (Lemon et Philips 1993). The stiffness of an implant depends on its Young modulus and also of the ratio between its section and length: for instance a hard steel spring can be much more flexible than a solid block of
acrylic, that is less hard but much stiff (Kittel 1998). This suggests that transverse strains will be amplified on a long but small diameter implant and cylindrical.

- A direct response to load, follows the lack of cushioning periodontal ligament (Sekine et al 1986)
- Consequently, there is a wide stress area (Kilamura et al. 2004) around the neck, at crest bone level, that is amplified by occlusal traumas.
- At the end of the first year of loading: bone loss has the same shape that the maximum stress area (Zechner et col 2004). These results directly involve occlusal conditions in bone loss. An other study imply, by a different way, uncontrolled occlusal trauma in bone loss (Ektessabi, Mouhyi et al 1997.99). In this case it is described as secondary to fissuring corrosion on titanium surface, produced under repeated occlusal impacts, in the weakness areas.

- As written above, the design of the implant, its diameter, its orientation and its surface processing, can also modify the level of bone loss.

- But other causes can also be responsible for primary or secondary bone loss, like rebuilding of the biologic space, the surgical trauma and the number of surgeries (Misch et al. 2005), the lack of cortical bone thickness and of course the infection.

### Usual occlusal model VS Mastication and Deglutition ([www.mastication-ppp.net](http://www.mastication-ppp.net))

But finally, occlusal anatomy and occlusal concept applied are deciding of the intensity and the way that the forces are transmitted to the bone by the implant complex. The implant immobility considerably amplifies the occlusal trauma, which additionally are poorly detected. In these conditions, even light, but bad balanced, occlusal modifications (by addition or substruction) can have negative consequences on the implant sustainability (Le Gall 1996, 97, Le Gall et Laurent 2002, 2011, Le Gall 2013, 2015).

The usual functioning model stems from the Gnathologic theory (Mc Collum 1939). It applies two main principles:

- Mandible-maxilla relationship and maximum intercuspidation are placed in a manipulated articular Centric Relation (CR). “However, many past notions in dentistry....particularly related to gnathology, have not withstood the test of time or the rigors of science” (Rinchuse et al 2005).
- Dynamic movements are balanced in laterality movements, complying with Canine Protected Occlusion (CPO) principle, introduced later (d'Amico 1958-1961).

“CPO, as the optimal type of functional occlusion to establish in orthodontic patients, is equivocal and unsupported by the evidence-based literature” (Rinchuse et al 2007).

The present knowledges in physiology show that our natural functioning model is founded on mastication (Lauret et Le Gall 1994,1996; Le Gall et al. 1994; Le Gall 1997, Le Gall et Laurent 2011; Le Gall 2013) and deglutition (Le Gall et al 2010, Le Gall 2013).

Observation and simulation of chewing function show that cycles, with the recruitment of the masticatory elevator muscles, are in centripetal orientation, with posterior contacts reaching the guiding limit envelope on the chewing side, that is harmoniously balanced on the whole extent of the occlusal surfaces (Fig.2 to 7). While the reverse laterality movement, do not allows to see and balance them. (Le Gall et al. 1994) The only balancing in CPO, forgets on the occlusal faces, functional malocclusions (overguiding and subguiding), that are :

- amplified by the stillness of implants,
- not detected, then no avoided by the lack of proprioception,
- and therefore, potentially dangerous for the perenniality of implants.

Mastication must be checked and balanced at the prosthetic insertion. It’s still a compulsory rule, because the usual articulators can’t simulate correctly chewing kinetics (Le Gall et Laurent 2011).The digital 3D/4D modeling will probably be able to propose soon a solution to this problem.

Moreover, for more than 95% of the patients (Posselt 1968, 1969; Joerger 2005, Joerger et al 2012), centric occlusion in CR is not accorded with our natural Maximum Intercuspidation Occlusion (Ingvall 1964; Sicher et Dubrul 1975).The occlusal contacts
during deglutition are naturally situated in Maximum Intercuspal Occlusion (MIO) (Le Gall et al 2010, Le Gall 2013).

To find or check easily, natural MIO, it’s convenient to associate simultaneously two protocols, still used separately (Le Gall et al 2010, Le Gall 2013): lingual posture during swallowing and a modified deprogramming anterior jig (Le Gall 2010). By this self-determined way, the patient relaxed and deprogrammed closes directly in natural occlusion with articular surfaces in functional relations.

When an implant is present, the mobility of the adjacent and opposite teeth must be taken into account to balance implant prosthesis, specifically at the time of first balancing, in a still not adapted bone (fig. 2,3).

In case of uncertainty on a single implant, the usual procedure, applied in this study, is to make a progressive loading on a provisional prosthesis.

In every case the initial balancing is cautiously realized (Le Gall et Lauret 2011) (fig. 4 et 5).

- Under a light occlusal pressure, contacts and guidances on implant must exist, but less marked than on adjacent natural teeth (Fig 2 to 7).

- In order to be well shared with them, under the more important pressure during chewing and swallowing

- At the time of initial balancing, the contacts and guidances must exist but without being dominant on implant prosthesis. They usually will appear well balanced 1 or 2 years later, without any alteration (Figure 6, 7), as a result of the physiological wear of neighboring natural teeth (Lambrecht et col 2006).

- It’s totally different in a strong and/or adapted bone, when an implant can share easily all the functional forces.
Material and Method

The following retrospective study has been realized on a randomized group, composed of 31 patients with 40 single implants or connected by two. Only one implant has been connected to a natural tooth. All of the restorations on implant have been inserted, balanced and sealed (with cautious cleaning at the collar) by the two authors. According to the usual procedures of the office, surgeries are minimum invasive and a peri-implant fibro-mucosa ring is maintained or reestablished. Women and men in good periodontal and general health are selected for implants, on still edentulous arches or after extractions following traumas, infection, fractures, or any other reasons. The smoking patients with an insufficient hygiene level are not retained. Some patients treated with bisphosphonates have been retained in accordance with their physician. The group was composed of 21 women (27 implants) and 9 men (13 implants). They ranged from 35 to 70 years old. It has been possible to measure precisely the level of bone of 36 implants, whose have been retained for the study. From them, 14 are anterior and 22 posterior (molars and bicuspid). The bone measurements have all been realized by the first co-author and checked by the second. The retro-alveolar x-rays have been taken with an angulator device and the measurement digital grid has been fitted on the appearing interspire pitch of every x-ray. Its real dimension of 0,9 mm, has allowed to precisely measure the bone level evolution. (fig. 8 à 20). The follow-up has ranged from 1 to a maximum of 8 years, with an average of 43,7 months. 

Fig. 6 and 7: All the final restorations has been placed and balanced 4 months after implant insertion. The first picture is from the day of placement, the second almost 7 years later. Between these two pictures, not any occlusal alteration has been done. Only M3 has been extracted with difficulty. Chewing guides, not dominant at the beginning, became progressively more marked, until they were similar to those of the neighboring teeth, due to their physiologic functional wearing, ranging 40 μm a year (Lambrechts et al.,2006). (clinical case 3).

Fig. 8: All radiographs were done using an angulator. However, to avoid any risk of parallax error, the bone height measurements were made by superimposing a modifiable numerical grid, the line spacing of which is set before each measurement, on the apparent interspore distance of the implant. Its real value of 0.9 mm will thus be able to serve as a reference to precisely determine the bone height (clinical case 3).
The restorations have been placed 5 months after implants insertion (clinical case 1).

Fig. 9:

Fig. 11:
X-ray after 42 months. On the average of the 2 implants, the gain is 0.67mm between 23 and 42 months (clinical case 1).

X-ray image 23 months later. On the average of X-ray image 23 months later. On the average of the 2 implants, the gain is 0.72 mm between 5 and 23 months (clinical case 1).

Fig. 10:

X-ray at 84 months. In average on the 2 implants, the gain is + 0.25 mm from 42 to 84 months. From 5 to 84 months, average bone gain is + 2.12 mm on 36 and + 1.16 mm on 37. Even bone papilla is rebuilt, the gain is + 2 mm at the top of the papilla (clinical case 1).

Fig. 12:

Fig. 13:
X-ray, at prosthetic impression 2 months after the implants insertion (clinical case 2).

Fig. 14.
X-ray 5 years later. The average bone augmentation is + 1.26 mm on 36 and + 2.07 mm on 37. The papilla rebuilding is remarkable: + 2.16 mm, and goes beyond Tarnow rule (Tarnow, 1992, 2000) (clinical case 2).

Occlusion and peri-implant bone level
This group is composed of a continuous group of patients with 1 or 2 implants, having asked a follow-up appointment, in a random way, during the last 5 months before the end of my private practice.

Three patients, still followed and published have been added.

The implants used are all, tapered Zimmer Dental Swiss Plus® one stage implants, with a transmucosal flared neck. The upper part of their necks, is first machined titanium and then micro-processed.

This 4,8 mm diameter head is identical to the second witness group.

Every time it has been possible, the reference first measures have been taken at the permanent prosthesis insertion and functional loading, but sometime later. Mesial and distal measures on the X-ray, allow to establish an average bone level, for each implant (fig.8). In case of difficulty, in extraction sites, the first reference measure has been placed one spire value above the last spire, to be placed at the limit of

Fig. 15a et 15b:
M1 implant has been inserted 10 days after extraction of the compromised tooth. The initial stability was good even with very few threads engaged in the bone (clinical case 3).

Fig.16: X-ray at 3 months, at the time of prosthetic impression (clinical case 3).

Fig.17a:
X-ray at 4 months, at the placement and functional balancing (figure 6), (clinical case 3)

Fig. 17b:
X-ray at 15 months, showing a beginning of bone remodeling.

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the machined neck and so to not overvalue potential bone gains.

Maximum Intercuspatation occlusion during swallowing has been checked and occlusal surfaces have been carefully balanced simulating actual mastication (Le Gall 2013).

The comparison group comes from a study realized and published by Akça and Çehreli (2008). It is composed of 49 bridges of 3 units, of which 34 are connected to a natural tooth and 30 not. In all, it represents 47 one stage implants Straumann Sin OcTa®. The patent of the 4.8 mm diameter head is shared with Zimmer dental®. Dynamic occlusion is balanced in Canine Protected Occlusion (CPO) and the follow-up is 2 years.

The only difference existing between the two groups is the occlusal concept: classical for the witness group and functional for the second group. The comparison of the resulting bone levels may then be relevant, in relation to the different occlusal concepts applied to the implants.

**Witness group: Two years Follow-up of implant bone level**

Unexpectedly, the control group shows a small but significant increase in bone level around implants connected to a natural tooth (+0.189 mm, on average) and a more important bone loss (average loss: -0.285 mm) around the 2 implants supporting the fixed restorations of 3 elements.
Similar results have still been obtained by an other study (Lindh et al. 2001). The authors have not known how to explain their results and have even considered as speculative any interpretation. In these two studies, occlusal faces have only been balanced in CPO, then probably with posterior malocclusions, because real chewing function has not been checked and balanced. In these conditions, interpretations can be proposed. In case of restorations with rigid connection between tooth and implant, two mechanisms can be involved, without any explanation on their level of implication:

- on one hand, the difference of resilience between implant and tooth result in light forces, applied to the neck of implant, that are stimulating for bone.

- on the other hand, due to the avoiding mechanisms of periodontal mechanoreceptors, the overgrowings contacts are moderate and/or avoided.

-for bridges on implants, mechanoreceptors are absent, forces are poorly regulated and patients chew on malocclusions. Developed forces are of medium to high intensity and responsible for bone loss (Chiba et al., 1994 ; Frost, 2003).

Retrospective follow-up of bone level on 40 implants

On the 40 implants, the measurements of 36 have been retained. Because, on 1 of the 4 implants not retained, functional balancing has not been done, on 1 other it had not been possible to determine the part of gain resulting either from peri-implantitis treatment, or occlusal balancing and on the 2 others it had not been possible to measure precisely the bone gain obtained. On 36 implants retained, the average bone level gain is +1,33 mm, with a follow-up mean of 43,7 months (Fig.8-12, 13-15, 16-26). The standard deviation is $\sigma$:1,51, pointing out homogeneous data, not scattered. The average bone augmentation is high and significant. According to the follow-up duration, the implants have been divided in 3 groups:

D group: from 4 to 8 years and more: 19 implants, 15 patients, 16 implants retained (13 posterior, 3 anterior). Average bone level gain: +1,77 mm. It ranges from 1 to +2,97 mm, with a standard deviation of $\sigma$: 1,74, with enough homogeneous data, not much scattered, with a very important average bone gain.

C group: from 2 to less than 4 years: 12 implants, 8 patients, 12 implants retained (5 posterior, 7 anterior). Average bone level gain: +0,94 mm (0-2,25)

AB group: less than 2 years: 9 implants, 7 patients, 8 implants retained (4 posterior, 4 anterior). Average bone level gain: +1,2 mm.

ABC group: 20 implants. The average bone gain is +1,02 mm with a standard deviation of $\sigma$: 1,25, showing very homogeneous data, not scattered.

On 22 molar and bicuspid implants, the average bone level gain is +1,45 mm, with a follow-up of 48,5 months in mean. The standard deviation is $\sigma$:1,58, showing homogeneous data, not much scattered. On 14 incisors and cuspids implants, the average gain is +1,15 mm, with a follow-up of 36 months in mean.

On the 3 cases of posterior, mandibular implants connected by 2, a progressive growing of inter-implant bone crest, below papilla, has been observed (Fig. 8-12, 13-15). For each case, the measures were respectively: +0,8 mm on 12 months, +2 mm on 79 months and +2,16 mm on 58 months for each of them.

Discussion of results

In the posterior sectors, where occlusal forces are much stronger than on anterior sector, the average gain even reach +1,45 mm, with an average follow-up of 48 months, against anterior +1,15 mm. These figures are surprisingly positives, and to be compared to those of Akça and Çerel, which are negatives, on only implants supported restorations, with a two years limited follow-up.

These data show clearly that meticulous occlusal balancing during mastication makes atraumatic the occlusal surfaces, with well balanced forces, maintained in the stimulation ranging. The consequence is an unhoped gain of bone level and a X-ray improvement of bone density (that has not been assessed). These improvements, in height and density, are not limited at one year, but continue a long time after. The posterior implants, where occlusal forces are stronger and with the longest follow-up, have often the best results in measured gain and bone density. Even posterior bone crests between connected implants have regrown.
in clinical conditions that went beyond Tarnow rules (1992,2000), which are not confirmed.

Initial publications (Roberts et col 1989), limiting adaptation and bone remodeling to the only first year are overpassed by theses results. As long as the bone is maintained in stimulation, adaptation will probably continue, decreasing progressively with the time. Contrary to what happens if the functional equilibration is not performed and significant bone level losses are observed, at least during the first two years. But we have not any precise long time reply. Additional studies should be undertaken, with functional occlusion as a reference and giving up the classical model that shows its limitations and the potential risks existing in implantology, to use rough balancing procedures. Without forget the border between stimulation and bone loss, that may be individualized and time variable, with limits and parameters still not completely mastered.

Then, be cautious, one can pass quickly from the best to the worst, as for instance, when a parafunctional habit like bruxism is present. Applying the only gnathologic procedures, generally result in an incorrectly balanced occlusion, with remaining misguidances or occlusal trauma, dangerous for the bone and the implant long time lasting. Occlusion on implants must be carefully completed, without any approximation!

With the criteria applied to the implant choice and the clinical protocols, mucositis and peri-implantitis frequ-

![Average gain (in mm)](image)

**Fig. 21:** Thirty-six anterior and posterior implants: average bone augmentation 1,33 mm; σ = 1,51. Followed period in year. Average: 3,6 years.
ency has considerably decreased. But infection around an implant can be directly responsible for bone loss and able to potentiate an occlusal trauma and conversely. Because, unlike periodontics, in implantology, occlusal overload can also be the only cause for bone loss and inflammation can sometimes be just a co-factor.

Taking into account these results, an other question is posed: Did, in periodontology, the possibility of occlusal etiology has to be reevaluated?

Bone loss or gains around implants don’t seem to affect, or fewer, neighboring natural teeth, why? This is probably a consequence of the damping effect and the avoidance mechanisms of the ligament, which limit the consequences of occlusal contacts on natural teeth, either in stimulation or in bone loss. This factor is probably the explanation to the minor role, recognized in periodontology, to occlusal etiology.

**Limits of this clinical study**

This clinical testing, realized in private practice, has been done “a posteriori”, when unhoped bone level augmentations, have been seen on the x-rays controls. The protocol has not been systematized in duration and regularity of x-ray controls. These conditions have limited the number of patients incorporated in the study. It’s a shame, because with a more important number of patients, the results would have been better and even still more significant.

In spite of the broad ranging in the age of the patients (35 to 70), consequently to their randomized selection, the general average standard deviation of 1.51, shows homogeneous and few scattered data. It shows that longtime, bone remodeling is possible, when the functional occlusal scheme is pertinent, in all of the adult ages, and that these data don’t limit, or very few, statistic analysis.

Implants have been placed either in healed crests or in immediate extraction sites. In the last case, bone levels are more difficult to measure because of healing and implant vertical placement in the socket, but the results are similar in bone gain.

In immediate implantations, a provisional crown has been done during insertion, whenever primary stability was considered sufficient. The success rate still published with these protocols (98.6% out of 426 implants) are similar to the two stages protocol and do not limit their use (Le Gall et Le Gall 2006).

**Conclusion**

This preliminary comparative study show significant bone level augmentations around implants neck, that increase progressively during several years. These results are unusual in long time lasting studies of implants, where its common to question about infectious or mechanical bone loss around implants. In these conditions, if the infectious factors are well considered, it’s not the same for the mechanical factors that are referred to the classical model so called functional, which is not a really functional model because it is not able to take into account mastication and deglutition (Lauret et Le Gall 1994,1996; Le Gall et Laurel 2011; Rinchuse et al., 2007). This is a fundamental error because the resulting occlusal procedures are approximate and incomplete. The analysis of bone gains and losses around the implants shows that they are directly related to the equilibration protocol used and that the classic occlusal functioning model must be abandoned for the long-term safety of implants and credibility of the occlusion.

The Organo-Functional theory of occlusion (Le Gall 2013) founded on mastication and deglutition physiology allows integrate the gnathology, by correcting its errors. The functional model of occlusion allows to take into account (Le Gall et Laurel 2011) all of functional kinetics, it explains the static and dynamic, relations existing between form and function of all of the masticatory apparatus components and allows then to give a coherent explanation to the relation between a large part of TmD and the functional balance of teeth. But finally, the real benchmarks are the clinical results regularly obtained, as those viewed here. Additional prospective studies have to be done, taking as a reference the natural functioning model. These studies should allow to well understand all of the deciding factors of bone stimulation and loss, and to show that a best clinical mastery of occlusal balance allows to easily optimize longlasting of implants and of prostheses they support.
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