in collaboration with dr. Silvano U. Tramonte

OPERATING PROTOCOL FOR THE IMMEDIATE-LOAD IMPLANTOLOGY OF THE ITALIAN SCHOOL

Introduction

The greatest expression of the circulation of this implant technique was represented by the national and international congresses held by the historic GISI (Gruppo Italiano Studi Implantari, Italian Implant Study Group), founded and directed by Giordano Muratori. From 1970 to 1997 the GISI congresses saw the participation of the most distinguished experts, documented by their published conference proceedings.

The recent conversion of delayed-load implantology to immediate loading has generated confusion in terms of concepts and definitions. The emerging implants used for immediate loading by the Swedish school, and identical to those employed for delayed loading, actually maintained the marked differences between the Swedish and Italian schools, since the immediate loading of the former is based on implants that are completely different from those employed by the latter. These substantial differences require a separate classification of the two approaches and identification by the names of the two schools to which they refer: the Italian school, on the strength of over half a century of experience, and the Swedish one, which has yielded to clinical and scientific evidence only recently.

Despite its belated acknowledgement of immediate loading, the Swedish school managed to produce vast literature in a very short time, thanks to its comprehensive and widespread presence within academia. Such literature comprises studies on the IL protocol (1-15), immediate loading with implants whose design features are still linked to delayed loading. Therefore, we feel it is essential to clarify the matter with a written protocol that can be used as a reference for the immediate loading and implant techniques of the Italian school.

This chapter will thus attempt to remedy for this shortcoming by briefly outlining the principles and indications that constitute the protocol and guidelines of the immediate loading technique of the Italian school.

Definitions

Immediate loading is an incontrovertible physiological fact that occurs starting with embryonic development, which constantly applies forces and exerts functions on the skeletal apparatus (16).

Immediate loading induces two concomitant activities in the peri-implant bone: functional activity and tissue cicatrization. The latter will evolve toward a reparative function (osseointegration) when there is an adequate load or a defensive one (fibrointegration) in the presence of an inadequate load. Fibrointegration is one of the two phases of implant failure, the other one being mobility, culminating with implant loss. It is obvious that the basic principles and techniques pertaining to immediate loading are quite different and sometimes contrast with those employed for delayed loading, which envisions healing of the peri-implant tissue without any loading. This partially explains why the surgical and prosthetic techniques can be perfectly outlined in a protocol in the case of submerged implants, while they can only partially be specified for emerging implants, whose range of applications is decidedly more complex and subjects these implants to a wide range of unplanned and unpredictable situations in delayed-load implantology.

By definition, a protocol is a strict operating manual that should guarantee the success of the procedure, based on case selection and the exclusion of variables. This is what makes delayed loading and - to an even greater extent - immediate loading derived from the two-step implants harder to manage. Consequently it is difficult to provide a suitable answer to the wide range of individual clinical situa-

tions. The exact opposite can be said of immediate loading with the implants and techniques devised by the Italian school.
The immediate loading used by the Italian school follows a protocol, wherever possible, and suggests the guidelines to preserve the full range of application options of these types of implants and this technique.
A protocol is a set of standards that regulates the sequence, preparation and execution of serial procedures that can "predictably" lead to a certain result. It is thus a set of strict and self-dependent rules that - from a mechanistic standpoint - influence a procedure, which should be adaptable to the different clinical situations and able to modulate a highly personalized therapeutic answer. To reduce the number of variables and keep all conditions under control, the procedure effectively becomes very selective, excluding a large number of patients from treatment.
Inversely, a guideline is a "trail" to be followed wisely, one that is full of advice and suggestions. It influences but is not completely binding. In other words, it respects the patient's individuality and special needs, leaving the oral surgeon free to make the most of the situation while also ensuring indispensable scientific support and reliable results, and drawing on previous experience.
Therefore, based on these considerations, we will identify three fundamental steps in immediate-loading rehabilitation according to the Italian school:

1) First or preoperative phase: guidelines and protocol;
2) Second or surgical phase: guidelines and protocol;
3) Third or postoperative phase: guidelines and protocol.

First or preoperative phase

Guidelines

During the preoperative phase we must obviously be sure to plan carefully, as we would do for any other implant surgery (17-19). The diagnosis will be based on the classic principles required to achieve both functional and cosmetic rehabilitation, where possible, while respecting at least the basic gnathological principle of a mutually protected occlusion (correct occlusal harmony as defined by Ugo Pasqualini) (20).
However, if we are planning a procedure with immediate loading, we will need more than this. There are absolute and relative contraindications to implant surgery in general and, as usual, they are equally important. In certain conditions the execution of immediate loading is more delicate and has a very high risk rate.
Aside from all the diagnostic tests that are closely connected with the surgery (17-21), we also need additional data about our patient. We need to verify that the bone metabolism is that of healthy bone tissue with a physiological turnover. For complete treatment of this topic, which goes beyond the scope of this chapter, readers can consult specific publications (22). Here we would merely like to point out that it is important to assess the normalcy of basic indicators such as: blood sugar, calcemia, phosphatemia, alkaline phosphatase, cholesterolemia, triglyceridemia, hematocrit with leukocyte formula, ESR (erythrocyte sedimentation rate), blood protein electrophoresis, transaminases, calciuria, phosphaturia, urinary hydroxyproline, and for female patients in menopause, also BMD (bone mineral densitometry).
Significant alterations in blood glucose, lipids, transaminases, calcium and phosphorus (both serum and urinary), phosphatase and hydroxyproline may indicate the presence of diseases that directly or indirectly affect the bone. These diseases do not fall within our area of competence, but we nevertheless recommend taking a cautious and careful attitude when planning implant surgery (23).
If there are any pathologies, we can examine the data and intervene by referring the patient to a specialist, but nothing can be done when patients are unwilling to cooperate or are careless. Consequently, before placing immediate-load implants, it is advisable to examine their general attitude, psychology, and gender.

Psychodiagnostics[1]

We can control and sometimes intervene by referring the patient to a specialist for a specific medical condition. Likewise, it is advisable to take the same precautions when dealing with certain psychological problems (personality disorders, phobias, idiosyncrasies) that affect some patients. These issues are rarely considered so serious as to

[1] In collaboration with Franco Merlini, psychotherapist in Milan.

be classified as frankly psychopathological, but there is no question that, for the reasons we are about to examine, inadequate consideration of the patient's "psychology" can affect compliance, especially in the postoperative phase, and it will strongly influence the patient's "perceived satisfaction" (24-27). It is important to bear in mind that the mouth as a whole represents a crucial somatopsychic crossroads in the evolution of mankind.

During the so-called oral phase, through the relationship with his/her mother's breast, the newborn comes into contact with the "outside" world for the first time, in a veritable melting pot of feelings, emotions, perceptions and somatopsychic hallucinations that represent the building blocks of mental life. At a later stage of human development, but also in primates, teeth acquire special meaning due to their social function.

Teeth are shown to frighten, threaten and attack, but also to meet, learn, approach and seduce. The loss of teeth, in both dreams and conscious life, is perceived as a loss of vitality, strength, energy, power, charm and relational skills in general.

Entering the mouth of a patient and operating on teeth always represents an act of "intimacy" that the patient might not be able to accept, despite the motivations to undergo implant surgery. As a result, any action involving the oral cavity, even if minor or minimally invasive, represents - on a psychological level - an event that can trigger possible regressive behavior in the patient, who will thus raise defensive barriers that can significantly undermine the outcome of the procedure.

Gender[1]

The patient's gender determines very different approaches and variable reactions during the various rehabilitation phases.

Women are generally more attentive and compliant, and they readily accept postoperative limitations and inconvenience. They show up for follow-up appointments without complaining, call promptly to be sure that everything is normal, follow instructions and express any doubts they may have.

Men, instead, tend to be more independent and less willing to consult the physician after the surgery. Because of their concept of "oral virility," their postoperative recovery can be as fast as it is fallacious.

Implantations and the placement of temporary prostheses are perceived as "gratifying" (the use of teeth as tools, strong chewing, dental aggression, percussion of the teeth, etc.) in order to prove that they are healthy; this is especially true among men. Predictably, women are much more concerned with the appearance of their smile.

Stress[1]

This is a very important factor, with no distinctions between men and women. It must be evaluated carefully because it will unquestionably produce new parafunctions, repetitive behavior, microtraumas, increased sensitivity to pain and so on. Stress leads to hyperactivity of the fixtures and subsequent overloads. For these types of patients the prescription of mouthguards is a good rule of thumb, as is the short-term use of benzodiazepines (where needed).

Histrionic personality[1]

This type of patient is naturally extroverted, essentially optimistic, fond of social interaction and always at ease in such circumstances, and usually rather self-confident. Far from being an advantage, however, this actually poses a concealed and less manageable risk. In fact, these patients tend to feel "good" right after temporary prosthesis cementation. They tend to consider the implant and prosthetic structure as indestructible (this is particularly true among men) because of the sensation of strength that such devices immediately convey (due to the lack of proprioceptive sensitivity and when there is no irritation).

Moreover, these patients tend to:

- forget to follow instructions, even when they are given to them in writing; it is essential to draw up an official document, asking the patient to sign a form indicating that they have received the set of instructions and the list of restrictions outlined by the implantologist;
- underestimate initial mobility of the temporary prosthesis, thinking that they can wait until it "moves more" before contacting the specialist;
- stop taking prescribed drugs, saying that they feel fine; these are patients who do not worry and believe that everything will go smoothly, that the prosthesis is very well made and that everyone else, included their own doctor, is probably overly concerned;
- avoid calling, since they believe that what is happening or has already happened is negligible, in spite of the fact that the problem may indeed carry some risks.

[1] In collaboration with Franco Merlini, psychotherapist in Milan.

The only thing we can do with such patients is to "identify" them, first of all, and then set up more frequent appointments in order to keep everything under control. We can identify the behavior of this type of patient by examining the occlusal surfaces of the temporary prosthesis, which should be manufactured in soft acrylic resin. Typically, these patients should not be given the idea of being "needy" and if they are not treated coldly or aloofly, they are happy to cooperate with their doctor. Moreover, referring them to the protocol will also help achieve this objective.

Introverted personality[1]

This type of patient, unlike the preceding one, is pessimistic, reticent and easily depressed. These patients have a hard time understanding the appropriate use of their implants. They have many doubts that we will never fully understand. They are also patients who conceal the truth. The fear of having ruined everything and the ensuing sense of guilt leads the patient to forget or deny certain facts. We should maintain a patient, respectful, blameless, sympathetic and attentive attitude. Our chief goal is to gain and maintain the trust of these patients, the trust they have probably never received from anyone and thus do not expect from their doctor either. It is, however, important to acknowledge their efforts in following instructions and show them a willingness to listen.

Hypochondriac personality[1]

These patients are unwittingly against solving their problem. This opposition can be pathological, and it represents psychological discomfort or aggressive conflict. In their minds, they never find the right doctor or definitive treatment. The patient-physician relationship is usually doomed to fail because this is the only way that the patient is entitled to continue feeling sick and complain about the doctors who took care of him/her, then turning to yet other specialists. These patients represent a great diagnostic and therapeutic challenge, due to the problems the doctor must face in order to investigate the case and then the difficulty in identifying the "problem" to be solved. This is by no means a cooperative patient, despite his/her full (but only apparent) trust in the treatment. There is nothing to gain by objecting with him/her and it is instead advisable to "share" his/her unshakable skepticism. In this type of patient, there can be phobic reactions to the implant, bordering on rejection. Surgery must be planned with the utmost care, respecting of the timing of the patient, who should feel in control.

Narcissistic personality[1]

These patients are not very reliable. They underestimate or do not properly evaluate the perception of minor irritation that should immediately urge them to consult the doctor. Their hypertrophic ego makes them feel overly self-confident, which often drives them to transgression; they refuse to recognize authority and tend to push things to the limit, looking for immediate satisfaction of their needs.

For instance, a patient who has had to refrain from fine dining for a long time may be unable to avoid giving in to certain temptations, for no apparent reason. Paralleling the behavior of histrionic patients, those with a narcissistic personality go as far as modifying instructions, changing medication, stopping treatment or turning to "alternative" medicines because, for example, they do not trust antibiotics. They stop taking the prescribed medication because, according to them, they are "dangerous" or unnecessary. Of course, all of this is done without consulting their implantologist. This is a patient who needs to dominate out of fear of being dominated. Naturally, the indication here is to avoid any form of symmetrical escalation.

Failure to understand the implications of the implant

In this case, the patient fails to understand and/or remember that an immediately loaded implant is designed to perform two concomitant functions, i.e. chewing and osseointegration.

Lack of proprioceptive sensitivity

In completely edentulous patients this lack of sensitivity may lead to the exertion of excessive masticatory force (28).

Parafunctions[1]

Regardless of how they are caused or implemented, parafunctions represent the greatest danger during the first weeks after placement of immediately loaded implants.

In edentulous patients the habits acquired with removable prostheses (parafunctions) remain, and this may cause overload. The forces applied on the

[1] In collaboration with Franco Merlini, psychotherapist in Milan.

implants will constantly lead to overload and this will always occur during lateral movements, since stress is almost never applied along the main axis of the fixture.
In totally or partially edentulous patients, there is no way to avoid this. Consequently, prompt placement of a mouthguard is advisable (29).

Planning protocol

Number of implants to be placed

The number of implants to be placed depends on many factors and specific conditions, and as a general rule we should try to match the number of teeth to be replaced. If possible, all implants should be placed during the same surgical session (30-32).

Implant size

In order to implement immediate loading, it is advisable to choose (for equivalent cores) a fixture with a larger thread diameter, according to the density and thickness of the bone tissue, and to reach maximum depth, preferably deep bicorticalism, respecting the anatomical structures that are considered to be at risk (mandibular canal, maxillary sinus), in order to maximize the ratio between the submerged and emerging structures.2
Any support implant, needles and/or mini-implants will be adapted to the existing bone morphology.

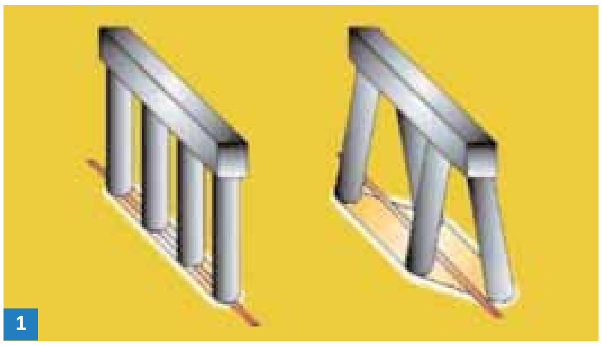
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Fig. 1 Note the broader support offered by unparallel implants compared to parallel ones, and the greater ability of the former to withstand and dissipate lateral loads.
Fig. 2 Bipod formed by a quick screw and a stabilizing needle.

Insertion axis

The insertion axis should permit placement of the longest possible implant, respecting the ideal loading axis in the case of single-tooth implants or the resultant of the axes for bipods, tripods or multiple implantations. The lack of parallelism of the cores of endosseous implant fixtures permits greater stability under stress. Finally, the insertion axis should make it possible to achieve bicorticalism wherever possible (Fig. 1).

Surgical planning

In general, it can be said that implant loading should be proportionate to the individual bone's ability to withstand it. This necessarily implies a final assessment by the surgeon when he/she drills, taps and inserts the implant. Consequently, this is the time to make final decisions regarding the size and morphology of the implant.
Each implant must ensure maximum support of the site chosen for its placement. To accomplish this, several things must be done.

1) Implants that can best exploit the dimensional and morphological characteristics of the bone should be used: screws that can ensure the broadest possible contact surface and maximum mechanical interpenetration with the bone, with wide threads and a large screw pitch for cancellous bone, and a narrower screw pitch for compact bone; bicortical screws to add support for the internal cortical bones, wherever possible; needles for cortical support even when dealing with very thin bone or for bipods or tripods joined together or connected to screws; blades to achieve maximum support for lateral loads in very narrow bone. To achieve this and all the following points, the implants should be adaptable to the various bone morphologies, and should be parallelized by bending and/or drilling at the emerging site right after insertion.
2) Crestal, basal, buccal, palatal or lingual multicorticalism (the maximum possible cortical support) must be implemented. When this is not feasible and support relies entirely on the thread, the implant should have wide threads and a large screw pitch that is inversely proportional to the type of bone: the lower the bone density, the greater the width and pitch of the screw.
3) Placement should coincide with the bone's long axis, even if this means resorting to a fixture an-

[2] Additional surface treatments (acid-etching, sandblasting, electrochemical treatments, etc.) increase the contact area at the bone/implant interface (33-35).

gled with respect to the ideal axis of the emerging post.
4) Divergent implants, both in the mesiodistal and buccopalatal or buccolingual direction, must be inserted in order to broaden the support base and thus achieve greater primary stability. It is important that the axes be divergent, counteracting each other, and that the resultant be as close as possible to the ideal loading axis.
5) Bipods and tripods (Fig. 2), implant complexes consisting of two or three implants, must be made with endosseous portions that diverge but are joined together at their emergence from the bone. This can be done by means of multiple implantations in the same site or close unparallel insertions, using various types of implants. The more difficult the case, the more useful and advisable the use of endosseous tripods.

Second or surgical phase

Guidelines

During the second phase, i.e. surgery, the most important objective is to achieve the best possible primary stability. This is done through extremely careful placements that are as atraumatic as possible, while trying to perform gradual drilling, without overheating the bone and with a very delicate insertion. Implant progression should be performed very carefully, without subjecting the bone tissue to excessive stress.
The purpose of each placement is to achieve internal cortical support (bicorticalism) that can guarantee the best immediate primary stability. This represents a crucial moment because as soon as the inner cortical bone is reached, we must immediately halt progression to avoid applying extractive forces ("corkscrew" effect) on the medullary bone in contact with the coronal surfaces of the threads, as this will produce severe damage, causing vascular injury and subsequent ischemic necrosis of the bone in between.
Only the surgeon's experience and sensitivity can tell him/her when to halt. Therefore, the procedure requires the utmost attention and caution, resisting the temptation of trying to attain greater stability.
Exceeding the limit during the coupling between the tip of implant and the cortical surface will inevitably lead to lesions and fractures between the bone contained in the threads and the portion that lies outside them.
In the case of single-tooth implants, the protocol recommends stabilization by means of a second implant soldered to the first one. The additional implant can be normal in size if there is enough space (molars), or it can be a needle implant or a screw with variable diameters if there is less space available (premolars and incisors) (Fig. 3).

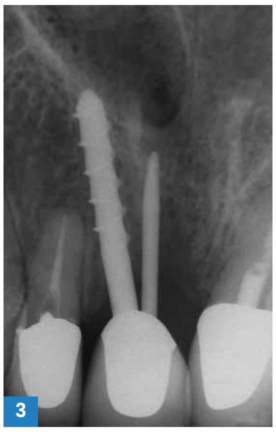


Fig. 3 Radiographic checkup of a bipod 6 years after placement (2001-07). Note the perfect osseointegration.

Protocol

Soldered bar

Let's assume that surgery ends with soldering of the supporting bar. This is a technique recommended to achieve immediate loading in the safest possible way: immediate splinting (30-34) (Fig. 4).
It is done with a circular and/or rectangular bar of Grade 2 titanium, with a diameter ranging from 1 to 1.5 mm, placed palatally or lingually with respect to the fixtures, laid above the mucosa without compression, and soldered to each implant by means of the intraoral solder. This creates extremely stable, strong and reliable implant splinting (Fig. 5).

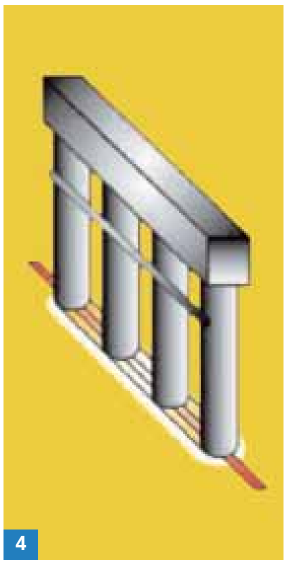


Fig. 4 The image shows the soldered bar below the temporary prosthesis, which should be placed so as to leave a sufficient gap between its base and the gum to allow proper hygiene practices during the post-surgical phase. The solder makes the structure more rigid, allowing each implant to dissipate stress and reducing the lever arm due to the presence of the soldered bar.


5

In the case of isolated implants, atraumatic splinting can be obtained using a provisional crown with retention wings fixed to the adjacent natural teeth, as long as they are stable.
An isolated implant stabilized by a diverging needle is much more reliable and predictable, so the technique that exploits a natural supporting structure should be employed only in those cases where the placement of a diverging needle is not feasible.
The use of the intraoral solder (Fig. 6) is indispensable. This need is acknowledged by the protocol, as its function is to ensure that the implants' micromovements fall within an acceptable range and do not jeopardize the final osseointegration.
Electrowelding, when used by experienced implantologists, offers the following advantages:
1) it permits implant splinting at the end of the surgical session, and independently of the placement of a temporary prosthesis; this means that any decementation or fracture of the temporary prosthesis will not affect the implants, which will still be protected by the stable primary splinting;
2) it creates reliable implant stabilization during the osteoclastic phase, which is the most dangerous moment for stability due to "grip" loss of the implant surfaces by the bone;
3) it dissipates and distributes the loads more effectively across the abutments, as well as any possible overload; even when the professional is able to provide the temporary prosthesis with an occlusion free of premature contacts (not always achievable), the patient's movements cannot be controlled and this can lead to unwise or simply unconscious activities;
4) it is the only technique that permits bipods, tripods and unparallel insertions in the same area, and a single abutment by soldering together the posts of the individual implants;
5) it makes it possible to attain structures with axial compensation;
6) it can be removed before placement of the final prosthesis or can be left in place, depending on the postoperative conditions and the degree of osseointegration.


6

The soldered bar should be kept in place for no less than 8 weeks, and ideally for 12.
Before proceeding with preparation of the final prosthesis, the bar should be removed to ensure proper evaluation of all implant abutments, but due also to the frequent need to adapt it to the final morphology of the soft tissues or the different requirements of the definitive prosthesis.
Final assessment of osseointegration is crucial: implants must exhibit optimal stability before placement of the definitive prosthesis.
Even for implantologists with extensive experience, evaluation of strongly splinted implants, especially when positioned close to each other, is sometimes difficult and is directly proportional to the diameter of the bar employed.
Removal of the bar is thus a fundamental step for correctly diagnosing possible flaws in the osseointegration process of every single implant. Indeed, because of the visual obstacle represented by the bar itself, such flaws would remain hidden but still dangerously active.
In advanced implant surgery on patients whose bone conditions make removal inadvisable, the bar can be maintained or repositioned based on vertical dimensional modifications of the peri-implant mucosa.
After the soldered bar has been removed, the state of osseointegration of immediate-load implants will make them fully comparable to any other type of implant. In short, the bar no longer serves any purpose, as it has been remarkably replaced by the bone apposition around the implants. Keeping the bar in place when this is not absolutely necessary can lead to a less cosmetic prosthesis and reduced control over oral hygiene.
Keeping the bar in place offers the following advantages:

1) protection of the peri-implant tissue: clearly, the presence of the bar allows more efficient distribution and dissipation of the loads, protecting the mucosa and peri-implant bone and reducing the risk of resorption (34);
2) preservation of the structure: isolated implants may be subject to several negative conditions (partial decementation and/or fracture of the prosthesis, occasional or continuous trauma, parafunctions, etc.) that a perfectly splinted structure can withstand better;
3) an increased number of treatable cases: keeping the bar permits treatment of extremely difficult conditions caused by the volumetric or densitometric scarcity of the available bone.

The disadvantages of keeping the bar in place are:

1) cosmetic problems, as the morphological conditions do not always permit perfect or total concealment of the bar;
2) an unnatural sensation due to the internal position of the bar (lingual or palatal), particularly sensitive patients sometimes find it difficult to accept an unnatural presence that "forces" the tip of the tongue to a constant contact, with effects that can be unpleasant at times;
3) hygienic problems, as perfect cleaning of the interdental spaces is not always possible;
4) prosthetic problems, which arise not only from the complex morphology at the junction between the bar and the abutment, but also the significant height reduction due to the presence of the bar, causing retention or cementation problems;
5) clinical visual obstacle, i.e. the presence of the bar makes it very difficult to observe any pathological peri-implant event, delaying diagnosis because it greatly diminishes signs and symptoms.

The presence of the bar in the patient's mouth ad vitam is thus up to the clinician's discretion, based on correct assessment of the balance between advantages and disadvantages with respect to the many and sometimes complex variables of each case.

Third or postoperative phase

Protocol

The third or postoperative phase has several steps.

Placement of the temporary prosthesis

An acrylic temporary prosthesis will be placed immediately in the same surgical session, establishing a correct vertical dimension and, more importantly, correct occlusion.

The temporary prosthesis must be prepared in advance, placed, relined intraorally and properly cemented. The use of a reinforced temporary prosthesis is advisable to ensure optimum function for a period of no less than 2-3 months (23, 30).

The temporary prosthesis should respect occlusal principles, providing a balanced occlusion both at the centric relation position and during lateral movements.

Sometimes a provisional crown with palatal or lingual retention wings, or with an interproximal-distal concavity (Fig. 7) can be used to support stabilization even further, exploiting the adjacent stable teeth in cases with isolated implants.

Application of immediate loading through immediate temporary prosthesis

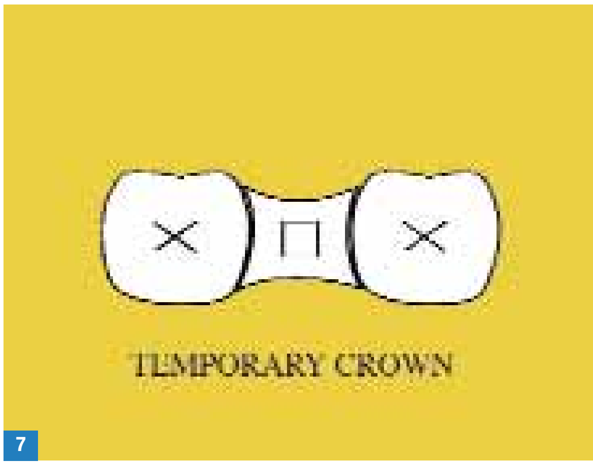
Balanced load application allows faster and better osseointegration.

To make a temporary prosthesis with the specific characteristics needed for immediate loading, the following principles should be respected.

Assessment of the applicable load: physiological or reduced

The load should be proportional to the surface and support area of the implant, and to the overall bone quality. Therefore, we can distinguish the load as physiological when there is good bone quality, and reduced in all other cases. The load will be adjusted according to:

1) reduction of the occlusal surface by reducing transverse diameters (Figs. 8-14);
2) underocclusion of the crown by reducing occlusal contacts (Fig. 9);
3) flat plane occlusion by eliminating occlusal contacts (Fig. 10);



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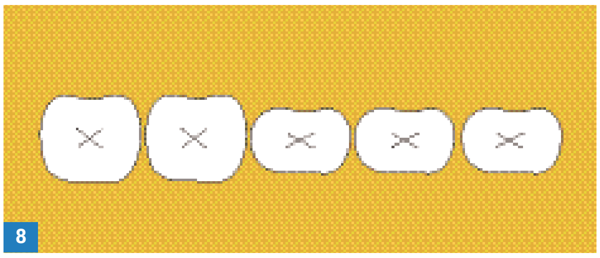
4) progressive loading, starting from a very reduced occlusion and proceeding by progressive increases until correct occlusion has been attained (Fig. 11).

Lateral stress control

With reference to lateral stress, we must clarify that in a theoretical stomatognathic model, lateral loads are nonexistent with the exception of the canine, which is the only tooth physiologically designed to withstand lateral forces (20). A gnathologically correct prosthesis based on this model does not have lateral loads. In a real patient showing parafunctions and automatisms (bruxism, etc.), with intermaxillary relationships that are completely subverted by vertical and centripetal resorption, the application of lateral forces with significant angles with respect to the implant and the ideal loading axes is almost inevitable.
The lateral load is always the most dangerous type of stress when applied to needle or screw implants, especially those with a small core, as this can lead to implant fracture (25) or mobility. We thus recommend careful evaluation of implant position with respect to mobile anatomical structures such as the tongue (19, 20, 36), cheeks and muscle insertions. The size of the tongue should also be taken in due consideration. The morphology, position and inclination of the antagonist teeth must also be assessed.
Stress control can be achieved by means of:
1) correct canine disclusion, with a more pronounced slope if necessary, and possible reduction of the cusps of diatoric teeth, down to zero (Fig. 12);
2) reduction of the buccolingual and buccopalatal surfaces (Fig. 13);
3) reduction of the mesiodistal surface (Fig. 14).

Follow-up

The occlusal check is performed with traditional means: articulating paper and specific detector solutions (Red Indicator) (37). The former is very practical, whereas the latter are more complex to use but very precise. Alternatively, the occlusal check can be performed with the aid of more sophisticated electronic tools (23) such as electromyographers.
The percussion sound test should be performed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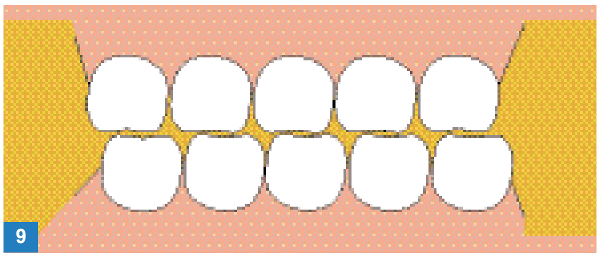
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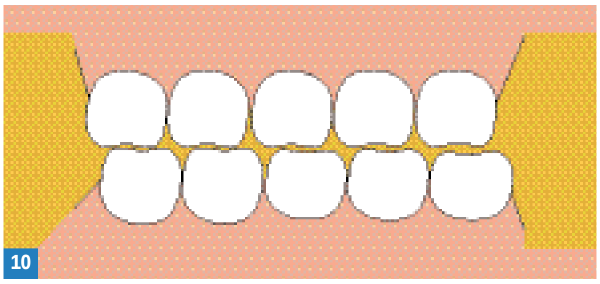
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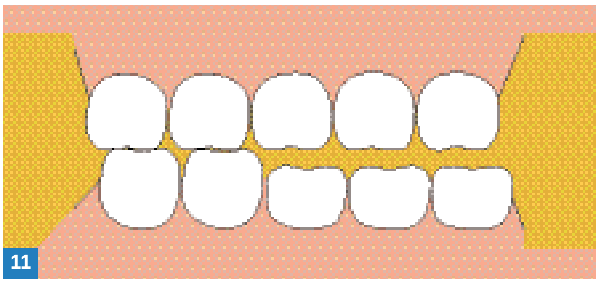
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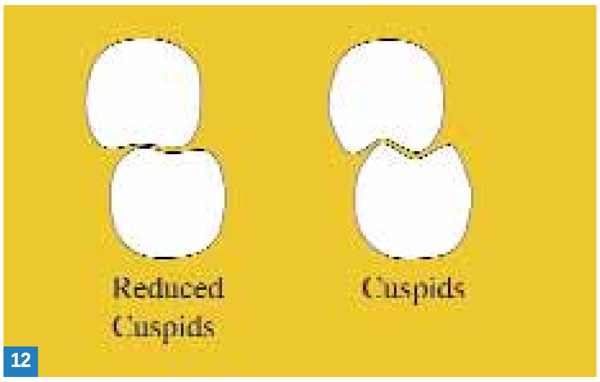

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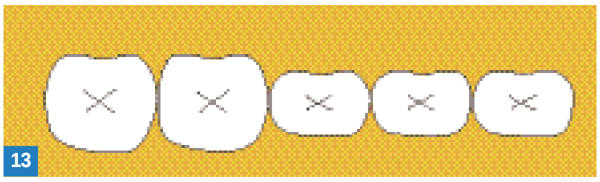
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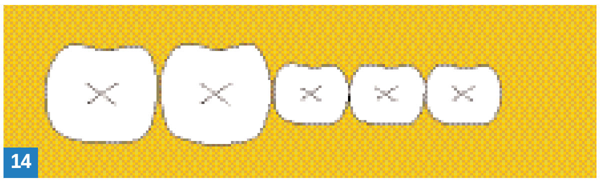
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Week 1: occlusal check

Week 2: occlusal check and checkup of the soft tissues

High-risk phase

Fixation phase week 3, 4, 6, 8, 12: checkup of the implants (sound and mobility)

Fixation phase

Month 3, 4, 6: general checkup
Month 12, 16: standard follow-up

15

16

17

with the temporary prosthesis in place, which should be removed in case of doubt for direct examination of the implants. An implant emitting a non-metallic sound should be checked for mobility (possibly by cutting the bar). At this stage, X-rays are not decisive, since radiographic signs are visible only later (Fig. 15).

Guidelines

Solutions to possible problems

Assessing the implant's mobility is very difficult when the fixture is soldered to the titanium bar. The percussion test remains the most reliable examination. When the implant, tapped at the top and along its main axis, produces a non-metallic sound, its stability should be assessed again upon solder removal.
If the implant shows mobility, it should be removed and immediately replaced with another one with a larger diameter, or removed and replaced 30 days later with another one with the same diameter, in both cases after careful surgical curettage. The bar is then repositioned and soldered to the implant.
If the mobile implant is isolated, it should be removed nevertheless and replaced with another one with a larger diameter, and then immediately stabilized by a supporting needle.
In the case of isolated implants, this type of double placement should be planned beforehand in order to avoid unscrewing, a common phenomenon observed with single immediate-load implants. Lateral forces can unscrew the implant during the peak of the osteoclastic phase (approximately around week 4-5), when the primary fixation becomes weaker (due to a decrease in bone compression).
Figures 16 and 17 show an example of maximum lateral stress: a canine replaced by an immediately loaded electrowelded bipodal implant and a gold-ceramic crown.
Isolated implants placed in the lower left and upper right areas are more readily subject to unscrewing during the postoperative osteoclastic phase, due to the action of the tongue, which pushes forward vigorously and applies a torque vector to the lingual-palatal surfaces of temporary crowns.
The needle soldered to the single screw counteracts rotation, thus preventing unscrewing.

Physiological and biodynamic principles of immediate loading

An immediately loaded implant is housed within a bone in a very active phase: reparative osteogenesis. The successful process leads to osseointegration, while its failure causes a defense reaction against the exogenous noxa: the attempt to expel the implant (early mobilization) or encapsulate it (fibrointegration). This means that, unlike delayed loading, immediate loading requires rapid action and prompt troubleshooting. It is imperative to act and solve any problem when the intervention can still be considered minimal and no significant bone loss has occurred yet.

Above all, immediate loading requires a thorough understanding of the phenomenon and its biomechanical principles, and thus it means learning how to manage it. This is the exact opposite of delayed loading, which involves simply waiting for the bone reparative process to take place.
Immediate loading induces and enhances all the mechanisms involved in tissue healing by means of direct action on the restorative cellular capacity, increasing it (38) through the functional activation of homeostatic mechanisms, on the basis of the stimulus-response principle (39, 40). During the first 20-40 days after surgery, absolute immobility of the implant is crucial in order to prevent degeneration of the newly formed osteoid toward fibrous tissue (41). This immobility can be obtained through two antithetical protocols: exclusion of the function according to the Swedish school or functionalization by splinting (42, 43) according to the Italian school, which ensures rigid stability and thus complete immobility of the implants through constant and perfect splinting of each implant (30, 32, 34, 44). The Italian school is still the only one that - since 1978 - has availed itself of an extraordinary tool that can ensure reliable and predictable functionalization by splinting: Mondani's intraoral solder (45).
Currently, the protocol that entails the exclusion of function is still considered the most advisable due to its predictability, since it is believed to provide greater protection of the primary stability during the crucial postoperative phase. Nevertheless, we should also note that the studies conducted to date have not investigated immediate loading with specific implants based on the principles of the Italian school (Apolloni, Bellavia, Bianchi, Garbaccio, Hruska, Lo Bello, Marini, Mondani, Muratori, Pasqualini, Pierazzini, Tramonte) and of prominent institutions such as the GISI, and AISI (Accademia Italiana di Stomatologia Implantoprotesica) (46). Moreover, the principles of delayed loading, considered "dogma" for far too long, have been applied to immediate loading only recently, but absurdly applying techniques pertaining strictly to delayed loading. The apparent scientific bias of protocols on delayed loading does not justify disregard for the existing techniques tested for the Italian school's immediate loading. In reality, the importance of using implants with large threads and cortical support has never been fully recognized (47, 48), let alone the use of the intraoral solder. Schnitman (49) in 1990 and Wohrley (50) in 1992 had already demonstrated that osseointegration can be achieved and maintained with immediate loading. In 2002 Bertolai et al. (51) showed that Italian implants with wide threads and reduced emergent portions are more effective for immediate loading that those with narrow threads and a prosthetic connection. In 1999 Bianchi (18) employed immediate loading with temporary immediate splinting (with the supporting bar soldered intraorally) and subsequent definitive prosthesis (upon removal of the bar) for a very interesting case of immediate loading versus delayed load (see Chapter 11, pp. 154, 155).
Recent studies have acknowledged the effectiveness of electrowelding for two-step implants as well (52-56).
Histological research has demonstrated the ability of implants with wide threads and narrow emergent portions to form an adequate epithelial seal (Fig. 18) (57), the indispensable prerequisite for optimal bone healing and subsequent osseointegration (18) (Figs. 19-21).
The choice of immediate loading is justified by virtue of an indisputable advantage in achieving more specific organization of the peri-implant bone, not only with respect to the bone/implant interface, but also as the expression of a morphostructural adaptation of the entire bone area affected by the propagation of functional stimuli (58-63). The regenerative phase of the surgical wound, after implant inclusion and with replacement of the hematoma by the fibrocellular blastema, has significant potential from a qualitative and quantitative standpoint, due to the ability of the connective elements to differentiate into the distinctive cellular phenotypes of the support tissues. The local metabolic status, already enhanced by the induction of growth factors, can be further increased by the direct action of the mechanical loads, which also participate in the phenotypical expression of the undifferentiated connective tissue. As far back as 1995, Salama et al. (64) forecast the evolution of the implant protocol, from load-free healing to a protocol that emphasizes and ensures healing with loaded

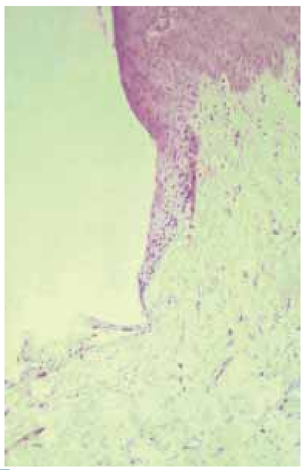
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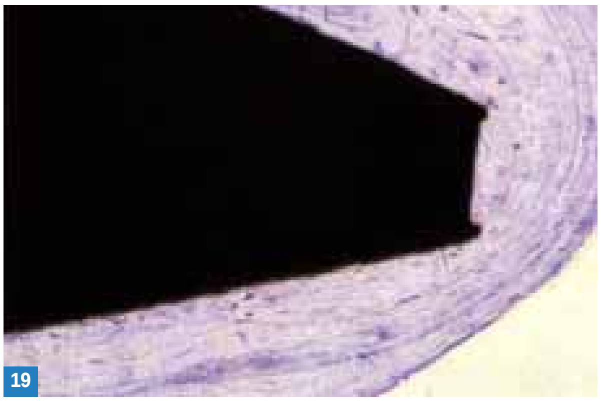
Fig. 18 Close-up of the epithelial attachment on an implant. Note the absence of keratinic protection and the progressive reduction of the cell layers (below), consisting only of germinal basal cells.

implants, albeit without overloading and preserving primary stability. Stability is obtained with an immediate loading protocol that can yield fully predictable outcomes, due to splinting of the implants to a titanium bar by intraoral soldering.
Immediate loading offers the great advantage of reducing rehabilitation time by enhancing the bone's regenerative response according to the theory of the causal histogenesis of bone tissue (47, 65), not merely with the aim of bone healing, but also by influencing its formation and orientation, in keeping with the trajectory patterns suitable for the dissipation of force along the most appropriate directrixes.
The studies of Salama (64) (1995), Schnitman (49) (1997) and Tarnow (66) (1997) show that a prosthesis that can ensure the stability and immobility of the implants can produce a stable and predictable long-term bone/implant relationship.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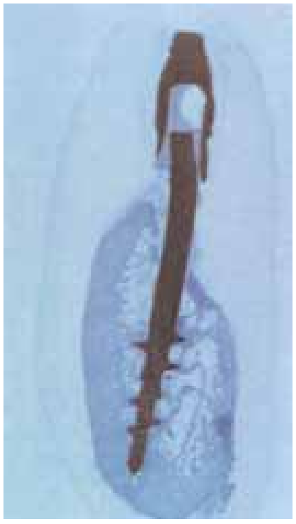
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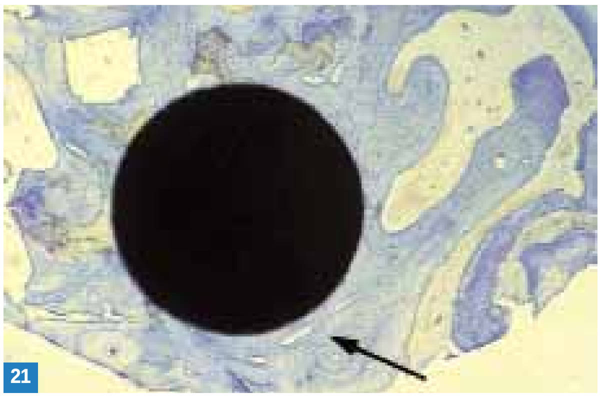
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Fig. 19 Osseointegration of a Tramonte screw (close-up of a thread).
Fig. 20 Osseointegration of a Garbaccio screw.
Fig. 21 Osseointegration of a Scialom-Mondani needle.

Conclusions

Immediate loading is a highly reliable and predictable technique, thanks to the possibilities offered by the soldering of implants to titanium bars, the use of implants that can be parallelized immediately by bending their necks, the possibility of employing angled placement techniques that permit the manufacture of any design, making the surgical and prosthetic phases more effective, and - lastly - the possibility of finding a prompt solution to the lack of primary fixation that can always affect implants, regardless the type of technique that is used.
In most cases, complications and failures can be avoided through careful and correct diagnosis, and specific planning.
Nevertheless, these complications can easily be overcome with quick, simple and effective solutions.

References

1. CHIAPASCO M., GATTI C., ROSSI E., HAEFLIGER W., MARKWALDER T.H. Implant-retained mandibular overdentures with immediate loading. A retrospective multicenter study on 226 consecutive cases. Clin Oral Implants Res 1997 Feb;8(1):48-57.
2. ROSSI E., HAEFLIGER W., CHIAPASCO M. Implant-retained mandibular overdentures with immediate loading: a prospective study of ITI implants. Int J Oral Maxillofac Implants 2000 May-Jun;15(3):383-8.
3. CHOW J., HUI E., LIU J., LI D., WAT P., LI W., YAU Y.K., LAW H. The Hong Kong Bridge Protocol. Immediate loading of mandibular Brånemark fixtures using a fixed provisional prosthesis: preliminary results. Clin Implant Dent Relat Res. 2001;3(3):166-74.
4. MISCH C.E., DEGIDI M. Five-year prospective study of immediate/early loading of fixed prostheses in completely edentulous jaws with a bone quality-based implant system. Clin Im-

plant Dent Relat Res 2003;5(1):17-28.
5. TESTORI T., DEL FABBRO M., SZMULKER-MONCLER S., FRANCETTI L., WEINSTEIN R.L. Immediate occlusal loading of Osseotite implants in the completely edentulous mandible. Int J Oral Maxillofac Implants 2003 Jul-Aug;18(4):544-51.
6. DEGIDI M., PIATTELLI A. Immediate functional and non-functional loading of dental implants: a 2- to 60-month follow-up study of 646 titanium implants. J Periodontol 2003 Feb;74(2):225-41.
7. VAN STEENBERGHE D., MOLLY L., JACOBS R., VANDEKERCKHOVE B., QUIRYNEN M., NAERT I. The immediate rehabilitation by means of a ready-made final fixed prosthesis in the edentulous mandible: a 1-year follow-up study on 50 consecutive patients. Clin Oral Implants Res 2004 Jun;15(3):360-5.
8. DEGIDI M., SCARANO A., PIATTELLI M., PERROTTI V., PIATTELLII A. Bone remodeling in immediately loaded and unloaded titanium dental implants: a histologic and histomorphometric study in humans. J Oral Implantol 2005;31(1):18-24.
9. QUINLAN P., NUMMIKOSKI P., SCHENK R., CAGNA D., MELLONIG J., HIGGINBOTTOM F., LANG K., BUSER D., COCHRAN D. Immediate and early loading of SLA ITI single-tooth implants: an in vivo study. Int J Oral Maxillofac Implants 2005 May-Jun;20(3):360-70.
10. ATTAED N.J., ZARB G.A. Immediate and early implant loading protocols: a literature review of clinical studies. J Prosthet Dent 2005 Sep;94(3):242-58.
11. GLAUSER R., RUHSTALLER P., WINDISCH S., ZEMBIC A., LUNDGREN A., GOTTLOW J., HäMMERLE C.H. Immediate occlusal loading of Brånemark System TiUnite implants placed predominantly in soft bone: 4-year results of a prospective clinical study. Clin Implant Dent Relat Res 2005;7 Suppl 1:S52-9.
12. BALSHI S.F., WOLFINGER G.J., BALSHI T.J. A prospective study of immediate functional loading, following the teeth in a day protocol: a case series of 55 consecutive edentulous maxillas. Clin Implant Dent Relat Res 2005;7(1):24-31.
13. SEGURA-MORI SARABIA L., DíAZ VIGIL-ESCALERA J., MAUVEZíN QUEVEDO M., GONZáLEZ GONZáLEZ I. Carga inmediata: situación actual. Immediate loading: current situation. RCOE [periódico na Internet] 2006 Dez; 11(5-6): 529-41.
14. CRESPI R., CAPPARè P, GHERLONE E, ROMANOS G.E. Immediate occlusal loading of implants placed in fresh sockets after tooth extraction. Int J Oral Maxillofac Implants 2007 Nov-Dec;22(6):955-62.
15. DEGIDI M., IEZZI G., SCARANO A., PIATTELLI A. Immediately loaded titanium implant with a tissue-stabilizing/maintaining design ("beyond platform switch") retrieved from man after 4 weeks: a histological and histomorphometrical evaluation. A case report. Clin Oral Implants Res 2008 Mar,19(3):276-82. Epub 2007 Dec 13.
16. Enciclopedia Medica Italiana. V. XI. Firenze: Ed. Uses; 1984. p. 2-18.
17. SPIEKERMANN H., DONATH K., JOVANOVIC S., RICTHER J. Atlante di odontostomatologica: Implantologia. Milano: Masson; 1999.
18. BIANCHI A., SANFILIPPO F., ZAFFE D. Implantologia e implantoprotesi. Basi biologiche. Biomeccanica. Applicazioni cliniche. Torino: UTET; 1999.
19. MISCH C.E. L'Odontoiatria implantare contemporanea. Parte prima: diagnosi e progettazione del trattamento. Roma: Antonio Delfino editore; 2003.
20. PASQUALINI U. Le patologie occlusali. Eziopatogenesi e terapia. Milano: Masson; 1993.
21. MEZZANOTTE P. Le indagini radiologiche pre e post-implantari. Milano: Masson; 2005.
22. MORO L., MODRIKY C., BETTICA P. I marcatori biochimico-clinici nella fisiopatologia ossea. Milano: Ed. Sorbona, 1994.
23. TRAMONTE S.U. Prevencion de complicaciones y fracasos en carga inmediata. Rev Espanola Odontoestomatologica de Implantes 2005 Dic;13(4):206-16.
24. SEMI A. Trattato di psicoanalisi. Vol II. Milano: Raffaello Cortina Editore; 1989.
25. GABBARD G.O. Psichiatria psicodinamica. Milano: Raffaello Cortina Editore.
26. MC WILLIAMS N. La diagnosi psicoanalitica. Astrolabio; 1999.
27. BERGERET J. La personalità normale e patologica. Milano: Raffaello Cortina Editore; 1984.
28. CHIESA D., CHIAVAROLO P., COLASANTO S., DE CICCO V., FERRANTE A. La nuova ortodonzia. Roma: Marrapese Editore; 2007. p. 11-70.
29. FISCHER W.F., O'TOOLE E.T. Personality characteristics of chronic bruxers. Behav Med 1993 Summer;19(2):82-6.
30. TRAMONTE S.U. La Maxima Expresion de la Carga Inmediata. I° Congreso Internacional SEI-ICOI. Barcelona. 2002.
31. MURATORI G. Implant isotopy (II). J Oral Implantol 1995;21(1):46-51.
32. ROSSI F., PASQUALINI M.E., MANGINI F., MANENTI P. Carico immediato di impianti monofasici in mascellare superiore. Dent Cadmos 2005;4:65-9.
33. PASQUALINI M.E., MANGINI F., COLOMBO D., MANENTI P., ROSSI F. Stabilizzazione di impianti emergenti a carico immediato. Saldatrice endorale. Dent Cadmos 2001;9:67-76.
34. LORENZON G., BIGNARDI C., ZANETTI E.M., PERTUSIO R. Analisi biomeccanica dei sistemi implantari. Dent Cadmos 2003;71(10):63-86.
35. PASQUALINI M.E. Le fratture da fatica dei metalli da impianto. Il Dentista Moderno 1993;(2):31.
36. PASQUALINI U., PASQUALINI M.E. Uses and advantages of the dry self-molding varnish, Red Indicator, in selective impressions. Dent Cadmos 1982 Oct;50(10):49-63.
37. DAL CARLO L. Influenza della lingua sull'integrazione degli impianti endossei. Doctor OS Mag 2003;14(5):479-84.
38. ROBERTS W.E. Fundamental principles of bone physiology, metabolism and loading. In: Naert I., Van Steemberghe D., Worthington P. (eds). Osseointegration and oral rehabilitation:

An introductory text-book. London: Quintessence; 1993. p. 157-70.
39. SCHENK R.K. Biology of fracture repair. In: Browner B.D., Jupiter J.B., Levine A..M., Traften P.G .(eds). Skeletal trauma. Philadelphia (USA): CV Saunders; 1992. p. 3-19.
40. CASTAMAN E. Principi biomeccanici di fissazione. Bologna: Edizioni Aulo Gaggi; 1993.
41. ASPENBERG P., GOODMAN S., TOKSVIG-LARSEN S., RYD L., ALBREKTSSON T. Intermittent micromotion inhibits bone ingrowth. Titanium implants in rabbits. Acta Orthop Scand. 1992 Apr;63(2):141-5.
42. LEDERMANN P.D. Kompendium des TPS-Schraubenimplantates im zahanlosen Unterkiefer. Berlin (Germany): Quintessence; 1986.
43. BABBUSH C.A., KENT J.N., MISIEK D.J. Titanium plasma-sprayed (TPS) screw implants for the reconstruction of the edentulous mandible. J Oral Maxillofac Surg 1986 Apr;44(4):274-82.
44. BRUNSKI J.B. Influence of biomechanical factors at the bone-biomaterial interface. The bone-biomaterial interface. University of Toronto Press, Toronto (Canada): En Davies JE (ed); 1991. p. 391-404.
45. MONDANI P.L., MONDANI P.M. The Pierluigi Mondani intraoral electric solder. Principles of development and explanation of the solder using syncrystallization. Riv Odontostomatol Implantoprotesi 1982 Jul-Aug;(4):28-32.
46. Consensus AISI (Accademia Italiana di Stomatologia Implantoprotesica). Dent Cadmos 2004;2:81-83.
47. LEMONS J.E. Considerazioni sui fattori biomeccanici e sui biomateriali degli impianti a forma di radice. In: McNeill C. L'occlusione. Basi scientifiche e pratica clinica. Milano: Scienza e tecnica dentistica; 1997. p. 195-202.
48. Vantaggiato G., Iezzi G., Fiera E., Perrotti V., Piattelli A. Histologic and histomorphometric report of three immediately loaded screw implants retrieved from man after a three-year loading period. Implant Dent 2008 Jun;17(2):192-9.
49. SCHNITMAN P.A., WOHRLE P., RUBENSTEIN J.E. Immediate fixed interim prostheses supported by two-stage threaded implants: methodology and results. J Oral Implantol 1990;16(2):96-105.
50. BIANCHI A., SAN FILIPPO F., ZAFFE D. Implantologia e implantoprotesi. Basi biologiche. Biomeccanica. Applicazione cliniche. Torino: UTET; 1999. p. 330-331.
51. BERTOLAI R., FERRETTI A., COLLEDAN E. Studio Sperimentale Clinico "Esperienza clinica nell'implantologia a carico immediato" collegato alla tesi di laurea di Colledan E: Impianti a carico immediato AA 2000-2001. Università di Firenze.
52. HRUSKA A., CHIAROMONTE BORDINARO A., MARZADURI E. Carico immediato postestrattivo. Valutazione clinica su 1373 impianti. Dent Cadmos 2003;5: 103-18.
53. DEGIDI M., GEHRKE P., SPANEL A., PIATTELLI A. Syncrystallization: a technique for temporization of immediately loaded implants with metal-reinforced acrylic resin restorations. Clin Implant Dent Relat Res 2006;8(3):123-34.
54. DAL CARLO L. La saldatura degli impianti sommersi: oltre 12 anni di esperienza clinica. Riv Ital Stomatol 2008;2:34-42.
55. FANALI S., VANNINI F. Impianti bifasici solidarizzati con sincristallizzatrice endorale. Doctor Os 2007 Nov-Dic;18(9):1047-56.
56. DAL CARLO L. Tecnica di protesi fissa su barra saldata nelle contenzioni definitive. Doctor Os 2004 Giu;15(6):637-45.
57. CAMERA A., PASQUALINI M.E., TRAMONTE S.U. Istologia comparata dei tessuti della "zona del colletto" di un dente naturale e di tre viti di Tramonte. Doctor Os 2005 Nov-Dec (Suppl).
58. PASQUALINI U., MANENTI P., PASQUALINI M.E.: Indagine istologica su ago emergente fratturato. Impl Orale 1999 Aprile;2: 42-5.
59. MOGLIONI E., DIOTALLEVI P., PEZZUTI E., FERRANTE G., PASQUALINI M.E., FLORIS P.M. Success rates in subject rehabilitated with immediate loading technique on according to AISI guide lines. Annali di stomatologia 2008; LVI(1-2):19-23.
60. PASSI P., MIOTTI A., CARLI P.O., DE MARCHI M. Tramonte screw for replacement of single teeth. G Stomatol Ortognatodonzia 1989 Apr-Jun;8(2):83-8.
61. MANGANO C., PERROTTI V., IEZZI G., SCARANO A., MANGANO F., PIATTELLI A. Bone response to modified titanium surface implants in nonhuman primates (Papio ursinus) and humans: histological evaluation. J Oral Implantol 2008;34(1):17-24.
62. GRASSI S., PIATTELLI A., FERRARO D.S., FIGUEIREDO L.C., FERES M., IEZZI G., SHIBLI J.A. Histologic evaluation of human bone integration on machined and sandblasted acid-etched titanium surfaces in type IV bone. J Oral Implantol 2007;33(1):8-12.
63. ORSINI G., PIATTELLI M., scarano A., petrone g., kenealy j., Piattelli A., Caputi S. Randomized, controlled histologic and histomorphometric evalutation of implants with nanometer-scale calcium phosphate added to the dual acid-etched surface in the human posterior maxilla. J Periodontol 2007 Feb;78(2):209-18.
64. SALAMA H., ROSE L.F., SALAMA M., BETTS N.J. Immediate loading of bilaterally splinted titanium rootform implants in fixed prosthodontics. A technique reexamined: two case reports. Int J Periodont Rest Dent 1995;15:344-61.
65. PAUWELS F. Gesammelte abhandlungen zur funktionellen Anatomie des Bewegungapparates. Berlin: Verlag; 1965.
66. TARNOW D., EMTYUIAZ S., CLASSI A. Immediate loading of threaded implants at stage 1 surgery in edentulous arches: ten consecutive case reports with 1 to 5 year data. Int L Oral Maxillofacial Implants 1997;12:319-24.

Fig. 2 Courtesy of Franco Rossi.
Figs. 19 Courtesy of A. Bianchi, F. Sanfilippo, D. Zaffe, from Implantologia e implantoprotesi. Basi biologiche. Biomeccanica. Applicazioni cliniche. Turin: UTET, 1999, pp. 326–31.