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Opinion

Interconnections between the Dental Implant and the Prosthetic Abutment

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Several scholars in recent years have tried to take stock of the reliability and the clinical efficacy of implant-prosthetic rehabilitation, carrying out long-term studies that reveal what were and with what incidence clinical complications were manifested a load of the installations. In this regard, complications have been distinguished in two major categories: biological and techniques, the latter essentially of a mechanical nature. The former is essentially identifiable with peri-implantitis and are therefore charged structural anatomical apparatus that supports the implant (hence the biological term), le secondly, they have to do with the components from which it is constituted, as a whole, an implant-prosthetic rehabilitation. The latter are: unscrewing or loss of the clamping screw, fracture of the screw tightening, loss of retention of the prosthetic superstructure, fracture of the abutment, fracture of the implant, fracture of the metal structure of the crown and fracture of the porcelain. Bragger., *et al.* recruited 89 implant-prosthetic rehabilitated patients in one study prospective long-term for a complete clinical and radiographic analysis at 1 year and 10 years from the load of the plant. It was not a simple assessment of the percentages of success / failure of implants at 10 years, but of a more extensive and complete analysis of the cause's failure and the role that biological and mechanical complications had had in the cases of implant failure. Not even those factors related to general health have been overlooked in this study of the patient nor the parafunctional ones (bruxism) that can often be the basis of mechanical complications. The times of the first manifestation of the aforementioned were noted complications and therapeutic measures promptly adopted in these cases. In the single-implant and single-crown rehabilitation group there were 69 units. 7 of these (10%) failed, 5 (7%) due to biological complications, 2 (3%) due to complications mechanical. Another study on 112 controlled implants for 10 years revealed that complication the most frequent technique is the loss of abutment due to unscrewing or fracture of the screw tightening (7.1% of cases). Unscrewing has been recognized as the most frequent implant mechanical problem also from other studies. We have already shown, literature in hand, that, among the mechanical complications, the most the unscrewing of the clamping screw is frequent. This problem is closely linked to stability of the screw joint, which in turn depends not only on the tightening torque, but also from the adaptation between implant and abutment fixation screw. The unscrewing also as a consequence it also involves an increase in the incidence of fractures of the vine itself. The loosening of the screw is due to the progressive increase in stress on the interface implant-shoulder-screw that leads to decrement of the preload (force of connection at the moment of initial invasion). All this leads to the opening of the fixture-abutment interface and to the presence of harmful and annoying rotational movements of the prosthetic load. In order for the joint of the screw to be stable, it must have been in the phase of screwing, an adequate preload, that there is considerable precision in the adaptation of the mating components of the implant and that the implant-abutment interface enjoys adequate autorotational requirements. When occlusal stresses exceed the plastic deformation limit of the material of the vine, one arrives at the fracture of the same. The screw undoubtedly represents the part of the plant that is most exposed to fracture of its reduced diameter compared to that of the implant or abutment. This on the one hand represents a security mechanism to safeguard the others implant components and supporting tissue; today, in fact, we tend to draw the plants in such a way as to make the vine the most fragile part of the whole system because it represents the most easily replaceable component without excessive time and cost. In the case of overloads or direct loads in an anomalous way on the system or phenomena parafunctional, the forces, just because absorbed all from the vine to the fracture, will not come transferred to the surrounding bone which otherwise would go towards that biological phenomenon which we will later indicate as retrograde perimplantitis. The vine tends to fracture more often at two specific points where the loads are concentrated: a level of change of section between shank and screw and at the root of the first coil (where the bulk of the load).Instead, if the fracture

of the fixture occurs, there must be a bone resorption peri-implant, in the presence of which the implant is subjected to higher bending forces. If the bone loss extends beyond the connecting screw, axial and bending voltages come applied at a less resistant region of the plant due to the absence of the screw connection within its sectional area. If then the bone recession has assumed a vertical architecture, one can have the concentration of the voltages at an exposed coil from which a rhyme of propagation begins to propagate fracture. The latter are the typical cases in which a biological failure of the plant (periimplantitis) is associated, in a relationship of strict consequence, even the most catastrophic mechanical failure (implant fracture).The problem of unscrewing is not only felt in implantology, but in the mechanics in general, where they use the following precautions to try to minimize this inconvenience: the tightening torque control; the control of the angle between plant and abutments; the use of an activation means. The torque is applied in the screw giving it the so-called preload, which is not other than what holds the threads of the screw tightly secured to the coupled counterpart joins the screw head and its housing through a locking force. The loosening of the screw, usually, is caused by situations that lead to processes of dilatations/contractions of prosthetic components such as: transverse dynamic loads, transversal displacements, elastic deformations due to blows, vibrations or sudden changes of temperature. Mastication, with its movements, causes the development of cutting forces and forces vertical ones that are unloaded on the tightening screws generating "twisting" movements: if these they are opposite to the thread tighten the clamping screw of the abutment, otherwise, with extremely easy, the screws will be loosened. Bickford argues that the breakdown of the screw joint occurs in two phases: in the first phase the preload gradually decreases due to the functional loads, in the second the functional load exceeds the preload of the screw, which loosens causing micromovements and settlements. To better understand the problem, we try to explain why the threaded screws tend to loose. The threaded coupling system was born in the third century BC with the cochlea of Archimedes, which today can be schematized by the coupling between the screw and a bolt, and it is the most frequently used system in modern mechanics. Its use and its operation are so obvious that the tensions in play are rarely examined in a way depth. The main causes that determine the loss of tension in a screw or in a any other threaded coupling are:

- Relaxation of tension;
- Spontaneous loosening.

A screw "relaxes" when there is a permanent modification of the original length in sense of its axis, or when the "relaxation" concerns the material it constitutes the interior of the vine. The factors mentioned above lead to a reduction in the preload (screw tension) by reducing, thus, the clamping force. The factors that can cause these permanent length changes are:

- Settlement (smoothing of the abutment surfaces that become smoother by the pressure generated by tightening)- sinking.
- (the pressure exerted by the subheading of the abutment is so high that it exceeds the resistance compression of the material itself)

Spontaneous loosening occurs when the screwing of the abutment or screws tightening determines a compression on the thread of the implant and the abutment, determining, in turn, a slight tension of the abutment that tends as if it were one spring. The voltage generated in this way is discharged on all the elements of the thread by placing them in compression in the equilibrium condition are the frictions that are generated on the threads in grip, above all under the head of the abutment, to oppose the unscrewing. Indeed, the tension present in the stem of the abutment, in the absence of these frictions, it would naturally be discharged with a light one rotation. This is why the couple being dismantled is always lower than the one requested inscrewing phase. The simplified mathematical formula that summarizes these concepts is:

T = K? F? d where T = torque,
K = empirical constant that takes into account the behavior of many factors such as friction on the threads and on the bolt interface (K is not a coefficient of friction, though it is related to it),
F = induced force or preload
d = nominal diameter of the screw.

The constant K can assume different values ??depending on the material of the screw, how it is been treated, of its greater or less roughness. The total friction is able to absorb 80-90% of the tightening torque. It is not easy to program the precise torque value capable of giving us the maximum of preload without risk of settling the thread or causing sinking of the sub-head of the vine. Regardless of what has been said, if it creates a situation in which vibrations occur or alternating loads are applied to the abutment, the blocking effect generated by the components that work by friction lose effectiveness, leaving room for a beginning of rotation of the abutment with subsequent rapid loss of tension. Vibrations can occur both in the longitudinal direction and in the transversal

direction, both at the same time in both directions. Transverse vibrations can derive from alternate horizontal loads and are much more damaging than others because they can lead to rapid loosening of any unbraked screw. Also, the longitudinal forces resulting from pulsating axial loads can give rise to slackening, but minor. In summary, the phenomenon of loosening of the stump and of the screw can occur when:

- The compressive load exceeds the preload of the connecting screw.
- The high compressive load causes disengagement of the coupling threads.
- Tensile forces cause plastic deformation of the clamping screws.
- The screw is loosened by settling.
- The cyclic masticatory load induces micromovements of the threaded components, wearing them contacts between the various components and causing diversion.
- Maladattings of the various components amplified by the load occur.
- The presence of discrepancies (gap) between the prosthesis and the abutment, with values ??between 100 and 175 microns, it produces the loosening of the clamping screw more easily so that these values? can be considered unacceptable Therefore, in order to avoid loosening of the clamping screws in mechanics, i following measures.

Figure 1

- Use of high-strength screws in order to obtain high preloads, making full use of the friction between the threads of the implant and the screw;
- Creation of a secure and precise mechanical coupling: increase in the friction coefficient by modifying the surface finish of the thread;
- Use of a sticker that eliminates the lateral movements (the game that exists between lives and nut screw is filled with this product which, by hardening, binds the pieces together, exalting the friction on the whole thread and on the whole treated surface). Returning to more strictly clinical speeches, the problem of unscrewing tends to occur more frequently at the level of individual plants, mainly in the first year of loading functional and especially in bruxist patients. With the introduction of prosthetic systems specifically designed for single implants and use of improved prosthetic components (golden screws, torque wrenches), the incidence of complications decreased especially in previous sectors. In the later sectors, however, where the masticatory dynamics and functional loads are much higher, the problem still seems to exist. The positioning of a crown beyond the long axis of the implant, as happens regularly, in the rehabilitation of a molar, in fact, it causes the formation of a cantilever e therefore the development of a twisting moment that can easily cause the screw to loosen. It would therefore be important in order to reduce this technical inconvenience to replace a single molar with two implants, but this is rarely possible in monodactylids since almost there is never an adequate mesio-distal amplitude of the bone. Some researchers claim that the mesio-distal mean amplitude of a maxillary first molar is 7.5 mm, while that of a first mandibular molar is 8.5 mm. These dimensions do not allow a space sufficient if not for the insertion of a single 3.5 mm system. In addition to the preload value of the screw and the occlusal design other important factors for the purposes of screw stability and abutment the position of the fixture and the precision, fit and rigidity of the prosthetic crown. The implantology's is therefore periodically engaged in tightening the clamping screws abutment; This procedure can be revealed, as well as long and expensive too counterproductive because it can lead to the application of an excessive force that can be to the basis of possible fractures of the vine itself. In addition, the screws, once they are loose, if they are been urged up to their limit of elasticity, they should be replaced, because, if reused at the same preload, they can stretch, causing reverse rotation, loosening or even breaking. Then the patient is not prompt, in case of unscrewing, in returning from the implantology's to the screwing the screw or rather replacing it, this way triggers one situation that exponentially increases the risk of fracture of the screw itself, because increase the radial and tangential components of the masticatory forces that effect on the screw/implant interface.

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