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MANAGEMENT AND PREVENTION OF COMPLICATIONS OF GUIDED BONE REGENERATION

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Abstract: *Guided bone regeneration using titanium-reinforced expanded teflon non-absorbable membranes (e-PTFE) has proven, through rigorous studies on many occasions, that it is a safe and predictable method to achieve bone growth at mandible and maxilla level, both vertically and horizontally. However, the technique itself is one that requires special operative skills and is not without postoperative complications. The purpose of this paper is to review most of these postoperative complications, their management and the key operative elements that help preventing them. Complications are presented both from the perspective of the meta-analysis performed from the present literature and from the point of view of the author's personal experience, personal casuistry being presented. This paper will discuss all this starting with the complications without negative impact on the bone regeneration such as, late exposure of the membrane and ending with the most serious ones, such as the suppuration of the augmented anatomical regions. All of these can be avoided or minimized by using a correct operating technique. In addition, once installed, we can minimize the negative effects on bone regeneration by a proper management applied at the right time.*

Guided bone regeneration was introduced by Dahlin in 1988, as a therapeutic method to achieve bone growth, using membranes as a cellular barrier. The concept of intentionally creating bone defects in order to observe bone growth was introduced 50 years ago by Murray and co-workers in 1957, when in the membranes of cellulose acetate used for nervous regeneration, the formation of bone tissue in experimental femoral defects in dogs was observed. In the maxillofacial area, in 1979, Kahnberg achieved guided bone growth in the rabbit jaw, using the same barrier membranes. All these experimental studies have shown that bone growth in a defect is much guided and accelerated, when by mechanical barriers, soft, epithelial tissue invasion is prevented.(1) Based on this, the concept of guided tissue regeneration (GTR) was introduced in the early 1980s, according to which a particular tissue can regenerate after tissue loss at this level, if the cells that form this tissue are preserved and protected to populate this lost space (Nyman et al., 1982; Gottlow et al., 1984).

This way, guided bone regeneration is based on the fundamental principle of guided tissue regeneration. Therefore, in a bone defect, we can have reparative bone growth, excluding other types of cells to invade the blood clot, letting only the possibility of osteogenic cells to populate the space.(1,2)

In the bone defects in which we want regeneration, the premises of the formation of this type of tissue must be created. For this reason, bone grafts have been suggested as vehicle-materials in this complicated process of osteogenesis. These materials managed to create obligatory conditions in osteogenesis: osteoconduction, osteoinduction, stability and maintaining the defect shape throughout osteogenesis.(2)

Depending on the type of defect, its size, topography and expectations, several types of barrier membranes are used; from those resorbable, made from collagen, polyglycolic acid or pericardium that are easy to apply but quite unpredictable and non-volatile in terms of stability, to non-resorbable ones (dense teflon, dense teflon reinforced with TI, expanded teflon, titan, latex meshes etc). In the case of non-absorbable membranes that require a second surgical removal time at 6-8 months, additional means can be used to maintain volume and preserve graft stability throughout the entire osteogenesis period: titanium pins, fixing screws, or spacing screws.(3,4)

Guided bone regeneration techniques are generally complicated, require special technical, manual skills, and experience in correctly choosing the cases that are suitable for this.(4)

Regardless of the choice made, all the studies show that in order to obtain mature bone, useful later in supporting the implants or in peridural reconstructions, the protective membranes should remain completely covered by the mucosa at least 6 months.(5)

Due to many local and general factors related to the type of membrane used, the covering technique, the suture, the manipulation and design of the flap, the stability of the graft, the tension present in the neighbouring tissues, asepsis compliance and the local-regional vascularization, these interventions probably have the highest percentage of complications of all dento-alveolar or periodontal surgeries.(5.6) Incidents of complications up to 45% are reported in the studies on bone regeneration Numerous ways have been tried to systematize these complications and to classify them, in order to be useful to

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professionals in detecting these complications in time in order to treat them.(6)

Classification of complications

Undoubtedly the most complex classification present in the literature is that of the department of periodontology of the faculty of dentistry in Milan, Italy, suggested by Filippo Fontana and Massimo Simion in 2011. They divide the complications into healing and surgical complications. Surgical complications can be divided into flap lesions, neuronal complications and vascular complications.(7,1)

Healing complications are further subdivided into four classes, taking into account the microbial invasion at the graft level and the early exposure of the barrier membrane.(8)

Surgical complications

Flap injuries are caused by mistakes in their handling, suturing, or prolonged ischemia to which they are exposed. These lesions usually materialize by developing areas of necrosis, at 48 hours, that can increase in size or be immediately limited. All these can be avoided through a series of intraoperative protocols (figure no. 1).(8)

Figure no. 3. Necrosis of the mucosal surface of a palatal flap used for connective tissue harvesting due to excessive thinning and accidental perforation. The evolution of its postoperative healing at 5 days, 7 days, respectively 14 days (Casuistry of Dr. Țânțar Cristian)

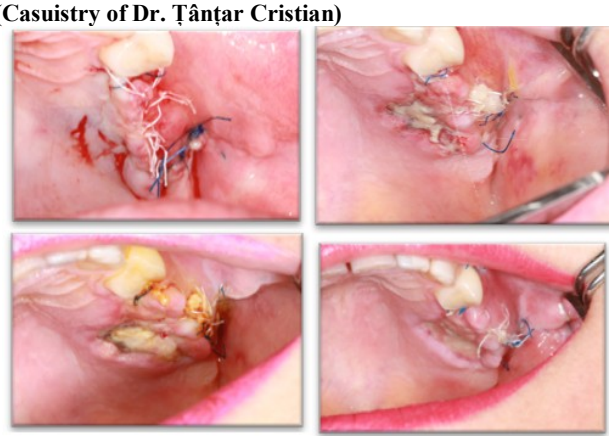
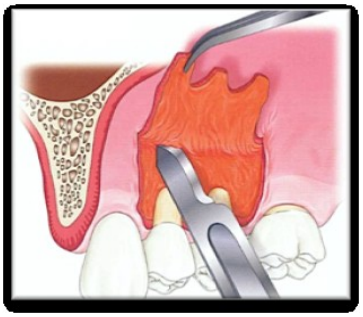


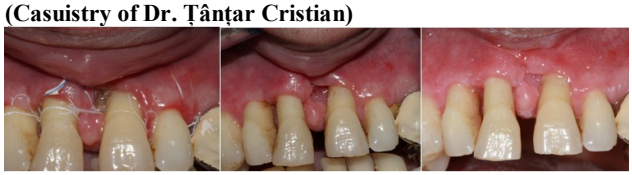
Figure no. 2. During the periosteal incisions of relaxation and de-tensioning of the flap, the periosteal vessels that are responsible for the local-regional vascularization can be injured



- periosteal incisions should be avoided without visual control of the nerve pack, which must be isolated in the wound. Their injury usually results in anesthesia, paresthesia or diastasis on the innervated territory.
- *Vascular complications* are frequently encountered and refer to damage to the vessels in the territory. As a result, post-surgical hematomas can be formed that will make healing very difficult and keep the flap in tension in the region of the bone graft, which will always lead to exposure of the membrane or graft. The most common hematomas are those of the sublingual or palatine space.
- in order to avoid these inconveniences, deperiostation and dissection should be done bluntly, with the help of detachers as gentle as possible.(10)
- regarding the healing complications, they are classified into four classes, as follows:

Class I. This class comprises situations in which the barrier membrane is exposed no more than 3 mm without showing purulent secretion. Studies show that expanded teflon membranes (Gore-Tex) withstand endo-oral bacterial invasion for about 4 weeks. After this period the bacteria can reach the level of bone graft. There are no solid studies on the dense teflon membrane, but this period is likely to increase greatly. Of major importance is the location of the exposure, related to the bone graft that covers it. The exposure with a favourable prognosis is the one in the middle of the graft. The closer to the edges of the membrane higher the risk of bacterial penetration under it (figure no. 3).

Figure no. 3. First-class complications. One can observe the exposure of the membrane in region 21 and its re-epithelialization after daily washing with antiseptic solutions (Casuistry of Dr. Țânțar Cristian)



Regarding resorbable membranes, things are different. They have a lower exposure rate but once exposed they are invaded bacterially immediately, the graft being immediately compromised.

Being considered a minor complication, simple instruction of the patient regarding brushing at this level and washing with 0.2% chlorhexidine twice a day can lead to a favourable prognosis. The membrane should not be removed sooner than 4-5 weeks. If the fenestration is on the edge of the membrane then a minor intervention can be done whereby only this portion can be suppressed by cutting, making it possible to cure and close the fenestration.(2)

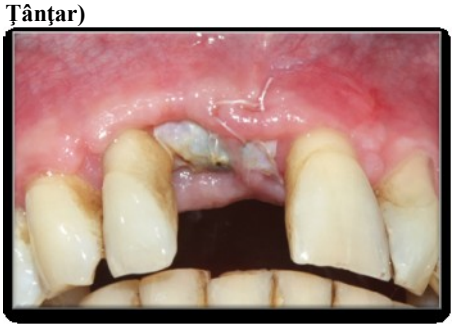
Class II is represented by exposures larger than 3mm without purulent secretion. In this case studies show that it would be ideal to remove the membrane as quickly as possible. From my personal experience, I can say that, however, the membrane should be left in place for at least 4 weeks, treated daily with antiseptic solution so that the grafted bone begins to vascularize sufficiently and to have bone regeneration at the end. After the surgical removal of the teflon membrane, the immature bone must be protected from any instrumental intervention and covered as best as possible with the covering mucosa for another 5 months, minimum.(2)

In ***Class III,*** all types of membrane exposures are taken into account but will always be associated with purulent secretion. The therapeutic protocol is the urgent removal of the membrane, of the bone graft, the careful curettage of the bony bed, the saline lavage and the re-formation of the mucosa. A period of 2-3 months must pass to reattempt any other bone regeneration intervention in that area. If, however, this complication appeared after 4 weeks and when the membrane is removed, a newly formed bone tissue is observed, the immature bone tissue is preserved, and the mucosa is carefully sutured over it.(11,2)

Class IV include the most severe complications that are characterized by the appearance of suppuration at the level of the bone graft without the flap showing dehiscence, with no

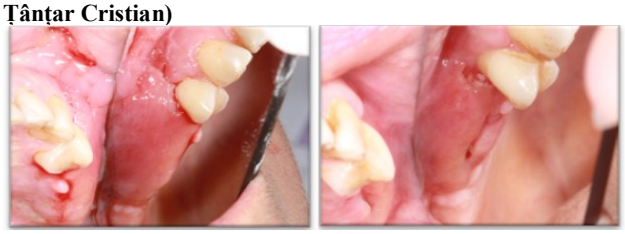
membrane exposure. Such complications usually occur in the first month after transplantation and are related to graft or membrane contamination usually during intraoperative handling. The therapeutic conduct is the same as in the case of the third class, with the addition of antibiotic therapy and careful post-operative control.(11,12)

Figure no. 3. Exposure of the membrane in the buccal cavity without showing signs of suppuration (Casuistry of Dr. Cristian Ţânţar)



Studies have shown that delaying the suppression of the osteosynthesis material can lead to the resorption of the preexisting basal bone (figure no. 4).(12,2)

Figure no. 4. Postoperative complication of the 4th class. The swelling of the tissues is noticed, as well as the appearance of the suppuration under the flap which is drained in the area of the mesial discharge, being more declive (Casuistry of Dr. Ţânţar Cristian)



Nowadays due to well-established surgical protocols, high-performance osteosynthesis materials and varied instrumentation, these complications can be minimized by observing certain fundamental principles, making guided bone regeneration a predictable task:

- any focal infection present on the target hemiarch; teeth with chronic periodontal processes (apical or marginal) or carious lesions should be cleared preoperatively,
- it is necessary to allow postextraction gingival tissue to heal in order to have a mucosa with a well-expressed and healthy texture,
- the rules and protocols regarding: the sterilization of the instrumentation, the fixing material and a perfect antisepis of the operative act must be strictly observed,
- the flaps should be created in such a way that they can completely cover the bone graft and the membrane to benefit from a rich vascularization during the healing period,
- the incisions of the flap should be located as far away as possible from the addition area,
- the deep incisions of the periosteum in order to relax the flap should be avoided because we interrupt the blood supply which is made largely through the periosteum vessels. More useful would be incisions closer to the end of the flap or if surgical skills allow, the indication would be the tunnelling, creating a space between the mucosa and periosteum located in the thickness of the connective tissue,
- it is compulsory to apply "tension-free" sutures to take over the tension from the terminal ends, which appears postoperatively due to edema in the first 3 days,
- the suture of the ends must be obligatory, double; suture in the inner mattress to keep the inner surfaces of the flaps in intimate contact and final suture at separate points,
- the post-operative check-ups and the training of maintaining the personal hygiene of the patient are considered mandatory in order to achieve the success of these types of interventions.

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