PRINCIPLES OF OVERDENTURE ON ONE-PIECE NARROW DENTAL IMPLANTS IN PATIENTS WITH DIFFERENT PATTERNS OF MANDIBULAR RIDGE RESORPTION

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PRINCIPLES OF OVERDENTURE ON ONE-PIECE NARROW DENTAL IMPLANTS IN PATIENTS WITH DIFFERENT PATTERNS OF MANDIBULAR RIDGE RESORPTION

(Abstract). **Aim:** To highlight the particularities of mandibular overdenture on one-piece narrow dental implants in patients with two frequent and high-difficulty clinical situations, namely flat alveolar ridge (also known as severe ridge resorption, when mainly vertical bone resorption occurs) and narrow alveolar ridge (which in its most severe form has a knife-edge appearance, when mainly horizontal bone resorption occurs). Narrow implant overdenture is a treatment alternative that responds well to the most important reason of patient dissatisfaction with conventional denture, namely its instability, through a relatively minimally invasive surgical intervention followed by relatively simple prosthetic procedures. To obtain a good outcome, particularization according to patient features, such as the morphology of the alveolar ridge is recommended. Deciding upon implant type, number, site, and attachment system should be made in accordance with such factors as bone offer and morphology of the alveolar ridge, edentulous and prosthetic status in the maxilla, prosthetic space, and the need to improve denture stability and retention. **Keywords:** DENTURE, MINI DENTAL IMPLANT, MANDIBULAR EDENTULOUS, FLAT RIDGE, NARROW RIDGE.

Complete mandibular edentulism is frequently treated by complete dentures, treatment option that often does not ensure a good outcome in terms of proper prosthesis stability and retention, and patient satisfaction. This is linked to objective factors, such as increased treatment difficulty due to the loss of all teeth and consequent ridge resorption, and subjective factors, as psychologically rejection of conventional complete denture due to associating it with aging and limitation of social functioning. According to current perspective, the new minimal treatment standard for mandibular complete edentulism is stated to be the two-conventional implant overdenture, treatment alternative that addresses the main deficiencies of complete denture (1-3). The usage of the narrow dental implants is beneficial especially in the aged edentulous patients, with unfavorable morphological conditions for the conventional or implant prosthetic rehabilitation (4, 5). This treatment option is well-adapted to the
older patients’ needs, as it addresses the main reason of dissatisfaction (increases prosthesis retention and stability), at moderate biological, financial and time costs, having also rather simple maintenance procedures and means of addressing possible complications (6).

The aim of this article was to highlight the particularities of mandibular overdenture on one-piece narrow dental implants in patients with two frequent and high-difficulty clinical situations, namely flat alveolar ridge (known also as severe ridge resorption, when mainly vertical bone resorption occurs) and narrow alveolar ridge (that in its most severe form has a knife-edge appearance, when mainly horizontal bone resorption occurs).

**General coordinates of treatment planning and conduct**

The following aspects are to be considered when planning for mandibular implant overdentures: accurate patient assessment, through anamnesis, clinical evaluation, panoramic radiographs, supplemented sometimes by lateral cephalometric radiographs and other investigations (7, 8); the number of narrow dental implants to be used, which vary, usually 2 to 4 implants being sufficient, a higher number being chosen when teeth or implant prosthesis are found in the maxilla, in younger patients (under 60 years), in those with a harder food diet, bruxism and a more obvious tendency to ridge resorption (fig.1); narrow dental implants sites, usually implants being placed in the interforaminal area, upon considering the bone density, width and height, and the prosthetic needs (a surgical template can be used for a more accurate localization of implant placement site); surgical technique of implant placement, by the usage of a flap technique (advantageous by the possibility to accurately evaluate bone width through direct assessment), or flapless technique (advantageous by the reduced invasiveness of the surgical procedure) (4, 9); loading protocol, which can be either an immediate loading protocol (i.e., immediate fixation of the metal rings in the overdenture base) or progressive loading protocol (i.e., soft lining materials were used as soft matrices during the osseointegration period); type of attachment system, which for one-piece narrow implants is usually O-Ring (e.g., miniSKY1 dental implants, Bredent; mini dental implants, IMTEC, later 3MESPE), some other variants being available (e.g., Locator, LODI implant system, Zest Anchors; magnet, Magfit, Aichi Steel Corporation)(10,11); overdenture design, which should aim to ensure adequate support, retention and stability, a complete coverage of the support area, in correspondence with the anatomical and functional borders, being usually preferred (a), should not exert pressure on the dental implants, when they are used only to increase retention, not for support (b), and should be made at correct intermaxillary relationship, providing a stable occlusion (c); previously made complete dentures can be either kept and transformed into overdentures (when considered satisfactory, this promoting a faster adjustment with the new treatment, aspect that should be considered especially in the elderly, known to have difficulty adapting to change, either preserved as interim prosthesis during the healing phase (when considered unsatisfactory, but not having severe deficiencies that may be risk factors for implant failure), either replaced before implant placement.
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One-piece narrow-dental implants for edentulous patient

Various types of dental implants can be used for implant overdenture, e.g. conventional or narrow, one-piece or two-piece design, for which different types of attachment systems are available. The one-piece narrow dental implants are mainly used in the completely edentulous elderly patients. Their narrow diameter is usually well-suited for them because of the severe bone loss and requiring minimally invasive surgical procedures. In this context, it should be mentioned that there isn’t a well-defined cut-off point for differentiating the mini-, from narrow-, from conventional-diameter dental implants. Generally, there are considered narrow implants those with a diameter below 3.75mm. Therefore, the 2.8 mm dental implants, as mini SKY 1, are included in either mini-, narrow-, or hybrid-dental implant category. The narrow dental implants are generally manufactured in different lengths (e.g., miniSKY1 is available in lengths of 10 mm, 12 mm and 14 mm, and MDI form 3M ESPE in lengths of 10 mm, 13 mm, 15 mm and 18 mm), suit-ing both vertical and horizontal ridge resorption. The one-piece design, usually encountered, has some advantages, among which is the possibility to verify the primary stability of the implants through horizontal percussion, or to easily address implant loss by placing another implant (not requiring major interventions or replacing the prosthesis). Also, the use of O-ring attachment system has the benefit to allow an implant divergence, less of 30 degrees. The usage of the implants mainly targets increasing prostheses’ retention and stability, and generally are not to be used for support.

Particularities of treatment conduct in patients with flat alveolar ridge

These patients usually have wider alveolar ridges that allow placement of larger diameter dental implants, but have a reduced bone height, which associates the need of use of shorter dental implants. This clinical situation is encountered more frequently in patients with the following characteristics: often old patients, with expectations mainly related to a solution for improving prosthesis retention by interventions that required minimal surgery, at moderate costs; patients complaining of poor denture retention and stability, and occasionally pain described as appearing under the dentures, main reason of dissatisfaction with conventional denture; many of them are long-time mandibular denture wearers, some of them having teeth or...
fixed conventional or implant prosthesis in the maxilla (these being risk factors for severe ridge resorption); usually eating a soft diet, motivated by the masticatory deficiencies related to the ill-fitting dentures; the attached mucosa occasionally presents alterations related to the long-period of denture wearing, as reduced thickness, it becoming painful under the pressure exerted by the denture; soft peripheral tissue may exhibit changes that increase treatment difficulty, such as: herniation of sublingual glands; displacement of muscle and ligaments attachments closely to the ridge crest; posterior position of tongue during rest position; tongue hyperactivity (that is related to patient’s functional particularities, prolonged wearing of ill-fitting dentures or involution phenomena); hypertonia and shortening of the lower lip orbicularis oris muscle that enhances mandibular denture instability; there can be encountered abnormal sagittal and horizontal ridge relationships, that can be related to factors such as the skeletal class, the pattern of the bone resorption of the jaws (centripetal in the maxilla, respectively centrifugal in the mandible) and the anterior hyperfunction syndrome (combination syndrome), all contributing to the facial appearance known as pseudo-skeletal class III facial appearance or the old man’s prognathism (12); these patients generally have oral conditions unfavorable to obtain a good denture retention, support and stability, with a high degree of treatment difficulty according to Prosthodontic Diagnostic Index (PDI) classification System of American College of Prosthodontists (ACP) (13), the usage of dental implants being considered appropriate in order to ensure an adequate functionality with the prosthesis.

Planning and conducting he treatment in these patients by narrow dental implant overdenture, without bone augmentation procedures, usually has the following pattern: a number between 2 and 4 narrow dental implants is usually sufficient; shorter dental implants of less than 12mm or 10 mm are frequently needed (14); dental implant placement site is in the inter foramin al region; in cases with severe ridge resorption, sometimes adequate bone quantity is found only nearby the mental symphysis, in these cases without bone augmentation the implant number being limited to 2 implants, placed in the most anterior part of the mandible (fig. 2); dental implants can be usually placed by a flapless technique; generally the bone density is assessed as being favorable in regard to ensuring a good primary stability for immediate implant loading; the vertical prosthetic space is generally sufficient for O-Ring attachment system, difficulties in this respect being encountered in patients with a hypodivergent class II skeletal pattern, in the context of the counter clock wise rotation of the mandible, that occurs in edentulous patients.

Fig. 2. In patients with severe ridge resorption, implants are placed more frequently closer to the mental symphysis
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**Particularities of treatment conduct in patients with narrow alveolar ridge**

These patients usually have unfavorable conditions for conventional denture and implant placement, due to the reduced width of alveolar bone and sometimes the sharp ridge crest, covered by a painful mucosa. Narrow dental implants are indicated especially in cases with narrow ridges, considering their diameter is well suited to bone width (at least 4 mm width). Narrow alveolar ridges are encountered more frequently in patients with the following characteristics: have more frequently a class II hypodivergent skeletal pattern, which associates tongue and lip muscle hyperactivity; are usually recent edentulous patients with low-density trabecular bone, and first time denture wearers; present to the dentist usually dissatisfied with denture instability and complaining about pain related to denture pressure; alveolar ridge morphology is usually high and thin, with a greater depth of the vestibular sulcus; different morphological aspects of the alveolar ridge are observed, characterized by the relatively frequent presence of cortical bone irregularities, such as exostosis, covered by thin mucosa, painful under pressure, which are linked to intolerance of conventional dentures; in previous wearers of ill-fitting dentures in which tooth loss is mainly linked to periodontal disease, there was rather often encountered flabby ridges and mucosal hyperplasia (12).

Planning and conducting edentulism rehabilitation in these patients by narrow dental implant overdenture has usually the following pattern: the number of implants is generally between 2 and 4 narrow dental implants, according to bone offer, the degree of overdenture retention needed and clinical situation on the opposite jaw (fig. 3); if the clinical situation requires, the number of implants can be increased later, after the stabilization of bone level after tooth extraction; implant scan usually have higher length, of more than 12 mm or 14 mm; implant diameter is usually smaller, corresponding to ridge width; more frequently the implants are placed by a flap technique, chosen in order to correct bone and mucosa alterations, and to adequately assess bone offer and the limits of implant placement (to prevent cortical perforation); progressive implant loading is usually preferred due to rather frequently encountered reduced bone density, for which soft silicone or acrylic materials may be used during the osseointegration period for amortization of occlusal forces or peri-implant soft tissue conditioning; the healing process is slower compared to the one of the patients with flat ridge considering that in these patients usually a flap technique is used for implant placement; the vertical prosthetic space may be decreased, in relation to the skeletal class, therefore implants with other type of attachment system (e.g., magnets) can be used; overdenture risk fracture is higher because of the reduced width and thickness of overdenture base, especially when there are placed more than

![Fig. 3. Patient with narrow mandibular ridge, with two implants placed for increasing denture’s retention](image-url)
two implants; dental implants are especially beneficial in recent edentulous patients with narrow ridges, through minimizing the bone resorption, which has the highest rate after tooth loss and is enhanced by ill-fitting dentures.

In both clinical situations, rehabilitation by recreating the correct intermaxillary relationship, with a stable occlusion, correct relationship of the implant with the overdenture base which should not exert pressure on the dental implants, as well as compliance with the recommendations after implant placement (as having a soft diet for the next following days, and maintain a good oral hygiene) are required.

CONCLUSIONS
We can conclude that narrow implant overdenture is as a treatment alternative that responds well to the most important reason of patient dissatisfaction with conventional prosthesis, namely the mandibular denture instability, through a relative minimal invasive surgical intervention followed by relatively simple prosthetic procedures. Aspects as accurate selection of narrow implant number and placement sites, correctness of overdenture execution, proper maintenance and monitoring are important prognostic factors. To obtain a good outcome, particularization according to patient features, such as the morphology of the alveolar ridge, is recommended. Deciding upon implant type, number, site, and attachment system should be made in accordance with factors as bone offer and morphology of the alveolar ridge, edentulous and prosthetic status in the maxilla, prosthetic space, and the need to improve denture’s stability. Prospective studies must be implemented to gain knowledge on best treatment coordinates for different clinical situations.

REFERENCES
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**NEWS**

**COULD CALCIUM HOLD THE KEY TO FIGHTING A DANGEROUS HOSPITAL INFECTION?**

*Clostridium difficile* (*C. difficile*) is an anaerobic gram-positive pathogen that is the leading cause of nosocomial bacterial infection globally. *C. difficile* infection (CDI) typically occurs after ingestion of infectious spores by a patient that has been treated with broad-spectrum antibiotics. While CDI is a toxin-mediated disease, transmission and pathogenesis are dependent on the ability to produce viable spores. These spores must become metabolically active (germinate) in order to cause disease. *C. difficile* spore germination occurs when spores encounter bile salts and other co-germinants within the small intestine, however, the germination signaling cascade is unclear. Here we describe a signaling role for Ca\(^{2+}\) during *C. difficile* spore germination and provide direct evidence that intestinal Ca\(^{2+}\) coordinates with bile salts to stimulate germination. Endogenous Ca\(^{2+}\) (released from within the spore) and a putative AAA+ ATPase, encoded by *Cd630_32980*, are both essential for taurocholate-glycine induced germination in the absence of exogenous Ca\(^{2+}\). However, environmental Ca\(^{2+}\) replaces glycine as a co-germinant and circumvents the need for endogenous Ca\(^{2+}\) fluxes. *Cd630_32980* is dispensable for colonization in a murine model of *C. difficile* infection and *ex vivo* germination in mouse ileal contents. Calcium-depletion of the ileal contents prevented mutant spore germination and reduced WT spore germination by 90%, indicating that Ca\(^{2+}\) present within the gastrointestinal tract plays a critical role in *C. difficile* germination, colonization, and pathogenesis. These data provide a biological mechanism that may explain why individuals with inefficient intestinal calcium absorption (*e.g.*, vitamin D deficiency, proton pump inhibitor use) are more prone to CDI and suggest that modulating free intestinal calcium is a potential strategy to curb the incidence of CDI (Travis J. Kochan, Madeline J. Somers, Alyssa M. Kaiser *et al*. Intestinal calcium and bile salts facilitate germination of Clostridium difficile spores. *PLOS Pathogens* 2017; 13(7): e1006443 DOI: 10.1371/journal.ppat.1006443).

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