Saucerization: a natural mechanism of peri-implant cervical adaptation

Abstract / *Cervical peri-implant bone saucerization, or simply saucerization, should be considered a morphological and functional adaptation of peri-implant cervical tissues. Humans are able to mimic nature. Osseointegrated implants imitate natural teeth, and are half inserted and half exposed. Peri-implant junctional epithelium takes the epidermal growth factor near neighboring bones which are reabsorbed in an inclined plane. This process is unavoidable and occurs regardless of implant design, type and commercial brand. Three-dimensionally, peri-implant cervical bone resembles a saucer and might be affected by surgery, the type of bone, implant design, occlusal load, time of use, sanitization and several other factors. Nevertheless, denying the process means ignoring some features of bone biopathology. All 206 human bones are round-shaped and, for this reason, do not allow straight angles at their borders and limits.*

Keywords: *Saucerization. Peri-implant cervical bone loss. Peri-implant cervical bone remodeling. Osseointegration.*

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INTRODUCTION: THE NAME!

Cervical peri-implant bone saucerization, or simply saucerization, is revealed by two-dimensional imaging examinations, such as radiography and tomographic slices, which evince that bone has acquired the shape of a saucer as a result of an inclined plane formed between the most cervical site touching the implant and the most occlusal site from the neighboring bone. Three-dimensional analysis of the cervical line in contact with the implant, the entire extension of the highest site and the occlusal surface from neighboring bones reveals an analogue image shaped as a saucer. The implant in the center is positioned as a cup (Fig 1).

The name given to a phenomenon or a given structure usually reveals its nature or origin and might imply judgment of value. If the aim is to grant saucerization a physiological connotation, we can refer to it as

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"Peri-implant Cervical Bone Remodeling". Nevertheless, if the aim is to grant this phenomenon a pathological nature, we can refer to it as "Peri-implant Cervical Bone Loss".

WHY DOES IT OCCUR?

The oral mucosa is attached to teeth by the junctional epithelium which has up to 30 cell layers connected by mechanisms and structures such as hemidesmosomes and a few adhering substances. The junctional epithelium has a higher number of cell layers in comparison to the oral mucosa. This might aim at providing greater attachment of the former to teeth, since a higher number of cell layers increases contact surface and provides a larger area for adhering mechanisms to act. This mechanism was described in the literature in 2010.[1] Once the

Figure 1. A saucer represents the tridimensional shape of peri-implant cervical bone subjected to saucerization around an osseointegrated implant which, in turn, is illustrated by a cup.

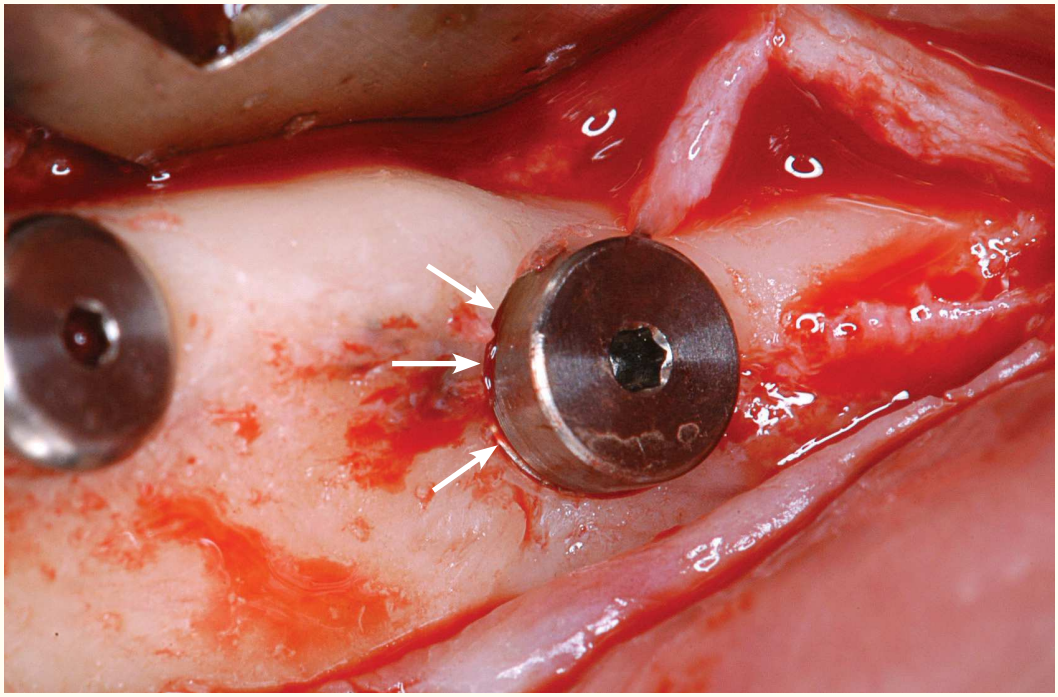

Figure 2. After implant placement, bone forms a right angle (arrows) which contradicts natural bone round anatomical shape: saucerization is a natural trend.

oral mucosa has been surgically prepared and receives an osseointegrated implant, bone is formed in an angle of approximately 90 degrees (Fig 2). Above that area, the oral mucosa along with the epithelium and the lamina propria/submucosa connective tissue is similar in thickness in comparison to neighboring tissues (10 to 15 layers) (Fig 3).

The amount of epidermal growth factor (EGF) greatly increases in saliva. The former maintains and/or speeds up continuous epithelial proliferation in order to preserve mucosa and skin despite ongoing desquamation.

Humans are able to mimic nature. Osseointegrated implants imitate natural teeth, and are half inserted and half exposed. Nevertheless, there is a need to increase mucosal attachment epithelium in the implant surface: Increased EGF in saliva allows epithelial proliferation to speed up and, as a result, produce peri-implant junctional epithelium (Fig 4).

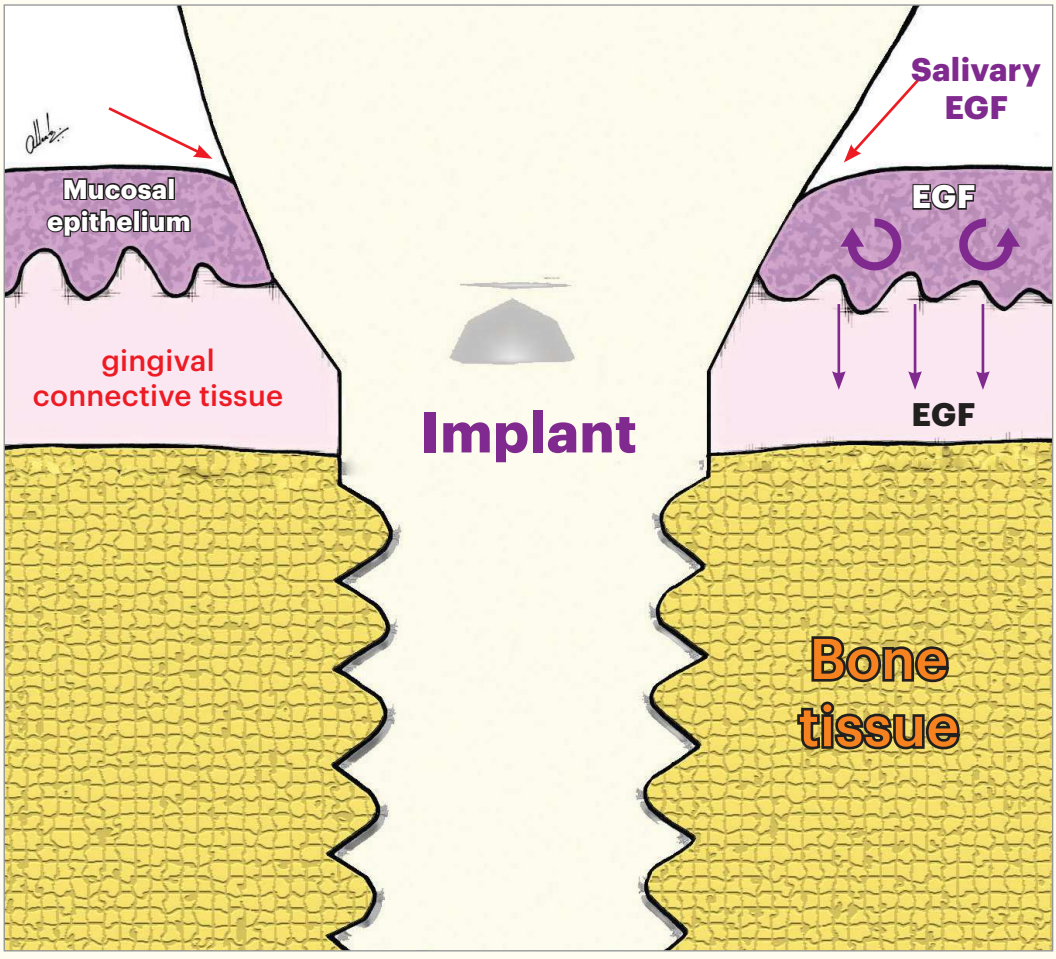

Figure 3. The oral mucosa is stimulated (arrows) by salivary and gingival EGF to proliferate and form peri-implant junctional epithelium and increase oral mucosa attachment as a result of increased thickness and a higher number of cell layers. EGF is partially radiated to gingival connective tissue.

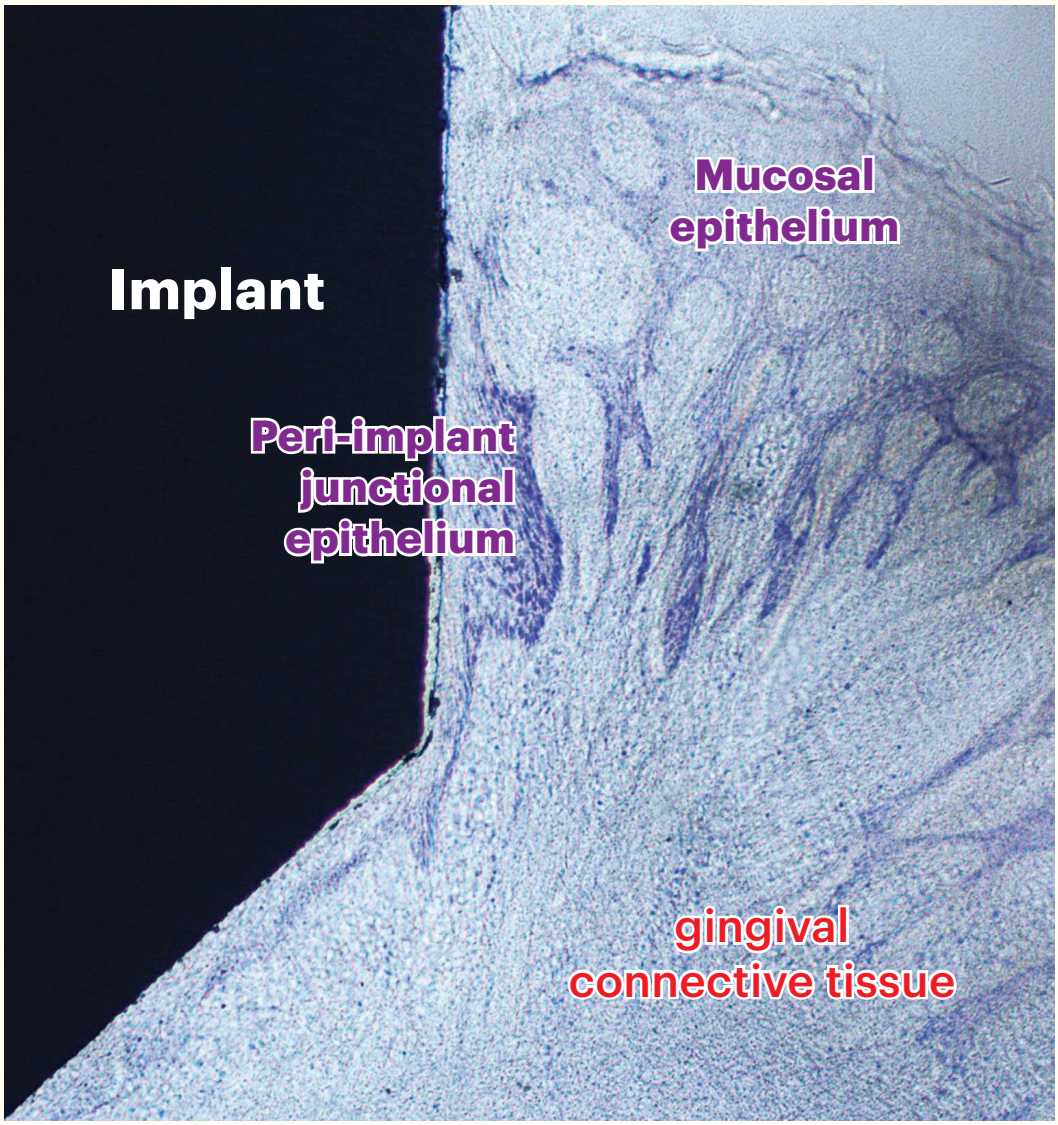

Figure 4. Peri-implant junctional epithelium in osseointegrated implant cervical surface[1] (toluidine blue, 40x).

Peri-implant junctional epithelium with 30 or more cell layers nearly reaches the right angle previously formed. Epithelial EGF molecules in subjacent connective tissue stimulate local bone resorption. As a result, bone surgically angled inevitably acquires a round shape (Fig 5). This process causes cervical peri-implant bone to acquire a tridimensional shape similar to a saucer. After a year, the condition becomes stable. Saucerization is a natural process in which cervical bone adapts to an osseointegrated implant regardless of its design, model or commercial brand.

The saucer-like shape of saucerized cervical bone — whether shallow or deep, open or closed — can be influenced by a number a factors, such as implant placement depth in relation to the bone surface. Further studies should be conducted to assess the determining factors of bone shape during saucerization,

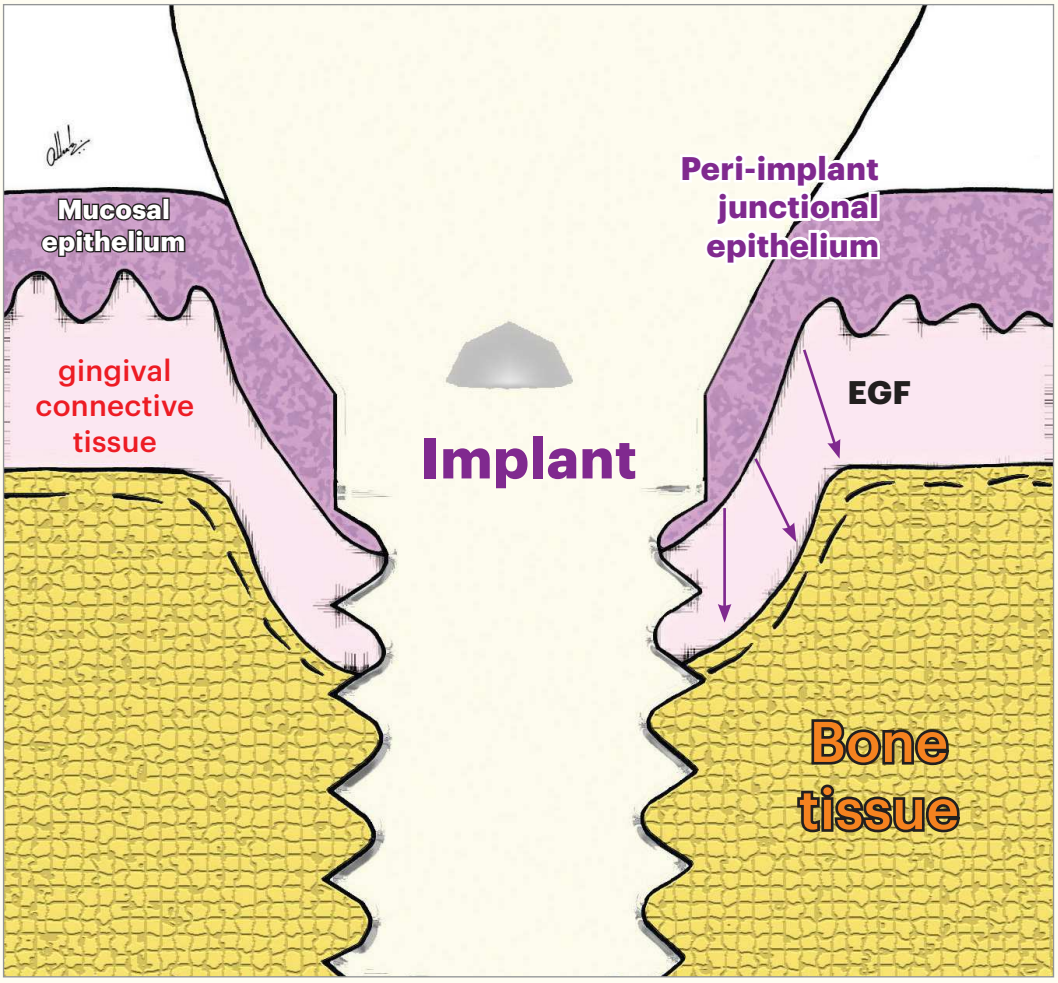

Figure 5. Peri-implant junctional epithelium releases EGF which radiates to gingival connective tissue and reaches subjacent bone, thereby promoting bone resorption and round-shaped surgical borders, or saucerization, during the first year of osseointegration.

a process that lasts one year. Also, the most convenient shape should also be assessed from a functional and esthetic standpoint.

SAUCERIZATION IS UNDENIABLE!

Disregarding or denying saucerization as a natural mechanism of peri-implant cervical adaptation means disregarding bone physiology and design. Out of the 206 bones that form the human body, none of them are in right angle. Bones are round by nature, since right angles injure cell structure and soft tissues. As a result, inflammation induces clasts to reabsorb angles and live or acute borders of bone surfaces.

Epithelial regeneration leads to junctional epithelium reproduction. Likewise, subjacent bone repair reproduces alveolar bone crest shape, of which cervical surface is round (Figs 6 and 7), by taking over the area

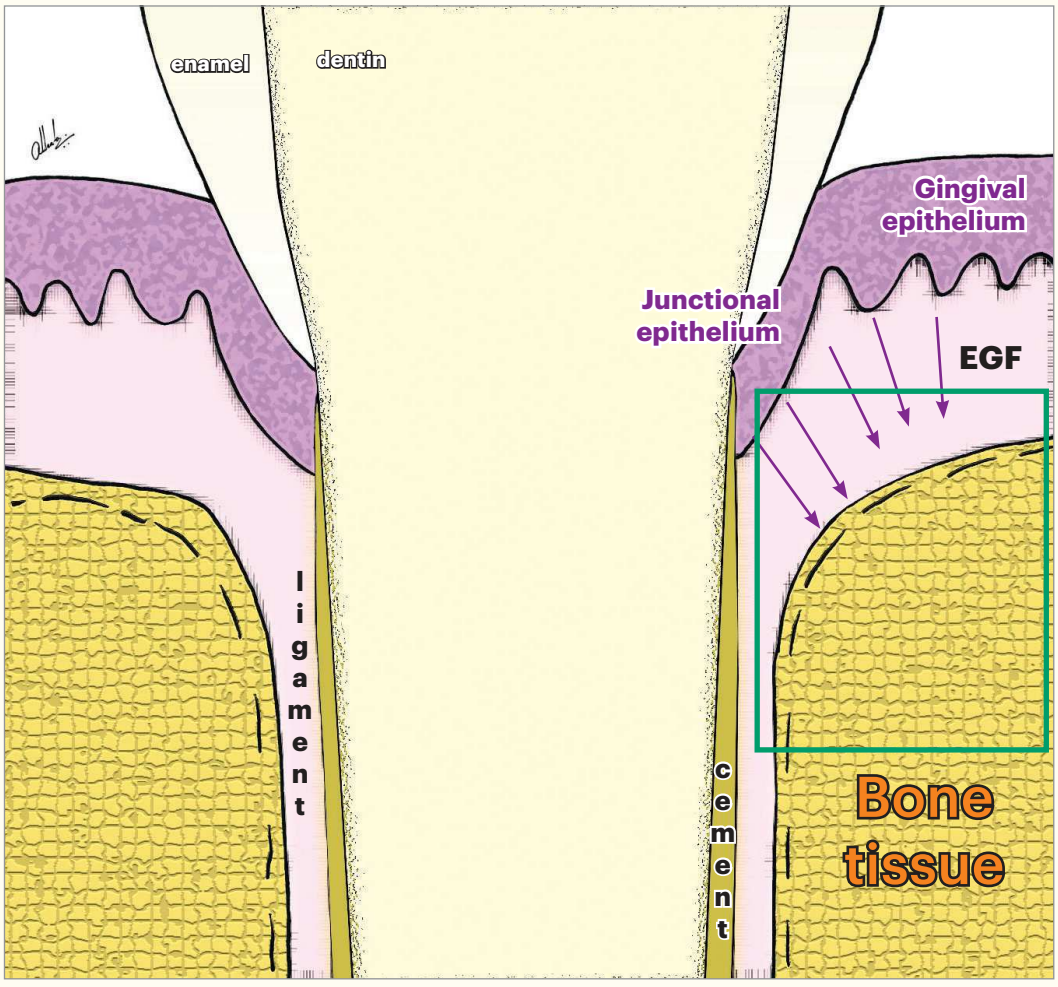

Figure 6. Cervical periodontal tooth structures are reproduced in osseointegrated implants as a result of round-shaped alveolar bone crests and peri-implant junctional epithelium.

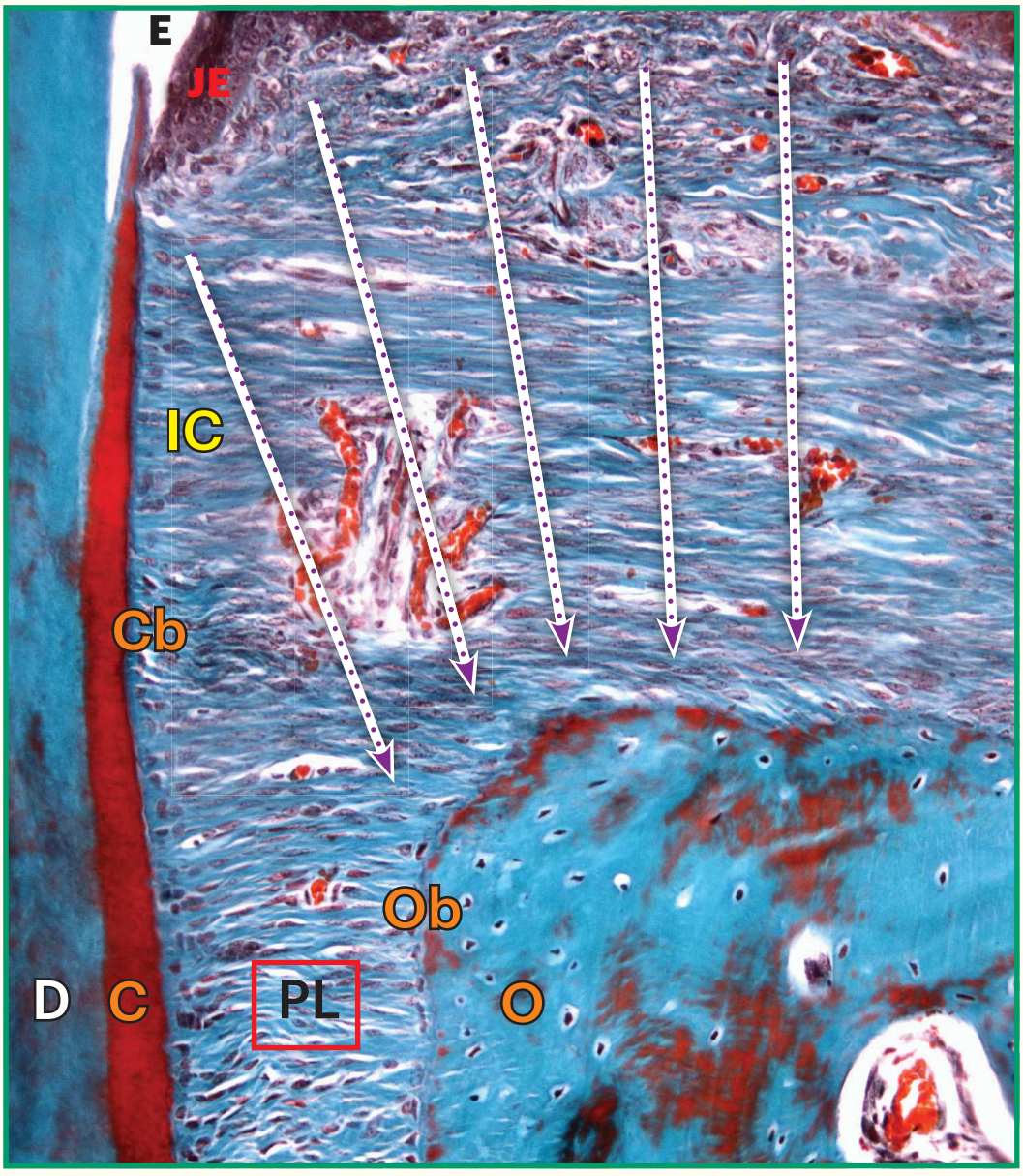

Figure 7. Round-shaped alveolar bone crest in harmony with junctional epithelium (JE) morphology and promoting ongoing EGF release, as illustrated by arrows (D = dentine; PL = periodontal ligament; O = alveolar bone; E = enamel; Ob = osteoblsts; TM, 10X).

surrounding peri-implant junctional epithelium.[2] Saucerization dimensions, shape and bone level might be subjected to question; however, overlooking the process by giving it a non-physiological nature implies looking down all aspects associated with bone biopathology.

BACTERIA AND OCCLUSAL LOADING

The oral mucosa is thinner than the junctional epithelium. Bacteria and by-products can penetrate the former more easily, but they do not. The epithelium is highly capable and counts on a number of mechanisms to prevent bacteria and by-products from entering, for instance, the gingiva; despite substantial amount of microbial biofilm such as bacterial plaque. In some cases, those mechanisms fail due to alterations, whether local and/or systemic. As a result, peri-implant mucositis and peri-implantitis arise.

Whenever implants are submerged, one's organism tends to reshape acute borders and right angles, surgically shaped for implant placement, as a result of bone formation over cervical limits by overlaying and embracing them into the structure. In these occasions, saucerization does not occur. Conversely, saucerization occurs with osseointegrated implants with or without occlusal loading. In other words, it occurs regardless of being in function, but whenever implants are exposed to the oral environment.

FINAL CONSIDERATIONS

Cervical peri-implant bone saucerization, or simply saucerization, should be considered as a morphological and functional adaptation of peri-implant cervical tissues. This process is unavoidable and occurs regardless of implant design, type and commercial brand. Three-dimensionally, peri-implant cervical bone might be affected by surgery, the type of bone, implant design, occlusal load, time of use, sanitization and several other factors. However, denying the process implies ignoring bone biopathology.

Some round-shaped implants, stable connections and platforms might affect saucerization, but not avoid it. Whenever bone tissue is subjected to live angling, it will inevitably become round-shaped and resemble a tridimensional saucer. Importantly, this applies to peri-implant cervical bone tissue.

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