Novel surgical approach

Snake technique in the treatment of posterior peri-implant soft-tissue defects

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Soft-tissue peri-implant defects (papillary loss, decrease of mucosal volume, gingival recession, dehiscence, alteration of the ridge colour) are common complications of implant treatment and affect the final aesthetic result and implant stability in the long term.[1,2] Many factors can influence the onset of peri-implant soft-tissue defects. Facial bone loss and thin biotype promote peri-implant recession,[3] and a soft-tissue thickness of less than 2 mm promotes peri-implant marginal bone loss.[4,5] The consequences are exposure of the implant and modification of the abutment–crown ratio. A combination of gingival recession and minimal keratinised mucosa leads to difficulties in plaque removal, inflammation and aesthetic complaints by patients.[6]

Soft-tissue grafting procedures in second-stage surgery are performed at immediate implantation sites for aesthetic reasons, papillary reconstruction, gain in width of keratinised mucosa, increase of mucosal volume and preservation of alveolar ridge contour.[7] The need for management of peri-implant soft-tissue defects is increasing, as immediate implantation is associated with peri-implant gingival recession as the result of the soft-tissue remodelling processes. Also, when implants are placed with no soft-tissue augmentation, peri-implant mucosa may become thin and greyish or may have altered texture due to scars if the flap was not properly managed.[8,9] Thin peri-implant mucosa (< 2 mm) may be transparent, and thus the implant or abutment may show through it.[10]

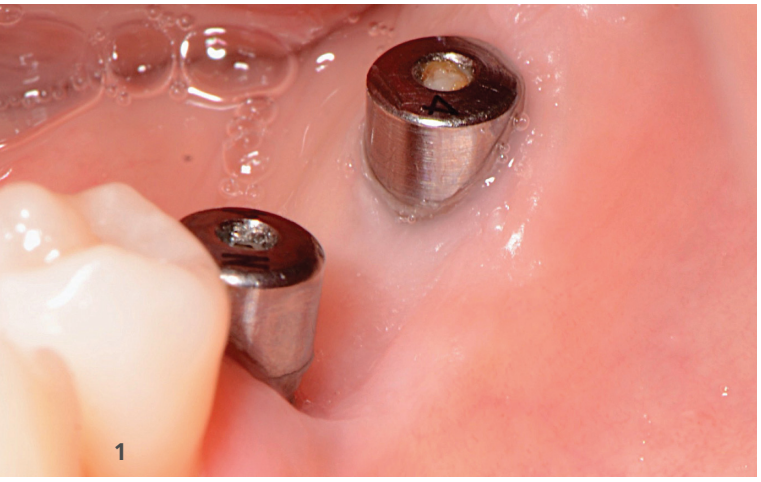
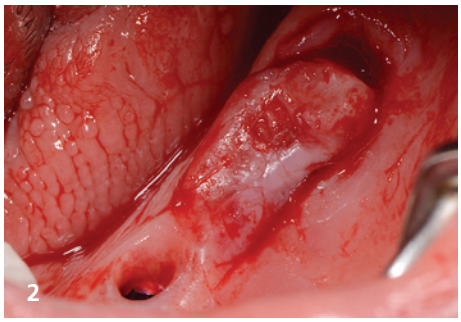
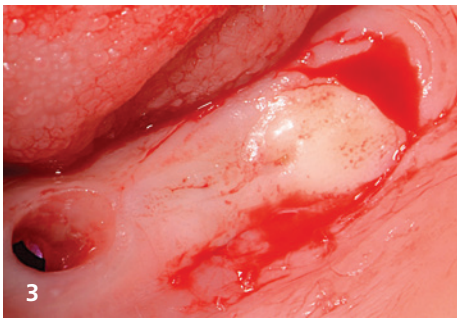
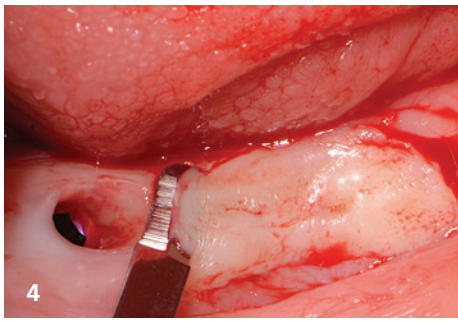


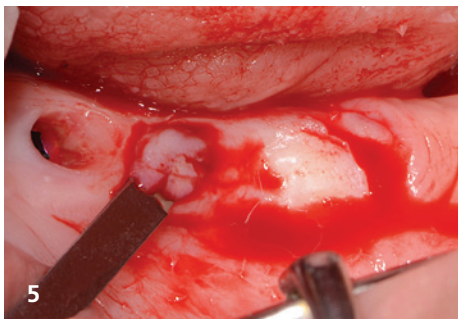
Fig. 1: Pre-op situation, showing the concave area between the implants favouring food retention and peri-implantitis.

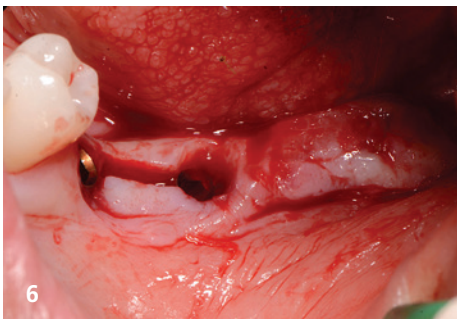
Various surgical techniques and a combination of surgical and prosthetic techniques have been described in the therapeutic management of the peri-implant soft-tissue defects. Arguments in favour of second-stage surgical interventions at the level of the peri-implant soft tissue are made in the literature. A review of the literature concluded that, when aesthetic demands are high or proper plaque control is not feasible, regeneration of keratinised mucosa is required in order to maintain the stability of the peri-implant soft tissue.[11] The design of the flap depends on the extent of the peri-implant gingival recession, vestibular depth, width of the attached gingiva and volume of the interproximal tissue.[1] A classic surgical approach uses apically or laterally positioned flaps at the time of implant exposure. These techniques are combined with a free gingival graft when the width of the keratinised mucosa over the alveolar ridge is minimal. An apically positioned flap or vestibuloplasty combined with a free gingival graft or subepithelial connective tissue graft is the best researched technique in soft peri-implant tissue grafting and has been reported to achieve gains in the width of keratinised mucosa of between 1.15 ± 0.81 mm and 2.57 ± 0.50 mm and partial coverage of the implant surface after peri-implant gingival recession.[12] The combination of an apically positioned flap with a collagen matrix, when used to increase the width of keratinised mucosa, has been found to result in less morbidity and surgery time, but to be as effective as the same technique combined with a free gingival graft.[13] Peri-implant soft-tissue conditioning using a free autologous epithelial graft has also been proposed in the management of supra-crestal and/or dehiscence-type defect morphology.[14] Techniques using autogenous grafts are significantly more effective in the increase of the peri-implant soft-tissue aesthetics and thickness compared with non-grafting techniques.[15,16]

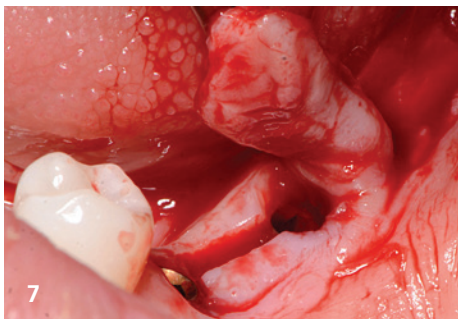


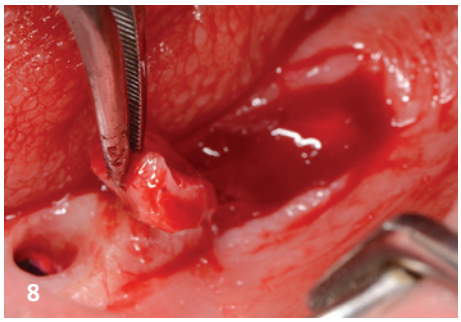


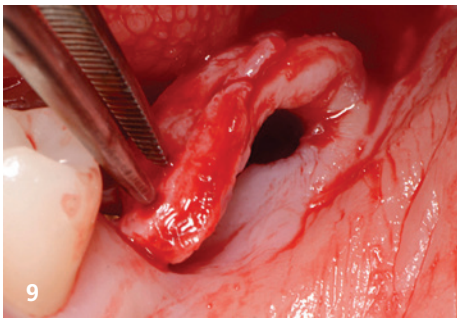


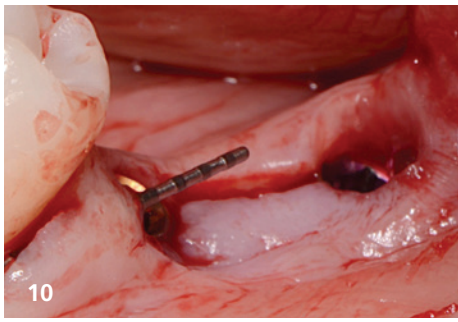








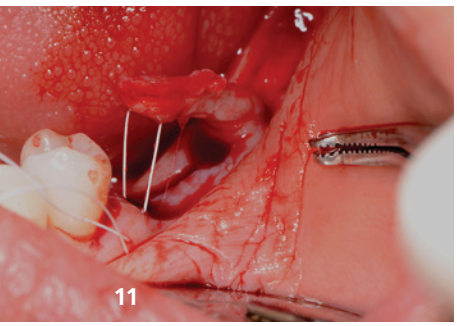


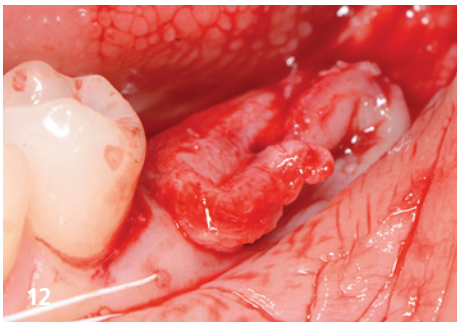


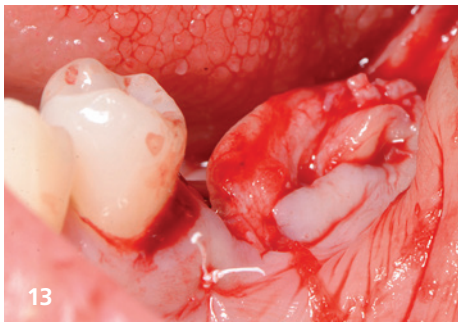
Figs. 2–5: Incising the flap edges and deepithelisation**. Figs. 6–9:** Partial thickness flap. **Fig. 10:** Pedicle gingival graft try-in.

A systematic review of the literature concluded that the use of autogenous grafts to increase mucosal thickness results in significantly less marginal bone loss in the long term and that the use of an apically positioned flap combined with an autogenous graft to increase the width of keratinised tissue improves bleeding on probing indices and marginal bone levels significantly.[17]

Despite the favourable outcome of the previously described techniques for conditioning of the peri-implant soft tissue, morbidity (because of the wound created at the palatal donor site), dynamic soft-tissue changes and the longer healing period must be considered. Also, although these techniques can resolve volume loss and shallow peri-implant recessions, they are less predictable in the management of deep or large peri-implant recessions and papillary loss.[1] These disadvantages can be overcome by epithelial or connective tissue pedicle flap techniques used with or without collagen matrices.[18,19] Pedicle flap techniques are a new minimally invasive surgical approach that can be performed at either a one-stage or two-stage surgery, in both anterior and posterior areas as well as at single and multiple adjacent implants.[18] Pedicle flap techniques are recommended especially in patients demanding retreatment of failed implants and edentulous patients receiving numerous implants that require soft-tissue conditioning with multiple connective grafts.[18] Pandolfi describes a modified flap design (omega roll envelope flap) that combines a roll flap with a modified pouch technique to correct localised horizontal alveolar ridge defects and to increase the peri-implant soft-tissue thickness.[20] This technique avoids harvesting autologous connective tissue from another donor site by using the supra-crestal connective tissue of the implant surgical site. Tabanella describes a buccal pedicle flap technique used in both anterior and posterior areas with a minimum of two adjacent implants.[18] The technique starts with a long lingual horizontal incision running slightly to the buccal side, followed by parasulcular incisions mesially and distally. The mucogingival junction is cut with a #15C blade to avoid flap perforation. The flap is positioned buccally and slight overlapping of tissue on the buccal side creates wrinkles of tissue that enable the increase of the mucosal volume. Moreno Rodriguez and Caffesse proposed a pedicle flap technique (laterally rotated flap) for the treatment of peri-implant defects.[21] The technique involves the creation of a buccal mesial and apical recipient area around each implant and rotating of a pedicle keratinised tissue flap by 90°







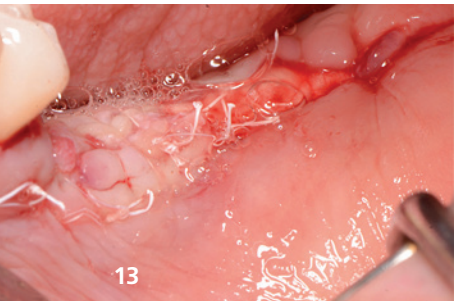


Fig. 11: Snake flap (suture at distal side). **Fig. 12:** Graft fixed on the mesial side with PTFE suture thread. **Fig. 13:** Graft rolled inside the gingival margins. **Fig. 14:** Immediate post-op situation, the final suture pressing on the flap to eliminate dead space. **Fig. 15:** Situation ten days post-op, showing excellent healing of the donor and receiving sites.

from the distopalatal and its positioning and suturing on the peri-implant buccal side.[21,22]

The objective of this paper is to present a novel surgical approach, the Snake modified pedicle flap technique, to peri-implant soft-tissue conditioning around loaded osseointegrated dental implants in the mandibular posterior area.

Case description

A 47-year-old patient presented with a severely resorbed mandibular posterior alveolar ridge due to molar extractions (Fig. 1). The patient was diagnosed with two posterior sites with peri-implant gingival recession and minimal keratinised tissue (< 1 mm). Peri-implant soft-tissue conditioning was performed four months after the initial implant surgery.

Surgical technique

Anaesthesia was performed in the surgical area with articaine and 1:100,000 adrenaline. The recipient site was prepared by sharp dissection in order to create a periosteal bed free of any muscle attachment. Two crestal parallel incisions were made on the distal area of the implants with a #15C blade and connected by a horizontal incision (Figs. 2–5). The extension of the incisions towards the crestal area and the distance between them depend on the amount of keratinised tissue grafting required for each case. The deepithelisation of the flap was performed with a #15C blade (Fig. 6). A partial thickness flap was raised (Fig. 7). The flap was released apically by inner superficial incision to allow passive displacement and suturing without tension. It was mesially displaced with a 180° rotation (Figs. 8 & 9). The mesial papilla was prepared for grafting with the tunnelling technique (Fig. 10). The resulting flap was sutured to the recipient bed at the base of the newly created vestibule with #5/0 non-resorbable PTFE suture thread (Coreflon, IMPLACORE). The graft was rolled inside the gingival margins and was fixed to the mesial side with PTFE sutures (Figs. 11–14).

The patient was instructed to rinse twice daily with a 0.12% chlorhexidine mouthrinse for two weeks. Anti-inflammatory therapy (400 mg of ibuprofen every eight hours) was prescribed for three days. The patient reported no discomfort or postoperative pain. The patient was further recommended to rinse with a 0.2% chlorhexidine mouthrinse twice a day for four weeks and to avoid mechanical hygiene on the operated area. The sutures were removed one week later. Excellent healing of the donor and receiving sites was noted at ten days postoperatively (Figs. 15 & 16). Control visits were scheduled at two and four weeks thereafter, followed by visits at three, six and 12 months, and every six months afterwards for five years (Figs. 17–20). After each control visit, professional maintenance procedures were performed at the surgical area.

Clinical measurements

Peri-implant probing depth was measured at the midpoint of the interproximal side, taking the highest value from the soft-tissue margin to the bottom of the peri-implant sulcus. The buccal thickness of the peri-implant mucosa was measured with an ISO #15 endodontic file at 2 mm from the soft-tissue margins mesial, distal and medial to the implant platform (reference point). The keratinised mucosa was measured with a periodontal probe between baseline and follow-up. The measurements were taken vertically from the implant platform to the free gingival margin at the mid-buccal point. The records were per-

Fig. 16: Clinical aspect of the peri-implant soft-tissue area after loading of the definitive restorations. **Fig. 17:** Clinical aspect of the peri-implant soft-tissue area at one-year follow-up. **Fig. 18:** Clinical aspect of the peri-implant soft-tissue area at two-year follow-up. **Fig. 19:** Clinical aspect of the peri-implant soft-tissue area at five-year follow-up.

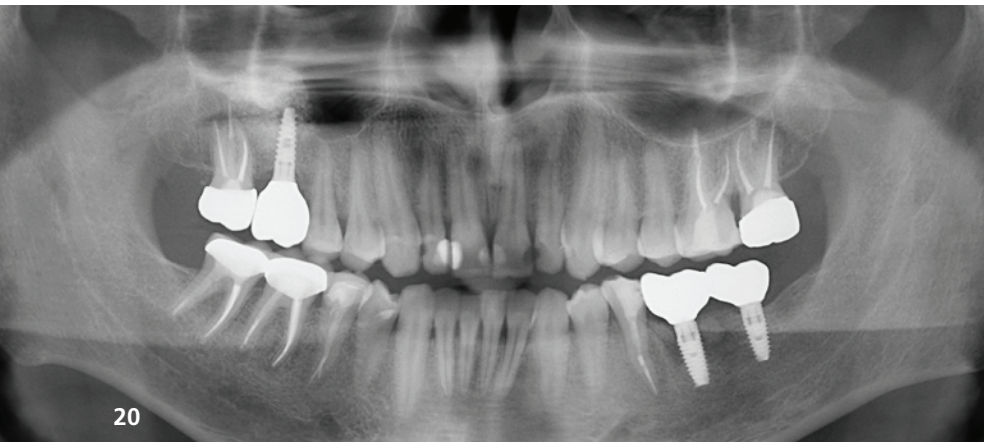
formed preoperatively, immediately postoperatively and at four weeks and one and two years postoperatively. The clinical parameters (width of keratinised mucosa, mucosal volume and recession coverage) were recorded at baseline and at follow-up intervals. At baseline, the width of keratinised mucosa was minimal (1 mm). The gain in width of keratinised mucosa was 2 mm at four weeks, 3 mm at one year and 4 mm at five years postoperatively. The gain in mucosal volume was 3 mm at four weeks, 4 mm at one year and 5 mm at five years postoperatively. The recession coverage was 100% at four weeks, 100% at one year and 100% at five years postoperatively.

Discussion

Research has focused on the health of the peri-implant soft tissue because of the importance of adequate width of keratinised mucosa and adequate mucosal thickness in the prevention of biological complications and crestal bone loss.[4,5] Also, non-mobile attached tissue is necessary to preserve transmucosal components of peri-implant tissue, thus avoiding peri-implant inflammation and biological complications, as well as preserving the peri-implant marginal bone.[24,25] Peri-implant soft-tissue conditioning techniques are recommended in clinical cases with factors that may alter good prognosis of the soft-tissue stability and implant coverage (convex prosthesis–abutment contour, thin mucosa, distance from the implant platform to the bone crest of >3 mm, interproximal tissue loss, implant positioned outside the bony envelope).[1]

There is limited scientific evidence regarding the treatment of peri-implant soft-tissue defects.[1] Gains in width of keratinised mucosa were reported by a systematic review that analysed the results of an apically positioned partial thickness flap combined with a free gingival graft, a subepithelial connective tissue graft or xenogeneic grafting material.[12] The same systematic review reported mean rates of between 28.0 and 96.3% for coverage of the soft-tissue recession when a coronally advanced flap was combined with a subepithelial connective tissue graft or allogenic grafting materials or a partial thickness flap was combined with a subepithelial connective tissue graft.[12] Despite the predictability of the classic apically or laterally positioned flap technique (combined with epithelialised soft tissue), recession due to graft contraction, wound stability failure or graft necrosis was reported.[17] Also, techniques that also use a connective tissue graft or collagen matrix can result in the creation of a mobile peri-implant mucosa that will hinder the stability of the peri-implant soft tissue and will promote biological complications.[26]

Considering the invasive character and the morbidity of the classic soft-tissue conditioning techniques, variants of the pedicle flap technique have been proposed for different clinical situations, mostly supported by schematic illustrations and clinical case reports.[18,20–22] Moreno Rodríguez et al. combined their clinical case report with a pilot study.[22] The test group included subjects with partial or complete maxillary implant rehabilitation, buccal soft-tissue defects (absence of keratinised tissue or a soft-tissue width or thickness of < 2 mm) around an osseointegrated implant, hard-tissue dehiscence at buccal level, transparency of the underlying implant surface on the buccal side, and plaque and bleeding indices of less than 30%. The researchers reported a mean 1.37 mm gain in clinical peri-implant buccal attachment, a 3.06 mm gain in soft-tissue thickness and a 4.69 mm gain in width of keratinised mucosa. They also reported the maintenance of the stability of the peri-implant soft tissue for a mean period of 13.50 ± 1.87 months (range of 12.00–18.00 months). Also, other researchers have used pedicle flap techniques in patients with a keratinised soft-tissue thickness and width of less than 2 mm on the buccal side and reported increases of the attached soft tissue and gains of over 2 mm in buccal mucosal thickness and keratinised tissue width.[18,20] Considering the outcome in the short and medium term, one study reported the improvement in width of keratinised mucosa and mucosal volume in the first three months but a 42.4% shrinkage at 12 months.[14]



Figs. 20–22: Pictures from 2017, 2019 and 2022.

Systematic reviews of the literature have found insufficient data to provide recommendations regarding the ideal technique, flap design or graft to be used in the conditioning of the peri-implant soft tissue in relation to the type of peri-implant defect and targeted therapeutic goals (gain in width of keratinised or attached mucosa and in mucosal thickness).[15–17,27]

The Snake technique was born from the desire to offer patients the least invasive technique in the treatment of vulnerable, thin peri-implant soft tissue. I have always thought of both the treatment plan and the treatment as if I were the patient, and if I were the patient, I would like to benefit from a complex treatment in a single surgical session without pain and with very fast postoperative healing. The Snake technique has exactly these advantages, and it has the further advantage of creating only one wound, rather

than two. Seeing the amount of quality keratinised tissue in the vicinity of the area to be augmented, I wondered why I would graft from the palate when I could use tissue from the immediate area requiring augmentation. Moreover, whereas a gingival graft harvested from the palate completely interrupts vascularisation, the Snake graft is permanently vascularised, which significantly reduces the risk of necrosis.

The distal donor area from where the flap is elevated ensures the availability of keratinised tissue and provides the quality of the connective tissue graft according to the need of the receiving area.[28] The 180° rotation of the flap supports the mobility of the flap without reducing muscle freedom and vestibular depth and while maintaining the blood supply in the mesial peri-implant area.[22] A partial thickness flap ensures the flexibility that supports the gain in mucosal volume. Also, it avoids the formation of peri-implant pseudo-pockets that could favour the growth of pathogenic bacteria.[18]

The patient had mobile peri-implant soft tissue, a width of keratinised tissue of less than 1 mm and mucosal thickness of less than 2 mm. The soft-tissue margin was at the level of the implant platform. The use of this technique resulted in significant improvements in peri-implant soft-tissue quality, and the attached keratinised tissue gain was 4 mm. The rotated flap employed in the Snake technique has the benefits of a free keratinised mucosa graft, increasing the width of the peri-implant buccal mucosa. It also ensures high blood supply and stability of the pedicle flap, resulting in less shrinkage over time compared with a free soft-tissue graft.[29]

Conclusion

Complete rehabilitation of the peri-implant soft-tissue defects can be successfully achieved using grafting procedures at second-stage surgery. The proposed Snake modified pedicle flap technique improved status of the soft tissue around dental implants considering the gains of width and thickness at one, two and five years postoperatively. The benefits are as follows: no need for a second wound, graft stability, better vascularisation, absence of necrosis risk, faster healing of both donor and receiving sites, and no additonal pain or discomfort. Randomised controlled studies with long-term follow-ups are necessary to validate the long-term predictability of this surgical technique.

About …

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graduated in dentistry from the Carol Davila University of Medicine and Pharmacy in Bucharest in Romania in 2001, was certified in implantology in 2004 and completed his PhD in surgery on the topic of bone regeneration around implants in 2019. He is the managing director of the Dental Progress clinic in Bucharest. Besides the Snake technique, he has invented the periosteal membrane surgical technique for bone augmentation. Dr Dima is cofounder and educational director of the Digital Dentistry Society in Romania and a member of the Society of Esthetic Dentistry in Romania, European Society of Cosmetic Dentistry and International Congress of Oral Implantologists. In 2020, he received the World's Top 100 Doctor in Dentistry lifetime achievement award from the Global Summits Institute.

Literature

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