

# Peri-implant Keratinized Mucosa—Necessity, Surgical Technique and Healing

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## Necessity

Today, the need for peri-implant keratinized tissue is still questionable. The issue could be answered by considering the periodontal scientific knowledge. Long term studies made obvious that a minimum of keratinized tissue around teeth is not required to maintain periodontal health, clinically.<sup>1-4</sup>

However, the periimplant mucosa is different to the supraalveolar tissue around teeth. The amount of collagen is higher and less fibroblasts are present<sup>5</sup>, and the tissue structure is more similar to scar tissue.<sup>5</sup> The organisation of the collagen fibres is different, too. Periimplant fibres don't insert in smooth implant/abutment surfaces, instead they run parallel.<sup>5</sup> Blood supply, i.e. vessels are more pronounced around teeth and therefore the peri-implant immune defense might be compromised.<sup>6</sup> Non-keratinized mucosa has

a different structure with less collagen fibres and dominating elastic fibres, which is the reason for its mobility.<sup>7,8</sup>

A main difference to teeth is the fact, that implant placement itself is a mucogingival surgical procedure, i.e. the character of the surrounding tissues can be created during implant placement or second stage surgery without an additional surgical intervention.

In an early histologic study Schroeder showed that implants placed in fixed mucosa result in healthy soft tissue conditions, 6–20 months after implantation of hollow-cylinder implants in monkeys.<sup>9</sup> However, keratinized mucosa as well as non-keratinized mucosa is capable to defense reaction against bacterial attack.<sup>10</sup> Wennström analysed the influence of the soft tissue character to the condition of the periimplant tissues. There was no difference in plaque accumulation and

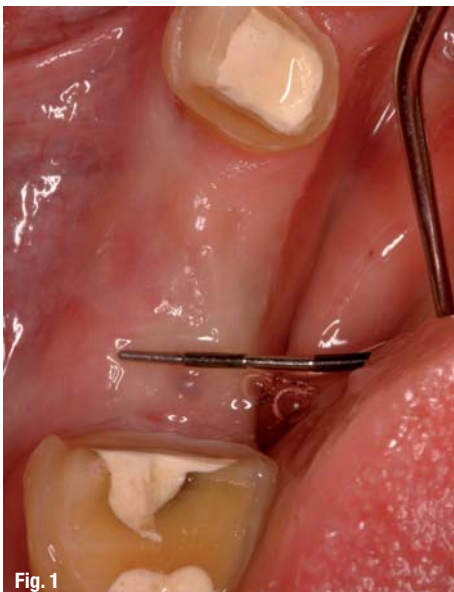


Fig. 1

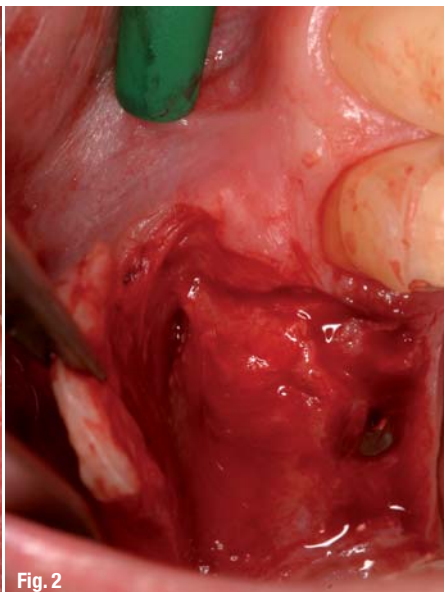


Fig. 2



Fig. 3

peri-implant health between a keratinized mucosa width of < 2mm and > 2mm.<sup>11</sup> Several other authors report from healthy situations without keratinized mucosa around implants, too.<sup>12,13</sup>

However, Chung and coworkers showed statistical significant differences in plaque accumulation and gingival inflammation when comparing implants with < 2mm keratinized mucosa and implants surrounded with > 2mm keratinized mucosa. The annual bone loss was more pronounced in the group with less than 2mm keratinized mucosa.<sup>14</sup> A correlation between keratinized mucosa and implant loss was established, too. In a study of 443 implants, 2.9% implant loss (97.1% success rate) occurred in the group of implants surrounded with keratinized mucosa, while 29.5% implant loss (70.5% success rate) occurred in the group of implants without keratinized mucosa.<sup>15</sup>

Studies are confirming significant more bone loss and inflammation<sup>16</sup> as well as a higher susceptibility to inflammation without keratinized mucosa.<sup>17-21</sup> This position is supported by several authors.<sup>11, 20, 22-31</sup>

Summarized, there is a higher risk for plaque accumulation, inflammation, and periimplantitis without keratinized tissue. If a perfect oral hygiene is established, non-keratinized mucosa might be maintained healthy.<sup>25</sup> This explains the good results in studies mentioned above, concluding periimplant stability

without keratinized tissue. However, a long lasting ideal oral hygiene can not be guaranteed for every patient and maybe compromised due to general diseases later. Therefore it is recommended to create keratinized tissue of at least 2 mm. Beside the functional aspect, keratinized tissue is esthetically more appealing.<sup>32</sup>

### Surgical techniques

Basically, two different approaches are used to create keratinized mucosa around implants.<sup>33-35</sup> Depending on the amount of missing keratinized tissue, apically repositioned flaps (Figs. 1-3) or free gingival grafts (Figs. 4-6) are the procedures of choice. Considering both techniques, free gingival grafts are more predictable. However, healing of the donor site is often uncomfortable for the patient. Besides, color match of tissue taken from the palate and the recipient bed is critical. A combination of an apical repositioned flap with a free gingival graft is also shown.<sup>34</sup>

### Healing

The healing of free gingival grafts was discovered in histologic and clinical observations. After fixation of the graft on the recipient bed it is solely dependent upon diffusion from its host bed, this occurs most efficiently through the fibrin clot.<sup>36</sup> At the first day, cap-

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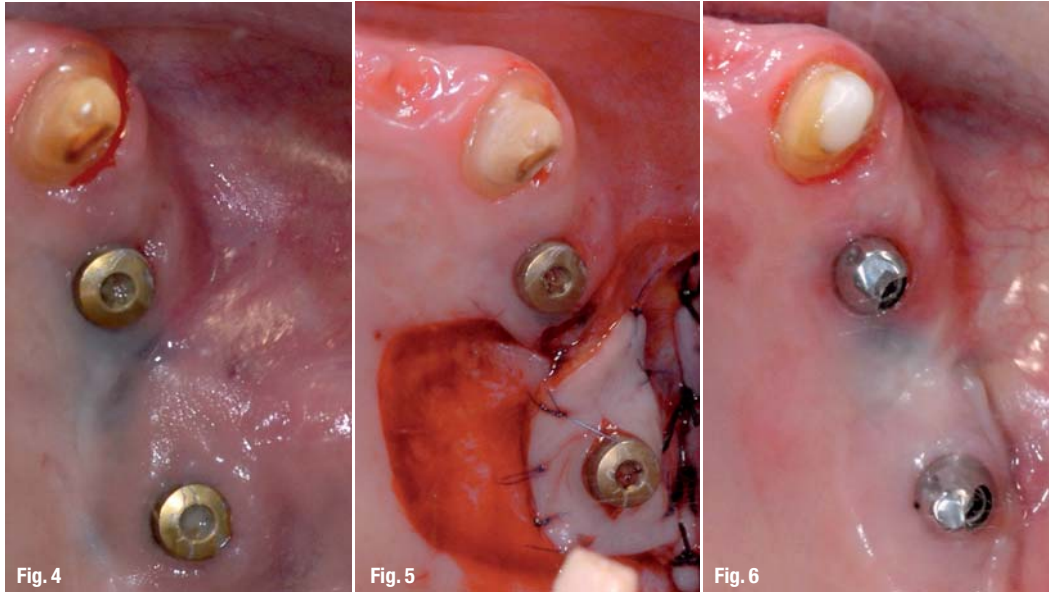


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illary proliferation begins. Between second and third day, some capillaries have extended into the graft.<sup>36</sup> An adequate blood supply appears to be present about the eighth day.<sup>37</sup> A connective tissue union between the graft and its bed begins around the fourth day and is complete by the tenth day.<sup>38</sup> If the graft is placed on a strong bleeding recipient bed or no adequate application of pressure is allowed after surgery, a hematoma will form. This will separate the graft from its bed and the risk for necrosis will increase, since neither rapid capillary penetration nor nutriment diffusion can occur through the hematoma.<sup>39</sup> Therefore, pressure against the graft for five minutes is recommended after surgery.<sup>38</sup> When transplanted, a diffusion system will maintain the graft for approximately three days until circulation is restored.<sup>36</sup> The thinner graft can be easily maintained by diffusion and is easier to vascularize. The thicker graft shows more desquamation, its vascularization is delayed and necrosis occurs. A graft properly immobilized on the nonbleeding, rigid recipient bed will undergo rapid vascularization.<sup>38</sup> In contrast, if the graft is mobile, the ingrowing capillaries will be torn. This tearing results in bleeding and hematoma formation.<sup>40</sup> To support adaptation and immobilization a crossing suture over the entire transplant must be placed. In suturing, the graft is stretched to conform to the recipient bed. This tension counteracts primary contraction and aids vascularization by reopening the grafts collapsed vessels.<sup>37</sup> It appears that ten weeks is a sufficient time for complete histological healing of a graft of intermediate thickness (0.75 mm), but 16 weeks may not be long enough for complete healing of a thick graft (1.75 mm).<sup>41</sup> The shrinkage of the free gingival graft is about 24%.<sup>42</sup> Rateitschak et al observed patients over 4 years, finding that graft shrinkage occurred during the first 30 days and then remained constant.<sup>43</sup>

Healing of the donor site is characterized by epithelialisation and regeneration of the connective tissue. Farnoush wrote that the healing process proceeds by secondary intention and that reepithelialisation takes about 2–4 weeks, depending on the wound size and surgical technique.<sup>44</sup> The application of hemostatic agents can accelerate wound healing. The placement of oxidized regenerated cellulose over the wound exhibited complete healing after 21 days.<sup>42</sup> Healing and regeneration of the underlying connective tissue will take at least 9 weeks.<sup>45,46</sup>

### Conclusion

Due to a possible decrease in oral hygiene and the fact, that implant placement itself includes peri-implant mucogingival surgery keratinized tissue must be created around implants. The appropriate surgical technique depends on the residual amount of keratinized mucosa. Small-sized dimensions can be generated by an apical repositioned flap while a large dimension will be established with a free gingival graft. A complete healing of a free gingival graft can be expected after approximately 12 weeks.

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