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Changes in Supracrestal Gingival Thickness using Porcine Collagen Matrix: A Retrospective Study
이종 콜라겐 매트릭스를 이용한 임플란트 상방 치은두께의 후향적 평가

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This study is a retrospective study evaluating the effect of porcine collagen matrix grafting on peri-implant gingival augmentation. Five patients (a total of 6 sites) who underwent implant surgery were included. The gingival thickness was measured and compared before and 4 months after surgery. As a result, the mean gingival thickness increased from 1.75 ± 0.25 mm to 3.83 ± 0.47 mm, with a mean increase of 2.08 ± 0.45 mm. This suggests that porcine collagen matrix grafting is an effective method for increasing gingival thickness around implants. Further study is needed to compare changes in gingival thickness according to the timing of grafting, and to evaluate the stability of the increased gingival thickness through long-term follow-up with more cases. *(J Korean Acad Esthet Dent 2024;33(1):11-16)*

Key words: Dental Implants; subperiosteal; collagen matrix, peri-implant

Introduction

Recently, there has been increased interest in the soft tissue beyond the hard tissue around implants. Various studies have been conducted on implants according to the width of the soft tissue around them, and evidence has emerged for the influence of soft tissue width. Although the focus has been on the width of keratinized gingiva, similar to keratinized mucosa width (KMW), the thickness of the soft tissue around implants, especially the most coronal part, can play an important role in the functional and aesthetic outcome of implant treatment and in the maintenance of peri-implant health.

The most frequent indication for surgical intervention to increase the mucosal thickness around implants is to improve the

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aesthetic outcome after the delivery of the final implant-supported prosthesis. This is usually done to weaken or eliminate the color effect of the abutment (e.g., titanium alloy, gold, or zirconia) on the buccal aspect of the mucosa, or to compensate for underlying bone deficiency that may occur due to unfavorable bone remodeling patterns before and after functional loading.[1] There are several methods to increase the supracrestal gingival thickness, including adjusting the implantation depth and transplanting autogenous gingival harvested from the palatal area. However, these methods are difficult due to anatomical limitations and the morbidity of creating a different surgical site.

Collagen matrix grafting can be used as an alternative to autogenous gingival grafting in soft tissue augmentation, and several preclinical studies have shown similar effects to autogenous gingival grafting in increasing soft tissue thickness.[2] In this study, we compared the preoperative and postoperative thicknesses in cases where two-stage implant placement was performed to evaluate the increased supracrestal gingival thickness when grafting the recently developed porcine collagen matrix (PCM).

Materials and Methods

For implant placement, a vertical incision was made in the mesial area of the anterior tooth, and a horizontal incision was made along the sulcular incision, followed by a horizontal incision on the edentulous alveolar ridge. After cutting the flap, the marginal area corresponding to the central area of the raised flap was fixed with tweezers and directly measured with a probe (Hufriendy). In this study, only cases with a gingival thickness of less than 3 mm were recruited. After implant placement, bone grafting was performed on the insufficient horizontal bone, and PCM (Collagen Graft 2, Dentium, Seoul, Korea) was positioned superiorly without fixation. Interrupted and mattress sutures were performed using nylon sutures (Ethilon 5-0, Johnson & Johnson, US). After a healing period of 4 months, a second surgery was performed, and the thickness of the flap was measured in the same way as in the first surgery when lifting the flap.

Results

Data were collected from cases applied to a total of 5 patients (6 sites). The mean age was 65.6 ± 7.6. All cases investigated were female patients. The mean thickness at the first surgery was 1.75 ± 0.25 mm, and the mean thickness at the second surgery was 3.83 ± 0.47 mm. The average increased gingival thickness was 2.08 ± 0.45 mm. (Fig. 1,2), (Table 1)

Table 1. Demography

Case	Age	Gender	Cause of Extraction	Site	Timing of implantation	Initial stability (Ncm)	Diameter	Length	Thickness at 1st Sx (mm)	Thickness of 2nd Sx (mm)	Period from 1st Sx to 2nd Sx (wks)
1	56	F	Perio	37	Delay	〈 20	6	8	2	4	16
2	62	F	Perio	46	Early	〉30	5.8	11.5	1.5	3	17
3	63	F	Perio	36	Early	〉10	5	10	2	3.5	18
4	81	F	Perio	26	Early	〈 20	5	10	2	4.5	16
5	66	F	Perio	36	Delay	〈 20	5	10	1.5	4	17
6	66	F	Perio	37	Delay	〈 20	5	10	1.5	4	17
	65.6 ± 7.6								1.75 ± 0.25	3.83 ± 0.25	

In this study, all cases recruited according to conditions were middle-aged or older female patients, which is consistent with previous studies showing that gingival thickness is thinner in women. Collagen grafts were performed with implant placement in three cases each in the early stage and delayed stage. We plan to add more cases in the future to compare the change in gingival thickness according to the time of grafting.

Rachel A et al. reported that when evaluating 6 months after Porcine Collagen Matrix grafting around implants, there was an increase of 0.7 ± 0.8 mm, and Lee et al reported that there was an increase of 1.79 ± 0.40 mm and 1.80 ± 0.34 mm in supracrestal connective tissue graft (SCTG) 5 months after collagen grafting in adults.[2,3] In this study, soft tissue thickness was remeasured approximately 4 months after collagen grafting, which may have influenced the large increase compared to previous studies. Therefore, long-term follow-up is required to evaluate the long-term stability of increased gingival thickness.

Compared to patients who underwent implants alone without collagen grafts, patients after the surgery did not experience additional inflammatory reactions or discomfort, and it was confirmed that the results of gingival augmentation in the secondary healing area could be achieved relatively easily. In addition, it would be good to conduct long-term follow-up and comparison with autogenous gingival through randomized controlled trials in the future.

Fig. 1. Intraoperative clinical photos. A. Before flap reflection; B. Pre-graft supracrestal gingival thickness; C. Porcine collagen matrix (PCM); D. Covering with PCM after implantation; E. After suture; F. Occlusal view after 2 weeks

Fig. 2. Clinical photos of Implant 2nd surgery. A. Occlusal view after 4 months; B. Check the gingival thickness; C. Implant Stabiltiy Quotient (ISQ) check

Discussion

According to Linkevicius T et al, supracrestal gingival thickness plays an important role in the pattern of marginal bone loss.[4] Short supracrestal gingival thickness at implant placement has been consistently associated with variable amounts of marginal bone loss due to physiological formation of the soft tissue component of the implant-supported device during healing. Previous studies have shown that when the vertical soft tissue thickness is less than 2 mm, approximately 1.5 mm of alveolar bone resorption occurs while a biological seal is formed between the soft tissue and the implant/abutment/prosthesis surface. Furthermore, it has been clearly shown that even implants that have undergone platform switching modifications are unable to maintain bone when the vertical soft tissue is thin at implant placement. This biological seal is the only and most important barrier protecting the osseointegrated implant from the contaminated oral environment.[4]

Thus, there is a direct connection between the pre-implant mucosa of the edentulous alveolar crest and the peri-implant soft tissues. The soft tissue thickness required to protect the basal bone around the implant is approximately 4 mm, which is wider than the biological width around the tooth. There are two ways to form the biological width around the implant: with crestal bone loss or without bone resorption. With the use of short implants becoming more common today, crestal bone loss has a more devastating effect. Even if the implant is placed excessively subcrestal, without platform shifting or without a stable conical connection, the formation of inflammatory infiltrates cannot be prevented, resulting in alveolar bone resorption. Therefore, compensation for the lack of vertical tissue thickness by increasing the vertical soft tissue thickness is a logical approach.

Connective tissue graft (CTG) has become an important aspect of the treatment options for gingival recession, existing or impending ridge defects, peri-implant tissue management, and thin gingiva. In edentulous areas or mild alveolar ridge defects around implants, CTG is an inexpensive means to increase the height of the ridge or improve the facial contour of the alveolar bone. Compared with autogenous bone harvesting, CTG involves less invasive surgery at the donor site and a shorter healing period. Autogenous gingival grafting is generally recognized as the gold standard in CTG. However, it can be difficult for general practitioners with specialized skills during the harvesting process, and postoperative complications such as uncontrolled bleeding, pain, and infection of the palatal donor site limit its establishment as a routine procedure.[5] As an alternative, PCM graft can solve the discomfort at the donor site, and more research is needed to determine whether it can provide similar results compared to SCTG.

The risk factors for gingival recession include pre-existing buccal bone defects, tissue biotype, implant malposition, stability, buccal bone thickness, and biomaterials used. First, the effect of pre-existing buccal bone defects on gingival recession was confirmed in the immediate implantation (type 1) study. Thin tissue biotype was identified as a risk factor for gingival recession. In a study of type 1 implant placement using a flapless surgical approach and immediate provisional restoration, thin biotype sites had significantly more recession than thick biotype sites after 1 year (0.75 ± 0.59 mm vs 0.25 ± 0.33 mm, respectively).[6] Two studies reported that the position of the implant in the extraction socket at type 1 placement sites was an important risk factor for mucosal recession. Implants that were malpositioned facially in the extraction sockets were significantly associated with an increased risk for mucosal recession. Recession of the mucosa was three times greater in facially malpositioned implants (1.8 ± 0.83 mm) compared to implants placed more orally in the socket (0.6 ± 0.55 mm); the difference was statistically significant. In patients with these risk factors, performing a CT graft for prevention or recovery may have predictive results, which has a significant impact on the prognosis of the implant and the patient's quality of life.

According to Tobias Waller et al., implants with small non-contained buccal bone dehiscences (≤5 mm) exhibited high implant survival rates and healthy peri-implant tissues at 7.5 years.[7] Therefore, small dehiscences are not considered to have a critical effect on implant survival. On the other hand, according to Amit S. Gharpure et al., the prevalence of peri-implantitis

and implant mucositis and pain/discomfort during oral hygiene were higher in the thin phenotype than in the thick phenotype.[8] Therefore, the prognosis of implants can be determined based on the phenotype of the gingiva around the implant rather than the small number of teeth.

Conclusion

The peri-implant phenotype has four components: KMW, mucosal thickness, supracrestal tissue height, and peri-implant bone thickness, and there are suggested threshold values for each. This study confirmed that the mucosal thickness of the tissue surrounding the double implant can be increased, and this can be compared with the implant group with thin mucosal thickness to compare the effect on the implant. In future studies, by adding more cases and conducting long-term follow-up, we will be able to measure indicators that confirm the effect of reducing marginal bone loss and improving health around implants, thereby confirming the relationship with implant health.

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이종 콜라겐 매트릭스를 이용한 임플란트 상방 치은두께의 후향적 평가

본 연구는 이종 콜라겐 매트릭스 이식술을 통한 임플란트 주위 치은 증대술에 대한 효과를 평가한 후향적 연구이다. 임플란트 수술을 받은 환자 5명(총 6개 부위)을 대상으로 하였으며, 수술 전과 수술 후 4개월 뒤의 치은 두께를 측정하여 비교하였다. 그 결과, 평균 치은 두께가 1.75 ± 0.25 mm에서 3.83 ± 0.47 mm로 증가했으며, 평균 증가량은 2.08 ± 0.45 mm였다. 이는 이종 콜라겐 매트릭스 이식술이 임플란트 주변의 치은 두께를 증가시키는 데 효과적인 방법임을 시시하며, 향후 더 많은 사례를 추가하여 이식 시기에 따른 치은 두께 변화를 비교하고, 장기간 추적 관찰을 통해 증가된 치은 두께의 장기적인 안정성을 평가가 필요하다.

키워드: 치과용 임플란트, 골막, 콜라겐 매트릭스, 임플란트 주변