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ORIGINAL RESEARCH

CLINICAL EVALUATION OF FREE GINGIVAL GRAFT SHRINKAGE IN HORIZONTAL AND VERTICAL DIMENSIONS

Serbest Dişeti Greftinin Yatay ve Dikey Boyutlardaki Büzülmesinin Klinik Olarak Değerlendirilmesi

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ABSTRACT

Purpose: *To assess the shrinkage of Free Gingival Graft (FGG) in horizontal and vertical dimensions and calculate the changes in the surface area of the transplanted tissue in a 3 months period.*
Materials and Methods: *A total of 30 FGG were placed aiming to increase attached gingiva around recession sites. Vertical recessions, horizontal recessions, surface area, plaque index, gingival index, periodontal probing depth and clinical attachment level were assesed at baseline, 1 and 3 months postoperatively.*
Results: *Graft shrinkage between baseline and 1 month was more evident than 1 to 3 months in either dimensions. Both horizontal and vertical dimensions were significantly decreased ($p<0.001$) at 1 and 3 months post operatively. There was no significant change in PI and GI scores postoperatively compared to baseline ($p>0.05$). .*
Conclusion: *The shrinkage of vertical and horizontal dimensions of the grafts were almost equal unlike the literature. In addition, the different dimensional changes observed in individual level deserve further research.*

Keywords: *Free gingival graft; shrinkage; surface area; individuality*

ÖZ

Amaç: *Serbest Dişeti Grefti (SDG) operasyonu sonrası ilk 3 aylık süre zarfında meydana gelebilecek horizontal ve vertikal büzülmenin değerlendirilmesi, ayrıca toplam yüzey alanındaki değişimin hesaplanmasıdır.*
Gereç ve Yöntem: *Dişeti çekilmesi olan bölgelerde keratinize dişeti dikey boyutunu artırmak amacıyla 30 adet SDG yerleştirilmiştir. Başlangıç ve operasyon sonrası 1. ve 3. aylarda dikey yöndeki dişeti çekilmesi, yatay yöndeki dişeti çekilmesi, greftin toplam yüzey alanı, plak indeksi (PI), gingival indeks (GI), periodontal sondalama derinliği ve klinik ataşman seviyesi ölçülmüştür.*
Bulgular: *Birinci ve 3. aylar arasında meydana gelen büzülmeye oranla, başlangıç ve 1. ay arasında daha belirgin greft büzülmesi gözlenmiştir. Horizontal ve vertikal greft boyutları 1. ve 3. aylarda anlamlı oranda azalmıştır ($p<0.001$). PI ve GI skorlarında başlangıca göre anlamlı bir değişim meydana gelmemiştir ($p>0.05$).*
Sonuç: *Greft boyutlarında meydana gelen büzülmedeki bireysel farklılıklar daha ileri düzeyde araştırılmalıdır.*

Anahtar kelimeler: *Büzülme; serbest dişeti grefti; yüzey alanı*

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Introduction

Gingival recession (GR) is described as the oral exposure of the root surface due to the displacement of the gingival margin apical to the cemento-enamel junction (CEJ) (1). In previous studies, the presence of sufficient attached gingiva was described as critical for the maintenance of gingival tissue health and for the prevention of continuous loss of attachment (2, 3). Lang and Löe suggested that less than apico-coranal width of 2 mm keratinized gingiva is inadequate for maintaining gingival health (3). On the contrary, other studies report that it is possible to maintain healthy marginal tissues even in areas with a reduced or missing keratinized gingiva (4, 5). The free gingival graft (FGG) is a surgical technique described approximately 50 years ago to increase keratinized tissue dimensions and prevent GR (6). FGG procedure is one of the most frequently approaches for gingival augmentation (7, 8). However, the horizontal and vertical changes in the transplanted tissue may occur over time (9), thus this situation may be crucial especially when applied to prevent further gingival recession. The shrinkage of FGG is a clinical phenomenon that occurs primarily during healing period in the first post-operative month (9, 10).

This study aims 1) To evaluate the shrinkage of FGG in both horizontal and vertical dimensions and calculate the changes in the surface area of the transplanted tissue in a 3 months period. 2) To asses the significance of FGG technique in clinical practice with clinical parameters

Materials and Methods

This prospective clinical study was performed between May 2011 and January 2013 in Istanbul University, Faculty of Dentistry, Department of Periodontology. Demographic data of the study subjects are shown in Table 1. 23 systemically healthy non-smoker subjects were included and received FGG to treat lack of keratinized tissue. The inclusion criteria for subject recruitment were as follows: 1) to have at least one tooth with insufficient attached gingiva and gingival recession in mandibular premolar to premolar area, 2) healthy bone levels determined radiographically; 3) absence of periodontal probing depth (PPD)<3 mm. Subjects were excluded from the study based on the following exclusion criterias: 1) subgingival restorations; 2) poor oral hygiene; 3) smoking; 4) pregnancy. The study protocol has been approved by the Ethical Commitee of Istanbul University. Informed consents were obtained prior to study.

Study Design

All patients received a full-mouth mechanical periodontal treatment combined with oral hygiene instructions. Roll technique (11) was applied to determine the keratinized tissue width 4 weeks after the initial periodontal treatment. Gingival recessions (11 subjects with Miller Class I: 15 grafts and 12 subjects with Miller Class II: 15 grafts) (12) were treated using masticatory palatal tissue grafts as free grafts on prepared supraperiostal recipient sites. A total of 30 FGGs were placed aiming to increase attached keratinised gingiva around recession sites. Gingival thicknesses were measured using a digital caliper of 0.01 mm resolution (Absolute, Mitutoyo Sul Americana, Suzano, Brazil) after carefully removing the spreader. All patients had thin gingival phenotype (≤ 1mm) which is described as a risk factor for gingival recession (13).

Clinical Assessments

All surgical procedures were performed by a single experienced clinician (EC) and the measurements by a calibrated investigator (VK). At baseline, 30 and 90 days after surgical procedures, full-mouth plaque index (PI) (14) and gingival index (GI) (15) were used to monitor oral hygiene status and gingival health conditions. Periodontal probing depth (PD), clinical attachment level (CAL), keratinized tissue (KT), vertical recession (VR) (distance between CEJ and the gingival margin), horizontal recession (HR) (mesio-distal distance of denuded tooth surface at enamel-cement level) were measured with a Williams Probe (Hu-Friedy Manufacturing, Chicago, IL, USA) to the nearest 0.5 mm. The same investigator measured the size of the graft in two dimensions (horizontal-vertical) at baseline and the follow-up visits. The surface area of FGG was calculated based on the following formula: surface area (SA)= width x length. FGG dimensional changes (percent shrinkage) were calculated based on the following formula: percent shrinkage = 100 x ([baseline dimension - postoperative dimension] / baseline dimension) (16).

Surgical Procedures

The recipient site prepared by a 90° horizontal incision at the mucogingival line using a no: 15 scalpel (Hu-Friedy Manufacturing, Chicago, IL, USA) following administration of local anesthesia.

A sharp dissection was utilized one to two teeth further than the planned graft area and deepened to the adequate depth (The partial-thickness flap is displaced apically and sutured), to overcome the movement of the transplanted palatal tissue.

The palatal graft was harvested from the palate corresponding to the premolar area and 2 mm away from the gingival margin. If necessary, the graft was prepared (thinned) to obtain a graft approximately 1.5 mm thickness. The grafts were then firmly adapted to the recipient area and sutured using absorbable sutures. (Pegesorb rapid,® 5-0 atruamatic polyglycolic acid sutures, Dogsan A.S. Trabzon, Turkey). The transplanted tissues were positioned with three sutures to the existing intact keratinized gingiva. Furthermore, horizontal sling sutures were utilized to gain better graft adaptation to the recipient site. Gauze soaked in saline was applied for 5 minutes with gentle compress. The recipient site was covered with periodontal dressing (Vocopac®, VOCO GmbH, Luxhaven, Germany).

Post-Surgical Care

The subjects were advised to abstain from brushing and flossing the operation site until suture removal and rinse twice daily with 0.12% chlorhexidine digluconate (Klorheks, Drogsan, Ankara, Turkey). The subjects were prescribed analgesics two times, daily (naproxyn sodium 550 mg, Apranax Fort, Abdi Ibrahim, Istanbul, Turkey) for the first 3 days. The sutures and periodontal dressing were removed ten days after the surgery.

At the second and third weeks, brushing the recipient site using a surgical brush (Curaprox Surgical Megasoft Toothbrush, Curaden Swiss, Istanbul, Turkey) directed coronally in the operated area was instructed. Patients were re-called, scheduled weekly for the first 4 weeks, then monthly until the end of the study.

Statistical Analysis

Prior to initiation of the study, power and sample size was calculated. Defect site measurements were used for data analysis. Descriptive statistics with mean±standart deviation were performed. As the data did not distrubute normally, a non-parametric test (Friedman test) was used to perform the statistical analysis. Statitistical significance was accepted as $p<0.001$. All results were evaluated at 95% confidence interval. Statistical software was used for analysis (Pass 2008/NCSS 2007, NCSS, Kaysville, Utah, USA).

Results

15 females and 8 males, (aged 23 to 59 years) were consecutively treated with FGG (Table 1).

Table 1. *Demographic features of the study population.*

Mean Age±SD	36.08±9.70
Range	23 - 59
Gender (female/male	15/8
Smokers	None

All grafts were healed without complications (clinical paresthesia, bleeding) at 3 months follow-up. Periodontal parameters and recession levels are presented in Table 2. PI and GI scores were kept below 1.00; PI: 0.41±0.62 and 0.50±0.67 at baseline and 3 months, respectively; GI: 0.38±0.55 and 0.34±0.55. PD and CAL measurements revealed no significant difference before and 3 months after harvesting the grafts ($p>0.001$). CAL measurements improved compared to baseline but the difference did not reach significancy. Vertical recession levels were decreased significantly at 3 months compared to baseline ($p<0.001$).

The dimensional changes between baseline and follow-up period are presented in Table 3 and Figs 1A-C. The decrease of the graft's horizontal dimensions were statistically significantly ($p<0.001$). Furthermore, there was a statistically significant reduction in the vertical dimension at all time-points ($p<0.001$). The calculated graft surface area also decreased during the follow-up period compared to baseline and this decrease was statistically significant ($p<0.001$). There was statistically significant KT gain observed from baseline (0.90±0.74 mm) to 1 month (6.75±1.36 mm) ($p <0.001$), and the change in KT was not significant from 1 to 3 months (6.46±1.33 mm) ($p>0.001$). We found that the shrinkage between the baseline and first month is statistically more significant than the shrinkage between the first and third months.

Table 2. *Periodontal measurements related to plaque accumulation and periodontal health situation.*

	Baseline (mm) (mean ± std. deviation)	1 month (mm) (mean ± std. deviation)	3 months (mm) (mean ± std. deviation)	p
PI	0.41 ± 0.62	0.75 ± 0.67	0.50 ± 0.67	>0.001
GI	0.38 ± 0.55	0.65 ± 0.60	0.34 ± 0.55	>0.001
PPD	1.81 ± 0.81	1.84 ± 0.67	1.67 ± 0.44	>0.001
CAL	4.57 ± 1.74	4.22 ± 1.81	3.95 ± 1.78	>0.001
HR	3.03 ± 0.82	3.00 ±0.98	2.84 ± 1.11	>0.001
VR	4.62 ± 1.82	4.03 ± 1.89	3.78 ± 1.86*	<0.001

*PI: Plaque index, GI: Gingival index, PPD: Periodontal probing depth, CAL: Clinical attachment level, HR: Horizontal recession, VR: Vertical recession, *: significantly different compared to baseline.*

Table 3. *Periodontal measurements related to changes in the vertical and horizontal dimensions and shrinkage of the free gingival grafts.*

Baseline (mm) (mean ± std. deviation)		1 month (mm) (mean ± std. deviation)	3 months (mm) (mean ± std. deviation)	p
KT	0.90 ± 0.74	6.75 ± 1.36*	6.46 ± 1.33 *	<0.001
HFGG	6.88 ± 0.91	6.44 ± 1.05*	6.09 ± 1.06*#	<0.001
VFGG	13.41 ± 2.47	12.50 ± 2.44*	12.03 ± 2.16*#	<0.001

*KT: Keratinized tissue, HFGG: Horizontal free gingival graft, VFGG: Vertical free gingival graft, *: Compared to baseline, #: Compared to 1 month.*

Figure 1A

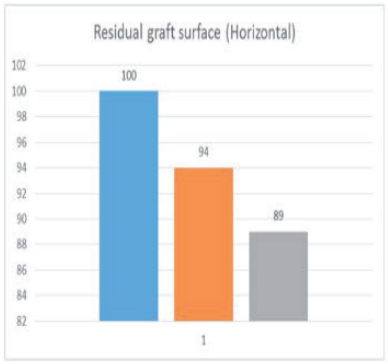

Figure 1B

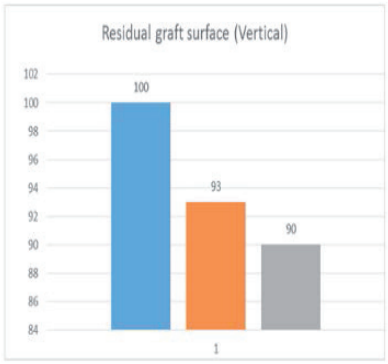

Figure 1C

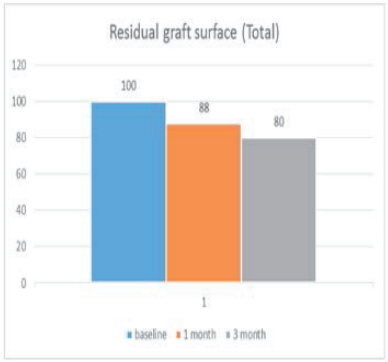

Figure (1A). *Residual graft in horizootal surface area.* ***(1B)*** *Residual graft in horizontal vertical area.* ***(1C)*** *Residual graft in total surface area.*

Discussion

The main objectives of this prospective clinical study were to assess the shrinkage of FGG in horizontal and vertical dimensions and to evaluate the alterations of clinical parameters during healing period of free gingival graft procedure. The results of the present study indicate that significant shrinkage of FGG extends up to 3 months.

In the present study, PI and GI scores were not statistically different at 3 months compared to baseline. PPD and CAL measurements revealed no significant difference between baseline and 3 months after harvesting the grafts ($p>0.001$). In addition, CAL measurements improved compared to baseline but no statistically significant difference was observed. Creeping attachment forms after the healing of a FGG, particularly in the lower anterior segment (17). In the present study, although root coverage was not the aim of the procedure, there was statistically significant reduction in vertical recession and a gain in periodontal attachment, confirming formation of a creeping attachment after the placement of the graft.

We extended the follow-up period to 3 months as greatest of dimensional alterations of FGG take place mainly at this term as reported previously (9, 18). Previous clinical studies presented an extensive variation of vertical shrinkage of FGG percentages from 31% to 45% (16, 19, 20). In the current study, horizontal and vertical dimensions of soft tissue grafts harvested from palatal gingiva was measured at baseline, 1 month and 3 months and graft areas were computed by multiplying the dimensions, subsequently the shrinkage of the grafts on percentage was calculated. Nine patients did not show any dimensional changes in 1 month. No shrinkage was observed in 10 patients at 1 month to 3 months. Also, in 5 patients no dimensional changes were seen at any time points. Silva *et al.* compared the dimensional changes of FGG in smokers and non-smokers. The initially 7 mm FGG width in both groups decreased to 3.9 mm (44%) in smokers and 4.8 mm (31%) in non-smokers at 3 months (16). In another study the shrinkage of FGG, either with tissue adhesives or with suturing technique, in both horizontal and vertical dimensions was evaluated. The percentage of shrinkage in vertical dimension was 16.6% and 22.4 % in suture group at days 21 and 180, respectively (21). In a clinical study, 19.7% and 24.8 % vertical shrinkage was reported at 21 and 180 days respectively (9). In the current study, the vertical dimensions (graft width) were 6.88±0,91 mm at baseline, 6.44±1.05 mm and 6.09±1.06 mm at 1 month and 3 month, respectively. The mean vertical graft shrinkage ratio was 6.10±10.63 % (0 to 30 days), 5.16±8.70 % (30 to 90 days), 10.87± 13.56 % (0 to 90 days) indicating that the mean vertical shrinkage of FGGs occuring in 3 months were much less compared to those studies. In addition, the horizontal dimensions may be an important criteria after FGG operations (9) and were evaluated in this study as 13.4 ± 2.47 mm baseline, 12.5 ± 2.43 mm and 12.03 ± 2.16 mm at 30 and 90 days respectively. The mean of horizontal graft shrinkage ratio was 6.63 ± 6.96 % (0 to 30 days), 3.40±4.80 % (30 to 90 days), 9.81±7.97 % (0 to 90 days), respectively. Silva *et al.* reported that horizontal graft size was reduced 18% and 25%, in smokers and 17% and 22% in non-smokers at days 30 and 90 days respectively (16). Hatipoglu *et al.* informed that horizontal shrinkage was 5.8% (day 21) and 10.2% (day 180) (9). Similarly, Guncu *et al.* reported that shrinkage in horizontal direction was 9.80% and 14.25% in the suture group at days 21 and 180, respectively (21).

The results of the present study showed significant shrinkage of the FGG in line with the literature. The shrinkage was most evident in the vertical dimension as evaluated almost two fold more than horizontal shrinkage in other studies (16, 21). However, vertical and horizontal shrinkage were almost equal in the present study. The results showed that mean initial graft surface area was 92.65 mm^2, 80.15 mm^2 at day 30, 72.87 mm^2 at day 90. The mean graft surface area shrinkage ratio was 12.15 ± 13.05% (0 to 30 days), 8.34 ± 9.92% (30 to 90 days), 19.09 ± 16. 5% (0 to 90 days), respectively. Conversely, Silva *et al.* reported reduced FGG surface area by 46% and 37% at 1 month in smokers and non-smokers, respectively. At 90 days, area was reduced by 58% and 44% in smokers and non-smokers, respectively (16). Hatipoglu *et al.* observed smaller mean graft shrinkage of 18.5%, 23.8% and 32.1% at 10, 21 and 180 days respectively (9).

Conclusion

The results of this study shows that the surface area of the FGGs decreased throughout the study. Unlike the literature, we found that the shrinkage of vertical and horizontal dimensions of the grafts were almost equal. We observed that graft shrinkage occurs concurrently in the vertical and horizontal

dimensions for a period of 90 days. Further clinical studies are needed to understand the mechanism of graft shrinkage that shows different clinical patern on patient base.

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None declared

Conflict of interest
None declared

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