Nanofat injector: a low-cost disposable device for standardization and optimization of grafting time

Nanofat injector: dispositivo descartável de baixo custo para padronização e otimização do tempo de enxertia

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Introduction: Nanofat graft improves skin quality in damage secondary to aging and scar sequelae. We present the initial results of the nanofat graft using a low-cost disposable device, proposing a standardization of its use according to the area to be treated. Methods: A prospective cohort was conducted from July 2019 to March 2020. The inclusion criterion was patients who underwent nanofat grafting for skin treatment. The exclusion criterion was the previous performance of some invasive treatment of the skin. Twenty consecutive patients who met the prerequisites were analyzed. The results were evaluated in the 6th postoperative month. The patients answered a questionnaire, classifying from 1 - very bad to 10 - excellent, changes in skin quality. Results: The twenty patients followed did not present any postoperative complications. Edema after the application was reduced between three and seven days. There was no hematoma or infection. Patients who underwent only nanofat grafting without another associated surgery could return to their activities after 24 hours. The scores reported by patients at 6 months were between 7 and 10, with a mean of 8. Conclusion: The use of the Smartneedle™ system for nanofat grafting presents patient satisfaction similar to other application methods and allows a uniform and standardized distribution of the graft according to the anatomical region and optimizing surgical time

Keywords: Fats; Face; Skin; Skin abnormalities; Facial expression.
INTRODUCTION

Tonnard et al., in 2013\(^1\), described the nanofat graft. The intradermal injection of the graft with 27 gauge needles became viable through the emulsification and filtering of the liposuctioned fat. The laboratory analysis showed complete destruction of the adipocytes and a total loss of the volumization capacity; however, it allows the isolation of the stromal vascular fraction of the fat, maintaining its regenerative potential intact\(^2\). The nanofat graft improves the quality of the skin in damages secondary to aging and in the healing sequelae\(^3,5\). This work aims to present the initial results of the nanofat graft with the use of a low-cost disposable device, proposing a standardization of its use according to the area to be treated.

METHODS

A prospective cohort was conducted from July 2019 to March 2020. The approval of the institutional review board of the Hospital de Clínicas de Porto Alegre was granted, project number 2008-0058, and this research-based study was conducted following the provisions of the Declaration of Helsinki. The inclusion criterion was patients who underwent nanofat grafting for skin treatment. The exclusion criterion was the previous performance of some invasive treatment of the skin. Twenty consecutive patients who met the prerequisites were analyzed.

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To remove the graft, we chose between the infraumbilical region or the inner thigh\(^6\). Infiltration is performed with saline solution and adrenaline at a concentration of 1:300,000. Liposuction is performed with a 3mm cannula, with 1mm holes and rough surface\(^1\), FAGA. The collected fat is washed and decanted\(^7\). The first part is the micrograft and is ready for use; the second is transferred 30 times by each of the three 2.4mm, 1.8mm and 1.4mm FAGA protractors. After transfers, the emulsified graft will be ready\(^1\). According to the need for nano graft volume, a percentage of the emulsified graft can go to the third
stage. This step consists of passing once in each of the three filters: FAGA: 0.5mm, 0.3mm and 0.15mm (Figures 1 and 2).

For application, the fat is transferred from the 20ml syringe to the 3ml syringe and coupled to the Multineedle 19 Needles System (JM Biotech Co. Ltd., Daegu, South Korea) (Figures 3 and 4). The depth to be grafted is standardized by anatomical region (Table 1 and Figure 5). The system is applied to 90 degrees concerning the skin for complete penetration of all needles. An application of 0.3ml of nano graft per stitch is performed (0.016ml injected by each needle) (Figure 6). After finishing the grafting, skin massage is performed with the nano graft.

RESULTS

The twenty patients followed did not present any postoperative complications. Edema after application decreased between three and seven days. There was no hematoma or infection. Patients who underwent only nanofat grafting without another associated surgery could return to their activities after 24 hours (Figures 7 and 8).

The scores reported by patients at six months were between 7 and 10, with a mean of 8 (Table 2).

DISCUSSION

The indication of nanofat graft aiming at skin treatment is growing worldwide. We did not find any article described with an unfavorable conclusion to its use. The main advantages of the nano graft are the maintenance of stem cells derived from adipose tissue (ADSCs), in addition to the possibility of intradermal grafting, which was not possible before its description. The ADSCs have already been widely studied, and their regenerative potential well documented, with several applications to plastic surgery. Sesé, in 2019, described that the isolation of ADSCs, when carried out by the mechanical emulsification system, requires a quantity of fat ten times lower than the standard method, enzymatic isolation, and produces a higher concentration of stem cells, which explains its regenerative potential. The process of obtaining the nano graft is summarized in three stages: micrograft, emulsified fat and nanofat graft. Despite adding surgical time – due to preparation in three stages – when compared to the classic graft, all stages generate grafts with properties to treat different changes in aging, as shown in Figure 1.

In 2013, Tonnard et al. described the application of the nano graft with 27 gauge needles. Still, the method requires a long time to perform, resulting in prolonged edema due to the formation of subdermal “fat lakes” and, mainly, the impossibility of standardizing the depth of application. Verpaele et al., in 2019, described a new method, where they associate micro-needling with the deposit of the nano graft; for this, 8ml and 20 minutes of micro-needling are required. The system described in this article allows standardizing the injection depth according to the different anatomical areas. With standardized grafting, injections are uniformly intradermal, reducing the risk of perforation of subdermal vascular plexus. This explains the lower potential of ecchymosis secondary to the procedure compared to the other methods already described.
Table 1. Depth to be grafted standardized by anatomical region.

| Muscle                    | Number of needles | Size |
|---------------------------|-------------------|------|
| Frontal                   | 19 needles        | 1mm  |
| Orbital                   | 19 needles        | 1mm  |
| Zygomatic                 | 19 needles        | 2mm  |
| Maxillary and Mandibular  | 19 needles        | 2mm  |
| Perioral                  | 19 needles        | 1mm  |
| Anterior cervical         | 19 needles        | 1mm  |
| Back of hands             | 19 needles        | 1mm  |
| Skin treatment after radiotherapy | 19 needles | 2mm  |

Figure 2. Nanofat graft (needle 27 gauge).

Figure 3. Multi needle System

Figure 4. Photo illustrating the moment of application of the Nanofat Injector - Disposable low cost device for fat grafting.

Figure 5. Anatomical regions for grafting.

Figure 6. Application of multi needle system.
Furthermore, the proposed technique allows the control of the injection volume of the nano graft, and with the system of 19 needles, it is possible to graft 8ml in 2 minutes. Each application of 0.3ml requires between three and five seconds, with an injection of 0.016ml per point, which reduces the risk of large deposits, as well as prolonged edema. If the surgeon’s goal is nano graft deposition and not microneedling, we believe this is the best system currently available. It allows a fast application, low morbidity, uniform deposit and adequate depth for the selected anatomical region. Finally, state-of-the-art technologies are usually associated with high investment. Still, the described system has a cost of R$ 65 per device, so it is possible to put it on the surgical budget without derailing the surgery.

**CONCLUSION**

The use of the **Smartneedle™** system for nanofat grafting presents results in patient satisfaction similar to other application methods. It allows a uniform and standardized distribution of the graft according to the anatomical region and optimizes surgical time.

**Table 2.** Satisfaction scores (0-10), age and gender of patients 6 months after surgery

| Score 0-10 6 months PO. | Age | Gender |
|-------------------------|-----|--------|
| MEC                     | 7   | 54     | F    |
| IT                      | 9   | 44     | F    |
| ES                      | 10  | 53     | F    |
| EM                      | 8   | 53     | F    |
| JP                      | 8   | 50     | F    |
| SM                      | 7   | 43     | F    |
| LG                      | 7   | 44     | F    |
| EP                      | 8   | 52     | F    |
| LP                      | 9   | 67     | F    |
| MG                      | 7   | 63     | F    |
| IR                      | 8   | 64     | F    |
| RP                      | 7   | 60     | F    |
| FL                      | 7   | 61     | F    |
| EB                      | 10  | 74     | F    |
| LB                      | 8   | 54     | F    |
| VR                      | 8   | 59     | F    |
| LC                      | 9   | 58     | F    |
| JM                      | 7   | 55     | F    |
| RR                      | 8   | 48     | F    |
| MT                      | 8   | 76     | F    |
Collaborations

JM  Analysis and/or data interpretation, Conceptualization, Data Curation, Final manuscript approval, Formal Analysis, Funding Acquisition, Investigation, Methodology, Project Administration, Realization of operations and/or trials, Resources, Software, Supervision, Validation, Visualization, Writing - Original Draft Preparation, Writing - Review & Editing

MP  Analysis and/or data interpretation, Conceptualization, Data Curation, Final manuscript approval, Formal Analysis, Funding Acquisition, Investigation, Methodology, Project Administration, Realization of operations and/or trials, Resources, Software, Supervision, Validation, Visualization, Writing - Original Draft Preparation, Writing - Review & Editing

ACPO  Analysis and/or data interpretation, Conceptualization, Data Curation, Final manuscript approval, Formal Analysis, Funding Acquisition, Investigation, Methodology, Project Administration, Realization of operations and/or trials, Resources, Software, Supervision, Validation, Visualization, Writing - Original Draft Preparation, Writing - Review & Editing

EMZ  Analysis and/or data interpretation, Conceptualization, Data Curation, Final manuscript approval, Formal Analysis, Funding Acquisition, Investigation, Methodology, Project Administration, Realization of operations and/or trials, Resources, Software, Supervision, Validation, Visualization, Writing - Original Draft Preparation, Writing - Review & Editing

CPP  Analysis and/or data interpretation, Conceptualization, Data Curation, Final manuscript approval, Formal Analysis, Funding Acquisition, Investigation, Methodology, Project Administration, Realization of operations and/or trials, Resources, Software, Supervision, Validation, Visualization, Writing - Original Draft Preparation, Writing - Review & Editing

JLM  Analysis and/or data interpretation, Conceptualization, Data Curation, Final manuscript approval, Formal Analysis, Funding Acquisition, Investigation, Methodology, Project Administration, Realization of operations and/or trials, Resources, Software, Supervision, Validation, Visualization, Writing - Original Draft Preparation, Writing - Review & Editing

MVMC  Analysis and/or data interpretation, Conceptualization, Data Curation, Final manuscript approval, Formal Analysis, Funding Acquisition, Investigation, Methodology, Project Administration, Realization of operations and/or trials, Resources, Software, Supervision, Validation, Visualization, Writing - Original Draft Preparation, Writing - Review & Editing

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