

## Natural Density-Can It be Achieved As a Result of One Surgery?

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Nowadays the effectiveness and naturalness of the results of follicular units transplantation is not doubted but the problem of hair density grown as a result of one surgery is a concern for many surgeons. How densely can the grafts be packed not harming their survivability? This issue became topical in the recent years, in the epoch of megasessions when lots of clinics in the world offered the possibility of transplanting big quantity (3-6 thousand) of follicular units in one surgery. We always believed that as a result of development of hair transplantation technology progress in the sphere of hair transplantation natural density could be achieved as a result of one surgery. But 5-6 years ago when we attempted to increase the density of transplanted grafts with the purpose of bringing it closer to naturalness safe density for the survival of grafts was considered 25 FU per 1.0 cm<sup>2</sup>. The research of M. Mayer et al indicated that the implantation of more than 30 FU in 1.0 cm<sup>2</sup>. reduced hair growth with 20-30%.<sup>4</sup> According to the opinion of many surgeons the density of 40 FU and more on 1.0 cm<sup>2</sup> reduced the survivability of grafts because of compression.<sup>3,4,7</sup>

What was the reason for the reduction of survivability of grafts, if it really occurred, in the circumstances of their dense packing? As a result of analyzing this problem we singled out four possible factors:

1. "Pressing" implanted grafts by the sides of very small recipient sites;
2. "Ultra fine" preparation of grafts, leading to absence of tissue around follicles and artificial splitting of follicular units with the purpose of enabling their implantation in small sites;
3. Crash injury of grafts at complicated moments during transplantation when assistants push them into small recipient sites;
4. Violation of blood circulation in the recipient site with excessive denseness.

High density can not be achieved without reducing sizes of recipient sites. But what is more favorable condition for the survival of graft: packing it in a free and big space like it was done with old punch technique or implantation in small recipient sites, the sides of which tightly press grafts and provide maximum contact of the implant with the surrounding tissues? In the latter case oxygenation is restored faster which is the main factor of survival of grafts, at the same time bleeding and hair loss are reduced.<sup>2,3</sup> The sizes of recipient sites from 0.8 mm to 1.5 mm are for long considered to be ideal for grafts containing 1-4 hair<sup>8</sup>. That's why there is no talk about "pressing" if the grafts are well prepared and are not pieces of tissue containing follicular. Accurate preparing under the adequate magnification and illumination provided by stereoscopic microscopes make it possible to achieve intact follicular units in which on the one hand, all the follicles are coated with fine layers of derma, and on the other hand, grafts don't have extra tissue and epidermis. Such follicular units have high survival capability and it is easy to implant them in recipients sites of <1.5 mm<sup>2,8</sup>.

Without a doubt the implantation of grafts in closely located small recipient sites is problematic for many assistants, especially at the beginning. But we can say for sure that this is not a technological but purely a problem of training: our experienced assistants packed 10-12 recipient sites of ≤1.0 mm per minute. Moreover, if asked they would tell you that they prefer to work on small recipient sites because they come across less complications with bleeding and graft popping.

Coming from the above-said the only real risk for the survival of grafts is violation of blood circulation in the recipient zone in the circumstance of excessive density. But how excessive is this density? The violation of blood circulation is not caused by closely located recipient sites only; it also

depends how and with what kind of instruments they are created. For minimizing negative effect on blood circulation in scalp the recipient sites should not be deep (up to 4.0 mm)<sup>1</sup>, should be small (<1.5 mm), and when creating recipient sites it is important that they are not united or merged, and finally the recipient sites should be created with maximum sharp instruments.

Our purpose was to figure out the dependence of survivability of grafts on density of their packing by double blind method of control.

The first series of observations were held on two volunteers in 2003.<sup>9</sup> Double-hair grafts were transplanted in the square space of bald scalp with 1.0 cm from the side. The grafts were obtained from small donor strips by using stereomicroscopes. For the creation of recipient sites Nokor needles were in use then. As our research showed tripling the density from 15 (in control sections) to 45 FU per cm<sup>2</sup> did not reduce the survivability of grafts which made up to 99 and 107% accordingly. Density of 89 hair in one patient and 96 hair in the other patient in 1.0 cm<sup>2</sup> was achieved (see figure 1,2).

Cheered by the positive results we repeated the analogical research after one year, in 3 sections of 1.0 cm<sup>2</sup> 21, 45 and 64 double-hair grafts were implanted.<sup>10</sup> Recipient sites this time were created with sharper 15<sup>0</sup> sharp point microblades which provided 64 sagittal slits in 1.0 cm<sup>2</sup> without their merging. After seven months out of 128 follicles (64 grafts) 123 hair grew in this section (see figure 3, 4). The survival rate made up to 96,1%. Based on the result of more than 100 grown hair on the limited section we assumed that compression as a factor of poor growth of implanted follicular units should not be considered.<sup>10</sup> After three years the similar results were achieved by Th. Nakatsui, J. Wong and D. Croot, who witnessed the growth of 126 hair out of 130 implanted follicles (72 grafts -14 single and 58 double-hair grafts) in coronal recipient sites in 1.0 cm<sup>2</sup> ( survival rate 96,92%).<sup>5</sup>

In 2005-2006 we started using recipient sites of <1.0 mm for the implantation of FU. They were created with 0.74 mm sharp point (for single-hair FU) and 1.0 mm sharp point (for double and triple hair FU) (see figure 5). In general for the creation of small (<1mm) recipient site hair transplant surgeons as a rule use 19G, 20G, 21G and 22G needles or 0.7-1.0 mm pre-cut chisel-tip razor blades. But to our opinion they cause trauma to the skin as the needles and blades are not sufficiently sharp and finally after creating 100-150 recipient sites become dull. That's why we made a choice in favor of higher quality sharp point microblades which remain sharp even after creating 1000 recipient sites. Thus we were able to further increase the density of recipient sites in 1.0 cm<sup>2</sup> and created the basis for further researches with the purpose of determining the survivability of FU in the circumstances of their packing in natural density-100FU per 1.0 cm<sup>2</sup>.

**Materials and Methods.** In 2007 we selected two volunteers for this research. The first volunteer was a healthy, smoker man of 35 years old with male pattern baldness of IV-a class according to Norwood scale. We marked template of 1.0 cm<sup>2</sup> in front area (see figure 6). 100 sagittal recipient sites in chess order were created with 1.0 mm sharp point microblades - 8 rows with 12-13 slits in each. The depth of recipient sites were strictly corresponding to the length of grafts which were created by cutting small donor strip under the stereomicroscope MEIJI with the capability of 20 times zooming. In the indicated recipient sites 100 FU - 70 double-hair and 30 single hair grafts were implanted. In total 170 follicles (see figure 7).

The second volunteer was also healthy, smoker of 48 years old with male pattern baldness of IV class according to Norwood scale. We marked square template with the side of 2.0 cm in vertex area. In this section with the space of 4.0 cm<sup>2</sup> we created 400 sagittal slits, 16 rows with 22-27 slits in each. 400 grafts were implanted in these recipient sites, among them 200 double-hair and 200 single hair grafts, in total 600 follicles (see figure 9).

**Results and Discussion.** After seven months we counted the hair which grew on the above sections. Neither the assistants nor the patients knew how many graft were implanted in the sections of our research. In the first case out of 170 implanted follicles 156 grew (survivability 92%) (see figure 8), in the second case out of 600 implanted follicles 574 grew (survivability 96%), (see figure 10).

Thus for the first time in our research we achieved natural density-100 FU per 1.0 cm<sup>2</sup> without harming the survivability which in both cases exceeded 90%. Furthermore the observation in the second case showed that the survivability of 96% was achieved not in the isolated section of 1.0 cm<sup>2</sup> but in the vertex section of 4.0 cm<sup>2</sup>. This area is not considered to be a favorable zone for the growth of implanted hair. The other unfavorable factor may be considered the circumstance that both patients were smokers. Nonetheless our research ended with positive result and we got over the barrier of 100 FU per 1.0 cm<sup>2</sup>. At the same time in the framework of this project we were not able to answer to at least two questions which always arise when conducting the similar research:

1. What is next? Would the further increase of density of packing transplanted follicles (more than 100 FU per 1.0 cm<sup>2</sup>) harm the survivability?
2. Would the survivability of grafts packed with natural density be harmed if we were to implant them not in isolated sections of 1 or 4.0 cm<sup>2</sup> but in bigger recipient area (50 or 100 cm<sup>2</sup>)?

In order to attempt and answer the first question we started observation on a volunteer in 2008. We implanted 116 grafts (46 double-hair and 70 single-hair, total 162 follicles) on the bald section of 1.0 cm<sup>2</sup> of the scalp's forehead-parietal part. For the creation of the recipient sites we used sharp point 0.74 mm (see figure 11, 12). We are anticipating the results in 6-8 months.

Regarding the second question-we observed the survivability of grafts packed with natural density on isolated sections surrounded by intact skin<sup>11</sup>. That's why we can not say that the survival rate of grafts would be as high on bigger recipient area (not on 1.0 or 4.0 cm<sup>2</sup> but on 50 or 100 cm<sup>2</sup>). In our practice the space of recipient areas is usually 60-200 cm<sup>2</sup>. For placing grafts with natural density in such big recipient area enormous number of grafts will be needed: 6-20 thousand grafts. It is simply impossible to obtain such quantity of grafts. In everyday practice we implant grafts with density of 25-40 and seldom 50-70 per cm<sup>2</sup>. Nevertheless our research clearly demonstrated that:

1. It is possible to achieve natural density in small recipient area of a few square centimeters as a result of one surgery;
2. Main factor limiting the results of our operation is not density of packing grafts but obtaining them in the required quantity.
3. Our favorable hair transplant surgery is vehemently developing and if a few years ago certain things were unimaginable now it is a reality. And this is most important.

## References

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**Fig.1** 45 double-hair grafts are placed in 1.0 cm<sup>2</sup>



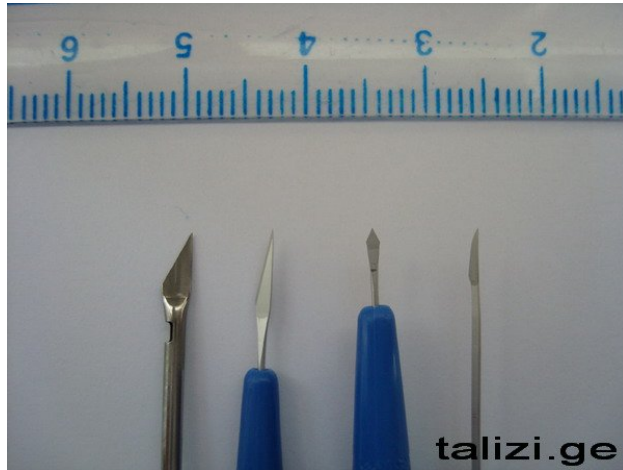
**Fig.2** Density of 89 hairs in 1.0 cm<sup>2</sup> was achieved



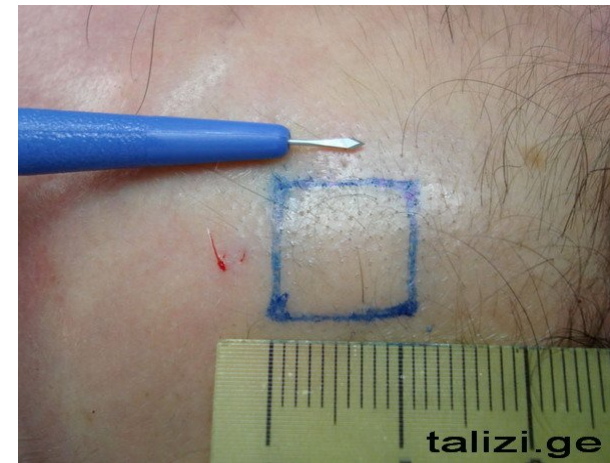
**Fig.3** Seven months after transplantation 21,45 and 64 double-hair grafts



**Fig.4** Density of 123 hairs in 1.0 cm<sup>2</sup> was achieved



**Fig.5** Nokor Needle, 15° sharppoint microblade, 1.0mm sharppoint microblade and 0.74mm sharppoint microblade



**Fig.6** Template 1.0 cm and 1.0 mm sharppoint microblade



**Fig.7** 100 grafts (70 double-hair and 30 single-hair FU) are placed in 1.0 cm<sup>2</sup>



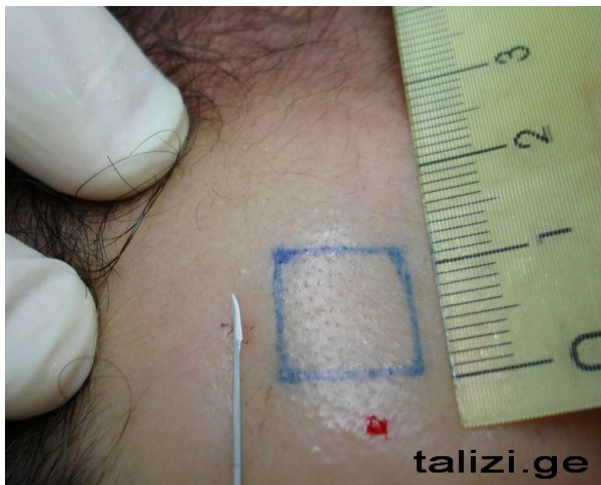
**Fig.8** 156 hairs grew in 1.0 cm<sup>2</sup>



**Fig.9** 400 grafts (200 double-hair and 200 single-hair FU) are placed in 4.0 cm<sup>2</sup> area



**Fig.10** After 7 month 574 hairs grew in 4.0 cm<sup>2</sup> area



**Fig.11** Template 1.0 cm<sup>2</sup> and 0.74 mm sharp point microblade



**Fig.12** 116 grafts (46 double-hair and 70 single-hair FU) are placed in 1.0 cm<sup>2</sup> area