INTRODUCTION

When Hair Restoration Surgery (HRS) was first popularized by Orentreich, the primary graft used was the “standard” 4 mm round punch graft. However, over the past 10 years we have seen the introduction of much more diversity with respect to the size and shape of grafts. Grafts used today vary significantly and can be described with respect to a number of different variables including:

- Number of hairs
- Number of follicular units (FU’s) per graft
- Graft shape (linear, rectangular, round, chubby, skinny)
- Size and type of the recipient site used (i.e. slit, slot or punch incisions). Although technically this last variable refers to the recipient site and not the graft, in clinical practice, grafts are often described in this manner.
- Process of graft production (i.e. cut “to size” vs. deliberately cut to contain a specific “number of hairs (or FU’s)”.

The reality of the situation was that for a long time a great deal of inconsistency and lack of specificity existed when grafts were described in the literature or at conferences. Often in the past all that was stated was that “Micrografts” or “Minigrafts” were used. This lack of specificity contributed to much of the confusion that existed when trying to compare different techniques that have developed over the years.

The creation of a more specific graft terminology and classification system (described later in this text) has helped improve communication between physicians and eliminate some of this confusion.

Today the situation is not as bad as in the past as many physician have started using the more specific terminology. In addition the majority of grafts used today are follicular unit grafts so there is not as much variation. However other types of grafts continue to be used and still have a place in hair transplantation. Continued attention to proper terminology remains important.

BACKGROUND AND HISTORY OF THE GRAFT TERMINOLOGY

History of Standard Grafts
Originally the first graft used in hair restoration was the Standard Punch Graft described by Orentreich. These grafts were harvested with large round punches (3.5mm to 4.0 mm in diameter), generally contained from 15 to 35 hairs, and were placed into slightly smaller round punch recipient sites (3.25mm to 4.0mm in diameter). These grafts are seldom used today.

History of Minigrafts
Historically, the first minigrafts referred to smaller grafts that were created from standard punch grafts by either splitting them in half or quarters. They would respectively contain about one-half or one-fourth the number of hairs of a standard graft. They were initially referred to as “split grafts” or “quartered grafts”. With the onset of using a slit-recipient site, the term “slit” graft arose to refer to these grafts when they were placed into slit incisions. With the introduction of strip harvesting came the ability to produce a wider variety of smaller minigrafts of various shapes and sizes. Some were cut thin and flat to fit slit incisions, others more square-shaped to fit round-recipient sites created by small punches. With the onset of slot recipient sites came the
production of grafts that were cut slightly wider and with a more rectangular-shaped to accommodate the size of this site. Although this population of minigrafts were very heterogeneous with respect to their size, shape, and number of hairs, they all continued to be lumped together under the single category of “minigrafts”. As a result, the term “minigraft” and “minigrafting” gradually lost its specificity and usefulness. Clearly, there was a need for a more specific terminology when referring to this diverse population of minigrafts. The one property all minigrafts share in common is containing more than one follicular unit (FU). For this reason the term **Multi Follicular Unit (MFU) Graft** was created (replacing minigraft) to categorize the broad population grafts that contain more than one follicular unit. In the classification system described later in this paper, multi-follicular unit grafts (MFU’s) are further sub-classified with respect to their shape (cut to fit a slit, slot, or round punch) and number of hairs (or FU’s).

**History of Micrografts and Follicular Units Grafts**

From a historical perspective, the first micrografts referred to one or two-hair grafts that were trimmed away from larger grafts and to use at the hairline. Physicians would ask their assistants to create a specific number of one or two-hair graft for this purpose. Little attention was paid to keeping follicular units intact. With the observation that hair seems to grow in natural groupings of one to four hairs, came the practice of creating micrografts that kept these natural groupings intact. The term Follicular Unit (FU) graft arose to specifically describe grafts that kept these natural groupings intact. The term micrograft is still used as a more general (less specific) term to describe both intact FU grafts as well as partial or sub-follicular unit (SFU) grafts (created by trimming 1-2 hairs away from intact FU’s).

**CLINICAL SIGNIFICANCE OF GRAFTS CUT “TO SIZE” vs “NUMBER OF HAIRS”**

The terms cut to the “number of hairs” or cut “to size” have been used to describe two methods of graft production. We feel it is important to differentiate between these methods because grafts within the two groups share certain properties that may affect clinical results.

**Grafts cut to the “number of hairs”** are prepared by the process where the physician instructs his assistants, preferably with the aide of magnification, to locate, isolate and dissect a population of grafts that contain a specific number of hairs (or intact FU’s). The deliberate trimming away of excess epithelium and tissue is an inherent part of this method of graft production. Most micrografts are created using the process of cutting grafts to “the number of hairs” This includes both “intact” FU grafts and SFU grafts (created by trimming 1-2 hairs away from intact FU’s.)

**Grafts cut “to size”** are prepared by the process where a physician instructs his assistants to cut a population of specific sized grafts he believes contains on average a desired number of hairs (or FU’s). There is less trimming of tissue with this method of graft production than when grafts are deliberately cut to contain a specific “number of hairs”. When cutting grafts “to size”, a physician has to factor in the donor density and adjust the size of the graft to ensure it will contain the “average” number of hairs (or FU’s) desired. Most Multi Follicular Unit (MFU) Grafts are created by the process of cutting grafts “to size”. These include traditional slit grafts, slot grafts and round grafts. One notable exception is a relatively new and increasingly popular type micro-slit graft which will be described in more detail below.
Differences between grafts cut by one of these two processes are relevant to the need for microscopic magnification when preparing grafts. When preparing large numbers of FU grafts cut to the “number of hairs”, the inherent greater amount of trimming that occurs potentially increases the chances for transection as well as the subsequent discarding of partially transected hairs. For this reason it is imperative to use microscopic magnification to prevent transaction and waste when preparing FU grafts. On the other hand, when preparing MFU’s cut “to size”, fewer cuts are made, and therefore there are less chances of transecting hairs. In addition, since less trimming occurs partially transected hairs are often left in as part of the graft. The viability and contribution of these partially transected hairs is debatable but they are not discarded. For these reasons microscopic magnification to prevent transaction and waste may not be as important when cutting MFU’s “to size”.

MODERN GRAFT TERMINOLOGY AND CLASSIFICATION SYSTEM

The following section describes in detail the current graft terminology and classification system used today. This is further illustrated in Table 1 and Table 2.

MULTI UNIT GRAFTS (MFU’S)

The category of Multi Follicular Unit (MFU) Grafts refers to the diverse population of grafts that contain more than one FU. This heterogeneous population of grafts is further sub-classified with respect to their shape (i.e. whether they are created to fit a slit, slot or round incision) and the average numbers of hairs (or FU’s) they contain. The following is a classification system for Multi Follicular Unit Grafts.

1. “Traditional” Slit Grafts are cut “to size”. They are cut thin and flat in order to fit into slit incisions. Ideally, they should be one FU wide with the hairs (or FU’s) lined up one behind the other, thus decreasing the potential for lateral hair compression and the need for removal of recipient area tissue. Traditional slit grafts are designated as small, medium or large, based on the average numbers of hairs (or FU’s) they contain:
   - Small slit grafts- 3 to 5 hairs or ~ 2 FU’s.
   - Medium slit grafts - 5-8 hairs or ~3 FU’s.
   - Large slit grafts - 6-12 hairs or ~ 4+ FU’s.

The most common traditional slit grafts used today are small slit grafts followed much less commonly by medium slit grafts with very few physicians using large slit grafts.

2. “Micro” Slit Grafts are an increasingly popular and relatively new classification of graft. They are slit grafts that are cut with magnification to contain as “specific number of FU’s”. When slit grafts are created in this manner, instructions can be given to search the more closely approximated pairs of FU’s. This, in turn, allows the creation of a population of slit grafts that are smaller in size than traditional slit grafts yet still have an equivalent numbers of hairs. For this reason we call them “micro-slit” grafts and a distinction is now made between “traditional” slit grafts and “micro-slit” grafts. Micro-slit grafts are designated as:
   - DFU Graft- Double follicular unit containing exactly 2 FU’s.
   - TFU Graft - Triple follicular unit containing exactly 3 FU’s.

The most popular micro-slit graft used today is the DFU.

3. Slot grafts are multi follicular unit grafts that are also usually cut to size. Ideally they should be two FU’s wide and rectangular in shape to fit slot-shaped incisions. Slot grafts are wider and contain more epithelium than slit grafts and therefore have a greater potential for compression of adjacentely situated FU’s. However, the removal of recipient tissue with a slot punch creates an incision that matches the shape and size of the graft and eliminates this potential for compression. The most common slot punches manufactured and used today are the Redfield (Hitzig) slot punches, which come in 2.5 mm, 3.8 mm, and 4.8 mm lengths. We therefore divide slots grafts like other MUGs into small, medium and large as follows:
• **Small slot grafts** – 2.5 mm in length and 5-8 hairs or ~ 4 FU’s.
• **Medium slot grafts** - 3.85 mm length and 8-12 hairs or ~ 6 FU’s.
• **Large slot grafts** - 4.1 mm length and 10 to 16+ hairs or ~ 8 FU’s.

From a practical standpoint, the most commonly used slot grafts today are small slot grafts with very few physicians using larger slot grafts today.

4. **Round grafts** - Round grafts are also cut “to size”. With the onset of strip harvesting most round grafts are created from strips of donor tissue and are therefore more square or rectangular than round. They are called round grafts because they fit into a round recipient site created by different sized punches. Round grafts (like slot grafts) also have the potential to be compressed if placed into too small a recipient site. The removal of recipient site tissue with an appropriately sized punch reduces this potential. As with other multi follicular unit grafts we divide round grafts into *small, medium, and large*, based on the average number of hairs or FU’s they typically contain:

- **Small round grafts** - are defined as containing from 5-8 hairs (~2-3 FU’s) and typically fit into a round recipient site created by a 1.25 to 1.5 mm punch.
- **Medium round grafts** - are defined as containing from 8-10 hairs (~4 to 5 FU’s). They generally fit into a round recipient site made by a 1.5 to 1.75 punch.
- **Large round grafts** - are arbitrarily defined as containing from 10 to 14 hairs (~5-7 FU’s) and usually require a punch recipient site greater than 1.75 to 2 mm in diameter.

**Standard round Punch graft** The original larger standard 4 mm punch graft fits into this group of a large round punch graft. Arbitrarily we place all grafts that fit into a punch greater than 2.0 mm into this category.

*From a practical standpoint, large punch grafts are seldom used any more.* Small and medium punch grafts are still used by some physicians in select patients with the inter density in small localized areas.

MICROGRAFTS
The category of Micrografts refers to either intact FU grafts or Sub Follicular Unit (SFU) Grafts created when hairs are vertically split off from an intact FU).

1. **Follicular Unit (FU) Grafts**  As stated above, with the observation that hair seems to cluster together in natural groupings of 1 to 4 hairs, came the practice of creating micrografts that kept these natural groupings together. These have been called **FU grafts**.

The term *chubby vs. skinny* has been applied to FU grafts. In the early years of total Follicular Unit Transplantation (FUT), grafts were often made *skinny* and extensively trimmed of as much epithelium and extra tissue as possible. This extensive trimming created very tiny fragile grafts with unprotected hair shafts that were potentially more susceptible to graft trauma and especially dehydration. In addition, unseen telogen follicles were at risk of being discarded in this process. This may have contributed to some of the poor densities seen with early total FUT. A modification in the technique has been the preparation of *chubby or pear-shaped grafts* which still includes the intentional trimming away of excess epithelium but leaves more tissue around the inferior and mid-porion of the graft. I believe the term *chubby* is a misnomer, as these grafts are still smaller than FU grafts (with equivalent amounts of hair) where deliberate shaping and trimming of the graft does not occur. However, they definitely contain more tissue than the older *stripped or skinny* FU grafts. Today with the trend toward dense packing and smaller incisions grafts are being trimmed more extensively than in the past but still retain some surrounding tissue.
When describing a procedure it has become important to not only say the total number of FU grafts used but to also list the breakdown of 1-4 hair FU grafts that were moved. This information is crucial for the continuing communication between physicians when comparing techniques and evaluating results.

2. **Sub Follicular Unit (SFU) Graft** - Originally most micrografts consisted of SFU grafts created by cutting away a 1 or 2 hair graft from a larger graft. Today most of the time FU grafts are kept intact.

The distinction between intact FU grafts and SFU grafts is subtle and it is not always necessary to distinguish because from a practical standpoint a one hair graft or two hair graft behaves basically the same whether it started out as an intact FU graft or was created as a SFU graft from a larger graft. However it is necessary to understand this concept and the difference between the two because on occasion it has clinical significance. The following are two examples:

- When one is trying to do eyebrow or beard transplants there is no need for three or four hair grafts. In these situations three and four hair intact FU grafts would be split into one and two hair SFU grafts.

- Another example may be when one attempts to highly dense pack a hairline to a density 50 FU/cm in one pass. This may be appropriate in a 50 years old male with only minor hair line recession, normal density behind the recession, and great density. In this patient you do not want a lot of three and four hair grafts and may need more one and two hair graft than the donor area will supply with its “natural” distribution. Once again in this situation three and four hair intact FU grafts would be split into one and two hair SFU grafts.

When interpreting the “true” hair density of grafts placed in different recipient areas it is important to know the size of the grafts used in that area. For example if someone dense packs a hairline with 50 FU/cm and the majority of the hairs are 1 hair FU’s than the hair density will be ~ 50 hairs/cm (50 x 1 = 50). On the other hand in the central core, if the grafts are placed at a density of 35 FU/cm but the majority of the grafts are 3 FU’s than the true hair density in this area would be 105 hairs/cm (35 x 3 = 105). Although the recipient sites were made were made at a density of 35/cm the actual hair density is 3 times higher. Without this knowledge one may incorrectly assume that the 50 incisions per cm created more hair than the 35 incisions per cm.

It is important to communicate to other physicians when this is done as it has clinical implications such as not needing to take as large a donor strip to get the required grafts.

3. **Follicular Family Grafts (FFs)** - The follicular family graft has been described by Seager and also by Tykocinski who called it a “follicular grouping”. They are the same entity and we prefer the term “follicular family” grafts. Follicular family grafts look very similar to FU grafts except FF’s contain from 4-6 hairs. It is often difficult to tell whether this entity consists of two very closely approximated individual FU’s or a single FU with a greater than usual number of hairs. Generally, two adjacent FU’s in the donor area are spaced approximately 1 mm apart (ranging from 0.2 mm to 1.2 mm) and it is usually fairly obvious, on casual observation, that each FU is an individual entity. FFs on the other hand contain may consist of two individual FU’s that are spaced so close together (~2 mm or less) that they appear to potentially be a single unit. As stated above, from a practical standpoint, an assistant cutting grafts often has trouble being sure if the entity consists of two separate FU or a single unit with a greater number of hairs.

Although FFs can often contain 5-6 hairs, they share many similarities with larger 4-hair FU grafts (i.e. they are similar in anatomical size, will fit into similar size micro-slits, and can be placed at similar densities). Due to these similarities, we have placed FFs in the category of micrografts.
4. **Follicular Pairing** - Some physicians have described the practice of placing two individual intact FU grafts into a single linear incision. Shapiro has called this process “**FU pairing**” and Harris has called it “Recombinant FU grafting”. With this technique, a 2-hair graft can be artificially created by combining a pair of 1-hair grafts; a 3-hair graft can be created by combining a 1- and 2-hair graft; a 4-hair graft can be created by combining a pair of 2-hair grafts. The minimal tissue and small size of FUGs allows for the process of **FU pairing**. In general this technique is used in situations where more 1-hair grafts are created than needed, while, at the same time, it was preferable to have a greater number of 2- to 3-hair FU grafts in selected areas where higher density is desired. For example if one is finished with the hairline and is now doing the central core but still has a number of 1 hair grafts available it may be better to combine them into two or 3 hair grafts for use in that area.

**GRAFT TERMINOLOGY SUMMARY**

From the above discussion it should be fairly obvious that describing a graft simply by the number of hairs is not specific enough. When one talks about a graft containing from 4-6 hairs they could be referring to a four hair FUG, a 5-6 hair FF graft, a 4-6 hair DFU micro-slit graft, or a traditional 4-6 hair small slit graft cut “to size”. Although each of these grafts may contain similar numbers of hairs, they differ in respect to their anatomic size. This, in turn, bestows different clinical characteristics with respect to the size of the incision used and how close they can safely be placed in a single session. This is one reason we cannot use a terminology for grafts that is only based on their number of hairs.

In a similar fashion, we cannot simply refer to grafts by their anatomical size because variations in donor hair density will create significant differences in the actual amount of hair that various sized grafts contain. Just saying “micrograft” and “minigraft” is obviously not specific enough. The graft terminology system proposed here is built on accepted past terminology yet more specific with respect to size and shape of the grafts. It reflects what is commonly being used today and, if used, will help us better evaluate different techniques.
### GRAFT TERMINOLOGY AND CLASSIFICATION TABLES

#### Table 1 – Micrograft Classification and Terminology

<table>
<thead>
<tr>
<th>GRAFT TYPE</th>
<th>HAIRS/ GRAFT</th>
<th>FU’S/ GRAFT</th>
<th>CUTTING PROCESS</th>
<th>RECIPIENT SITE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Follicular Unit (FU) Graft</td>
<td>1-4</td>
<td>1</td>
<td>Cut To “number of hairs”</td>
<td>Needle/ Micro-slit</td>
</tr>
<tr>
<td>Sub-Follicular Unit (SFU)Graft</td>
<td>1-2</td>
<td>&gt;1</td>
<td>Cut To “number of hairs”</td>
<td>Needle/ Micro-slit</td>
</tr>
<tr>
<td>Follicular Family Graft (FF)</td>
<td>5-6</td>
<td>1 (?)</td>
<td>Cut To “number of hairs”</td>
<td>Needle/ Micro-slit</td>
</tr>
</tbody>
</table>

1. Micrografts refer to either an intact FU graft or Sub-follicular (SFU) graft (created when hairs are vertically split off from an intact FU).

2. Slit grafts are cut thin and flat to fit into slit incisions. Ideally, they should be one FU wide with the hairs lined up one behind the other. In the past, they were most commonly cut "to size" and were designated as either small, medium, or large slit grafts based on the average number of hairs (or FUs) they contained. Today, a second category of slit grafts called “micro-slit grafts” exist in which they are cut with magnification to deliberately contain an exact number of FUs. When cut in this manner, we now designate them as micro–slit grafts. The most commonly used micro slit graft is the DFU which contains 2 follicular units.

3. Slot minigrafts are cut in a more rectangular shape in order to fit the size of a slot incision. Although they are usually cut “to size”, ideally, they should be two FUs wide. To prevent compression, slot grafts require the removal of tissue with a "slot punch".

4. “Round" minigrafts are inserted into round recipient site holes that are created with trephines or "punches". The grafts, however, are created from strips of donor tissue and are therefore more square or rectangular than round. Round minigrafts are usually cut “to size”.

5. Standard grafts are prepared like "round" minigrafts and are inserted into holes made by trephines that are larger than 2 mm in diameter. The latter are most commonly 3.25 to 3.5 mm in diameter. While they have been called "standard" grafts for many years, because they are so rarely used today, this is a misnomer.

#### Table 2 – Multi Follicular Unit (MFU) Graft Classification and Terminology

<table>
<thead>
<tr>
<th>GRAFT TYPE</th>
<th>HAIRS/ GRAFT</th>
<th>FU’S/ GRAFT</th>
<th>CUTTING PROCESS</th>
<th>RECIPIENT SITE</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>MICRO-SLIT GRAFTS</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Double FU Graft (DFU)</td>
<td>3-5</td>
<td>2</td>
<td>Cut to “number of FU’s”</td>
<td>Slit</td>
</tr>
<tr>
<td>Triple FU Graft (TFU)</td>
<td>5-8</td>
<td>3</td>
<td>Cut to “number of FU’s”</td>
<td>Slit</td>
</tr>
<tr>
<td><strong>TRADITIONAL SLIT GRAFTS</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Small Slot Graft</td>
<td>3-5</td>
<td>~2</td>
<td>Cut to “Size”</td>
<td>Slit</td>
</tr>
<tr>
<td>Medium Slot Graft</td>
<td>5-8</td>
<td>~3</td>
<td>Cut to “Size”</td>
<td>Slit</td>
</tr>
<tr>
<td>Large Slot Graft</td>
<td>6-12</td>
<td>~4</td>
<td>Cut to “Size”</td>
<td>Slit</td>
</tr>
<tr>
<td><strong>SLOT GRAFTS</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Small Slot Graft</td>
<td>6-8</td>
<td>~4</td>
<td>Cut to “Size”</td>
<td>Slot</td>
</tr>
<tr>
<td>Medium Slot Graft</td>
<td>8-12</td>
<td>~6</td>
<td>Cut to “Size”</td>
<td>Slot</td>
</tr>
<tr>
<td>Large Slot Graft</td>
<td>10-16+</td>
<td>~8</td>
<td>Cut to “Size”</td>
<td>Slot</td>
</tr>
<tr>
<td><strong>ROUND GRAFTS</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Small Round Graft</td>
<td>5-8</td>
<td>~2-3</td>
<td>Cut to “Size”</td>
<td>Punch</td>
</tr>
<tr>
<td>Medium Round Graft</td>
<td>8-10</td>
<td>~4-5</td>
<td>Cut to “Size”</td>
<td>Punch</td>
</tr>
<tr>
<td>Large Round Graft d</td>
<td>10-14+</td>
<td>~6-15+</td>
<td>Cut to “Size”</td>
<td>Punch</td>
</tr>
<tr>
<td>Standard Punch Graft</td>
<td>15-30</td>
<td></td>
<td>Cut to “Size”</td>
<td>Punch</td>
</tr>
</tbody>
</table>

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