Follicular Unit Transplantation: Comparison of Video Microscopic vs. Combination Methods

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Background In 2004, Sharon Keene introduced a video microscope to the hair transplant field and discussed about the benefits such as ergonomics, quality assurance, and easy teaching. In 2009, our clinic set up digital video microscope systems. CCD-chip-loaded hand-held digital video microscope was connected to a 19-inch high definition (HD) LCD monitor. We compared the transection rates and graft-cutting time of two graft-dissecting methods to decide which one is more efficient.

Methods Two technicians performed follicular unit graft dissection via two different methods of video microscopic and a combination of video microscope for slivering and loupe magnification for graft-cutting. All the procedures were recorded on high-definition digital video camera and cross-checked on the video clips.

Results The transection rate of digital video microscope use was 2.2% while the combination method 1.6%. For comparison of graft-producing time, the combination method could produce about equal amount of grafts in 186% faster the time.

Conclusions The work efficiency was greater with the combination method. The total graft productivity was nearly 2 times larger while the transection rates of two methods showed very close results.

Keywords Follicular unit transplantation, Transection rates, Microscopic dissection

INTRODUCTION

Since Limmer first introduced binocular optic microscopes in 1988 [1], its use for slivering and graft-cutting has been widely used. In 2004, Sharon Keene introduced a video microscope to the hair transplantation field. She also discussed about advantages of it as follows: ergonomics, quality assurance, and easy teaching [2].

In 2004, Paul T. Rose and Ron Shapiro published the first comparison of transection rates between the combination method of multi-bladed knife slivering and loupe magnification graft-cutting versus binocular microscopic graft-dissecting [3].

In 2009, our clinic newly set up the video microscope systems with its latest products. Sony CCD-chip-loaded hand-held digital video camera, Samsung 19-inch HD (high definition) LCD monitor, an LED ring-light source, and a multi-stand were the instruments as a complete system [4]. The CCD-chip-loaded digital video microscope was originally developed for inspecting semiconductor factories. Since the digital video camera was intended for massive production, the price of our system could be also reasonable.

Our purpose is to evaluate the transection rates and productivity of graft dissection under 2 different methods. The first one is a video microscopic method, and the second one is a combination method.

We compared the transection rates and graft-cutting time of two graft-dissecting methods to decide which one would be more efficient and accurate.
METHODS

Twelve of 0.5 cm-length strip sections was obtained from each 6 hair transplantation patients’ horizontal ellipse of the mid-occipital portion. All patients were ethnic Koreans with black-colored hair. The widths of strips were from 1.3 cm to 1.9 cm.

For donor strip harvesting, we used Haber spreader. The operator first makes a superficial incision no deeper than 2 mm on the scalp along the strip design then hires Haber spreader to separate the tissue without further transecting the hair follicles [5].

Digital video microscopic graft-dissecting method (Fig. 1) and combination method of digital video microscopic slivering and graft cutting with 2.5x loupes (Fig. 1) were compared for transection rates and graft-producing time. After slivering under 20x digital video microscope, 2 technicians perform graft-cutting with 2 different methods; half of slivers with a digital video microscope while the other half with loupes on all 6 patients. It could deliver more reasonable and reliable comparison.

For both methods, an LED ring-light source was employed and attached to the one end of the CCD microscope (Fig. 2). Integral light sources were not used since the light reflecting on water used for hydration of hair follicles. It decreased the visuality [4].

All the procedures were recorded on an HD video camera for each patient. For digital video microscopic slivering and graft-cutting, works of both technicians were recorded by a single shot. And graft-cutting with loupes was separately recorded with an HD video camera. The first data was taken when the video clips were recording. Then, two reviewers were cross-checked on the
video clips to measure transection rates, slivering time, and graft-cutting time for the written data.

Our definition of transection stands for the transections of hair shafts below epidermis level. For counting transected follicles, ones during strip harvesting with Haber spreader were not included. Only ones which were checked in the video clip were counted. The survival rate of transected hair follicles is directly related to level of transection [5]. And, the figures were confirmed as two reviewers checked the data over again.

RESULTS

For the results of only use of digital video microscope, two technicians produced a total of 522 grafts (1,125 hairs) for 5,415 seconds. The transection rate was 2.2%, and the average graft-producing rate was about 348 grafts/hour (Table 1).

For the results of the combination method, the two same technicians produced a total of 528 grafts (1,039 hairs) for 2,917 seconds. The transection rate was 1.6%, and the average graft-producing rate was about 588 grafts/hour (Table 2).

For producing nearly equivalent number of grafts, the combination method performed in about 186% faster the time with 0.6% less the transection rate.

DISCUSSION

The visuality of a digital video microscope system is comparably good to binocular optic microscopes. However, one little lacking feature of a digital video microscope is its less 3D effect. The comparison of overall image to binocular optic microscope is just that much decreased. Our technicians took about 3 months to adapt to its less 3D effects.

When our technicians prepare the last step of graft-cutting, we perform through our original “finger-rolling and blade-flipping techniques.” The techniques are for cutting the grafts in 3D-teardrop shape which assembles the natural hair follicles without squeezing trauma of forceps.

Most clinics do not use a microscope for slivering as the focus cannot be maintained on handling a thick piece of tissue [6]. But, video image is resolved this problem of focus. The video microscopic method at slivering is more accuracy and easier handling than only loupe or microscopic method. So, we used video microscopic method at slivering in all cases of this study.

Using advanced technology with CCD-chip-loaded hand held digital video camera, LCD monitor and LED ring-light source (Fig. 3), our digital video microscopic system optimize setting and overcome the technical limitation on video camera setting and backlighting of previous study. Our study showed that the graft

Table 1. Transection and graft-dissection rates only under 20x digital video microscope system

| Patient | Created FUs (Hair count) | Running time | Transected hair | Hair transection rate (%) | Speed of graft dissection (sec/graft) |
|---------|--------------------------|--------------|-----------------|--------------------------|--------------------------------------|
| 1       | 109 (244)                | 18'13"       | 2               | 2.0                      | 9.9                                  |
| 2       | 97 (207)                 | 16'01"       | 3               | 3.0                      | 9.8                                  |
| 3       | 77 (162)                 | 12'09"       | 2               | 2.4                      | 9.5                                  |
| 4       | 73 (141)                 | 11'27"       | 2               | 2.9                      | 9.8                                  |
| 5       | 69 (141)                 | 12'37"       | 1               | 2.1                      | 11.8                                 |
| 6       | 97 (200)                 | 19'48"       | 1 me           | 0.5                      | 10.9                                 |
| Total sum | 522 (1,125)           | 90'15"       | 11              | -                        | -                                    |
| Mean    | 87 (188)                 | 15'03"       | 1.8             | 2.15                     | 10.3                                 |

Average graft-producing rate: 348 grafts/hour.

Table 2. Transection and graft-dissection rates under the combination method of 20x digital video microscopes and 2.5x loupes

| Patient | Created FUs (Hair count) | Running time | Transected hair | Hair transection rate (%) | Speed of graft dissection (sec/graft) |
|---------|--------------------------|--------------|-----------------|--------------------------|--------------------------------------|
| 1       | 113 (153)                | 10'06"       | 1               | 0.3                      | 5.3                                  |
| 2       | 95 (203)                 | 7'37"        | 4               | 1.9                      | 4.7                                  |
| 3       | 78 (164)                 | 7'31"        | 2               | 1.2                      | 5.7                                  |
| 4       | 64 (152)                 | 6'12"        | 4               | 2.6                      | 5.9                                  |
| 5       | 60 (123)                 | 5'18"        | 3               | 2.4                      | 8.9                                  |
| 6       | 118 (244)                | 11'53"       | 3               | 1.2                      | 6.0                                  |
| Total sum | 528 (1,039)           | 48'37"       | 17              | -                        | -                                    |
| Mean    | 88 (173)                 | 8'06"        | 2.8             | 1.6                      | 6.1                                  |

Average graft-producing rate: 588 grafts/hour.

Fig. 3. CCD-loaded hand-held video camera, 19-inch HD LCD monitor, a ring-light source, and a multi-stand as a full set.
yields using slivering under video microscope and cutting under loupe magnification is most efficient. In cutting under loupe magnification, Asian is more adaptable than Caucasian. It’s for Asian hair characterizes high caliber, more definite contrast to skin color, and low density [7].

CONCLUSION

The graft productivity was about 588 grafts/hour for the combination method. The data showed that the work efficiency was about two times greater with the combination method. The combination method showed equivalent transection rates with the two-fold faster graft-cutting time than the digital video microscopic method.

The total graft productivity was nearly two times greater with the combination method, and transection rates of two methods showed very close results. For maximizing graft production, the combination method is more efficient with faster graft-cutting time.

As our clinic has performed over 400 hair transplantation cases with the video microscopic graft preparation, the digital video microscope system has outstanding qualities in terms of ergonomics, graft-quality control, and easiness of teaching.

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