Split or flattened hair direction around the parietal whorl (PW) can be cosmetically problematic. Patients with such whorls may appear to have hair loss because the scalp is visible. Some patients report severe disruptions in their social life, and some patients fear that others assume that they did not properly wash their hair and are lazy or unhygienic. Particularly, some affected patients are unable to go out in public or on a date without wearing a hat because of clumpy or greasy hair that looks as if it has not been shampooed for several days. People experiencing this condition tend to be under an extreme amount of emotional stress or to suffer from an inferiority complex.

In most such cases, we have historically performed hair transplantation to create a camouflage. However, inadequate space is available to create a slit in the interfollicular space for the hair transplants. Hair growth takes place in a whirl-like pattern, making it even more difficult to ameliorate the see-through appearance.

Although hair transplantation may be successful and exhibit good transplant survival, it does not successfully decrease the visibility of the scalp in the vertex area. However, we have observed relatively good outcomes after the scalp medical tattooing (SMT) technique.

### MATERIALS AND METHODS

This retrospective study was approved by the internal institutional review board of Korea National Institute of Bioethics Policy (IRB No. 2015-0288-001).

We performed SMT in 38 patients who were admitted for camouflage of a bifid PW. Six of these 38 patients had a history of ineffective hair transplantation surgery. The 38 patients comprised 34 women and 4 men. The average patient age was 33.4 years (range, 20.0–58.0 years).

The procedure techniques used in this study were identical to those used in the authors’ previously published article on applying SMT to treat bifid Parietal Whorls.

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scalp alopecia.\textsuperscript{1} We only used jet black color ink of a commercial product. Patient follow-ups were performed at 2 and 6 weeks after the procedure. A slight touch-up procedure was performed to correct partially faded tattoo dots in 24 patients (63%). The mean follow-up duration was 12.3 months (range, 8–24 months).

RESULTS

Overall, the patients’ cosmetic appearance was markedly improved as judged by both the patients and the surgeon. No specific complications occurred, such as infection, hair loss in the operative field, or other problems.

One case involved treatment of a simple anterior type split PW in a 31-year-old woman. She was under great emotional stress from being teased about appearing to have vertex alopecia. Twenty-four months after SMT, the scalp visibility in the split region had markedly decreased (Fig. 1).

Another case involved treatment of a complex (severely split and flattened) PW in a 27-year-old woman (Fig. 2). Her hair around the PW was severely flat and split, and she was told that it appeared she had not washed her hair for several days. She could not go out in public or on a date without wearing a hat; she even quit a job that required working in an office environment because social etiquette does not allow for wearing hats in an office.

DISCUSSION

PWs are normal occurrences. The direction of growth of the hair follicle is determined at 10 to 18 weeks of gestational age. The hair follicle orientation that is determined during this period remains unchanged for the rest of a person’s life. The hair surrounding the PW may grow either counterclockwise or clockwise. No clear factor that determines the direction of hair growth around the PW has yet been discovered.\textsuperscript{2,3}

A classification system for PW patterns has been described. Ziering and Krenitsky\textsuperscript{4} described five different patterns of PWs: the Z, S, DSS, DSZ, and diffusion patterns (Fig. 3). The diffusion pattern refers to diverse directions of hair growth with multiple foci that surround the PW. The authors reported that the diffusion pattern is present in 9.8\% of males and 77.8\% of females. They also described differences in the incidence of this pattern among different ethnic groups. The diffusion pattern is reportedly more common among African American females and less common among white men.

In Asians, hair strands tend to be less dense, thicker, straighter, and darker; East Asians, however, have the lightest skin color among all Asians. Such a
characteristic has great clinical importance. For example, these patients visit the clinic to treat vertex alopecia at relatively early stages of hair loss.

Bifid PWs can be considered similar in concept and cause esthetic problems. Individuals who are more sensitive to esthetic values can become stressed and seek ways to alleviate their condition.

After consultation with native English speakers and hair surgeons, we have named this split or flattened type of hair growth as “bifid PW.” However, we still wonder whether there is another term that better describes such a phenomenon. Regardless, we believe that this is a more descriptive term for such PWs than the “diffusion pattern” described by Ziering and Krenitsky. This is because the direction of hair growth does not exhibit a certain pattern around the PW; instead, the hair grows in various directions with separation or flattening. We have divided bifid PWs into simple and complex types depending on the direction of hair growth and degree of separation (Figs. 1, 2, and 4). Simple type was divided into anterior, lateral, and posterior types according to the direction of hair separation direction.

Complex type is similar in concept with what has been previously described by Ziering as diffusion pattern. It refers to the phenomenon of hair growing flattened all around the PW in 360 degrees. Bifid PW can be found anywhere on the scalp with the most typical type being the frontal whorl. However, frontal whorls can be only corrected via hair transplantation, and the only bifid whorl that can be camouflaged with the help of scalp medical tattoo is the PW. Thus, the authors confined the study population to those with bifid PWs. In case there happens to be any other similar type of esthetic problems occurring elsewhere in the scalp, such a method can equally be applied. Hair transplantation for patients with bifid PWs is minimally effective. Inadequate

Fig. 3. Ziering whorl classification. A, “Z” pattern. B, “S” pattern. C, “DSS” pattern. D, “DSZ” pattern. E, Diffusion pattern.

Fig. 4. Complex parietal whorl. A 31-year-old woman with a very severe form of split and flattened parietal whorl (complex type).
space is available to create a slit in the interfollicular space of the bifid sites for the hair transplants. Although hair transplantation may be successful and exhibit good transplant survival, it does not successfully decrease the visibility of the scalp in the vertex area in authors’ experiences. Consequently, we have designed a camouflaging technique that involves SMT (Fig. 5).

SMT

Medical tattooing is performed for different reasons in various areas of the human body, including the scalp.1,5–7 Park et al8 described the advantages of this technique according to their clinical experience with micropigmentation for scalp alopecia and scalp scarring. Medical tattoos have been employed under the names of dermography, medical tattoo, scalp micropigmentation (SMP, NHI, Seoul, Korea), and micropigmentation. However, a specific clinic registered SMP as their own trademark. Thus, Korean Society of Hair Restoration Surgery has officially agreed on the term Scalp Medical Tattoo (SMT) to designate the tattoo technique that is applied by a physician on the scalp for medical purposes.

We have confirmed that SMT may effectively reduce the scalp visibility in patients’ bifid PWs. When treating bifid PWs, the needle should not be positioned according to the growth of the adjacent hair (ie, at an acute angle from the scalp) even though the hair around the PW grows in a whirl-like shape. Thus, it is very important to maintain the needle at a 90-degree angle from the skin surface regardless of the angle between the hair and the scalp. This is the only way to create a tattoo dot at a consistent depth and of a consistent small size. The targeting depth for pigmentation is 1.5 mm on average (1—2 mm), where the upper papillary dermis is located.

Judging by the authors’ experiences, there are 4 important principles to accomplish natural SMT; one should mark the dot small, vividly, consistently, and in abundance to avoid unnatural results. One should also keep in mind that vertex hairs thin as the patient ages, and of course, there could be additional progress in alopecia. Therefore, dots need to be marked smaller than thought.

Importantly, this method is a camouflage technique that simply decreases the visibility of the scalp through the hair. Thus, the patient should be made aware of the fact that this method cannot provide the fullness that is provided by hair itself. A sufficient explanation must be given to patients, and their informed consent must be obtained before the procedure is performed because there is no other way to ameliorate the see-through appearance than to perform SMT.

Cautions

Application of tattoo or hair transplantation on the vertex area is controversial among hair surgeons. Therefore, one should take extreme caution on choosing a certain procedure, and there needs to be thorough counseling before the procedure. Also, attention should be given to patients with body dysmorphic disorder. Patients need to be thoroughly informed about what could happen in the future, and patients’ occupation, age, condition of possible safe donor area, and family history should be reviewed. Extra caution should always be taken in patients of young age. In treating young patients, the authors also have restricted
the surgical indications to professional dancers, actors, or those who serve in an occupation where they contact many people.

Patients should also be provided with the following information before the procedure. First, the tattooing effect may be inadequate if future hair loss occurs in the vertex region. Patients should be informed of possible hair thinning as an aging process and pigment fading over time. In patients with vertex alopecia, the medication history, history of adverse drug reactions, condition of the safe donor area for hair transplantation, and previous hair transplants should be carefully considered to identify proper indications for the procedure.

Moreover, although additional hair transplantation or tattooing can be performed in the future, pigment removal by a laser may be necessary. Tattoo removal may be difficult, and scarring may occur after laser treatment.

CONCLUSION

SMT appears to be an effective method that helps to camouflage the see-through appearance of bifid PWs.

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