



# Hair regrowth using a properly fitted scalp cooling cap during adjuvant chemotherapy for breast cancer

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## Abstract

Patients with breast cancer desire to avoid chemotherapy-induced alopecia because it induces mental stress during treatment. Scalp cooling can suppress chemotherapy-induced alopecia without increasing the risk of scalp metastasis; however, in certain cases, alopecia cannot be prevented. The use of properly fitted scalp cooling caps has not yet been explored in Asian patients. Here, we report a case of hair regrowth using a properly fitted scalp cooling cap during adjuvant chemotherapy for breast cancer. A 51-year-old Japanese woman who was recalled by screening mammography for grouped amorphous calcifications and architectural distortion visited our hospital. Preoperative diagnosis was cT2N0M0 cStage IIA. Sentinel lymph node biopsy revealed axillary metastasis; hence, left mastectomy and axillary lymph node resection were performed. Pathological diagnosis revealed ER/PgR-positive and HER2-negative invasive lobular carcinoma (pT3N2M0 pStage IIIA). Adjuvant chemotherapy comprising four cycles of docetaxel every 3 weeks as well as four cycles of FEC every 3 weeks was performed with scalp cooling. After the first cycle of docetaxel, a 10-cm oval hair loss patch was observed at the vertex of the patient's head. Assuming the scalp cooling cap was not efficiently in contact with the vertex of the patient's head, we modified and properly fit the scalp cooling cap. After the third cycle of docetaxel, hair regrowth at the vertex began and gradually increased during chemotherapy. The patient did not require hair wigs during and after adjuvant chemotherapy. The scalp cooling cap should be carefully fitted at the vertex of the head, which is difficult to be covered, particularly in the case of Japanese patients. In addition, further development of properly fitted scalp cooling caps suitable for various individuals is necessary.

**Keywords** Breast cancer · Scalp cooling cap · Hair regrowth · Adjuvant chemotherapy · Alopecia

## Introduction

Patients with breast cancer often suffer from various concerns owing to estrogen suppression, sexual dysfunction, pain, cancer recurrence possibility, and chemotherapy-induced alopecia [1]. Patients desire to avoid chemotherapy-induced alopecia because it can induce mental stress [2]. Since the 1970s, scalp cooling has been used to prevent chemotherapy-induced alopecia [3]. With the development

in devices, which can keep the scalp temperature low more consecutively for a long time, scalp cooling has more efficiently prevented chemotherapy-induced alopecia in affected patients than that decades ago [4–7]. Furthermore, recent studies have shown that scalp cooling is associated with fewer side effects that lead to the risk of scalp metastasis [7, 8]. However, scalp cooling is not popular in Japan; a possible reason for this is that properly fitted scalp cooling caps are not yet explored in the Japanese population owing to fewer large-scale clinical trials regarding scalp cooling. Here, we report a case of hair regrowth using a properly fitted scalp cooling cap during adjuvant chemotherapy for breast cancer.

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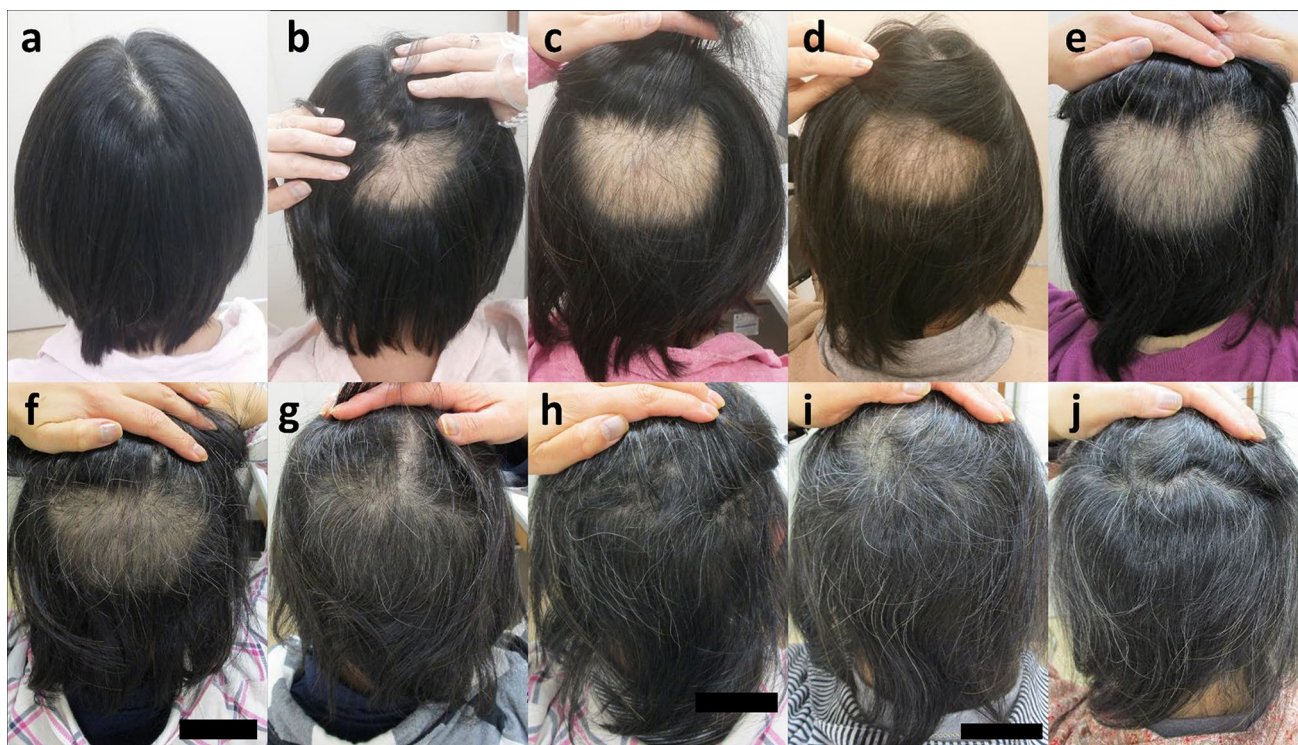
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## Case report

A 51-year-old Japanese postmenopausal woman with no past medical history was recalled by screening mammography for grouped amorphous calcifications and architectural distortion and visited our hospital. Ultrasonography and magnetic resonance imaging revealed a 40-mm non-mass lesion in her left breast. Core needle biopsy of this lesion revealed invasive lobular carcinoma. Preoperative staging was cT2N0M0 cStage IIA. Because axillary metastasis was found in one of the one sentinel lymph node, left mastectomy, and axillary lymph node resection were performed. Pathological diagnosis revealed invasive lobular carcinoma (invasive lesion: 90 mm, ER/PgR: positive, HER2: negative, lymph node metastasis 5/7). Final staging was pT3N2M0 pStage IIIA. Adjuvant chemotherapy comprising four cycles of docetaxel every 3 weeks (75 mg/m<sup>2</sup> on day 1) and four cycles of FEC every 3 weeks (epirubicin: 100 mg/m<sup>2</sup>, cyclophosphamide: 500 mg/m<sup>2</sup>, and 5-FU: 500 mg/m<sup>2</sup> on day 1) was performed with scalp cooling, followed by radiation and adjuvant endocrine therapies. The Paxman scalp cooling system (Century Medical Co., Tokyo, Japan) was used to prevent chemotherapy-induced alopecia.

Scalp cooling cap size “S” was the most appropriate for our patient’s head. She had a brachycephalic skull, which is typical among Japanese women [9]; the biparietal (side to side) and occipitofrontal (front to back) diameters of her head were 150 and 180 mm, respectively. For scalp cooling, her hair was first thoroughly wetted. Next, a commercial hair treatment agent was applied to the entire hair, and a pre-cooled scalp cooling cap was attached 30 min before infusing the anticancer drug. Further, her head was kept chilled at a skin temperature of 19 °C during chemotherapy and kept cool for up to 90 min after terminating the anticancer drug infusion. Her head was checked and photographed at every stage.

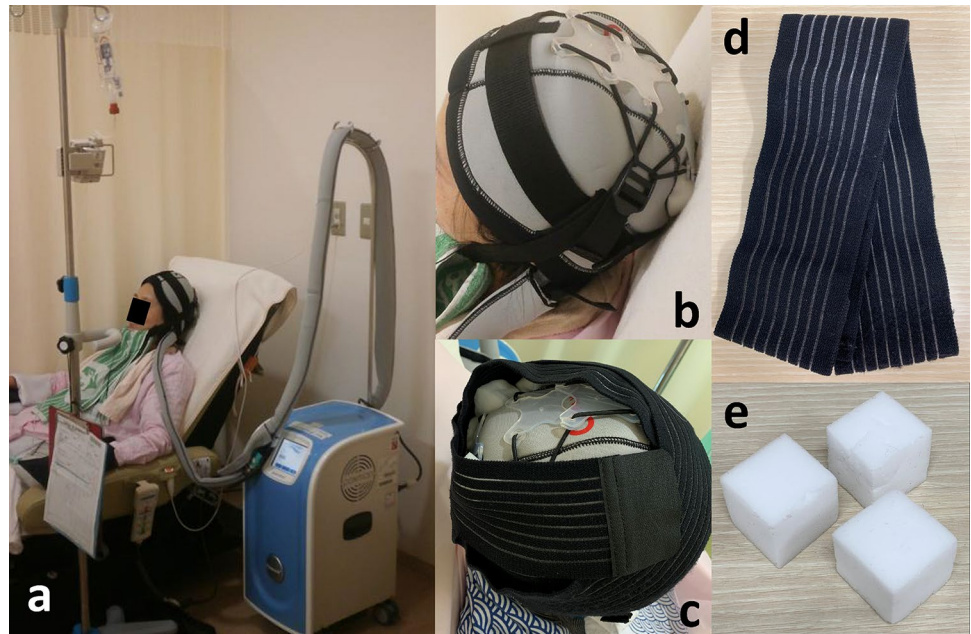
After the first cycle of docetaxel, a 10-cm oval hair loss patch was observed at the vertex of her head (Fig. 1a, b). Assuming the scalp cooling cap was not efficiently in contact with the vertex of her head, we modified and properly fit the scalp cooling cap. A lap supporter and sponge were used to fit the scalp cooling cap such that the cap adhered to the entire head (Fig. 2). In addition, the patient was allowed to watch instructional videos on how to wear a scalp cooling cap on the Paxman USA website to improve her understanding. Although the hair loss spread after the second cycle of docetaxel (Fig. 1c), hair regrowth at the vertex began after the third cycle (Fig. 1d) and gradually improved during



**Fig. 1** **a** The vertex of the patient’s head before chemotherapy; after the **b** first, **c** second, **d** third, and **e** fourth cycles of docetaxel administration every 3 weeks (75 mg/m<sup>2</sup> on day 1); and after the **f** first, **g** sec-

ond, **h** third, and **i** fourth cycles of FEC administration every 3 weeks (epirubicin, 100 mg/m<sup>2</sup>; cyclophosphamide, 500 mg/m<sup>2</sup>, and 5-FU, 500 mg/m<sup>2</sup> on day 1). **j** One month after the end of chemotherapy

**Fig. 2** **a** Patient wearing the scalp cooling cap during chemotherapy and **b** before and **c** after modification with **d** a lap supporter and **e** sponge



chemotherapy (Fig. 1e–j). She did not require hair wigs during and after adjuvant chemotherapy.

## Discussion

The type of chemotherapy, proper fitting of the scalp cooling cap, and intrinsic characteristics of patients influence the effects of scalp cooling during chemotherapy [4]; the present case report focuses on the importance of a properly fitted scalp cooling cap.

Scalp cooling induces hair regrowth during chemotherapy even when initiated after hair loss. Some cases have reportedly experienced hair regrowth using scalp cooling even after hair loss during chemotherapy without scalp cooling [10, 11]. However, no head cover rates, which are the ratios of the patients without wigs, vary depending on the type of chemotherapy. A previous study showed that the no head cover rate was relatively higher during docetaxel administration (61–94%) than during FEC administration (33–58%) [5]. Our patient underwent chemotherapy with scalp cooling and suffered hair loss during docetaxel every 3 weeks; however, her hair regrew during docetaxel every 3 weeks after the scalp cooling cap was properly fitted. Therefore, our results especially indicate that a modified and properly fitted scalp cooling cap resulted in hair regrowth because the other factors, i.e., the type of chemotherapy and the intrinsic characteristics of patients, had less impact on her hair regrowth.

It is necessary to understand the intrinsic characteristics of patients to properly fit the scalp cooling cap. In particular, the results may vary based on patient's ethnic backgrounds. van den Hurk et al. reported that the no head cover rate was

lower in Asians (33%) than that in West Europeans (51%) [5] and suggested two reasons for this observation. The first reason is that the maximum tolerable chemotherapy is lower and the toxicity rate is higher in the Asians than in the West Europeans. The second reason is that mechanical properties of hair and hair growth rate differ among the Asians and West Europeans. The present case revealed that the skull shape is another reason for the lower no head cover rate in Asians. Cephalic index, an indicator of the skull shape, is the ratio of the maximum width (side to side) to the maximum length (front to back) of the head. Japanese women tend to have a brachycephalic (short-headed) skull with a cephalic index of  $> 82\%$  [9]. Therefore, clinicians need to ensure that the scalp cooling cap adheres to the entire head of Japanese patients wearing caps designed to fit West Europeans with a mesocephalic or dolichocephalic skull. It is geometrically difficult for the scalp cooling cap designed for patients with a dolichocephalic skull to adhere to the vertex and front of the head of a patient with a brachycephalic skull. Furthermore, the scalp cooling cap is easier to be modified to better fit the front of the head than the vertex; however, in that case, the scalp cooling cap would not further adhere to the skin at the vertex. We assumed this to be the reason for hair loss in only the vertex of our patient's head.

In case of Japanese patients, there are three solutions to prevent hair loss at the vertex of the head during chemotherapy with scalp cooling. First, the medical staff should convey if the scalp cooling cap is barely in contact with the skin at the vertex of the head. We used a lap supporter and sponge to ensure that the scalp cooling cap completely adheres to the head, particularly at the vertex. Second, patient education is essential because it is easier for the patient himself



to feel if the scalp cooling cap is well-fitted via the sense of touch. Our patient was allowed to watch instructional videos on how to wear a head cap on the Paxman USA website to improve her understanding. Third, the development of a new scalp cooling cap designed specifically for Japanese women will further prevent chemotherapy-induced alopecia. Furthermore, this problem can be solved by developing a scalp cooling cap using a material that can more easily adhere to the head.

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### Compliance with ethical standards

**Conflict of interest** The authors were lent the Paxman scalp cooling system for free from Century Medical Co. The authors have no financial relationship to Century Medical Co. or Paxman USA. These companies are not involved in this report. The authors declare that they have no other conflict of interest.

**Ethical approval** For this type of study, formal consent is not required.

**Informed consent** Informed consent was obtained from the patient included in the report.

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