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Original Article

Factors Affecting the Response and Patient Satisfaction of Topical Immunotherapy in Alopecia Areata: A Nationwide Study

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ABSTRACT

Background: Contact immunotherapy using diphenylcyclopropenone (DPCP) is a recommended treatment for severe alopecia areata (AA); however, few clinical factors are known, and few standardized application methods affecting therapeutic efficacy have been devised.
Objective: To confirm the therapeutic response of DPCP immunotherapy in AA, first we analyze the factors influencing its outcome and patient satisfaction levels, after which we standardize the DPCP treatment method for better outcomes.
Methods: We utilized a nationwide questionnaire-based survey to assess patient satisfaction and undertook a medical record review involving 412 patients currently undergoing treatment for DPCP.
Results: The patients' mean age was 36.4 years, and 27% of the cases were diagnosed as AA in childhood. Treatment response was higher when DPCP was used to treat the entire scalp, including subclinical lesions, and longer treatment durations and longer intervals between treatments were associated with a better treatment response. Atopy (atopic dermatitis, allergic rhinitis and bronchial asthma), thyroid disorder, and extent of hair loss were all negatively correlated with the treatment response. However, there was no correlation between the treatment response and factors such as the age of onset, a family history of AA, nail changes, or AA duration, which are commonly known to be associated with a poor prognosis.
Conclusion: DPCP immunotherapy is an effective treatment for AA, and the study demonstrated the factors affecting DPCP treatment response and patients' satisfaction and may contribute to standardizing the DPCP treatment method for better outcomes.

Keywords: Alopecia areata; Autoimmune disease; Diphenylcyclopropenone; Immunotherapy

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INTRODUCTION

Alopecia areata (AA) is an autoimmune skin disease that causes non-scarring alopecia. The cumulative lifetime incidence was estimated to be 2.1%, indicating a minor increase compared to the findings of a previous study[1]. The condition does not show any significant preference for a particular gender, and the average age of onset is 33 years. While approximately 30% to 50% of individuals experience spontaneous recovery within the first year of diagnosis, 14% to 25% of patients develop more severe forms, known as alopecia universalis and alopecia totalis, wherein the chances of recovery are minimal[2].

The psychological impact on patients with AA is significant, and this is not surprising given that the condition is chronic, relapsing, and unpredictable. AA has no established cure or preventive treatment, and most therapies focus on halting disease progression[3]. Though the USFDA recently approved JAK inhibitors as a severe AA treatment, JAK inhibitors are available only to a small portion of patients, as they are approved for severe AA and are expensive as well[4].

Contact immunotherapy is the best-documented treatment for severe or refractory AA[5]. Presently, squaric acid dibutyl ester and diphenylcyclopropenone (DPCP) are the two compounds that remain in active use. Despite being widely used worldwide, factors affecting therapeutic outcomes and patient satisfaction as regards this treatment method remain not well known[6]. Furthermore, the details of the administration of immunotherapy, including the treatment intervals and the extent of each application, lack standardization and are not well established, as they heavily rely on the experience of the clinician. This deficiency in standardization is primarily due to the absence of research that compares clinical responses and patient satisfaction levels with regard to different application methods. In order to reduce recurrence and maintain the effectiveness of immunotherapy, it is essential to standardize application methods based on objective data.

In this study, we utilized a nationwide questionnaire-based survey and chart reviews to confirm clinical efficacy. Also, we analyzed prognostic factors to identify patient and treatment factors predictive of therapeutic success.

MATERIALS AND METHODS

Participants

The study was conducted between May 1, 2022 and April 30, 2023. We enrolled 412 patients between the ages of 3 and 80 years who had been diagnosed with AA by a dermatologist and who had undergone DPCP therapy. We categorized AA into four subtypes: patchy type AA, alopecia totalis/universalis, and alopecia ophiasis to analyze treatment outcomes and satisfaction levels according to these AA subtypes. We excluded patients with other scalp disorders, such as seborrheic dermatitis, psoriasis, and other types of scarring alopecia. None of the research participants received any concomitant treatment; i.e., all received only the DPCP therapy.

We recorded the demographic characteristics and treatment-associated factors of patients who received DPCP for AA from 30 general hospitals in South Korea. Demographic data included age, sex, age of onset, previous treatment profiles, comorbidities, the presence of nail changes, and family history. In this research, we defined the category of atopy to include atopic dermatitis, allergic rhinitis, and bronchial asthma. We collected treatment-associated factors, including the extent of the disease, the disease duration, the application extent, the DPCP treatment interval, the duration between disease and the onset of immunotherapy, DPCP outcome, and adverse reactions after applying DPCP. We used the Severity of Alopecia Tool (SALT) and divided patients into three groups: mild and moderate (S0–S2, 0%–49%), severe (S3–S4, 50%–99%), and complete (S5, 100%), as classified previously[7,8].

Satisfaction questionnaire

A questionnaire was used to estimate the factors influencing patient satisfaction. We used the following five-point scale on this questionnaire: 1 (Very unsatisfied), 2 (Unsatisfied), 3 (Neutral), 4 (Satisfied), and 5 (Very satisfied).

Therapeutic efficacy

Percent scalp hair regrowth based on the SALT score was measured as follows: (SALT score after treatment – Baseline SALT score) / Baseline SALT score × 100. We classified therapeutic efficacy into four categories: no response (NR; 0%–24% improvement), minimal response (MR; 25%–49% improvement), partial response (PR; 50%–99% improvement), and complete response (CR; 100% improvement)[9].

Statistical analyses

We analyzed the data using IBM SPSS version 24.0 for Windows (IBM Corp., Armonk, NY, USA). Descriptive statistics were used to summarize the characteristics of the study population. The analysis of factors affecting treatment responses was conducted using the Chi-square test, while factors influencing patient satisfaction were assessed employing various statistical methods depending on the normality of the data. Specifically, when the data adhered to normal distribution, analysis of variance (ANOVA) and Student's t-test were employed. Conversely, in instances where normality assumptions were not met, the Kruskal-Wallis test and Mann-Whitney U test were utilized. A significance level of $p < 0.05$ was considered statistically significant.

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Ethics statement

The study design was reviewed and approved by the Institutional Review Board (IRB) of Chungnam National University Hospital (CNUH-IRB-2022-03-071). We also gained all other approvals from participating institutes where necessary.

RESULTS

Demographics

The demographic and clinical data are presented in **Table 1**. The study included 412 subjects with a median age of onset of 36.47 years. Most patients had prior treatments, including intralesional steroids (192, 46.6%); topical steroids (176, 42.7%); oral immunosuppressants such as cyclosporine, methotrexate, or a Janus kinase inhibitor (130, 31.6%); phototherapy (60, 14.6%); and/or an oral corticosteroid (167, 40.5%).

Adverse reactions after DPCP therapy were reported in 194 patients (47.1%). Among them, 149 patients (36.2%) had local adverse reactions, which included contact dermatitis, hyperpigmentation, and lymph node enlargement. Additionally, forty-five patients (10.9%) experienced systemic adverse reactions, such as erythema-multiforme-like systemic skin eruptions and fever. However, none of the patients discontinued DPCP therapy due to adverse events.

Table 1. Demographic data of patients

Variables	Values (n=412)
Age (yr)	36.47±15.49
Sex	
Male	188 (45.6)
Female	224 (54.4)
Age at onset (yr)	29.98±15.92
Childhood onset (<18)	111 (26.9)
Adult onset (≥18)	301 (73.1)
Disease duration	
<2 yr	87 (21.1)
≥2 yr	325 (78.9)
Type of AA	
Patch type AA	175 (42.5)
AA totalis/universalis	228 (55.3)
AA ophiasis	9 (2.2)
Extent of disease (SALT)	
S1 (<25%)	71 (17.2)
S2 (25%–49%)	56 (13.6)
S3 (50%–74%)	39 (9.5)
S4 (75%–99%)	183 (44.4)
S5 (100%)	63 (15.3)
Comorbidities	
Atopy (AD, AR, BA)	87 (21.1)
Thyroid disease	9 (2.2)
None	357 (86.7)
Nail change	
Yes	48 (11.7)
No	364 (88.3)
Family history of AA	
Yes	358 (86.9)
No	54 (13.1)
Prior treatment (multiple responses possible)	
Intralesional steroids	194 (46.6)
Topical corticosteroids	176 (42.7)
Systemic steroids	167 (40.5)
Phototherapy	60 (14.6)
Systemic immunosuppresant (e.g. cyclosporin, methotrexate)	130 (31.6)
Adverse reaction	
Systemic	45 (10.9)
Localized	149 (36.2)
None	218 (52.9)

Values are presented as mean ± standard deviation or number (%).
AA: alopecia areata, SALT: Severity of Alopecia Tool, AD: atopic dermatitis, AR: allergic rhinitis, BA: bronchial asthma.

Factors affecting treatment responses

Among the 412 patients, 19 patients (4.6%) showed a complete response, 194 patients (47.1%) revealed a partial response, 60 patients (14.6%) achieved a minimal response, and 139 patients (33.7%) showed no response to DPCP. More than half of the AA patients (213/412, 51.7%) exhibited hair regrowth exceeding 50% of their initial AA condition.

The relationships between the factors and the treatment responses are shown in **Table 2**. Several parameters, including the presence of comorbidities such as atopy and thyroid disease (p=0.034) and the extent of hair loss (initial SALT), showed a negative impact on the treatment response to DPCP (p=0.031). However, the disease duration, AA family history, the period from AA diagnosis to DPCP treatment, nail changes, and adverse reactions after application of DPCP were not found to be significantly related to DPCP responsiveness. Interestingly, the treatment duration and interval were significantly related to the treatment response. It appears that longer DPCP treatment durations have a positive prognostic effect (p<0.001) and that longer treatment intervals also exhibit beneficial prognostic effects with DPCP (p=0.012).

Still, there is no standard protocol for the application of DPCP. According to our research, methods by which to apply DPCP to scalp lesions varied between institutions and included the following: 1) DPCP treatment to limited areas of the AA lesions (44, 10.7%), 2) DPCP treatment to the entire AA lesion (150, 36.4%), and 3) DPCP treatment to the entire scalp, including subclinical lesions (218, 52.9%). The treatment response was higher in the group for which the entire scalp was treated with DPCP (p=0.002), suggesting that DPCP should be applied not merely to the affected area and/or subclinical lesions. This finding may stem from the fact that patients with AA who respond well to DPCP continue to receive the DPCP treatment, and physicians increase the treatment interval after hair regrowth.

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Table 2. Factors affecting treatment responses

Factors	Treatment response				*p*-value
	NR	MR	PR	CR	
Gender					0.119
Male	52 (37.4)	29 (48.3)	98 (50.5)	9 (47.4)	
Female	87 (62.6)	31 (51.7)	96 (49.5)	10 (52.6)	
Onset					0.100
Childhood onset (<18 yr)	48 (34.5)	14 (23.3)	44 (22.7)	5 (26.3)	
Adult onset (≥18 yr)	91 (65.5)	46 (76.7)	150 (77.3)	14 (73.7)	
Disease duration					0.970
<2 yr	31 (22.3)	13 (21.7)	39 (20.1)	4 (21.1)	
≥2 yr	108 (77.7)	47 (78.3)	155 (79.9)	15 (78.9)	
Comorbidity					**0.034**
Atopy (AD, AR, BA)	35 (25.2)	13 (21.7)	39 (20.1)	0 (0)	
Thyroid	7 (5.0)	1 (1.7)	2 (1.0)	0 (0)	
No	97 (69.8)	46 (76.7)	153 (78.9)	19 (100)	
Family history of AA					0.252
Yes	23 (16.5)	10 (16.7)	19 (9.8)	2 (10.5)	
No	116 (83.5)	50 (83.3)	175 (90.2)	17 (89.5)	
Period from diagnosis to DPCP treatment					0.624
<1 yr	69 (49.6)	33 (55.0)	95 (49.0)	12 (63.2)	
1–2 yr	17 (12.2)	10 (16.7)	39 (20.1)	2 (10.5)	
2–3 yr	19 (13.7)	7 (11.7)	23 (11.9)	1 (5.3)	
>3 yr	34 (24.5)	10 (16.7)	37 (19.1)	4 (21.1)	
Treatment duration					**<0.001**
<1 yr	74 (53.2)	23 (38.3)	53 (27.3)	2 (10.5)	
1–2 yr	26 (18.7)	7 (11.7)	43 (22.2)	7 (36.8)	
2–3 yr	14 (10.1)	9 (15.0)	27 (13.9)	5 (26.3)	
>3 yr	25 (18.0)	21 (35.0)	71 (36.6)	5 (26.3)	
Treatment interval					**0.012**
1 wk	79 (56.8)	34 (56.7)	111 (57.2)	4 (21.1)	
2 wk	31 (22.3)	18 (30.0)	41 (21.1)	5 (26.3)	
>2 wk	29 (20.9)	8 (13.3)	42 (21.6)	10 (52.6)	
Nail change					0.081
Yes	23 (16.5)	5 (8.3)	20 (10.3)	0 (0)	
No	116 (83.5)	55 (91.7)	174 (89.7)	19 (100)	
Application method					**0.002**
Limited AA lesion	23 (16.5)	7 (11.7)	13 (6.7)	1 (5.3)	
Whole AA lesion	61 (43.9)	23 (38.3)	60 (30.9)	6 (31.6)	
Entire scalp	55 (39.6)	30 (50.0)	121 (62.4)	12 (63.2)	
Initial SALT					**0.031**
S0–S2	42 (30.2)	21 (35.0)	58 (29.9)	6 (31.6)	
S3–S4	65 (46.8)	36 (60.0)	112 (57.7)	9 (47.4)	
S5	32 (23.0)	3 (5.0)	24 (12.4)	4 (21.1)	
Adverse reaction					0.776
Systemic	13 (9.4)	8 (13.3)	21 (10.8)	3 (15.8)	
Localized	46 (33.1)	20 (33.3)	75 (38.7)	8 (42.1)	
None	80 (57.6)	32 (53.3)	98 (50.5)	8 (42.1)	

Values are presented as number (%). Bold indicates statistical significance.
NR: no reponse, 0%–24% improvement, MR: minimal response, 25%–49% improvement, PR: partial response, 50%–99% improvement, CR: complete response, 100% improvement, AD: atopic dermatitis, AR: allergic rhinitis, BA: bronchial asthma, AA: alopecia areata, DPCP: diphenylcyclopropenone, SALT: Severity of Alopecia Tool.

Table 3. Factors affecting patient satisfaction

Factors	Average of satisfaction (SD)	*p*-value
Gender		0.054
Male	4.10 (0.88)	
Female	3.92 (0.95)	
Onset		0.118
Childhood onset (<18 yr)	3.88 (0.84)	
Adult onset (≥18 yr)	4.04 (0.95)	
Disease duration		0.896
<2 yr	3.99 (0.88)	
≥2 yr	4.00 (0.94)	
Comorbidity		0.081
Atopy (AD, AR, BA)	3.94 (0.91)	
Thyroid	3.40 (1.35)	
None	4.03 (0.91)	
Family history of AA		0.752
Yes	3.96 (0.85)	
No	4.01 (0.94)	
Period from diagnosis to DPCP treatment		0.879
<1 yr	4.02 (0.91)	
1–2 yr	3.96 (0.97)	
2–3 yr	4.06 (0.82)	
>3 yr	3.95 (0.98)	
Treatment duration		**0.013**
<1 yr	3.84 (0.93)	
1–2 yr	3.95 (1.02)	
2–3 yr	4.18 (0.91)	
>3 yr	4.16 (0.81)	
Treatment interval		**<0.001**
1 wk	3.86 (0.95)	
2 wk	4.05 (0.90)	
>2 wk	4.30 (0.79)	
Nail change		**0.005**
Yes	3.65 (0.98)	
No	4.05 (0.91)	
Application method		0.162
Limited AA lesion	3.75 (1.04)	
Whole AA lesion	4.02 (0.89)	
Entire scalp	4.04 (0.92)	
Initial SALT		**0.039**
S0–S2	4.07 (0.87)	
S3–S4	4.04 (0.89)	
S5	3.73 (1.11)	
Adverse reaction of DPCP		0.059
Systemic	3.84 (1.09)	
Localized	3.90 (0.98)	
None	4.10 (0.84)	
Treatment response		**<0.001**
NR	3.55 (1.02)	
MR	3.97 (0.80)	
PR	4.30 (0.73)	
CR	4.26 (1.05)	

Bold indicates statistical significance.
SD: standard deviation, AD: atopic dermatitis, AR: allergic rhinitis, BA: bronchial asthma, AA: alopecia areata, DPCP: diphenylcyclopropenone, SALT: Severity of Alopecia Tool, NR: no reponse, 0%–24% improvement, MR: minimal response, 25%–49% improvement, PR: partial response, 50%–99% improvement, CR: complete response, 100% improvement.

Factors affecting patient satisfaction

The correlation between treatment associated factors and the patients' satisfaction is detailed in **Table 3**. The average satisfaction score for the DPCP treatment was 4.0 ± 0.92. Clinical factors such as disease onset, disease duration, comorbidities, a family history of AA, the period from diagnosis to DPCP treatment, the

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application method, and adverse reactions did not significantly correlate with patient satisfaction. However, like the treatment response data, the treatment duration (p=0.013) and treatment interval (p<0.001) showed a positive relationship with patient satisfaction, possibly for the same reason behind the treatment response result. Moreover, patients with nail deformities (p=0.005) and high initial SALT scores (p=0.039) showed low satisfaction.

DISCUSSION

Among all participants with AA in this study, more than half (213, 51.7%) showed hair regrowth exceeding 50% of their initial AA area, a finding consistent with those in earlier work[10]. We conducted a subgroup analysis considering typical factors known to determine the prognosis of AA, such as age of disease onset, comorbidities, family history, initial SALT, and nail changes. Additionally, we elucidated the impact of treatment-associated factors, including adverse reactions, treatment duration, and treatment intervals, on response and satisfaction outcomes. Numerous predictive factors influencing DPCP treatment outcomes have been documented in the literature. These factors encompass the type and extent of AA, the age of disease onset, the duration of AA before the commencement of the DPCP treatment, a family history of AA, atopy, and nail changes[11,12].

In this study, we observed that comorbidities such as atopy, thyroid disorder, and the extent of AA (SALT) significantly influenced the clinical response to a DPCP treatment. However, in contrast to previous reports, age of onset, a family history of AA, the period from AA diagnosis to DPCP treatment, and nail changes did not show statistical significance with regard to clinical outcomes. These findings suggest that certain factors associated with poor prognosis of AA, do not necessarily lead to unfavorable outcomes after a DPCP treatment. Therefore, physicians may consider a DPCP treatment even in patients with the aforementioned clinical factors, which are associated with a poor prognosis in AA. Moreover, there was a definite correlation between the treatment interval and duration and the level of satisfaction and the response. We hypothesized that patients who are satisfied with their DPCP treatment are more likely to continue with it. This inclination is attributable to the nature of the disease, which can fluctuate in response to various triggering factors. Consequently, both physicians and patients may choose to extend the intervals between treatments instead of discontinuing the treatment when the patient's disease is well managed. As is commonly understood, patients being treated with DPCP are relatively more severe than others, and AA lesions exhibit greater fluctuations in these severe cases, making it difficult to discontinue the DPCP treatment. Therefore, the results here suggest that when patients achieve satisfactory results, physicians can consider continuing the DPCP treatment and cautiously extending the treatment intervals, thereby reducing the risk of acute flare-ups of AA. However, given that this study is cross-sectional, we cannot rule out the possibility that the patients included in the survey are predominantly those who have responded well to their DPCP treatment.

Furthermore, this study underscores the necessity for a standardized protocol regarding the application of DPCP. In the survey, we found that every institution has its own guidelines for applying DPCP. Our study confirmed that applying DPCP to the entire scalp, including any subclinical lesions, can result in improved clinical outcomes. In previous reports, researchers suggested applying DPCP to the entire scalp, even if the alopecia lesions are small[13]. However, related clinical evidence was lacking. Therefore, we recommend the application of DPCP to the whole scalp, including subclinical lesions, for better clinical outcomes and to reduce instances of recurrence.

Contrary to the treatment response, nail changes significantly influence patients' levels of satisfaction. Compared to hair loss, nail changes are easily ignored by physicians despite the fact that they are associated with poor prognosis. Therefore, physicians must understand that multiple factors can negatively impact emotional or perceived satisfaction, regardless of treatment responsiveness in the form of hair regrowth. When considered, the treatment outcomes align with patients' satisfaction.

To the best of our knowledge, this is the largest study of the use of DPCP for the treatment of AA, and it represents the first nationwide investigation into contact immunotherapy. This research included 412 patients who completed the provided questionnaire, and their relevant medical records are available. The study has four practical implications. First, continuing the DPCP treatment even after achieving satisfactory results could benefit patient outcomes. Second, physicians can extend the treatment interval for patients who have achieved satisfactory results with their DPCP treatment. Third, DPCP could be a promising treatment option for patients with commonly known poor prognostic factors, such as early-onset AA, a family history of AA, and nail changes. Finally, including subclinical areas during the DPCP treatment improves treatment responses and prevents recurrence. In conclusion, this nationwide study elucidated the factors affecting DPCP treatment responses and patients' levels of satisfaction and may thus contribute to standardizing the DPCP treatment method.

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CONFLICTS OF INTEREST

The authors have nothing to disclose.

DATA SHARING STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

REFERENCES

1. Mirzoyev SA, Schrum AG, Davis MD, Torgerson RR. Lifetime incidence risk of alopecia areata estimated at 2.1% by Rochester Epidemiology Project, 1990–2009. J Invest Dermatol 2014;134:1141-1142. PUBMED | CROSSREF
2. Toussi A, Barton VR, Le ST, Agbai ON, Kiuru M. Psychosocial and psychiatric comorbidities and health-related quality of life in alopecia areata: a systematic review. J Am Acad Dermatol 2021;85:162-175. PUBMED | CROSSREF
3. Lintzeri DA, Constantinou A, Hillmann K, Ghoreschi K, Vogt A, Blume-Peytavi U. Alopecia areata - current understanding and management. J Dtsch Dermatol Ges 2022;20:59-90.
4. Liu M, Gao Y, Yuan Y, Yang K, Shen C, Wang J, et al. Janus kinase inhibitors for alopecia areata: a systematic review and meta-analysis. JAMA Netw Open 2023;6:e2320351. PUBMED | CROSSREF
5. Mahasaksiri T, Kositkuljorn C, Anuntrangsee T, Suchonwanit P. Application of topical immunotherapy in the treatment of alopecia areata: a review and update. Drug Des Devel Ther 2021;15:1285-1298. PUBMED | CROSSREF
6. Chiang KS, Mesinkovska NA, Piliang MP, Bergfeld WF. Clinical efficacy of diphenylcyclopropenone in alopecia areata: retrospective data analysis of 50 patients. J Investig Dermatol Symp Proc 2015;17:50-55. PUBMED | CROSSREF
7. Olsen EA, Hordinsky MK, Price VH, Roberts JL, Shapiro J, Canfield D, et al. Alopecia areata investigational assessment guidelines--Part II. J Am Acad Dermatol 2004;51:440-447. PUBMED | CROSSREF
8. Wyrwich KW, Kitchen H, Knight S, Aldhouse NV, Macey J, Nunes FP, et al. The Alopecia Areata Investigator Global Assessment scale: a measure for evaluating clinically meaningful success in clinical trials. Br J Dermatol 2020;183:702-709. PUBMED | CROSSREF
9. Tiwary AK, Mishra DK, Chaudhary SS. Comparative study of efficacy and safety of topical squaric acid dibutylester and diphenylcyclopropenone for the treatment of alopecia areata. N Am J Med Sci 2016;8:237-242. PUBMED | CROSSREF
10. Singh G, Lavanya M. Topical immunotherapy in alopecia areata. Int J Trichology 2010;2:36-39. PUBMED | CROSSREF
11. Wasserman D, Guzman-Sanchez DA, Scott K, McMichael A. Alopecia areata. Int J Dermatol 2007;46:121-131. PUBMED | CROSSREF
12. Rokhsar CK, Shupack JL, Vafai JJ, Washenik K. Efficacy of topical sensitizers in the treatment of alopecia areata. J Am Acad Dermatol 1998;39:751-761. PUBMED | CROSSREF
13. Huang CM, Tsai TF. Topical diphenylcyclopropenone in the treatment of alopecia areata: a 10-year follow-up of 86 cases in a single center. Zhonghua Pifuke Yixue Zazhi 2022;40:214-221. CROSSREF