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Efficacy of 15% Trichloroacetic Acid Peel versus 35% Glycolic Acid Peel in Acanthosis Nigricans - At a Tertiary Care Center in Central Karnataka

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Abstract: ***Background**: Acanthosis nigricans (AN) is a chronic dermatosis characterized by hyperpigmented, velvety thickening of the skin, commonly affecting intertriginous areas such as the neck, axillae, and groin. It is frequently associated with obesity, insulin resistance, diabetes mellitus, and metabolic syndrome. Various treatment modalities have been explored, including topical agents and chemical peels. However, comparative data on the efficacy of trichloroacetic acid (TCA) and glycolic acid (GA) peels remain limited. **Objective**: To compare the efficacy and safety of 15% trichloroacetic acid (TCA) peel versus 35% glycolic acid (GA) peel in reducing hyperpigmentation, skin thickness, and lesion extent in patients with acanthosis nigricans. **Methods**: A randomized comparative therapeutic study was conducted at the Department of Dermatology, Bapuji Hospital and Chigateri General Hospital, Davangere, from October 2025 to March 2026. A total of 40 adult patients (aged ≥18 years) with a clinical diagnosis of AN affecting the face, neck, or elbows were enrolled and randomly assigned to two groups: Group A received 15% TCA peel (n=20) and Group B received 35% GA peel (n=20). Three peeling sessions were performed at two-week intervals, followed by two weeks of additional follow-up. Efficacy was assessed using the Acanthosis Nigricans Area and Severity Index (ANASI) score at baseline and each session, Physician Assessment Score (PAS), and Patient Satisfaction Score (PSS). Safety was evaluated by recording adverse effects after each session. Statistical analysis was performed using SPSS version 27.0, with $p<0.05$ considered statistically significant. **Results**: Both groups showed a significant reduction in ANASI scores over time (TCA: from 13.35±2.78 to 7.95±3.43; GA: from 14.15±2.80 to 8.10±4.06; repeated measures ANOVA: $p<0.001$ for both groups, partial $\eta^2=0.927$ and 0.921, respectively). No statistically significant difference was observed between the two groups at any follow-up visit ($p>0.05$ for all time points). The mean percentage improvement was 42.48±16.21% in the TCA group and 44.81±21.48% in the GA group ($p=0.701$). Median patient satisfaction scores were 3 and 4, respectively ($p=0.491$). The most common adverse effects were dryness (25.0% vs. 20.0%) and erythema with burning (20.0% vs. 30.0%). Post-inflammatory hyperpigmentation occurred in 10.0% of each group. No serious adverse events were reported. The overall distribution of adverse effects did not differ significantly between the groups ($p=0.991$). **Conclusion**: Both 15% trichloroacetic acid peel and 35% glycolic acid peel are effective and safe treatment options for acanthosis nigricans, producing significant and comparable improvement in ANASI scores, patient satisfaction, and clinical appearance of lesions with minimal adverse effects. The choice between the two agents may be guided by clinician experience, patient tolerance, and availability.*

Keywords: Acanthosis nigricans, chemical peel, trichloroacetic acid, glycolic acid, ANASI score

1. Introduction

Acanthosis nigricans (AN) is a skin condition characterized by velvety, hyperpigmented thickening with poorly defined borders, typically affecting intertriginous areas such as the back of the neck, axilla, and groin. It usually reflects underlying systemic disease and is most commonly associated with insulin resistance, diabetes mellitus, and obesity. Less commonly, AN may indicate internal malignancy, endocrine disorders, or drug reactions (e.g., to systemic glucocorticoids or oral contraceptives).[1,2] First described in 1890 and linked to malignancy, AN has since been associated with endocrinopathies, medications, and most importantly, obesity and insulin resistance.[3]

Reported prevalence of acanthosis nigricans varies widely from 4.5% to 74%, depending on the study population. It is significantly higher among overweight or obese individuals: approximately 49% to 58% in overweight/obese children and adolescents, and 60% to 74% in obese adults.[4-6]

Several pathogenic factors at the skin level contribute to acanthosis nigricans (AN) in the setting of insulin resistance (IR). Insulin-like growth factor (IGF), fibroblast growth factor receptor (FGFR), and epidermal growth factor receptor (EGFR) promote proliferation of epidermal keratinocytes and dermal fibroblasts. These changes, along with a general pro-inflammatory state and IR-related abnormalities in glucose and lipid metabolism, are thought to drive the development of AN.[7,8]

Various treatment modalities for AN include topical agents, oral agents, and interventional procedures, though most studies are case-control or pilot studies with few randomized controlled trials. Topical retinoids are considered first-line treatment. Other topical options include vitamin D analogs, depigmenting agents, and keratolytics. Oral insulin sensitizers are used due to insulin resistance's role in the disease, and oral retinoids are reserved for generalized AN. Very superficial and superficial chemical peels - such as

glycolic acid, trichloroacetic acid, mandelic acid, and lactic acid - have also been tried.[9-11] This study aims to compare the efficacy and safety of 15% trichloroacetic acid (TCA) peel versus 35% glycolic acid (GA) peel in reducing hyperpigmentation, skin thickness, and lesion extent in patients with acanthosis nigricans.

2. Methodology

A randomized comparative therapeutic study was conducted among patients attending the outpatient Department of Dermatology at Bapuji Hospital and Chigateri General Hospital, attached to J.J.M. Medical College, Davangere, from October 2025 to March 2026. All adults aged 18 years and older with a clinical diagnosis of acanthosis nigricans (AN) affecting the face, neck, elbow, or any combination of these sites were enrolled. Pregnant and lactating females, individuals with hypersensitivity to the peeling agent, those having a skin infection at the AN site (herpes, pyoderma, folliculitis), persons prone to keloid formation, and those with a history of any topical application in the preceding four weeks were excluded from the study. Based on previous cases at the hospital over one year, a minimum sample size of 40 was considered. Convenient sampling was employed; all patients meeting the inclusion and exclusion criteria who consented to participate during the data collection period were included. After obtaining ethical committee approval and clearance, patients fulfilling the inclusion criteria were enrolled. A detailed history was taken, including demographic details, history of the lesions, family history, past history, and treatment history. Every patient was clinically examined to assess the site and severity of AN. Relevant laboratory investigations were performed when necessary to rule out other comorbidities in suspected cases. Dermatoscopy was done at baseline. Any patient with features mentioned in the exclusion criteria was excluded from the study. Written informed consent was obtained from the remaining patients.

The participants were randomly divided into two groups: Group A received treatment with 15% trichloroacetic acid (TCA) peel, and Group B received treatment with 35% glycolic acid (GA) peel. Pre-procedure photographs of the lesions were taken using a mobile phone camera. A five-minute post-auricular test peel was performed to evaluate any hypersensitivity to the peeling agent. After degreasing the area with acetone, the peel was applied: 15% TCA in Group A and 35% GA in Group B. The endpoint for TCA peel was frosting, and for GA peel, it was the appearance of erythema or a burning sensation. Neutralization was performed using cold water. Three peeling sessions were carried out at two-week intervals. The patients were followed up for an additional two weeks to check for any improvement or worsening of results. Throughout this duration, patients were instructed to apply broad-spectrum sunscreen, and counseling on lifestyle modifications was also provided. Efficacy assessment was performed using: (1) the Acanthosis Nigricans Area and Severity Index (ANASI) score at baseline and at each peeling session; (2) photographs of the lesions at baseline and each session, which were compared and evaluated independently by an observer after three sessions using a 5-point Physician Assessment Score (PAS: 0 = no improvement, 1 = 1–25% improvement, 2 = 26–50% improvement, 3 = 51–75% improvement, 4 = 76–100% improvement); and (3) Patient Satisfaction Score (PSS: worsening = –1, no improvement = 0, mild improvement = 1, moderate improvement = 2, excellent improvement = 3). Safety assessment was conducted after each session, during which patients were interviewed and examined for any adverse effects such as erythema, peeling of skin, post-inflammatory hyperpigmentation (PIH), or any burning sensation related to peeling. Statistical analysis was carried out to compare the efficacy between the two treatment arms.

Statistical analysis:

The collected data were entered into a Microsoft Excel sheet and analyzed using IBM SPSS Statistics for Windows, Version 27.0 (Armonk, NY: IBM Corp). Sociodemographic variables were summarized using descriptive statistics such as percentage, frequency, mean, median, standard deviation, and interquartile range, depending on the normality of data distribution. Categorical variables were compared using the Chi-square test to assess associations. Logistic regression analysis was performed to determine significant predictors of outcomes. P-value ≤ 0.05 was considered statistically significant. Results were presented using appropriate tables, figures, and graphs.

3. Results

A total of 40 patients (20 in the TCA group and 20 in the glycolic acid group) completed the study. Baseline demographic and anthropometric characteristics are summarized in **Table 1**. The mean age was 39.10 ± 10.95 years in the TCA group and 33.65 ± 7.78 years in the GA group, with no significant difference (p = 0.078). Females constituted 70.0% of the TCA group and 60.0% of the GA group (p = 0.507). Disease duration was comparable between the two groups (3.45 ± 1.88 vs. 3.15 ± 1.76 years, p = 0.605). However, significant differences were observed in height (163.50 ± 5.78 cm vs. 168.35 ± 5.15 cm, p = 0.008), weight (72.10 ± 8.19 kg vs. 83.10 ± 9.56 kg, p < 0.001), and BMI (27.18 ± 3.22 kg/m² vs. 29.39 ± 3.54 kg/m², p = 0.046), indicating that the GA group had a significantly higher BMI at baseline.

Table 1. Baseline Demographic and Anthropometric Characteristics

Variable	TCA Group (n=20)	GA Group (n=20)	p-value
Age (years)	39.10 ± 10.95	33.65 ± 7.78	0.078
Male, n (%)	6 (30.0)	8 (40.0)	0.507
Female, n (%)	14 (70.0)	12 (60.0)	
Duration of disease (years)	3.45 ± 1.88	3.15 ± 1.76	0.605
Height (cm)	163.50 ± 5.78	168.35 ± 5.15	0.008*
Weight (kg)	72.10 ± 8.19	83.10 ± 9.56	<0.001*
BMI (kg/m²)	27.18 ± 3.22	29.39 ± 3.54	0.046*

Table 2 presents the clinical characteristics of acanthosis nigricans. Neck involvement was universal in both groups (100%). Face involvement was seen in 25.0% of the TCA group and 20.0% of the GA group (p = 0.705). Axillary involvement (85.0% vs. 80.0%, p = 0.677) and groin involvement (80.0% vs. 85.0%, p = 0.677) were similarly distributed, with no significant differences between the groups.

Table 2: Clinical Characteristics of Acanthosis Nigricans

Variable	TCA n (%)	GA n (%)	p-value
Neck involvement	20 (100.0)	20 (100.0)	—
Face involvement	5 (25.0)	4 (20.0)	0.705
Axillary involvement	17 (85.0)	16 (80.0)	0.677
Groin involvement	16 (80.0)	17 (85.0)	0.677

The distribution of comorbidities is shown in **Table 3**. The most common comorbidities were diabetes mellitus (25.0% in TCA vs. 20.0% in GA), insulin resistance (20.0% vs. 25.0%), and PCOS (20.0% vs. 15.0%). Notably, three patients (15.0%) in the GA group had no comorbidity, whereas all patients in the TCA group had at least one comorbidity. The overall distribution of comorbidities did not differ significantly between the groups ($\chi^2 = 7.365$, $p = 0.498$).

Table 3: Distribution of Comorbidities

Comorbidity	TCA n (%)	GA n (%)
Diabetes Mellitus	5 (25.0)	4 (20.0)
Insulin Resistance	4 (20.0)	5 (25.0)
PCOS	4 (20.0)	3 (15.0)
Dyslipidemia	3 (15.0)	3 (15.0)
DM + HTN	2 (10.0)	0
HTN + Dyslipidemia	1 (5.0)	1 (5.0)
Hypothyroidism	1 (5.0)	0
DM + Dyslipidemia	0	1 (5.0)
No Comorbidity	0	3 (15.0)
$\chi^2 = 7.365$, $p = 0.498$		

Mean ANASI scores showed a progressive reduction throughout the study period in both treatment groups. Independent samples t-test demonstrated no significant difference between the TCA and glycolic acid groups at baseline or at any follow-up visit (all $p>0.05$). Repeated measures ANOVA revealed a highly significant reduction in ANASI scores over time within both the TCA group ($F=242.15$, $p<0.001$, partial $\eta^2=0.927$) and the glycolic acid group ($F=220.85$, $p<0.001$, partial $\eta^2=0.921$), indicating a large treatment effect in both groups.(Table 4).

Table 4: Comparison of ANASI Scores Between and Within Treatment Groups During Follow-up

Follow-up Visit	TCA Group (Mean ± SD)	GA Group (Mean ± SD)	Between-Group p-value†
Baseline	13.35 ± 2.78	14.15 ± 2.80	0.370
Week 2	11.95 ± 3.25	12.45 ± 2.70	0.600
Week 4	10.75 ± 3.14	10.80 ± 3.65	0.963
Week 6	9.35 ± 3.18	9.30 ± 3.95	0.965
Week 8	7.95 ± 3.43	8.10 ± 4.06	0.900
Repeated Measures ANOVA	F = 242.15, <0.001*	F = 220.85, <0.001*	

† Independent samples t-test comparing TCA and GA groups at each visit.
Repeated measures ANOVA assessing change in ANASI scores over time within each treatment group

Treatment response and patient satisfaction are summarized in **Table 5**. The mean reduction in ANASI score was 5.40 ± 1.73 in the TCA group and 6.05 ± 2.72 in the GA group ($p = 0.373$). The percentage improvement was 42.48 ± 16.21% for TCA and 44.81 ± 21.48% for GA ($p = 0.701$). The median patient satisfaction score was 3 (mild to moderate improvement) in the TCA group and 4 (moderate to excellent improvement) in the GA group, though the difference was not statistically significant ($p = 0.491$).

Table 5: Treatment Response and Patient Satisfaction

Variable	TCA Group	GA Group	p-value
Reduction in ANASI score	5.40 ± 1.73	6.05 ± 2.72	0.373
Percentage improvement (%)	42.48 ± 16.21	44.81 ± 21.48	0.701
Median satisfaction score	3	4	0.491

Adverse effects observed during treatment are listed in **Table 6**. The most common adverse effects were dryness (25.0% in TCA vs. 20.0% in GA) and erythema with burning (20.0% vs. 30.0%). Post-inflammatory hyperpigmentation occurred in 10.0% of each group. No serious adverse events were reported. The overall distribution of adverse effects did not differ significantly between the two groups ($\chi^2 = 0.844$, $p = 0.991$). In both groups, 10.0% of patients reported no adverse effects.

Table 6: Adverse Effects Observed During Treatment

Adverse Effect	TCA n (%)	GA n (%)
Dryness	5 (25.0)	4 (20.0)
Erythema with burning	4 (20.0)	6 (30.0)
Mild erythema	2 (10.0)	2 (10.0)
Peeling	3 (15.0)	3 (15.0)
Post-inflammatory hyperpigmentation	2 (10.0)	2 (10.0)
Transient burning	2 (10.0)	1 (5.0)
No adverse effects	2 (10.0)	2 (10.0)
$\chi^2 = 0.844$, $p = 0.991$		

4. Discussion

Acanthosis nigricans (AN) is a chronic dermatosis characterized by hyperpigmented, velvety thickening of the skin, commonly affecting the neck, axillae, and flexural regions. It is frequently associated with obesity, insulin resistance, diabetes mellitus, polycystic ovarian syndrome (PCOS), and metabolic syndrome. Owing to its cosmetic impact and association with metabolic abnormalities, several therapeutic modalities including topical agents, chemical peels, lasers, and combination therapies have been investigated. The present study compared the efficacy and safety of 15% trichloroacetic acid (TCA) peel and 35% glycolic acid (GA) peel in patients with acanthosis nigricans. In the present study, the mean age of patients was 39.10±10.95 years in the TCA group and 33.65±7.78 years in the glycolic acid group, with no statistically significant difference between groups. Females constituted 65% of the study population, indicating a female predominance. Similar observations have been reported in previous studies evaluating therapeutic interventions for AN. Khashaba et al.[12] reported that the majority of their study population consisted of female patients, reflecting the greater cosmetic concern among women seeking treatment for AN. The predominance of female patients may also be related to the higher prevalence of obesity, insulin resistance, and PCOS among women presenting with AN.

The present study demonstrated a high prevalence of metabolic comorbidities including diabetes mellitus, insulin resistance, dyslipidemia, and PCOS. These findings support the well-established relationship between AN and metabolic dysfunction. Previous studies have similarly reported obesity and insulin resistance as the most common underlying

abnormalities in patients with AN, highlighting the importance of evaluating associated metabolic disorders during patient management.

Neck involvement was observed in all patients, while axillary and groin involvement were present in more than 80% of cases. Similar site distribution has been consistently reported in the literature, with the neck being the most frequently affected site due to repeated friction, increased pigmentation, and higher susceptibility to insulin-mediated epidermal proliferation.[12,13]

The principal finding of the present study was the significant reduction in ANASI scores observed in both treatment groups throughout the follow-up period. In the TCA group, the mean ANASI score decreased from 13.35±2.78 at baseline to 7.95±3.43 at week 8, while in the glycolic acid group it decreased from 14.15±2.80 to 8.10±4.06. Repeated measures ANOVA demonstrated highly significant improvement within both treatment groups (TCA: $F=242.148$, $p<0.001$; GA: $F=220.846$, $p<0.001$), indicating substantial clinical benefit from both peeling agents. These findings are consistent with previous studies that reported significant reductions in ANASI scores and clinical severity following treatment with TCA and glycolic acid peels.[5,14,15]

The efficacy observed with TCA peel in the present study is in agreement with previous reports. Bharati et al.[13] compared 15% TCA peel with 35% glycolic acid peel and demonstrated significant improvement in ANASI scores in both groups following treatment. However, they reported a greater reduction in ANASI scores and superior physician global assessment outcomes in the TCA group, suggesting a slight advantage of TCA over glycolic acid. In contrast, the present study found comparable efficacy between the two treatment modalities, with no statistically significant difference in overall improvement. Variations in patient demographics, disease severity, treatment duration, and assessment methods may account for these differences. The efficacy of TCA peel observed in the present study is also supported by the randomized controlled trial conducted by Ali et al.[16], who compared TCA peel with topical tretinoin in patients with acanthosis nigricans. Both treatment modalities produced clinical improvement; however, TCA peel demonstrated faster and more pronounced improvement in pigmentation and lesion thickness, supporting its utility as an effective therapeutic option for AN. The findings of the present study further reinforce the role of TCA peel as a safe and efficacious modality in the management of acanthosis nigricans.

The effectiveness of TCA peel observed in the current study is further supported by Khashaba et al.,[12] who evaluated 15% TCA peel alone and in combination with microneedling. They observed significant improvement in acanthosis nigricans grades after TCA treatment, confirming its effectiveness as a standalone therapy. Combination therapy yielded additional benefits, particularly with respect to pigmentation and texture improvement. Similarly, Baldissera et al.[17] highlighted the effectiveness of trichloroacetic acid peels in improving hyperpigmentation and skin texture in patients with acanthosis nigricans and emphasized their role as a simple, cost-effective, and minimally invasive treatment option. Similarly, Fouda et al.[15] compared TCA 20% peel with fractional carbon dioxide laser in patients with pseudo-acanthosis nigricans and demonstrated significant clinical improvement and reduction in ANASI scores following TCA treatment. Although laser therapy produced superior outcomes, TCA peel remained an effective and safe treatment modality. The glycolic acid group in the present study also demonstrated significant improvement during follow-up. Glycolic acid is an alpha-hydroxy acid that promotes epidermal exfoliation, decreases corneocyte cohesion, accelerates epidermal turnover, and reduces hyperpigmentation. These mechanisms contribute to the improvement in both pigmentation and skin texture observed in AN lesions. Ghiasi et al.[14] reported significant clinical improvement following glycolic acid peeling in patients with acanthosis nigricans, supporting the efficacy of glycolic acid-based treatment approaches.

Despite significant within-group improvement, no statistically significant difference was observed between the TCA and glycolic acid groups at baseline or any subsequent follow-up visit. The mean reduction in ANASI score was 5.40±1.73 in the TCA group and 6.05±2.72 in the glycolic acid group ($p=0.373$). Similarly, percentage improvement was 42.48±16.21% and 44.81±21.48%, respectively ($p=0.701$). These findings suggest that both peeling agents provide comparable clinical efficacy. A recent systematic review evaluating randomized controlled trials on AN treatment also concluded that both TCA and glycolic acid peels are effective treatment modalities with favourable efficacy and safety profiles.[5]

Patient satisfaction represents an important outcome measure because AN primarily affects cosmetic appearance and quality of life. In the present study, patient satisfaction scores were comparable between the two groups, with no statistically significant difference observed ($p=0.491$). These findings indicate that the subjective perception of improvement was similar regardless of the peeling agent used. Comparable levels of patient satisfaction have also been reported in previous studies evaluating chemical peels for AN.

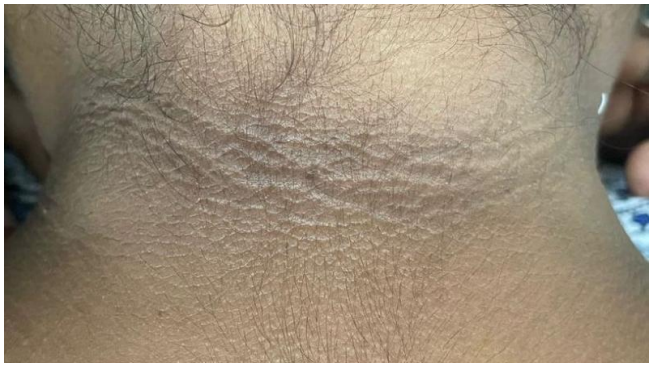
Both treatment modalities were well tolerated. The most common adverse effects observed were dryness, erythema with burning sensation, peeling, and post-inflammatory hyperpigmentation. Most adverse events were mild, transient, and resolved without intervention. Importantly, no serious complications or treatment discontinuations occurred. Similar safety profiles have been reported in previous studies involving TCA and glycolic acid peels. The comparable adverse-effect profile observed in the present study further supports the safe use of both agents in routine clinical practice.

The strengths of the present study include prospective follow-up, objective assessment using ANASI scoring, evaluation of both efficacy and safety outcomes, and the application of repeated measures ANOVA to assess treatment response over time. However, certain limitations should be acknowledged. The sample size was relatively small, the follow-up period was limited to eight weeks, and long-term recurrence rates were not assessed. In addition, objective pigment

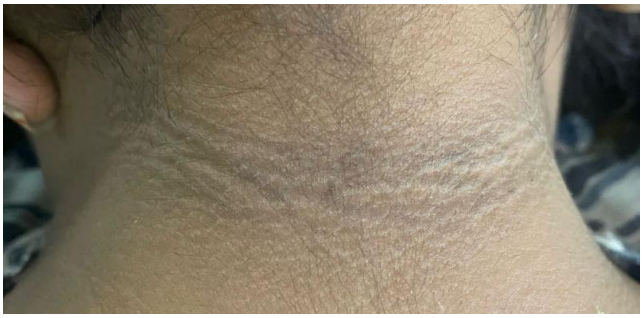
quantification techniques and quality-of-life assessment tools were not employed.

5. Conclusion

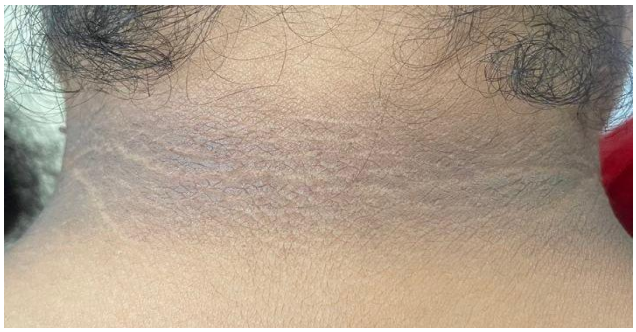
In conclusion, both 15% trichloroacetic acid peel and 35% glycolic acid peel produced significant improvement in ANASI scores, patient satisfaction, and clinical appearance of lesions with minimal adverse effects. Although glycolic acid demonstrated marginally higher percentage improvement, the difference was not statistically significant. The findings suggest that both treatment modalities are effective, safe, and economical options for the management of acanthosis nigricans. Larger multicentric randomized studies with longer follow-up periods are warranted to establish the optimal treatment regimen and evaluate long-term outcomes.



Baseline TCA peel



8th week



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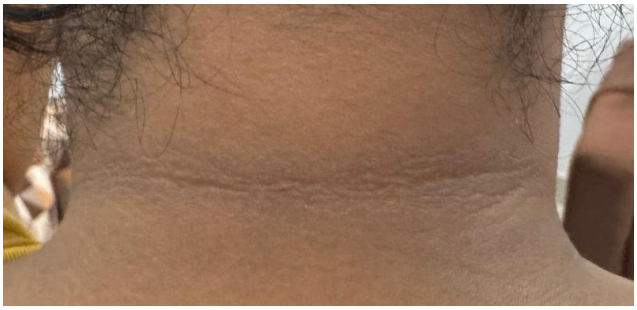

8th week

Declarations

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Conflict of interest: None

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