Treatment of morphea with narrowband ultraviolet B: a case series

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ABSTRACT

Introduction:Morphea, is a rare autoimmune disease presenting with fibrotic changes in the dermis and subcutis. It is a benign condition associated with significant atrophy and sclerosis leading to disfigurement, flexure contractures, and impaired function. Ultraviolet A1 and photochemotherapy are highly effective treatment options but are not readily available in the country. Narrowband ultraviolet B (NBUVB), on the other hand, is readily available, affordable, and safe to use.

Case summary: Three patients diagnosed with different variants of morphea (bilateral generalize morphea, unilateral generalized morphea, and circumscribed morphea). underwent 30 sessions of NBUVB. Treatment response was assessed using tightness and itch Visual Analogue Scale (VAS), Modified Skin Score (MSS), photographic comparison, ultrasonographic measurement, and histopathologic analysis.

NBUVB treatment resulted to 14-60% decrease in the tightness and itch VAS. MSS was also reduced by 35-50%. The size, pigmentation, and erythema of the lesions also decreased. Ultrasonography showed an improvement in the thickness of lesions after treatment. Histopathologic study showed less packed collagen with increase in inter-bundle spaces.

Conclusion: Response to treatment was influenced by the age of the lesion and anatomical location. More chronic lesions tend to have less response. Lesions on the face exhibited the greatest improvement while lesions on the lower extremities had the least improvement. This is the first case series study in the country that uses NBUVB as treatment for morphea. The improvement of the sclerotic and atrophic lesions treated with narrowband UVB treatment may be an acceptable substitute for UVA1 and PUVA.

Keywords: *Morphea, Localized scleroderma, Narrowband-UVB, Phototherapy*

INTRODUCTION

Morphea, also known as localized scleroderma, is a chronic progressive inflammatory disease of the dermis and the subcutaneous fat that leads to fibrotic changes.[1,2] Unlike systemic sclerosis, it is not associated with acrosclerosis, internal organ involvement, and Raynaud's phenomenon.[3] Morphea is classified into various clinical presentations according to the appearance of the lesions and the depth of involvement. (Table 1).

Disease pathogenesis involves infiltration of mononuclear cells in the skin and surrounding blood vessels, which release T-cell–derived cytokines, such as interleukin-4 (IL-4). IL-4 enhances collagen production

Table 1. Classification of Morphea according to Laxer and Zulian (2006) [4]

Classification	Subtypes	Description
Circumscribed	Superficial variant	Oval areas of induration limited to the epidermis and dermis
	Deep variant (previously known as subcutaneous morphea or morphea profunda) [a]	Oval areas of deep induration including the subcutaneous tissue
Linear	Trunk/limb variantb	Linear induration involving the dermis and subcutaneous tissue
	Head variant	
	En coup de sabrec	Linear induration involving the dermis of the face and scalp
	Parry-Romberg	Loss of the dermis and subcutaneous fat of the unilateral face
Generalized		Four or more >3 cm individual indurated plaques, located on greater than two of the seven anatomical sites [d]
Pansclerotic [e]		Circumferential involvement of the limbs involving the epidermis, dermis, subcutaneous tissue, muscle and bone
Mixed variant		Combination of three or more of the previous types

a May include the fascia and muscle; overlying skin may not be involved
b May include muscle and bone
c May involve the underlying muscle, bone, and central nervous system
d The seven anatomical sites include head and neck, each extremity, anterior trunk and posterior trunk
e May affect other areas of the body with full depth sclerosis

by the fibroblast as well as TNF-β production. TNF-β promotes synthesis of extracellular proteins such as inhibitors of metalloproteinases-1 (collagenases). Since collagenases degrade collagen, their decrease leads to collagen excess leading to sclerosis and fibrosis.[2]

Cutaneous lesions would start with an inflammatory or active stage, which is a gradually enlarging, painful or pruritic, and erythematous or dusky violaceous patch. Then, these lesions become sclerotic and tethered to the underlying tissue giving them a characteristic "bound-down" feeling.[4] After several months to years, the sclerotic patches soften and become atrophic like "cigarette paper" or "cliff drop depressions". [1,4] Due to excess collagen deposition, hair follicles and sweat glands become destroyed leading to hairless and anhidrotic lesions.[4]

Morphea is a rare condition with an incidence rate of 0.4 to 2.7% per 100,000 population. Majority are adults (50-65 percent).[5] Females are more commonly affected than males (ratio of 2.6 to 4.2:1) except for the linear variant, which is equally seen in both sexes.[5] In the 2012 Census of the Outpatient Department of Philippine General Hospital Section of Dermatology, only three out of 14,252 consults were diagnosed with morphea.

Although a generally benign condition, morbidity results from significant atrophy and sclerosis, which lead to disfigurement, flexure contractures, and impaired function. Since skin damage may become irreversible once the lesions persist for more than 6 months, disease management should be geared towards the control of progression and improvement of cutaneous lesions.[1,4]

Treatment of morphea depends on the disease activity, body surface area and depth of involvement, cosmetic disfigurement, and risk for functional impairment. Topical treatments in the form of Vitamin D analogues, imiquimod, corticosteroids, and tacrolimus,

are recommended in superficial and localized lesions of morphea while systemic treatments like methotrexate in combination with corticosteroids are recommended for deeper involvement up to the musculoskeletal level.[5]

Phototherapy may be used instead of immunosuppressive agents like methotrexate and/or systemic glucocorticoids in cases that are only dermal in depth. The choice of phototherapy device is influenced by the depth of skin pathology. In morphea, phototherapy enhances collagenase activity resulting in the degradation of excess collagen. Since cutaneous pathology starts in the reticular dermis, UVA1 and PUVA, which penetrate as deep as the mid or lower dermis, are acceptable treatment options. [1] However, powerful and efficient UVA1 light sourced from metal halide lamps is too expensive and is not readily available in the country largely because of cost. Furthermore, there is scarcity of psoralen supply for PUVA.

Narrow-Band UVB (NB UVB) has the same mechanism of action as UVA1 and PUVA in the treatment of sclerosing dermatitis but can only penetrate the upper papillary dermis. The use of NB UVB has superseded PUVA in various dermatoses because it is less phototoxic and carcinogenic than PUVA and relatively safer for use among patients with brown or dark skin. Furthermore, NB UVB is affordable and available in most dermatologic institutions in the country.

METHODS

In this case series, patients were treated with narrowband UVB thrice weekly with an incremental dose increase of 10% per session for a total of 30 sessions. (Table 2) The following were used to measure treatment efficacy:

A. Visual Analogue Scale (VAS) scoring

Patient satisfaction was measured every treatment session using the sum of tightness and itch VAS, where 0 stands for not itchy or tight and 10 for maximal tightness or itch.[7,8]

B. Modified Skin Score (Physician Evaluation)

Physician evaluation was performed after every session, documenting the thickness and area of involvement of the skin from the seven regions of the body (head and neck, trunk, arms, hands, fingers, legs, and feet). Each part was palpated and graded based on thickness, where 0 stands for normal skin, 1 for slightly palpable skin, 2 for decreased ability to move the skin, and 3 for non-movable skin. The area of involvement was assessed and graded as follows: 0 for no involvement, 1 for <33%, 2 for 33%-67%, and 3 for >67%. The sum of the thickness and the area of involvement is the modified skin score, with 42 as the highest score.7

D. Clinical appearance of the lesions (Physician Evaluation)

The appearance of the lesions was also assessed per session. The assessor documented if the size of the lesions decreased, increased, or stayed the same. Changes in color (hyperpigmentation or erythema) were also monitored and documented.

C. High Frequency Ultrasonography

The skin thickness of representative lesions and the adjacent normal skin were measured by a radiologist using a 10-11MHz linear transducer (Mindray Model: DC-3 Year: 4/13) before and after treatment, every morning. Measurement was taken from the epidermis

Table 2. Treatment regimen

Laboratory examination	Generalized morphea	Circumscribed morphea	Unilateral Generalized morphea
Initial Narrowband UVB dose (mj/cm2)	250	100	150
Incremental increase (%)	10		
Sessions per week	3		

and dermis, which appeared as a hyperechoic band on the topmost area up to the bottom of the hypodermis, which appeared hypoechoic with hyperechoic linear echoes running parallel to the skin.[8,9] The percentage difference in the skin thickness between the adjacent normal skin and the representative lesion was compared before and after treatment. Percent difference was computed using the formula below.

$$\frac{\text{[Pre or Post-treatment skin thickness - thickness of the normal]}}{\text{Normal skin}} \text{ X100}$$

The Wilcoxon matched pairs signed-rank test was used to determine the significance of the percent change in skin thickness before and after treatment.

D. Histopathologic Analysis

Skin biopsy was taken from selected lesions to confirm clinical diagnosis. A repeat biopsy was done from the adjacent area of the previous biopsy site after the 30th session of phototherapy to document changes post-treatment. Hematoxylin-eosin and Verhoeff's elastic van Gieson stain were used.[6,7]

RESULTS

A. Description of cases

The first case is a 64-year-old female with generalized morphea who presented with a ten-year history of indurated sclerotic and atrophic patches on the proximal parts of both extremities, sparing the neck, face , forearms and hands. Lesions on the popliteal areas were tender while the other lesions were pruritic (Figures 1 to 4). There were no previous consults done nor medications taken. Skin biopsy of the inflammatory lesion on the left popliteal area showed thickened collagen bundles, tissue edema with enlarged, tortuous vessels, and perivascular infiltrates such as lymphocytes and plasma cells (Figure 5a). Biopsy of a stable lesion on the left arm showed homogenization, crowding of thickened collagen bundles with a few infiltrates, and blood (Figure 5b).

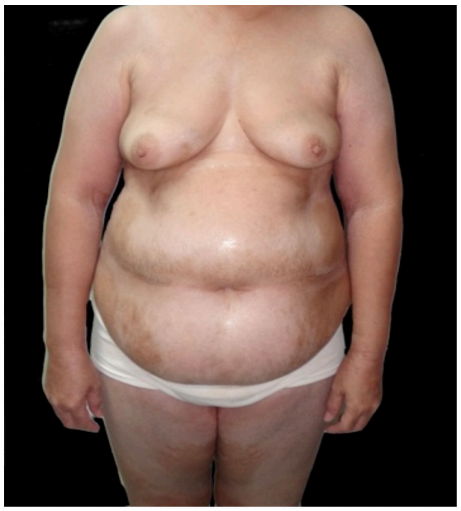

Figure 1. Multiple hyperpigmented and hypopigmented atrophic patches on the trunk and both extremities.

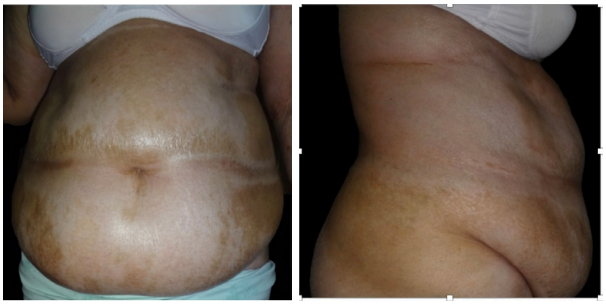

Figure 2. Multiple hyperpigmented, well-defined, irregularly shaped atrophic and sclerotic patches on the anterior and lateral surfaces of the abdomen.

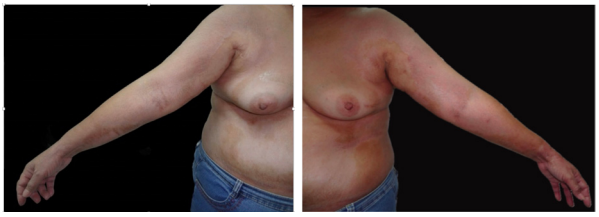

Figure 3. Atrophic hypopigmeneted well-defined irregularly shaped patches on the right and left upper extremities; some patches are sclerotic.

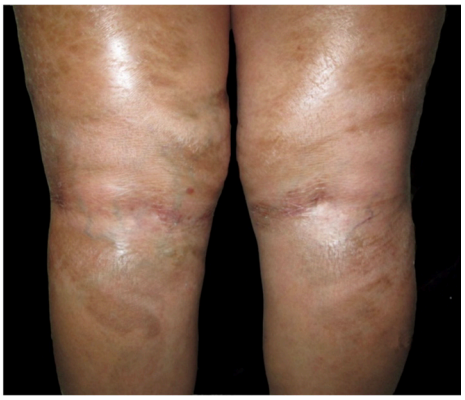

Figure 4. Popliteal area with hyperpigmented atrophic and sclerotic patches with noted erythema (and tenderness on palpation) of the lateral aspects of both popliteal folds

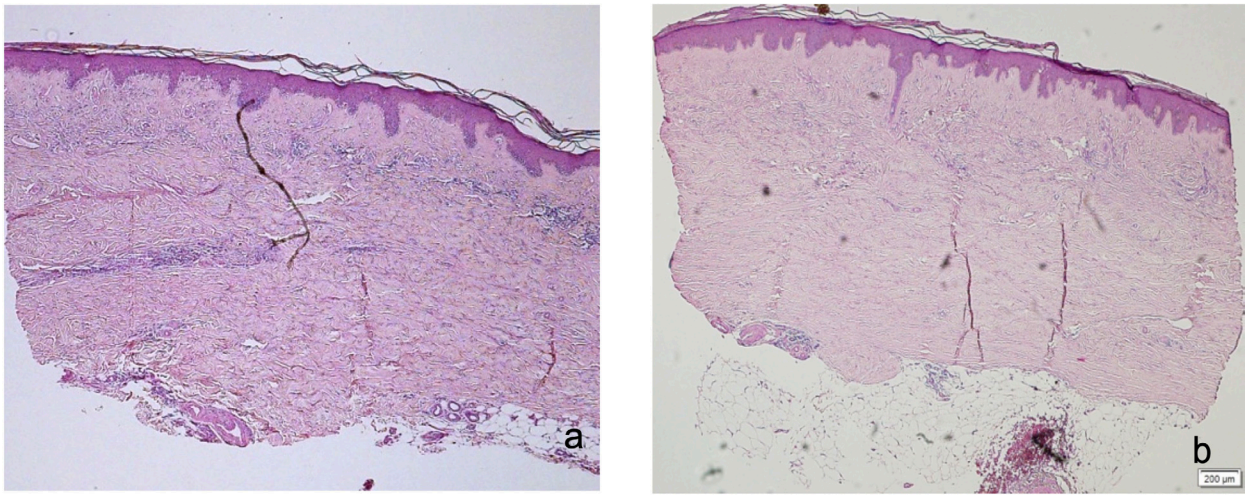

Figure 5. a. Inflammatory lesion. Biopsy of a lesion on the left popliteal area showing thickened collagen bundles with enlarged and tortuous vessels and perivascular infiltrates composed of lymphocytes admixed with some plasma cells. b. Stable lesion. Biopsy of a lesion on the right arm showed homogenized collagen bundles of the dermis with less inflammatory cells and few prominent blood vessels consistent with a stable lesion.

The second case is a 44-year-old female with unilateral generalized morphea who presented with a 15-year history of hyperpigmented atrophic slightly pruritic patches located on the left arm, forearm, thigh and leg, sparing the face, neck, hands, and feet (Figure 6). She initially sought consult and was prescribed with clobetasol which she had been applying twice a day for the last 15 years without resolution of the lesions. The patient was diagnosed with papillary thyroid carcinoma and underwent total thyroidectomy. Antinuclear antibody with immunofluorescence was positive with homogenous pattern. Histopathology of the lesions taken from the lower extremity showed atrophic epidermis with densely packed thick collagen bundles in the dermis with superficial perivascular infiltrate of lymphocytes and plasma cells (Figure 7).

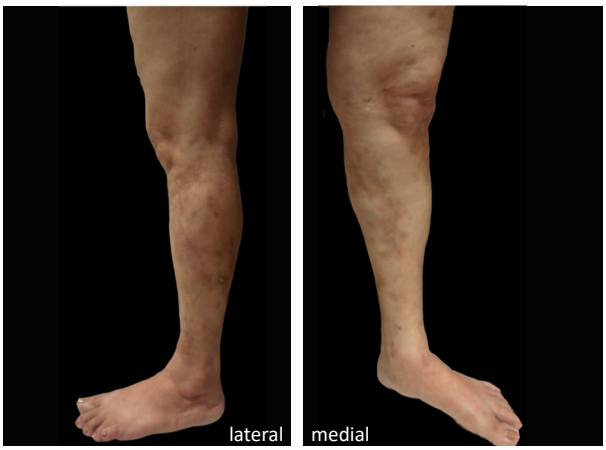

Figure 6. Multiple well-defined irregularly-shaped atrophic and sclerotic patches on the left lower extremity.

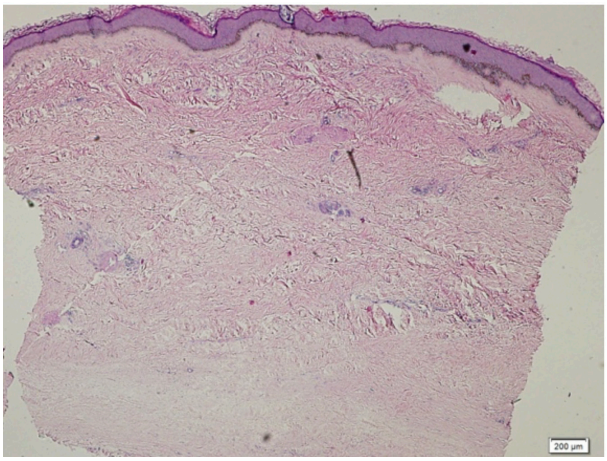

Figure 7. Biopsy of a lesion on the left lower extremity showing atrophic epidermis with densely packed, thick collagen bundles in the dermis with superficial perivascular infiltrate of lymphocytes and plasma cells.

The third case is a 22-year-old who presented with a four-year history of slightly pruritic atrophic and sclerotic patches on the left zygomaticomaxillary, infraorbital, and nasolabial areas but without hemifacial atrophy and other systemic manifestations such as seizures and blurring of vision (Figure 8). There were no previous consults done nor medications taken. Histopathology of a lesion showed homogenized collagen bundles and thick sclerosis in the mid-dermis, which was consistent with morphea (Figure 9).

Figure 8. a. Solitary ill-defined, oval-shaped sclerotic patch on the left zygomatico-temporal area. b. Multiple hyperpigmented, well-defined, and oval-shaped atrophic patches on the left infraorbital and nasolabial areas

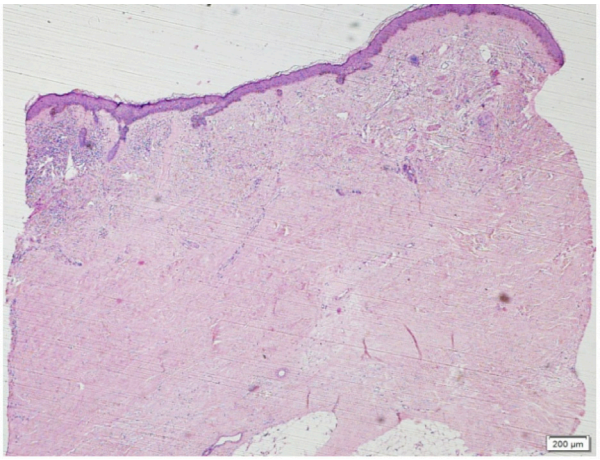

Figure 9. Skin biopsy of the lesion on the zygomatico-temporal area showing atrophic epidermis with densely packed, thick collagen bundles in the dermis with thick sclerosis in the mid dermis.

All patients had no co-morbidities like diabetes mellitus, genetic disorders, or history of intake of bleomycin, taxanes, cisplatin, and ergot alkaloids. They had no exposure to radiation and chemicals like pesticides, epoxy resins, and vinyl chloride. All patients had elevated erythrocyte sedimentation rate but with unremarkable fasting blood glucose, C-reactive protein, liver enzymes (aspartate aminotransferase and alanine transaminase), renal parameters (blood urea nitrogen and creatinine), radiography, and electrocardiogram results. Tables 3 and 4 show the summary of clinical findings and laboratory results.

Table 3. Summary of the clinical findings

Characteristics	Generalized morphea	Circumscribed morphea	Unilateral Generalized morphea
Age (years) / Gender / Skin type	64/Female Skin type IV	22/Female Skin type V	44/Female Skin type IV
Duration (years)	10	4	15
Evolution of morphea lesions	Erythematous patches to Sclerotic to Atrophic		
Involved areas	Symmetrical trunk and proximal extremities	Unilateral side of the face	Unilateral left lower extremity, forearm, and lower back
Spared	Neck, facial, and acral areas	Rest of the body parts	neck, facial, and acral areas
Spontaneous resolution	NONE		
Review of systems	Unremarkable		Myalgia (on the involved extremities)
Past Medical history	Unremarkable		Papillary Carcinoma s/p thyroidectomy
Family Medical History	Unremarkable		Diabetes mellitus Goiter

Table 4. Summary of the laboratory findings

Laboratory examination	Generalized morphea	Circumscribed morphea	Unilateral Generalized morphea
Complete Blood Count	unremarkable	unremarkable	unremarkable
Chest Xray	unremarkable	unremarkable	unremarkable
Erythrocyte Sedimentation rate (N: 0-20 mm/hr)	Elevated (40)	Elevated (40)	Elevated (42)
C-reactive protein	Normal	Normal	Normal
Antinuclear Antibody with immunofluorescence	-	Normal	Elevated homogenous pattern

B. Measure of treatment response

Patient's Evaluation: Tightness and Itch Visual Analogue Scale Score

Tightness and itch VAS scores decreased by more than 60% from the baseline in the patients with generalized (69%) and circumscribed (63%) morphea. Both cases showed initial improvement on the 5th session of NB-UVB at doses of 365 mj/cm2 and 161 mj/cm2, respectively (Tables 5 and 6). By breaking down the VAS scores, it was noted that tightness was worse on the inflammatory lesions (popliteal areas) while itch was mainly felt on the stable lesions (upper extremities and abdomen). After the 30th session, pruritus on the stable lesions completely resolved while tightness of the inflammatory and stable lesions decreased by 40-50% (Table 7).

The patient with unilateral generalized morphea had the least decrease in VAS scores at 14%. Initial improvement was noted on the 9th session of NBUVB (Tables 5 and 6).

Table 5. Tightness and Itch Visual Analogue Scale Score

Cases	Pre-treatment	Post-treatment (30 sessions)	% change
Generalized morphea	38	14	63
Circumscribed morphea	16	5	69
Unilateral Generalized morphea	14	12	14

Table 6. Number of NB-UVB sessions and corresponding dose with initial improvement in visual analogue scale score.

Case	Session number with observed initial response	Dose with observed initial response (mj/cm^2)
Generalized morphea Tightness Itch	 6 5	 401 365
Circumscribed morphea Tightness Itch	 5 5	 161
Unilateral Generalized morphea Tightness Itch	 9 9	 320

Table 7. Tightness and Itch Visual Analogue Scale Score of the patient with Bilateral Generalized Morphea.

Areas	Pre-Treatment	Post-treatment (30 Sessions)	% Change
Popliteal (Inflammatory) Tightness Itch	 10 0	 5 0	 50 0
Abdomen (Stable) Tightness Itch	 7 8	 4 0	 43 100
Arm (Stable) Tightness Itch	 8 5	 4 0	 50 100

Physician's evaluation: Modified Skin Score (MSS)

Modified skin scores decreased by more than 30% in all subjects. The patient with circumscribed morphea on the face had the greatest decrease at 50%, followed by the patient with bilateral generalized morphea at 41% (Table 8). The clinically apparent change in modified skin score was first noted on the 9th session for the stable lesion of the patient with bilateral generalized morphea at 534 mj/cm2 (Table 9). Meanwhile, change was observed on the 11th session of phototherapy for the circumscribed morphea on the face and the inflammatory lesion of the generalized morphea patient at doses 110 mj/cm2 and 646mj/cm2, respectively (Table 9). For the patient with unilateral generalized morphea, clinically apparent response was initially noted after the 9th session with a corresponding dose of 352 mj/cm2 (Tables 8 and 9).

Table 8. Modified Skin Score of the Patients with Circumscribed Morphea

Case	Pre-Treatment	Post-Treatment (30 Sessions)	% Change
Bilateral Generalized morphea	17	10	41.2
Circumscribed morphea	6	3	50
Unilateral Generalized morphea	14	9	35.7

Table 9. Number of NB-UVB sessions and corresponding dose with initial improvement in Modified Skin Score

Case	Session with Initial improvement	Dose of Narrowband UVB (mj/cm2)
Bilateral Generalized Morphea		
Stable Lesions	9	534
Inflammatory Lesions	11	646
Circumscribed morphea	11	110
Unilateral generalized morphea	9	352

Physician's evaluation: Clinical appearance of the lesions

For the patient with generalized morphea, all lesions were noted to be smaller, less erythematous and hyperpigmented (Figure 10). All lesions of the patient with circumscribed morphea became smaller. The lesion on the left zygomaticotemporal area was noted to be less hyperpigmented (Figure 11). For the patient with unilateral generalized morphea, there was no visible improvement of the lesions in terms of size and color.

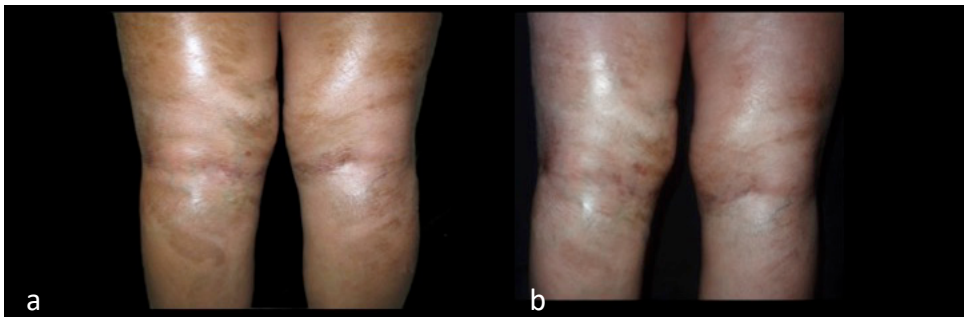

Figure 10 Representative lesions of the patient with generalized morphea a. before and b. after treatment

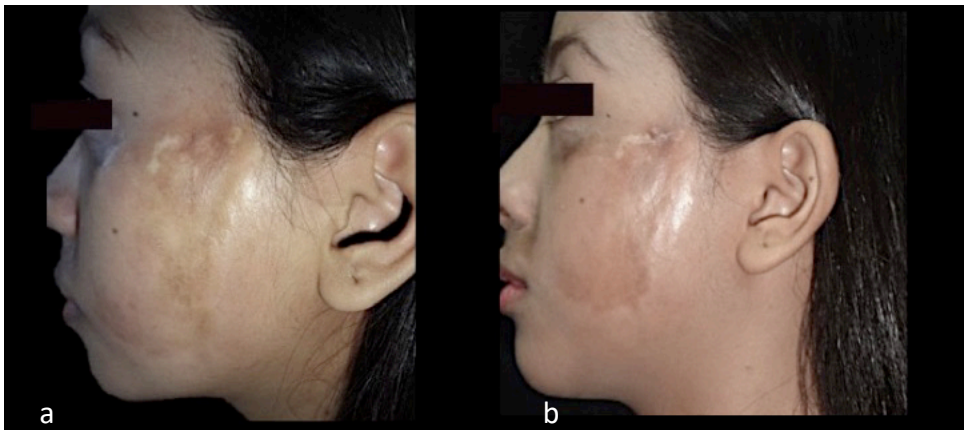

Figure 11 Representative lesions of the patient with circumscribed morphea a. before and b. after treatment

High Frequency Ultrasonography

For the patient with generalized morphea, inflammatory lesions on the left lateral and left popliteal areas were 37.8% and 47.1% percent thicker than the adjacent normal skin, respectively. After 30 sessions of phototherapy, the difference of the thickness of the lesions from the normal skin decreased to 11% and 6.5%, respectively. On the other hand, the atrophic lesions on the arm and forearm were 52% and 58% thinner than the normal skin. After treatment, the lesions became thicker thereby decreasing the percent difference from normal skin to 15% and 3.8%, respectively (Table 10).

Table 10. Ultrasound Measurement of Patients with Generalized Morphea

Evolution	Body Part	Adjacent normal skin (control)	Pre-Treatment		Post-Treatment	
			UTZ (mm)	% diff	UTZ (mm)	% diff
Inflammatory	Left Popliteal	5.5	10.4	47.1	5.9	6.7
	Lateral of the Left popliteal area	6.9	11.1	37.8	7.8	11.5
Stable/atrophic	Right arm	16.8	8.0	52.4	14.2	15.5
	Right forearm	7.9	3.3	58.2	7.6	3.8

Skin thickness was measured on the left temple and left zygoma for the patient with circumscribed morphea. Both lesions were 19.8% and 27.3% thicker than the contralateral normal skin, respectively. Post treatment, the percent difference from the normal skin decreased to 0% and 10.2% (Table 11).

For the patient with unilateral generalized morphea, the lesions on the upper extremity (percent difference of 24.6 % to 4.6 %) demonstrated better response than the lesions on the lower extremity (percent difference of 19.4% to 14.3%) (Table 12).

The Wilcoxon matched pairs signed-rank test showed a statistically significant decrease in the percent difference from normal skin of 27.5% post-treatment ($p=0.0078$). (Appendix A)

Table 11. Ultrasound Measurement of Patient with Circumscribed Morphea.

Body Part	Contralateral normal skin (control)	Pre-Treatment		Post-Treatment	
		mm	% difference	mm	% difference
Left Temple (Stable/ Atrophic)	13.1	10.5	19.8	13.1	0
Left Zygoma (Stable/Atrophic)	4.4	3.2	27.3	4.9	10.2

Table 12. Ultrasound Measurement of Patients with Unilateral Generalized Morphea

Body Part	Adjacent normal skin (control	Pre-Treatment		Post-Treatment	
		UTZ (mm)	% difference	UTZ (mm)	% difference
Left leg (Stable/atrophic)	9.8	7.9	19.4	8.4	14.3
Left forearm (Stable)	6.5	8.1	24.6	6.2	4.6

Histopathology

Analysis generally showed less packed collagen bundles mostly in the upper third of the dermis characterized by an increase in inter-bundle space. Furthermore, Verhoeff-Van Geison elastic stain showed slightly increased elastic fibers in the papillary dermis in one patient (unilateral generalized morphea) and slightly increased wavy elastic fibers in a focal area of the upper mid dermis in another patient (circumscribed morphea). (Figures 12-14)

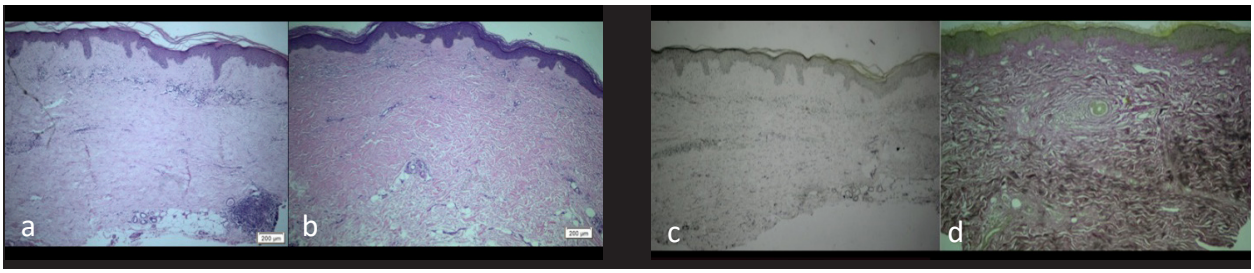

Figure 12 a. Before and b. after treatment biopsy of the lesions on the left popliteal fold of the patient with generalized morphea using H&E stain. c. Before and d. after treatment biopsy of the lesions on the left popliteal fold of the patient with generalized morphea usin Verhoeff-Van Geison stain.

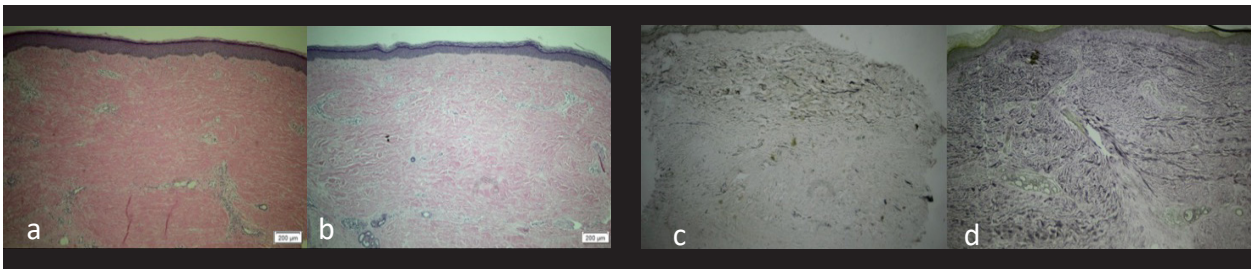

Figure 13 a. Before and b. after treatment biopsy on the lesion of the left lower extremity of the patient with unilateral generalized morphea using H&En stain. c. Before and d. after treatment biopsy on the lesion of the left lower extremity of the patient with unilateral generalized morphea using Verhoeff-Van Geison stain.

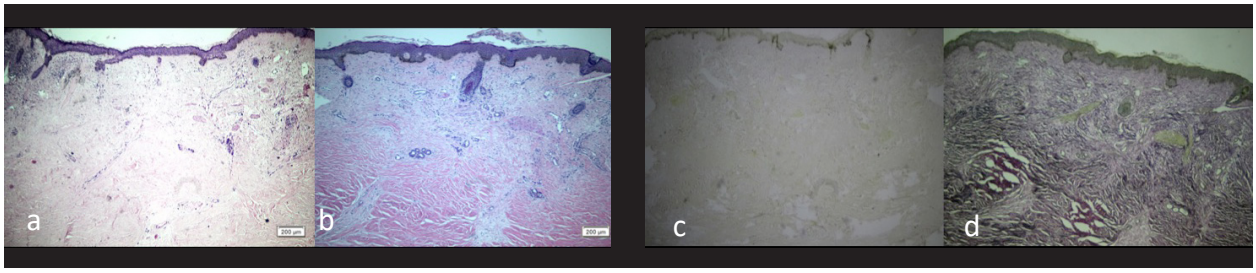

Figure 14 a. Before and b. after treatment biopsy of the lesion on the zygomatico-temporal area of the patient with circumscribed morphea using H&E stain. c. Before and d. after treatment biopsy of the lesion on the zygomatico-temporal area of the patient with circumscribed morphea using Verhoeff-Van Geison stain.

DISCUSSION

Like other phototherapeutic modalities, NB UVB up-regulates metalloproteinase-1 (MPP-1), which has collagenase activity and degrades excess collagen. It also inhibits the release of tissue inhibitors of MMP-1 and increases production of cytokines, such as IL-1 and IL-6, which further stimulate MPP-1 production.[10]

Currently, studies on the use of NB UVB in the treatment of morphea are limited. Some of these even concluded that NB UVB can be an alternative treatment option for morphea when UVA1 is not available.[8,9] In a study done by Buense et al., patients with localized scleroderma who went through 10 sessions of NB UVB exhibited a decrease in thickness of the skin lesions by as much as 60% as measured by 7-14-MHz high frequency sonographic transducers.[8]

Narrowband UVB completely relieved pruritus in all patients. The type of lesion, whether inflammatory or stable, was not contributory to treatment response. The improvement of the cutaneous lesions was influenced by the anatomic location and the duration of the lesions. In general, facial lesions responded more favorably than lesions on the other parts of the body, with the least response seen on the lesions located on the lower extremities. Furthermore, there was an inverse relationship between the duration of the lesion and treatment response.

Percent differences from the adjacent normal skin before and after treatment were compared to determine the improvement of skin thickness measured by ultrasonography. This was done to show that the improvement in thickness is relative to the thickness of the normal skin, which served as the standard measurement of skin thickness for the specific areas where the lesions were located. After treatment, atrophic lesions became thicker while sclerotic and indurated lesions became thinner with decrease in percent difference from the normal skin.

The increase in inter-bundle space and slight increase in elastic fibers may have possibly contributed to the decrease in the tightness of the sclerotic skin. In a study done by Majewski et al., the expression and tissue distribution of intercellular adhesion molecule-1 (ICAM-1) in the skin biopsies of patients with systemic and localized scleroderma were studied and compared to normal individuals. In the normal skin, ICAM-1 was restricted to the vascular endothelium, infiltrating mononuclear cells and keratinocytes.[11] In morphea, upregulation of adhesion molecules, as well as vessel damage, facilitates recruitment of T-lymphocytes, which are capable of producing pro-fibrotic cytokines, IL-4,IL-6, and TNF-β, resulting in sclerosis.[12] NB UVB inhibits ICAM-1 upregulation by keratinocytes in inflammatory diseases. Hence, it can, along with its enhancing effect in matrix metalloproteinases synthesis, further stimulate collagen degradation resulting in the softening of fibrosis. [12]

CONCLUSION

Morphea causes discomfort and may compromise activities of daily living. Currently, the lack of a clinically effective and safe treatment option poses a grave concern to the inflicted individuals and physicians in the country. Whether as a primary treatment option or as an adjunct to conventional medications, as shown in this case series, the use of the more readily available NB UVB for morphea appears an acceptable treatment in the absence of UVA1 therapy or photochemotherapy.

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Appendix A. Change in skin thickness before and after treatment with NB-UVB using skin ultrasonography.

	N	% Difference from normal skin					W value		P value**
				Percentiles					
		mean ± SD	95% CI	25th	50th (Median)	75th	Positive ranks	Negative ranks	
Pre-treatment	8	35.83 ±15.27	23.06, 48.59	21.00	32.55	51.08	0	36	0.0078
Post-treatment	8	8.33±5.44	3.78, 12.87	4.00	8.45	13.60			
Post-treatment – pre-treatment	8	-27.50±15.61	-40.55, -14.45	-39.53	-23.15	-17.78			

* Wilcoxon matched pairs signed-rank test

** α* ilco two-tailed