A novel modality using microwave technology for the treatment of Fox-Fordyce disease (FFD)

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Fox-Fordyce disease (FFD) (also known as apocrine miliaria) is a rare dermatologic condition characterized by multiple skin-colored, equidistant, perifollicular papules distributed in areas rich in apocrine glands. These areas typically include the axillae, anogenital, and periareolar regions.[1] This condition primarily affects young females between 15 and 35 years of age, and rarely presents before puberty. The disease is often severely pruritic and may be exacerbated by sympathetic stimulation such as stress, exercise, excitement, and hot weather.[1-3] The diagnosis is typically made clinically but histopathologic examination may display infundibular plugging, parakeratosis, spongiosis, and acanthosis.[4,5] Perifollicular foam cells are now believed to be a distinct and specific feature of FFD.[4] Therapeutic modalities are commonly lackluster and no definitive treatment exists for this entity.

MiraDry (Miramar Labs Incorporated, Santa Clara, CA) is a novel microwave device that was recently approved by the Food and Drug Administration in 2011 for the treatment of primary axillary hyperhidrosis. It targets the eccrine, apocrine, and apoeccrine sweat glands in addition to hair follicles by targeting the dermal-hypodermal junction through dielectric heating.[6] We report a case of axillary FFD treated with this novel noninvasive microwave technology.

CASE REPORT

A 25-year-old female presented with a 2-year history of pruritic papules in the bilateral axillae. The paroxysmal pruritus was exacerbated by exercise and stress. She had been using a sensitive skin deodorant and denied any changes in her shaving cream or razor. The patient also denied any changes to her axillary sweating patterns or volume. There was no history of axillary hair removal procedures or family history of similar lesions. On physical examination, she had multiple, monomorphic, flesh-colored to yellow, conical papules in the bilateral axillary vaults, with extension to the axillary folds.

The patient was clinically diagnosed with FFD. Initially, tretinoin 0.1% cream was started to the affected areas daily, but she returned after 3 months without any improvement in appearance or pruritus. At this time, MiraDry microwave technology (Miramar Labs Inc), given its capability to target hair follicles, eccrine, apocrine, and apoeccrine sweat glands was recommended to the patient.

The procedure consisted of several steps: delineation of the axillary vault with a treatment template based on the individual size of the axilla (ranging from 60-120 mm), injection of 17 mL of local anesthetic (1% lidocaine with 1:100,000 epinephrine) in the dermis of each axilla, followed by injection of 40 mL of sterile saline into the upper half of each axilla, and treatment with the microwave MiraDry system (Miramar Labs Inc) at a selected energy level. We utilized an energy level of 3 for the first treatment session followed by a maximum energy level of 5 for the second treatment 9 months later. The patient developed the expected sequelae from the procedure including: temporary pain, swelling, and bruising, which resolved within 5 to 7 days after the procedure. The longer-term effects

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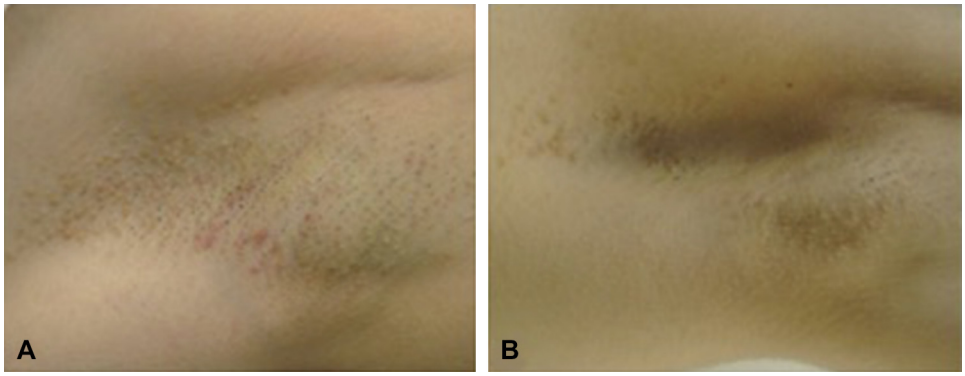

Fig 1. Left axilla at baseline (**A**) and 2 months after the second treatment (**B**).

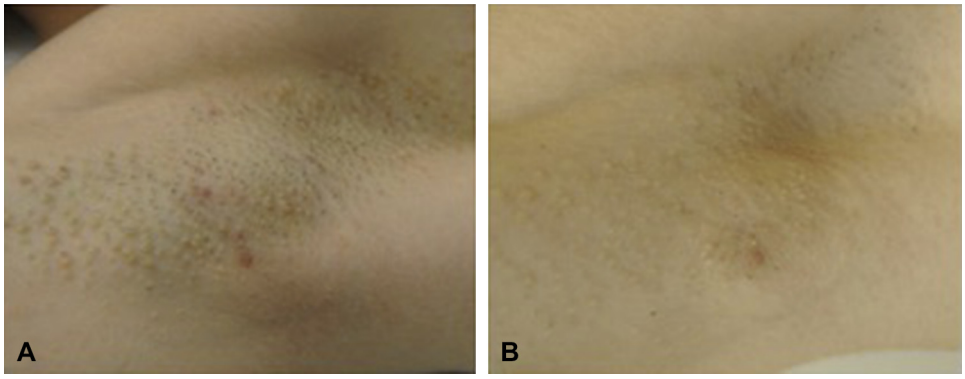

Fig 2. Right axilla at baseline (**A**) and 2 months after the second treatment (**B**).

included altered sensation in the skin of the axillae that resolved within 4 to 6 weeks for the left axilla, but has persisted, although improved, in the right axilla 4 months after the second treatment. The patient denied any accompanying muscle weakness of the right upper extremity.

The patient had marginal improvement of the symptomatic lesions after the first treatment, but significant clearance after the second treatment was achieved at a higher energy setting (Figs 1 and 2). The pruritus resolved after the second treatment session, with a dramatic impact in her quality of life. In addition, there was a marked decrease in the axillary hair density after 2 treatment sessions. There was no evidence of recurrence at the 4-month follow-up.

DISCUSSION

FFD was first described by George Henry Fox and John Addison Fordyce[7] in the early 20th century. It is believed that the primary pathophysiologic process involves a hyperkeratotic plug causing infundibular obstruction with resultant dilation of the apocrine duct.[1] This may lead to formation of a retention cyst, ductal rupture, and subsequent inflammatory response to the spewed material.[1] The lymphohistiocytic infiltrate may be the cause of the intense pruritus that often accompanies the lesions.[3,4,8] The precise pathogenesis of FFD remains unknown but hormonal factors, genetics, and stress are all thought to be contributors.[1]

Currently, there has yet to be a consistently effective treatment for FFD. However, many different therapeutic modalities have shown variable efficacy in small subsets of patients. These include topical clindamycin, oral contraceptives, topical and oral retinoids, topical pimecrolimus, topical and intralesional corticosteroids, excision-liposuction with curettage, and fractional carbon-dioxide laser.[1]

Because the pathophysiology of FFD is now believed to be follicularly driven, we hypothesized that the thermolysis of hair follicles and sweat glands may potentially alter this pathogenic pathway. Therefore, we looked to a new noninvasive technology device that uses microwave energy to preferentially target the dermal-hypodermal junction. This microwave device, currently marketed as MiraDry (Miramar Labs Inc), emits a 5800 Megahertz microwave frequency to cause dielectric heating at the dermal-hypodermal junction resulting in destruction of the sweat glands and hair follicles.[6] Application of concurrent contact cooling to the

epidermis and papillary dermis restricts the zone of thermolysis to the dermal-subcutaneous interface, between the cooled upper layers and the inert subcutaneous tissue.

To our knowledge, this is the first reported case of successfully treating FFD using noninvasive microwave technology. We observed a decrease in the number of papules, hair density, and sweating of the treated areas with complete resolution of the associated pruritus. Further follow-up showed no signs of recurrence and the patient continues to be extremely satisfied with the therapeutic outcome. The average gravimetric sweat reduction for patients treated with MiraDry (Miramar Labs Inc) is reported to be 82% at 12 months and may explain why we were unable to achieve complete clearance of the lesions.[6] The residual folliculo-sebaceous-apocrine units may not have reached the temperature threshold necessary to achieve thermal ablation, and thus are susceptible to the underlying pathologic pathway. A third treatment session at a maximum energy level will be performed. This procedure is generally not covered by insurance and may cost $1000-2000 per treatment. Larger scale studies and long-term follow-up are warranted to determine this treatment's efficacy.

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