SHORT COMMUNICATION

Beau's Lines and Onychomadesis: A Systematic Review of Characteristics and Aetiology

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Beau's lines and onychomadesis were first described in 1846 and 1937, respectively (1, 2). These nail dystrophies result from slowing or cessation of nail plate production following an insult to the nail matrix. In Beau's lines, a slowing or temporary disruption of cell growth from the nail matrix results in transverse grooves on the nail plate, whereas onychomadesis involves complete separation of the nail plate due to cessation of nail plate production over 2–3 weeks. The 2 conditions can present independently or concurrently. The aim of this study is to investigate the characteristics and aetiology of Beau's lines and onychomadesis by performing a systematic review of studies related to cases published in English.

MATERIALS AND METHODS

On 30 December 2021 we performed a systematic review of papers published in MEDLINE, Embase, and Cochrane databases, using the following terms: "Beau's lines", "onychomadesis" and "nail shedding". Information sources for the search were processed according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement. The search identified a total of 488 non-duplicate studies. Of these, 249 were considered eligible after their title and abstract had been carefully screened. The full-text assessment led to the exclusion of further 16 papers because they did not contain specific information on cases with Beau's lines or onychomadesis ($n=13$) or they included patients who were ultimately diagnosed with another nail disorder ($n=3$). A flow diagram of the literature screening is shown in **Fig. 1** and all article data included in the review are shown in Table SI.

RESULTS

A total of 233 individual studies were included and divided into 3 categories: Beau's lines, onychomadesis, and both (if Beau's lines and onychomadesis were simultaneously observed in a single patient or were not differentiated in the study) (Table SII). The most common studies were case reports or series, followed by retrospective studies. There were more cases of onychomadesis ($n=908$) than Beau's lines ($n=233$). Patients with onychomadesis had onset at a younger age (23.4 vs 41.6 years) and were more symptomatic (12.1% vs 2.5%) than patients with Beau's lines. Multiple nails were affected in most patients.

Among studies reporting aetiology (Table SIII), drugs (36.3%), particularly chemotherapeutic agents, were the most common cause of Beau's lines, followed by non-autoimmune systemic diseases (25.0%), trauma (12.5%), and infection (7.5%). In contrast, infection (36.9%) was the most common cause of onychomadesis, followed by drugs (14.6%), especially antiepileptics, and non-autoimmune systemic diseases (13.8%). Furthermore, idiopathic onychomadesis has been reported rarely as a

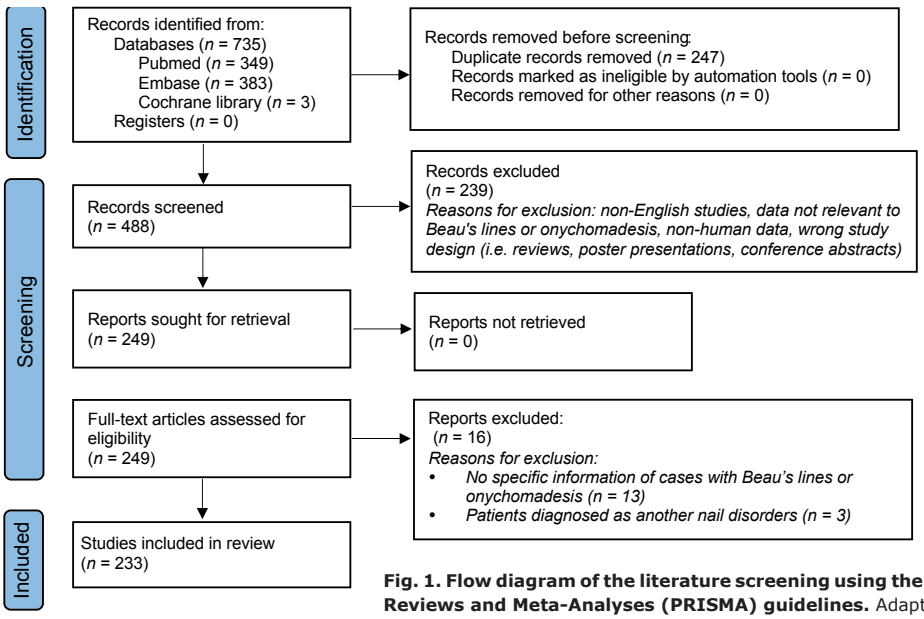

Fig. 1. Flow diagram of the literature screening using the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines. Adapted from http://www.prisma-statement.org

sporadic, seasonal or familial form. When Beau's lines and onychomadesis coexist, infection (43.3%, especially hand-foot-and-mouth disease), drugs (16.7%, especially cytotoxic agents), and non-autoimmune systemic diseases (13.3%) were the most common causes.

Management of Beau's lines and onychomadesis generally involved observation until self-resolution. However, in cases precipitated by underlying disease or medication, managing the disease or discontinuing the causative drug was needed to prevent further damage to the nail matrix and recurrence (Table SII). In selected cases of onychomadesis (5.6%), topical agents such as keratolytics, antibiotics or fibroblast growth factor or nail surgery, such as nail extraction or curettage of pyogenic granuloma, were used to relieve symptoms (3–6). Beau's lines cases, except in 1 patient who developed the Beau's line then deceased during hospitalization after 2 months, resolved or improved without recurrence (7). The majority of onychomadesis cases also improved, while exacerbation of symptoms, residual sequelae, or recurrence were reported in 0.8%, 2.4%, and 3.2% of studies, respectively. One study reported that 3 out of 44 patients with recurrent onychomadesis treated with 40% urea cream worsened (3), and 3 studies reported residual sequelae, such as onycholysis, thin and brittle nails, and minor scarring after onychomadesis (8–10). Studies reported recurrence of onychomadesis in the setting of idiopathic familial or sporadic cases, or in a child with spinal muscular atrophy (11, 12).

DISCUSSION

This study provides insight into the characteristics and diverse aetiologies of Beau's lines and onychomadesis and expands understanding of their prognosis. A previous literature review of all associations with onychomadesis demonstrated only a narrative description about the causes without specific information on their frequency or prognosis and a comparative analysis with Beau's lines that have similar pathophysiological mechanisms (13).

Beau's lines and onychomadesis are self-limiting nail disorders that share a common pathophysiology and have excellent prognosis. However, patients and non-dermatology trained physicians may worry about the appearance and underlying cause of these nail disorders and feel that they warrant more aggressive treatment. Understanding the aetiology of these 2 conditions and avoiding associated risk factors can promote favourable patient outcomes. This study revealed that the most common causes of Beau's lines and onychomadesis were drugs (36.3%) and infections (36.9%), respectively. Other causes have been identified as non-autoimmune systemic diseases, autoimmune systemic diseases, trauma, neonatal or hereditary diseases, anatomical anomaly, neurological or neuromuscular diseases, onychomycosis, etc. In addition, microtrauma by active hobbies or sports cause onychomadesis, and unrecognized microtrauma may play an important role in cases of idiopathic onychomadesis (11). Patients with modifiable risk factors should be educated not to inflict any additional damage to their nail matrix, and be encouraged to make self-identified behavioural changes.

Onychomadesis is a more severe presentation of Beau's lines caused by profound insults sufficient to disrupt nail production. In advanced cases of onychomadesis, inflammation and granulation tissue may develop in the lateral or proximal nail folds causing pain and secondary infection, and impairing quality of life. These cases may require nail plate removal, curettage of the pyogenic granuloma that arises with onychomadesis, or topical agents. Furthermore, depending on the severity or repeated exposure of the inciting event, permanent damage to the nail matrix, nail deformity, or retronychia may develop (14,15). Onychomadesis that has such complications or does not improve due to spontaneous nail shedding may require timely nail removal. In terms of other treatment modalities for onychomadesis, nail avulsion has been described for diagnosis and management of symptoms in severe cases with painful oedema of the proximal nail folds (4). The rationale for using keratolytics in the management of onychomadesis is, especially in recurrent forms, such as multi-layered onychomadesis or thickening nails, to promote nail softening, enable trimming, and facilitate chemical avulsion when indicated (3). Antibacterial ointment has been prescribed to a patient who developed onychomadesis after hand-foot-and-mouth disease to prevent impetigo and other secondary bacterial infections (5). Fibroblast growth factor was used in a case of onychomadesis with delayed regrowth of the nail to promote proliferation of nail matrix keratinocytes, as it is known to act on epidermal keratinocytes (6). However, in general, Beau's lines and onychomadesis resolve spontaneously as long as the underlying nail matrix is not permanently damaged, so the first-line management is observation. Thus, active treatment reported in the literature may be unnecessary, and further validation of treatment efficacy in large-scale studies is warranted.

Limitations of this study include the lack of high-quality prospective studies, and some studies did not report detailed data. In addition, there is publication bias, as there were more cases of onychomadesis than Beau's lines, considering onychomadesis is a severe form of Beau's lines.

To our knowledge, this is the first systematic review on the characteristics and aetiology of Beau's lines and onychomadesis. Further studies are needed to improve our understanding of these conditions.

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