Presence of Subungual Osteochondroma Deformans in Severely Mycotic Toenails

Christopher B. Stewart, DPM, FACFAS & Maryellen A. Waltz, DPM, AACFAS

Central Virginia Foot & Ankle Laser Center, Charlottesville, Virginia

Statement of Purpose

The purpose of this study is to highlight the role of the subungual osteochondroma deformans (SOD) lesion as it relates to onychomycosis. Although several advancements in the treatment of onychomycosis have been made over the years, it is still a truism that a highly efficacious, predictable treatment continues to challenge the medical community at large. We define the subungual osteochondroma deformans lesion as a firm subungual growth diagnosed in the presence of onychomycosis. In order to be a true SOD lesion there must be nail plate fungal infection. SOD lesions can be comprised of bone, cartilage or a combination of bone and cartilage extending from the dorsal aspect of the distal phalanx of the digit. The origin of SOD lesions is thought to be genetics, trauma, or digital recurvatum of the distal phalanx. SOD lesions can cause onycholysis, moderate to severe dystrophy, ingrown toenails, and auto-avulsion. Three variants have been identified: Type 1- bone only (true subungual exostosis-Fig.1); Type 2- cartilage only (chondroma-Fig. 2); Type 3- bone and cartilage combination (osteochondroma- Fig. 3).

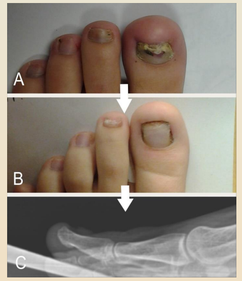

Fig. 1. SOD type I lesion

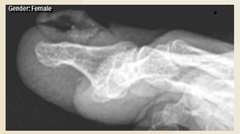

Fig. 2. SOD type II lesion

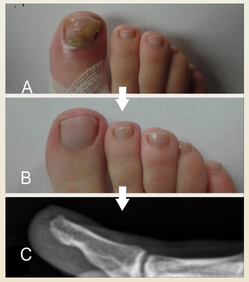

Fig. 3. SOD type III lesion

Population and Methodology

This study retrospectively compares outcomes between two groups of patients with severe pedal onychomycosis. One group of 25 severely mycotic toenails were treated using our proprietary Nd:YAG laser-based algorithm combined with avulsion of each toenail. The second group of 71 toenails, were not only treated with the same laser-based surgical algorithm but were also assessed for the presence of SOD lesions which were removed when present.

The final results, comparing each pre-treated nail to each post-treated nail were summarized using digital planimetry (Fig.4). Planimetry is the process by which percent reduction in nail discoloration is expressed using a two dimensional area over time.

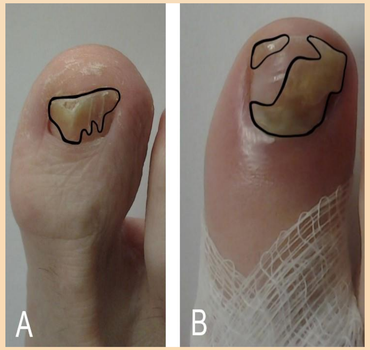

Fig. 4. Depiction of surface area (A, B) affected by onychomycosis as analyzed via planimetry prior to nail restoration treatment.

Literature Review

Fungal infection of the nail, onychomycosis, is the most common nail disease. It has been reported that 20% of people between 40 and 60 years of age have this medical condition, while up to 90% of Americans over the age of 65 may have this infection (1). A study on quality of life found that patients with confirmed onychomycosis experienced problems with nail-trimming, embarrassment, pain, nail pressure, and discomfort wearing shoes (2). Onychomycosis is difficult to treat and historically 20% of patients with affliction of the toenail do not respond to therapy (3). Remission after treatment is also rare and recurrence is common due to the difficulty in eradicating the pathogen (1). Cure rates are low and treatment can extend over a lengthy period and can be expensive. The presence of dermatophytes, primarily Trichophyton rubrum, cause most of the superficial fungal infections (4). A 2009 study by Malay, Yi, Borowsky, et al discussed the variety of variables that significantly decreased the likelihood of cure rates such as the presence of yeast, hyperhidrosis, tobacco use, proximal involvement (lunula), and greater than 50% involvement in the transverse width of the nail (5).

Mycological culture has been commonly used to diagnose and determine therapeutic intervention (6). In a study of non-dermatophyte onychomycosis, false-negative results were found to occur in 25% of subjects (7). Several studies found that nail plate biopsy using the periodic acid-Schiff stain (PAS) produced greater accuracy in the diagnosis of onychomycosis (8, 9). One study suggested that a combination of culture and histopathological evaluation of the nail plate yields greater accuracy of diagnosis since histopathology alone does not provide information about vitality of the fungi or accurate identification of the pathogen (10). Accurate pathogen identification via PCR assay has demonstrated to be twice as sensitive as culture in identifying dermatophytes, thereby allowing organism identification to complement the high sensitivity of PAS (Periodic Acid-Schiff Stain)/Gomori Methenamine Silver/Fontana Masson Stain (11).

Current treatments include topical applications, systemic medications, surgical procedures, and laser-based approaches. Topical antifungals are reported to be relatively ineffective for extensive disease, as the drug does not often penetrate the nail plate (1). Systemic antifungals were reported to require at least three months of treatment and can create drug and other adverse reactions (1). Adverse reactions include hepatitis, headache, gastrointestinal upset, and rash (12). Partial or total nail avulsion has also been used to treat onychomycosis permitting the removal of the affected portion of the nail (12). In a study of 40 patients in 2007, Grover and colleagues reported that none of the severe cases of onychomycosis were cured by avulsion (13). Additionally, unappealing nail dystrophy and pain can progress to the point where some sufferers opt to undergo permanent removal of the offending nail via a matrixectomy procedure.

In the1980s researchers utilized lasers in the treatment of nail fungus via creation of holes in the nail plate to provide optimal access of topical solutions to the fungus (14). Interestingly, there have been some recent efforts to return to nail hole drilling as a way to better deliver topical medications to the nailbed. Most laser treatment protocols direct the laser energy through the nail plate itself. Though several lasers are FDA approved for the treatment of onychomycosis it is important to note that this approval is typically for the "temporary clearing" of nails and not for a "cure".

Results

Analysis of 25 Fungal Nails

A retrospective analysis was performed on 25 severely mycotic toenails treated with surgical nail avulsion and our 1064 Nd:YAG laser-based surgical algorithm over a 12-month period not taking into account the presence or absence of an SOD lesion in each toe.

Improvement across all 25 toenails was 54.81% as measured by digital planimetry.

Analysis of 71 Fungal Nails

A retrospective analysis was performed on 71 severely mycotic toenails treated with surgical nail avulsion and our 1064 Nd: YAG laser-based surgical algorithm over a 12-month period evaluating for the presence or absence of an SOD lesion in each toe. When present, all SOD lesions were surgically removed.

The incidence of Subungual Osteochondroma Deformans was 53/71 toes (74.65%). This was determined via radiography and physical palpation of the nail bed. These nails were also rated using digital picture planimetry both before and after treatment (Figs. 1-6).

Nails in this case series showed 96.48% improvement in nail appearance.

Analysis & Discussion

This study supports our hypothesis that removal of SOD lesions in severely mycotic toenails greatly improves overall treatment outcomes. We calculated a 55% improvement using our surgical laser-based algorithm in addition to nail avulsion. Furthermore, and most significantly, we calculated a 96% improvement when this same protocol was combined with removal of all SOD lesions when present (Fig. 7). Our experience to date finds that the majority of SOD lesions are of the Type 3 variant, which presents as an osseous spur with a cartilaginous cap. Plain radiographs provide some assistance in diagnosing these lesions but often underrepresent the size of the spur due to the contribution of the cartilaginous component (Fig. 3).

Overall, 53 out of the 71 nails reviewed in our second group had confirmed SOD or 74.65%. This incidence, nearly 3 out of 4, is much higher than the "uncommon" incidence of digital subungual exostosis in the general population (15). We attribute much of the relative difference to the direct relationship Subungual Osteochondroma Deformans lesions have with onychomycosis.

Fungal nail research is challenging for many reasons. The slow rate of nail regrowth makes developing successful treatment protocols a long and arduous process. In addition, the only true test for mycolotic cure is to avulse and analyze the entire nail plate post treatment. Since this is a cosmetic procedure, we have found patients reluctant to undergo a complete avulsion after waiting 6-12 months for their new nail to grow in. For this reason and due to the relatively unreliable analyses of culture specimens, we, and many others, rely largely upon visual analysis using measures such as thickness and planimetry (percent reduction in nail discoloration over time). In conclusion, findings of SOD lesions beneath the nail plate correlate highly with advanced pedal onychomycosis. It is the combination of SOD excision with a multi-faceted laser-based treatment algorithm that has yielded 96% or greater improvement in toenails.

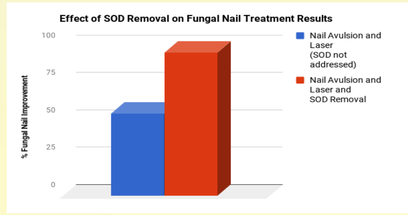

Fig. 7. Representation of the significant role SOD lesions play on percent improvement of fungal nails with nail restorative treatments via nail avulsion and laser based therapies when addressed.

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