ISSN 1855-9913

Journal of the Laser and Health Academy
Vol. 2013, No.1; www.laserandhealth.com

Er:YAG Laser Treatment of Intractable Plantar Keratosis (IPK)

Suzana Koltaj
Olivier's Surgical Clinic, Moravske Toplice, Slovenia

ABSTRACT

Intractable Plantar Keratosis (IPK), caused by an accumulation of dead skin cells that harden and thicken over an area of the foot, is a very unpleasant and painful condition normally found on the ball-of-the-foot, the heel, and/or the inside of the big toe. Currently available treatment options for IPK are associated with different limitations and side effects, so there is a great need for novel less invasive therapies. In this current study we wanted to elucidate the efficacy of ablative laser treatment with Er:YAG laser for intractable plantar keratosis. 43 patients with one or more plantar keratosis were treated with 2940 nm Er:YAG laser. All corn seed tissue was precisely removed by laser ablation to prevent recurrences. Follow-ups were made 5, 14, 30 and 90 days and 1 year after the treatment. During the healing time, which lasted approximately 3 weeks, most of the patients didn't report any pain and none took any analgesics. From our study we can concluded that Er:YAG laser therapy is an efficacious and safe method for treatment of IPK. In comparison with other available therapies, laser treatment of IPK is minimally invasive and enables clearing of all callus tissue, preventing recurrences. IPK treatment with Er:YAG laser presents a great solution for patients with quick healing, no post-operative pain and no scars observed.

Key words: Intractable Plantar Keratosis (IPK), Er:YAG laser, ablative laser treatment

Article: J. LA&HA, Vol. 2013, No.1; pp. 32-35.
Received: May 20, 2013; Accepted: May 29, 2013.

I. INTRODUCTION

Intractable Plantar Keratosis (IPK), known by different names (plantar Callus, "corn seed", Clavus durus), is a very unpleasant and painful condition caused by an accumulation of dead skin cells that harden and thicken over an area of the foot (Fig.1). Calluses are normally found on the ball-of-the-foot, the heel, and/or the inside of the big toe (Fig 2). Some calluses have a deep seated core known as a nucleation. IPK occurs equally in both men and women and presents the body's defense mechanism for protecting the foot against excessive pressure and friction [1].

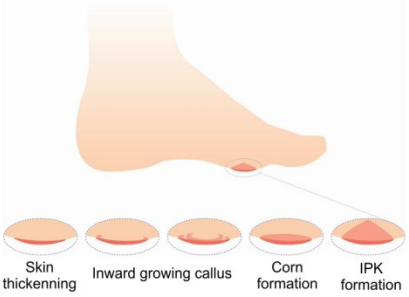

Fig. 1: Developmental steps of IPK formation.

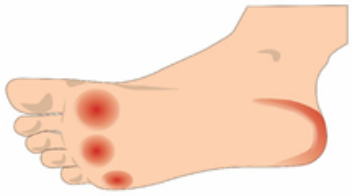

Fig. 2: Main distribution of IPKs.

Currently there are various treatment options for intractable plantar keratosis such as electrosurgery, cryosurgery, chemical agents (salicylic acid), and scalpel removal [2–5]. Among the available therapeutic options, none are uniformly effective and most are associated with different limitations and side effects, like necrotic debris, inflammation, extensive bleeding, long recovery times, post-operative pain, scaring and relatively high recurrence rates due to difficulties in removing deeper corns. So there is a great need for novel, less invasive therapies with low risk of adverse side-effects.

Our aim was to evaluate the safety and efficacy of ablative laser treatment with Er:YAG laser for intractable plantar keratosis.

II. MATERIALS AND METHODS

In a period of 2 years (2009-2011), 43 patients with an average age of 42.6 and with one or more plantar keratosis were treated in Olivier's clinic in Moravske Toplice (Table 1). This study was conducted in accordance with the Declaration of Helsinki as well as

the principles of good clinical practice. All patients provided written informed consent. For juvenile patients (younger than 18 years), informed consent was provided by a parent or a legal guardian before entry into the study.

Demographic data		
Gender		
Male	**14**	32,56%
Female	**29**	67,44%
	43	100,00%
Age		
average:	**42,6**	
range:	8 - 81	

Table 1: Demographic data of IPK patients treated with Er:YAG.

One hour before the procedure the foot with IPK was soaked in warm water with disinfecting solution. After cutting the outer part of IPK (Fig. 3) each patient received a single treatment with 2940 nm Er:YAG laser (Dualis SP II, Fotona, Ljubljana, Slovenia) using a 6 mm spot size handpiece. Energy was set between 250 and 500 mJ with pulse duration set between 0.3 – 1.5 msec. Repetition rates of 10 Hz were used. Before treatment local anesthesia was given around the callus with 4-6 radially distributed points of injection.

Fig. 3: Cutting the outer part of IPK.

All corn seed tissue was precisely removed by laser ablation to prevent recurrences (Fig 4). The wound was covered with topical cream to keep it moist and lubricated, and covered with bandages for a period of 3-4 days. To ameliorate tissue reaction and reduce secretion, ice was applied on top of the bandages. The efficacy of the treatment was evaluated visually (by clinical inspection of the IPKs and comparison with the photos). Follow-ups were scheduled at 5, 14, 30 and 90 days and 1 year after the treatment. Additionally, patients were asked to describe their satisfaction on a four-point scale (0 - no satisfaction, 1 - minimal satisfaction, 2 - good satisfaction, 3 - excellent satisfaction) by evaluating the level of pain and reporting any adverse effects they may have noticed during the treatment or in the post-treatment period.

Fig. 4: Examples of precise laser removal of the callus.

III. RESULTS

52 IPK lesions were treated with an average diameter of 17.2 mm (range between 11 and 32 mm), measured after reduction to the normal skin level.

The distribution of IPKs was quite symmetrical on both feet – there were 27 calluses on the right foot and 25 on the left foot. The distribution of IPKs on various locations on the feet was as follows: the largest portion of calluses was located on the balls of the feet (around 52%, on locations 1, 2 and 3 on Fig. 5) and all toes (27%, on locations 7-10). Almost 80% of all calluses treated were on these locations. There were also significant numbers of calluses located on the heels (around 15%, location 6), while very few were found in the central sole area (5%, locations 4,5).

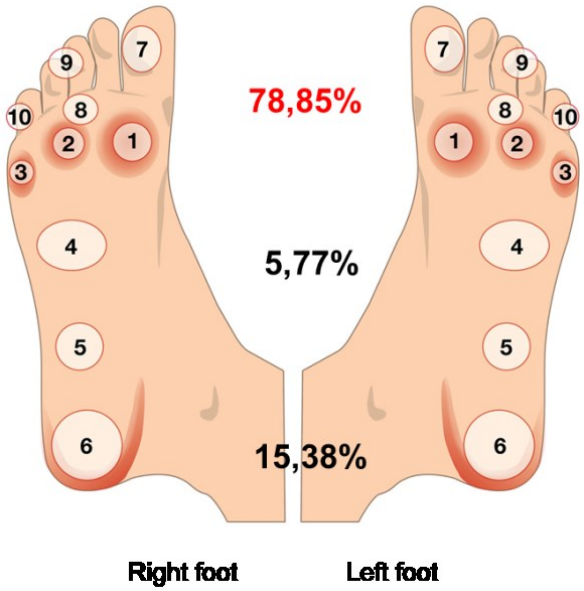

Fig. 5: Location, frequency and distribution of 52 treated IPKs.

A single laser treatment was applied to all 52 IPKs. Follow-ups were scheduled at 5, 14, 30, 90 days and 1 year after the treatment and were executed on average at 5.3 days (3-14), 16.3 days (range: 6-48) and 46.0 days (range: 20-72) after the treatment. Two examples of patient follow-ups are shown in Figures 6 and 7 below.

Fig. 6: Follow-ups at 5, 18, 26 and 52 days after treatment with Er:YAG.

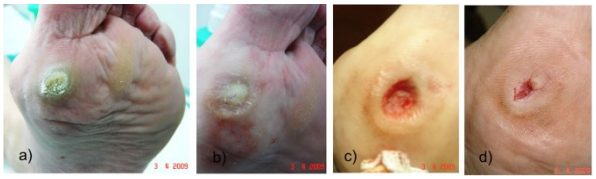

Fig. 7: IPK before Er:YAG treatment (a), after shaving, ready for laser therapy (b), immediately after (c) and 3 days after treatment with Er:YAG laser (d).

During the healing time most of the patients didn't report any pain and none took any analgesics. Just a few patients (5 or 11.6%) were prescribed general antibiotics since they came to the treatment with inflamed IPK. All treated IPKs were completely healed in a period of 3 to 5 weeks without any scars observed.

After 3 months 84% of the patients were highly satisfied with the results of the treatment, while the remaining 16% assessed their results as good. At the 1-year follow up the majority of patients (77%) were still remarkably satisfied with the results of the treatment, while 10 patients (23%) who developed non-homogeneous, wart like thickening of the skin on their soles expressed reduced, minimal satisfaction.

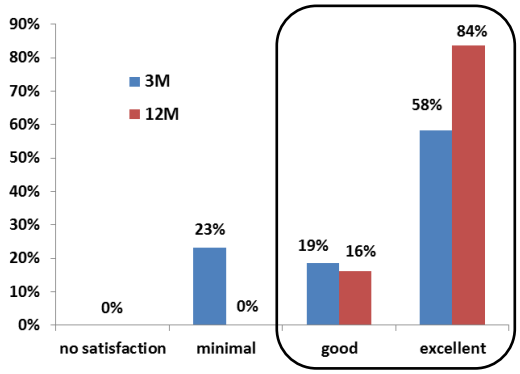

Fig. 8: Patient's assessment of satisfaction with Er:YAG laser treatment of IPK after 3 and 12 months.

Those patients with minimal satisfaction at the one year follow-up were invited for inspection, and all were retreated with Er:YAG. After the Er:YAG treatment all of these patients received an additional laser therapy for warts [10], for which we used an Nd:YAG laser that was integrated with the same laser system (Dualis SP II, Fotona).

IV. DISCUSSION

The Er:YAG laser with a wavelength of 2940 nm is an excellent tool for tissue ablation, since it has a maximum absorption in water almost 16 times higher than the absorption of the CO2 laser [6]. Er:YAG lasers have a great potential for treating different types of cutaneous lesions. It is already widely used for treating different types of keratosis such as actinic keratosis, seborrheic keratosis, and warts [7–9].

Several patients' photographs presented in this paper (Fig. 6, Fig. 7 and Fig. 9, Fig. 10) clearly show the simplicity of the procedure and the accuracy of lesion (corn seed tissue) removal. Also, the healing phases visible on these pictures indicate un-eventful healings, without complications or discomfort, as confirmed also by the patients.

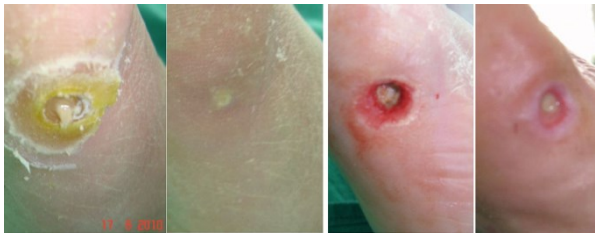

Fig. 9: IPK before Er:YAG treatment (a), after shaving, ready for laser therapy (b), immediately after (c) and 5 days after the treatment (d).

The case presented in Fig. 10 is a very characteristic one as it nicely shows how accurately deep and delicate calluses can be cleared. This one, on the third toe, protruded down to the envelope of the interphalangeal joint. An excellently cleared and non-injured joint envelope is nicely visible at the bottom of ablative hole on Fig.10c below.

Figure 10: IPK before treatment (a), depth of the IPK (b), immediately after laser treatment – corn cleared down to joint envelope (c) and 5 days after the treatment (d).

The average healing time was 3 weeks, which is still much quicker than reported with any of the traditional methods [2–5]. The treatment was well tolerated by all patients.

A single treatment was sufficient to heal IPK in 77% of the cases. From our patient interviews a year after the treatment, we can conclude that patients who

maintained regular foot care with baths, foot cream and suitable footwear at home were very satisfied with the results of the treatment.

10 patients (23%) developed non-homogeneous, wart-like thickening lesions on the locations of their previous IPKs. Clinical inspection of these lesions showed indications of plantar warts rather than IPKs. After these findings we assume that at baseline, before the initial treatment, these patients had concurrent IPK and plantar wart lesions and that the recurrence was mainly caused by wart viruses. All of these 10 patients were retreated with Er:YAG laser, and additionally we added Nd:YAG laser therapy for plantar warts, which uses a deeply penetrating photo-thermal effect to eradicate viruses under the lesions. We believe that such a combined therapy (Er:YAG + Nd:YAG) would be optimal for all lesions where a suspicion of concurrency (IPK and warts) exists.

V. CONCLUSIONS

Er:YAG laser therapy is an efficacious and safe method for treatment of intractable plantar keratosis. In comparison with other available therapies Er:YAG laser treatment of IPK is more accurate and thus less invasive to the surrounding tissue. Also, high accuracy enables excellent clearance of corn seed tissue, resulting in lower recurrence in comparison to other therapies.

Further reduction of recurrences could be achieved with the introduction of additional Nd:YAG laser irradiation, especially in cases with potential concurrent plantar warts.

Er:YAG laser therapy for IPK presents a great solution for patients with quick healing and no post-operative pain and no scars or other adverse effects observed.

REFERENCES

1. Mann RA, DuVries HL (1973) Intractable plantar keratosis. The Orthopedic clinics of North America 4: 67–73.
2. Curtin JW (1977) Functional surgery for intractable conditions of the sole of the foot. Plastic and reconstructive surgery 59: 806–811.
3. Hatcher RM, Goller WL, Weil LS (1978) Intractable plantar keratoses: a review of surgical corrections. Journal of the American Podiatry Association 68: 377–386.
4. Gibbard KW, Kilmartin TE (2003) The Weil osteotomy for the treatment of painful plantar keratoses. The Foot 13: 199–203.
5. Van Brederode RL, Engel ED (n.d.) Combined cryotherapy/70% salicylic acid treatment for plantar verrucae. The Journal of foot and ankle surgery : official publication of the American College of Foot and Ankle Surgeons 40: 36–41..
6. Walsh JT, Deutsch TF (1989) Er:YAG laser ablation of tissue: measurement of ablation rates. Lasers in surgery and medicine 9: 327–337.
7. Dmovsek-Olup B, Vedlin B (1997) Use of Er:YAG laser for benign skin disorders. Lasers in surgery and medicine 21: 13–19.
8. Wollina U, Konrad H, Karamfilov T (2001) Treatment of common warts and actinic keratoses by Er:YAG laser. Journal of cutaneous laser therapy 3: 63–66.
9. Khatri KA (2003) Ablation of cutaneous lesions using an erbium:YAG laser. Journal of cosmetic and laser therapy : official publication of the European Society for Laser Dermatology 5: 150–153.
10. Semprimoznik K, Sult R., Gorsic M: (2012) Treatment of warts with 1064 nm Nd:YAG, LA&HA - Journal of the Laser and Health Academy, Volume: 2011 | Number: 1 Pages:90-93.