Case report

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Treatment of recalcitrant viral warts using a 577-nm wavelength high-power optically pumped semiconductor laser

Behandlung hartnäckiger viraler Warzen mit einem 577 nm, optisch gepumpten Hochleistungs-Halbleiterlaser

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Abstract: We report the use of a 577-nm wavelength high-power optically pumped semiconductor laser (HOPSL) to treat 12 patients with multiple recalcitrant non-genital warts that had not responded to conservative and invasive treatment. The patients were treated weekly using a 577 nm HOPSL connected to a scanner device. Ten patients with warts showed complete clearance after treatment. One patient had partial clearance and one did not respond at all. Slight to medium pain (visual analog scale, VAS=2–6) was reported during treatment. After treatment there was no evidence of scarring. After the 6-month follow-up there was no recurrence of the completely cleared warts.

Keywords: recalcitrant viral warts; 577 nm HOPSL.

Zusammenfassung: Die Autoren berichten über die Anwendung eines 577 nm, optisch gepumpten Hochleistungs-Halbleiterlasers (HOPSL) im Rahmen der Behandlung von 12 Patienten mit hartnäckigen multiplen, nicht-genitalen Warzen, die nicht auf eine konservative bzw. invasive Behandlung angesprochen haben. Die Patienten wurden wöchentlich mit einem 577 nm-HOPSL mit angeschlossenem Scanner-Gerät behandelt. Zehn Patienten mit Warzen zeigten nach der Behandlung eine komplette Abheilung. Ein Patient zeigte eine Teilremission, ein Patient sprach nicht auf die Therapie an. Die Patienten berichteten über leichte bis mittlere Schmerzen (visuelle Analogskala, VAS=2–6) während der Behandlung. Nach der Behandlung gab es keine Anzeichen für Narbenbildung. Nach 6 Monaten Follow-up kam es zu keinem Wiederauftreten der vollständig abgeheilten Warzen.

Schlüsselwörter: hartnäckige virale Warzen; 577 nm HOPSL.

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1 Introduction

Normally viral infections of the skin are self-limiting [1]. However, despite this self-limitation it is not possible to predict the endurance of infection. Although various therapies are available [2–4], there is no therapeutic option that offers guaranteed clearance and often therapy is associated with a long down time and/or much pain. The carbon dioxide (CO_2) laser [5, 6] and the erbium: yttrium aluminum garnet (Er:YAG) laser [7] ablates the tissue but this modality is also often associated with scarring. Moreover, the plume and gas produced during the ablation is infectious and must be evacuated. Potassium titanyl phosphate (KTP) lasers, either non-consumables requiring 532-nm KTP lasers [8] or consumable-based KTP pumped dye lasers requiring a dye cartridge when using 585 nm wavelength, are also an established option for therapy but need a scanner to achieve reproducible results. The pulsed dye laser (PDL) [9–11] clears the warts by selective photothermolysis of the blood vessels supplying the wart with nutrients. Treatment with the PDL is actually the favored therapy in the treatment of viral warts. But the resulting costs for the dye kit make the treatment very expensive. Use of the long-pulsed neodymium:YAG (Nd:YAG) laser is also a proven therapy [9, 12].

We report on the use of a 577-nm high-power optically pumped semiconductor laser (HOPSL) with a scanner device for the treatment of 12 patients with multiple recalcitrant non-genital warts that had failed to respond to

other treatments such as CO_2 laser therapy, cryotherapy with liquid nitrogen and/or topical treatments such as keratolysis combined with 5-fluorouracil (5-FU).

2 Subjects and methods

2.1 Patient group

Twelve patients (eight female and four male) took part in this study (Table 1). The patient age ranged from 4 to 37 years, with a median of 12 years. Nine patients were aged 14 years or younger. All patients had warts that had proved resistant to conservative and invasive therapy with a persistence of 12 months or longer. They had failed to respond to therapy with keratolysis, keratolysis combined with 5-FU, cryotherapy with liquid nitrogen, keratolysis with curettage, wIRA® irradiation which uses water-filtered infrared light, or erbium:YAG, long pulsed Nd:YAG and CO_2 laser treatment. All patients had multiple warts on either their hands or feet or both, and two patients had periungual warts.

All patients and their parents were informed about the experimental nature of the therapy. All consented in written form and had sufficient time for consideration. Treatments were undertaken in accordance with ethical principles.

Table 1: Treated patients.

Patient no.	Age	Gender	Localization	Previous treatments
1	4	F	Hands, feet	Cryo
2	5	F	Hands, feet	Cryo, curettage
3	7	F	Hands, feet	Cryo, curettage
4	7	M	Feet	Curettage, CO_2 laser
5	12	M	Hands, feet	5-FU, curettage, cryo
6	12	F	Hands	5-FU, curettage, Er:YAG laser
7[a]	12	F	Feet	Curettage, CO_2 laser
8	13	F	Feet	Curettage, Er:YAG laser
9	14	M	Hands	5-FU, curettage, wIRA®
10	16	M	Feet	5-FU, curettage, cryo
11	32	F	Feet	Cryo
12[b]	37	F	Feet	Cryo, CO_2 laser, Nd:YAG laser

F, Female; M, male; 5-FU, 5-fluorouracil; wIRA®, irradiation which uses water-filtered infrared light.

[a]In patient no. 7 the warts did not clear at all. [b]In patient no. 12 the warts only cleared partially.

2.2 Treatment protocol

Initially all patients were treated weekly, and after the first two sessions, every 2nd week, with a 577-nm HOPSL (QuadroStarPRO^{YELLOW}; Asclepion Laser Technologies GmbH, Jena, Germany) connected to a cooled scanner device. The spot size was 1 mm, the size of the scanner pattern was 15×15 mm at 100% density with 36-ms pulses and a radiant exposure of 16–22 J/cm^2 for each pass (Figure 1). Before laser treatment, each wart underwent curettage after keratolysis with Guttaplast® plaster (Beiersdorf AG, Hamburg, Germany) that has been removed before curettage. After curettage each wart was treated immediately with the laser. The whole treatment included three passes in one session with a waiting time of 3 s, before and after each scan allowing the cold scanner in skin contact to cool down the treatment area for better pain control. Throughout the whole treatment no bleeding was observed. The scanner pattern was large enough to extend about 0.5 cm over the borders of the wart. If the wart was too big to fit within the scanner pattern, the scanner was repositioned to overlap the treated area at the borders.

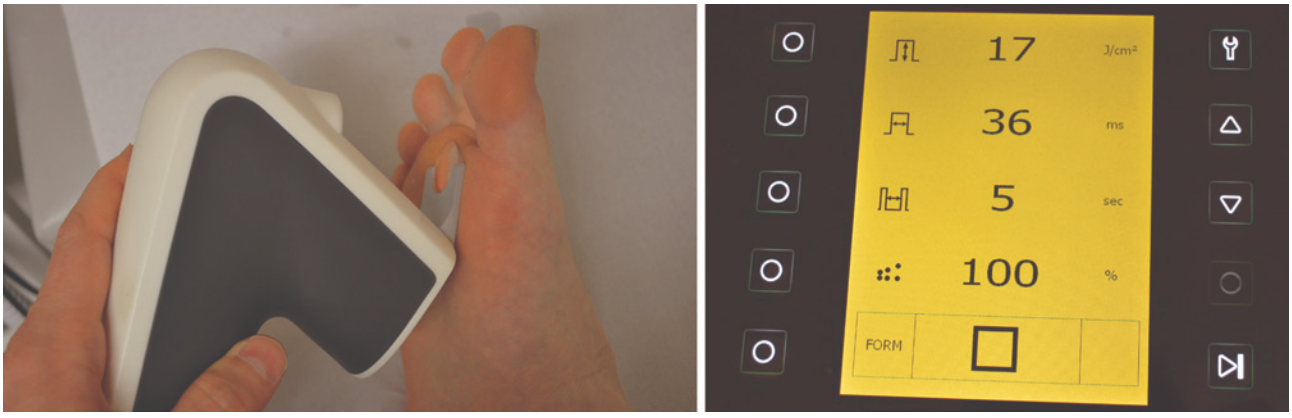

Figure 1: Laser set-up (left) and chosen laser parameters (right).

Emla® cream, an anesthetic cream, was used in two cases where the cooling of the scanner device was insufficient, but the pain control remained not sufficient (visual analog scale, VAS=6). Therefore later on, cold air was applied parallel to the treatment with a skin cooling system (Cryo 6; Zimmer Medizin Systeme GmbH, Neu-Ulm, Germany). Patients reported better pain control (VAS=3–4) with the added cold air. Multiple sessions were necessary for all the patients. There was a 1-week interval between the first two sessions. After the 2nd treatment a rest interval of 2 weeks was implemented. The patients were instructed how to peel the hyperkeratotic areas between treatments and how to disinfect their homes, all their shoes and clothing. No other wart treatment was allowed between the weekly sessions. The main criterion to end the treatment was that no wart was dermoscopically visible (handyscope; FotoFinder Systems GmbH, Bad Birnbach, Germany).

2.3 Assessment

Each patient was reviewed by the same clinician. They were interviewed about any adverse effects, about pain after treatment and about any change in the warts. Progress was documented on a chart which depicted feet and hands and successfully treated warts were marked off after dermatoscopic control. The success of the treatment was graded into: complete clearance, partial clearance and no change/progress. Complete clearance meant a recovery of the normal skin at all sites of previous infected areas. Partial clearance was defined as recovery of normal skin at more than 50% of the infected area. All others were rated in the "no change/progress" group. All patients were asked about the pain during treatment and asked to evaluate the pain level using a 1–10 visual analog scale (VAS).

3 Results

Ten patients showed complete improvement with treatment (Figures 2 and 3). The warts disappeared completely after 3–12 sessions of treatment. Only two out of 12 patients showed partial or no improvement and did not wish to continue the treatment (Table 2). It was suggested to one of those patients that she should stop the treatment because of a lack of improvement after four treatments. However, the patient wanted to continue, hoping that there would be some improvement. After the 6th appointment the treatment was stopped.

The median treatment session number was five. Typically an improvement could be seen after the second laser therapy. However, in two cases there was an improvement even after the first treatment. In contrast to another

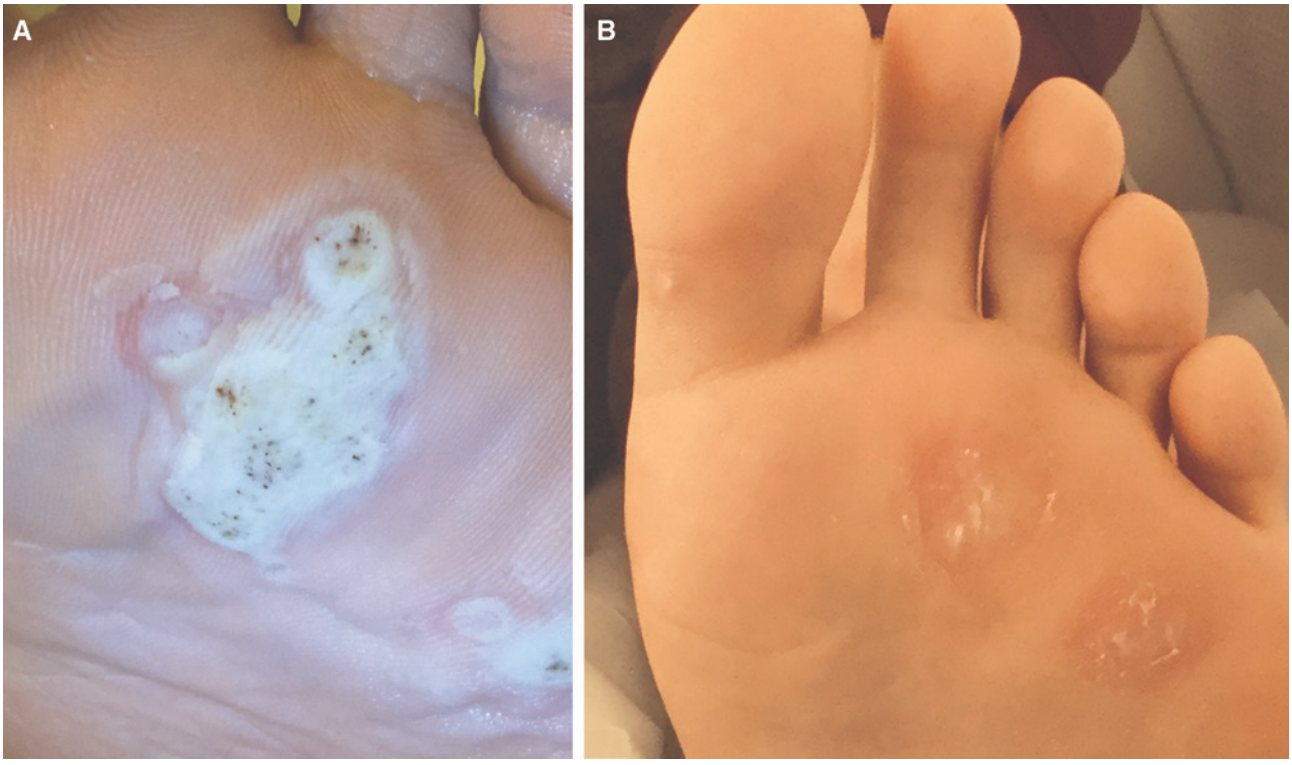

Figure 2: Patient no. 10. Left foot before the 3rd treatment (A) and 1 week after the 7th treatment (B).

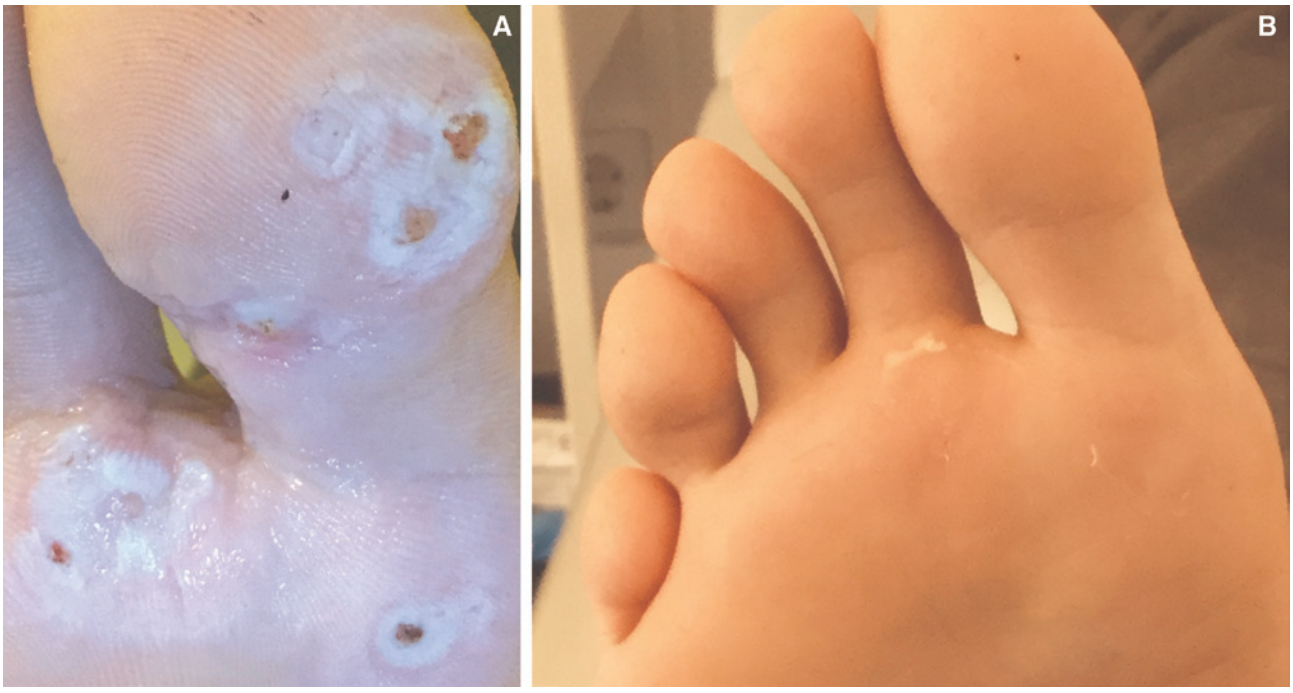

Figure 3: Patient no. 10. Right foot before the 3rd treatment (A) and 1 week after the 7th treatment (B).

Table 2: Results and side effects after treatment using a 577-nm wavelength high-power optically pumped semiconductor laser.

Patient no.	Number of sessions	VAS	Side effects	Recurrence after 6 months
1	5	4	Erythema	No
2	6	5	Erythema	No
3	3	2	–	No
4	4	6	–	No
5	12	4	Erythema	No
6	3	5	Erythema	No
7	6	5	Erythema	Yes[a]
8	5	6	–	No
9	4	4	Erythema	No
10	7	4	Blistering	No
11	5	5	Erythema	No
12	6	5	Blistering	Yes[b]

VAS, Visual analog scale.
[a]In patient no. 7 the warts did not clear at all. [b]In patient no. 12 the warts only cleared partially.

two patients, nothing could be seen until after the fourth treatment. Only two patients failed to be clear of warts despite receiving six treatments. One of them did not progress any further after the third treatment and in the other the warts did not clear at all.

Overall, the follow-up period was 6 months. No recurrences were reported during that time in 10 out of 12 patients. Most patients reported a median pain score of 5 during treatment (Table 2). If the pain was too high a cold air treatment was added. Doing this the pain assessed at least one point lower on the VAS. All of the patients who underwent CO_2 surgery and cryotherapy before laser treatment found the laser therapy less painful and more practical because of the almost wound-free therapy. Most patients experienced erythema around the treatment area. Two patients reported blistering after treatment but no patient reported local or systemic infection. No scarring was observed.

4 Discussion

When the therapy with the HOPSL was initiated, we expected an improvement for 80% of patients because the used laser is a system comparable to the 532-nm KTP laser chosen in [8]. The results showed complete clearing in 83.3% (n=10) of the patients and were better than expected. This response rate is comparable to that achieved in studies using a PDL (73.9% [9], 75% [11] and up to 99% [13] complete clearing rate) with less additional costs as no dye kit is necessary as consumables. The treatment was well-tolerated by the patients with no need for local anesthesia and no need for needles. The therapy is quick to perform and because of the automated

scanner device highly reproducible. Compared to the KTP study [8] where 25 patients were treated with a median age of 42 years, we treated younger (median age, 12 years) and fewer patients (only 12 in number). The previous treatments in our report included a failed laser therapy but none of the participants on the study had been treated with intra-lesion bleomycin. The KTP study used spot sizes of 1 mm. No information about the size of the scanned area was provided. We applied 36-ms pulses with a radiant exposure of 16–22 J/cm^2 compared to 30-ms pulses with a radiant exposure of 15–18 J/cm^2 in the KTP study. However, both pulse times are below the thermal confinement time.

We observed a complete clearance in 83% of cases with a follow-up time of 6 months compared to 48% (12 out of 25 patients) for complete clearance plus five patients with virtual clearance in the KTP study. The median number of total treatments in this study was five (range, 3–12) compared to three treatments in median in the KTP study (range, 1–8). Follow-up data was obtained in all cases after 6 months. In common with the KTP study, there was no recurrence reported in those cases who had shown complete clearance. Only two patients reported a pain score higher than 5 mitigated by adding cold air for better pain control. Most patients (7 out of 12) experienced erythema around the treatment area. Two out of 12 patients reported blistering after treatment, compared to two from 25 in the KTP study. None of the participants reported local or systemic infection. No scarring was observed as well as in the KTP study. Considering blood absorption as the target of treatment, the significantly deeper penetration of the 577 nm HOPSL comparing to the 532-nm KTP is an important point to state.

5 Conclusion

The 577 nm HOPSL laser can be a useful tool in treatment of recalcitrant warts. Compared to the KTP study [8], higher complete clearance rates could be achieved. The better clearing rates could have been influenced by the patients being younger, the deeper penetration of the 577 nm laser and higher radiant exposure. To investigate this, studies with a larger number of patients are required.

Conflict of interest statement: The authors state no conflict of interest. All authors have read the journal's Publication Ethics and Publication Malpractice Statement available at the journal's website and hereby confirm that they comply with all its parts applicable to the present scientific work.

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