Cold Air in Laser Therapy: First Experiences with a New Cooling System

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Summary

There is a long tradition of cooling as an analgesic procedure. The present work introduces the use of cold air as a cooling medium in dermatological laser therapy. This article describes the theoretical and practical details and compares them with the normal procedures to date, with the outcome that in almost all the cases the new method is superior to the old procedures.

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Introduction

Snow and ice have been used for therapy since ancient times. In his writings, *Hippocrates of Chios* (460-377 BC) recommended cold beverages for fighting fever and the application of cold compresses and pieces of ice to relieve the pain of gout and burns.

Today, cryotherapy has become an indispensable part of daily therapy in rheumatology, orthopedics, sports medicine and neurology. In these cases, the target zones are tissue structures deep below the skin.

For some time now, cryotherapy has enjoyed increasing attention as an additional therapy in dermatology, particularly in dermatological laser therapy (1, 2, 3, 4, 6, 7, 8). The objective is twofold:

1. The analgesic effect makes treatment more pleasant for the patient.

2. Because of thermal protection of the epidermis, increased therapeutic energies can be applied.

In contrast to the classical areas of application, in laser therapy mainly the epidermis will be cooled in order to provide it with analgesic and thermal protection, on the one hand, and to have only a minimal effect on the laser therapy's target structures, on the other hand.

Furthermore, the cooling should have a minimal effect on the strength and course of the laser beam. The types of application in cryotherapy are manifold, however, a differentiation must be made between contact cooling and non-contact cooling.

In the case of *contact cooling*, the usually liquid or solid cooling agent is brought into direct contact with the skin. This includes:

-Moistening the skin (cold of evaporation).

-Application of cooling elements (direct cooling).

-Application of ice (gel) (direct cooling and cold of evaporation).

-Application of cold sprays such as ethyl chloride (cold of evaporation).

-Application of cold conductors, e.g. "chilled tip" hand piece for the long-pulsed Nd:YAG laser (4),

metal "cooling finger" for the Ruby laser (5), saphire lens in a diode laser (direct cooling).

In the case of *non-contact cooling*, a suitable gaseous medium is used to transfer cold to the skin. These include:

-Cooling with cold air.

-Cooling with other gases, primarily liquid nitrogen.

To date, mainly contact cooling was used in dermatology (1, 2, 4, 5).

In the following work, the use of cold air as a cooling medium in dermatological laser therapy is introduced.

Method

We used the cold air device "Cryo S" (Zimmer Elektromedizin). This device produces a permanent cold airflow from the ambient air, namely a flow of 500 to 1000 liters per minute at temperatures of up to -22°F (-30°C). Previously its scope of use was primarily in cryotherapy for diseases of the muscoloskeletal system. First, the unmodified device was used in various dermatological laser treatments. We discovered that the air tube included with the device was too unwieldy and too large.

Furthermore, the diameter of the application nozzle included with the device was too large, thereby making point-focal application more difficult. In addition, the airflow reaching the skin fanned out in all directions which, particularly in treatments of the face, led to eye and breathing problems.

For this reason, we had the air transport system optimized (Laser Medical GmbH).

Table 1

Laser types and indications when using cold air therapy (n = 166)

Laser type	Indication	N
Alexandrite laser	Hypertrichosis	124
Pulse dye laser	Flammenous nevus	14
Pulsed dye laser	Hemangioma	7
Q-switched Nd:YAG laser	Tattooing	12
Q-switched Ruby laser	Tattooing	9

The modified system consists of a thinner tube to which a special cooling attachment is connected which assumes the function of the previous plastic attachments. Cynosure® laser handpieces can be slipped onto the cooling attachment without modification. The attachment can be easily adapted to other types of lasers. This has the following advantages over the air conduction system supplied by the Zimmer company:

-Since the tube and the handpiece are connected to one another, only one hand is required for treatment.

-The airflow hits the skin at the exact location of the laser application.

-The handpieces remain cool, which is particularly important in extensive treatments.

-The airflow is less and more easily directed, which patients find more agreeable.

-For reasons of design, there is one direction in which the applied air flow does not propagate. This is of particular advantage for facial therapies, since the area of the eyes and nose can be protected from strong airflow.

-The application temperature is higher (approx. 10.4°F (-12°C)), which patients also find more agreeable.

Results

We treated 166 patients with various laser systems using cold air therapy. The majority of cases were epilation treatments with the alexandrite laser (Cynosure® Apogee).

This was followed by treatments of the flammeous nevus and hemangiomas with the pulsed dye laser. Finally, treatments with the Q-switched Nd:YAG laser and the Q-switched Ruby laser were carried out for tattoos.

Table 1 shows the distribution of the treatment indications.

The two most important parameters, which we evaluated by means of questionnaires, were patient satisfaction, which in most cases showed a correlation to the analgesic effect of the cooling method, and the objective thermal protection of the epidermis, which was demonstrated by the application of higher energies with a simultaneous reduction in side effects (erythema, swelling, incrustation).

In addition, we evaluated whether and to what extent the application of cold air provided an improvement in patients who had been treated with other cooling measures (usually contact cooling with ice gel).

Table 2
Air flow temperature from the new cooling attachment at various cooling levels

Cooling level	Air flow temperature from the cooling attachment
1	15.8°F (-9°C)
2	14°F (-10°C)
3	12.2°F (-11°C)
4	10.4°F (-12°C)
5	8.6°F (-13°C)
6	5°F (-15°C)

Table 3

Cooling level	Skin temperature after 1 second (initial 32°C)
2	87.8°F (31°C)
4	84.2°F (29°C)
6	82.4°F (28°C)

Table 4

Cooling level	Skin temperature after 8 seconds (initial 32°C)
2	68°F (20°C)
4	64.4°F (18°C)
6	59°F (15°C)

Less than 3% of the patients treated rejected the cold air therapy. The reasons stated included the following: breathing and eye problems associated with facial treatment, shoulder pain from the cold air current, noise.

97% of the patients treated found the cold air treatment to be at least equal to other methods of cooling. 86% of the patients clearly preferred cold air therapy. If the perinasal area is not taken into account, this percentage increases to almost 100%. All the patients who underwent axillary or bikini zone epilation indicated that cold air therapy had a better analgesic effect than other methods of cooling.

The results were similar in an application observation with 48 patients (*Fuchs* et al.) in which, during each treatment, a comparison was made between one side which was treated with cold air cooling and the other which was cooled with ice. 75% of patients preferred cold air cooling in the area of the face, whereas almost 100% of the patients favored cold air in other areas.

The advantages of cold air therapy most frequently cited in the questionnaire were:

- Treatment more pleasant.

- Constant cooling.

- Less pain.

-Fewer side effects: less erythema, less swelling and incrustation.

-More hygienic: no substance application.

In addition to the questionnaire, the temperature of the airflow and the skin was measured. The results are shown in Tables 2 to 4.

With respect to the achievable skin temperatures with an application time of one second (typical in treatment with the alexandrite laser, for instance), it must be noted that they refer to an initial skin temperature of 89.6°F (32°C).

However, the treatment usually includes the adjacent skin areas, so that the cooling effect can be increased through pretherapeutic reduction of the skin temperature of adjacent areas.

Discussion

There is no doubt about the positive analgesic effect of cooling in dermatological laser therapy. To date usually contact cooling methods were used. However, besides their analgesic effect, these methods have some disadvantages which, depending on the application, can be more or less significant. In many cases, these

disadvantages can be avoided by using non-contact cooling methods.

The general advantage of non-contact cooling methods in dermatological laser therapy is that no medium impedes the laser beam. In particular, there is no interface that is subject to dispersion, transmission, and reflection losses. In addition, the work is faster and more agreeable for the patient and the person carrying out the treatment, since no substances have to be applied directly to the skin.

Cooling with liquid nitrogen has been known for some time. However, the advantage of being able to achieve lower temperatures can easily prove disadvantageous, since the skin can be damaged by freezing if the treatment is not carried out carefully. Also, from an economic standpoint, the application of liquid nitrogen must be qualified, as it involves high costs (the nitrogen itself as well as transportation and storage costs).

Cold air application is a new type of therapy in the area of non-contact cooling methods. It uses deeply chilled air between –4° F (–20) and –22° F (–30°C) that is applied in specific doses to the area of the body undergoing treatment. The danger of damage from freezing is considerably lower than with nitrogen, since the minimum temperature is higher. Furthermore, cold air therapy requires significantly lower operating costs, as there is none except the cost of electricity.

Patient acceptance of cold air therapy is very high. With the exception of treatment in the perinasal area, almost 100% of patients preferred cold air cooling. In order to avoid the problems in the centrofacial area, we last used a nose clamp or asked the patients to hold their noses closed and used closed safety glasses. This eliminated most of the breathing and eye problems. It is very important to inform the patients in detail about the problems of air cooling in the facial area. In almost all cases, initial feelings of fear were overcome.

From the standpoint of the person carrying out the treatment, it must be noted that cold air therapy is more effective, safer and more agreeable:

- It is faster, since there are no interruptions for applying cooling media.
- The area under treatment is always visible.
- In the case of extensive treatments, no breaks are required in order to cool the handpieces.
- Cooling medium does not have to be prepared or disposed of.
- The cooling substance does not have to be cleaned off after treatment. Reduction in waste.
- The laser handpieces and protective attachments are not soiled by dispersed cooling material, which is particularly prevalent with ice gel cooling and can lead to the contamination of lenses.

However, some critical remarks must also be made. The use of a separate cooling device requires an expenditure for the purchase cost and for maintenance. The additional space requirements must also be taken into account in small treatment rooms. The problem of facial treatment has already been discussed.

Finally, no long-term study has been carried out with regard to the effect of cryotherapy in general and cold air therapy in particular on the results of dermatological laser treatments.

There were no signs of a recognizable, decreased effect in the patients we treated. However, there is a change in the skin color due to cooling. In a treatment of the flammeous nevus and hemangiomas with the pulsed dye laser, this might possibly affect the treatment results.

In summary, we see analgesic cold air application in dermatological laser therapy as an effective alternative to the traditional cooling methods that is well accepted both by patients and persons carrying out the treatment.

Literature

In the authors' possession.

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