

## Clinical and Morphological Factors in Evaluation of Efficacy of Facial Carcinoma Treatment by High-Energy Pulsed Neodymium Laser

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### Abstract

**Purpose:** In this study the influence of clinical and morphological peculiarities of facial carcinoma on the results of treatment by means of Neodymium (Nd) laser radiation was estimated.

**Methods:** The light of high-energy mono pulsed Nd laser ( $\lambda = 1060$  nm) was used to treat 2805 patients with 2940 histologically confirmed facial carcinoma, stages T1-2 N0 M0. Of those 2845 were classified as primary basal cell carcinoma (BCC) and 95 as squamous cells carcinoma (SCC). The patients were followed-up from 1 year to 13 years (median: 7 years) after treatment.

**Results:** The overall frequency of tumor recurrence after laser radiation was revealed in 2% of all irradiated tumors (median: 10.0 months). The rate of recurrence depended on type of tumors (1.9% in BCC and 5.3% in SCC), clinical peculiarities (3.5% in nodular-ulcerative and 4.5% infiltrative-ulcerative tumors), localization (3.2% in tumors located in nasolabial area) and tumor size.

**Conclusion:** Neodymium laser radiation is an effective method for treatment of facial carcinomas stages T1-2 N0 M0 whose results depend on tumor morphology, stage of the disease, clinical characteristics and localization.

**Keywords:** Facial carcinoma; Basal cell carcinoma; Squamous cell carcinoma; Neodymium laser radiation

### Introduction

Skin carcinomas are regarded as a comparatively favorable form of malignant tumor easily accessible for treatment. The traditional approach for treatment of these malignancies involves surgery, Mohs' micrographic surgery, radiotherapy, cryosurgery, curettage, electrodesiccation and topical chemotherapy. The methods warranty 93.0-98.9% recovery rate in patients with stage T1-2 N0 M0 of disease [1,2]. However treatment of skin carcinomas localized on the face presents difficulties due to the complex anatomy of the area, which localized on the face approximately in 79.6-90.6% patients [3]. The use of above mentioned methods for the treatment of facial carcinoma results in tumor recurrence in 1.6- 9.5% patients [3-10]. The progress in treatment of skin carcinoma has been achieved after laser radiation was introduced into practice [11-20]. Previously we have shown that treatment of facial skin carcinoma by high-energy Nd laser radiation, resulted in deep destruction of tumors [21] and low recurrence rate [22,23]. In this paper the influence of morphological pattern, stage of disease, clinical features and accurate localization on the results of facial carcinoma treatment by Nd laser radiation are described.

### Material and Methods

#### Patients

The study was carried out on 2805 patients with newly diagnosed facial carcinoma of whom 986 (35.2) were men and 1819 (64.8%) were women. The age of patients varied from 18 to 90 years, average 61 year. All tumors (total number 2940; 2845 BCC and 95 SCC) were morphologically confirmed carcinomas (Table 1). The group of patients with SCC consisted of 63 (66.3%) patients with poorly-differentiated SCC and 32 (33.7%) patients with highly-differentiated keratinizing SCC. According to the UICC classification [24], 2609 (88.7%) tumors were staged as T1 NO MO and 331 (11.3%) as T2 NO MO carcinomas

(Table 2). Tumor size varied from 0.3 to 5.0 cm in the diameter. The clinical features of tumors and their localizations are shown in Table 3 and 4. The patients were followed-up from 1 year to 13 years (median: 7.0 years) after treatment.

The outpatient treatment was conducted in accordance with the Declaration of Helsinki and treatment protocols were reviewed and approved by the local medical ethics committee. Patients were informed in details about the forthcoming treatment and probable complications and the signed consents were taken in all case.

#### Treatment procedure

Two high-energy pulsed Nd lasers, Pulsar-1 000 and its modification Pulsar-1000M, (LOMO, Russia) were used. The Nd lasers were of solid

Diagnosis	Patients n	Tumours n	Recurrences	
			n	%
Basal cell carcinoma	2710	2845	54	1.9
Squamous cell carcinoma	95	95	5	5.3
Total	2805	2940	59	2.0

**Table 1:** Numbers of patients, numbers of carcinomas and frequency of recurrences after laser radiation treatment.

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state ( $\lambda = 1060$  nm) and mono pulsed mode, pulse duration 1 and 4.5 msec and the maximum pulse energies 700 and 1 000 J, respectively; the diameter of irradiated spots varied from 5 to 15 mm.

The Nd laser was used for treatment of facial carcinomas of all localization except malignancies located on the eyelid. Irradiation was performed under local infiltrative anesthesia with 1% solution of lydocain hydrochloride with adrenaline. Depending on the size and clinical characteristics tumors and the close adjacent tissues were subjected to 1- 9 successive and partially overlapping impulses (the energy density 150-400 J/cm<sup>2</sup> and 45-100 sec intervals between impulses) during which 110- 5210 J light energy were delivered to the target tissue. During procedure eyes of the patients and providers were protected by glasses absorbing Nd lasers radiation.

The laser treatment of a BCC required safety margins of the irradiation field of 2- 5 mm versus at least 6-10 mm for SCC including a zone of clinically clear skin around the tumor. The width of safety margins depended on histology as well as sizes, clinical features and a site of the lesions. In the vast majority of cases the treatment was carried out in a single session.

The laser irradiation resulted in destruction of tumors and the involved tissues with the development of coagulatory necrosis which depth depended on the energy density (J/cm<sup>2</sup>) of the laser ray. The necrotizing tissues were replaced by crust usually for 3-4 weeks and after the crust had lapsed of the wounds healed and became covered with epithelium for the next 2-3 weeks depending on the size.

To be convinced of complete destruction of carcinoma by laser beam the samples of tissues from treated lesions were subjected to histological assay. The presence of tumor cells or dubious results appeared to be the indication command for the application of the successive sessions of irradiation.

## Results

The overall frequency of biopsy-confirmed recurrences of carcinomas after laser treatment was detected in 2.0% of all cases, 1.9% in BCC patients and 5.3% in SCC patients (Table 1) Of 63 patients with poorly-differentiated SCC recurrence was diagnosed in 2 (3.2%) cases and of 32 patients with highly-differentiated keratinizing SCC recurrence was diagnosed in 3 (9.4%) cases. Percentage of facial carcinoma recurrences depended on the morphological pattern and the stage of tumor disease (Table 2) in stage T1 carcinomas overall recurrences were observed in 1.8% cases and in stage T2 - in 3.3 %, particularly in 1.7% stage T1 BCC cases and 3.1% stage T2 BCC cases, and in 4.6% stage T1 SCC cases and 12.5% stage T2 SCC cases. The most common recurrences were revealed in nodular-ulcerative (3.5%) and infiltrative-ulcerative (4.5%) carcinomas as well as in BCC located in nasolabial area – 3.2% cases (Table 3 and 4) Of 59 recurrences 42 (71.2%) occurred within the first year of follow-up (range from 4 to 67 months; median: 10 months), among those in 38 (70.3%) of 54 patients with BCC (range from 6 to 67 months; median: 11 months) and in 4 (80.0%) of 5 patients with SCC (range from 4 to 15 months; median: 8 months).

Diagnosis	Stage				Total	
	T1		T2			
	Tumours n	Recurrences n ( %)	Tumours n	Recurrences n ( %)	Tumours n	Recurrences n ( %)
Basal cell carcinoma	2522	44 (1.7)	323	10 (3.1)	2845	54 (1.9)
Squamous cell carcinoma	87	4 (4.6)	8	1 (12.5)	95	5 (5.3)
Total	2609 (88.7%)	48(1.8)	331 (11.3%)	11 (3.3)	2940 (100%)	59 (2.0)

**Table 2:** Frequency of recurrences after laser radiation treatment carcinomas depending on their morphology and stage of the disease.

Clinical characteristics of the tumours	Basal cell carcinoma		Squamous cell carcinoma		Total	
	Tumours n	Recurrences n (%)	Tumours n	Recurrences n (%)	Tumours n	Recurrences n (%)
Superficial	536	4 (0.7)	-	- (-)	536	4 (0.7)
Flat	1035	11 (1.1)	38	0 (0)	1073	11 (1.0)
Nodular	480	10 (2.1)	23	1 (4.3)	503	11 (2.2)
Nodular- ulcerative	412	13 (3.1)	19	2 (10.5)	431	15 (3.5)
Infiltrative- ulcerative	382	16 (4.2)	15	2 (13.3)	397	18 (4.5)
Total	2845 (96.8%)	54 (1.9)	95 (3.2%)	5 (5.3)	2940 (100%)	59 (2.0)

**Table 3:** Frequency of recurrences after laser radiation treatment carcinomas depending on their clinical features.

Localization of the tumours	Basal cell carcinoma		Squamous cell carcinoma		Total	
	Tumours n	Recurrences n (%)	Tumours n	Recurrences n (%)	Tumours n	Recurrences n (%)
Frontotemporal	482	6 (1.3)	23	1 (4.3)	505	7 (1.4)
Cheek	667	10 (1.5)	30	2 (6.7)	697	12 (1.7)
Nose	783	17 (2.2)	17	1 (5.9)	800	18 (2.2)
Nasolabial area	364	12 (3.3)	11	0 (0)	375	12 (3.2)
Periorbital area	298	6 (2.0)	-	- (-)	298	6 (2.0)
Chin and jaw area	251	3 (1.2)	14	1 (7.1)	265	4 (1.5)
Total	2845 (96.8%)	54 (1.9)	95 (3.2%)	5 (5.3)	2940 (100%)	59 (2.0)

**Table 4:** Frequency of recurrences after laser radiation treatment carcinomas depending on their localization.

Forty five (83.3%) patients with recurrences of BCC after the first irradiation were subjected to the second session of laser therapy and no recurrences were revealed thereafter. The rest of patients with prognostic unfavorable recurrent BCC and patients with recurrent SCC were subjected to the surgery, radiotherapy or combined treatment. The viable tumor cells were detected in wounds of only 9 (0.3%) patients with BCC after the scabs fell off.

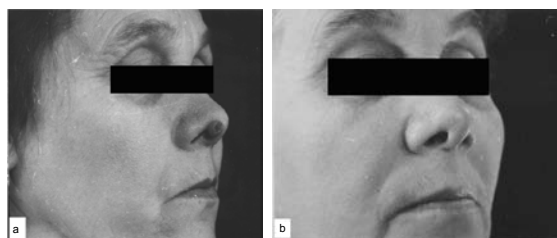
## Discussion

Relapse frequency of facial skin carcinomas stages T1-2 N0 M0 after treatment by neodymium lasers radiation is not too high. The most frequently recurrences (70.3%-80.0%) are revealed as well as with after other methods of therapy of skin carcinomas; it ranges from 70.0 % to 82.4 % during the first year of monitoring [2,3,7,9]. A low percentage of facial carcinoma recurrences after laser treatment might be explained by the deeply penetrating laser energy [21] so that was possible to impact on the entire tumor mass. Concurrent high-order focusing of laser beam lets to preserve general body of the surrounding normal tissues from damage and thus to achieve a favorable therapeutic and cosmetic results (Figure 1 and 2 a, b).

The clinical effect of the laser radiation depends on the morphology of the tumor and stage of the disease. Due to substantial differences in biology of BCC and SCC the former is a more, in terms of efficacy, appropriate target for laser therapy than the latter and it is not a surprise that the period between laser beam application and recurrence BCC is considerably longer than that for SCC (67 and 15 months, respectively). At the same time the results of treatment of poorly-differentiated SCCs appears to be more successful in comparison with highly-differentiated keratinizing SCCs, suggestively because keratic stratification increased physical density of tumor surface thus partly decreasing the penetration of the laser beam energy to deeper layers and to affect the entire tumor mass. Along with increasing of stage of the disease the efficacy of laser radiation decreases and this observation is specifically fair for SCCs and not for BCCs.



**Figure 1:** Female patient C. aged 63. Basal cell carcinoma of the right temporal area. (a) before treatment, (b) 3.5 years after laser therapy.



**Figure 2:** Female patient U. aged 52. Basal cell carcinoma of the tip of the nose. (a) before treatment, (b) 5 years after laser therapy.

Clinical features and localization of tumors contribute to the efficacy of treatment of facial carcinoma by means of laser radiation. In case of carcinoma location on the nasal cartilage the use of laser radiation is limited due to likelihood of recurrence development and probable appearance of cosmetic defect. The most favorable results are observed in patients with superficial lesions. In case of nodular-ulcerative and infiltrative-ulcerative tumors recurrence rate increases. The most often recurrences are detected in patients possessing BCC in nasolabial area. There are no evident differences in recurrence rate of SCCs depending on localization on the face but the insufficient number of observations does not let us affirm it with confidence. Similar correlation between clinical and morphological peculiarities of facial carcinomas and therapeutic efficacy is described for other methods of facial carcinomas treatment [1,3,7].

It is worthy to stress that radiation Nd laser as well as other types of lasers [11-14] does not cause resistance of tumor cells to this therapeutic modality and therefore it may be effectively used for successive sessions in case of recurrences of BCC after initial laser application and also limited BCC recurrences that appeared after other methods of treatment [22,23].

The safety margin for laser treatment around tumors, which is often limited on the face, is the same as after surgery [4,5] as well as in case of treatment of skin carcinoma by CO<sub>2</sub> laser [13,14]. After the rejection of necrotic masses the positive wound margin on histological examination is observed only in some patients with BCC (0.3%) that confirms safety of margins.

Neodymium laser radiation has photo destructive impact through the thermal, hydrodynamic and photochemical effects of laser beam, which cause destruction, evaporation and coagulation of the tumor and adjacent normal tissues blood vessels. As far as these effects take place within millisecs the spread of tumor cells into body as the result of tumor destroy seems to be the doubtful event.

## Conclusion

Radiation of the high-energy pulsed neodymium laser appears to be an effective treatment for facial carcinoma of stages T1-2 N0 M0. The results of laser therapy depend on tumor morphology, stage of the disease, clinical features of the lesion and its localization.

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