Histological effects of NightLase® in the soft palate of rats

A pilot study

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Introduction

Snoring is a common problem in adults that affects between 20–50 % of the population.[1–3] Although there is no exact definition of snoring, the term indicates a breathing sound that arises during nighttime or daytime sleep.[4] The sound of snoring is usually a consequence of the vibration of pharyngeal soft tissue (most commonly soft palate), so treatment focuses on reducing these vibrations.[4,5]

There are many types of surgical treatment procedures that have been defined up to now.[5–9] In addition to these surgical treatments, some non-surgical procedures are available.[10,11] Among the treatment options, the main goal is to find a simple, safe and effective procedure that benefits a speedy recovery and return to normal daily life.

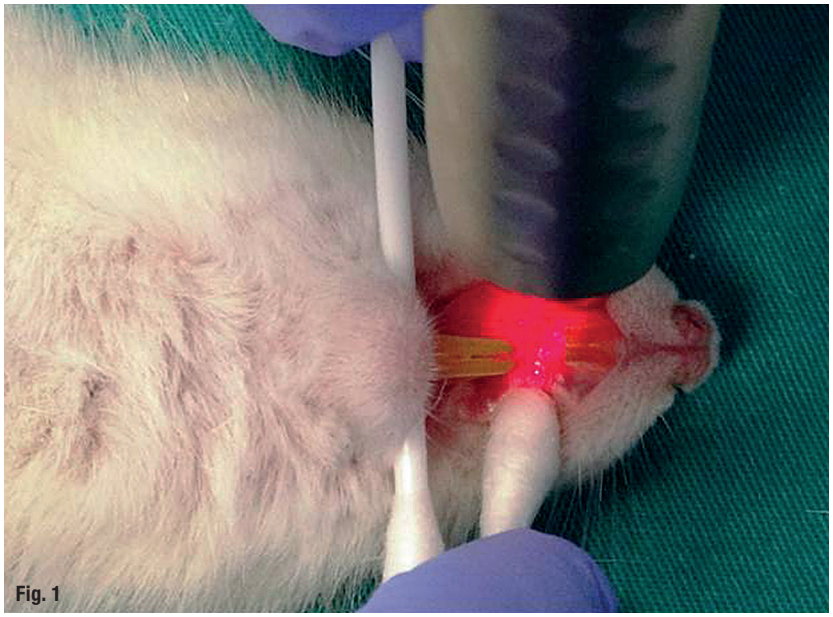

Fig. 1

Fig. 1: Application of the PS04 handpiece to the soft palate of the rat.

In the past, Nd:YAG laser irradiation was used for stiffening the soft palate using a low energy method as a less invasive alternative. Nd:YAG laser stiffening of the soft palate was reported to be simple, safe and effective for reducing the length of the soft palate in the canine model.[3] Recently a new laser irradiation tool was introduced in the market known as NightLase®, which claims to be a non-invasive and effective method for the treatment of snoring and sleep apnea. This treatment is reported to be a fast, safe and efficient method for decreasing the amplitude of snoring through the use of superficial Er:YAG laser light.[10] However, there is no information in the literature about the histological effects of this treatment model on living tissues. Therefore, this study aims to assess the effects of Er:YAG laser irradiation on the histological structures of the soft palate in rat models.

Materials and methods

Twenty adult female Wistar albino rats weighing 200 to 250 g were used in this study. Rats were randomised into two groups as an experimental (n=10) and a control group (n=10) following the approval of an animal use protocol by the Bezmialem Vakif University Animal Care Committee.

The rats were anaesthetised and Er:YAG laser energy (LightWalker AT, Fotona, Slovenia) was delivered with a snoring handpiece (PS04, Light-

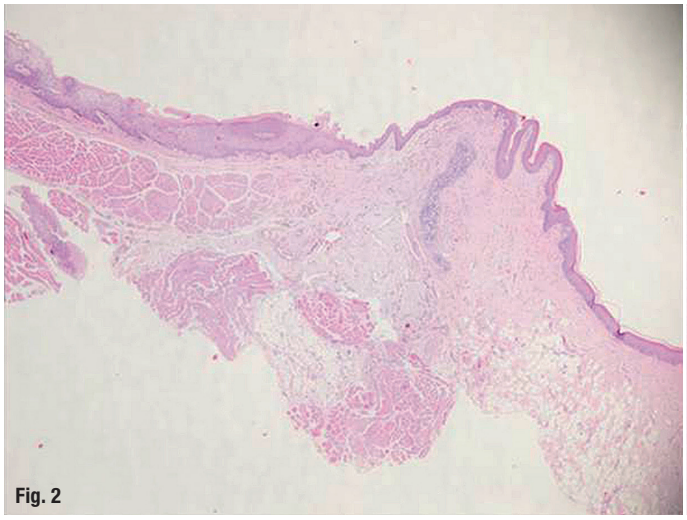
Fig. 2

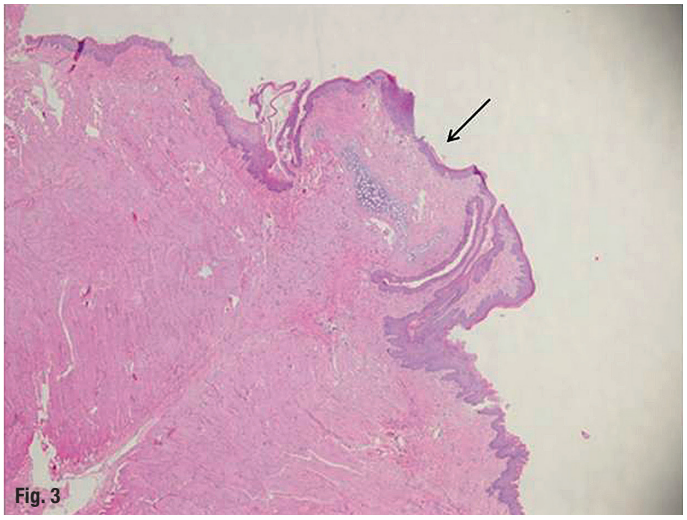
Fig. 3

Fig. 2: Normal mucosa of the control group.
Fig. 3: Acute shrinkage of the soft palate.

Walker AT, Fotona, Slovenia) in non-contact mode (1.15 W, 2 Hz, 1.57 J/cm^2, SMOOTH mode, Fig. 1). The surface of the soft palate of each rat in the experimental group was irradiated for two minutes. The laser beam was manually guided across the soft palate horizontally. The control group did not receive any treatment (Fig. 2).

The animals were sacrificed after 24 hours, one week, three weeks or five weeks. The soft palates of each rat were removed by excisional biopsy. The specimens underwent histological examination with an optical microscope (CX 31, Olympus, Tokyo, Japan) used for the examination (X4 and X10 zoom).

Sections were evaluated by an experienced pathologist without any knowledge of the type of animal group and inflammation; contraction was reported as grading from 1+ to 3+. Statistical analysis was done with Statistical Package for Social Sciences (SPSS) for Windows 10 and, where appropriate, Mann-Whitney U-Test and Spearman's rho, with P values less than 0.05 considered significant.

Results

The overlying mucosa of each rat in the experimental group was intact, with some superficial blanching, but carbonisation of the tissue was not observed. All animals recovered normally and tolerated normal intake of food and water within 1 ± 1.5 hours after reaction from the anaesthesia, without any complications thereafter. There was no exposed wound, bleeding or necrosis to be found when the soft palate was observed macroscopically after sacrificing the animals.

A noticeable contraction of the soft palate occurred immediately after laser application (Fig. 3). After the first 24 hours, contraction of the tissue was labeled as level 2.5. Shrinkage decreased gradually and was scored as 1.6 at the first week, 1.3 at the third week, but was still present at the end of fifth week at level 1.

Discussion

This study evaluated the contraction of the soft palate of rats after Er:YAG laser irradiation. Histologically, acute shrinkage was observed in the experiment (Fig. 3). Snoring is a problem that affects the majority of the population. A narrowed pharyngeal airway and extra vibratory tissue are what cause snoring,[5] and the general aim of treatment options is to expand the airway and eliminate the redundant vibratory structures. The optimal treatment would effectively decrease the sound of snoring while being simple and safe.[4]

Research on surgical approaches of snoring and sleep apnea has focused on causing less tissue damage. Haytaoglu et al. compared the effects of palatal implants and uvulopalatal flaps on snoring and sleep apnea management.[7] They reported that hospitalisation, preoperative laboratory studies and loss of labor make uvulopalatal flaps an expensive and non-preferred method for snoring and sleep apnea treatment, while palatal implants could be placed in shorter time under local anaesthesia with a lower rate of morbidity.

Wang et al. used Nd:YAG laser as an alternative to uvulopalatopharyngoplasty (UPPP) on an animal model and demonstrated the stiffening and elevation of the soft palate.[3] They reported that Nd:YAG laser seemed to be effective in palate shortening and stiffness of the canine, but it remained to be determined if it would produce the same effects in human subjects.

Traditional surgical and non-surgical treatments do not provide satisfactory consequences, and surgical methods are also associated with some significant risks such as pain, haemorrhage, infection and malfunction.[3,4] Er:YAG laser irradiation, on the other hand, is reported to be a non-invasive and more effective method available for treating snoring and sleep apnea.[10,14] The method uses Er:YAG laser energy, which causes a contraction of the collagen fibers and provides an opening of the airway to decrease snoring and apnea with a 90% success rate. No side effects have been reported after Er:YAG laser irradiation in the treatment of snoring.[10] Similarly, Dovsak et al. showed that Er:YAG laser treatment is a safe method and is easily tolerated by patients.[14]

In this study, mucosal contraction can be seen immediately after laser irradiation as a result of the thermal effect on the tissue. Due to the contraction of the pharyngeal soft tissue, the airway expanded and vibrations of the pharyngeal soft tissue were eliminated. Meanwhile, the mucosa remained intact, with no evidence of bleeding, severe inflammation, carbonisation, necrosis or any other complication.

Among the literature, this is the first study to evaluate the contraction of the soft palate from a histological basis after NightLase® application. The limitations of the current study include using a small number of animals because of animal-use protocols, which unfortunately makes it difficult to state predictive value. Another limitation is the need for sacrification of the rats for histological analysis, which made repetitive application of NightLase® impossible. Future studies with higher numbers of subjects and repetitive laser irradiation are needed to be able to draw more definitive conclusions.

Conclusions

The present study indicates that Er:YAG laser irradiation with a snoring handpiece (PS04) causes acute shrinkage of the mucosa. This contraction decreases gradually but is still present at the end of fifth week. This treatment option may be considered safe due to the absence of any carbonisation, necrosis or haemorrhage._

Editorial note: A list of references is available from the publisher.

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Kurz & bündig

Schnarchen betrifft die Mehrheit der Bevölkerung. Verursacht wird es durch eine Verengung der Luftröhre und Vibrationen der umgebenden Gewebe. Schnarchbehandlungen zielen darauf ab, die Atemwege zu erweitern und Strukturen, die wiederkehrende Vibrationen begünstigen, zu eliminieren. Vor Kurzem wurde ein neues Gerät zur Laserbestrahlung vorgestellt (NightLase®, Fotona), welches eine nichtinvasive und effektive Methode zur Behandlung von Schnarchen und Schlafapnoe darstellen soll.

Die vorliegende Studie ermittelt den Effekt einer Bestrahlung durch Er:YAG-Laser auf die histologischen Strukturen des Gaumensegels bei Ratten. Insgesamt 20 ausgewachsene, weibliche Wistar-Albinoratten mit einem Gewicht zwischen 200 und 250 g wurden in dieser Studie untersucht. Die Ratten wurden randomisiert in zwei Gruppen (n = 10) eingeteilt, wovon eine Gruppe die Kontrollgruppe darstellte und nicht behandelt wurde. Die Tiere der zweiten Gruppe erhielten nach Anästhesie eine Laserbestrahlung (LightWalker AT, Fotona, Slovenia) durch ein spezielles Schnarch-Handstück (PS04, LightWalker AT, Fotona, Slovenia) im Non-Kontakt-Modus (1,15 W, 2 Hz, 1,57 J/cm², SMOOTH mode, Fig. 1). Dabei wurde die Oberfläche des Gaumensegels für zwei Minuten bestrahlt und der Laserstrahl manuell horizontal über das Gaumensegel geführt.

Die Auswertung der histologischen Ergebnisse lässt den Schluss zu, dass eine Er:YAG-Bestrahlung durch ein Schnarch-Handstück (PS04) ein starkes Zusammenziehen der Mukosa bewirkt. Dieses war auch fünf Wochen nach der Laserbehandlung noch messbar, wenn auch stark abgeschwächt. Da keine Karbonisation, Nekrose oder Blutung festgestellt wurde, kann diese Behandlung als sicher bewertet werden.

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