Effect of Diode Lasers on Human Sperm Motility

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ABSTRACT

This preliminary study was performed to determine the effect of diode lasers on human sperm motility. The in vitro survey was performed as a randomized clinical trial, in which 25 out of 55 patients with primary or secondary infertility and asthenospermia were evaluated. It was indicated in results that the mean total sperm motility, progressive sperm motility, Class C sperm motility, Class D sperm motility, and VCL were significantly increased in samples receiving infrared and red radiation, but there was no significant difference in the control group. The findings suggest that diode lasers may be used as an optimal therapeutic option for treatment of male factor infertility resulting from disordered motility.

Keywords: Diode lasers, human sperm, motility

INTRODUCTION

Infertility is defined as failure to achieve a clinical pregnancy after 12 months or more of regular unprotected sexual intercourse [1]. The prevalence is different worldwide with a mean 15% rate [2, 3]. This is not solely a somatic problem and may impose numerous psychological burdens on affected couples. Accordingly, prompt treatment is important [4].

In 30 to 40 percent of cases, both partners for and in 20% only the male factors are responsible leading to this matter that totally half cases are related to male factors [5]. Semen quality is the most important factor and the initial step in male-factor infertility assessment, especially sperm concentration, morphology, and motility via semen analysis. Usually, however, multiple parameters in semen analysis are abnormal: asospermia, low semen volume, asthenospermia, tratospermia, oligospermia, and pyospermia are common isolated abnormalities.

Abnormality in sperm motility is responsible for 6 percent of male-factor infertility [6]. It may be idiopathic or owed to intrastructural sperm disorders, abstinence, anti-sperm antibodies in semen, genital infections, partial obstruction of semen outlet, and varicocele [7-9]. In idiopathic asthenospermia, antioxidants are used including vitamin C, vitamin E, pentoxifylline, and L-carnitine [10, 11]. In asthenospermia from other causes, the first therapeutic choice is the Assisted Reproductive Technique (ART) that mainly includes in vitro options and is an expensive method [12]. As regards the energy-less status of low-motility sperm, an optimal energy source may be a solution. Currently, low-level laser therapy with immunological, anti-inflammatory, metabolic, and analgesic effects is used in certain cases [13]. Photobiomodulation of mitochondria may be the main mechanism of action for these lasers, leading to better motility through different wavelength use via cytochromes [7]. The effects of different wavelengths may be different, however. Accordingly, in this study the effect of red and infrared lasers with 635 and 830 nanometer wavelengths were compared for human sperm motility.

METHODS AND MATERIALS

In this interventional in vitro survey, 25 out of 55 men with primary or secondary infertility were enrolled. The exclusion criteria were asospermia, severe oligospermia, pyospermia, and zero-motility sperm in initial semen analysis. These patients had no genetic syndrome and also there was no antibody against sperm in their semen. No infertility treatment agent had been used in the last six months according to their expression.

This study was approved by the local ethical committee and informed consent forms were completed by all participants. The samples were taken by self-masturbation in the lab under direct observation by camera and the samples were stored in special tubes and centrifuged at a temperature of 37°C for 20 to 30 minutes in an incubator to reduce agglutination. The semen quality was assessed by an optical technique. Then from each semen sample, three separate wells with 37'C temperature each one 50 landa were filled: one was for the red laser, one for the infrared laser, and one as control sample.

Each laser probe was established on a fixed base with a stable laser diameter and distance from sample. For wells with a 0.7 mm diameter, the cross-section should be 0.38 mm^2 and so the beam cross-section was fixed at 0.38 mm^2; 200 mill-watts were needed to achieve 4 J/cm^2 of energy and it was projected from one centimeter for eight seconds with a continuous wave to each sample.

For spermogram preparation five landa from each sample were transferred from the well containing 50 landa to a special slide at a temperature of 37°C. After laser projection from all three samples a spermogram was prepared to determine the immediate effects of the lasers. The next evaluations were performed after 15, 30, 45, 60, 90, and 120 seconds for all three samples. Between these times, the wells were transferred to the 37°C incubators and after every transmission of five landa the same process was carried out. The spermogram was prepared by CASA software. In it the semen sample was put under a microscope with a sperm chamber slide (the chamber model was Weili-9000). According to WHO criteria, rapid forward progression constitutes grade A motility, slow progression grade B, movement without progression grade C, and no movement grade D. A total of grades A and B constitutes progressive motility. VCL was defined as curvy linear velocity (sperm velocity along its real path) with micrometer per second unit.

Data analysis was performed among 25 subjects by SPSS (version 13.0) software [Statistical Procedures for Social Sciences; Chicago, Illinois, USA]. Repeated-measures ANOVA test (regarding to parametric distribution) was used for comparison of different measurements and were considered statistically significant at P values less than 0.05.

RESULTS

The mean (± standard deviation) was 31.36 (±5.88) years. The mean semen volume was 3.95 (±1.36) milliliters. The mean semen pH was 7.74 (± 0.18), which is in the normal range. The mean total motility, progressive motility, class C motility, and VLC measurements demonstrated the greatest increase in infrared laser samples and class D motility showed the greatest increase in red laser samples.

Across the study, the mean total motility, progressive motility, class C motility, class D motility, and VLC measurements demonstrated no significant increase in control samples ($P > 0.05$), but all showed significant difference in red and infrared groups ($P=0.0001$) (Figures 1 and 2).

ISSN: 2223-9944, eISSN: 2223-9553

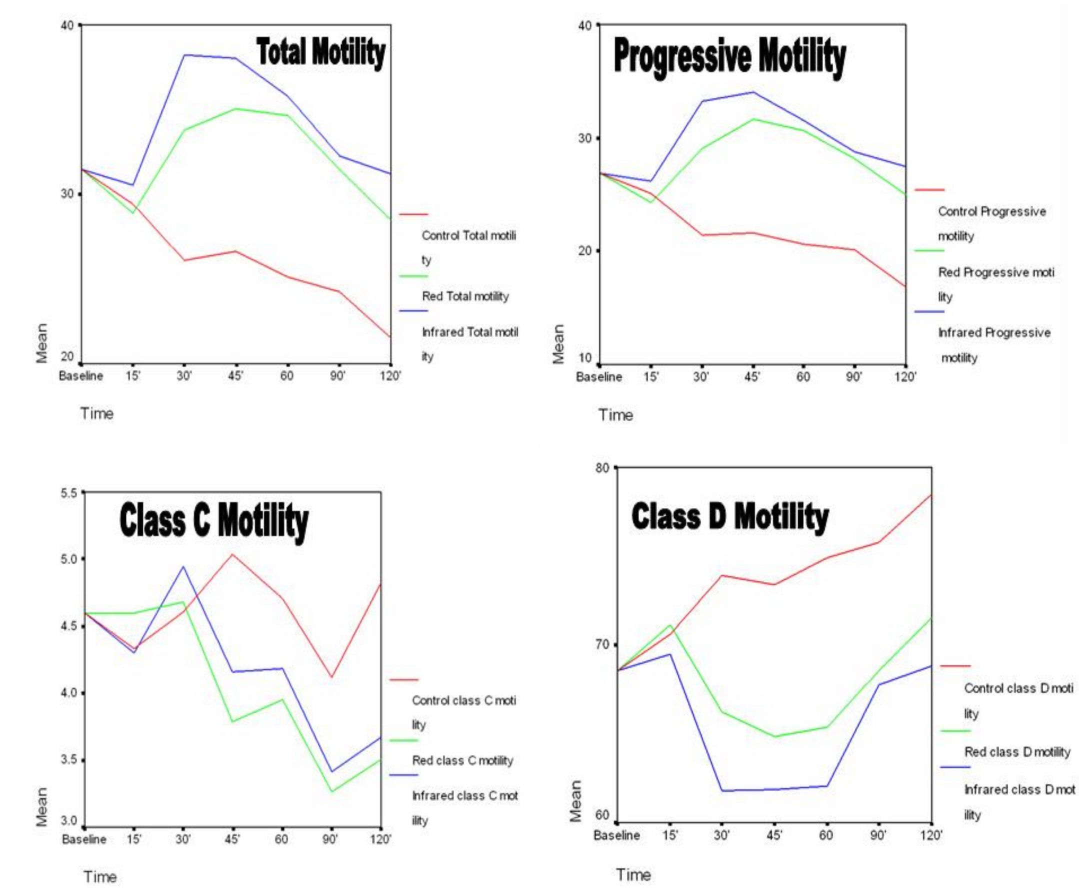

Figure 1. Motility change across the study in different samples

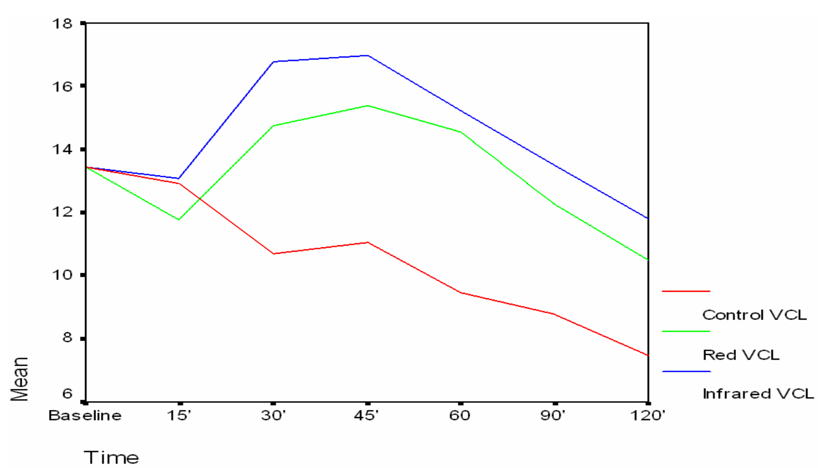

Figure 2. VLC change across the study in different samples

DISCUSSION

In this study the effects of diode (infrared and red) lasers on spermograms were compared with each other and also with a no-laser control group. As mentioned in the Results section all motility parameters in semen analysis were significantly increased and improved across the study in both red and infrared groups with statistically significant differences. There was, however, no statistically significant difference between these two laser groups and minimally better results in the infrared group. The control samples also showed no significant change across the study but showed significant difference with both laser samples.

The infrared laser may penetrate different tissues from the red laser. The better results in the infrared group require further studies on genetic changes in tissues exposed directly to this laser and the safety of this laser in use. The results obtained in this study were in congruence with previous similar investigations and demonstrated good efficacy of lasers for improvement of sperm motility. Sato and colleagues [14] demonstrated that laser therapy may improve both motility and speed of human sperm, similarly to our findings. Lenzi and colleagues [15] similarly found that laser projection may increase ATP use rate and lead to increased speed and motility of sperm. Ocana and colleagues [16] found that a helium-neon laser with a 632.8 nanometer wavelength may induce acrosomal reaction and lead to better motility of sperm, as found in our study. Iffaldar and colleagues [17] found that a helium-neon laser with a 632.8 nanometer wavelength could improve sperm quality, as in our study. Corral and colleagues [18] reported better linear motility and speed of sperm exposed to a diode laser with a 655 nanometer wavelength.

According to the obtained results in this study and other similar studies, it may be concluded that lasers may be used as an optimal therapeutic option for treatment of male factor infertility owed to disordered motility, resulting in an increased success rate of ART, especially IUI and IVF. It is recommended that further studies should be carried out with a larger sample size and evaluation of sperm's genetic factors before and after laser exposure.

ISSN: 2223-9944, eISSN: 2223-9553
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ISSN: 2223-9944, eISSN: 2223-9553

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