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EFFECTIVENESS OF LOW INTENSITY LASER THERAPY ON THE WOUND HEALING USING BATES JENSEN WOUND ASSESSMENT TOOL IN SUBJECTS WITH PRESSURE ULCERS

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ABSTRACT

Background: Pressure ulcers are injuries to skin and underlying tissues resulting from prolonged pressure on the skin which often develop on skin that covers bony areas of the body, such as the heels, ankles, hips and sacrum. Without care, pressure ulcers continue to grow in diameter and depth and are exceptionally difficult to heal. Therefore, enormous effort is required to find effective and reliable techniques for preventing the initiation of ulcers and eliminating them once they develop. This study has been done to assess the efficacy of low intensity laser therapy (LILT) on the wound healing dynamics in human subjects with pressure ulcers using Bates Jensen wound assessment tool.

Methods: A total of 130 subjects were enrolled for the study and after randomization the subjects were allocated to control and experimental groups each consisting of 65 subjects. The subjects of the control group received conventional wound dressing for the pressure ulcer for 3 weeks where as the subjects of the experimental group underwent LILT and conventional wound dressing for 3 weeks. On Day 1 and after 3 weeks, the BWAT score of the pressure ulcer was recorded.

Results: The results showed a significant difference between pre and post intervention values in experimental group compared to control group ($p < 0.05$).

Conclusion: The study has brought out that LILT has better healing of pressure ulcers when compared to the conventional wound management to compare the wound healing dynamics among the subjects in the control and experimental groups.

Keywords: Pressure ulcers, LILT, BWAT Score, Diabetes.

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INTRODUCTION

Pressure ulcers are injuries to skin and underlying tissues resulting from prolonged pressure on the skin which often develop on skin that covers bony areas of the body, such as the heels, ankles, hips and sacrum. Without proper attention, pressure ulcers continue to grow in diameter and depth thereby enhances morbidity.¹In the United States, the annual number of patients who develop a pressure ulcer is estimated at 1.7 million. An overall prevalence of 9.2% among institutionalized patients and 5 to 10% in hospitals, about 30% in geriatric clinics and homes for the elderly.²

The contributing factors of pressure ulcers are stress, time, spasticity, infection, edema, denervation, moisture and poor nutrition.^{3,4} The loss of cutaneous sensitivity contributes to ulceration by removing one of the important warning signals about excess pressure, pain.⁵ Paralysis leads to atrophy of the skin with thinning of this protective barrier, making the skin more susceptible to minor traumatic forces, such as friction and shear forces.^{6,7} Loss of surface epithelium leads to water loss across the skin, creating maceration and adherence of the skin to clothing and bedding, which raises the coefficient of friction for further insult.⁸Pressure ulcers are one of the major complications of spinal cord injury and diabetic patients. Ulcers are usually accompanied by an inflammatory reaction and secondary infection due to local bacterial colonization or by systemic infection. Low intensity laser therapy (LILT) is classified under class 3 B with a power varying between 5 to 500mW. It has been used as promising adjunctive treatment for the pressure ulcers due to its photochemical response. Laser therapy is associated with increased collagen synthesis, rate of healing and wound closure, tensile strength, tensile stress, number of degranulated mast cells and reduced wound healing time.⁹ In view of absence of large scale prospective, randomized, controlled clinical trials in human subjects, this study has been done to assess the efficacy of LILT on the wound healing dynamics using Bates Jensen wound assessment tool subjects with pressure ulcers. The efficient management of pressure ulcers requires a multidisciplinary team made up of physicians, clinical nurse practitioners, dieticians, social workers, occupational and physical therapists. The AHCP (Agency for health care policy and research) guidelines emphasizes the initial care of the pressure ulcer involves debridement, wound cleansing, the application of dressings and possibly adjunctive therapy.¹⁰

MATERIALS AND METHODOLOGY:

A total of 130 subjects with pressure ulcers who were admitted in three tertiary care hospitals in Tirupati, A.P were taken up for the study. A total of 117(excluding 13 dropouts) samples, male-66 number that is 56.4%, female-51 number that is 43.6% were finally selected for the study. The mean age group of the samples was 45.26 ± 15.88 in the experimental group. In control group, mean age of samples was 45.98 ± 14.12 . The control group is represented by 63 samples (drop outs = 2) while the experimental group consists of 54 samples (drop outs = 11). A prospective, randomized, controlled protocol approved by the Institutional ethics committee was conducted and informed consent was obtained from all subjects or their families. Subjects with grade II pressure ulcers were included in the study. Patients were then randomly assigned to one of the two groups, and were treated for 3 weeks or until the ulcer healed whichever occurred first. Control group (n=63) subjects were randomized to receive only conventional wound dressing. Ulcers were cleansed gently with topical substance with physiological normal saline, moistened gauze and dried. Regular change of dressing was done and patients were given instructions not to lie on the pressure ulcer to diminish the pressure effects on skin microcirculation. Pressure ulcer was assessed on first day and BWAT score was calculated. Conventional wound therapy was done regularly and re-assessment of the wound was done at the end of 3rd week and statistical analysis done. Experimental group (n=54) subjects were randomized to receive both the conventional wound dressing and a regimen of LILT for 3 weeks for the pressure ulcers. A total of six sessions of laser therapy was given per week. The equipment used was TECH LASER THERAPY SS (Laser therapy unit) which is a versatile, solid state laser, continuous output with visible red at 632.8 nm wavelength and power output of 10 mW. Scanning mode was used which was very useful for treating larger areas such as sacrum, buttocks etc., Laser therapy has the advantage of short treatment and the ability to be applied without touching the wound, thus minimizing the cross- infection risk. During the treatment, protective goggles were given to the subject. The subject made lie down on the bed and the scanner was used to treat the pressure ulcer. The distance of 70 cm was maintained between and the scanner and the subject. The treatment was given with a frequency of 6 days per week and dosage of 9.54 J/cm² to 13.35 J/cm².

Dosage calculation:

Laser power output (W) = 10 mW = 0.01 W
 The size of the beam aperture of the laser therapy unit is 0.314 cm²
 Laser Power Density (W/cm²) = Output Power (W) / Beam area (cm²)
 Power Density (W/cm²) = 0.01W/0.314 cm²
 = 0.0318 W/cm²
 Energy Density (Joule/cm²) = Power Density (W/cm²) x Time (Seconds)
 = 0.0318 x 300 sec (5 min) or (7 min)
 = 9.54 J/cm² to 13.35 J/cm²

Both groups were given the same preventive information and local ulcer therapy. The pressure ulcers of these samples were assessed on day 1 and

after 3 weeks by using BWAT score. All statistical computations have been done using IBM SPSS 19.0 version. The data has been analyzed by the following standard statistical methods. Mean values have been calculated for BWAT scores of the pressure ulcers of day 1 and after 3 weeks of the control and experimental groups separately. This has been done using paired t- test. Further mean differences and percentages of change between control and experimental groups for various variables have been done and its significance from the angle of study of thesis using independent sample t-test. The differences were found to be statistically significant at p < 0.05 level.

Table 1: BWAT scores of day 1 and after 3 weeks among subjects with pressure ulcers in control and experimental groups

Group	BWAT score	Mean	N	Std. Deviation	t- statistic	p-value
Control	Day1	48.11	63	6.884	35.302	0.000*
	After 3 weeks	34.29	63	7.239		
Experimental	Day1	49.30	54	9.622	39.027	0.000*
	After 3 weeks	29.15	54	8.272		

Table 2: Mean Difference of BWAT scores of control and experimental groups

Group	Mean	N	Std. Deviation	t- statistic	p-value
Control	13.825	63	3.1084	9.907	0.000*
Experimental	20.148	54	3.7937		

Table 1 reflects the BWAT scores of day1 and after 3 weeks among subjects with pressure ulcers in control and experimental groups. The mean BWAT score of control group decreased from 48.11 ± 6.88 to 34.29 ± 7.23, where as the mean BWAT score of experimental group decreased from 49.30 ± 9.62 to

29.15 ± 8.27. Table 2 quotes the mean difference of BWAT scores between the control and experimental groups which is significant at p<0.05 level.

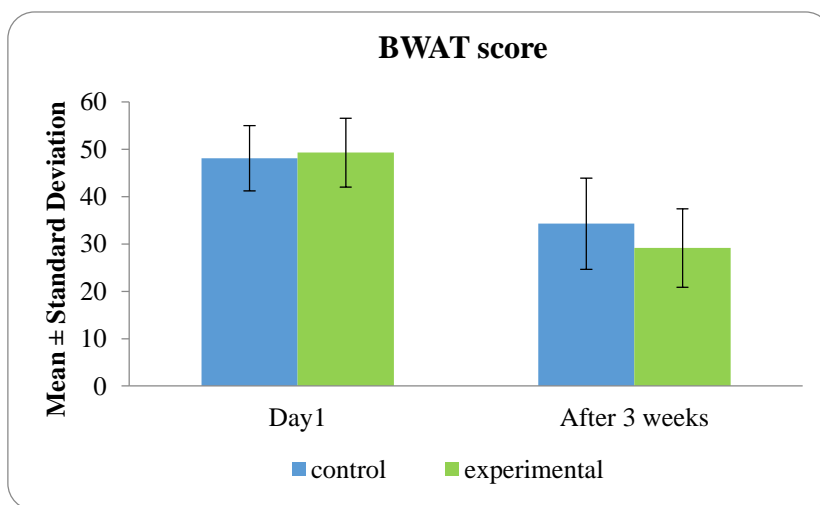


Figure 1: Comparison of BWAT scores of day 1 and after 3 weeks among subjects with pressure ulcers in control and experimental groups

Further, to observe whether there is any influence of diabetes in healing of pressure ulcers, the following tables 3 and 4 reports the statistical summary. The non- diabetic subjects have better

wound healing when compared to that of diabetic subjects in both the control and experimental groups.

Table 3: Mean percent change of BWAT scores in diabetic and non-diabetics in the control and experimental groups

Group	Diabetes	Mean	N	Std. Deviation	t- statistic	p-value
Control	No	15.0541	37	2.58141	4.219	0.000*
	Yes	12.0769	26	2.99230		
Experimental	No	21.7742	31	3.04094	4.189	0.000*
	Yes	17.9565	23	3.64914		

Table 3 shows the mean percent change of BWAT scores of 15.05 ± 2.58 in non diabetic subjects when compared to diabetic subjects of 12.07 ± 2.99 of the control group. The mean percent change of BWAT scores 21.77 ± 3.04 in non diabetic subjects when compared to diabetic subjects of 17.95 ± 3.64 in the experimental group. The mean difference of BWAT scores between non diabetic and diabetic subjects is significant at $p < 0.05$ level.

49.30 ± 9.62 (Day 1) to 29.15 ± 8.27 (after 3 weeks). The mean difference between the control and experimental groups was significant at $p < 0.05$ level.

In this study, LILT resulted in significant wound healing which is evident in the reduction of BWAT scores in a marked level from day 1 to after 3 weeks. During wound healing, the inflammatory process involves a vascular response, a hemostatic response, a cellular response and a immune response which are controlled by a complex interaction of neural and humoral mediators. During proliferative phase, the epithelial tissues have a high regenerative capacity and undergo a process known as re-epithelialization followed by remodeling phase.

The proposed mechanism of action of laser therapy is associated with the ability of the cell to absorb the photon and transform the energy into A.T.P which is used by the cell for its function. The light absorbing components of the cells are termed chromophores or photoacceptors and are contained within the mitochondria and cell membrane. Laser stimulation has been shown to enhance the production of ATP by forming singlet oxygen, reactive oxygen species (ROS) or nitric oxide, all which influence the normal formation of ATP (Derr and Fine 1965; Lubart et al.1990). The increased ATP prompts homeostatic function of the cells to resume. Furthermore, the ATP energy may drive the messenger RNA to foster cell mitosis and proliferation.

The mean percent change of BWAT scores is 21.77 ± 3.04 in non-diabetic subjects when compared to diabetic subjects of 17.95 ± 3.64 in the experimental group in table 3. The mean difference of BWAT scores between non diabetic and diabetic subjects is significant at $p < 0.05$ level. The results shows the evidence of better wound healing in non-diabetic subjects when compared to diabetic subjects. The factors which may delay the

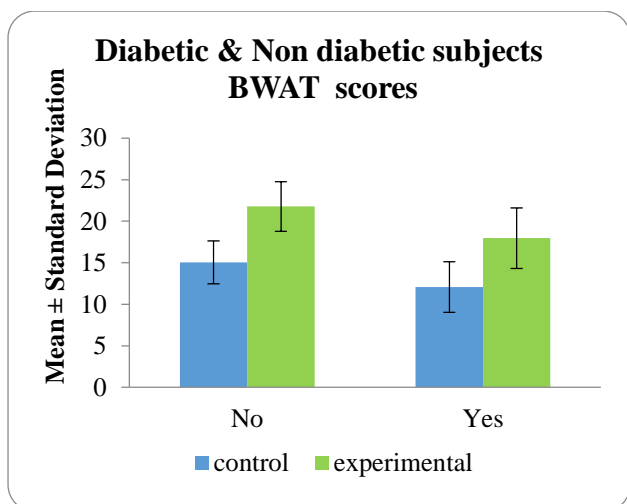


Figure 2: Mean percent change of BWAT scores in diabetic and non diabetics in the control and experimental groups

DISCUSSION

The demographic data includes a total number of 117 subjects. The control group consisted of 63 subjects including 36 male and 27 female subjects with a mean age group of 45.98 ± 14.12 . Among 63 subjects, 26 were diabetic and 37 were non diabetic. The experimental group consisted of 54 subjects including 30 male and 24 female subjects with a mean age group of 45.26 ± 15.88 . Among 54 subjects, 23 were diabetic and 31 were non diabetic. In the present study, the mean BWAT score of experimental group decreased from 48.11 ± 6.88 (Day 1) to 34.92 ± 7.23 (after 3 weeks) whereas the mean BWAT score of control group decreased from

wound healing might be arterial insufficiency and peripheral neuropathy which are most common among diabetic subjects. Subjects with diabetes are prone to peripheral vascular disease in both macrovessels and microvessels. They also have dampened immune response which compromises the ability to combat infection. A study done by Maiya GA et al on "effect of low intensity helium-neon laser irradiation on diabetic wound healing dynamics" concluded that laser photostimulation promotes the tissue repair process of diabetic wounds.¹¹

In the present study, the wound healing is evident in both the diabetic and non diabetic subjects and the rate of healing is better in the non diabetic subjects in both the control and experimental groups. Biochemical and histological analysis of the pressure ulcers were not done in this study which might be incorporated in future studies.

CONCLUSION

The study has brought out that LILT has better healing of pressure ulcers when compared to the conventional wound management. The rate of healing was better in non diabetic subjects when compared to that of diabetic subjects in both the control and experimental groups. Improvement of wound healing with LILT has increased the quality of life in the subjects with pressure ulcers thereby enhancing the self esteem of the subjects. Good interdisciplinary approach among the physiotherapists, nursing professionals, surgeons and physicians helped in the holistic rehabilitation of the subjects with pressure ulcers in this study.

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