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"LLLT": Low Level Laser Therapy for Treatment of Pain Associated With Early Orthodontic Treatment.

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Abstract: *The aim of this study was to evaluate the pain sensation that orthodontic patients experience when elastic separators (ES) and kesling separators (KS) are placed mesial and distal to 1st molars in the maxilla to determine the degree of analgesic efficacy of low-level laser therapy (LLLT) compared to a placebo treatment. The study was conducted with 64 orthodontic patients (Group I (ES) group- 32 patients, Group II(KS) group- 32 patients) who were fitted with elastic and kesling separatorsmesial and distal to 1st molars in the maxilla. Right quadrant was chosen to be irradiated with an 830-nm laser, 2 w , applied for 20 s per point. Three points were irradiated in the buccal face and three were irradiated in the palate. The same procedure was applied in the contralateral quadrant with a placebo light. A visual analogue scale was used to assess pain 5 min, 6 h, 24 h, 48 h, and 72 h after placement of the separators. Maximum pain occurred 6–24 h after placement of the separators.Pain intensity was significantly lower in the laser treated quadrant (mean of ES -1.9095 , KS- 0.8917) than in the placebo treated quadrant (mean of ES - 3.4846 , KS – 2.1012).Pain intensity was significantly lower in the kesling separator group than elastic separator group (mean of ES- 1.9095 ,KS – 0.8917). LLLT at these parameters can reduce pain in patients following placement of orthodontic rubber and kesling separators.*

I. Introduction

Despite the recent progress that has been made in the area of orthodontics, patients still associate orthodontic treatments with pain[1] .It has been demonstrated that after compression of the periodontal ligament, prostaglandins and other mediators of inflammation, such as substance P, histamine, and serotonin, cause sensitivity to the free nerve terminations and discomfort after orthodontic adjustment or placement of dental separators.

Report attributed the increase in the levels of prostaglandin E2 to the initial intensity of the pain, and the increase in interleukin (IL)-1 to the intensity of pain 1 day later[2]. Most orthodontists use analgesics or non-steroidal anti-inflammatory drugs (NSAIDs) to reduce pain in adult patients.The type of pain that occurs during orthodontic treatment is an inflammatory type of pain, not an infection-related pain; it is localized and of short duration. For this reason, some authors have recommended the use of local analgesic therapy in order to avoid drug regimens.One local treatment that has been proposed for pain control by various authors is low-level laser therapy (LLLT). LLLT can modulate the inflammatory process and thus reduce pain[1].

Among nonpharmacological methods, researchers have demonstrated that low-level laser therapy (LLLT) produces an analgesic effect in some clinical and therapeutic applications Some authors have attributed the analgesia produced by LLLT irradiation to its anti-inflammatory and neuronal effect, including breath stimulation of nerve cells and lymphocytes thereby transmitting stabilization of the membrane potential and releasing neurotransmitters into the inflammatory tissue[2].In addition to the analgesic effect, several researchers have reported that LLLT provoked tissue biostimulation. Currently specific wavelengths with specific energy densities are suggested for application in bone remodeling. benefit of radiation instead of medications relates to the fact that there are no systematic negative effects on the patient's body. The interaction of LLLT with bone components has been studied under different conditions and with different wavelengths and energy densities, within the medical field.

From these investigations, it has been reported that a wavelength of 660nm will increase the number of osteoblasts in the irradiated area.15 With up to a wavelength of 780 nm, significant regeneration of the trabecular bone has been observed The wavelength of 830 nm, produced by the aluminum gallium arsenide diode laser (AlGaAs) has been considered to have greater tissue penetration power than that shown by other systems.Local CO2 laser irradiation therapy could act as a high level laser (HLLT), where there is a photo-bio-destructive reaction that induces to cellular vaporization. On the other hand, the utilization of LLLTirradiation generates a photobioactive reaction that stimulates cellular proliferation and differentiation[3]. LLLT seems to be a good option for treating the pain that comes with orthodontic treatment. Moreover, it appears to act as a stimulant for bone and fiber repair, as well as possibly speeding up the rate of tooth movement. Therefore, the objective of this study was to evaluate the effectiveness of using a single dose of LLLT at a wavelength of 830nm in the treatment of pain inherent in orthodontic tooth movement[4].

II. Materials And Methods

Sample Size

Sixty four orthodontic patients were randomly assigned to two groups.
Group I – elastic separator group (ES) consist 32 patients , age 12-21 years; mean 16.5 years.
Group II – kesling separator group (KS) consist 32 patients , age 12-21 years; mean 16.5 years.

Statistical Analysis

Mann-Whitney Test used to check significant difference between control and experiment site in both group. Wilcoxon Signed Ranks Test used to check significant difference between control and experiment site in same group. A p values less than 0.05 was considered statistically significant.Minimum 64 patients (32 per group) SD of 3 at 5% risk and 90% power. (Reference :M.Artes-Ribas et al)

III. Methodology

1. In group I patients were given elastic separator and in group II patients were given kesling separator in the mesial and distal to 1st molars of the maxilla (fig.1,2)
2. Five minutes following placement of elastic separators, patients were treated with the laser application and placebo procedure. At the time of laser irradiation, both the patient and orthodontist used goggles designed to block the wavelength of the laser used in accordance with safety standards. The patient was also fitted with an opaque mask beneath the glasses to obscure his or her vision.
3. Three points were irradiated in the vestibular zone (two points in the third cervical, mesial, or distal regions and one in the apical third, fig.3,4) and three points were irradiated in the palatal zone in the experimental quadrant. The total energy released in all laser-treated teeth was 12 J (vestibular area, 6 J, and palatal area, 6 J). The laser was applied in such a way that it was in direct contact with the mucosa without any pressure.(fig.5,6,7)

4 The same procedure was repeated in the contralateral quadrant, but with a placebo light (polymerizing light , fig.8)

5 A single operator placed the separators and applied the laser and placebo light .

Pain Assessment

A visual analogue scale (VAS), 10 cm in length (00no pain, 100worst pain imaginable), for each of the quadrants was used. Patients were trained to assess pain in the following periods: T1, before placing the rubber separator; T2, 5 min after placement of elastic separators (when the laser or placebo light was applied); T3, 6 h post-treatment; T4, 24 h post-treatment; T5, 48 h post-treatment, and T6, 72 h post-treatment. Each patient was required to indicate whether s/he had taken any rescue analgesic in any of the periods recorded. Four days after the treatment, the questionnaires were collected and the separators were removed.

Criteria For Selection Of Samples-

Inclusion Criteria

- Absence of acute or chronic dental disease.
- Absence of periodontal or gum disease.
- Free from severe systemic disease.
- No fixed orthodontic retainer in the dental arch.
- No ankylosis or tooth implants in the arch.
- No consumption of analgesic drugs during the 48 h preceding the test.

IV. Result

Pain Perception Of The Experimental Side Vs. Placebo Side

The level of pain in the quadrant where the laser was applied was lower than the one reported for the control side. Pain level reported for the experimental laser side was significantly less than that reported for the control placebo side in both group(table 1,2). when compare between two separators pain reported less with kesling separator in both side in both group (table 3,4).

Progression Of Pain

The quadrant exposed to placebo light was associated with higher pain scores than the laser-irradiated quadrant at all experimental time points. During the 72-h experimental period, the presence of pain was first reported at 5 min (T2), with pain intensity peaking between 6 and 48 h (T3–T4) and then decreasing thereafter at 72-h time .

V. Discussion

This study investigated the efficacy of LLLT in the prevention of pain following the placement of elastic separators during early orthodontic treatment. It was found that the laser-irradiated quadrant presented with less pain compared with the control quadrant in all cases studied. The forces applied to produce orthodontic movements almost always generate a certain degree of discomfort or pain, and the intensity of that pain varies among patients. Achieving an effective method of pain control without administration of drugs is a common research goal in all areas of the health sciences.

The study was performed with a "split mouth" design, allowing for within-subject controls. Although the VAS pain assessment is a subjective method in which there is great variability across individuals, it is one of the best methods available for pain studies In this study, VAS data were collected at multiple time points: time of separator placement and 5 min later (at the time of irradiation), as well as 6, 24, 48, and 72 h posttreatment.Intensity of pain is less at experiment site in ES and KS. Perception of pain starts from 5 min and its maximum intensity at 48 hours(maximum-6 in ES group , maximum-2 in kesling) after that was gradually decreasing. when compare between two groups it was more in ES group (maximum – 6 , table 3,4) than KS group (maximum – 2, table 3,4)

Different wavelengths can be used in LLLT. The most commonly used are 632.8-, 660-, 780-, 810-, 830-, 904 and 980-nm lasers. The type of laser used in this study was chosen based on a careful literature review through which it was determined that the 830-nm diode laser appeared to be the one with the greatest analgesic capacity. Meta-analysis results by Enwemeka showed that the 830-nm laser has a robust analgesic efficacy, and this finding was corroborated by both clinical and in vitro studies, including the noteworthy studies performed by Chow et al. Other wavelengths (e.g., 670-nm diode laser) have also been used to achieve pain reduction after multiband placement [5]

Other types of lasers, such as CO2 and Er, Cr:YSGG lasers, have also been used to obtain an analgesic effect, but with mixed results. While Fujiyama et al. obtained good results with a CO2 laser in unfocused mode, no other significant improvements have been found[6]. However, there appears to be an analgesic trend when an Er, Cr:YSGG laser is used .

Pain is a complex phenomenon with immense individual variability in perception that can be influenced by many external factors, such as the degree of anxiety prior to orthodontic treatment . Some of the patients reported that they perceived more of a discomfort than a sharp pain, as evidenced by the fact that none of them needed to take drugs for pain. However, at all times, they reported feeling less pain or discomfort on the side where the laser had been applied than on the control side. This study showed that pain on the laser-irradiated side was significantly less than that on non-irradiated side[7,8,9]. It is also worth noting that the LLLT resulted in favorable pain reduction, as indexed by the VAS scale, without producing any secondary effects in any of the 64 cases.

Orthodontic patients are sometimes given NSAIDs to reduce pain, but these drugs have been shown to decrease the rate of tooth movement[10] . Use of low-laser power density treatments (i.e., phototherapy, LLLT) in orthodontic treatments can reduce treatment time , pain and discomfort in a noninvasive manner, removing the need for anti-inflammatory drugs[11].

VI. Conclusions

The. Pain intensity was significantly lower in the laser-treated quadrant than in the control side. Peak discomfort was documented 6–24 h after elastic separator placement, and pain intensity began to be reduced 48 h post-treatment.pain intensity was less with kesling separator than elastic separator. Application of LLLT radiation using a AlGaAs at the infrared wavelength of 830 nm promoted pain reduction after orthodontic movement caused by placement of elastomeric and kesling separators ,and can be a clinically relevant alternative, because it Is a non-invasive method with no adverse effects noted.

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Figures

Figure - 1

Figure - 2

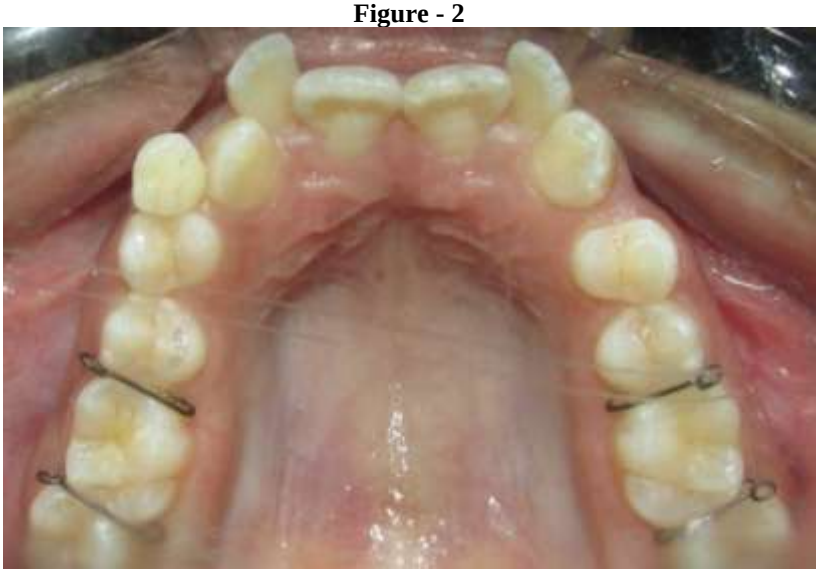

Figure - 3

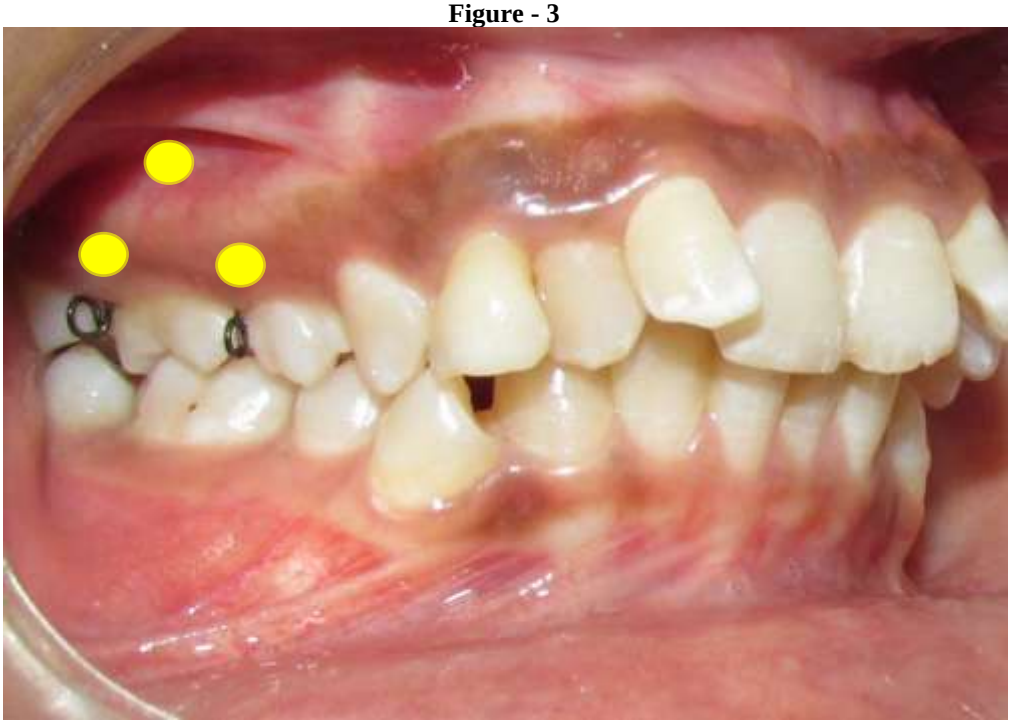

Figure - 4

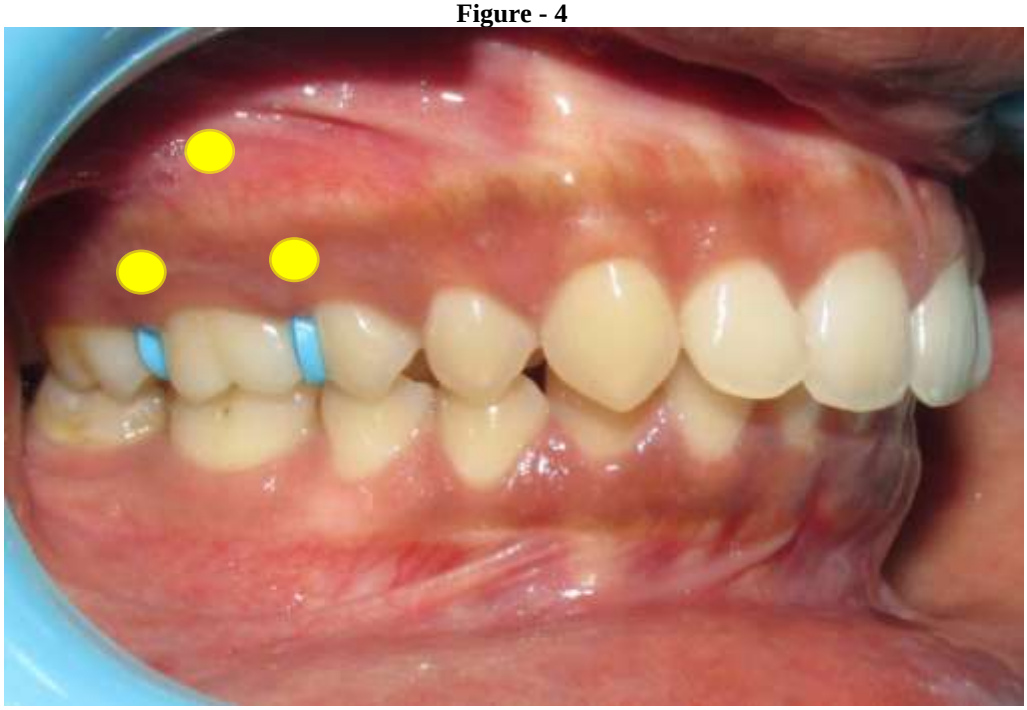

Figure – 5

Figure – 6

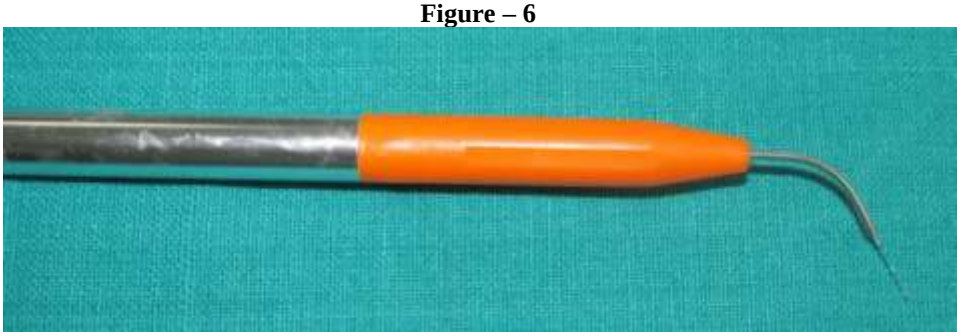

Figure - 7

Figure – 8

Tables

TABLE – 1

Separator = ES

Wilcoxon Signed Ranks Test : Comparison between case and control group

Group	Time	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
						Lower Bound	Upper Bound		
Experiment	Pre Treatment	32	.0000	.00000	.00000	.0000	.0000	.00	.00
	5 min	32	.8125	.64446	.11392	.5801	1.0449	.00	2.00
	6 hrs	32	.9688	.69488	.12284	.7182	1.2193	.00	2.00
	24 hrs	32	1.2812	.95830	.16941	.9357	1.6268	.00	4.00
	48 hrs	32	1.5000	1.13592	.20080	1.0905	1.9095	.00	6.00
	72 hrs	32	1.2500	.87988	.15554	.9328	1.5672	.00	3.00
Control	Pre Treatment	32	.0000	.00000	.00000	.0000	.0000	.00	.00
	5 min	32	1.2500	.67202	.11880	1.0077	1.4923	.00	2.00
	6 hrs	32	1.8125	.78030	.13794	1.5312	2.0938	.00	3.00
	24 hrs	32	2.4375	1.13415	.20049	2.0286	2.8464	.00	5.00
	48 hrs	32	2.9375	1.31830	.23304	2.4622	3.4128	.00	5.00
	72 hrs	32	3.0000	1.34404	.23760	2.5154	3.4846	.00	5.00

	Pre Treatment - Pre Treatment	5 min - 5 min	6 hrs - 6 hrs	24 hrs - 24 hrs	48 hrs - 48 hrs	72 hrs - 72 hrs
Z	.000	-2.841	-4.396	-4.401	-4.595	-4.749
p-value	1.000	.005	.000	.000	.000	.000

TABLE – 2

Separator = KS

Wilcoxon Signed Ranks Test : Comparison between case and control group

Group	Time	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
						Lower Bound	Upper Bound		
Experiment	Pre Treatment	32	.0000	.00000	.00000	.0000	.0000	.00	.00
	5 min	32	.2188	.42001	.07425	.0673	.3702	.00	1.00
	6 hrs	32	.2188	.49084	.08677	.0418	.3957	.00	2.00
	24 hrs	32	.3438	.54532	.09640	.1471	.5404	.00	2.00
	48 hrs	32	.5625	.61892	.10941	.3394	.7856	.00	2.00
	72 hrs	32	.6562	.65300	.11544	.4208	.8917	.00	2.00
Control	Pre Treatment	32	.0000	.00000	.00000	.0000	.0000	.00	.00
	5 min	32	.7812	.65915	.11652	.5436	1.0189	.00	2.00
	6 hrs	32	.9062	.68906	.12181	.6578	1.1547	.00	2.00
	24 hrs	32	1.3125	1.02980	.18204	.9412	1.6838	.00	4.00
	48 hrs	32	1.6562	1.18074	.20873	1.2305	2.0820	.00	4.00
	72 hrs	32	1.6562	1.23417	.21817	1.2113	2.1012	.00	4.00

	Pre Treatment - Pre Treatment	5 min - 5 min	6 hrs - 6 hrs	24 hrs - 24 hrs	48 hrs - 48 hrs	72 hrs - 72 hrs
Z	.000	-4.025	-4.300	-4.520	-4.448	-4.138
p-value	1.000	.000	.000	.000	.000	.000

TABLE - 3
Non Parametric Test : Mann-Whitney Test

Experiment Group : Comparison between two separators

Separators	Time	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
						Lower Bound	Upper Bound		
ES	Pre Treatment	32	.0000	.00000	.00000	.0000	.0000	.00	.00
	5 min	32	.8125	.64446	.11392	.5801	1.0449	.00	2.00
	6 hrs	32	.9688	.69488	.12284	.7182	1.2193	.00	2.00
	24 hrs	32	1.2812	.95830	.16941	.9357	1.6268	.00	4.00
	48 hrs	32	1.5000	1.13592	.20080	1.0905	1.9095	.00	6.00
	72 hrs	32	1.2500	.87988	.15554	.9328	1.5672	.00	3.00
KS	Pre Treatment	32	.0000	.00000	.00000	.0000	.0000	.00	.00
	5 min	32	.2188	.42001	.07425	.0673	.3702	.00	1.00
	6 hrs	32	.2188	.49084	.08677	.0418	.3957	.00	2.00
	24 hrs	32	.3438	.54532	.09640	.1471	.5404	.00	2.00
	48 hrs	32	.5625	.61892	.10941	.3394	.7856	.00	2.00
	72 hrs	32	.6562	.65300	.11544	.4208	.8917	.00	2.00

	Experiment					
	Pre Treatment	5 min	6 hrs	24 hrs	48 hrs	72 hrs
Mann-Whitney U	512.000	258.000	215.000	218.500	233.000	317.500
Wilcoxon W	1040.000	786.000	743.000	746.500	761.000	845.500
Z	.000	-3.870	-4.437	-4.237	-3.972	-2.785
p-value	1.000	.000	.000	.000	.000	.005

TABLE - 4

Control : Comparison between two separators

Separators	Time	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
						Lower Bound	Upper Bound		
EB	Pre Treatment	32	.0000	.00000	.00000	.0000	.0000	.00	.00
	5 min	32	1.2500	.67202	.11880	1.0077	1.4923	.00	2.00
	6 hrs	32	1.8125	.78030	.13794	1.5312	2.0938	.00	3.00
	24 hrs	32	2.4375	1.13415	.20049	2.0286	2.8464	.00	5.00
	48 hrs	32	2.9375	1.31830	.23304	2.4622	3.4128	.00	5.00
	72 hrs	32	3.0000	1.34404	.23760	2.5154	3.4846	.00	5.00
KB	Pre Treatment	32	.0000	.00000	.00000	.0000	.0000	.00	.00
	5 min	32	.7812	.65915	.11652	.5436	1.0189	.00	2.00
	6 hrs	32	.9062	.68906	.12181	.6578	1.1547	.00	2.00
	24 hrs	32	1.3125	1.02980	.18204	.9412	1.6838	.00	4.00
	48 hrs	32	1.6562	1.18074	.20873	1.2305	2.0820	.00	4.00
	72 hrs	32	1.6562	1.23417	.21817	1.2113	2.1012	.00	4.00

	Control					
	Pre Treatment	5 min	6 hrs	24 hrs	48 hrs	72 hrs
Mann-Whitney U	512.000	330.000	203.500	230.500	234.500	235.500
Wilcoxon W	1040.000	858.000	731.500	758.500	762.500	763.500
Z	.000	-2.675	-4.408	-3.913	-3.810	-3.796
p-value	1.000	.007	.000	.000	.000	.000