# 27 - EFFECTS OF ELECTROMAGNETIC FIELDS EMITTED BY MATTRESS IN SCIATICA EXPERIMENTAL MODEL

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## INTRODUCTION

Low back pain is the most frequent reason for work absence (GONZALEZ-HIDALGO, 2006, Brox et al., 2006) causing serious socio-economic problems (WYNNE-JONES, DUNN, MAIN, 2008). About 35% of patients with low back pain, develop a framework of sciatica (MORÁN, 2001). This can be regarded as a painful syndrome, in which pain is perceived at the lower limb, in the absence of any local disturbance (NORTH et al., 1996).

The sciatica occur due to sciatic nerve compression, and the disc herniation is the most common cause, in addition, we can mention: degenerative processes, infections, traumatic hip dislocations, congenital anomalies (Dosan et al. 2004 ) piriformis syndrome (ROSSI et al., 2001) among others. Symptoms include low back pain and along of the nerve path, sensory disturbances and lower limb muscles weakness, innervated by the sciatic (KOBAYASHI, YOSHIZAWA, YAMADA, 2004).

The sciatica deleterious effects may have high morbidity due to poor results of the conservative treatments. In most cases, refers to therapeutic intervention with analgesics, anti-inflammatories and physical therapy resources (SHABBAT et al., 2007) and with the failure of the conservative treatment, surgery can occur (COX, 2002).

Extremely low electromagnetic fields are present in the environment, of natural origin (storms, lunar and solar variations) and man-made sources. These fields induce electric currents in tissues, which remain within plans. In addition, several side events may occur that involve biochemical and structural changes at the cellular and subcellular level. Currently, there is evidence that these fields do not produce cytogenetic changes and are not directly mutagenic, but studies evaluating residences and occupations electromagnetic fields in the face of increased risks of abortion and cancer are contradictory; only in relation to childhood leukemia appears to be strong evidence when exposed to fields above 0.4 μT. However, a growing body of evidence indicates that current pericellular, set by the fields, can alter the ion transport of macromolecules by membrane and influence interactions on the cell surface. Thus, low frequency fields are used in medical treatments, including stimulation of fractures healing (TENFORDE, 1992, AHLBOM et al. 2001; FEYCHTING; AHLBOM; KHEIFETS, 2005; LEO et al., 2009).

For the model of sciatic compression created by Bennett and Xie (1988), there is the symptoms reproduction observed in humans, as it gives the possibility to evaluate the use of resources in order to alter the symptoms in sciatica cases, like the low intensity electromagnetic fields, verifying the pain evolution by analyzing the march times.

Thus, the objective of this study was to assess pain in animals subjected to a sciatica experimental model, and kept on mattresses with emission of electromagnetic field.

## MATERIALS AND METHODS

### Experimental Groups

• This study used 24 Wistar adult male rats, obtained at the Central Vivarium of the Paraná West State University, weighing 377.60 ± 24.78 g, and age 14 ± 2 weeks, kept in photoperiod 12 h, with water and food ad libitum. The animals were randomly divided into three groups:

• G1 (n=8) – submitted to sciatica and kept in standard plastic cage (control);

• G2 (n=8) – submitted to sciatica and kept in plastic cage based on sepilho and mattress;

• G3 (n=8) – submitted to sciatica and kept in plastic cage based on sepilho and mattress emitting electromagnetic Field.

The project was conducted according to international standards of ethics in animal experiments (ANDERSEN et al., 2004).

### Sciatica Experimental Model

The animals were anesthetized with intramuscular injection of ketamine (0.1 mL/100 g) and xylazine (0.1 mL/100 g) intraperitoneally. After shaving, the site of the surgical procedure, there was an incision parallel to the biceps femoris fibers of the animal right thigh, exposing the sciatic nerve. Following the original model described by Bennett and Xie (1988), was carried out around the compression of the sciatic nerve in four distinct regions along the same, with a distance of approximately 1 mm from each other, using catgut wire chrome 4.0, with purpose of reproducing chronic pain in the same path, then the suture was carried out by planes.

### Functional Disability Test

The test was characterized primarily by a metal cylinder in motion, and a computer program with connection to a metal boot adapted to the animal's paw, originally described by Tonussi and Ferreira (1992).

The animals walked on the cylinder, of approximately 30 cm in diameter covered with stainless steel screen, which by means of an electric motor performed 3 rpm. In the animals hind limbs were adapted boots, made with metal, which led to information of the right paw, through a wire, to a computer, which has a program that shows the paw elevation time (PET) of the animal walking on the cylinder in one minute; the left hind limb was also kept connected to a boot, but without input information into the computer.

The experiment was started with the animals training on the cylinder, the next day were recorded PET values of the normal gait. Then there was the surgery of the sciatic nerve compression, revaluations occurring in the 3rd, 4th and 8th days after surgery. Normally animals, without changes, exhibit in their march to maintain the paw in the air about 10 seconds, and animals with pain have longer periods of PET (CUNHA et al., 2008).

### Aplication of the Electromagnetic Field

To achieve the electromagnetic Field, it was used in G3 a mattress, adapted to the cage size, with emitting low intensity electromagnetic field, similar to those used by humans (NewMicrons ®) (fig 1). To evaluate the intensity of the electromagnetic field, we used an electromagnetic field meter digital, model DRE 010, positioned on the mattress, which showed field of 2.5 mG. Thus, the animals soon after the surgical procedure to induce sciatica started using the transmitter mattress as a

therapy form (fig 2). G2 was also used mattress similar, however, there was no emission of electromagnetic field (fig 3). And for G1, the animals were still using as a kind of bed just shavings.

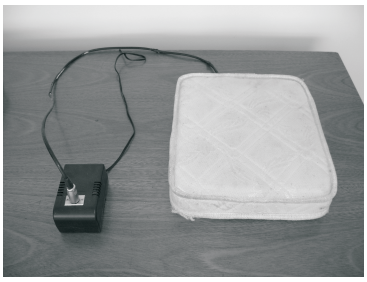

Figure – mattress with the electromagnetic field, adapted to the size of the animals cage.

Figure – mattress emitting electromagnetic field coupled to the animals cage, covered with shavings.

Figura – mattress without producing electromagnetic field, adapted to the animals cage.

Statistical Analysis

The results were expressed by descriptive statistics (mean and standard deviation) and analyzed by inferential statistics, analysis of variance (ANOVA) with repeated measures for comparison within groups, and ANOVA one-way with post-hoc of Tukey for comparison between the groups, the level of significance was $\alpha = 0.05$.

**RESULTS**

The results showed that all groups showed a significant PET increase, when comparing the moment pre-injury, with the time after the sciatica induction (3rd PO day). When comparing the time pre-sciatica with the 4th postoperative day, there was a significant difference only for G3. And to make the comparison with the 8th PO, only G1 had a significant difference (fig 4). By comparing the values obtained on the 3rd postoperative day, with 4th and 8th PO days, decreased significantly for both G2 and in G3 (fig. 4).

In the comparison between groups, at no time there was a significant difference between them.

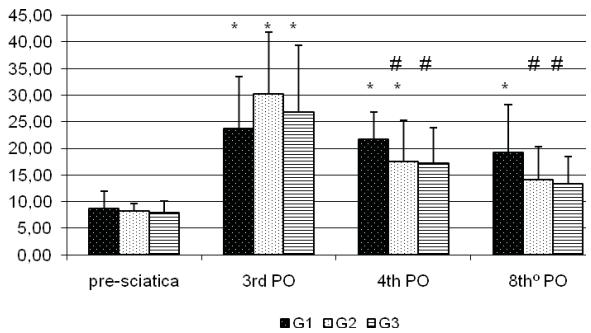


Figure – PET values for groups G1 (control), G2 (mattress sham) and G3 (mattress with electromagnetic field). * Significant difference when comparing with the time pre-sciatica. # Significant difference when comparing with the 3rd postoperative day.

**DISCUSSION**

Despite the well documented efficacy in short-term antiinflammatory pharmacotherapy, antiinflammatory drugs directly interfere with the healing. Furthermore, the literature reports over 15,000 deaths per year among patients with prescription NSAIDs, because its side effects (ODELL; SORGNARD, 2008). Therefore, other forms of treatment for inflammatory disorders such as sciatica, given shape, such as low level laser therapy (CUNHA et al., 2008) and therapeutic ultrasound (CIENA et al., 2009).

Since the low frequency electromagnetic fields, despite the literature disagreement, can produce harmful effects such as childhood leukemia and other cancers, the International Commission on Non-Ionizing Radiation calls to 60 Hz, exposure until 83 μT. For this reason, the present study we used the electromagnetic field with low intensity, ie, 2.5 mG.

According to Blank (1995), the most energetic radiation "ionizing" and ultraviolet cause cell damage. Lower frequency as microwaves can also cause cells damage. But. the transmission frequencies have benign effects. However, even at high frequencies, there are disagreements, as Arendash et al. (2009) who report beneficial effects of the field with a frequency of 918 MHz, on increasing the memory in knockout mice to develop Alzheimer's.

Electric currents applied to the body, which can be formed by the electromagnetic induction phenomenon (TENFORDE, 1992), may modulate or accelerate inflammatory processes, particularly by modulating the chronic pain. Possible actions include: torsional effect of polarized molecules, pH normalization, cAMP formation and activation, cell membrane repair and stabilization (ODELL; SORGNARD, 2008). One of the possible beneficial effects of low frequency electromagnetic fields is the changes in protein synthesis, which are similar to those after cellular stress. It is also suggested that magnetic fields could have a direct effect on the reactions of electron transfer (BLANK, 1995). In this study the electromagnetic field produced by the mattress, resulting in a significant pain decrease, producing restoration of baseline on the 4th postoperative day, which did not happen to other groups. However, please note that when comparing with the evaluation in 3rd PO, the two groups which used mattress (electromagnetic field and sham) had a significant decrease in the 4th and the 8th postoperative day. This fact is believed, that occurred because of the weight distribution be damped, least irritating the sciatic nerve committed, whereas for the control group there was no such decrease significantly.

Conversely, Prato et al. (1995) report that when using a 60 Hz magnetic field, ranging from 0 to 547 μT, observed a nonlinear reduction response in analgesia (0-547 μT). Since the difference in findings may consist of just the intensity, whereas the one used here was 2.5 mG, which is extremely lower than that used by these authors, and they report that the lowering effect of analgesia occurred at high intensities the magnetic field.

The rating form used in this study proved to be effective in evaluating, in a functional way, the pain of sciatica experimental model (CIENA et al., 2009, CUNHA et al., 2008) and in the present study can be observed, as we mentioned, the control group showed no significant pain reduction, thereby facilitating the analysis of treatment modalities used. Limitations of this study can be cited the fact that the lack of correlation with histomorphometric findings, indicating as subjects for future studies.

**CONCLUSION**

In conclusion, this study showed that the mattress produced pain relief in animals with sciatica experimental model, and when the electromagnetic field was active, the restoration of the PET initial values occurred more quickly.

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**EFFECTS OF ELECTROMAGNETIC FIELDS EMITTED BY MATTRESS IN SCIATICA EXPERIMENTAL MODEL**

**ABSTRACT:**

The sciatica can be regarded as a painful syndrome, in which pain is perceived at the end of the lower limb, and occur due compression of the sciatic nerve. Symptoms include pain and along the path of the nerve, sensory disturbances and muscular weakness. Extremely low electromagnetic fields are present in the environment and are used in health treatments. The aim of this study was to assess pain in animals undergoing an sciatica experimental model, and kept on mattresses with electromagnetic field. Twenty four Wistar rats were divided into three groups: G1 (n = 8) – sciatica and kept in plastic cage (control), G2 (n = 8) – sciatica and mattress without electromagnetic field, G3 (n = 8) – sciatica and mattress emitting electromagnetic field (2.5 mG). The sciatica was induced by sciatic nerve compression, near the belly of the biceps femoris. Pain assessment was performed by the Functional Disability Test, which assesses the paw elevation time (PET) of the animal walking on a metal cylinder, for 1 minute. The evaluations were performed: pre-sciatica, and 3, 4, and 8 days postoperatively. The results showed that all groups showed a significant increase in the PET, the moment when comparing pre-injury, with time after the induction of sciatica (3rd day PO). When comparing the time pre-sciatica with the 4th postoperative day, there was a significant difference only for G3. And to make the comparison with the 8th PO, only G1 had a significant difference. By comparing the values obtained on the 3rd postoperative day, with 4 and 8 days PO, decreased significantly for both G2 and G3. Conclude that the mattress produced pain relief, and when the electromagnetic field was active, the restoration of the initial values of PET occurred more quickly.

**KEYWORDS:** sciatic neuropathy, magnetic field therapy, pain.

**EFFETS DES CHAMPS ÉLECTROMAGNÉTIQUES ÉMIS PAR LES MATELAS MODÈLE EXPÉRIMENTAL DE LA SCIATIQUE**

**RÉSUMÉ:**

La douleur sciatique peut être considérée comme un syndrome douloureux, où la douleur est perçue à l'extrémité du membre inférieur, et avec la compression du nerf sciatique. Les symptômes comprennent la douleur et le long du trajet du nerf, troubles sensoriels et de faiblesse musculaire. Extrêmement faibles champs électromagnétiques sont présents dans l'environnement et sont utilisés dans les traitements pour la santé. L'étude était d'évaluer la douleur chez les animaux subissant un modèle expérimental de douleur sciatique, et conservés sur des matelas à l'émission de champ électromagnétique. 24 rats Wistar ont été divisés en trois groupes: G1 (n = 8) - sciatique et maintenus en cage en plastique (de contrôle), G2 (n = 8) - sciatique et matelas sans problème, G3 (n = 8) - La sciatique matelas et émettant un champ électromagnétique (2,5 mg). La douleur sciatique est provoquée par la compression du nerf sciatique, près du ventre du biceps fémoral. Evaluation de la douleur a été réalisée par le test de l'incapacité fonctionnelle, qui évalue le temps broncher (TEP) de l'animal errant sur un cylindre métallique, pendant 1 minute. Les évaluations ont été effectuées: la pré-sciatique, et 3, 4, et 8 jours après l'opération. Les résultats ont montré que tous les groupes ont montré une augmentation significative de la PTE, le moment où la comparaison avant l'accident, avec le temps après l'induction de la sciatique (3ème jour PO). Lorsque l'on compare l'époque pré-sciatique avec le 4 e jour post-opératoire, il y avait une différence significative que pour le G3. Et pour faire la comparaison avec le PO 8 e, seuls G1 avait une différence significative. En comparant les valeurs obtenues sur le 3e jour post-opératoire, avec 4 et 8 jours PO, a diminué sensiblement pour les deux G2 et G3 pour. Conclure que le matelas produit soulagement de la douleur, et lorsque le champ électromagnétique a été actif, la restauration de la valeur initiale de TEP est survenue plus rapidement.

**MOTS-CLÉS:** neuropathie sciatique, la thérapie de champ magnétique, de la douleur.

**EFECTOS DE LOS CAMPOS ELECTROMAGNÉTICOS EMITIDOS POR COLCHÓN EM MODELO EXPERIMENTAL DE LA CIÁTICA**

**RESUMEN:**

El dolor ciática puede ser considerado como una síndrome dolorosa en que el dolor se percibe al final de la extremidad inferior, y con la compresión del nervio ciático. Los síntomas incluyen dolor y por el camino de los nervios, alteraciones sensoriales y debilidad muscular. Extremadamente bajos campos electromagnéticos están presentes en el medio ambiente y se utilizan en tratamientos para la salud. El objetivo fue evaluar el dolor en los animales sometidos a un modelo experimental de dolor ciático, y mantenerse en los colchones con la cuestión de los campos electromagnéticos. Veinticuatro ratas Wistar se dividieron en tres grupos: G1 (n = 8) – ciática y se mantienen en jaulas de plástico (control), G2 (n = 8) – ciática y el colchón, sin emisores, G3 (n = 8) – ciática colchón y emisores de campos electromagnéticos (2,5 mG). El dolor ciático fue inducida por la compresión del nervio ciático, cerca del vientre del bíceps femoral. La evaluación del dolor se realizó mediante la prueba de la incapacidad funcional, que evalúa el tiempo de pestañear (TEP) de los animales errantes en un cilindro metálico, por 1 minuto. Las evaluaciones se realizaron: pre-ciática, y 3, 4, y 8 días después de la operación. Los resultados mostraron en todos los grupos un aumento significativo en el TEP, en el momento cuando se comparan antes de la lesión, con el tiempo

después de la inducción de la ciática (3º día PO). Al comparar la época pre-ciática con el día de la 4ª postoperatorio, hubo una diferencia significativa sólo para G3. Y para hacer la comparación con el PO, el 8º, sólo G1 había una diferencia significativa. Al comparar los valores obtenidos en el día de la 3ª postoperatorio, con 4 y 8 días PO, disminuyó significativamente, tanto para el G2 y G3. La conclusión de que el colchón producido el alivio del dolor, y cuando el campo electromagnético se activa, la restauración de los valores iniciales de TEP se produjo con mayor rapidez.

**PALABRAS-CLAVE:** neuropatía ciática, terapia de campo magnético, dolor.

**EFEITOS DO CAMPO ELETROMAGNÉTICO EMITIDOS POR COLCHÃO EM MODELO EXPERIMENTAL DE CIATALGIA**

**RESUMO:**

A lombociatalgia pode ser considerada como uma síndrome dolorosa referida, na qual a dor é percebida na extremidade do membro inferior, devendo-se a compressão do nervo isquiático. Os sintomas incluem dor lombar e ao longo do trajeto do nervo, distúrbios sensoriais e fraqueza muscular. Campos eletromagnéticos extremamente baixos estão presentes no ambiente e são empregados em tratamentos na área da saúde. O objetivo do estudo foi avaliar a dor em animais submetidos a um modelo experimental de ciatalgia, e mantidos em colchões com emissão de campo eletromagnético. Foram utilizados 24 ratos Wistar, divididos em três grupos: G1 (n=8) – ciatalgia e mantidos em gaiola de plástico (controle); G2 (n=8) – ciatalgia e colchão sem emissão; G3 (n=8) – ciatalgia e colchão emitindo campo eletromagnético (2,5 mG). A ciatalgia foi induzida por meio de compressão do ciático, próximo ao ventre do bíceps femoral. A avaliação da dor foi realizada pelo Teste de Incapacidade Funcional, que avalia o Tempo de Elevação da Pata (TEP) do animal deambulando sobre um cilindro metálico, durante 1 minuto. As avaliações ocorreram: pré-ciatalgia, e 3º, 4º, e ao 8º dias de pós-operatório. Os resultados apontaram que em todos os grupos houve aumento significativo do TEP, ao comparar o momento pré-lesão, com o momento após a indução de ciatalgia (3º dia PO). Ao comparar o momento pré-ciatalgia com o 4º dia PO, não havia diferença significativa apenas para G3. E ao realizar a comparação com o 8º PO, apenas G1 mantinha diferença significativa. Ao comparar os valores obtidos no 3º dia PO, com o 4º e 8º dias PO, houve redução significativa tanto para G2 quanto para G3. Conclui-se que o colchão produziu diminuição da dor, sendo que quando o campo eletromagnético estava ativo, a restauração dos valores iniciais, do TEP, ocorreu mais rapidamente.

**PALAVRAS-CHAVE:** neuropatia ciática, terapia de campo magnético, dor.

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