

Kinesthetic Evaluation of Surgical Interventions To Improve Physiologic Performance

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Abstract

Background: The evaluation of rat movement patterns is pertinent when studying the particular influence an injury may have on ambulation. Previous studies have found that these animals will alter their load-bearing away from the injured limb. Change also occurs in the stride width between the immobilized limb and the opposite hind limb. The Functional indices for print length (PL), distance between first and fifth digits or toe spreading (TS), distance between second and fourth digits or intermediary toes (IT), and toe to opposite foot (TOF), was determined for each of the experimental groups. The focus of the present study was to evaluate ambulatory function throughout the healing period and to compare results to presurgical ambulatory function following the experimental interventions; laser induced gastrocnemius lacerations versus cold knife as well as the effect of exogenous nerve growth factor (NGF) injections into the muscle wound.

Methods: The research used thirty two 300g male Sprague Dawley rat subjects.

<u>Experimental Groups:</u>	<u>Number of Animals in Group</u>
Group A: CO2 Laser incisions; (without NGF)	8
Group B: CO2 Laser incisions; with added NGF	8
Group C: Cold knife incision; (without NGF)	8
Group D: Cold knife incision; with added NGF	8

Pre and post-operatively, gait analyses criteria were used to assess recovery of limb movement using a custom designed tunnel apparatus that contained a bromophenol blue paper walkway to capture the foot prints of each rat. An analysis of variance was applied to compare changes from baseline values among and within the experimental groups over time.

Preliminary Results: Preoperatively, differences in functional indices among the experimental groups were not significant ($p > .05$) when using the value of $p < .05$ for statistically significant data. Significant improvements (return towards baseline values) were found for the following parameters/groups. For the parameter, PL, from pre-surgical values to the final observation (Day 35), Group B (laser incision with added NGF) was shown to have the closest return to its preoperative baseline (i.e. most complete healing); Group D (cold knife incision with added NGF) was found to have the next closest return to its preoperative baseline for the parameter, PL. Group C (cold knife without added NGF) showed the least amount of healing with respect to baseline for the PL parameter. A similar pattern of healing was demonstrated for two other measured parameters; TS and IT. The functional indices for these last two parameters indicated a value which exceeded the pre-surgical value. The TOF and SS indices showed changes from pre-surgical values that were not consistent with the measurements obtained for the other indices.

Discussion: Additional exogenous growth factor was the most important surgical intervention when analyzing physiological performance after injury. Group B (laser incision and added NGF) returned towards pre-surgical values earlier than the other experimental groups as indicated by measurements of PL, TS, IT. When ranking the healing towards baseline by treatment, the following relationship was found; Group B > Group D > Group A > Group C. Additional analyses are underway to examine the significance of indices that showed changes that exceeded presurgical values. For example, TOF reflects the stride length during ambulation which increased beyond pre-surgical values by Day 35. This observation needs to be examined more closely as it may reflect an adaptation related to healing. Similar considerations for SS need to be addressed. The experiment showed that utilizing both the CO2 laser for incision and additional growth factor postoperatively improved the physiological performance of a muscle over a shortened healing time.