Clinical Effectiveness of Continuous Passive Motion (CPM) Following Hip Surgery in Children

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INTRODUCTION:
The clinical concept of continuous passive motion (CPM) is based on the premise that post-operative stiffness in a joint can be avoided if full range of motion is applied to the joint immediately following surgery, and is continued until the joint is no longer at risk of developing stiffness. This study hypothesizes that use of CPM following femoroacetabular impingement (FAI) surgery in the pediatric population improves clinical outcomes in terms of modified Harris Hip Score (mHHS). This study further hypothesizes that usage of CPM decreases the length of stay in the hospital (LOS), number of physical therapy (PT) visits, and the number of physician (MD) visits.

METHODS:
Study Design. This study used a non-experimental, retrospective design to compare three groups of patients that underwent FAI surgery. The groups were determined based on their use of post-operative CPM. Groups were evaluated based on the clinical effectiveness of CPM in terms of mHHS, as well as CPM’s impact on utilization of other healthcare services. The mHHS was determined by the attending physician as described below.

Sample. All patients that underwent FAI surgery by a fellowship trained, pediatric orthopedic surgeon between July 2009 and September 2010 were part of a single pediatric hospital. There were 29 total patients in this study. All patients self-selected into one of three groups determined primarily by their ability to pay for CPM. The groups consisted of a control (no CPM) and two intervention groups. The intervention groups were based on the amount of CPM utilized. One group used two days of CPM (2day) and the other group used two weeks of CPM (2week).

Analytical Process. All analyses for this study were performed using SPSS (Version 14.1.2, Microsoft, Redmond, Washington, USA) and Excel (Version 12.0.1, IBM, Armonk, New York, USA) and Excel. Descriptive analysis was performed to determine demographic variation as well as the mean and median values for the mHHS, LOS in the hospital, PT visits, and MD visits that each group consumed.

Kruskal-Wallis (KW) analysis was performed to determine statistical differences in mHHS, LOS in the hospital, PT visits, and MD visits for each group. The KW test compared the mean ranks of each group.

RESULTS:
Descriptives. Twenty-nine pediatric patients were divided into a control and two intervention groups. The control group consisted of eight patients. The 2day group had six patients, and the 2week group had 15 patients. The average patient age was 15 years, 2 months (range = 11 years, 4 months to 18 years, 8 months). Sixty-two percent of patients were male, 38% were female.

CPM Effect on Clinical Outcomes. Pre-op. There was not a statistically significant difference in hip scores among the three groups pre-operatively (p = 0.158). The mean pre-op hip score was 82.9±6.4 for the control; 84.3±3.6 for 2day; and 79.2±6.3 for 2week. The median pre-op hip score was 86.0 for the control, 83.5 for 2day, and 79.0 for 2week.

6 weeks post-op. There was a statistically significant difference in hip scores among the three groups at six weeks post-op (p < 0.001). The mean hip score at six weeks post-op was 87.6±4.5 for the control; 91.1±1.9 for 2day; and 94.8±2.0 for 2week. The median hip score at six weeks post-op was 89.0 for the control, 90.5 for 2day, and 95.0 for 2week. At six weeks post-op we begin to see that the two CPM groups are showing higher mHHSs.

3 months post-op. There was a statistically significant difference in hip scores among the three groups at three months post-op (p < 0.001). The mean hip score at three months post-op was 91.6±3.2 for the control; 96.8±2.4 for 2day; and 99.4±1.3 for 2week. The median hip score at three months post-op was 92.0 for the control, 98.0 for 2day, and 100.0 for 2week. At three months post-op both CPM groups are doing better than the control and the 2week group has an average mHHS above 99.

6 months post-op. There was a statistically significant difference in hip scores between the three groups at six months post-op (p < 0.001). The mean hip score at six months post-op was 96.4±1.9 for the control; 97.9±2.4 for 2day; and 99.6±1.8 for 2week. The median hip score at six months post-op was 96.7±2.0 for the control; 98.7±2.5 for 2day; and 100.0 for 2week. At six months post op we continue to see that the control group has not caught up to the two CPM groups in terms of mHHS.

9 months post-op. There was a statistically significant difference in hip scores between the three groups at nine months post-op (p < 0.001). The mean hip score at nine months post-op was 97.6±1.2 for the control; 98.6±0.8 for 2day; and 99.8±0.6 for 2week. The median hip score at nine months was 98.0 for the control, 99.0 for 2day, and 100.0 for 2week. At nine months post-op we continue to see an improvement in hip score among the three groups but the control and 2day groups have not caught up to the 2week group. Based on these results we can accept the hypothesis that the use of CPM following FAI surgery in the pediatric population improves clinical outcomes in terms of mHHS.

CPM Effect on Length of Stay (LOS), PT Visits, and MD Visits. There was a statistically significant difference in LOS between the three groups (p = 0.016). The average LOS was 3.6±0.5 days for the control, 2.7±0.5 days for 2day, and 2.7±0.8 days for 2week. The median LOS was four days for the control, three days for 2day, and two days for 2week. The result of this analysis indicates that we can accept the hypothesis that use of CPM following FAI surgery in the pediatric population decreases LOS in the hospital, although there is virtually no difference between the 2day and 2week groups.

There was a statistically significant difference in the number of PT visits utilized between the three groups (p < 0.001). The average number of PT visits utilized was 25±5.1 for the control, 17.1±7±2.6 for 2day, and 8.8±1.8 for 2week. The median number of PT visits was 25 for the control, 16 for 2day, and 8 for 2week. The result of this analysis indicates that we can accept the hypothesis that the use of CPM following FAI surgery in the pediatric population reduces the number of physical therapy visits utilized.

There was a statistically significant difference in the number of MD visits utilized between the three groups (p < 0.001). The average number of MD visits utilized was 6.0±0.5 for the control, 4.7±0.5 for 2day, and 4.2±0.4 for 2week. The median number of MD visits was six for the control, five for 2day, and four for 2week. The result of this analysis indicates that we can accept the hypothesis that the use of CPM following FAI surgery in the pediatric population reduces the number of physician visits utilized.

DISCUSSION:
This study has important limitations related to sample size and its retrospective design. However, in this sample of patients the use of CPM seemed to have a positive impact on clinical outcomes and consumption of other healthcare services such as length of stay, PT visits, and MD visits.

SIGNIFICANCE:
The efficacy of CPM use following hip surgery in children is under-represented in the orthopedic literature. This study points out the benefits of CPM use for this population and may be an important baseline for future studies as well as the treatment decision making process.