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Lumbar Spine Extension Mobility Increases with Longer Participation in Football

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LUMBAR SPINE EXTENSION MOBILITY INCREASES WITH
LONGER PARTICIPATION IN FOOTBALL

by

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Nicole Nord
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Bachelor of Science in Physical Therapy
University of North Dakota, 2004

A Scholarly Project
Submitted to the Graduate Faculty
of the University of North Dakota
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for the degree of
Doctor of Physical Therapy

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2006
This scholarly project, submitted by Matthew Linback, Nicole Nord, and Kari Pedersen in partial fulfillment for the Degree of Doctor of Physical Therapy from the University of North Dakota, has been read by the Faculty Advisor under whom the work has been done and is hereby approved.

Faculty Advisor

Chair, Department of Physical Therapy
PERMISSION

Title    Lumbar Spine Extension Mobility Increases with Longer Participation in Football

Department Physical Therapy

Degree Doctor of Physical Therapy

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Date 12/27/05
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Kari Pedersen
ABSTRACT

Purpose: Football players are known to develop lumbar spine pathologies, especially extension pathologies (i.e., spondylolysis and spondylolisthesis). This study examined the possibility of increased mobility in the lumbar spine with increased exposure to football, possible correlating the increased motion with lumbar spine pathologies. Extension of the lumbar spine in college football players was measured and the results of two groups were compared: those who had completed one or two years of eligibility versus those who had completed three or four years. The influence of the collision nature of football on lumbar extension was examined.

Subjects: Thirty-nine male collegiate football players from the University of North Dakota volunteered to participate in this study.

Instrumentation: Lumbar extension measurements were taken using two inclinometers.

Procedure: The inclinometers were placed on the spinous process of $T_{12}$ and $S_{1-2}$. Lumbar extension for each subject was measured 3 times and a mean value was taken for use in statistical analysis.

Data Analysis: Using an independent samples T-test, a significant difference ($p \leq .05$) was found in lumbar extension measurements between first- and second-year players ($N = 15$) versus third- and fourth-year players ($N = 24$).
Conclusion and Clinical Implications: Third- and fourth-year collegiate football players demonstrated more lumbar extension range of motion versus first- and second-year players, supporting the hypothesis that lumbar extension increases with the amount of participation in playing football. Since research implies that longevity in football leads to an increased incidence of lumbar pathology, there may be a correlation between this incidence and the increased mobility that tends to develop over time with participation.
CHAPTER I

LITERATURE REVIEW

Introduction

It has been well documented that participation in American tackle football at any level can lead to injury. Due to the high velocity collisions, as well as twisting, turning, and pulling of limbs and body segments, many uncommon forces are placed on the body while participating in this sport. Many studies have been conducted investigating the results of these forces on body segments with most focusing on joint injuries, such as sprains and strains of ankles, knees, and the vertebral column.¹ The focus of this study is to examine the results of these high velocity collisions as they relate to extension of the lumbar spine.

When applied with great force, repeated hyperextension of the lumbar spine may lead to excessive mobility. This excessive mobility may lead to immediate injury or injuries that develop over time as a result of repeated hyperextension of the vertebral bodies and stretching of the stabilizing ligaments of the lumbar spine.

This review includes studies that focus on the incidence of injuries to the lumbar spine. This review includes studies that focus on the incidence of injuries to the lumbar spine sustained while playing football, the forces placed on the body that may lead to structural changes and injury, and some of the long-term effects that may occur because of these injuries.
After reviewing the literature surrounding injuries of the lumbar spine, both immediate and long-term, the most common injuries to this region found in multiple studies were spondylolysis, spondylolisthesis, herniated nucleus pulposus, disc space narrowing, spinal instability, and various degrees of lumbosacral strain. However, these studies have not addressed the relationship between increased lumbar range of motion and the possible incidence of various spinal pathologies; therefore, it was the intent of this project to examine the potential relationship between level of participation in football and increased lumbar spine mobility.

Background

Anatomy of Lumbar Spine

The vertebrae of the lumbar spine do not have any bony connections to each other or to other structures to provide stability. Therefore, the lumbar spine is reliant on the spinal ligaments (anterior and posterior longitudinal ligaments), deep and superficial spinal muscles, and lumbosacral fascia for external support.

In one study, the posterior longitudinal ligament (PLL) was dissected to obtain a better understanding of its insertion sites and the support it provided to the lumbar spine. It was discovered that the PLL has two layers, superficial and deep. Lateral fibers are attached to the annulus fibrosus and to the rim of the adjacent vertebrae. Medial fibers are attached additionally to the posterior wall of the vertebral bodies by bridging the foramina. Since these foramina become enlarged in the lower segments of the vertebral column, the number of
attachment points at the posterior wall of the vertebral bodies decrease caudally.\textsuperscript{6} This places more caudal segments of the lumbar spine at increased risk of injury due to an increase in the lack of support.

Excessive movements can cause the ligaments and joint capsules of the lumbar spine trauma. The ligaments and joint capsules provide some support and help with controlled joint movements.\textsuperscript{5}

Muscle contusions and sprains to the lumbar spine are commonly reported. When the muscle becomes injured, they are unable to function as they could prior to the injury. This causes the vertebral segments to be susceptible to shear, torsional, tensile, and compressive forces.\textsuperscript{5} The paravertebral musculature is prone to heightened tissue tension or spasm from direct blows.

During flexion, the ligament having the greatest amount of stress is the PLL. For extension and lateral bending, it is the anterior longitudinal ligament (ALL) that has the greatest amount of stress. Body rotation causes stress to the facet capsular ligament, and intersegmental forward rotation stresses the interspinous ligament during flexion.

**Forces Applied to Lumbar Spine**

Many times throughout the course of a football game or practice, the spine is subjected to compressive, shear, and lateral bending loads of large magnitude. Many of these forces are applied to the body throughout the course of everyday life, but it is the large magnitude of these forces that can lead to structural changes and damage to the supporting structures of the lumbar spine. This dynamic loading pattern places the lumbar spine motion segments at risk of
stress at the laminae\textsuperscript{7} which may be the main reason for the high incidence of low back pain in players with spondylolysis.\textsuperscript{2} Large magnitude forces applied to abnormal movements during football participation can lead to injury and structural damage of the lumbar spine.

As previously mentioned, the spine is subject to many large magnitude forces throughout the course of a football season. The following table provides an example of injuries commonly encountered in football followed by the forces that can cause them.\textsuperscript{5}

Table 1. Spinal Pathologies and Associated Causative Forces

<table>
<thead>
<tr>
<th>Spinal Pathology</th>
<th>Causative Forces</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spondylosis/spondylolisthesis</td>
<td>trunk hyperextension (Hall), repeated and forceful hyperextension (Harvey)</td>
</tr>
<tr>
<td>Disk space narrowing</td>
<td>lifting or loaded forward flexion (Hill)</td>
</tr>
<tr>
<td>Fractures</td>
<td>direct blow (Hall)</td>
</tr>
<tr>
<td>Contusions/strains/sprains</td>
<td>direct blow, forced excessive motion (Hall)</td>
</tr>
<tr>
<td>SI joint dysfunction</td>
<td>trunk rotation in either flexion or extension, fall onto sacrum (Hall)</td>
</tr>
<tr>
<td>Facet joint dysfunction</td>
<td>excessive trunk rotation in either flexion or extension (Hall), repeated and forceful hyperextension</td>
</tr>
</tbody>
</table>

A study of interest related to the magnitudes of the forces applied to the lumbar spine at the L\textsubscript{4-5} segment when hitting a blocking sled found the following: the mean impact force measured at the blocking sled was 3013 ± 598 N.\textsuperscript{7} The mean peak compression force at the L\textsubscript{4-5} motion segment was 8679 ± 1965 N.\textsuperscript{4}
The mean peak anteroposterior shear force was $3304 \pm 1116$ N, and the mean peak lateral shear force was $1709 \pm 411$ N.\textsuperscript{7} The magnitude of the loads on the L\textsubscript{4-5} motion segment during football blocking exceeds those determined during fatigue studies to cause pathologic changes in both the lumbar disk and the pars interarticularis.\textsuperscript{7} These data suggest that the mechanics of repetitive blocking may be responsible for the increased incidence of lumbar spine injury incurred by football linemen.\textsuperscript{7}

**Incidence of Injuries and Abnormalities**

Low back pain is a common presenting symptom among players of American football.\textsuperscript{2} Some studies have focused on the causes of the pain while others have examined the mechanical forces that lead to such reports of low back pain and the long-term effects of these injuries and forces that are placed on the body. Previous studies have shown that football players have an increased number of skeletal abnormalities, such as spondylolysis, spondylolisthesis, Schmorl’s node, disc space narrowing, scoliosis, balloon disc, lumbus vertebrae, Scheuerman’s disease, spina bifida occulta, spinal instability, spurring, facet arthropathy, and apophyseal abnormalities.\textsuperscript{8,9} (See Table 2 for definitions.) Athletes with abnormal radiographic results have a higher frequency of low back pain compared to those with normal radiographs.\textsuperscript{2} In particular, several investigations evaluating the prevalence of spondylolysis and spondylolisthesis in football players have noted rates ranging from 15% to 50%.\textsuperscript{3,10,11}
Table 2. Definitions of Spinal Abnormalities Used When Reading Radiographs

<table>
<thead>
<tr>
<th>Lumbar Spine Abnormality</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transitional vertebrae</td>
<td>The fifth lumbar vertebrae assumes characteristics of the sacral segments with one (incomplete) or both (complete) transverse processes fusing with the first sacral segment. Alternatively, the S₁ vertebral body assumes characteristics of the lumbar vertebrae with one (incomplete) or both (complete) lateral masses forming a transverse process. A rudimentary disc may be present at the L₅-S₁ levels in the above transitions.</td>
</tr>
<tr>
<td>Scoliosis</td>
<td>Lateral curvature of spine in the frontal plane greater than 10° as measured by the methods of Cobb.¹</td>
</tr>
<tr>
<td>Spondylolysis</td>
<td>Defect of the pars interarticularis.</td>
</tr>
<tr>
<td>Spondylolisthesis</td>
<td>Ventral slippage of a vertebral body on another as measured by the Meyerding grading system.⁸</td>
</tr>
<tr>
<td>Schmorl's node</td>
<td>Sharply marginated, sclerotic indentation in the vertebral endplate (secondary to chronic herniation of the nucleus pulposus through the affected endplate).</td>
</tr>
<tr>
<td>Balloon disc</td>
<td>More than 20% reduction in middle vertebral height compared with anterior and posterior vertebral height above or below affected disc.</td>
</tr>
<tr>
<td>Limbus vertebrae</td>
<td>separate, sclerotic, triangular ossicle adjacent to but separate from the vertebral endplate. The affected endplate contains an adjacent, irregular, focal, sclerotic defect (secondary to chronic herniation of disc material through the attachment of the annulus fibrosis).</td>
</tr>
<tr>
<td>Scheuermann's disease</td>
<td>Irregularity of the anterior portion of the endplates of three consecutive vertebral bodies with at least 5° of anterior wedging in each vertebral body.</td>
</tr>
</tbody>
</table>
Table 2. Definitions of Spinal Abnormalities Used When Reading Radiographs
(cont.)

<table>
<thead>
<tr>
<th>Lumbar Spine Abnormality</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spina bifida occulta</td>
<td>Congenital defect in the posterior elements of the vertebral column.</td>
</tr>
<tr>
<td>Disc space narrowing</td>
<td>More than 20% reduction in affected disc space compared with the disc space above and below. The normal disc space of L₅-S₁ was estimated to be 2/3 that of L₄-₅.</td>
</tr>
<tr>
<td>Spinal instability</td>
<td>The amount of angular or translational displacement on the lateral view determined according to the method of Dupuis et al² was measured in the flexion and neutral positions, and spinal instability was defined as greater when the amount of angulation by flexion was more than 5° and/or the amount of translation by flexion was more than 3 mm.</td>
</tr>
<tr>
<td>Spurring</td>
<td>Osteophyte(s) arising from the anterior or posterior aspect of the affected vertebral endplate.</td>
</tr>
<tr>
<td>Facet arthropathy</td>
<td>Joint space narrowing, subchondral sclerosis or osteophyte formation involving the facet joints of the spine.</td>
</tr>
</tbody>
</table>

In one particular study, the authors, Jun et al,¹ analyzed the relationship between lumbar spine abnormalities viewed through radiographs taken during the pre-participation physical examination and the incidence of low back pain during a one-year period in 742 college and 171 high school football players. Table 3 shows the frequency of prevalent abnormalities in radiographs studied. The main abnormalities found were spondylolysis, disc space narrowing, spinal instability, Schmorl’s node, balloon disc, and spina bifida occulta. Scoliosis,
Table 3. Frequency of Abnormal Radiographs Found

<table>
<thead>
<tr>
<th></th>
<th>% of High School Players (n = 171)</th>
<th>% of College Players (N = 742)</th>
<th>$\chi^2$</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spondylolysis</td>
<td>11.1</td>
<td>10.4</td>
<td>0.080</td>
<td>NS</td>
</tr>
<tr>
<td>Disc space narrowing</td>
<td>7.6</td>
<td>12.4</td>
<td>3.141</td>
<td>NS</td>
</tr>
<tr>
<td>Spinal instability</td>
<td>25.1</td>
<td>30.5</td>
<td>1.887</td>
<td>NS</td>
</tr>
<tr>
<td>Schmorl's node</td>
<td>11.7</td>
<td>10.2</td>
<td>0.312</td>
<td>NS</td>
</tr>
<tr>
<td>Balloon disc</td>
<td>11.7</td>
<td>13.3</td>
<td>0.332</td>
<td>NS</td>
</tr>
<tr>
<td>Spina bifida occulta</td>
<td>20.5</td>
<td>17.7</td>
<td>0.739</td>
<td>NS</td>
</tr>
<tr>
<td>No abnormalities</td>
<td>36.3</td>
<td>39.8</td>
<td>0.715</td>
<td>NS</td>
</tr>
</tbody>
</table>

spondylolisthesis, Scheuermann's disease, and facet arthropathy were not found, and the frequency of transitional vertebrae, limbus vertebrae, and spurring was less than 2.0% for each.¹ Spondylolysis was most frequently observed in the L₅ vertebra (in 89.5% of cases found at the high school level and in 81.8% of cases at the college level), disc space narrowing and spinal instability were most frequently found at the L₄-₅ levels (84.6% and 74.4%, respectively, of high school players; 82.6% and 77.0%, respectively, of college players), Schmorl's node was most frequently observed in the upper lumbar spine, balloon disc was most frequently observed in the lumbar spine, and spina bifida occulta was most frequently observed in the S₁ vertebra.¹ Most cases of disc space narrowing (in 81.8% of high school players and in 84.2% of college players) were combined
with spinal instability, whereas spinal instability was combined much less with
disc space narrowing (in 28.1% of high school players; in 36.8% of college
players). Overall, 109 high school players (61.7%) and 446 college players
(60.2%) had at least 1 of the 6 main skeletal abnormalities. The frequency of the
6 main skeletal abnormalities did not differ between high school and college
players.

With regard to college players, the incidence of low back pain as 49.4% in
players with at least 1 of the 6 main abnormalities, and 32.1% in players with no
such abnormalities. Player with spondylolysis, disc space narrowing, and spinal
instability had a higher incidence of low back pain (80.5%, 59.8%, and 53.5%,
respectively) than those without any of the 6 main abnormalities. Players with
spondylolysis had a higher incidence of low back pain than those with disc space
narrowing or spinal instability, but players with disc space narrowing or spinal
instability had a similar incidence of low back pain. These findings suggest that
there may be a relationship between the reports of low back pain and related
spine injuries.

When comparing college level to high school level of competition, there
are still no clear results as to the number of reported injuries. The incidence of
injury is estimated to be approximately 10 to 15 injuries per 1000 playing hours.
There are, however, great differences among different age groups and skill
levels. Inklaar stated that senior players sustained more injuries than youth
players. The incidence of injuries seems to increase suddenly in the 14- to 16-
year-old age group. Sixteen- to 18-year-old players seem to have an incidence
similar to that of senior players.\textsuperscript{14} The incidence of increased injury to the 14- to 16-year-old age group may be due to an increase in the length of long bones during puberty resulting in longer level arms. This may result in increased force placed on the body during collisions. At these younger ages, muscle strength has not yet developed to a level to stabilize the body during these high impact collisions. Studies regarding different skill levels show contradictory results. Two research groups have reported that high-level players have a higher incidence of injury in games but lower incidence in training sessions than low-level players.\textsuperscript{15-16} Inklaar et al\textsuperscript{17} found that high-level teams have a significantly higher risk of injury than teams at a lower level of play, while Blaser and Aeschlimann\textsuperscript{18} reported just the opposite due to their findings that low-level athletes participated in more games where injuries are more likely to occur. Poulsen et al\textsuperscript{19} found no difference in the injury rate per 1000 hours of practice or games between high-level and low-level football players.

**Possible Causes of Injury Not Related to Mechanical Forces**

The following are possible causes of low back pain that are not due to mechanical forces applied to the spine: growth spurt, poor sporting equipment (lack of protection), improper technique, changes in training intensity or frequency (lack of rest for proper recovery time), leg length inequality (4 mm or more difference), and genetic defects. Decreased strength of the core musculature, inflexibility of the lumbar spine, and tight hamstrings and hip flexor muscles may also cause low back pain.\textsuperscript{20}
Playing football demands weight loading of the spine leading to compression injuries. Excessive motions produced increased tensile stresses on the spinal ligaments. Torque, rotation, and sheer forces can also cause spinal injuries.\(^5\)

It is clear that participants in football are at risk of increased chance of injury to the lumbar spine. It has also been shown that the majority of these injuries result from the repeated high magnitude forces that are applied to the lumbar spine during the course of a game and practice sessions.

However, it is still unclear whether or not there is a link between the level of competition and amount of time spent playing football and its effects on the number or type of injuries incurred. For example, in the study by Jun et al,\(^2\) it was found that by viewing radiographs of high school and college football players, the percentage of those with no spinal abnormalities was higher in college football players when compared to those in high school. Those involved in college football are at a higher level of competition and have also participated in football longer than those at the high school level. This same study also showed that the types of lumbar spine injuries reported were similar at both the high school and college level.

In a study done by Jones et al,\(^21\) it was found that prior to training and competing in Division I football, the athletes had a similar amount of radiographic abnormalities of the lumbar spine as an age-matched control group. These abnormalities included, but were not limited to, spondylolysis and spondylolisthesis. When looking at a study done by McCarroll et al,\(^11\) the rate of
spondylolysis and spondylolisthesis was higher in college football players than in the general populations. The difference in these studies could be due to the fact that Jones et al.\textsuperscript{21} looked at athletes prior to training and competing in college level football and McCarroll et al.\textsuperscript{11} looked at athletes who already had been competing at the college level. The results of these two studies report opposite findings. It is still up for debate as to whether or not the level of competition plays a role in the incidence of reported lumbar spine injury. The one constant found in these and other studies is that high magnitude forces are placed on the lumbar spine and, as a result, can lead to mechanical deformities of lumbar spine structures and injury.
CHAPTER II

METHODS

Subjects

Thirty-nine collegiate football players from the University of North Dakota volunteered to participate in this study. Prior to testing, all subjects were healthy and were informed of the purpose and the testing procedures. Exclusion criteria included the following: any previous spinal surgeries, any current back pathologies, or any known risk factor which prohibited them from fully participating in this study. Each subject read and signed a consent form approved by the University of North Dakota Human Subjects Review Board (see appendix).

Instrumentation

Lumbar extension measurements were taken using the guidelines recommended in the *Guides to the Evaluation of Permanent Impairment* by the American Medical Association. Saur et al as well as Kippers et al researched the reliability and validity of measuring lumbar range of motion using an inclinometer and found this technique to be highly reliable and valid. However, they expressed their concern regarding the need for further refinement of the measurement technique for extension.
The two-inclinometer technique is preferred for measuring lumbar extension. Reading from 0° to 360°, the inclinometer is a fluid-filled compass used to measure a specific range of motion. The two-inclinometer method utilizes two inclinometers to measure the lumbar range of motion. Each device is positioned at different landmarks on the spine and secured. For measuring lumbar extension, the inclinometer is placed on the spinous processes of T₁₂ and S₁₂. When secured in place, each inclinometer marker is reset to 0° with the subject standing in a neutral position. With any movement of the subject, the fluid is displaced with movement of the marker to demonstrate the degree of movement. The two measurements are read and are subtracted giving the researcher a positive reading measured in degrees.

Testing Procedure

Intrarater reliability was established in PT 583, an instrumentation course, prior to conducting this study. All subjects participated in one session of testing which took approximately 15 minutes. After signing the consent form, each subject drew a random number upon entry and this number was the only means of identifying the subject throughout the remainder of the study. Subjects were required to answer questions related to any previous or current back pathologies. Also, height and weight measurements were collected. Subjects removed upper body clothing to allow for accurate marking of spinal landmarks. Subjects were then instructed to perform 3 trials of lumbar extension. Using one researcher, subjects were measured 3 times using the two-inclinometer method. The 3
measurements were recorded and mean value as taken for use in the statistical analysis.

**Marking Protocol**

After removing upper body clothing, the subject was marked with a dot on the spinous processes of T_{12} and S_{1-2} using a marking pen. One of two researchers manually palpated and found the landmark in order to mark the specific spinous processes. All 3 researchers were adequately trained in palpation techniques. Chiarello and Savidge, however, researched and discovered that prior palpation training did not improve measurement techniques for lumbar extension using a fluid goniometer. After one researcher marked the specified landmarks, the third researcher performing the measurements verified the accuracy of the landmarks identified.

**Lumbar Extension Testing Protocol**

Ensink et al. state that “extension lumbar range of motion was shown to be independent of the time of measurement.” Lumbar extension measurements for this present study were done during the football team’s preseason prior to a routine strengthening practice in midafternoon. Lumbar extension measurements were performed according to the American Medical Association’s guidelines.

After the subject was marked on spinous processes T_{12} and S_{1-2}, he was instructed to perform 3 practice trials of extension. Each subject was told to place both hands on hips and stand with feet shoulder width apart. The participant was instructed to bend backwards while attempting to keep legs
straight and pelvis stable. Three trials were completed prior to testing to modulate the large gains obtained through a brief learning period and to allow the subjects to feel comfortable with the movement.

After 3 warm-up trials were completed, the subject approached the third researcher who verified the landmarks and who facilitated compliance of the three trials. Subject was instructed to place hands on hips and stand with feet shoulder width apart. One researcher visually ensured subject was standing with the spine in a neutral position. While placing one fluid inclinometer on each marked spinous process, the inclinometer was zeroed. Once an accurate and secure placement was established, the subject was instructed to bend backwards as far as possible and hole for 1 to 2 seconds before returning to neutral. The measurements were read and recorded by the second researcher. Without moving the fluid inclinometers, two more measurements were taken using the same instructions and procedures as the first trial. Data collected were entered into SPSS Version II, Chicago, III, and an independent samples T-test was run. All variables were normally distributed except in group 1 in which the height distribution was slightly platykurtic due to smaller sample size and a large range of heights.
CHAPTER III

RESULTS

A total of 39 subjects were divided into 2 groups for this study. Group 1: players who had completed their first or second year of eligibility (N = 15). Group 2: players who had completed their third or fourth year of eligibility (N = 24).

When comparing the two groups, the following results were found:

• There was no significant difference in height between groups (t(37) = -.531, p = .598).
• There was no significant difference in weight between groups (t(37) = -.230, p = .819).
• There was a significant difference in lumbar spine extension between groups (t(37) = -2.065, p = .046).
• Lumbar spine extension ROM was greater by 4.55° for players in group 2. (See Tables 4 and 5)
Table 4. Independent Samples Test (t-test for equality of means)

<table>
<thead>
<tr>
<th></th>
<th>t</th>
<th>df</th>
<th>Sig. (2-tailed)</th>
<th>Mean Difference</th>
<th>Std. Error Difference</th>
<th>95% Confidence Interval of the Difference Lower</th>
<th>95% Confidence Interval of the Difference Upper</th>
</tr>
</thead>
<tbody>
<tr>
<td>Height (inches)</td>
<td>-0.531</td>
<td>37</td>
<td>0.598</td>
<td>-0.4417</td>
<td>0.83107</td>
<td>-2.12557</td>
<td>1.24224</td>
</tr>
<tr>
<td>Weight (pounds)</td>
<td>-0.230</td>
<td>37</td>
<td>0.819</td>
<td>-3.2417</td>
<td>14.07146</td>
<td>-31.75316</td>
<td>25.26983</td>
</tr>
<tr>
<td>LS spine extension (deg)</td>
<td>-2.065</td>
<td>37</td>
<td>0.046</td>
<td>-4.5527773</td>
<td>2.29445223</td>
<td>-9.019422</td>
<td>-0.08613275</td>
</tr>
</tbody>
</table>
Table 5. Group Characteristics of Height, Weight, and Lumbar Spine Extension Range of Motion

<table>
<thead>
<tr>
<th>Study Group</th>
<th>Height in Inches</th>
<th>Weight in Pounds</th>
<th>LS Spine Ext. in Degrees</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Year 1 or 2</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>N</td>
<td>15</td>
<td>15</td>
<td>15</td>
</tr>
<tr>
<td>Mean</td>
<td>73.2667</td>
<td>238.4667</td>
<td>30.377777</td>
</tr>
<tr>
<td>Std. Deviation</td>
<td>2.73774</td>
<td>44.66041</td>
<td>7.54338430</td>
</tr>
<tr>
<td>Minimum</td>
<td>67.00</td>
<td>165.00</td>
<td>19.3333</td>
</tr>
<tr>
<td>Maximum</td>
<td>77.00</td>
<td>285.00</td>
<td>42.6667</td>
</tr>
<tr>
<td>Kurtosis</td>
<td>1.324</td>
<td>-1.300</td>
<td>-1.1257</td>
</tr>
<tr>
<td>Std. Error of Kurtosis</td>
<td>1.121</td>
<td>1.121</td>
<td>1.121</td>
</tr>
<tr>
<td>Skewness</td>
<td>-1.214</td>
<td>-.529</td>
<td>.118</td>
</tr>
<tr>
<td>Std. Error of Skewness</td>
<td>.580</td>
<td>.580</td>
<td>.580</td>
</tr>
<tr>
<td>Median</td>
<td>74.00000</td>
<td>260.0000</td>
<td>28.66666700</td>
</tr>
<tr>
<td><strong>Year 3 or 4</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>N</td>
<td>24</td>
<td>24</td>
<td>24</td>
</tr>
<tr>
<td>Mean</td>
<td>73.7083</td>
<td>241.7083</td>
<td>34.9305546</td>
</tr>
<tr>
<td>Std. Deviation</td>
<td>2.38618</td>
<td>41.54775</td>
<td>6.12587721</td>
</tr>
<tr>
<td>Minimum</td>
<td>68.00</td>
<td>180.00</td>
<td>20.33333</td>
</tr>
<tr>
<td>Maximum</td>
<td>79.00</td>
<td>320.00</td>
<td>48.33333</td>
</tr>
<tr>
<td>Kurtosis</td>
<td>.641</td>
<td>-.897</td>
<td>1.103</td>
</tr>
<tr>
<td>Std. Error of Kurtosis</td>
<td>.918</td>
<td>.918</td>
<td>.918</td>
</tr>
<tr>
<td>Skewness</td>
<td>.126</td>
<td>.298</td>
<td>-.539</td>
</tr>
<tr>
<td>Std. Error of Skewness</td>
<td>.472</td>
<td>.472</td>
<td>.472</td>
</tr>
<tr>
<td>Median</td>
<td>73.0000</td>
<td>235.0000</td>
<td>36.3333350</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>N</td>
<td>39</td>
<td>39</td>
<td>39</td>
</tr>
<tr>
<td>Mean</td>
<td>73.5385</td>
<td>240.4615</td>
<td>33.1794864</td>
</tr>
<tr>
<td>Std. Deviation</td>
<td>2.50101</td>
<td>42.21614</td>
<td>6.97943777</td>
</tr>
<tr>
<td>Minimum</td>
<td>67.00</td>
<td>165.00</td>
<td>19.33333</td>
</tr>
<tr>
<td>Maximum</td>
<td>79.00</td>
<td>320.00</td>
<td>48.33333</td>
</tr>
<tr>
<td>Kurtosis</td>
<td>.975</td>
<td>-1.009</td>
<td>-.440</td>
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<tr>
<td>Std. Error of Kurtosis</td>
<td>.741</td>
<td>.741</td>
<td>.741</td>
</tr>
<tr>
<td>Skewness</td>
<td>-.505</td>
<td>-.052</td>
<td>-.356</td>
</tr>
<tr>
<td>Std. Error of Skewness</td>
<td>.378</td>
<td>.378</td>
<td>.378</td>
</tr>
<tr>
<td>Median</td>
<td>73.0000</td>
<td>240.0000</td>
<td>34.3000000</td>
</tr>
</tbody>
</table>
Further testing beyond the initial research question was accomplished by regrouping the data by football position. After analyzing the data for these distributions it was discovered the sample size of each group was too small to obtain valid results.

The data were then regrouped into 3 groups based on similar movements incurred during football practice and games. These data were run using a single factor ANOVA.

Group 1: Linemen (LM) (offensive and defensive linemen)
Group 2: Offensive Backs (OB) (quarterbacks, running backs, wide receivers)
Group 3: Defensive Backs (DB) (defensive backs and linebackers).

Results show there was no significant difference between groups in lumbar spine extension (LM, OB, DB) \(F(2,36) = .518, p = .600\) partial \(\eta^2 = .028\), power = .129). Small sample size here could have made this comparison demonstrate less difference than anticipated. See Tables 6 and 7.

Table 6. Descriptive Statistics (Dependent Variable: LS spine extension in degrees)

<table>
<thead>
<tr>
<th>Positions, 3 groups</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Linemen</td>
<td>32.421052</td>
<td>5.59303119</td>
<td>19</td>
</tr>
<tr>
<td>Offensive backs</td>
<td>32.666665</td>
<td>7.26398328</td>
<td>19</td>
</tr>
<tr>
<td>Defensive backs</td>
<td>35.133333</td>
<td>9.19769094</td>
<td>19</td>
</tr>
<tr>
<td>Total</td>
<td>33.179486</td>
<td>6.97943777</td>
<td>19</td>
</tr>
</tbody>
</table>
Table 7. Tests of Between Subjects Effects (Dependent Variable: LS spine extension in degrees)

<table>
<thead>
<tr>
<th>Source</th>
<th>Type III Sum of Squares</th>
<th>df</th>
<th>Mean Square</th>
<th>F</th>
<th>Sig.</th>
<th>Partial Eta Squared</th>
<th>Noncent. Parameter</th>
<th>Observed Power</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corrected Model</td>
<td>51.734</td>
<td>2</td>
<td>25.867</td>
<td>.518</td>
<td>.600</td>
<td>.028</td>
<td>1.035</td>
<td>.129</td>
</tr>
<tr>
<td>Intercept</td>
<td>39758.525</td>
<td>1</td>
<td>39758.525</td>
<td>795.461</td>
<td>.600</td>
<td>.957</td>
<td>795.461</td>
<td>1.000</td>
</tr>
<tr>
<td>POSITN3</td>
<td>51.734</td>
<td>2</td>
<td>25.867</td>
<td>.518</td>
<td>.600</td>
<td>.028</td>
<td>1.035</td>
<td>.129</td>
</tr>
<tr>
<td>Error</td>
<td>1799.343</td>
<td>36</td>
<td>49.982</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Total</td>
<td>44785.331</td>
<td>39</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Corrected Total</td>
<td>1851.077</td>
<td>38</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Figure 1. Lumbar ROM for collegiate football players in their 1st and 2nd years compared to players in their 3rd and 4th years. Values represent means. *Denotes differences between groups. *P < .05
Discussion

After collecting and analyzing the data, it was found there is an increase in range of motion in the lumbar spine when comparing first- and second-year to third- and fourth-year college football players. The two groups demonstrated homogeneity in both height and weight measurements.

Speculation is that increased ROM leads to increased pathology in high performance football players. By damaging the supporting structures of the lumbar spine, there is an increased risk of instability and such pathologies as spondylolisthesis or damage to the joint capsule and possibly degenerative joint disease. Currently, spinal instability is not regarded as a source of low back pain. McCarron et al. found that when reviewing college football players, there was a higher incidence (15.2%) of lumbar spondylolysis and spondylolisthesis than in the general population.

According to Gerbino and d’Hemecourt, it is clear that participants in football are at risk of increased chance of injury to the lumbar spine. In the study by Gatt et al., their data suggest that the mechanics of repetitive blocking sustained during the course of football practice and games may be responsible for the increased number of lumbar spine pathologies by football players. Peterson et al. found that 5.9% of football injuries occurred at the lumbar spine. Of these injuries, 44% were mild, 27% were moderate, and 27% were of severe magnitude. It has also been shown that the majority of these injuries result from the repeated high magnitude forces that are applied to the lumbar spine during the course of a game and practice sessions.
In one study, 101 adults with low back pain or functional disorders underwent passive functional flexion-extension examinations. The patient population was broken down into 5 groups with similar pathologies or physical conditions and their motion parameters compared to a normal population and to each other. Results showed that patient groups displayed significantly hypomobile motion in comparison to the normal population, except for the group of high-performance athletes who had significant hypermobility. According to Nyland and Johnson, collegiate football players displayed increased cervical spine range of motion compared to high school players. This increase may be due to the motions and forces encountered during football training and playing. This finding could suggest a trend in increased mobility in the spine due to participation in American football over time.

When considering the methodology used in this study, one limitation found was that one researcher was used to mark the spinous processes of the football players while a second researcher placed the double inclinometers and performed the testing and reading. Although this had a possibility to increase the measurement error, the second researcher also checked the markings to ensure proper inclinometer placement.

Although the researchers followed the American Medical Association’s guidelines for measuring extension of the lumbar spine, according to Norkin and White, there is still a 3° to 5° intrarater measurement error. The measurement error associated with lumbar spine extension is one of the main limitations of this study. The difference between the two groups was 4.55° which falls within the
speculated measurement error. This difference, although demonstrating statistical significance, may not imply clinical significance. Further research to examine mobility changes with length of involvement in a contact sport of this nature is warranted.

**Conclusion**

It would seem logical to assume that a long-term involvement with a collision activity such as American football would tend to promote increased mobility in a number of joints. This increase in motion may lead to such conditions as low back pain, degenerative disc disease (DDD), or spondylolisthesis. Gerbino and d'Hemecourt feel that "football players, in general, increase their risk of developing low back pain or DDD as their years of involvement with their sport increases."

There appears to be a relationship between the amount of time playing football and the degree of lumbar spine extension. There is a possibility that the longer one participates in football the greater the likelihood of developing increased extension mobility of the lumbar spine. With increased extension of the lumbar spine, due to the collision nature of football, there may be stretching of the ligaments leading to instability which may increase the risk of injury or pathology. The added mobility could induce biomechanical stresses to spinal joint and periarticular structures, resulting in pathologies and resultant dysfunction and disability in this region.
APPENDIX
REPORT OF ACTION: EXEMPT/EXPEDITED REVIEW
University of North Dakota Institutional Review Board

Date: 6/9/2005

Principal Investigator: Romanick, Mark; Linback, Matt; Nord, Nicole; Pedersen, Kari

Department: Physical Therapy

Project Title: The Effects of Repeated, High-Impact Collisions While Playing College Football on the Extension of the Spine

The above referenced project was reviewed by a designated member for the University's Institutional Review Board on June 10, 2005 and the following action was taken:

- Project approved. Expedited Review Category No.
- Next scheduled review must be before: June 9, 2006
- Copies of the attached consent form with the IRB approval stamp dated June 10, 2005 must be used in obtaining consent for this study.

Project approved. Exempt Review Category No.

☐ This approval is valid until ________________ as long as approved procedures are followed. No periodic review scheduled unless so stated in the Remarks Section.
☐ Copies of the attached consent form with the IRB approval stamp dated ________________ must be used in obtaining consent for this study.

☐ Minor modifications required. The required corrections/additions must be submitted to RDC for review and approval. This study may NOT be started UNTIL final IRB approval has been received.
   (See Remarks Section for further information.)

☐ Project approval deferred. This study may not be started until final IRB approval has been received.
   (See Remarks Section for further information.)

REMARKS: Any unanticipated problem or adverse occurrence in the course of the research project must be reported within 72 hours to the IRB Chairperson or RDC by submitting an Unanticipated Problem/Adverse Event Form.

Any changes in protocol or Consent Forms must receive IRB approval prior to being implemented. You must submit a Protocol Change Form with all revised research documents to include changes to protocol, consent forms, or supportive materials, with the appropriate signatures, to Research Development and Compliance for review and approval.

PLEASE NOTE: Requested revisions for student proposals MUST include adviser’s signature. All revisions MUST be highlighted.

☑ Education Requirements Completed. (Project cannot be started until IRB education requirements are met.)

cc: Chair, Physical Therapy; Dean, School of Medicine

Signature of Designated IRB Member
UNO's Institutional Review Board

Date

If the proposed project (clinical medical) is to be part of a research activity funded by a Federal Agency, a special assurance statement or a completed 310 Form may be required. Contact RDC to obtain the required documents.

(Revised 07/2004)
University of North Dakota Human Subjects Review Form

All research with human participants conducted by faculty, staff, and students associated with the University of North Dakota, must be reviewed and approved as prescribed by the University's policies and procedures governing the use of human subjects. It is the intent of the University of North Dakota (UND), through the Institutional Review Board (IRB) and Research Development and Compliance (RD&C), to assist investigators engaged in human subject research to conduct their research along ethical guidelines reflecting professional as well as community standards. The University has an obligation to ensure that all research involving human subjects meets regulations established by the United States Code of Federal Regulations (CFR). When completing the Human Subjects Review Form, use the "IRB Checklist" for additional guidance.

Please provide the information requested below:

**Principal Investigator:** Mark Romanick, Matt Linback, Nicole Nord, Kari Pedersen

**Telephone:** 701-777-2831

**E-mail Address:** mroman@medicine.nodak.edu

**Complete Mailing Address:** Box 9037, Physical Therapy Department, UND, Grand Forks, ND 58202-9037

**School/College:** University of North Dakota

**Department:** Physical Therapy

**Student Adviser (if applicable):** Mark Romanick

**Telephone:** See Above

**E-mail Address:**

**Address or Box #:**

**School/College:**

**Department:**

**Project Title:** The effects of repeated, high-impact collisions while playing college football on the extension of the spine.

**Proposed Project Dates:**

- **Beginning Date:** 05/23/05
- **Completion Date:** 12/16/05

**Funding agencies supporting this research:** NA

*(A copy of the funding proposal for each agency identified above MUST be attached to this proposal when submitted.)*

Does the Principal Investigator or any researcher associated with this project have a financial interest in the results of this project? If yes, please submit, on a separate piece of paper, an additional explanation of the financial interest (other than receipt of a grant)?

___ YES or X NO

If your project has been or will be submitted to other IRBs, list those Boards below, along with the status of each proposal.

<table>
<thead>
<tr>
<th>Date submitted</th>
<th>Status</th>
<th>Approved</th>
<th>Pending</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Type of Project:** Check "Yes" or "No" for each of the following.

___ YES or __ NO New Project

___ YES or __ NO Continuation/Renewal

___ YES or __ NO Dissertation/Thesis

___ YES or __ NO Student Research Project

Is this a Protocol Change for previously approved project? If yes, submit a signed copy of this form with the changes bolded or highlighted.

___ YES or __ NO

Does your project involve medical record information? If yes, complete the HIPAA Compliance Application and submit it with this form.

___ YES or __ NO

Does your project include Genetic Research? If yes, refer to Chapter 3 of the Researcher Handbook for additional guidelines regarding your topic.

___ YES or __ NO

Does your project include Internet Research? If yes, refer to Chapter 3 of the Researcher Handbook for additional guidelines regarding your topic.

___ YES or __ NO

Will subjects or data be provided by Altru Health Systems? If yes, submit two copies of the proposal. A copy of the proposal will be provided to Altru.

___ YES or __ NO

Will research subjects be recruited at another organization (e.g., hospitals, schools, YMCA) or will assistance with the data collection be obtained from another organization?

___ YES or __ NO
If yes, list all institutions:

Letters from each organization must accompany this proposal. Each letter must illustrate that the organization understands their involvement in that study, and agrees to participate in the study. Letters must include the name and title of the individual signing the letter and, if possible, should be printed on letterhead.

**Subject Classification**: This study will involve subjects who are in the following special populations: Check all that apply.

- Minors (< 18 years)
- Prisoners
- Persons with impaired ability to understand their involvement and/or consequences of participation in this research
- Pregnant Women/Fetuses
- UND Students
- Other

For information about protections for each of the special populations, refer to Chapter 5 of the Researcher Handbook.

**This study will involve**: Check all that apply.

- Deception
- Radiation
- New Drugs (IND)
- Non-approved Use of Drug(s)
- Recombinant DNA
- None of the above will be involved in this study

----

**I. Project Overview**

Please provide a brief explanation (limit to 200 words or less) of the rationale and purpose of the study, introduction of any sponsor(s) of the study, and justification for use of human subjects and/or special populations (e.g., vulnerable populations such as minors, prisoners, pregnant women/fetuses).

The purpose of this study is to measure the extension of the lumbar spine in up to 115 subjects who play college football using inclinometers comparing the results of two groups: first and second year players versus third, fourth, and fifth year players. We will be examining the influence of the collision nature of football on extension range of motion on the low back.

**II. Protocol Description**

Please provide a succinct description of the procedures to be used by addressing the instructions under each of the following categories. Individuals conducting clinical research please refer to the “Guidelines for Clinical-Research Protocols” on the Research and Program Development website.

1. **Subject Selection.**

   a) Describe recruitment procedures (i.e., how subjects will be recruited, who will recruit them, where and when they will be recruited and for how long) and include copies of any advertisements, fliers, etc., that will be used to recruit subjects. If incentive payments will be made to anyone for enrolling participants, describe the incentive package.

   Obtained oral consent from head football coach as well as the strength and conditioning coach of UND football to proceed with testing of the football team. Subjects will be addressed prior to conditioning workouts, conducted by the University of North Dakota strength and conditioning staff, and be recruited on the day of their study participation. There will be no use of fliers or advertisements in the recruiting process. The team will be addressed orally and asked for their individual participation in the study.

   b) Describe your subject selection procedures and criteria, paying special attention to the rationale for including subjects from any of the categories listed in the “Subject Classification” section above.

   Inclusion criteria: Current members of UND football team, 18 years of age and older.

   c) Describe your exclusionary criteria and provide a rationale for excluding subject categories.

   Exclusion criteria: Previous history of back surgery, disc pathology, or vertebral fractures will be excluded to prevent exacerbations of prior conditions.

   d) Describe the estimated number of subjects that will participate and the rationale for using that number of subjects.
This study will include up to 115 subjects in order to obtain a large enough sample size for each group to ensure a normal distribution.

e) Specify the potential for valid results. If you have used a power analysis to determine the number of subjects, describe your method.

2. Description of Methodology.
  a) Describe the procedures used to obtain informed consent.

     Each participant will fill out an Informed Consent which will be presented to them prior to any testing (see attached forms).

  b) Describe where the research will be conducted. Document the resources and facilities to be used to carry out the proposed research. Please note staffing, funding, and space available to conduct this research.

     Research will be conducted in the Memorial Stadium weight room at UND. Staff will include three student researchers who will be performing tests and recording measurements.

  c) Indicate who will carry out the research procedures.

     Matt Linback, Kari Pedersen, and Nicole Nord will perform height and weight calculations, measure lumbar spine extension and will record all data.

  e) Briefly describe the procedures and techniques to be used and the amount of time that is required by the subjects to complete them.

     Subjects will be required to answer questions related to history of back pathology (see attached forms). Height and weight calculations will be measured on a mechanical medical scale. Subjects will be required to remove upper body clothing for testing purposes in order to access and achieve optimal contact with the spine. Lumbar spine extension will be measured with the subject in standing, hands on hips. Researcher will palpate for spinous processes of T12 and S1-2 which will be marked with a marking pen. Subjects will perform three back extension trials to “warm up”. Subjects will then perform three trials for which the researchers will record measurements and calculate the mean.

  f) Describe audio/visual procedures and proper disposal of tapes.

     There will be no audio/visual procedures.

  f) Describe the qualifications of the individuals conducting all procedures used in the study.

     All student researchers are in the physical therapy program at UND. Reliability has already been established with this particular measuring device for spine motion measurements. Intrarater reliability for its use will be established in the PT 583: Instrumentation course prior to the study.

  g) Describe compensation procedures (payment or class credit for the subjects, etc.).

     Attachments Necessary: Copies of all instruments (such as survey/interview questions, data collection forms completed by subjects, etc.) must be attached to this proposal.

     Subject participation is voluntary and subjects will not receive any compensation. See attached for interview questions.


  a) Clearly describe the anticipated risks to the subject/others including any physical, emotional, and financial risks that might result from this study.

     Physical risks: repeated lumbar extension may aggravate pain if there are any undiagnosed lumbar pathologies. To minimize risks subjects will perform three warm-up trials. There are not any foreseeable emotional or financial risks.
b) Indicate whether there will be a way to link subject responses and/or data sheets to consent forms, and if so, what the justification is for having that link.

There is not a need to link the subject’s number to the name/consent form.

4. Subject Protection.

a) Describe precautions you will take to minimize potential risks to the subjects (e.g., sterile conditions, informing subjects that some individuals may have strong emotional reactions to the procedures, debriefing, etc.).

The part of the inclinometer that will be in contact with the subject’s skin will be cleansed with rubbing alcohol between subject use to prevent spread of bacteria.

b) Describe procedures you will implement to protect confidentiality (such as coding subject data, removing identifying information, reporting data in aggregate form, etc.).

Initially subjects will sign an Informed Consent. Subjects will then be randomly assigned a subject number, which will not be associated with their Informed Consent. During the testing process subjects will only be identified by their subject number, not their name.

c) Indicate that the subject will be provided with a copy of the consent form and how this will be done.

Subjects will be given two copies of the informed consent, one that they can keep and one that they sign and return to us.

d) Describe the protocol regarding record retention. Please indicate that research data from this study and consent forms will both be retained in separate locked locations for a minimum of three years following the completion of the study.

Describe: 1) the storage location of the research data (separate from consent forms and subject personal data) 2) who will have access to the data 3) how the data will be destroyed 4) the storage location of consent forms and personal data (separate from research data) 5) how the consent forms will be destroyed

The consent forms and data will be kept in separated locked file cabinets in the University of North Dakota Physical Therapy Department for three years beyond the completion of the research project. Only the researchers, advisor, and people who audit IRB procedures will have access to the data. After three years forms will be shredded and disposed.

d) Describe procedures to deal with adverse reactions (referrals to helping agencies, procedures for dealing with trauma, etc.).

If any subject has an adverse reaction to testing procedures we will immediately refer them to proper healthcare professionals.

e) Include an explanation of medical treatment available if injury or adverse reaction occurs and responsibility for costs involved.

III. Benefits of the Study

Clearly describe the benefits to the subject and to society resulting from this study (such as learning experiences, services received, etc.). Please note: payment is not a benefit and should be listed in the Protocol Description section under Methodology.

By completing this study we are trying to help identify risks related to the lumbar spine associated with collegiate football.

IV. Consent Form

A copy of the consent form must be attached to this proposal. If no consent form is to be used, document the procedures to be used to protect human subjects. Refer to the RD&C website for further information regarding consent form regulations.
Please note: Regulations require that all consent forms, and all pages of the consent forms, be kept for a minimum of 3 years after the completion of the study, even if the subject does not continue participation. The consent form must be written in language that can easily be read by the subject population and any use of jargon or technical language should be avoided. It is recommended that the consent form be written in the third person (please see the examples on the RD&C website), and at no higher than an 8th grade reading level. A two inch by two inch blank space must be left on the bottom of each page of the consent form for the IRB approval stamp. The consent form must include the following elements:

a) An introduction of the principal investigator
b) An explanation of the purposes of the research
c) The expected duration of subject participation
d) A brief summary of the project procedures
e) A description of the benefits to the subject/others anticipated from this study
f) A paragraph describing any reasonably foreseeable risks or discomforts to the subject
g) Disclosure of any alternative procedures/treatments that are advantageous to the subject
h) An explanation of compensation/medical treatment available if injury occurs.

i) A description of how confidentiality of subjects and data will be maintained. Indicate that the data and consent forms will be stored separately for at least three years following the completion of the study. Indicate where, in general, the data and consent documents will be stored and who will have access. The following statement must be included in all consent forms and informational letters: "Only the researcher, the adviser, [if applicable] and people who audit IRB procedures will have access to the data." Please make appropriate additions to the persons that may have access to your research data. Indicate how the data will be disposed of. Be sure to list any mandatory reporting requirements that may require breaking confidentiality.

j) The names, telephone numbers and addresses of two individuals to contact for information (generally the student and student adviser). This information should be included in the following statement: "If you have questions about the research, please call (insert Principal Investigator's name) at (insert phone number of Principal Investigator) or (insert Adviser's name) at (insert Adviser's phone number). If you have any other questions or concerns, please call Research Development and Compliance at 777-4279."

k) If applicable: an explanation of who to contact in the event of a research-related injury to the subject.

l) If applicable: an explanation of financial interest must be included.

m) Regarding participation in the study:
   1) An indication that participation is voluntary and that no penalties or loss of benefits will result from refusal to participate.
   2) An indication that the subject may discontinue participation at any time without penalty, with an explanation of how they can discontinue participation.
   3) An explanation of circumstances which may result in the termination of a subject’s participation in the study.
   4) A description of any anticipated costs to the subject.
   5) A statement indicating whether the subject will be informed of the findings of the study.
   6) A statement indicating that the subject will receive a copy of the consent form.

By signing below, you are verifying that the information provided in the Human Subjects Review Form and attached information is accurate and that the project will be completed as indicated.

Signatures:

(Principal Investigator) Date:

(Student Adviser) Date:

Requirements for submitting proposals:
Additional information can be found on the IRB web site at www.und.nodak.edu/dept/orpd/regucomm/IRB/index.html.

Original Proposals and all attachments should be submitted to Research Development and Compliance, P.O. Box 7134, Grand Forks, ND 58202-7134, or brought to Room 105, Twamley Hall.

Prior to receiving IRB approval, researchers must complete the required IRB human subjects’ education. Please go to http://www.und.nodak.edu/dept/orpd/regucomm/IRB/IRBEducation.htm for more information.

The criteria for determining what category your proposal will be reviewed under is listed on page 3 of the IRB Checklist. Your reviewer will assign a review category to your proposal. Should your protocol require full Board review, you will need to provide additional copies. Further information can be found on the RD&C website regarding required copies and IRB review categories, or you may call the RD&C office at 701 777-4279.

In cases where the proposed work is part of a proposal to a potential funding source, one copy of the completed proposal to the funding agency (agreement/contract if there is no proposal) must be attached to the completed Human Subjects Review Form if the proposal is non-clinical; 7 copies if the proposal is clinical-medical. If the proposed work is being conducted for a pharmaceutical company, 7 copies of the company’s protocol must be provided.

Please Note: Student Researchers must complete the “Student Consent to Release of Educational Record".

Revised 6/7/04
INVESTIGATOR LETTER OF ASSURANCE OF COMPLIANCE WITH ALL APPLICABLE FEDERAL REGULATIONS FOR THE PROTECTION OF THE RIGHTS OF HUMAN SUBJECTS

I _________________________ (Name of Investigator)

agree that, in conducting research under the approval of the University of North Dakota Institutional Review Board, I will fully comply and assume responsibility for the enforcement of compliance with all applicable federal regulations and University policies for the protection of the rights of human subjects engaged in research. Specific regulations include the Federal Common Rule for Protection of the Rights of Human Subjects 45 CFR 46. I will also assure compliance to the ethical principles set forth in the National Commission for the Protection of Human Subjects of Biomedical and Behavioral Research document, The Belmont Report.

I understand the University's policies concerning research involving human subjects and agree to the following:

1. Should I wish to make changes in the approved protocol for this project, I will submit them for review PRIOR to initiating the changes.

2. If any problems involving human subjects occur, I will immediately notify the Chair of the IRB, or the IRB Coordinator.

3. I will cooperate with the UND IRB by submitting Research Project Review and Progress Reports in a timely manner.

I understand the failure to do so may result in the suspension or termination of proposed research and possible reporting to federal agencies.

_________________________________________  _________________________
Investigator Signature                        Date
STUDENT RESEARCHERS: As of June 4, 1997 (based on the recommendation of UND Legal Counsel) the University of North Dakota IRB is unable to approve your project unless the following "Student Consent to Release of Educational Record" is signed and included with your "Human Subjects Review Form."

STUDENT CONSENT TO RELEASE OF EDUCATIONAL RECORD

Pursuant to the Family Educational Rights and Privacy Act of 1974, I hereby consent to the Institutional Review Board's access to those portions of my educational record which involve research that I wish to conduct under the Board's auspices. I understand that the Board may need to review my study data based on a question from a participant or under a random audit.

The study to which this release pertains is

________________________________________________________

I understand that such information concerning my educational record will not be released except on the condition that the Institutional Review Board will not permit any other party to have access to such information without my written consent. I also understand that this policy will be explained to those persons requesting any educational information and that this release will be kept with the study documentation.

________________________________________________________

NAID #

Printed Name

________________________________________________________

Date

Signature of Student Researcher

1Consent required by 20 U.S.C. 1232g.
You are invited to participate in a research study being done by Matt Linback, Nicole Nord, and Kari Pedersen, all of the Physical Therapy department, under the supervision of their advisor Mark Romanick of the University of North Dakota, Physical Therapy department. All student researchers are in the physical therapy program at UND. Reliability has already been established with this particular measuring device for spine motion measurements. Intrarater reliability for its use will be established in the PT 583: Instrumentation course prior to the study.

This study will help provide data assessing the effects of repeated high-impact collisions on the spine due to playing college football. Anticipated participation time will be approximately 15 minutes. Subjects will be required to answer questions related to history of back pathology. Height and weight calculations will be measured. Subjects will be required to remove upper body clothing. Low back extension will be measured with the subject in standing, hands on hips. Researcher will feel for bony landmarks that will be marked with a marking pen. A trial will be to bend back as far as possible with hands on hips and readings of the devices will be taken. You will perform 3 trials to “warm up”. You will then perform 3 trials. There will be no audio/visual procedures.

Possible risks may include development of pain if there are any undiagnosed spine injuries. If any subject has an adverse reaction to testing procedures we will immediately refer them to proper healthcare professionals. There are not any foreseeable emotional or financial risks. By completing this study we are trying to determine risks related to the spine associated with collegiate football. Although injury while involved in this study is unlikely, medical attention will be made available to you should an injury occur. Payment for any medical care you receive while a participant in this study is your responsibility.

Any information from this study and that can be identified with you will remain confidential and will be disclosed only with your permission. Your name will not be associated with any data that will be collected. All data and consent forms will be kept in separate locked cabinets in the Physical Therapy Department for 3 years after the completion of this study. Only the researchers, the advisor, and people who audit IRB procedures will have access to the data. After 3 years, the data will be shredded.

Participation is voluntary, and your decision whether or not to participate will not change your future relations with the University of North Dakota. If you decide to participate, you are free to leave the study at any time without penalty. Exclusion criteria will include any previous history of back surgery, disc pathology, or vertebral fractures will be excluded to prevent exacerbations of prior conditions.

If you have any questions about the research, you may call Mark Romanick at 777-2831 or Nicole Nord at 740-8553. If you have any other questions or concerns, please call the Research Development and Compliance office at 777-4279.

You will be given a copy of this consent form for future reference.

All of my questions have been answered and I am encouraged to ask any questions that I may have concerning this study in the future.

_____________________________  ________________________________
Participants Signature          Witness Signature

_____________________________
Date

_____________________________
Date
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Participants Signature

Date

Witness Signature

Date

University of North Dakota
Institutional Review Board
Approved on JUN 10 2005
Expires on JUN 9 2005
REFERENCES


