Wrist Pain in Young Gymnasts: Frequency and Effects Upon Training Over 1 Year

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Objective: To determine the frequency and characteristics of wrist pain in young, nonelite gymnasts over a 1-year training period, and to describe the effects of chronic wrist upon gymnastics training.

Design: Prospective cohort study.

Setting: Los Angeles-based gymnastics club.

Participants: Forty-seven nonelite female and male gymnasts between 5 and 16 years of age.

Assessments: Each subject completed an interview-based questionnaire and received a physical exam at the study onset and at the end of 1 year of training. The questionnaire detailed training habits and elicited a history and description of wrist pain.

Main Outcome Measures: The frequency of wrist pain and several measures of training were reported at the study onset and at 1 year. Gymnasts with wrist pain were compared with those who were pain-free.

Main Results: Wrist pain was reported by 57% (27 of 47) of subjects at the study onset. Eighty-nine percent (24 of 27) reported wrist pain both at the study onset and 1 year later. Nineteen gymnasts (40%) were pain-free at each collection. The floor exercise, the pommel horse, and the balance beam were most frequently associated with wrist pain symptoms.

Multivariate analysis revealed that adolescent gymnasts between 10 and 14 years of age were significantly more likely to report wrist pain at each survey than those who were either above or below this age range (p = 0.03). Forty-two percent of subjects with wrist pain at each survey reported that the symptoms interfered with training. Only five gymnasts with wrist pain were seen by physicians. Training intensity increased in gymnasts with and without wrist pain. The relative increase within each group was statistically significant among pain-free gymnasts (p = 0.003), but was not for those with wrist pain (p = 0.08).

Conclusions: Wrist pain among young, nonelite gymnasts is common, and appears to persist with continued training in the vast majority of those who report symptoms. Adolescent gymnasts between 10 and 14 years of age training at this level are significantly more likely to have wrist pain. Wrist pain appears to have a negative effect upon training, based upon both self-report and training intensity measures; however, more study is needed with respect to this issue.

Key Words: Wrist—Gymnastics—Training—Children—Youth—Overuse—Athletics.

INTRODUCTION

During gymnastics training, the upper extremities are regularly used to support body weight. In this setting, wrist injuries and symptoms of wrist pain are common. In studies of competitive gymnasts, the wrist accounts for 15 to 20% of injuries classified as gradual onset, exceeded only by the back and knee.1,2 These studies were based on a definition of injury in which the gymnasts either missed a portion of training or competition or presented to a medical provider for evaluation. More recent studies have assessed the prevalence of symptoms of wrist pain. In these surveys, wrist pain is quite common, with symptoms described by 46 to 79% of gymnasts at both elite and nonelite levels.3-7 In one study, 37% reported that they were able to train without limitations despite their symptoms, and just 13% of those with wrist pain sought medical attention.6 Thus, studies that define injury as lost participation time or as that assessed by a medical provider will likely underestimate those affected by overuse syndromes involving the wrist.

It is important to consider that symptoms of wrist pain have been associated with radiographic injury to the distal radial physis. Several studies have described distal radial growth plate injury in gymnasts with wrist pain.1-6,8-13 Recently, the frequency of wrist pain was found to be directly related to the grade of radiographic injury to the distal radial growth plate.7 In addition, other studies have described gymnasts to display a more positive ulnar variance, thought to be due to damage to growth of the distal radius and/or stimulation of ulnar growth from loading of the wrist joint.3,8,9,12-14 Others have argued that the development of positive ulnar variance is related to genetic factors.15 These findings raise
ALTERATION IN GROWTH. Caine et al.4 reported that of gymnastics, the individual becomes stronger and more skilled, or whether such symptoms eventually resolve as the gymnast matures.6,13 It is not clear whether such symptoms eventually resolve as the individual becomes stronger and more skilled, or whether they persist in the face of continued loading of the ulna. This study did not include a description of wrist pain symptoms. Conversely, a study of Canadian gymnasts reported no distal radial physeal injuries over a 3-year study period.12 In addition, Caine et al.4 found that 26% of female gymnasts training 20 to 27 hours per week developed wrist injuries described as gradual onset. The rate of distal radial growth plate injury was estimated to be 2.7 per 100 participants per year in that study. Since injury was defined as resulting in loss of any portion of training or competition, those who had wrist pain but were able to continue to train were not included in this analysis.

Cross-sectional studies have reported that wrist pain symptoms can be present for several months.6,13 It is not clear whether such symptoms eventually resolve as the individual becomes stronger and more skilled, or whether they persist in the face of continued loading of the ulna—creating a greater concern for the potential for alteration in growth. Caine et al.4 reported that of gymnasts who lost time from training or competition due to overuse injury of the wrist, the rate of reinjury was 50%.

In addition, the effects of wrist pain upon training have not been extensively evaluated. Wrist pain can affect training by limiting the number of repetitions performed in a session and can cause loss of training days.4,6 However, some gymnasts with wrist pain continue to train without apparent restriction.6 There are no longitudinal data available as to how wrist pain caused by repetitive loading affects training progression over time (e.g., advancement in skill level and training intensity).

Given these issues, the purposes of this study were 1) to determine the prevalence and characteristics of wrist pain among young, nonlinear gymnasts during a 1-year training period, and 2) to describe the effects of wrist pain upon gymnastics training.

METHODS

Gymnasts between 5 and 16 years of age training at a well established Los Angeles area club were asked to participate in this prospective study. Written informed consent was obtained from each participant and the participant’s parent or guardian. The study was reviewed and approved by the Office for the Protection of Human Subjects of the University of California, Los Angeles.

Each subject was administered a questionnaire and received a physical examination at the study onset and at the end of 12 months of training. The questionnaire was administered using an interview format by one of the authors (J. D.). It provided information on age, gender, and age of initiation of training. Specific training parameters assessed in the questionnaire included skill level and hours per week of training. Skill levels are generally categorized as either precompetitive or competitive. Competitive levels, with the exception of the elite level, are classified numerically by USA Gymnastics. Since the numerical systems are different for girls and boys, comparable groupings were created based upon the USA Gymnastics skill level classification system. For the purposes of the study, these groupings were categorized as precompetitive, beginning, middle, advanced, or elite (Table 1). Training elements (a series of defined training movements) that specifically load the wrist joint were also recorded by the coaching staff. Training intensity was defined as the product of the skill level and the number of training elements performed per hour of training. A history and description of wrist pain was obtained. Gymnasts were asked if they had any pain of their wrists during the last 6 months of training. If they answered “yes,” they were then asked to clarify the pain further, including the nature of onset (sudden or gradual) and the status of the symptoms (worse, better, or unchanged). Gymnasts with a history of acute wrist injuries were excluded from the study. The pain was further characterized by the nature of the symptoms (aching, swelling, and so forth); the location; the duration; and whether the pain was present before, during, or after training sessions. Gymnasts with wrist pain were asked to report which activities and events caused wrist pain. They were also asked if wrist pain symptoms caused them to miss training sessions or if the pain limited the number of repetitions performed in a training session. The questionnaire was administered at the same time of year for each data collection (during the spring competitive season). All gymnasts completed a questionnaire at baseline and at 1 year. This questionnaire has been used in previously published studies by our group.6,12,13 The physical examination included an exam of each wrist and measurements of height and weight. Height and weight were measured using a standard medical scale with height rod (Detecto Co., Jericho, NY). Grip strength was measured using a Jaymar dynamometer (JA Preston Corp., Jackson, MI). The average of three measurements was used in the statistical analysis. The same protocol was used for the baseline and 1-year measurements.

Data analysis was performed using the STATA statistical software program (STATA Corp., College Station, TX). Descriptive statistics were used to summarize the findings. Univariate analysis (using the Student t-test and

TABLE 1. Grading and distribution of skill level (N = 47)

<table>
<thead>
<tr>
<th>Category</th>
<th>USA gymnastics levels</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Study rank</td>
<td>USA</td>
</tr>
<tr>
<td>Pre-competitive</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Beginning</td>
<td>2</td>
<td>5.6</td>
</tr>
<tr>
<td>Middle</td>
<td>3</td>
<td>7.8</td>
</tr>
<tr>
<td>Advanced</td>
<td>4</td>
<td>8.10</td>
</tr>
<tr>
<td>Elite</td>
<td>5</td>
<td>Elite</td>
</tr>
</tbody>
</table>

* Pre-competitive levels are not numerically classified.
RESULTS

Forty-seven subjects (21 girls, 26 boys) with a mean age of 9.6 years were evaluated over 1 year of gymnastics training. The subjects initiated training at 5.3 years of age and trained an average of 7.9 hours per week. The mean skill level was 1.8, indicating a beginning level of training. Eighty-seven percent were training below the advanced level. The study group characteristics are summarized in Table 2. The girls trained a significantly greater number of hours per week than the boys (9.6 for girls versus 6.4 for boys, p < 0.01). There were no other significant differences between boys and girls at baseline.

At the study onset, 57% (27 of 47) reported wrist pain within the last 6 months of training. Twenty-six of 27 were symptomatic at the time of the survey. There was no difference in the prevalence of wrist pain between girls and boys (57.1% versus 57.7%; p = 0.83) The pain location was dorsal in 56%, palmar in 22%, radial in 7%, and ulnar in 7%. Three gymnasts could not localize the symptoms. Forty-one percent of those who reported wrist pain had had symptoms for at least 6 months.

Changes in selected variables over one year are shown in Table 3. By the end of the year of observation, the gymnasts displayed significant increases relative to baseline measurements in height (p < 0.0001) and weight (p < 0.0001). The increases in height and weight were significantly associated with age (p = 0.013 for height; p = 0.004 for weight). There were no significant differences in the increases in height and weight based upon gender. With respect to training, skill level (p = 0.04), the number of training elements per session (p = 0.0001), and training intensity (p = 0.02) increased significantly over the year. The changes in skill level, training elements performed per session, and training intensity were not associated with age. When the analysis was stratified by gender, skill level significantly increased significantly for the boys (p < 0.001) but did not change significantly for the girls (p = 0.553). Training elements per session increased in both groups, but to a greater extent in the girls (p = 0.02). Gender did not influence the increase in training intensity (p = 0.44).

Twenty-four (89%) of the 27 gymnasts who had pain at the study onset also reported wrist pain 1 year later (referred to as the wrist pain group). Fifty-two percent of girls (11 of 21) and 50% of boys (13 of 26) reported pain symptoms at each data collection (p = 0.81 for girls versus boys). Only one gymnast who was pain-free at baseline reported pain at 1 year. Nineteen gymnasts (40%) were pain-free at both surveys (pain-free group).

For those with pain at each survey, the events most frequently associated with wrist pain were the floor exercise (72% of girls, 52% of boys), the pommel horse (52% of boys), and the balance beam (23% of girls). Forty-two percent of the wrist pain group reported that they either lost training days or that they could not perform complete training sessions because of their symptoms. Only three gymnasts had symptoms with nongymnastics activities. Thirty-eight percent of the wrist pain group had symptoms that were reproducible on physical examination. Wrist bracing devices were worn by 17% of those in the wrist pain group. None of those who were pain-free used any form of wrist support. Only five gymnasts in the wrist pain group sought the care of a physician.

A comparison of the wrist pain group (N = 24) and pain-free group (N = 19) is presented in Table 4. Gymnasts in the wrist pain group initiated training at a later age (p = 0.01). There was a significant difference in the mean height and weight between the two groups. The girls in the pain group were taller (131.6 cm versus 128.9 cm; p = 0.04) and heavier (68.3 kg versus 28.4 kg; p = 0.01) than the pain-free group. The girls in the wrist pain group had significantly decreased training elements and training intensity compared to the pain-free group. Gender did not influence the increase in training intensity (p = 0.44).

### Table 2. Study group characteristics

<table>
<thead>
<tr>
<th>Variable</th>
<th>Total (N = 47)</th>
<th>Girls (N = 21)</th>
<th>Boys (N = 26)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean ± SD</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age (yrs)</td>
<td>9.6 ± 2.4</td>
<td>9.4 ± 2.2</td>
<td>9.7 ± 2.6</td>
</tr>
<tr>
<td>Ht (cm)</td>
<td>131.2 ± 14.8</td>
<td>129.8 ± 15.2</td>
<td>131.3 ± 13.4</td>
</tr>
<tr>
<td>Wt (kg)</td>
<td>29.8 ± 8.9</td>
<td>28.4 ± 8.6</td>
<td>31.0 ± 9.2</td>
</tr>
<tr>
<td>Age began training</td>
<td>5.3 ± 1.9</td>
<td>5.0 ± 2.0</td>
<td>5.5 ± 1.9</td>
</tr>
<tr>
<td>Skill level</td>
<td>1.8 ± 0.8</td>
<td>1.8 ± 0.7</td>
<td>1.8 ± 0.8</td>
</tr>
<tr>
<td>Training hours/week</td>
<td>7.9 ± 4.3</td>
<td>4.4 ± 4.4</td>
<td>6.4 ± 3.8</td>
</tr>
<tr>
<td>Training elements/week</td>
<td>27.3 ± 65.9</td>
<td>259.2 ± 167.9</td>
<td>284.8 ± 327.5</td>
</tr>
<tr>
<td>Years in training</td>
<td>4.4 ± 1.8</td>
<td>4.3 ± 1.8</td>
<td>4.4 ± 2.1</td>
</tr>
</tbody>
</table>

* p value < 0.0001 vs. boys

### Table 3. Changes in selected variables over one year (N = 47)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Study onset</th>
<th>12 months</th>
<th>*p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean ± SD</td>
<td>Mean ± SD</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ht (cm)</td>
<td>131.2 ± 14.8</td>
<td>136.5 ± 13.6</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Wt (kg)</td>
<td>65.7 ± 19.6</td>
<td>74.4 ± 22.6</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Skill level</td>
<td>1.8 ± 0.8</td>
<td>2.1 ± 1.0</td>
<td>0.04</td>
</tr>
<tr>
<td>Training hours/week</td>
<td>7.9 ± 4.4</td>
<td>8.0 ± 4.0</td>
<td>0.8</td>
</tr>
<tr>
<td>Training elements/week</td>
<td>254.0 ± 265.9</td>
<td>370.3 ± 208.4</td>
<td>0.0001</td>
</tr>
<tr>
<td>Training intensity</td>
<td>70.9 ± 91.5</td>
<td>116.2 ± 119.4</td>
<td>0.02</td>
</tr>
</tbody>
</table>

* p value of 12 month data compared to study onset.

### Table 4. Comparison of pain-free gymnasts and gymnasts with wrist pain at one year

<table>
<thead>
<tr>
<th>Variable</th>
<th>Pain free groupa (N = 19)</th>
<th>Wrist pain groupb (N = 24)</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean ± SD</td>
<td>Mean ± SD</td>
<td>Mean ± SD</td>
<td></td>
</tr>
<tr>
<td>Age (yrs)</td>
<td>9.6 ± 2.4</td>
<td>11.3 ± 1.8</td>
<td>0.01</td>
</tr>
<tr>
<td>Ht (cm)</td>
<td>131.6 ± 14.6</td>
<td>139.6 ± 10.4</td>
<td>0.04</td>
</tr>
<tr>
<td>Wt (kg)</td>
<td>68.3 ± 22.3</td>
<td>77.8 ± 20.1</td>
<td>0.16</td>
</tr>
<tr>
<td>Age began training</td>
<td>4.7 ± 1.8</td>
<td>5.5 ± 1.6</td>
<td>0.13</td>
</tr>
<tr>
<td>Years in training</td>
<td>4.9 ± 2.2</td>
<td>5.8 ± 1.4</td>
<td>0.71</td>
</tr>
<tr>
<td>Skill level</td>
<td>1.7 ± 0.7</td>
<td>2.4 ± 1.1</td>
<td>0.04</td>
</tr>
<tr>
<td>Training hours/week</td>
<td>7.1 ± 4.6</td>
<td>8.4 ± 3.4</td>
<td>0.31</td>
</tr>
<tr>
<td>Training elements/week</td>
<td>287.7 ± 145.0</td>
<td>412.3 ± 237.1</td>
<td>0.06</td>
</tr>
<tr>
<td>Training intensity</td>
<td>82.1 ± 37.1</td>
<td>132.3 ± 144.0</td>
<td>0.16</td>
</tr>
</tbody>
</table>

a painfree group = reported no pain both at study onset and at one year

b wrist pain group = reported pain both at study onset and at one year
younger age, had more years of training, trained a greater
number of hours per week at a higher skill level, per-
formed a greater number of training elements per week,
and trained at a greater intensity level. These differences,
however, were not statistically significant at baseline
(data not shown). By the end of the year, the difference
in skill level between the two groups was significantly
different ($p = 0.04$).

Univariate analysis found that gymnasts in the wrist
pain group were significantly older and taller than those
who were pain-free (Table 4). Of those between 10 and
14 years of age at 1 year, 73% had wrist pain at the study
onset and at 1 year, compared with 29% of those who
were either less than 10 or more than 14 years of age.
($p = 0.004$, Fig. 1). Multivariate logistic regression
analysis revealed this age range to be significantly asso-
ciated with wrist pain, independent of training intensity,
age of initiation of training, years of training, gender,
height, and weight ($p = 0.03$). The 1-year changes in
height and training intensity were not associated with
wrist pain ($p = 0.15$ and $p = 0.2$, respectively).

Table 4 compares several measures of training within
the pain-free and wrist pain groups. Those were no sig-
nificant within-group changes for skill level and training
hours per week. The number of training elements per-
formed per week increased in both groups and increased
significantly in the wrist pain group. Training intensity
increased within each group over the year; however, the
increase reached statistical significance only in the pain-
free group (49 units versus 82 units, $p = 0.003$).

DISCUSSION

This study of skeletally immature young gymnasts is
the first to describe the frequency and characteristics of
wrist pain symptoms in a longitudinal fashion. Despite
the relatively modest training loads and young age of the
subjects, wrist pain was reported by 57% at the initiation
of this study. This frequency is within the range reported
in previous cross-sectional studies.$^{3,4,6}$ In the current
study, wrist pain was most commonly described as aching
in quality and dorsally located. It was most fre-
quently associated with the floor exercise, the pommel
horse, and, to a lesser extent, the balance beam. These
findings are consistent with prior work by our group.$^6,13$

In one of the few prospective studies investigating
wrist injuries in gymnasts, Caine et al. studied 50 female
gymnasts over a 1-year training period.$^4$ They found that
46% had wrist pain symptoms at baseline. The subjects
in their study were followed for 1 year, and 13 (26%)
developed wrist injuries of gradual onset (injury was
defined as loss of any portion of training time or com-
petition). Similar to the data presented here, the floor
exercise was the event most commonly associated with
symptoms. Their report differs in several ways from the
current study. Their study population consisted of high-
level female gymnasts training a minimum of 20 hours
per week, while the study presented here examined both
male and female gymnasts training at lower skill levels
for 7.9 hours per week. Another difference from the cur-
rent study is that wrist injuries and not wrist pain symp-
toms were assessed prospectively. This distinction is im-
portant since radiographic findings of wrist pain symp-
toms are associated with distal radial growth plate
injury.$^{13}$ In the study presented here, 58% of those in the
wrist pain group trained without missing training ses-
sions or reducing their workouts. In a previously pub-
lished study of older gymnasts training 12 hours per
week, 37% of those with wrist pain reported no limita-
tions upon training.$^{11}$ Given these observations, studies
that report wrist injury without including wrist pain
symptoms may underestimate those at risk for growth
plate injury.

The most significant finding of this study was that
89% of those gymnasts who reported wrist pain at the

![FIG. 1. Gymnasts between 10 and 14 years of age were significantly more likely to have reported wrist pain at the study onset and at
1 year ($p = 0.004$). Multivariate logistic regression found this age range to be independently associated with wrist pain after adjusting for
height, weight, the age that training began, total years of training, and training intensity ($p = 0.03$).](image-url)
investigating shear stress and fracture toughness of the osteochondral junction found adolescent bovine specimens to be more susceptible to shear stress and to demonstrate reduced fracture toughness compared with either immature or mature specimens.24 Thus, the results of the current study with respect to wrist pain suggest that adolescents in this age range are more likely to suffer consequences from repetitive loading compared with participants who are younger (and presumably more skeletally immature) or those who are older (and presumably more skeletally mature).

Since chronologic age is a marker for growth rate, we also analyzed the relationship between change in height and wrist pain. We did not find a significant association between change in height over 1 year and wrist pain. However, peak height velocity occurs at approximately 12.5 years in female gymnasts and 13.6 years in active boys.25,26 It is best measured over several years. Given the average age of the subjects in this study and the limited time period, peak height velocity could not be determined from this study.

Wrist pain appeared to have an adverse effect on training. This finding is based upon both subjective and objective measures. Twenty-one percent of those surveyed (10 of 47) reported that wrist pain limited training. Of these 10 gymnasts, six stated they were unable to perform full workouts but did not routinely miss training sessions because of wrist pain. Four reported that wrist pain caused them to miss at least some training sessions. Moreover, while training intensity clearly increased in both those who were pain-free and in those with chronic pain, the relative increase was statistically significant only in the former group.

**Study Limitations**

The relatively small sample size and short study period limit the statistical analysis and generalizability of the results. Moreover, the gymnasts studied were of a relatively young age, trained at lower skill levels, and trained at modest intensity levels. As such, the results may not be applicable to more advanced gymnasts. Since the study collected data at two time points, variations in training loads between the collection times cannot be assessed. Though the duration of wrist pain symptoms was obtained, whether the symptoms waxed and waned between the sampling times cannot be determined. In addition, some observations such as the duration of wrist pain symptoms and the number of training sessions during the study onset also reported pain at the end of the year. Since this study did not obtain data on changes in symptoms during the study period, it is possible that some subjects may have had symptoms that temporarily waned and then recurred by the end of the year. Nonetheless, this finding, along with the reported duration of symptoms (mean, 4–6 months), indicates that wrist pain in skeletally immature gymnasts should not be considered a transient phenomenon. It may also be noted that while this study was not designed to evaluate the effectiveness of wrist bracing, only one of nine gymnasts who had pain and were using a wrist brace at the initial data collection reported no pain at the end of the year. Since chronic wrist pain may be linked to stress injury of the distal radial physis and the development of positive ulnar variance, parents and coaches who are aware of wrist pain symptoms should be encouraged to seek physician consultation.3,7,9,12–14 Given that only five gymnasts with chronic pain were evaluated by a physician, programs to increase awareness of this issue among gymnasts, parents, and coaches are indicated.

The majority of the gymnasts in this study (43 of 47) were categorized as either those with wrist pain (N = 24) or those who were pain-free (N = 19) at each data collection. Gymnasts in the wrist pain group were older, began training at a younger age, and had been in training longer than those who were pain-free. They trained at higher levels with respect to hours of training per week, skill level, training elements per week, and overall training intensity. Of these differences, age, height, and skill level were significantly different between the two groups at the end of the year. Previous studies have shown a similar overall profile when comparing gymnasts with and without wrist pain.6,13

Adolescent gymnasts were significantly more likely to have wrist pain at both surveys. Seventy-three percent of gymnasts between 10 and 14 years of age had wrist pain at the study onset and at 1 year, compared with 29% of those either less than 10 years of age or greater than 14 years. Gymnasts within this age range were significantly more likely to have chronic pain even when adjusted for training intensity, age of initiation of training, years of training, and gender (p = 0.03). This finding is consistent with the concept of increased risk of injury during the adolescent growth spurt.18,19 It is supported by biomechanical studies and studies of fracture occurrence that have reported the physis to be more vulnerable to injury during this phase.20–23 In addition, a recent study

**TABLE 5. Training progression among gymnasts based upon wrist pain status**

<table>
<thead>
<tr>
<th></th>
<th>Pain free groupa (N = 19)</th>
<th>Chronic pain groupb (N = 24)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Study onset</td>
<td>12 mos</td>
</tr>
<tr>
<td>Skill level</td>
<td>1.6</td>
<td>1.7</td>
</tr>
<tr>
<td>Training hours/week</td>
<td>7.1</td>
<td>7.1</td>
</tr>
<tr>
<td>Training elements/week</td>
<td>222</td>
<td>287</td>
</tr>
<tr>
<td>Training intensity</td>
<td>49</td>
<td>82</td>
</tr>
</tbody>
</table>

a painfree group = reported no pain both at study onset and at one year.

b wrist pain group = reported pain both at study onset and at one year.
missed may be affected by recall bias. Our results with respect to chronologic age and wrist pain are consistent with the concept that the adolescent growth spurt is associated with a greater risk of injury. However, as discussed, chronologic age is an imperfect marker for determining phase of growth. A study of several years’ duration in which peak height velocity is determined would best assess this relationship. Although the findings suggest that wrist pain impedes training progression, the relatively short observation period and the modest training progression of the study group limit this analysis. Studies that observe training over a greater length of time in conjunction with larger changes in training are needed. In addition, gymnasts who reported wrist pain at the time the study was initiated may have already altered their training, potentially leading to an underestimation of the extent to which training is affected. Thus, to truly appreciate the effect of wrist pain upon training, a study that follows gymnasts as they enter training (pain-free) and then observes the effects of the development of wrist pain upon gymnasts training at similar intensity levels would be desirable. Finally, other factors that can affect training, such as nutrition, coaching, individual technique, and equipment, were not assessed in this study.

CONCLUSIONS

Wrist pain due to repetitive loading is common among young gymnasts and does not appear to be transient in the face of continued training. Adolescents between 10 and 14 years of age are more likely to have wrist pain than gymnasts who are either below or above this age range. Although training appears to be affected adversely by wrist pain based upon self-report and training intensity measures, more study is needed in this area. Finally, young gymnasts should be encouraged to report symptoms of wrist pain to their parents, coaches, and physicians. In addition, physicians who care for youngsters involved in gymnastics should inquire about the presence of wrist pain symptoms. Though most gymnasts experience wrist pain only with gymnastics-related activities, because of the concern for injury to the distal radial growth plate, physician consultation for gymnasts with persistent symptoms is advisable.

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