

The Effectiveness of Balance Training Programs on Reducing the Incidence of Ankle Sprains in Adolescent Athletes

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Clinical Scenario

Ankle sprains are one of the most common sport-related injuries treated by rehabilitation professionals. These injuries often result in lost participation and can lead to subsequent injury episodes. Therefore, it is important to determine appropriate means of preventing these injuries. There has recently been an increase in the popularity of balance training programs for the prevention of knee anterior cruciate ligament (ACL) injury, with some thought that starting these programs in younger athletes may be most beneficial. However, there is the potential that these types of training programs may also be beneficial for decreasing the risk of other lower extremity injuries, including ankle sprains in the adolescent athlete.

Focused Clinical Question

Are balance training programs effective at reducing ankle sprain injury rates in adolescent athletes?

Summary of Search, “Best Evidence” appraised, and Key Findings

- The literature was searched for studies of level 2 evidence or higher that investigated the effect of balance or proprioceptive training programs on ankle sprain incidence in adolescent athletes.
- Two high quality RCT and 2 cohort studies were included.
- Two studies demonstrated reductions in ankle sprain injury rates following balance training programs that included preseason and in-season supervised sessions.

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- Differences were not noted between control subjects and those that participated in either a home-based or an in-season only balance training program.
- Subject compliance was higher in the two studies that had supervised training sessions.

Clinical Bottom Line

There is moderate evidence to support the use of a supervised balance training program that includes both preseason and in-season supervised sessions to reduce the rate of ankle sprains in adolescent athletes.

Strength of Recommendation. Level B evidence exists that supervised preseason and in-season balance training programs are effective in reducing the rate of ankle sprains in adolescent athletes.

Search Strategy

Terms Used to Guide Search Strategy

- **Patient/Client Group:** adolescent OR high school AND athlete
- **Intervention (or Assessment):** balance OR proprioception OR training AND prevention,
- **Comparison:** no intervention AND control
- **Outcome(s):** ankle injury AND incidence OR risk

Sources of Evidence Searched

- The Cochrane Library
- PEDro Database
- Medline
- CINAHL
- Sport Discus
- Additional resources obtained via review of reference lists and hand search

Inclusion and Exclusion Criteria

Inclusion

- Studies investigating multiple lower extremity injury rates if subanalyses for ankle sprains were reported.
- Level 2 evidence or higher
- Limited to English language
- Limited to humans
- Limited to the last 10 years (1998-2008)

Exclusion

- Studies using multi-component programs (balance + plyometrics and/or strength, etc)
- Mixed subject pool (adult and adolescent)

Results of Search

Four relevant studies^{1,2,3,4} were located and categorized as shown in Table 1 (based on Levels of Evidence, Centre for Evidence Based Medicine, 1998).

One additional study⁵ investigating balance training and injury prevention in adolescents was located but not included in this CAT because the results did not provide enough data to compare relative risk specific to ankles sprains.

Best Evidence

The following studies were identified as the “best” evidence and selected for inclusion in the CAT (Table 2). Reasons for selecting these studies were because they were graded with a level of evidence of 2 or higher, studied a balance training intervention in adolescent athletes, and described the effect of the intervention on the outcome of interest (rate of ankle sprain injuries).

Implications for Practice, Education and Future Research

Only 2^{2,3} of the 4 studies reviewed in this CAT demonstrated a significant reduction in ankle sprain injury risk. These findings indicate that in general, balance training programs are moderately effective in reducing the risk of ankle sprains in adolescent athletes. There were some important differences in the design of the balance training programs that may have resulted in the aforementioned findings, including

Table 1 Summary of Study Designs of Articles Retrieved

Level of Evidence	Study Design/ Methodology	Number Located	Author (Year)
1b	RCT	2	Emery et al (2007) ¹ McGuine et al (2006) ²
2b	Cohort	2	McHugh et al (2007) ³ Malliou et al (2004) ⁴

Table 2 Characteristics of Included Studies

Study Design	Emery et al (2007) ¹ Cluster RCT	McGuine et al (2006) ² RCT	McHugh et al (2007) ³ Cohort	Malliou et al (2004) ⁴ Cohort
Participants	920 high school male and female basketball athletes (12-18 yr, median = 16). Randomized by school via computer generation of randomized numbers. Subjects were eligible if they were high school juniors or seniors and on their interscholastic basketball teams. Subjects were excluded if they had an injury within 6-weeks that prevented full participation in basketball at the start of the season, had a history of systemic disease or neurologic disorder.	765 high school male and female soccer and basketball athletes (14-17.5 yr). Approximately 2/3 of the subjects in each group were female. Teams were randomized into experimental or control groups. Subjects were eligible if they were included on the school's interscholastic roster and were injury free on the first day of preseason practice. Groups were comparable at the start of the study. 90% follow-up in experimental group.	125 males playing on two high school varsity football teams over the course of 3 seasons (15-18 yr). Categorized according to BMI and ankle sprain history as minimal, low, moderate, or high risk of sustaining a subsequent ankle sprain. Subjects in the low, moderate or high risk group participated in the balance training intervention. Subjects with minimal risk served as controls. Pre-intervention data also served as control data. 84 varsity players were included in the pre-intervention period (61 subjects were followed for 1 season, total = 107 player-seasons).	100 young soccer players from 4 teams (15-18 yr). Team randomization (2 teams as experimental and 2 teams as controls). Groups comparable at the start with respect to age, height, weight, and balance stability indices. No mention of the number lost at follow-up.

(continued)

Table 2 continued

Study Design	Emery et al (2007) ¹ Cluster RCT	McGuine et al (2006) ² RCT	McHugh et al (2007) ³ Cohort	Malliou et al (2004) ⁴ Cohort
Intervention Investigated	<p>Home-based basketball-specific balance training program using a wobble board (20 min).</p> <p>5-min sport-specific balance training warm-up component done approximately 5x/week before each practice.</p> <p>Program progressed at 2 and 4 weeks with each team.</p> <p>Subjects kept self-report compliance journals.</p> <p>No blinding of subjects or therapists.</p> <p>Assessors were blinded.</p>	<p>5-phase balance training program performed before or after practice.</p> <p>Phases 1-4 consisted of 5 sessions per week for 4 weeks in the pre-season.</p> <p>Phase 5 consisted of 3 sessions per week for 10 min in-season.</p> <p>Each balance exercise was performed for 30 seconds with a 30-second rest interval.</p> <p>Exercises progression: (1) single-leg on firm surface with eyes open and closed, (2) functional sport activities while maintaining a single-leg balance, (3) double-leg balance on balance board, (4) balance board single-leg balance with eyes open and closed, (5) functional sport activities on the balance board.</p> <p>No blinding of subjects, therapists, or assessors.</p>	<p>Single-leg balance training on a foam stability pad.</p> <p>5 min on each leg, 5 days/week for 4 weeks in the pre-season.</p> <p>5 min on each leg 2x/week for 9 weeks during the season.</p> <p>Program performed as a station during regular weight training sessions under the supervision of an athletic trainer during the season.</p>	<p>20 min sessions twice a week over the course competition performed in a supervised setting.</p> <p>Exercises performed on the Biodex Stability System, mini trampoline and balance boards.</p> <p>An attempt was made to maintain balance during soccer specific activities such as agilities and heading.</p>

Outcome Measure(s)	Primary Outcome: All injuries that required medical attention, took the athlete out of the session (practice or game) or resulted in them missing the next session Secondary Outcomes: Subject compliance	Primary Outcome: Rate of ankle sprains. Secondary Outcomes: Subject compliance.	Primary Outcome: Incidence of lower limb injuries. Incidence of injury severity. Secondary Outcomes: Balance ability (Total Index, A-P Index, M-L Index).
Main Findings	Significant decrease in acute-onset injuries [$p=0.047$, $RR=0.71$ (95% CI; 0.5-0.99)] No significant reduction in ankle sprains in the training group [$p=.15$, $RR=0.71$ (95% CI; 0.45-1.13)] 60.3% of the training group participated in the home-based training program as collected via self-report compliance procedure Median number of self-report home-based sessions was 9 (range 0-43)	During pre-intervention period, 25% (21/84) subjects sustained an inversion ankle sprain. Prevalence of non-contact ankle sprains was significantly reduced ($P < 0.01$, 18% to 4%) for at risk subjects who participated in the balance training program. Injury incidence for subjects participating in the intervention was significantly lower ($P < 0.01$) following the training [0.5 (95% CI, 0.2-1.3)] compared to pre-intervention [2.2 (95% CI, 1.1-3.8)].	No statistically significant differences in any lower extremity injury rates, including ankle sprains (22 in trained group, 38 in control). Significant improvement in all 3 balance indices in the trained group following training (post) compared to prior to training (pre) with no differences across time in the control group.

(continued)

Table 2 continued

Study Design	Emery et al (2007) ¹ Cluster RCT	McGuine et al (2006) ² RCT	McHugh et al (2007) ³ Cohort	Malliou et al (2004) ⁴ Cohort
Level of Evidence	1b	1b	2b	2b
Validity Score (if applicable)	PE德罗 6/10	PE德罗 6/10	NA	NA
Conclusion	Non-significant, but clinically important trend towards decreasing ankle sprains with a home-based in-season program.	Decrease of 38% of ankle sprains in the high school soccer and basketball athletes participating in the balance training program that included both pre-season and in-season training and monitoring by team staff.	Injury reduction in non-contact ankle sprains of 77%, was enough to reduce the increased risk of ankle sprains associated with high BMI and history of previous ankle sprains found in a previous study.	Non-significant difference in ankle sprains in young soccer players following an in-season training program.
			Overall reduction in risk of 77% (95%CI, 31-92%). 90.2% compliance rate (minimum 34 of 38 sessions attended, 20 pre-season and 18 in-season).	

the timing of program implementation and subject compliance in completing the required training sessions.

The two studies^{2,3} that reported significant reductions in ankle sprains used balance training programs that had both preseason and in-season components and were performed in a team setting as part of the regular training or practice session, thus were supervised by a coach or athletic trainer. These two studies also reported better subject compliance ($\geq 90\%$). The home-based program,¹ which included a short group training component, was dependent upon subjects performing the majority of the balance training exercises on their own. The findings of this study demonstrated lower subject compliance (60.3%) with subjects participating, on average, in 9 training sessions (range 0–43). The other study⁴ that did not find a reduction in ankle sprains only used an in-season program and did not report subject compliance.

Clinicians implementing injury prevention programs should consider including a supervised preseason phase that progresses from basic balance exercises (eyes open, firm surface) to more challenging exercises (eyes closed, uneven support surfaces, sport-specific drills). The program should then transition to a supervised in-season phase, where exercises continue to progress in difficulty, although at a lower volume and frequency than used in the preseason phase. Athletes should be educated that participating in each training session is important, and their compliance with the training program is an increased benefit to them.

Future research should include well-designed prospective studies that allow for blinding of the assessors to improve study quality, longer follow-up, and longer intervention periods that span across seasons or multiple years. Studies should also investigate the effect of balance training programs on injury rates in a variety of girls' and boys' sports, compare variations of program design (timing, frequency, duration, etc.), and determine the most effective balance progression. This CAT should be reviewed in two years to determine whether additional best evidence has been published that may change the clinical bottom line for this specific clinical question.

References

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