

Readiness for En Pointe Work in Young Ballet Dancers

Are There Proven Screening Tools and Training Protocols for a Population at Increased Risk of Injury?

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Abstract

To progress to a high level in classical ballet, en pointe is a requirement. The aim of this literature review was to evaluate the available evidence relating to readiness for dancing en pointe, including injury rates in the adolescent dancer population, screening tools, and pre-pointe training methods. It has been emphasized that young dancers are a demographic at increased risk of injury, especially as they progress through the growth spurt and increase their training hours. Dancers are commonly screened at the pre-pointe level, but unfortunately the majority of evidence resulting from this process, as reported in the literature, is subjective in nature. Hence, there is large variance regarding an appropriate time or level to commence en pointe training, and it remains unclear what dance teachers should be looking for in making this decision. A further paucity of evidence is demonstrated with regard to pre-pointe training protocols or instruction; in this review, no published literature was found on the topic. As such, there is a clear need for further study of pre-pointe screening and en pointe training protocols.

To progress to a high level in classical ballet, en pointe is a requirement rather than an option. En pointe requires close to

maximal plantar flexion at the ankle and tarsal joints, resulting in the dorsum of the forefoot positioning in a direct line with the anterior aspect of the tibia.¹ This allows the dancer to rise onto the padded distal end, or toe box, of her pointe shoes. Pointe shoes differ from ballet slippers in that they have a rigid vamp, toe box, and stiff shank. These characteristics allow the dancer to dance on the toe tips more safely and for longer duration in comparison to ballet slippers.

Classical ballet is physically demanding, especially when dancing en pointe, with forces directed through the foot potentially increasing up to 12 times normal body weight.^{2,3}

Traditionally en pointe work begins when the dancer is around 12 years of age.^{4,5} It is assumed that by that age the dancer will have participated in at least 3 or 4 years of classical ballet training, and therefore will possess adequate cognitive ability, strength, technique, alignment, coordination, and bone development.⁵⁻⁸ Without adequacy in these areas, excessive stress may be placed on trunk, pelvic girdle, leg, ankle, and foot, increasing the potential for injury.^{5,9,10}

In dance, like any physical activity, there is an associated risk of injury. Professional dance companies have variously reported that 67% to 95% of their dancers are injured on an annual basis.¹¹⁻¹⁶ Broad statements have been made in the literature regarding younger dancers, particularly adolescents, being at a higher risk of injury than their professional counterparts.^{6,10,11,17} Unfortunately, the literature related to this population is limited, lacking in detail, and does not lend itself to direct comparison due to differing methods of data collection, age variation of individuals, inconsistency in classification of injury, and limited recording of the dance form during which the injury resulted.

Chronological age has historically been used as the criterion for commencement of en pointe training.^{2,4,5} However, many investigators now suggest that parameters other than or in addition to chronological age must be taken into consideration when making this decision.^{4,5,10} Parameters that have been proposed include years of training, combined ankle and foot plantar flexion range of motion, lower extremity strength, neuromuscular control, and skill acquisition.^{4,7,8} Simply put, there is no standardized method for assessing readiness for en pointe training, and importantly, no evidence to indicate current methods are appropriate to ensure a successful and safe transition to this dance form. Within the assessment tools that exist,

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the methodology lacks valid or reliable measurement. In addition, there has been little discussion in the literature regarding who is best qualified to conduct screenings.

Once en pointe readiness has been assessed and any impairment identified, a pre-pointe training program is commonly introduced.^{4,7} The term pre-pointe is relatively new in the dance world and defines training that the young dancer undertakes in class, as well as any remedial or technical work required. The aim of pre-pointe training is to facilitate a smooth and safe transition to dancing en pointe. A range of methods is employed by ballet schools, including additional technique classes, body conditioning classes, specific pre-pointe exercises, and education regarding the use and care of pointe shoes.^{7,8} As with assessment of readiness for en pointe work, no standardized program exists; each ballet school will commonly use a combination of various training methods based on teacher experience, curriculum requirements, and ideally students' individual needs.^{7,8}

The aim of this literature review was to evaluate empirically the available evidence in relation to readiness for dancing en pointe, including injury rates in the adolescent dancer population, screening tools, and pre-pointe training methods.

Methods

Search Strategy

A search of Google Scholar with the term pre-pointe initially returned 78,700 results. As many of the scientific papers were not relevant to dance, a Population Intervention Comparison and Outcome (PICO) search strategy was developed (see Table 1 for full description).

Table 1 PICO Search Strategy

Population	Dance, Pre-pointe, Adolescent Dancers
Intervention	Screening or Training
Comparison	No Intervention
Outcome	Applicability

Databases were searched from their date of inception to October 2016. The electronic search was performed on the following databases: CINAHL, Medline, PubMed, and SPORTDiscus. Reference lists of the relevant studies were manually searched to identify potentially eligible studies (the so-called “snowball technique”). The search strategy centered on the terms pre-pointe, screening, training, and dance. The search terms and strategies are summarized in Table 2.

This literature search involved peer reviewed journal articles that included original research, secondary research, and literature reviews. The combination of sources provided information regarding injury incidence and prevention, dance screening and assessment tools, factors relevant to the commencement of pointe training, and currently used pre-pointe training programs and tools.

Study Selection

The titles and abstracts from the studies identified by the search strategy were screened by the lead author (CA) to determine relevance to the topic. Items were excluded if they were not relevant to the topic, initially by title and abstract, followed by full text evaluation. Studies included were limited to English language publication.

Results

The search strategy resulted in 2,108 articles. The majority of these (1,765)

were not relevant to dance. Additionally, while 322 included dance as a key topic, they had no relation to ballet, pointe, or an adolescent dance population. All articles that were not of relevance to this review were excluded.

Through a systematic process, shown in Figure 1, a total of 27 studies were utilized in this review. This included 26 peer reviewed journal articles and one editorial.

The key themes summarized from the retained articles include the following: prevalence of injury in a young dancer population; general dance screening and assessment tools; en pointe requirements; and pre-pointe screening protocols. No published literature was found on guidelines for pre-pointe training; however, it was alluded to in some of the studies.

Discussion

Injury Associated with Young Dancers

The majority of investigators suggest that the greatest proportion of dance injuries occur during adolescence.^{6,10,11,17} Three longitudinal studies support this to varying degrees, with rates of injury in this population ranging between 32% and 51%,¹¹ 42.6%,⁹ and 85.9%.¹⁸ However, due to differing methodology and variance in population demographics, these studies cannot be directly compared.

Gamboa et al.¹¹ retrospectively analyzed screening data, injury surveillance data, and treatment records

Table 2 Search Terms and Variations

Terms Used	Search Terms	Boolean Modifiers Used
Pre-pointe*, pre point*	Pre-pointe*, pre point*	
Screening	Pre-pointe*, pre point*	AND Screening
Training	Pre-pointe*, pre point*	AND Screening OR Training
Danc*	Pre-pointe*, pre point*	AND Screening OR Training AND Danc*

*Asterisk is a wildcard symbol that in searching broadens the search term – i.e., pre-pointe, pre pointe, pre-pointes, pre points, and dance, dancing, dancer.

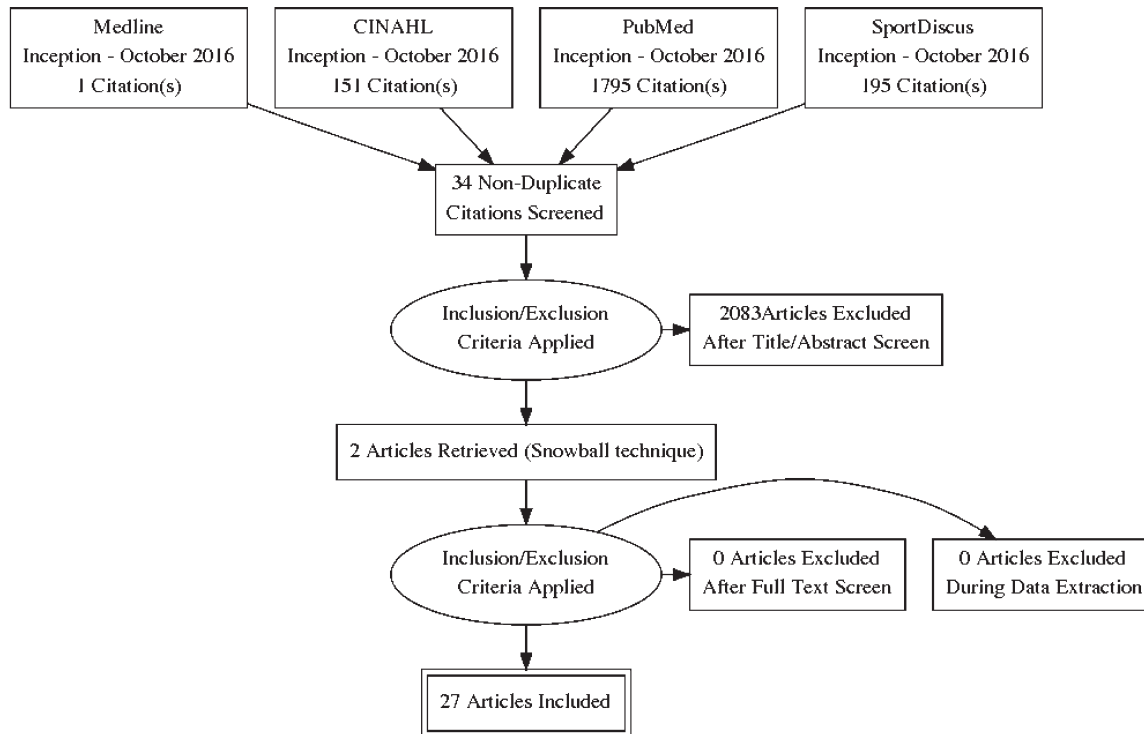


Figure 1 PRISMA Diagram – search process using terms “pre pointe” AND screening OR training AND dance.”

of 359 dance students between 9 and 20 years of age (average: 14.7 ± 1.9 years) over a period of 5 years. The study population was 20% male and 80% female. All subjects attended an elite pre-professional boarding school and participated in approximately 20 hours of ballet classes in addition to 2 hours of cross training and Pilates mat classes per week. An injury was considered to have occurred when a dancer sought at least one treatment session from a physical therapist at the school. Injuries were further classified according to region of the body, side of the body, type (traumatic or atraumatic-overuse), and month of onset. The greatest number of injuries occurred at the foot or ankle (53.4%), followed by the hip (21.6%), knee (16.1%), and back (9.4%). Most injuries were identified as being a result of overuse. While this study contributes to the body of literature in adolescent dance injuries, there were some methodological issues. The definition of when an injury occurred may limit its comparison to other studies. Also, the absence of breakdown by age group and the inclusion of older dancers does not allow for direct comparison

between age groups (differences in the influence of skeletal maturity, puberty, and dance level suggest that including dancers in the older age groups may skew the results).

Steinberg et al.⁹ recruited 1,336 female dancers between 8 and 16 years of age and recorded prospective data over a 15-year period. These dancers were classified as non-professional, drawn from a variety of dance schools, and all screened at the same dance medical center. As the dancers were at a pre-professional level, dance type and total participation hours varied across the cohort. Dancers participated in a minimum of 2 hours of ballet a week, and total dancing hours per week increased with age (average 3.2 hours at age nine, 8.8 hours at age 13, and 11.3 hours at age 16). The average age of the dancers was 13.3 years (standard deviation not given). An injury was recorded if the subject reported it (means of reporting not stated), and this was then followed by a physical examination. It was shown that as a subject increased in age there was a higher risk of injury, as evidenced by 10% of subjects experiencing an injury in the 8-year-old cohort in comparison

to 33% in the 16-year-old cohort. It was suggested that this increase was due to multiple factors, including: increase in training hours, pre-pubertal growth spurt, extending joint range of motion for better performance, and type of exercise, such as dancing en pointe.^{5,9,19}

This same article highlights that the greatest incidence (number of injuries in comparison to hours of training per week) of injury occurred in the 11- to 13-year-old cohort. This is of particular interest, as this age range marks the traditional time for beginning en pointe training. Although Steinberg recorded the anatomical location of injuries, it was poorly defined. Pathology and anatomical location were combined in some instances, and several joint complexes, such as the hip, were not mentioned. With inconsistencies in the recording of injury type and site, together with limited information about training hours and type of dance across age ranges, it is difficult to speculate if there was an underlying cause of injury.

Caine et al.¹⁸ studied 71 pre-professional dancers between 11 and 21 years of age, recording retrospective injury

data over a period of 8.5 months. All data were collected via a questionnaire that each dancer filled out at the end of the school year. The population included both male (38%) and female (62%) dancers, with the mean age of 17.37 years for males (95% CI: 16.07 to 18.67) and 16.41 years for females (95% CI: 15.69 to 17.12). All dancers trained 6 days per week, with total duration of training varying from 12.5 to 20 hours. The incidence of injury across the total age range was 85.9%; however, injury classification did vary from minor, such as blisters, to more severe (requiring time away from dance). Incidence of injury was highest in the 18 to 21 age group (4.55/1,000 hours), followed by the 14–18 year olds (3.41/1,000 hours), and the 11 to 12 year old age group (2.86/1,000 hours). In the female cohort, the lower extremity accounted for 91.55% of injuries. The hip (19.72%) and ankle (19.72%) were the most common anatomical sites of injury. It is important to note that the females had a significantly greater percentage of injury in both the ankle (19.72%) and foot (9.86%) than their male counterparts (ankle 6.98% and foot 6.98%). This finding is of interest as females' training traditionally includes time en pointe. Across all participants, the most common injury pathology was tendinitis (22.81%), followed by sprain (16.67%) and strain (14.91%), all of which are injuries closely associated with pointe training.

This study contributes recent data on injury prevalence in a pre-professional dance population in addition to highlighting different rates and locations of injury between age groups. However, it is important for several reasons to view the results with caution in the context of younger populations. First, the largest rate of injury was in the older students (18 to 21 years); second, there was a broad scope of classification of injury; and third, the sample was non-random, and potentially schools more concerned with the safety of their dancers were those likely to participate. Future research is required involving a broader range of schools, with different teaching styles and student numbers, to gain a more

comprehensive understanding of this issue.

Poggini et al.¹⁰ and Luke and Micheli⁶ described common injuries that present during the pubescent growth spurt, or in young dancers generally. Both propose that adolescent dancers are at a high risk of overuse injuries, typically as a result of functional overloading, with growth spurt seen as a physiological risk factor.^{6,10,20,21} The Poggini et al. study divided common risk factors into intrinsic (muscle tendon imbalances and anatomical malalignments) and extrinsic (training errors, footwear, and training surfaces) categories. While the range of overuse injuries reported in ballet is extensive, common injury sites in an adolescent population most notably include the knee (in particular patella tendon issues), foot and ankle (tendinitis), toe joints, hip, lower back, and lower leg.

Luke and Micheli⁶ emphasize the need for involvement of a dance medicine professional to promote an understanding of the complex nature of training and injury prevention in the young dancer population. Factors that should be taken into consideration when managing injuries in these dancers are growth, flexibility, degree of turnout, muscle imbalance, and en pointe work.⁶

While there are some epidemiological studies pertaining to injury rates and incidence in an adolescent dance population,^{9,11,18} further research is needed that has a consistent methodological approach, so that data can be readily compared and cross-analyzed.

General Dance Screening

The screening of dancers is not a new concept. Experienced teachers and choreographers have undertaken screening for a range of reasons, including aesthetics and identification of technical faults and anatomical weaknesses.²² Most commonly, physical and medical screening occurs at two main stages in a dancer's development, the pre-pointe level of ballet training and when advancement to a professional career becomes a consideration.²²

For over two decades, medically driven screenings have been determined to be of importance for injury

risk reduction.²²⁻²⁶ Liederbach²⁵ notes the significance of uncovering pathology and quantifying risk, determining attributes necessary for participation, developing characteristics for a given level of performance, and establishing individual baseline data for educational and rehabilitative goal setting.

A summary of the most commonly accepted components of medical and physical screening is shown in Table 3.

Examination of the literature identified that there was a lack of consistency among the screening processes used. While the screening methods have been described, there is little information regarding their reliability or validity. The outcome measures used in the assessment of range of motion, postural evaluation, and technical ability are not consistent. While dance programs may need to adapt and individualize segments of the screening tools they use, from the standpoint of research in the field at least, there is clearly a need for a standardized, evidence-based medical and physical protocol that is both valid and reliable.

En Pointe Requirements and Pre-Pointe Screening Protocols

A survey of 74 American dance schools conducted by Meck et al.² in 2004 found that eight pre-pointe evaluation components were commonly used: age, years of dance experience, present injuries, past injuries, relevé alignment and stability, plié alignment and stability, tendu strength and activation of the intrinsic foot muscles, and upper body alignment and stability. Age was the most frequently reported evaluation component (95.9%) across all schools. The minimum age considered for progression to en pointe training was reported to range between 9 and 13 years. The majority of schools (39.2%) identified 12 years as the most appropriate age.

The literature suggests that the criterion of chronological age alone is insufficient as an indication for commencement of en pointe training.^{2,4,5,7,8} Richardson et al.⁴ noted the importance of assessing strength with control and skill acquisition in pre-pointe screening, in conjunction with the traditional criteria of age, foot and

Table 3 Summary of Screening Components^{11,22-25,27}

Screening Area	What is Encompassed
History	Past and current training habits Dance history and genres Injury history
Subjective Examination	General health Menstrual patterns Nutritional practices Weight (BMI)
Physical Examination	Posture Specific technical ability Range of motion (upper limb, spine, hip, knees, foot, and ankle) Flexibility (global and specific) Strength (global and specific)

ankle plantar flexion range of motion, and years of training. For their own study, these investigators recruited 37 pre-pointe students from two professional ballet schools, with an average age of 12.3 years (range: 9 to 17 years) and average years of ballet training of 6.5 (range: 1 to 12 years). All nine tests used by Richardson et al.⁴ had either previous reliability testing or a methodology that had been utilized in earlier dance-related studies. In addition to individual testing, the dance teachers involved, who were blinded to test outcomes, were asked to grade each student according to their personal perception of her technical skill and readiness to dance en pointe. This was undertaken using a 4-point Likert-type scale, where 0 = poor and 4 = excellent. The nine tests were analyzed together using MANOVA in an attempt to correlate teacher classification for en pointe readiness with dancers' age or experience. No statistical significance was achieved; however, three of the tests (Sauté test, Airplane test, and Topple test) did correlate with teacher classifications.

While these results suggest that evaluation of functional readiness to begin en pointe training may be of value, the results must be treated with caution. All testing occurred in a single session, which could induce fatigue-related error for both the dancers and assessors. Furthermore, the dance teachers' subjective opinions in relation to readiness for en pointe training could vary significantly, and there is no agreed upon standard by which to evaluate this assessment.

Shah⁷ went further to highlight that while some dance teachers will ask for radiographs of a student's feet to assess readiness for pointe work, the radiographic appearance of growth plate closure does not correlate with the completion of boney maturation, which will occur much later into the teenage years. Additionally, it was stressed that if a dancer were to wait for bone maturity to start pointe training it might very well limit her opportunity to attain a position in a pre-professional or professional ballet company. Rather than using age or boney maturity, Shah⁷ noted the importance of taking a thorough history and physical examination. In history taking, it was proposed to note such factors as age, teacher recommendations, years of dance training, hours of training per week (ballet and other dance forms), dance goals, difficulties with specific technique in class, and injuries both past and present. In the physical examination, measures of plantar flexion (greater than 90°), assessment of positions in first, second, and fifth positions and the compensation strategies observed, relevé (multiple positions), alignment of anterior tibia and dorsum of foot, relevé passé, grand plié (multiple positions), Topple test, Airplane test, and Saute test are recommended. It was highlighted that if the above criteria are used, then some dancers may never possess the capability to dance en pointe. However, currently there is no published literature on whether limiting those dancers from taking part due to medical screening reduces their

risk of injury either in the immediate or long term.

Ultimately, it became apparent in the review of available research that despite statements in the literature about the importance of appropriate evaluation criteria, a standardized screening or evaluation tool does not exist to assess a dancer's readiness for en pointe work.

Pre-Pointe Training Regimens

While it is noted across the literature that a dancer wishing to progress to dancing en pointe requires certain levels of technical ability, strength, flexibility, maturity, and coordination,^{5-8,20} there is no formal research to validate the introduction of pre-pointe training. Shah⁷ noted that as no universal standards exist, it is difficult for both dance schools and teachers to know how hard to train students or predict how an individual may progress. Variation in students' natural capabilities—both physical and mental—and schools' training methods along with class structure, mean that some students may require more input than others in transitioning to dance en pointe. Unfortunately, no literature was found in this review that addresses whether dancers who undertake a pre-pointe program are at an advantage over those who do not, or whether completion of these programs would decrease the risk of injury associated with pointe work. However, pending such research, common clinical sense would argue that a dancer planning to undertake a rigorous discipline such as pointe work would benefit from a

dedicated program of strength training and conditioning.

Limitations of Review

A limitation of this review is that the screening of literature was completed by a single author, thus reducing its rigor. In addition, use of the search term “pre-pointe” rather than “pointe” may have reduced the number of relevant articles returned in the search.

Conclusion

Throughout the search of the literature pertaining to factors that influence a young ballet dancers’ readiness for dancing en pointe, several key themes were identified. It was found that young dancers are a demographic at increased injury risk, especially as they increase in age and training hours. While it was not directly recorded, it was often eluded to that when dancers progress to a certain point in their career, the transition to dancing in pointe shoes becomes a requirement, which may be a potential risk factor for injury. As the literature pertaining to this fact lacks consistency of recording methods and demographics, it is difficult to calculate the extent of the risk.

Dance screening is not a new concept, and it has been used to evaluate aesthetics, technical strengths and weaknesses, as well as medical and physical issues. There is a large variance through the literature as to what these screenings should entail, and many of the physical tests currently used lack reliability or validity testing. It is important to note that psychological screening was not mentioned in the literature searched.

Dancers are commonly screened at the pre-pointe level, but unfortunately the results of such screenings as reported in the literature reviewed here were largely subjective in nature. Hence, there was considerable variance as to an appropriate time or level to commence en pointe training, and it was unclear what dance teachers may be looking for in making that decision. Judging by the literature reviewed, a consistent assessment criterion does not exist to assist in determining if a dancer is ready to begin en pointe work.

Further paucity of evidence was demonstrated with regard to pre-pointe training protocols or instruction. While studies stressed the importance of a dancer possessing adequate mental maturity and physical ability, no published literature was found on the best way for these students to transition to this new dance form. As such there is a strong need for further research in relation to pre-pointe screening and training protocols.

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