

# Ankle Subtalar Joint Range of Motion: Does it correlate with Foot & Ankle Injuries in Professional and Collegiate Basketball Players?

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## Background:

- Foot and ankle (F&A) injuries comprise a significant portion of injuries in the National Basketball Association (NBA)
- Lateral ankle sprains are the most frequent orthopaedic injury
- These injuries result in significant morbidity (approx. 20-50% of individuals with ankle sprains have some form of subsequent documented disability)
- Stable subtalar joint (STJ) motion is crucial to prevent excessive Talocrural Joint (TCJ) stresses and therefore injury in basketball athletes

## Aim

- Our aim is to determine the relationship of ROM, more specifically at the STJ, obtained during preseason workouts with ankle injuries amongst athletes of multiple teams over the course of a basketball season

## Significance of Study

- Prior studies looking prospectively at the correlation of ROM at the ankle and injuries focused on the TCJ and failed to account for the STJ.
- To our knowledge this would be the first study to correlate preseason ROM of the STJ with ankle injuries in basketball players.

## Methods

- Bilateral TCJ and STJ range of motion measurements in dorsiflexion (DF), plantarflexion (PF), eversion (E) and inversion (I) along with bilateral weight bearing ankle x-rays were taken during preseason physicals of an NBA G League team and two collegiate male basketball teams by a standardized protocol.

## Primary Endpoint

- Number of ankle injuries defined as that causing functional limitation of play, substitution, or stoppage of play.
- This definition is a modified version of that used in earlier studies investigating ankle injuries in basketball

## Exclusion Criteria:

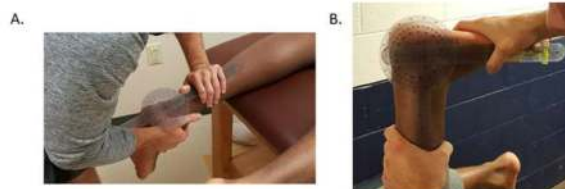
- Extremities that tested positive for the anterior drawer test or talar tilt test at the time of the examination
- Ankle brace wear

Variable	Overall (n=77)	Standard Deviation
Age (years)	21.3	2.3
Height (inches)	76.1	2.9
Weight (lbs.)	200.86	21.71
Dorsiflexion (degrees)	16.56°	5.79°
Plantarflexion (degrees)	37.52°	12.05°
Inversion (degrees)	13.38°	4.45°
Eversion (degrees)	7.06°	3.10°
Combination motion (degrees)	20.44°	5.99°

**Table 1.** Demographic Data and Talocrural/Subtalar Range of Motion. Combination motion= Inversion + Eversion. All values expressed as mean values unless otherwise specified. n= number of extremities

Risk Factor	Injured Extremities %		
	With risk factor	Without risk factor	P Value
Combination Motion $\geq 18^\circ$ And Subtalar Difference $\geq 5^\circ$	19.2% (10/52)	4.0% (1/25)	<b>0.0068</b>
Subtalar Mobility Index $\leq 3.9$	20.4% (10/49)	3.6% (1/28)	<b>0.0487</b>
History of Previous Injury	10.8% (4/37)	17.5% (7/40)	0.52
Shoe Type- High Top	29.4% (5/17)	10.0% (6/60)	0.0580
Pre Game Taping	10.0% (2/20)	15.8% (9/57)	0.7181
Bony Abnormalities on Preseason X-rays	12.5% (2/16)	14.8% (9/61)	1.00

**Table 2.** Risk Factors for Injury. 2 tail Fisher Exact Test was used to compare categorized risk factors with foot and ankle Injury. All significant values in bold ( $p < 0.05$ ). Combination motion= Inversion+Eversion. Subtalar difference= Inversion-Eversion. Subtalar Mobility Index = |combination motion/subtalar difference|. Total n included in analysis=77. Total Injured Extremities= 11.



**Figure 1.** Representative Pictures for Measurement Procedure

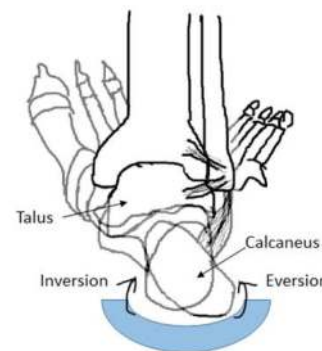
- Inversion/Eversion-While prone and with the tibia stabilized in the sagittal plane, the midfoot is locked with the TCJ at neutral and then the calcaneus is inverted/everted. The goniometer is placed at the midpoint between malleoli with the stationary arm in the midline of leg and the moving arm at the midline of calcaneus.
- Dorsiflexion/Plantarflexion-While prone and with the knee at 90 degrees, using one hand the bottom of the foot is brought into dorsiflexion/plantarflexion. The goniometer is placed with the fulcrum aligned slightly inferior to lateral malleolus. The stationary arm is in the midline of lateral aspect lower extremity in line with fibular head. The moving arm remains parallel to 5<sup>th</sup> metatarsal.

## Results

- Total of 40 athletes (12 G League & 28 collegiate) participated (mean age: 21.3)
- A total of 3 extremities in 2 athletes were excluded
- There was a total of 11 foot & ankle injuries (9 lateral ankle sprains, 1 metatarsal stress fracture, and 1 plantar fascia tear)
- Total 4,196 athlete exposures (games + practices)
- Injury rate of 2.62 per 1000 athlete exposures
- Extremities with a combination motion (Inversion + Eversion)  $\geq 18^\circ$  and a subtalar difference (Inversion-Eversion)  $\geq 5^\circ$  were 12.76 times more likely to sustain a F&A injury ( $p=0.0181$ ).
- A significant difference was noted between extremities with a "subtalar mobility index" (|combination motion/subtalar difference|)  $\leq 3.9$  and the incidence of F&A injury ( $p=0.0487$ ) (Table 1).
- No significant differences were found when comparing shoe type (low top, high top, or high top with air cells), pregame taping, history of previous injury, DF, PF, E, I, or bony abnormalities seen on x-ray.

## Discussion

- Our findings suggest that an increased arc of subtalar motion  $\geq 18^\circ$  favoring inversion  $\geq 5^\circ$  is a vital factor for predicting injury as these extremities had a greater than 12 times higher incidence of F&A injury.
- Additionally, we have defined a "subtalar mobility index" where extremities with a value of  $\leq 3.9$  had a statistically significant correlation with the incidence of F&A injury.
- This results of this study suggests special attention should be directed at the STJ to help identify at risk athletes during pre-season physical examinations.



**Figure 2.** Range of motion of the Subtalar Joint (STJ) (Right Foot Pictured). Combination motion concept: Combination motion= Inversion + Eversion. The increased arc of subtalar motion should be stable. An increased arc  $\geq 18^\circ$  favoring inversion  $\geq 5^\circ$  is predictive for injury. Extremities with these parameters had a 12.76 times higher incidence of foot & ankle injury ( $p=0.018$ )