Tibial Torsion, Foot Progression Angle and Toe Out: A Literature Review to Support the Use of a New Clinimetric Tool to Determine Lower Extremity Orthotic Alignment in Stance Control Orthoses
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INTRODUCTION
A new clinimetric tool has proven to be useful (Reese 2011) in the determination of biomechanical factors for the fabrication of a stance control orthosis (SCO). The tool was developed for the practical means of transferring skeletal transverse plane axial determinants into the custom fabrication process. The literature search revealed that several procedures have parallel definitions. The review clarified the definition for tibial torsion (LeDamany 1903), foot progression angle (FPA)(Losel 1996), toe out (Lehneis 1967) and line of progression (LOP)(Staheli 1985). In the fabrication of a SCO there is a critical need to match the anatomical knee and ankle axial centers with the orthotic componentry due to the dynamic nature of orthosis.

OBJECTIVE
The review clarified the clinical terms and matched the best description of the clinical technique for measurement of the LOP and the long axis of the foot (LAF) with the new clinimetric tool. The terms may also be linked to higher discovery procedures such as roentograms, computed tomography, fluoroscopy and ultrasound (Guven 2009), which are not practical in a clinical orthotics office. The discussion will be limited to direct goniometric means (Stuberg 1991) to establish a visual reference for transmitting the biomechanical features of the individual to the orthotic fabrication process.

METHOD
Various search engines were utilized, which included the U.S. National Library of Medicine PubMed, Google Scholar, and PogoFrog.

DISCUSSION
The range of tibial torsion from gestation through ambulatory weight bearing is slightly medial in the fetus through 20° of lateral rotation (Hutter 1949) in the adult. The twist of the tibia must be combined with rotation in the limb for a complete orthotic axial match. Rotation (Rosen 1955) occurs between the two segments of the limb, but does not include torsion of the femur. Since a SCO is applied below the hip joint, femoral neck angle (Yoshioka 1987) does not impact the rotational elements of the orthosis. On the other hand measurement of tibial torsion alone does not satisfy the fabrication criteria. Two-segment limb rotation, which does include the unlocking of the screw home mechanism of the knee and tibial torsion, must be accommodated in the fabrication of an SCO.

An amalgamated technique whereby the LOP is compared to the LAF (Eyadah 2001) appears to be the method best suited for use of the new clinical device. The LAF has no common definition. The point bisecting the width of the heel is the common proximal end of the LAF. Losel described the LAF as a line bisecting the heel, and running through the second toe. A line running through the second ray appears to be the biomechanical choice when compared to the four definitions in the literature for the distal LFA reference point. Mann in the Atlas of Orthotics describes the distal end of the long axis as running between the second and third toe.

CONCLUSION
The clinical method that combines a visualization of the LOP with the LAF is the technique that is best suited for the use of the new clinical tool. The LOP can be represented by a patient sitting on an exam table with a leg flexed to 90°. The femur and knee axis are perpendicular to the edge of the table, which allows the examiner to view the LOP as a line running down the whole limb. The femur is viewed with the hip in neutral internal or external rotation.

Placement of the new clinical tool on the plantar surface of the foot with the knee in full extension allows the clinician to align the LAF with the built-in goniometer. Extending the lower limb to full extension several times in a range of motion allows the examiner to visualize the LOP down the mid thigh-femur and through the tibial tuberosity (Wynne-Davies 1964) and perpendicular to the knee axis while maintaining the hip in neutral rotation. A bubble level on the goniometer pointer, when centered allows a transverse rotational degree reading that combines tibial torsion, limb rotation with the LOP with the lower limb in full extension. The rotational reading then can be transferred to the fabrication process through the use of the new clinical tool on the individual’s fabrication positive model.

The new tool serves both clinical and fabrication measurement and biomechanical visualization requirements for the fabrication of a custom SCO in a manner that is consistent with goniometric measurement.

REFERENCES
Staheli L. J Bone Joint Surg Am. 67A, 39±47. 1985