Essentials of Deformity Planning

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KEYWORDS

• Deformity • Deformity planning • Radiographic angles • Varus • Valgus
• Radiographic measurements • Osteotomy rules

KEY POINTS

- Physical examination of the entire lower extremity in dynamic and static phases is essential for a complete evaluation of a foot and ankle deformity.
- Radiographic evaluations should include pelvis, hips, knees, and ankles to provide practitioner with weightbearing analysis of joint and muscle influences.
- Deformity analysis should involve comprehensive knowledge of biomechanics as well as compensatory mechanisms of joints.

INTRODUCTION/HISTORY

Deformity planning is a process that is innate to even the most novice of surgeons. As we evaluate each patient clinically, we see a problem and can classify this as a deformity. It is how we come to this conclusion that needs to be reproducible and accurate. We each have different methods as to how we attain the end goal of deformity correction, and it is not the purpose of this article to change one's practice; however, it is the purpose to perhaps enhance the ability to achieve this quicker and with more reproducible outcomes. The authors discuss key elements to clinical evaluation, radiographic assessment, and osteotomy to better create that normal limb alignment.

CLINICAL EVALUATION

Physical examination of the entire lower extremity is essential for a complete evaluation of a foot and ankle deformity. There are instances whereby a foot and ankle deformity comes from compensatory mechanisms from a more proximal site; therefore,

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evaluation of the pelvis, femur, and tibia should be included with the ankle and foot. Practitioners should evaluate statically sitting, laying, and standing. Dynamic evaluation should be performed to see the soft tissue influences on the bone structure.

Goniometers may be thought of today as primitive tools but are a favorite to most planning surgeons. These simple devices are a lost art in today's ever changing digital world. Newer applications and programs allow for assistance in deformity planning but cannot replace basic knowledge when clinically assessing patients, and we must not forget about paper-doll cutouts and pen-and-paper drawings. Many planning modules for external fixators have software that is designed to use basic deformity parameters in assessing and finding the deformities. Inexpensive applications, such as Bone Ninja, can be a tool that allows a surgeon to, in real time, take pictures of radiographs or clinical deformities and perform the surgery in front of patients to see what the correction would be like. These programs can streamline deformity planning and allow images to be shared and discussed with colleagues. Whether you are using a digital device or pencil and paper, similar outcomes should be achieved and should ultimately allow the practitioner to isolate the deformity and pick the type of correction needed.

RADIOGRAPHIC ASSESSMENT

Radiographic assessment for most foot and ankle practices involved the ankle and below. Norms have been established regarding foot and ankle measurements.[1–12] It is essential in preparing for large deformity correction that proximal films be obtained to ensure no other influences are present. Commonly, long leg films should be obtained and evaluated. These radiographs are only possible if institutions have programs that allow stitching of the radiographs together or if they have full-length cassettes for radiographs that span from the pelvis to the floor. Practitioners should make sure they use a measuring device, whether it is a grid they place on the plate itself or a mag ball to allow for calibration. They should standardize their format with patella forward for all the films as well as accommodating with 1-cm heel lifts to make the pelvis even. Radiology technologists should be in tune with deformity and should understand the signs to watch for gross limb length discrepancy, including pelvic tilt, shoulder droop, and head tilt.

When assessing for a foot and ankle deformity, standard anterior posterior and lateral radiographs should be viewed. Additional films can be obtained with a calcaneal axial which and show frontal plan involvement but perhaps is better suited through Saltzman views, if clinics practices and equipment allow.[1,13] These views have been shown to allow the best visualization of the calcaneal tibial relationship.[9,14]

RADIOGRAPHIC EVALUATION

As stated before, radiographic assessment of deformity is crucial when planning procedures to correct the foot and ankle deformity. There are different planes that must be evaluated to objectively evaluate the magnitude of the deformity. For the sake of this article, pertinent radiographic angles are reviewed for the foot and ankle.

Ankle

Frontal plane analysis of the ankle is best suited with anteroposterior (AP) as well as mortise views. Care should be taken to include most if not all of the tibia in the film. The mortise view is often just to see congruity of the joint and is not normally used for angle measurements. The sagittal plane should be taken with medial malleoli against the cassette with the ankle at 90° (**Figs. 1** and **2**).