Malalignment and Malorientation in the Frontal Plane

**Malalignment**

Malalignment refers to the loss of collinearity of the hip, knee, and ankle in the frontal plane. Therefore, if the MAD exceeds the normal range, there is malalignment of the hip, knee, and ankle (see Fig. 1-8a). Frontal plane MAD may arise from four anatomic sources: (a) femoral frontal plane deformity; (b) tibial frontal plane deformity; (c) frontal plane knee joint laxity, including subluxation or dislocation; and (d) femoral or tibial condylar deficiency. These sources can be categorized as osseous, interosseous, and condylar.

We designed a malalignment test (MAT) to identify the source(s) of the MAD (Paley and Tetsworth 1992). The orientation of the knee joint line in the frontal plane has a known orientation to the tibial and femoral mechanical axes (MPTA and mL DFA) (Paley et al. 1994). Less than $85^\circ$ and greater than $90^\circ$ are considered to be abnormal for both the mL DFA and the MPTA and identify the femur and/or tibia as a source of the MAD (Fig. 2-1a and d).

The femoral and tibial frontal plane knee joint lines should be within $3^\circ$ of parallel in a standing position (Paley et al. 1994). The angle between the femoral and tibial joint lines is the JLCA. A JLCA greater than $3^\circ$ is abnormal and indicates either ligamentous laxity with opening of the joint on the lax side or loss of cartilage height as a source of the MAD (Fig. 2-1b and e). Another interosseous source of malalignment is medial or lateral subluxation of the tibia on the femur (Fig. 2-1b and e). Normally, the midpoints of the tibial plateaus and femoral condyles correspond within 3 mm.

The femoral and tibial joint lines are actually made up of two collinear half-lines representing the orientation of the medial and lateral femoral and tibial condyles, respectively. If there is a step or angulation between the two condylar joint lines, this is evidence of a condylar source of the MAD (Fig. 2-1c and f).

The MAT is performed directly on the radiograph (Fig. 2-2). There is no need to trace the bone onto paper. A sharpened film-marking pencil (e.g., DIXON Tru/Color Black 2225; Price Modern, Baltimore, MD) is better than wax markers, which make thick lines that are more difficult to remove. The pencil produces a fine line, which can be easily erased using an alcohol swab (Fig. 2-2a). A long ruler or the edge of another long radiograph is used to aid in drawing the lines (Fig. 2-2b). Before drawing any line, it is preferable to mark the joint center points that need to be connected (e.g., center of femoral head and center of knee).

A clear plastic protractor or goniometer is used to measure angles. Protractors are more accurate and reliable than are goniometers. Inexpensive or “complimentary” goniometers are often poorly made and are of questionable accuracy ($\pm 2^\circ$).
CHAPTER 2  Malalignment and Malorientation in the Frontal Plane

a. i

b. i

c. i

d. i

\[ \text{mLDFA} > 90^\circ \]

\[ \text{mLDFA} > 90^\circ \]

\[ \text{MPTA} < 85^\circ \]

\[ \text{MPTA} < 85^\circ \]