Radiographic assessment of the safe zone for medial oblique opening wedge high tibial osteotomy

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ABSTRACT

**Purpose.** To compare different cephalocaudal angles of the X-ray beam in measuring internal rotation of the proximal tibia that best demonstrates the safe zone.

**Methods.** 10 pairs of embalmed, disarticulated knee joints from 10 cadavers were used. Soft tissues around the proximal tibia and the proximal tibiofibular joint (PTFJ) were dissected to reveal the articular cartilage. A narrow area between the end of the articular cartilage of the posterolateral proximal tibia and of the PTFJ was identified as the safe zone with a U-shape metal used as a radiographic marker. Translation of the proximal tibia was controlled during internal rotation of the proximal tibia. Internal rotation of the proximal tibia that best demonstrated the safe zone (the U-shape metal at its most outermost point) was measured at 0º, 5º, 10º, 15º, 20º, and 25º cephalocaudal angles of the X-ray beam.

**Results.** The mean internal rotation of the proximal tibia that best demonstrated the safe zone at 0º, 5º, 10º, 15º, 20º, and 25º cephalocaudal angle of the X-ray beam were 50º, 45º, 37º, 32º, 23º, and 19º, respectively.

**Conclusion.** The safe zone was best demonstrated with 50º and 45º internal rotation of the proximal tibia at 0º and 5º cephalocaudal angles of the X-ray beam, respectively.

**Key words:** osteotomy; radiography; tibia

INTRODUCTION

The medial oblique opening wedge high tibial osteotomy (HTO) is a popular procedure for treating unicompartmental knee osteoarthritis without a fibular osteotomy. The osteotomy starts obliquely upward from the medial metaphysis of the proximal tibia and extends to the lateral cortex just above the proximal tibiofibular joint (PTFJ). The lateral end of the osteotomy must accurately point to a safe zone between the end of the articular cartilage of the posterolateral proximal tibia and of the PTFJ. Mis-direction of the osteotomy is common and may penetrate the articular cartilage. Anteroposterior

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and lateral radiographs of the proximal tibia cannot
demonstrate the safe zone clearly. We therefore
compared different cephalocaudal angles of the
X-ray beam in measuring the internal rotation of the
proximal tibia that best demonstrated the safe zone.

**MATERIALS AND METHODS**

10 pairs of embalmed, disarticulated knee joints
from 10 cadavers were used. Soft tissues around the
proximal tibia and the PTFJ were dissected to reveal
the articular cartilage. A narrow area between the
end of the articular cartilage of the posterolateral
proximal tibia and of the PTFJ was identified as the
safe zone with a U-shape metal used as a radiographic
marker (Fig. 1a). A line was drawn on the articular
surface 1 cm anteriorly parallel to the posterior
aspect of the proximal tibia. It was used as a reference
for measuring the rotational angle of the proximal
tibia (Fig. 1b). A 50-cm long wooden block with 2
adjustable clamps was placed on the X-ray table
(Fig. 1c). The proximal tibia of the specimens was
fixed with the clamps but could be rotated through
the distal tibia (Fig. 1d). Translation of the proximal
tibia was controlled during internal rotation of the
proximal tibia. The X-ray beam of the C-arm image
intensifier was vertically adjusted (0° cephalocaudal
angle). The rotation angle of the proximal tibia was
calibrated to 0° by a goniometer, based on the line
on the articular surface of the proximal tibia and
the floor of the wooden block (Fig. 2). The proximal
tibia was then internally rotated from 0º to 90º
until the U-shape metal at the safe zone was at its
outermost point under the C-arm image intensifier. A
radiograph was taken for the best assessment of the
safe zone. The procedure was repeated with 5º, 10º,
15º, 20º, and 25º cephalocaudal angles of the X-ray
beam (Fig. 2).

RESULTS

The mean internal rotation of the proximal tibia
that best demonstrated the safe zone at 0º, 5º, 10º,
15º, 20º, and 25º cephalocaudal angles of the X-ray
beam were 50º, 45º, 37º, 32º, 23º, and 19º, respectively
(Table).

DISCUSSION

As a radiographic marker for the osteotomy line, a
Kirschner wire is inserted from the medial cortex of
the proximal tibia and extends obliquely upward to
the lateral cortex. Accurate demonstration of the safe
zone during HTO decreases the risk of penetrating
the knee joint or PTFJ. As the articular cartilage
surface of the PTFJ at the tibial site is oblique in the
coronal plan,7 the safe zone was best demonstrated
with 50º and 45º internal rotation of the proximal tibia
at 0º and 5º cephalocaudal angles of the X-ray beam,
respectively. Other cephalocaudal angles of the X-ray
beam could demonstrate the safe zone with lesser
degrees of internal rotation of the proximal tibia,
but excessive tilting of the X-ray beam is close to the
operative field.

REFERENCES