

Nail-gun discharge distance, nail penetration, and patella fracture severity

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Introduction

A carpenter inadvertently nailed himself with a pneumatic nailer (nail-gun) causing penetration trauma into the superoanterior aspect of his right knee resulting in a longitudinal fracture through the patella. The extent of the nail penetration was such that it buried itself with the nail head flush with the knee surface. For several reasons, it was necessary to determine from the injury analysis the probable distance from the knee to the tip of the nailer at the time the nail was discharged.

Methods

The actual nailer involved in the incident and similar 2¼ inch long #10 nails were used in the tests. Nails were discharged into ½ inch plywood over 2x4's to simulate the work conditions on the date of the incident and to adjust the air compressor to a proper pressure setting. Four lower extremity cadaver specimens were then set-up to simulate the posture of the worker at the time of the incident. The anatomical location and entry angle of the nail was determined from medical records and x-rays. The nailer was placed over the cadaver along the estimated nail entry angle at distances of 0, 1, 4, and 8 inches to the knee. Nails were discharged at these distances and the amount of nail penetration was measured and the degree of resultant tissue pathology was observed and documented. The knee was dissected and the patellae excised for close observation and documentation of the fracture severity.

Results

A probable range of 80-100 psi was determined for the work conditions and 100 psi was selected for the cadaver tests. The amount of nail penetration into the patella was found to be generally similar to that into the wood set-up. Tests conducted from nailer tip distances of 4 and 8 inches resulted in partial penetration and no patella fractures. Near-full nail penetration and minor patella fractures were achieved at nail release distances of 1 inch. Complete nail penetration and patella fracture severity similar to what the worker sustained was reproduced only in the tests at 0" distance.

Discussion

The results indicated that the nailer tip was flush with the knee surface when the nail was discharged. The determination that the nailer tip was flush to the knee at discharge was important input to the mechanical evaluation of the reason for discharge and subsequently for causation and liability assessment.