

TITLE: INFLUENCE OF SPINAL NEEDLE TIP DESIGN AND BEVEL ORIENTATION ON FLUID LEAK ACROSS HUMAN DURA

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Introduction. Postdural puncture headache may be related to cerebrospinal fluid (CSF) leak across the dural defect. Some have postulated that using a pencil point needle or orienting the needle bevel parallel to the long axis of the spinal column may lessen the magnitude of CSF leak following dural puncture. We used an *in vitro* model of dural puncture to study these hypotheses.

Methods. Samples of dorsal lumbar (L2-L5) dura were obtained at autopsy from six cadavers. Each sample yielded multiple specimens. These were mounted on a chamber with a vertical column. The chamber was filled with normal saline to a height of 150 mm above the specimen to approximate lumbar CSF pressure in the lateral recumbent position. Needle advancement was standardized by mounting the needle on a stereotactic frame. A 90° angle of approach to the plane of the dura was used for all punctures. Each specimen was punctured once with either a 22 gauge Whittacre (pencil point) needle or a 22 gauge standard B.D. needle with a flat bevel and secondary side bevels. The bevel was oriented either parallel to or perpendicular to the long axis of the dura. Time to loss of 1 milliliter of saline was recorded. Data are presented as leak rates in ml/min. Statistical analysis was by ANOVA and Neuman-Keuls where appropriate.

Results. We found no significant difference in mean leak rates when the flat bevel needle was used in two different orientations (see Table). However, the mean leak rate following pencil point needle puncture was significantly less than following puncture with the flat bevel needle.

Discussion. Bevel orientation had no effect on rate of fluid leak. Our findings are consistent with a model of human dura in which no parallel arrangement of fibers exists. A flat bevel needle tends to create the same size defect regardless of bevel orientation. The lower leak rate observed following pencil point puncture may be due to stretching of a small hole in an elastic dural membrane followed by recoil when the needle is withdrawn. The resulting defect may be smaller than one left by a flat bevel needle. In so much as post-dural puncture headache may be related to CSF leak, these findings may have implications for clinical practice. We used an *in vitro* model of dural puncture, therefore these hypotheses need to be tested in a clinical setting.

Type of needle tip	N	Leak rate (ml/min, mean ± SD)
A. 22G flat bevel; perpendicular to long axis	20	13.1 ± 6
B. 22G flat bevel; parallel to long axis of dura	20	11.1 ± 5
C. 22G Whittacre (pencil point)	20	7.7 ± 3

ANOVA indicated a significant result; $p = .003$.

Follow-up with Neuman-Keuls test:

A vs. C, $.001 < p < .005$; B vs. C, $.025 < p < .05$;

A vs. B, $.1 < p < .2$