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J W Dahlbeck, K W McCluney, J W Yeakley, M J Fenstermacher, C Bonmati, G Van Horn, 3rd and J Aldag

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The Interuncal Distance: A New MR Measurement for the Hippocampal Atrophy of Alzheimer Disease

The most common cause of a pathologic decline in memory and learning (senile dementia) is Alzheimer disease [1]. Despite recent advances in our understanding of the pathophysiology of this disease, we cannot make a definite diagnosis noninvasively, except by exclusion [2]. Thus, we thought that a more specific diagnostic tool or measurement was needed, one that would more accurately reflect the hallmark of Alzheimer disease: cellular pathologic changes in the hippocampal formations [3]. To evaluate atrophy in these formations, we have developed a direct measurement that uses MR images. We have termed this measurement the *interuncal distance*. This report describes its clinical trial use.

Materials and Methods

MR images of the brain of 10 patients with the clinical diagnosis of Alzheimer-type dementia were compared retrospectively with MR images of control patients. All patients in both groups were more than 60 years old. Patients in the Alzheimer group had had the diagnosis Alzheimer-type dementia included in their chart when they were discharged from the hospital and had MR images of the brain that were interpreted as normal except for the presence of atrophy. Patients were not included in the study if their MR images showed any signs of trauma, multiple infarctions, or other abnormal findings. Control subjects were selected randomly and included in the study only if their MR images showed no signs of trauma, multiple infarctions, or any other abnormal findings except atrophy.

The interuncal distances were obtained directly from axial MR images of the brain by measuring the distance between the uncus of the temporal lobes at the level of the suprasellar cistern (Fig. 1). Spin-density (proton) weighted axial images (SE 2000/20/1 [TR/TE/excitations]) were arbitrarily selected for these measurements. The images were reproduced on film with no magnification factor. The measurements correspond to the centimeter scale on the films.

All images were acquired on a 1.5-T Signa scanner (General Electric, Milwaukee, WI). MR parameters included a 24.0-cm field of view, 5-mm slice thickness with a 2.5-mm gap, and a 256 × 192 matrix. ECG or peripheral cardiac gating was used on all long TR

images. The variability of the angle and the level of section would have influenced the interuncal measurement only if the patient's head were tilted overtly at the time of imaging. If this had occurred, the MR image would have been excluded from the study. Coronal views were not used even though they would be somewhat more accurate and reproducible. The intent of this research was to provide a rapid and practical means of evaluating Alzheimer disease, and as coronal images are usually not readily available as part of a standard MR evaluation, the direct applicability of this research would have been diminished if coronal views had been necessary.

The 10 patients with Alzheimer-type dementia had an average interuncal distance of 37.3 mm. The average interuncal distance in the 10 control subjects was 22.2 mm. Actual measurements and statistical analysis are shown in Table 1. Inasmuch as the ranges do not overlap, and the means are significantly different, the two groups appear to have different interuncal characteristics. As the small distances appear not to be associated with pathologic changes, a one-tail cutoff is appropriate and suggests a midpoint between the upper limit of the normal range and the lower limit of the Alzheimer range, which would be $(25.6 + [34.0 - 25.6/2]) = 29.8 = 30.0$ mm. These findings need to be validated on larger groups of control subjects and patients with Alzheimer dementia before a clinical value can be firmly established.

Discussion

Although hippocampal atrophy is an early hallmark of Alzheimer disease, the previously reported methods for detecting or measuring this atrophy have been somewhat indirect and cumbersome and, to some extent, have largely ignored the temporal lobe [4–6]. In contrast, measuring the interuncal distance is a practical method of quickly assessing hippocampal atrophy. The greater the atrophy is, the greater the distance will be. This measurement is obtained on axial MR images of the brain by measuring the distance between the uncus at the level of the suprasellar cistern (Fig. 1). The interuncal distance thus appears to be a more direct reflection of hippocampal atrophy than methods previously reported.

TABLE 1: Interuncal Distances in Patients with Alzheimer-Type Dementia and in Control Subjects

	Alzheimer Patients (n = 10)	Control Subjects (n = 10)
	35.2	25.6
	36.4	16.2
	41.4	24.8
	38.6	25.6
	43.0	12.6
	35.4	22.4
	38.2	25.6
	35.6	22.4
	34.0	25.0
	35.0	22.2
Mean ^a	37.3	22.2
Standard Deviation	3.0	4.4

Note.—Distances are in millimeters.

^at test (18) = 8.90, $p < .001$.

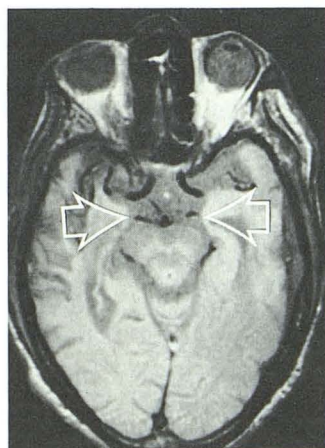


Fig. 1.—Interuncal distance lies between points of arrows; in this patient with Alzheimer disease, it was 35.2 mm. Spin-density (proton) weighted axial MR image (SE 2000/20/1) of brain.

The work reported here is preliminary, and the study needs to be extended to a larger sample of control subjects and to a group of patients with autopsy-proved Alzheimer disease in a blinded prospective analysis. However, our statistical analysis suggests that, in the proper clinical setting, an interuncal distance greater than 30 mm may indicate the hippocampal atrophy of Alzheimer disease.

Scott W. Dahlbeck

Kerry W. McCluney

Joel W. Yeakley

Marc J. Fenstermacher

Carmen Bonmati

Gage Van Horn III

University of Texas Health Science Center

Houston, TX 77031

Jean Aldag

University of Illinois College of Medicine

Peoria, IL 61656

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