

Absence of Commissurotomy Symptoms
with Agenesis of Corpus Callosum

Surgical section of the corpus callosum and anterior commissure was long supposed to produce no important behavioral symptoms in man according to views that prevailed during the 1940's and 50's (Akelaitis ; Bremer). In more recent studies ~~however~~, a large number of behavioral and neurological symptoms have been demonstrated in human patients following cerebral commissurotomy that can be directly attributed to the loss of the neocortical commissures (Bogen and Vogel; Gazzaniga et al; Sperry). The symptoms in these commissurotomy patients may be referred to collectively as the syndrome of the neocortical commissures or the syndrome of hemisphere disconnection. The great bulk of the symptoms observed in these patients, however, may be ascribed specifically to the elimination of the corpus callosum which contains well over 95% of the divided commissural fibers.

The same series of tests on which the above commissurotomy patients were found to be moderately-to severely impaired, were administered in the present study to another patient in whom the callosum was judged

to be absent as a result of agensis. The patient was a girl of twenty, in whom no cranial abnormality was suspected before age 20.

She was a sophomore in college ~~and~~ above average in intelligence..

She was first seen by one of us (R. Saul) in June() 1967 shortly after she had been hospitalized to initiate treatment for ^{acute} hydrocephalus.

Complete absence of the corpus callosum was then inferred from her cranial X-rays. Following relief of the hydr^ocephalus ^{by shunt installation} and her return

to college, the patient cooperated taking a battery of performance tests

used earlier (Sperry, Gazzaniga and Bogen) to reveal impairments caused

by lesions of the neocortical commissures. The principal aim was to

obtain a comparison for the effect of ^eilimination of the callosum by surgery

and that caused by developmental anomaly.

Case History and Testing Procedure (Saul) ^{to see} ^{here by} [↳] L-handed!

Tests were administered that had been shown in work with commis-

surotomy patients to involve the cross-integration of cerebral processes

separately lateralized to right and left hemispheres. A series of

specific task performances were employed ~~that had been~~ found to be

impaired in persons with surgical removal of the neocommissures. It is

presumed that the activities involved depend in part upon the function of the neocortical commissures under normal conditions. Most of the tests were administered in a simple examination unit described elsewhere (Sperry, Harvey) that permits lateralized examination of right and left halves of the visual fields, and right and left limbs in all possible combinations and in association with auditory and olfactory stimuli as desired. Procedures for the specific tests employed are described below in context. The tests are listed for convenience under a series of main headings. Obvious extensions, variations and refinements of most of the main types of test listed are possible and have been used to some extent in our commissurotomy studies. No attempt was made to make the following all-inclusive or exhaustive in this regard. The instructions for many of these tests must be given very thoroughly when a performance is controlled through the minor hemisphere. Verbal instructions are commonly reinforced by actual demonstrations of the procedure and generally the performance is run through on the dominant side first. As will be seen, these extra precautions used in testing

commissurotomy patients proved to be unnecessary in this case with agensis of the callosum.

Results:

Cross-recognition between right and left halves of visual field: With subject's gaze centered on a designated fixation point on the projection screen, a picture of an object, geometric shape, a word or other visual stimulus is then flashed at 1/10 sec. or less to left or right visual half field. The same and other stimuli are then flashed in sequence to the opposite half field and Subject signals by pointing to the same stimulus when he recognizes it on the opposite side. Commissurotomy patients fail on this test for all excepting very simple attributes of vision like position, light flux, and color in some cases. The performance scores of K.S., by contrast, were as good as those of normal subjects. She had no difficulty performing the "broken bar" test in which bars are flashed to left and right fields at different tilts and aligned straight or at angles to each other. She was able to correctly identify colors, patterns, and fairly complex

pictures going from one side to the other in either direction.

Verbal description for subordinate visual half field: When visual material is flashed at 1/10 sec. or less to the left half of the visual field commissurotomy patients are unable to name or describe the left field stimuli in speech or writing. This has been true except for extremely simple attributes of the visual stimulus (Bosche and Sperry) the exact limits of which remain to be worked out. K.S. on the other hand readily named and described visual material projected to either half field at an essentially normal level. No reliable difference was noted between the responses for left and right sides.

Crossed tactual retrieval for stimuli presented to visual half fields: A picture of an object is flashed to left or right visual half field and subject then retrieves this object from among an array of ten items by blind touch using the hand on the opposite side. Commissurotomy ^{patients(?)} are able to retrieve successfully under these conditions when they use the hand on the same side on which the visual stimulus was projected, but fail when they are required to use the opposite hand.

K.S. had no difficulty performing with either hand for either visual half field.

Cross-recognition between left and right hands: An object that has been handled and identified by one hand is removed and placed among a collection of other diverse items for cross retrieval by the other hand. Visual, auditory and other non-tactual cues are excluded. Whereas commissurotomy patients can retrieve correctly under these conditions ^{when} using the same hand with which the test object was initially identified, they ^{regularly} fail when required to use the opposite hand. Variations on this test ^{that} involving ^e cross-matching, cross-comparisons, grab-bag presentation, and use of the feet give basically the same result. There are exceptions as in vision with the simpler attributes of manual somesthesia the exact limits of which differ individually and remain to be determined. Apparently these can be mediated in the ipsilateral projection system and allow for some cross-recognition of cruder discriminations between the hands in most subjects. In K.S., however, cross-recognition from one to the

other hand was performed in either direction on these tests with essentially normal proficiency.

Verbal description of objects in subordinate hand: Commissurotomy subjects are unable to name or describe in speech or in writing objects that have been identified solely by touch with the left hand. Occasional exceptions may occur where crude features of the object like a sharp point allow it to be identified through the ipsilateral system. More rarely where the name is sufficiently simple and familiar and the conditions right the minor hemisphere may utter the correct name (). Under most conditions, however, the commissurotomized subject is unable to name or verbally describe objects placed in the subordinate hand. K.S., on the contrary, had no noticeable difficulty in calling or writing the names of objects placed in either hand.

Cross-replication of hand and finger postures: With subject's two hands extended out of subject's sight behind a screen, the examiner forcibly places one of subject's hands into a prescribed posture such

as a closed fist or open hand, or with one or more digits extended, etc.

The subject then tries to mimic the same posture in mirror form with the other hand. Normal subjects are able to copy the imposed posture with considerable accuracy with the opposite hand whereas the commissurotomy subjects fail as a rule to better than occasionally make correctly the closed fist or open hand with all fingers extended. K.S. was able to cross-replicate the imposed postures at a normal level, working in either direction right to left or left to right.

In a related test the hand-finger posture to be copied is projected as an outline sketch to left or right visual half field and subject tries to replicate the pose with the opposite hand. Commissurotomy patients, unlike normal subjects, have great difficulty with the crossed combinations but perform well with the homolateral combinations. K.S. performed the crossed as well as the homolateral tests at an essentially normal level in both directions.

Locating crossed mirror points on hands and fingers: Subject's hands are extended behind a shield palm up with fingers spread wide.

Examiner touches lightly with a hair or stylus a point on one of the four fingers or on the palm at the base of the fingers. The subject then tries to point to the corresponding mirror point on the opposite hand using the tip of the thumb of the opposite hand. Commissurotomy subjects regularly fail on this test but K.S. succeeded readily in both directions with a proficiency that was grossly normal.

12/60

ref. cc

Right side? no
no duplication?

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Saul Sperry - OK?

Surgical section of the neocortical commissures in man produces a large number of behavioral and neurological symptoms. Their detection requires the use of performance tasks specifically involving cross integration of cerebral processes separately lateralized to the right and left hemispheres. In order to compare the effects of callosal deprivation by surgery on the one hand and by developmental anomaly on the other, the same series of tests (on which commissurotomy patients performed to be moderately to severely impaired) were administered to another patient with callosal agenesis. The patient, a twenty year old college student with above average intelligence, had been hospitalized several months earlier for treatment of acute hydrocephalus secondary to aqueductal stenosis. Complete absence of the corpus callosum was inferred from contrast studies. She improved rapidly after shunt installation and

had been found under similar conditions

was discharged with no gross neurological nor mental deficits and an essentially normal EEG.

The majority of the tests will be described under the following series of main headings: cross recognition between the right and left halves of the visual fields and between the right and left hands, verbal description for the subordinate visual half field and of objects in the subordinate hand, cross tactual retrieval for stimuli presented audibly or to the visual half fields, cross replication of hand and finger postures, and location of ^{crossed} mirror or points on the hands and fingers.

The essentially normal test performance scores of our patient, ^{on all of these tests stand in sharp} contrasted ^{sharply} with those ^{of the commissurotomy patients.}

have general factor I.

Earlier psychological studies in callosal agenesis employed standardized tests which measured intelligence, transfer of learning, perceptual-motor coordination and a degree of perceptual asymmetry observed with dichotic stimulation. ^{observed deficits were minimal} The positive findings were ^{impairment not normal} contradictory and inconclusive and may well reflect associated malformation of the cerebral hemispheres. By contrast, the absence of commissurotomy symptoms in our patient

underscores the plasticity of the immature brain and affords experimental support for the contention that in the absence of the corpus callosum, asymmetrical organization (dominance) fails to develop. Alternate hypotheses include the use of ipsilateral projection systems and of the anterior commissure or other subcortical pathways in interhemispheric transfer.