CLINICAL NOTE

Monocular Patching May Worsen Sensory-Attentional Neglect: A Case Report

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ABSTRACT. Barrett AM, Crucian GP, Beversdorf DQ, Heilman KM. Monocular patching may worsen sensory-attentional neglect: a case report. Arch Phys Med Rehabil 2001;82:516-8.

To determine whether monocular patching influences the performance of a patient with primarily sensory-attentional bias on the line bisection task, we present a case study of a 49-year-old woman who had right cortical infarction affecting temporal, parietal, and occipital regions. She had primarily sensory-attentional bias when performing the line bisection task on a video apparatus. In hospital, she was tested with monocular eye patching of the left or the right eye or unpatched. Paradoxically, the right-eye patching significantly worsened and the left patch significantly improved performance. The eye may have some input to the ipsilateral as well as the contralateral superior colliculus. Alternatively, the patch—a novel tactile stimulus—may induce orienting to its side via noncollicular mechanisms. When using a monocular patch for any reason, clinicians should be aware that increased spatial bias may occur.

Key Words: Case report; Cerebrovascular accident; Eye protective devices; Perceptual disorders; Rehabilitation.

PATIENTS WITH UNILATERAL spatial neglect after right hemisphere stroke can fail to report, respond, or orient to novel or meaningful stimuli on the left side of space.[1] Neglect is associated with considerable morbidity. Although treatments for neglect are available, subpopulations of patients with neglect may respond best to specific therapies directed at the neuropsychologic mechanisms of their deficit.

Sprague[2] showed that the superior colliculus plays an important role in orienting behaviors. When cats with unilateral cortical lesions and contralesional orienting failure received surgical ablation of the contralesional superior colliculus, their deficit improved. Sprague[2] posited that ablating the contralesional superior colliculus disinhibited the ipsilesional colliculus and improved contralesional orienting.

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Unlike the cortex, the colliculi receive heavily monocular input from the contralateral eye.[3] Posner and Rafal[4] proposed that, in humans with neglect, left collicular activity could be decreased by occluding the input from the right eye. Patching the right eye, by reducing inhibition from the left colliculus, could release right-sided collicular-cortical systems, improving patients' leftward orienting. Investigators subsequently reported that right-eye patching reduces neglect in some patients with right hemisphere damage,[5-8] but not all patients improve.[9]

Patients with neglect may have primarily sensory-attentional or motor-intentional deficits.[10] Patching the ipsilesional eye, which may influence subcortical orienting systems, may influence attention more than intention. Thus, ideal candidates for this therapy might be patients with primarily attentional neglect. In this study, we examined the effect of monocular patching on line bisection errors in a patient with primarily attentional neglect after right hemisphere stroke.

METHODS

Subject

JJ, a 49-year-old woman, had a right temporal-parietal-occipital infarction. She had a left lower quadrantanopsia, left arm weakness (4/5), and left spatial neglect, with extinction of left-sided stimuli to double simultaneous stimulation in all sensory modalities, neglect dyslexia, and 41-mm rightward error when bisecting a 210-mm line. Because of the posterior location of her lesion, we suspected (1) her primary deficit was sensory-attentional, (2) her line bisection performance might benefit from ipsilesional eye patching and deteriorate with contralesional eye patching, and (3) if both sensory-attentional and motor-intentional deficit contributed to her overall line bisection error, monocular patching would influence the sensory-attentional, and not the motor-intentional, component.

Procedure

Characterization of neglect as primarily attentional. To learn the extent to which sensory-attentional and motor-intentional deficit contributed to JJ's line bisection performance, we had her bisect lines while indirectly watching her hand on a video monitor.[11] In the direct condition, left and right as JJ saw them on the video screen corresponded with the left and right sides of the actual workspace where she bisected lines. In the indirect condition, a 180° change in camera perspective reversed the image on the video screen. Therefore, in the indirect trials, when the patient moved her hand rightward in the actual workspace, her hand would appear to move leftward on the monitor, and vice versa.

This paradigm allowed us to break down overall line bisection error into motor-intentional (failure to move leftward) and sensory-attentional (unawareness of the left) components. The patient's mean error in the direct condition was computed and compared with her mean error in the indirect condition. Attentional and intentional error components are derived by using the formulas: $x + y =$ [error in the direct condition] and $x - y =$ [error in the indirect condition], where $x =$ intentional component of error and y = attentional component of error. This is performed because it is assumed that sensory-attentional error will change signs when the stimulus on the screen is reversed and intentional error will not. Sensory-attentional and motor-intentional error components always add up to the total error in the direct condition.

The direction in which subjects err in the indirect condition suggests whether primarily sensory-attentional or motor-intentional deficit is present. With primarily motor-intentional bias, errors may be unchanged between the direct and indirect conditions. With primarily sensory-attentional bias, however, the subject will err rightward in the direct condition but leftward in the indirect condition.

Effect of monocular patching. To learn if eye patching changes the severity of neglect by influencing sensory-attentional or motor-intentional systems, we had the patient bisect lines under 3 conditions: unpatched and while wearing a right or a left eye patch. One hundred twenty lines were bisected in blocks of 20 under each of the conditions by using the video apparatus described earlier. To determine the sensory-attentional and motor-intentional components of errors under each patch condition, performance in the direct condition was compared with performance in the corresponding indirect condition.

RESULTS

JJ erred 34.8 ± 11.86mm (standard deviation) rightward in the direct condition. In the indirect condition she erred 8.4 ± 7.68mm leftward. This leftward shift from the direct to the indirect condition (table 1) is significant (paired t test, t = 14.912, $p < .001$) and suggests her left spatial neglect was caused by a primarily sensory-attentional deficit. In subjects with primary sensory-attentional deficit, reversing the image on the screen will reverse the side on which the errors occur because the defect is dependent on how the stimulus is perceived.[11]

Right-eye patching increased the patient's errors in the direct condition (41.4 ± 5.45mm) and left-eye patching decreased errors (21.15 ± 8.12mm, repeated-measures analysis of variance [ANOVA], $p < .001$). These results contradict the predicted pattern (table 1).

Figure 1 shows total line bisection error in the unpatched, right-, and left-patch conditions, and also shows the total line bisection error broken down into sensory-attentional and motor-intentional components. We had hypothesized that eye patching might influence sensory-attentional, but not motor-intentional, bias. As can be seen in table 1 and figure 1, right- and left-eye patching did influence sensory-attentional differently than motor-intentional error components (side of patch by direct-indirect interaction significant, $p < .001$). The sensory-attentional component of total line bisection error increased with ipsilesional patching and decreased with contralesional patching. The motor-intentional component of total line bisection error was reduced by either left or right patch placement.

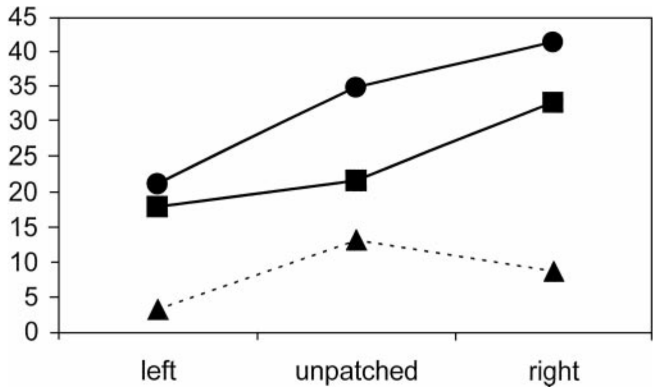

Fig 1. Influence of monocular patching on attentional and intentional components of neglect in the current study. Left-patch, unpatched, and right-patch conditions are depicted on the *x* axis; the *y* axis indicates the subject's mean error in millimeters rightward of center. Overall error (●) increased when the subject wore a right, ipsilesional patch, and decreased when the subject wore a left, contralesional patch, opposite to the predicted pattern (reverse Sprague effect). The sensory-attentional component of the overall deficit (■) similarly increased with ipsilesional patching and decreased with contralesional patching. The motor-intentional component of error (▲) decreased under both patch conditions. The reverse Sprague effect was thus a sensory-attentional phenomenon in this patient.

Table 1: Error in Direct and Indirect Conditions and Calculated Attentional and Intentional Error for Unpatched, Right, and Left Conditions

	Left Patch Right Error (mm)	Unpatched Right Error (mm)	Right Patch Right Error (mm)
Direct condition	21.15 ± 8.12*	34.8 ± 11.86*†	41.4 ± 5.45*
Indirect condition	−14.7 ± 10.5	−8.4 ± 7.68†	−23.9 ± 8.76
Attentional error	17.9	21.6	32.65
Intentional error	3.225	13.2	8.75

* Patch conditions significantly different, 2 × 3 repeated-measures ANOVA (df = 2, F = 27.08883), $p < .001$.
† Paired t test, df = 19, t = 14.912, $p < .001$. See text for explanation of derivation of attentional and intentional error components.

CONCLUSION

Previous investigators[7,8] have reported that, inconsistent with the Sprague effect, patients with left spatial neglect may improve with left-eye patching. It is possible that their patients had primarily motor-intentional deficits because patching either eye decreased our patient's motor-intentional rightward bias. We observed an effect completely reversed from that predicted by Posner and Rafal.[4] Although the "reverse Sprague effect" appeared to be related to changes of attentional bias, the mechanisms explaining these results remain to be determined. It is possible that the primate superior colliculus, unlike the colliculus of the cat, may receive substantial ipsilateral monocular input.[12-15] Williams et al[16] also reported that in primates the ratio of contralateral to ipsilateral input to the superior colliculus may vary considerably among individuals. Right-eye patching could thus inhibit the human right colliculus by decreasing its ipsilateral input, worsening leftward orienting. Left-eye patching may then have the opposite effect. It is also possible, however, that because the patch was a novel tactile stimulus, it induced asymmetric orienting to its side rather than acting on collicular-cortical systems. Unfortunately, we could not repeat the experiment with a nonoccluding tactile stimulus to test this hypothesis, because our patient recovered quickly from neglect.

Based on our results, we recommend that when clinicians use monocular patches in patients with neglect, they retest for neglect with the patch in place, even if the eye is being patched for another ocular condition. Repeat reassessment will help to ensure that neither worsening of neglect with contralesional eye patching nor paradoxic worsening of neglect with ipsilesional eye patching has occurred.

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