Complementary, Holistic, and Integrative Medicine: Sensory Integration

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Introduction

The maturation and organization of the brain is essential for the progress of human development. A. Jean Ayres first proposed a model of human development in the 1960s that she termed “sensory integration” (SI). (1)(2) According to Ayres’ theory, SI occurs under the dynamic influence of sensory inputs: gravitational, tactile, proprioceptive, vestibular, visual, and auditory sensations. This process, which begins in the womb, allows for the development of adaptive responses that, in turn, lay the foundation for more complex skills such as language, emotional regulation, and computation. (1)(2) Inefficiencies at more basic levels lead to difficulties in higher areas. (3) According to proponents, sensory integration dysfunction (SID) can manifest as a broad range of developmental and behavioral difficulties. (4) Some estimate that 5% to 10% of the general pediatric population and 40% to 88% of children who have disabilities suffer from SID. (3)(4)

Since its introduction, SI theory has attracted many supporters. SI-based therapy subsequently developed out of this theory and is practiced by trained therapists, particularly occupational therapists. (5) The SI Special Interest Section of the American Occupational Therapy Association reported 12,000 members in 2006. More than 50% of occupational therapists identifying themselves as working primarily with children rated SI as a primary or secondary practice focus. (3) This support is not universal, and most physicians are either unfamiliar with the concept or reject SID as a diagnostic entity. Indeed, considerable debate exists among individuals and disciplines as to the existence of SID as a condition. Despite this lack of agreement, pediatricians often see treatments based on SI theory in the multidisciplinary treatment plans of children who have autism, attention-deficit/hyperactivity disorder, mood disorders, and other conditions. Therefore, they should have an understanding of the construct.

Therapy is designed to guide controlled sensory inputs from activities rich in tactile, vestibular, and proprioceptive sensations. Treatment is highly individualized but guided by key principles (Table). (5)(6) A wide variety of equipment is used, including swings, ball pits, scooter boards, bolster swings, rope ladders, pillows, and vestibulator swings. (7) According to SI theory, SID is a potentially reversible disorganization of the central nervous system rather than a disease process or brain damage. (1)(2) The goal, then, is not to teach skills, but to facilitate organization of the brain so it may learn effectively from the environment. Thus, higher-level skills naturally follow on the sound foundation gained from therapy. (5)

In 2007, Miller and associates (8) published a new classification scheme for SID in hopes of enhancing diagnostic specificity and improving the quality of research on the topic. This system categorizes the consideration of SI into specific elements: sensory integration theory (discussed previously), sensory processing disorder (SPD), and sensory integration treatment. This classification separates the theoretical foundation from the disorder and the condition from the treatment. SPD is subdivided further into three specific patterns: sensory modulation disorder (SMD), sensory discrimination disorder (SDD), and sensory-based motor disability. These patterns are categorized into types. SMD is subdivided into overresponsive, underresponsive, and sensory seeking/craving subtypes. SDD has no subtypes. Sensory-based motor disability is subdivided into postural disorder and dyspraxia.

Using this framework, SPD has been included in the Diagnostic Classification of Mental Health and Developmental Disorders of Infancy and Early Childhood Revised, the Diagnostic

Abbreviations

AAP: American Academy of Pediatrics
OT: occupational therapy
SI: sensory integration
SID: sensory integration dysfunction
SDD: sensory discrimination disorder
SMD: sensory modulation disorder
SPD: sensory processing disorder

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Evidence of Efficacy

In 2007, Miller and associates (3) noted more than 80 published studies on the efficacy of SI therapy in diverse populations, most of which involved small groups or case studies. A review of meta-analyses and reviews of the published research yielded mixed results. A 1982 meta-analysis concluded that SI research literature provided suggestive support for the effects of SI therapy. (9) However, this analysis was limited to only eight studies, and later reviewers criticized the original studies in the analysis and the method of analysis. (10) Four literature reviews between 1988 and 1994 concluded that the evidence was insufficient to support the efficacy of SI therapy. (11) A 1999 meta-analysis of research from 1972 to 1994 showed a trend in the published literature, with earlier studies showing greater treatment effect than more recent studies. (11) The conclusion was that there was an absence of treatment effect in recent studies, and no benefit could be shown when comparing SI therapy and alternative treatments. In the pediatric literature, as part of a 2004 American Academy of Pediatrics (AAP) policy for treating children who have motor disabilities, and in a 2007 AAP policy on management of children who have autism spectrum disorders, it was concluded that the scientific legitimacy of SI interventions had not been established. (12)(13)

Throughout these analyses and reviews, authors commented frequently on how a lack of standard diagnostic criteria, small sample sizes, lack of standardized treatment, and disparate outcome measures made interpretation problematic. (14)(15)(16) This situation was addressed by Parham and associates (7) in 2007, when they evaluated the validity of SI outcomes research in relation to fidelity (faithfulness of intervention to underlying therapeutic principles). They concluded that inferences regarding SI effectiveness could not be drawn with confidence until fidelity was addressed adequately in outcomes research.

Having stated the need to increase the rigor of SI research, Miller and colleagues (3)(17) employed their new taxonomy in a study assessing SI treatment efficacy. They designed a randomized, controlled pilot study to test the efficacy of occupational therapy (OT)/SI in children who had SMD through pretest and posttest measures of behavior, sensory and adaptive functioning, and physiology. Inclusion criteria included clinical diagnosis by a qualified occupational therapist using a comprehensive evaluation method: standardized diagnostic questionnaires, measures of ectodermal response, and clinical confirmation by parent interview. Exclusion criteria included: age younger than 3 years, intelligence quotient below 85, previous SI treatment, serious confounding event, and current special education services. Outcome measures employed the Leiter-R (cognitive/intelligence) and Short Sensory Profile (measuring sensory processing dysfunction), Vineland Adaptive Behavior Scale, Child Behavioral Checklist, and Goal Attainment Scaling.

In contrast to previous studies in which treatment was individualized and, therefore, difficult to compare, treatment was standardized using a manual. Twenty-four participants were randomized to three arms. Seven children were in the SI treatment group (OT/SI interventions twice a week for 10 weeks), ten in the activity placebo group (arts and crafts, puzzles, blocks by nontherapists), and seven in the no treatment group (no treatment wait list group).

Power requirements were not met in the analysis. In addition, several difficulties were identified in the use of ectodermal response measures as a physiologic marker (>50% of the collected data were unusable). The authors concluded that efficacy might be suggested on several measures, most notably the Goal Attainment Scaling. Further, they noted how this study highlighted the dif-
ficulties of assessing SMD and in dealing with the impact of comorbidity. However, this study represents a step forward because the authors used a structured system for participant inclusion, treatment, and outcome measurement. The authors suggested future research using this model in a larger population, perhaps across several collaborative sites.

**Safety Profile**
The safety profile for SI therapy is difficult to assess. No studies could be found directly addressing safety profile or treatment-related adverse events. However, because many of the interventions incorporated are used elsewhere in OT treatment, it would seem reasonable to assume a safety profile similar to that of non-SI-based OT.

**Summary**
Developmental and behavioral disorders are complex and diverse. Physicians often are asked their opinions on treatments or to authorize therapies that lack a clear evidence base. SI therapy is a popular treatment for multiple conditions, but strong empiric evidence in a standard case-control format does not yet support its efficacy.

Kemper and Cohen (18) have provided a context within which to discuss SI treatments with families. If a therapy is considered to be safe, the physician and family can judge whether it should be incorporated into treatment. If there is little risk and the therapy is not keeping the child from more effective treatments, including that therapy is reasonable. If, however, one therapy is chosen over another that more clearly is efficacious treatment for a given condition because of expense or available treatment time, the less efficacious therapy should not be incorporated. Such therapy decisions are made best by a well-informed family in consultation with their physician and therapists.

Recent moves to standardize SI diagnosis and treatment in research may result in more definitive assessment of treatment efficacy in the future. Identification of appropriate patient populations and well-defined outcome measures should expand the field of research, although SI already is the most widely studied treatment in OT. At present, SI therapy should be considered a potential adjunctive treatment, but not at the expense of evidenced-based therapies or needed instruction in the school.

**References**
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