

Title: There is no evidence that a brushing protocol is an effective intervention for reducing undesirable behaviors in children ages 3-5 with sensory defensiveness.

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CLINICAL SCENARIO:

Condition/Problem:

Sensory Processing Disorder (SPD) is a term that encompasses many types of sensory dysfunction. Sensory Processing Disorder is any dysfunction related to sensory input, including the inability to discriminate and interpret sensations, modulate incoming stimuli, or organize the input for use (Kramer & Hinjosa, 2010).

One subtype of SPD is Sensory Modulation Disorder (SMD), which is characterized by a lack of appropriate organization of incoming sensory input within the nervous system. Dysfunction in sensory modulation generates a response that falls along a sensory registration continuum, with hyperresponsivity at one extreme and hyporesponsivity at the opposite extreme. (Royeen & Lane, 1991). Therefore, hyperresponsivity and hyporesponsivity are both sub-types of SMD. The hyperresponsivity sub-type has also been termed as Sensory Defensiveness (Wilbarger & Wilbarger, 1991). Sensory Defensiveness refers to the over-responsivity to sensory stimuli, resulting in a tendency to adversely react to nonthreatening sensory input. Adverse reactions to sensory input may be demonstrated through sensory avoidance, fear, anxiety, aggression, resistance to change, and/or the desire to control situations (Royeen & Lane, 1991).

Incidence/Prevalence:

Incidence rates for Sensory Modulation Disorder, specifically Sensory Defensiveness are not reported in current literature or in government statistics. Sensory Processing Disorder has incidence rates reported in current literature, however no statistics are reported by the government. For children with autism, 85-95% of children demonstrate some degree of sensory processing dysfunction on the Sensory Profile (Tomchek & Dunn, 2007; Watling, Deitz, & White, 2000). An additional article reports that 5-13% of kindergarten aged children have sensory processing issues affecting their performance in the classroom, as reported via the Sensory Profile (Ahn, Miller, Milberger, & McIntosh, 2004).

Impact of the Problem on Activity/Performance:

Individuals with Sensory Modulation disorders, more specifically Sensory Defensiveness, often have difficulty with both occupational activities and performance. Children with Sensory Defensiveness may present with sensitivities to one or more sensory systems, such as tactile, visual, auditory, vestibular, and proprioceptive. These sensitivities may cause avoidance, fear of participation, and/or adverse behaviors in response to activities that may stimulate these systems, as specific sensory input may cause overreaction and heightened arousal. For example, a child with tactile defensiveness may avoid hygiene, bathing, dressing, or grooming activities. A child with vestibular or proprioceptive defensiveness may avoid movement activities, such as running,

jumping, or climbing (Wilbarger & Wilbarger, 1991). Additionally, these sensory sensitivities may also produce undesirable behaviors such as temper tantrums, aggression, and/or the desire to the control situation. As a result of these types of avoidances and adverse reactions, individuals with Sensory Defensiveness will have difficulty with occupational performance in areas of education, play (leisure/participation), social activities, and community activities.

Intervention:

A brushing intervention involves applying rapid and firm pressure touch to the arms, hands, back, legs, and feet with a non-scratching brush with many bristles. Often, brushing is combined with other treatments such as: joint compressions or a sensory diet. A sensory diet consists of individualized and varied sensory input throughout the day, in order to help modulate behavior. Joint compressions consist of deep pressure applied to the shoulder, elbow, wrist, hip, knee, and ankle joints. This intervention may be administered multiple times throughout the day, on an individual basis (Wilbarger & Wilbarger, 1991).

Why is this intervention appropriate for OT:

Brushing is a preparatory occupational therapy intervention for children with sensory modulation disorders. This intervention prepares the client to participate in occupations such as school, play, self-care, etc. The sensory input from the brushing can calm and prepare the body, so that the client may concentrate and focus on their occupation. According to the Internal Classification of Function and Disability (ICF), brushing is classified as an intervention that treats body functions and structures (WHO, 2002).

OT Theoretical Basis:

The use of brushing as an intervention for sensory defensiveness disorders is supported by the Sensory Integration (SI) frame of reference. Several main underlying concepts of the SI frame of reference theoretically support this intervention. According to Schaaf et al. (2010), “successful integration and organization of sensory information results in and is further developed by adaptive responses” (p.100). Additionally, “as a result of neuroplasticity, enriched experiences effect change in the nervous system” (p. 101). Lastly, the SI frame of reference states that “sensory integration is a foundation for physical and social engagement and participation in daily life activities and routines”(p. 101). Through brushing, neurological changes are thought to occur, which in turn may result in behavioral changes and improved occupational performance.

Science Behind the Intervention:

The science behind brushing has not been proven by research as factual. The theorized mechanism of change behind brushing is that firm tactile input helps to decrease arousal levels and increase normalized automatic responses. These changes are thought to occur due to changes in neural structures and greater organization of sensory stimuli as it comes into the nervous system. Research with animals has shown preliminary data that enhanced sensory opportunities and input results in increased synaptic density and cortical changes in the brain. These studies suggest that neurological changes due to increased sensory input may result in higher level adaptive responses, and thus may lead to behavioral changes (Schaaf et al., 2010).

FOCUSED CLINICAL QUESTION:

Does administering a brushing intervention for children ages 3-5 with sensory defensiveness result in decreasing undesirable behaviors when compared to no intervention?

SUMMARY:

Does administering a brushing intervention for children ages 3-5 with sensory defensiveness result in decreasing undesirable behaviors when compared to no intervention? A total of 15 databases and/or occupational therapy journals were searched in order to answer this question, and five relevant articles were located. Three level 5 articles were selected for critique; these case studies were included in both of the higher level systematic reviews and therefore the higher level articles could not be selected. Based on the results, there is no evidence that a brushing protocol is an effective intervention for reducing undesirable behaviors in children ages 3-5 with sensory defensiveness.

CLINICAL BOTTOM LINE:

There is no evidence that a brushing protocol is an effective intervention for reducing undesirable behaviors in children ages 3-5 with sensory defensiveness.

Limitation of this CAT:

This critically appraised paper has been reviewed by occupational therapy graduate students and the course instructor.

SEARCH STRATEGY:

Table 1: Search Strategy

Database Searched	Search Terms	Limits Used	Inclusion/Exclusion Criteria
CINAHL OVID Journals Cochrane Library MEDLINE EBSCO Host OT CATS OT Seeker OT Search Google Scholar Asian Journal of OT Australian Journal of OT British Journal of OT Canadian Journal of OT New Zealand Journal of OT Occupational Therapy International	“Wilbarger Protocol” “Brushing” “Deep Pressure & Proprioceptive Technique” “Therapressure” “Brushing + Compressions” “Sensory Defensiveness” “Sensory Summation Technique”	Full Text English Text	Inclusion Criteria: pediatric population

Table 2: Summary of Study Designs of Articles Retrieved

Level	Study Design/Methodology of Articles Retrieved	Total Number Located	Database Source	Citation (Name, Year)
Level 1a	Systematic reviews or Metanalysis of RCTs	0		
Level 1b	Individualized RCTs	0		
Level 2a	Systematic reviews of cohort studies	0		
Level 2b	Individualized cohort studies and low quality RCTs	0		
Level 3a	Systematic reviews of case-control studies	2	Google Scholar CINAHL	Weeks, Boshoff, and Stewart, 2012 Bhopti and Brown, 2013
Level 3b	Case-control studies and non-randomized controlled trials	0		
Level 4	Case-series and poor quality cohort and case-control studies	0		
Level 5	Expert Opinion (qualitative, descriptive single case studies, descriptive research)	3	CINAHL	Stagnitti, Raison, and Ryan, 1999 Kinnealey, 1998 Benson, Beeman, Smitsky, and Provident, 2011

Table 3: Summary of Included Studies

	Study 1: Stagnitti, Raison, and Ryan, 1999	Study 2: Kinnealey, 1998	Study 3: Benson, Beeman, Smitsky, and Provident, 2011
Design	Case Study, AB Design	Case Study	Case Study, AB design
Blinding of Therapist/ Assessor	Not stated	Not stated	No (same OT completed brushing and did pre- post assessments)
Level of Evidence	Level 5	Level 5	Level 5
Population	5 year old boy with suspected Asperger's (ASD) diagnosis, moderate sensory defensiveness, as diagnosed based on Wilbarger & Wilbarger (1991)	3 1/2 year old girl with sensory defensiveness, as defined by Wilbarger & Wilbarger (1991)	Two 5 y.o. boys: Client 1 had a diagnosis of ASD and Client 2 had a diagnosis of PDD-NOS. Both boys showed signs of sensory modulation difficulties as determined by clinician
Intervention Investigated	Sensory Summation Technique: brushing the arms, back, and legs with a soft surgical brush, then providing 10 gentle joint compressions to arm and leg joints, then providing sensory input to fingers & toes Treatment dosage: 3x daily for Week 1, 4- 5x daily for Week 2; Parents applied intervention within the home Occupational therapy sessions 1x/wk, 4 weeks immediate post initial assessment	"Sensory Integration" treatment in a private clinic 1x/wk, 1 hr, 30 weeks (focusing on proprioceptive & tactile experiences, social skills, fine-motor activities) Brushing was included over a 3 month period; given periodically throughout day by parents.	Client 1: Received Deep Pressure and Proprioceptive Technique (DPPT) protocol (brushing administered in combination with a sensory diet); Treatment time was 21 days; brushing was done every 2 hrs at school (3x total) and parents reported a consistent brushing schedule at home Client 2: Received a Non-Specific Child- Guided Brushing Technique (NST); brushing was administered only if requested by the child or

	Continued occupational therapy sessions and Sensory Summation Technique (2 weeks) at five months post initial assessment (OT therapy addressed behavioral modifications with reinforcement and narrative stories)		if child could benefit from it based on child's behavior; Treatment time was 22 days; brushing was typically done 1x at school and 1-2x at home per day
Comparison Intervention	No comparison	No comparison	No comparison
Dependent Variables	Undesirable behaviors	Undesirable behaviors	Undesirable behaviors
Outcome Measures	Miller Assessment of Play (MAP); Sensory Checklist; Parent Interview	Behavioral Style Questionnaire; Ten treatment goals created by therapist to measure treatment success	School Function Assessment, Part 3 (Selected categories): Following Social Conventions, Compliance with Adult Directives and School Rules, Task Behavior/Completion, Positive Interaction, and Behavior Regulation.
Type of Results	Assessments; Observations	Assessment (no scores given for pre-post test of Behavioral Style Questionnaire); Observations	Assessment
Results	6 months post initial assessment: -The MAP showed no areas of difficulty. -Sensory Checklist: improvements were noted in all areas.	Behavioral Style Questionnaire showed improved scores in 6 of 9 areas tested (activity, rhythmicity, approach, adaptability, intensity, and mood). All treatment goals were met post-intervention.	1 week post-intervention assessment results: - Client 1 improved in Following Social Conventions (+4%), Positive Interaction, Behavior Regulation (+4%). -Client 2 improved in all areas:

	Parental observations also indicated improvements through subjective report.	Parental observations also indicated improvements through subjective report.	Task Behavior (+11%) and Behavior Regulation (+10%)
Conclusion	The sensory summation technique was shown to be very effective at treating the child's sensory defensiveness.	Sensory integration therapy, which included brushing, was shown to be effective at improving social, emotional, and behavioral outcomes based on objective observations, parental report, and treatment goal attainment.	Both children showed positive improvements. Improved occupational performance may be a result of the act of brushing rather than the amount of time intervals and frequency of the brushing. As time was the main differing factor between the two participants, the outcomes indicate that brushing effectiveness is not contingent upon adherence to Wilbarger protocol.

IMPLICATIONS FOR PRACTICE, EDUCATION, AND FUTURE RESEARCH:

Overall Conclusions:

All three studies reviewed in this CAT were case studies. Researchers in all three case studies concluded that a brushing protocol helped to decrease undesirable behaviors associated with sensory defensiveness. While the undesirable behaviors varied for each participant, these behaviors were categorized as follows: lack of emotional regulation, aggression, controlling, withdrawal and isolation, and sensory avoidance. For example, the studies indicated a reduction in hitting and kicking aggressive behavior, decreased withdrawal symptoms such as curling into a ball, and improved sensory avoidance, as shown by a higher tolerance for tactile and vestibular input. In addition, they found improved emotional regulation as a result of a reduction in temper tantrums and a decrease in controlling behaviors such as creating intricate rules for the family to follow.

The case studies gathered data through observation, parental report, and standardized assessments. Two of the case studies did not report scores for the assessments, and the other case study found non-significant results. Additionally, the authors concluded that there were positive results based on subjective observations and parental report. Consequently, the results were not statistically significant due to the lack of rigor in the study designs.

Correspondingly, a high level of variability between the case studies may have had an impact on the behaviors observed in the participants. In addition, the case studies lacked

adequate detail in regards to study design and administration protocols. Within the reported brushing protocols, the case studies differed in administration, location of intervention, and treatment dosages. Participants received brushing from parents and/or therapists, at home, school, or a combination of locations. Brushing frequency varied over a duration of two or three weeks, in the form of a set schedule (i.e. every two hours or three to five times per day) or on an as-needed basis, as determined by the child's behaviors. Additionally, increased attention from the therapists and caregivers, along with individual differences of the participants, such as gender, age, diagnosis, and personal preferences, may have influenced the observed behaviors.

Finally, adjunct interventions, such as a structured sensory diet, additional occupational therapy sessions, social skills training, and behavioral programs were used in conjunction with the brushing protocols. Overall, these case studies demonstrate a lack of rigor due to the interaction of the uncontrolled components and variables within the study designs. Therefore, the positive results may be attributed to a combination of the factors, and not solely the brushing protocol.

In conclusion, there is no evidence that a brushing protocol is an effective intervention for reducing undesirable behaviors in children ages 3-5 with sensory defensiveness.

Boundaries:

The three articles reviewed had a total of four participants, 3 boys and 1 girl, between the ages of 3-5 years. Three of the four participants had primary diagnoses of Pervasive Developmental Delay- Not Otherwise Specified, Autism Spectrum Disorder, and suspected Asperger's Syndrome. All participants had either suspected or diagnosed sensory defensiveness, as determined by authors' clinical judgement.

Implications for Practice:

There is no evidence to support the effectiveness of a brushing protocol to reduce undesirable behaviors associated with sensory defensiveness. The results of the case studies should be interpreted with caution, due to confounding variables and lack of rigor in study designs. The small sample size and limited population demographics reduce the generalizability of these results. Further research at a higher level of rigor needs to be conducted in order to determine the clinical effectiveness of a brushing intervention.

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