The Design of Saliva Wicking Scarves for Individuals with Oral Motor Impairments

Jiayi Ren, Bai Li, Huantian Cao, Michele Lobo
University of Delaware, USA

Keywords: scarf design, oral motor impairments, sialorrhea, textile

Introduction Sialorrhea, or the drainage of saliva outside of the mouth, is often observed in individuals with neurologic diseases, such as cerebral palsy or motor neuron disease, and can cause psychosocial and physical health problems that impact quality of life (Hockstein et al., 2004; Hornibrook & Cochrane, 2012, p.1). Sialorrhea may cause problems with social isolation (Reddihough, Erasmus, Johnson, McKellar, & Jongerius, 2010), self-esteem (Sénécal, 2012), or skin irritation and rashes (Norderyd et al., 2017; Reddihough et al., 2010). For caregivers, frequent clothing changes associated with sialorrhea can be burdensome (Norderyd et al., 2017). For older children with sialorrhea, there are no products to meet their functional as well as aesthetic needs. The most commonly implemented solution for older children with sialorrhea is the use of a bandana as a scarf. The bandanas use cotton fabric so they are breathable and comfortable, but they are also extremely permeable, allowing saliva to penetrate through to underlying clothing. Prior research has not focused on developing a functional, attractive, comfortable scarf to meet the needs of children with sialorrhea. The **purpose** of this research was to address this gap by developing quick-drying and high wicking scarves for older children (age 4-16) aiming to be cosmetically pleasing, affordable, and functional to prevent saliva from dampening clothing.

Testing and Results Four different wicking fabrics or waterproof fabrics were chosen as potential materials for prototype design (Table 1). All of the fabrics were available in the market through an online venue (Seattle Fabrics, Seattle, Washington) or a local fabric store (Jo-Ann Stores, Inc., Hudson, Ohio), ensuring the solution could be an affordable and replicable option. The fabric thickness was measured using a portable thickness gauge (SDL Atlas Inc., Rock Hill, SC), and data are in Table 1.

Table 1. Fabrics used in the textile testing

Fabric	Material List	Thickness (mm)
Waterproof Breathable PUL knit fabric	100% Polyester fabric backed 100% Polyurethane coating	.47 (σ = .01)
Waterproof PUL knit fabric	83% Polyester, 15% Polyurethane, 2% Agglutinant	.64 (σ = .01)
Stay-Dri Wicking knit Fabric	100% Polyester	.53 (σ = .01)
Dryline Wicking Spandex knit fabric	A knit fabric containing spandex fiber	.80 (σ = .01)

To measure the functional aspect of moisture management, a wicking rate test was conducted to test the ability of liquid to diffuse in each fabric. A solution tinted with red food

Figure 1. Wicking test

coloring was prepared in a beaker to gauge the diffusion distance. Three 1" × 10" samples of each fabric were cut along both the warp and weft directions. On each sample, a pencil line was drawn one centimeter away from the shorter edge of the fabric sample. A glass rod was placed across the top of the beaker. The end of the unmarked fabric sample was attached to the glass rod. The sample was then submerged to the one-centimeter pencil mark in the dye solution for five minutes, after which the strip was removed from the beaker, placed on a paper towel, and diffusion distance was measured (Figure 1). The wicking data are in Table 2. One-way ANOVA was used to compare the wicking test results among fabrics. There were significant differences among fabric's wicking performance ($F=278.82$, $p < .01$). Tukey HSD post hoc test separated the fabrics into 3 groups (significant at $p < .05$): (Stay-Dri = Dryline) > Waterproof PUL > Waterproof breathable PUL. The Stay-dri Wicking and Dryline Wicking Spandex fabrics have better wicking performance than the other two fabrics. In addition, t-tests showed the Dryline Wicking Spandex has similar wicking performance in the wick and weft directions ($p = .09$) (Table 2).

In relation to comfort for the prototype, the stiffness of each fabric was tested. Softer fabrics would be expected to provide better wearing comfort. Stiffness of the fabric was measured using a Handle-O-Meter Tester (Thwing-Albert Instrument Co., West Berlin, NJ) after conditioned at 21°C and 65% relative humidity per standard test method ASTM D6828. The stiffness data are in Table 2. One-way ANOVA was used to compare stiffness results among fabrics. There were significant differences among the fabrics for stiffness ($F = 530.21$, $p < .01$). Tukey HSD post hoc test separated the fabrics into 3 groups (significant at $p < .05$): (Stay-Dri = Dryline) < Waterproof breathable PUL < Waterproof PUL. The two wicking fabrics Stay-Dri and Dryline were softer (Table 2) than the two waterproof fabrics.

Table 2. Results for the fabric testing (standard deviation data in parentheses)

	Waterproof Breathable PUL Fabric		Waterproof PUL fabric		Stay-Dri Wicking Fabric		Dryline Wicking Spandex	
	Warp	Weft	Warp	Weft	Warp	Weft	Warp	Weft
Wicking rate (cm)	.67 (.21)	.17 (.12)	3.20 (.10)	3.27 (.10)	9.63 (.12)	8.33 (.12)	8.03 (.35)	9.20 (.82)
P-value of t-test (warp, weft wicking comp.)	.02		.87		<.01		.09	
Stiffness (g)	17.75 (1.94)		24.96 (.36)		3.89 (.08)		5.18(.07)	

Based on the results shown above, Dryline Wicking Spandex fabric was selected for prototyping because of its better softness, wicking and similar wicking in warp and filling directions. The researchers conducted a review of trending scarf designs and selected seven

different prototype styles (for children size 6) in this study. Prototype #1 was a multilayer regular banana-shaped scarf. The inner layer could tuck into the collar of the shirt to keep it from dampening with saliva. The six other prototypes were designed to be closer to the neck to achieve the functional purpose of saliva wicking while being cosmetically pleasing. Prototypes #2 and #3 were inspired by neck gaiters. Prototype #4 was a form of mock turtleneck dickey. Prototypes #5 to #7 were evolved from stylishly designed scarves.

1 2 3 4 5 6 7

Figure 2. Prototypes to meet the functional and aesthetic needs of users with sialorrhea

In this study, the majority of designs were single layer designs requiring the fabrics to be high wicking; therefore, waterproof fabrics were not appropriate. In **future research**, these waterproof fabrics might be used for multi-layer design solutions, as a bottom layer to keep saliva from dampening underlying clothing. Next steps for this research include developing multi-layer prototypes, testing prototypes on end users, and gathering feedback from end users related to comfort and aesthetics of the prototypes.

References

Bothwell, J. E., Clarke, K., Dooley, J. M., Gordon, K. E., Anderson, R., Wood, E. P., Camfield, C. S., & Camfield, P. R. (2002). Botulinum toxin A as a treatment for excessive drooling in children. *Pediatric neurology*, *27*(1), 18-22.

Hockstein, N. G., Samadi, D. S., Gendron, K., & Handler, S. D. (2004). Sialorrhea: a management challenge. *American family physician*, *69*(11).

Hornibrook, J., & Cochrane, N. (2012). Contemporary surgical management of severe sialorrhea in children. *ISRN pediatrics*, *2012*.

Mullen, L. (2018, March 04). The Best Bibs for Heavy Droolers. Retrieved from https://www.themerrymomma.com/2018/03/best-bibs-heavy-droolers/

Norderyd, J., Graf, J., Marcusson, A., Nilsson, K., Sjöstrand, E., Steinwall, G., Ärleskog, E., & Bågesund, M. (2017). Sublingual administration of atropine eyedrops in children with excessive drooling–a pilot study. *International journal of paediatric dentistry*, *27*(1), 22-29.

Reddihough, D., Erasmus, C. E., Johnson, H., McKellar, G. M. W., & Jongerius, P. H. (2010). Botulinum toxin assessment, intervention and aftercare for paediatric and adult drooling: international consensus statement. *European journal of neurology*, *17*, 109-121.

Sénécal, A. M. (2012). *The application of cognitive orientation to daily occupational performance (CO-OP) for self-management of drooling in children* (Doctoral dissertation, McGill University Libraries).