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Exploratory Study of Female NCAA Athlete User Needs and Prototype Design and Evaluation of A Hamstring Compression Sleeve

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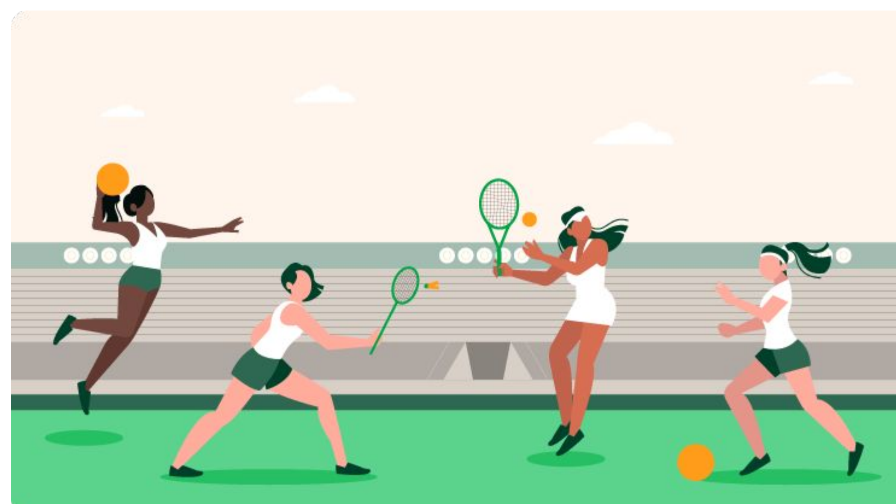
Spring 2024

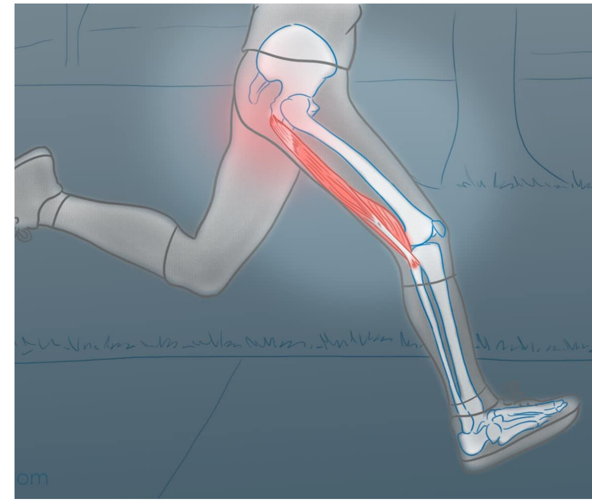
Table of Contents

Intro and Background

- Female student-athletes competing in NCAA women's championship sports increased in 2021-22 by 5% (10,726 students) from 2020-21, the largest percentage rise since 2000-01.
- Despite progress, disparities remain in participation rates, societal norms, and resource availability for women in sports.
- Female athletes participating in sports that require a lot of running frequently suffer from hamstring injuries (HSIs), which are linked to a prolonged healing time and a high rate of reinjury (Opar et al., 2012)



Review of Literature



Anatomy of Hamstring Muscles

- The hamstring, a crucial muscle group for athletes participating in sports that include high intensity running, is susceptible to various injuries
- HSIs manifest as acute pain in the posterior thigh due to the disruption of hamstring muscle fibers (Opar et al., 2012)

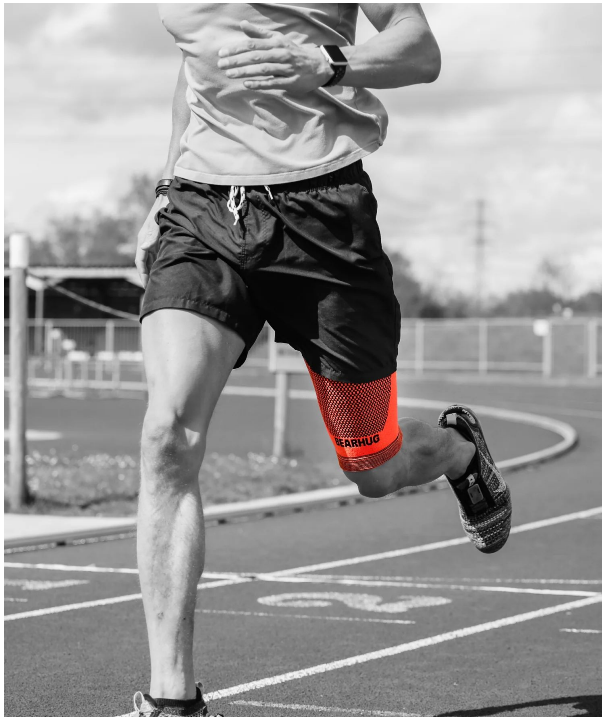
Delayed Onset Muscle Soreness (DOMS)

- DOMS is characterized by a dull ache, tenderness, stiffness, and weakness in previously engaged muscles (Croisier, 2003)
- While classified as a mild injury, DOMS significantly impacts exercise performance, representing one of the most common causes of performance impairment (De Oliveira, 2023).

Review of Literature

Compression Garments

- Franke et al's (2021) study indicated that over 80% of athletes use CGs primarily to prevent re-injury, with nearly half prioritizing secondary sports injury prevention, and nearly 90% of those seeking to reduce recurrent injuries reported positive perceived effects of CG use for this purpose



Kinesio Technology (KT) Tape

- KT tape is an ultra-thin and breathable tape with a very high level of elasticity
- It optimizes skin, blood, and lymph flow

Review of Literature

- CS fit and sizing
- CS design and product development
- CS aesthetics
- CS materials and properties

**CS=compression sleeve

The User-Centered Design (UCD) process

In the current interdisciplinary mixed methods experimental study, a UCD framework was adapted from Morris et al. (2017) (Figure 4). The framework guided the comprehensive examination of NCAA female athlete user-needs, followed by qualitative and quantitative analysis of surveys, material performance, and field testing.

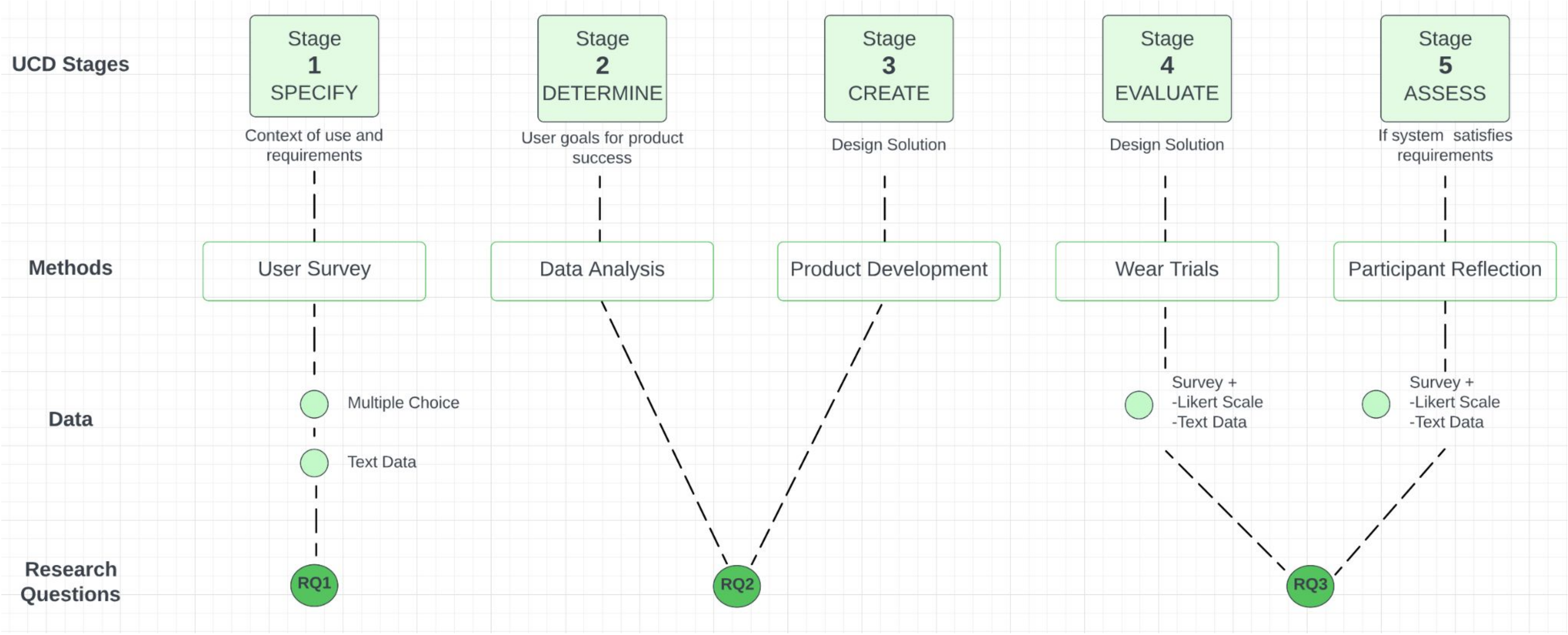
Research Questions

RQ1: What are the user-needs of female NCAA athletes for CS design aimed at reducing hamstring injuries and recovery time from DOMS?

RQ2: How does a prototype design that satisfies NCAA female athlete user-needs look like when incorporating the science between KT tape and CS?

RQ3: How does incorporating the science behind KT tape in a custom made CS affect the recovery time of DOMS, and to what extent is the prototype successful in reducing the impact of DOMS?

The User-Centered Design (UCD) process adapted from Morris et al. (2017)



Methods

Stage 1: Specify

RQ1: What are the user-needs of female NCAA athletes for CS design aimed at reducing hamstring injuries and recovery time from DOMS?

- Gathered user-needs data via Qualtrics survey distributed to current and recently graduated female NCAA athletes
- The survey data was analyzed using Excel software for analyzing the quantitative data, as well as tabulating frequencies of qualitative data.

Stage 2: Determine

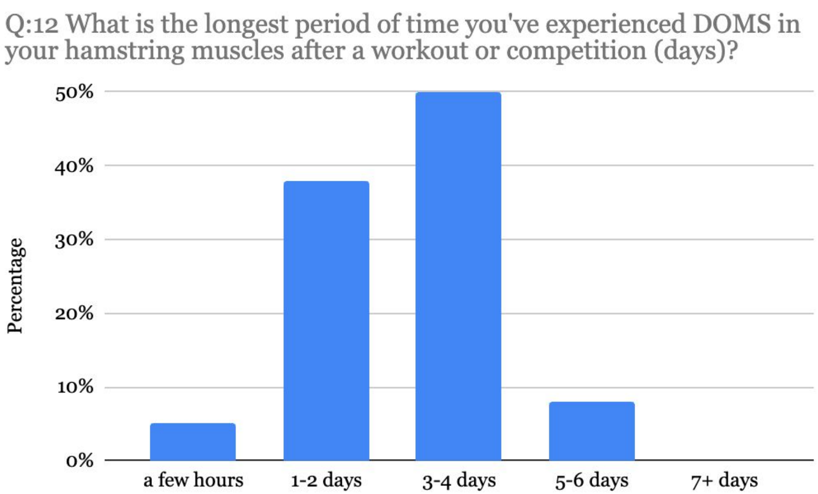
RQ2: How does a prototype design that satisfies NCAA female athlete user-needs look like when incorporating the science between KT tape and CS?

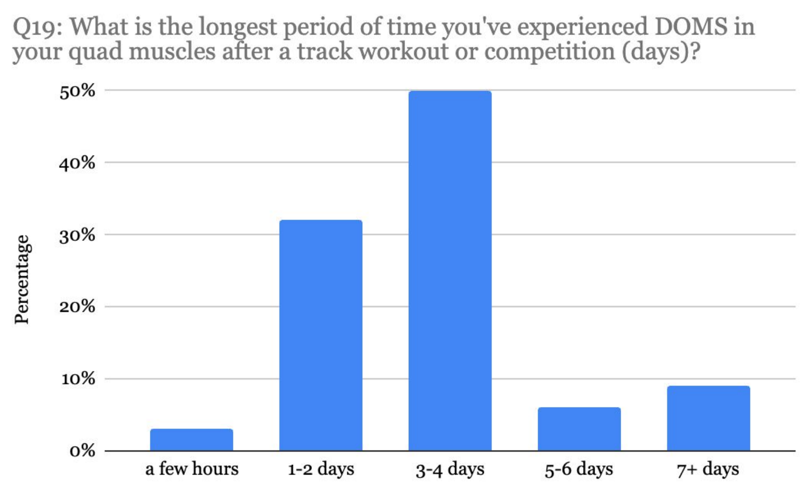
- User needs and design criteria for a CS were determined by integrating the themes analyzed from the qualitative data with the quantitative findings using Excel.

Results

Stage 1: Specify-Initial User-Needs Survey

- 36 Respondents
- All were current or former NCAA female athletes
- Between ages 18-24
- Asked about sports related injuries: “shin splints” and “ankle injuries” (14.04%), “hamstring strains” (10.53%), “quad strain” (5.26%)
- 85% respondents experienced DOMS in their hamstrings after training/ competition
- 79% of respondents experienced DOMS in their quads after training/ competition





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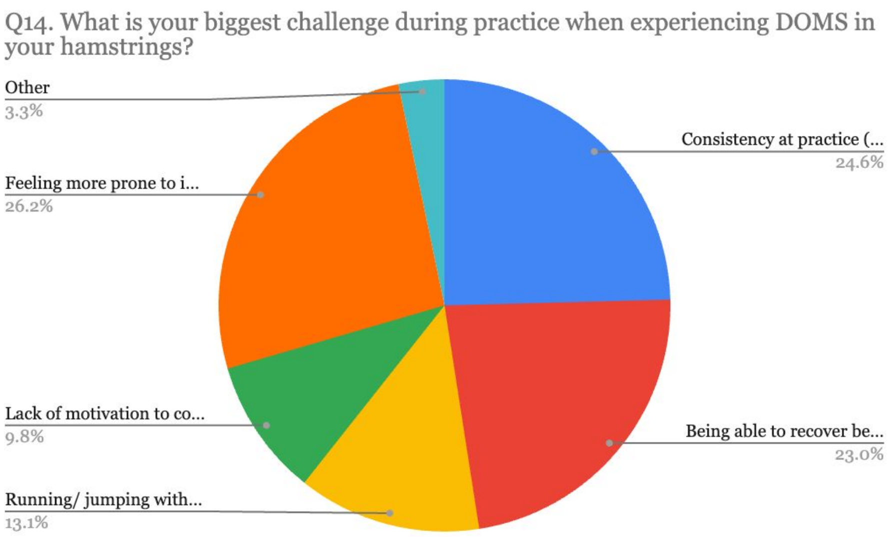
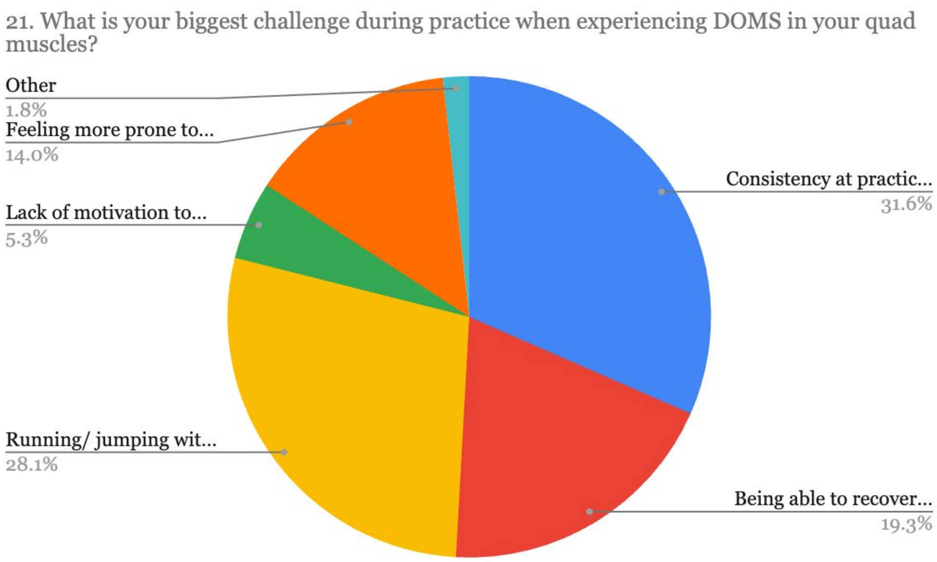
Results

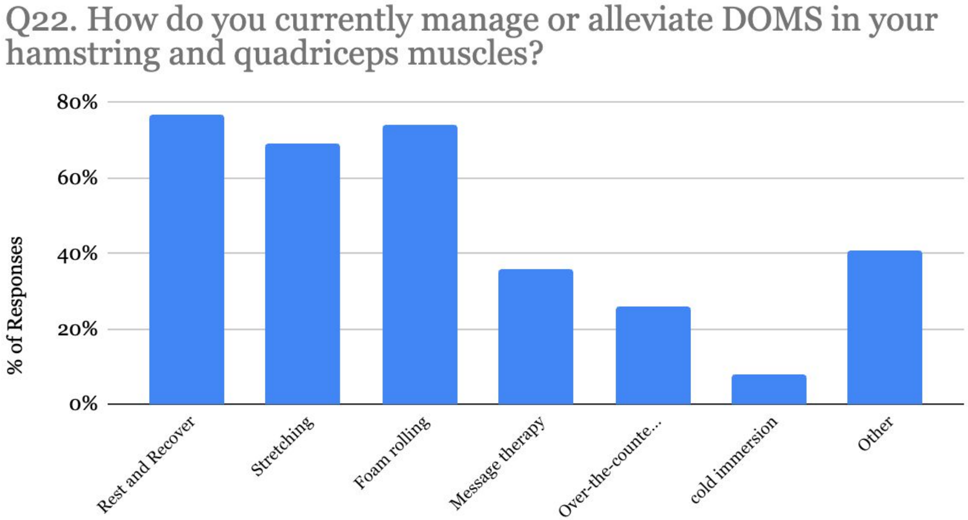
Stage 1: Specify-Initial User-Needs Survey





Results

Stage 1: Specify-Initial User-Needs Survey



Desired CS properties

- Durability 8.38/10
- Light in weight 6.76/10
- High level of stretch 6.62/10
- Breathability 6.48/10
- Smooth 5.71/10

Methods

Stage 2: Determine

Air Permeability

Schroeder fabric thickness gauge

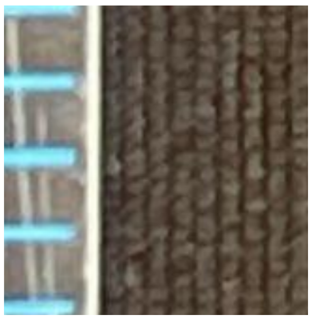
GSM circular cutter, and weighed on a Schröder fabric weight balance.

Tinius Olsen H5KT Benchtop Tester for elongation

Methods

Stage 3: Determine

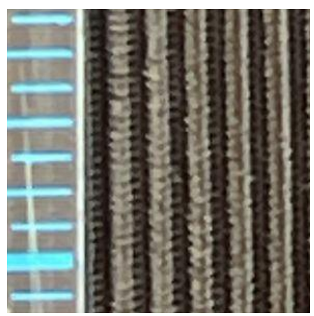
a)



b)

c)

d)



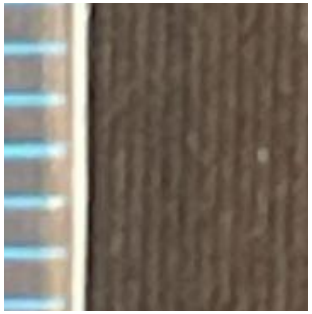
e)

The final fabrics selected were: (a) Superflex Heavy Compression Spandex, (b) Spacer with Wicking, (c) Eco-Move Recycled Matte Nylon Spandex Tricot, (d) Ribbed Spandex and (e) Spacer Scuba Knit

Results

Stage 2: Determine

- The fabric that had the highest air permeability was Eco-Move Recycled Matte Nylon spandex Tricot Fabric, and the least was Superflex Heavy Compression spandex.
- The fabric that had the highest elongation was Superflex Heavy Compression Spandex, and the least was Spacer with wicking.
- The fabric that was the heaviest was Spacer Scuba knit, and the lightest was Eco-Move Recycled Matte Nylon spandex Tricot Fabric.
- The fabric that had the highest thickness was Spacer Scuba Knit, and the least was Eco-Move Recycled Matte Nylon spandex Tricot Fabric.



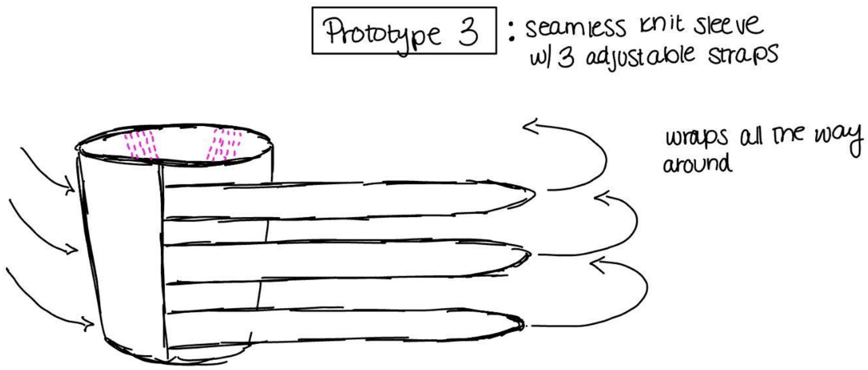
Chosen Fabric

- Spacer Scuba Knit, fabric was chosen for the CS prototype.
    - Highest thickness (1.3mm)
    - Second lowest air permeability (165.39 mm/s),
    - High elongation percentage (432.84%) compared to the other fabrics.

Methods

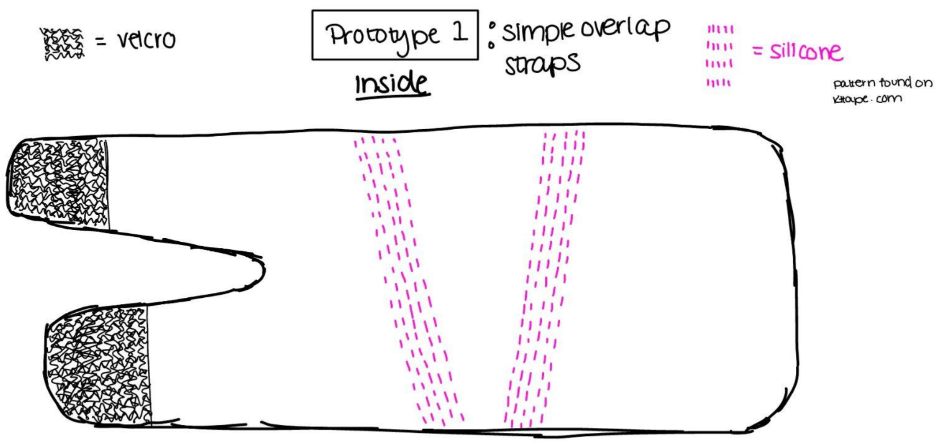
Stage 3: Create

RQ2: How does incorporating the science behind KT tape in a custom made CS affect the perception of recovery time of DOMS?



PROS
- Allow for adjustable compression all the way around the leg
- KT tape will fall in the right place every time
- can most likely avoid seamless knit
- straps can be made out of different material than the sleeve itself

CONS
- Not adjustable sizing



Sleeve Materials
- Lycra
- Neoprene
- Merino wool
- TENCELL Lyocell fibers } combine
- Spandex

Textile Tests
- Elongation
- Stretch recovery testing
- MMT
- Abrasia

Methods

Stage 3: Create

Inside (top) and outside (bottom) of initial prototype 1

Inside (top) and outside (bottome) of initial prototype 2

Methods

Stage 3: Create

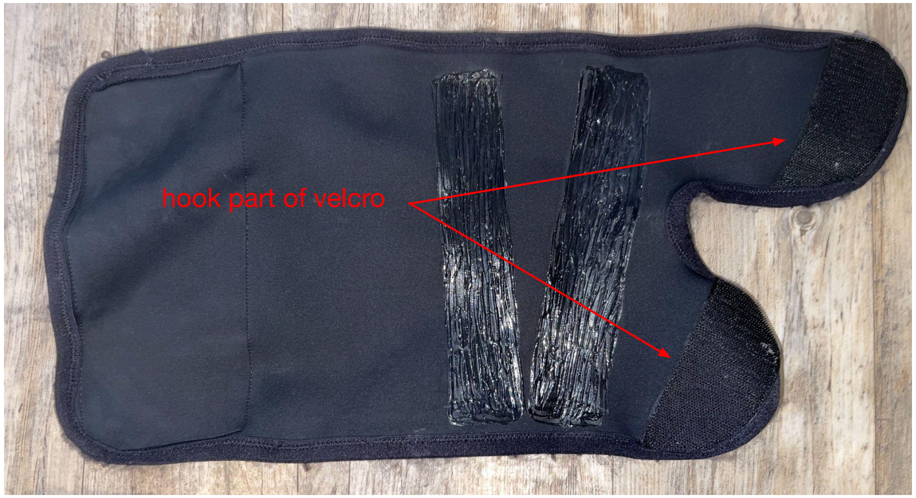
- There were six total prototypes made. Three for the right leg, and three for the left leg.
- The sizes included small, medium, and large.

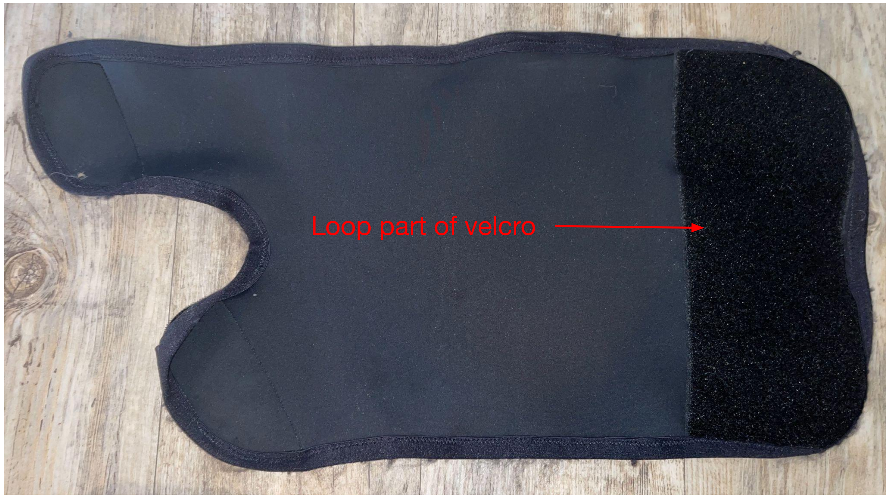
Front and back of assembled CS prototype for right leg.

Methods

Stage 3: Create

- The Velcro strip that was used was black, 4'' wide and cut to fit each size. It's a sew-on, hook and loop tape fastening nylon fabric tape.



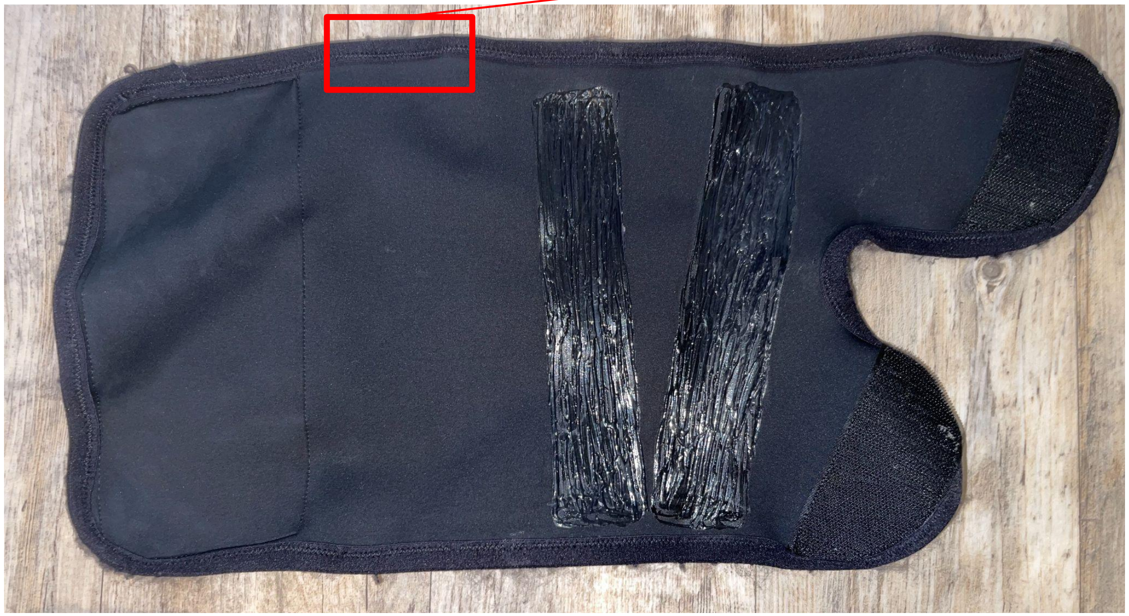


Front and back of assembled CS prototype for right leg.

Methods

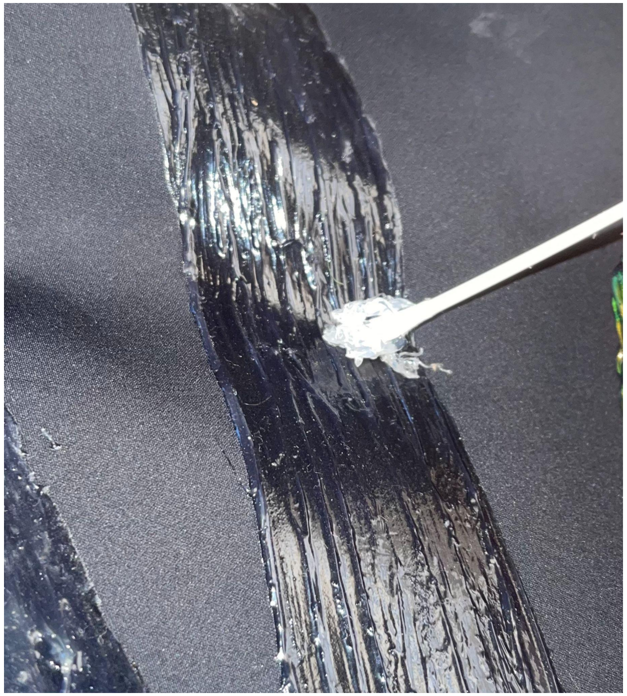
Stage 3: Create

- After the velcro was sewn on, in order to finish the edges of the sleeve, 1” fold-over elastic was sewn on using a zig-zag stitch.



Methods

Stage 3: Create



Silicone paint application on the fabric surface inside the CS prototype.

Methods

Stage 4: Evaluate

RQ3: How does incorporating the science behind KT tape in a custom made CS affect the recovery time of DOMS, and to what extent is the prototype successful in reducing the impact of DOMS?

Session 1

1. Gather consent
2. Health and Demographic Survey

Functional Testing

3.	Isometric Hamstring test	(peak force)	*Hypothesis 1*
4.	Isometric Quad test	(peak force)	*Hypothesis 2*
5.	Sparta Single Leg Jump Test	(Jump height and max power)	*Hypothesis 3 and 4*

Sprint Protocol

6.	Warm-up		
7.	Don CS Prototype		
8.	Sprint Test		
9.	Baseline Soreness Survey	(Perceptions of soreness)	*Hypothesis 5*
10.	Comfort Survey	(Perceptions of comfort)	

Methods

Stage 4: Evaluate

Sessions 2, 3, and 4

1. Changes in Health Survey
2. Soreness Survey (perceptions of soreness) *Hypothesis 5*

Functional Testing

3. Isometric Hamstring test (peak force)
4. Isometric Quad test (peak force)
5. Sparta Single Leg Jump Test (Jump height and max power)

Methods

Stage 4: Evaluate

Stage 5: Assess

Sessions 2, 3, and 4

1. Changes in Health Survey
2. Soreness Survey (perceptions of soreness) *Hypothesis 5*

Functional Testing

3. Isometric Hamstring test (peak force)
4. Isometric Quad test (peak force)
5. Sparta Single Leg Jump Test (Jump height and max power)

Hypotheses

H1:The leg that the participant wears the CS on will result in an overall higher hamstring peakforce average by Session 4 than the control leg.

H2: The leg that the participant wears the CS on will result in an overall higher quad peakforce by Session 4 than the control leg.

H3: The leg that the participant wears the CS on will result in an overall higher jump height by session 4 than the control leg.

H4: The leg that the participant wears the CS on will result in an overall higher max power by session 4 than the control leg.

H5: The participant will have a perception of less soreness in the leg that wore the CS compared to the control leg by Session 4.

Methods

Stage 4: Evaluate

H1

The researcher measuring Hamstring Peak force on a volunteering participant.

H2

Researcher measuring Quad Peak force on a volunteering participant.

H3 and H4

Participant completing single leg test with Sparta software

Methods

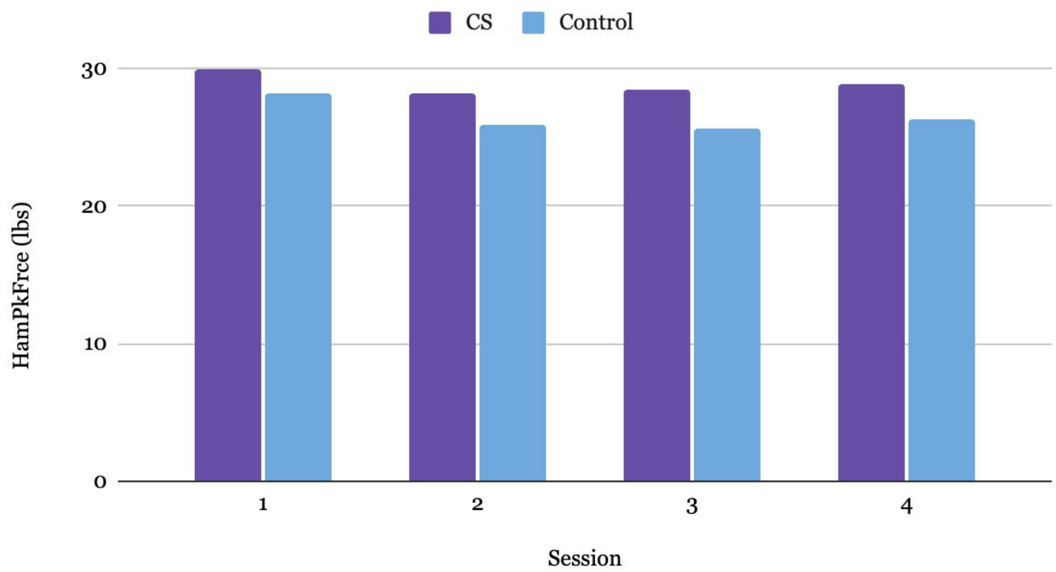
Stage 5: Assess

Front and back view of CS on participant

- By following the layout of a high-intensity interval training (HIIT), the Sprint Test included the participant running at maximum speed for 15 repetitions of 30 meters sprints.
- Each sprint departed every 65 seconds.

Results: *Hypothesis 1*

Stage 4: Evaluate- Estimated Marginal Means of HamPkFrce



- This bar graph compares the means of hamstring peak force between the control leg and the CS leg across the four sessions show that a similar pattern occurred between the four sessions for both legs
- Across all sessions, the mean HamPkFrce decreased slightly less for the CS than the control leg. This leads to the belief that hypothesis 1 is supported, but further data analysis had to be conducted

Results: *Hypothesis 1*

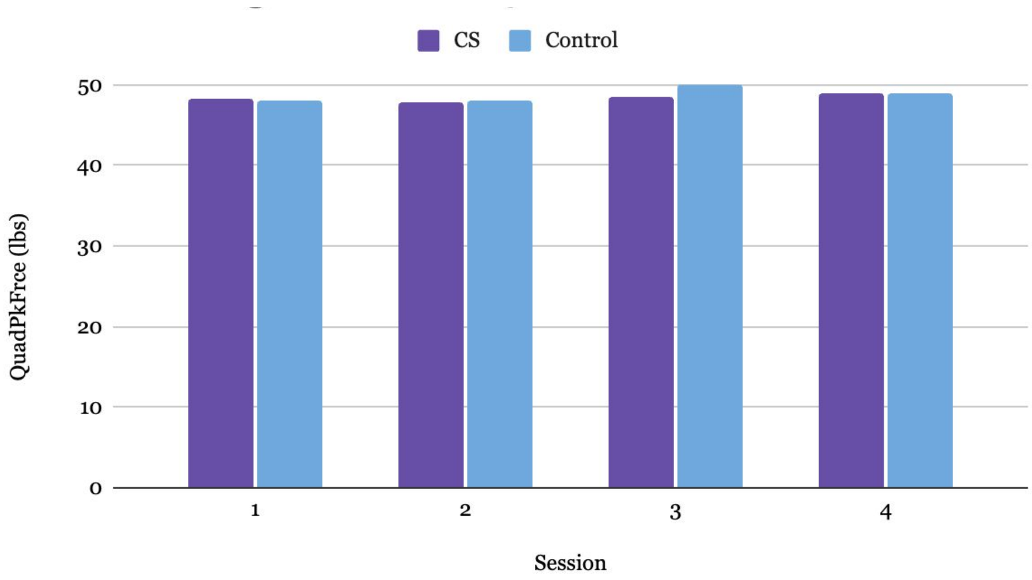
Stage 4: Evaluate- Test of Between-Subjects Effects for Hamstring peak force

Measure: HamPkFrce						
Transformed Variable: Average						
Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Intercept	48942.16	1	48942.16	272.065	<.001	0.951
Sleeve	87.399	1	87.399	0.486	0.497	0.034
Error	2518.477	14	179.891			

- The intercept is highly significant ($p < .001$), indicating that there is a significant overall effect on HamPkFrce when all other variables are held constant.
- The main effect of the independent variable "Sleeve" assesses whether there are significant differences in the dependent variable (HamPkFrce) between the control and CS leg. In this case, the effect of the CS is **NOT** significant, as indicated by the non-significant p-value ($p = .497$).

Results: *Hypothesis 2*

Stage 4: Evaluate- Estimated Marginal Means of QuadPkFrce



- This bar graph compares the means of quad peak force between the control leg and the CS leg across the four sessions show that a similar pattern occurred between the four sessions for both legs
- Even though the mean QuadPkFrce increased slightly for the CS, the control leg increased more by Session 4. Therefore hypothesis 2 is **NOT** supported.

Results: *Hypothesis 2*

Stage 4: Evaluate- Test of Between-Subjects Effects for Quad peak force

Measure: QuadPkFrce						
Transformed Variable: Average						
Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Intercept	150997.331	1	150997.331	4121.852	<.001	0.997
Sleeve	2.989	1	2.989	0.082	0.779	0.006
Error	512.867	14	36.633			

- The intercept term represents the estimated mean of the dependent variable (QuadPkFrce) when all independent variables are set to zero.
- In this analysis, the intercept is highly significant ($p < .001$), indicating that there is a significant overall effect on QuadPkFrce when all other variables are held constant. In this case, the effect of Sleeve is **NOT** significant ($p = .779$).

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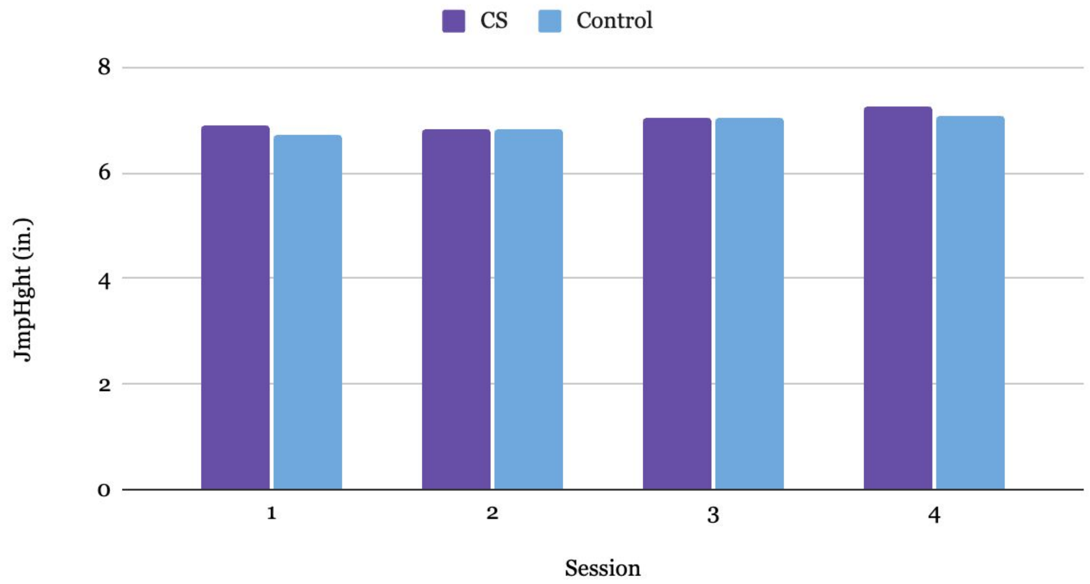
Results: *Hypothesis 3*

Stage 4: Evaluate- Estimated Marginal Means of JmpHght



- This bar graph compares the means of JmpHght between the control leg and the CS leg across the four sessions show that a similar pattern occurred between the four sessions for both legs
- Even though the mean JmpHght increased slightly for the CS, the control leg increased slightly more by session 4. Therefore hypothesis 3 is **NOT** supported.

Results: *Hypothesis 3*

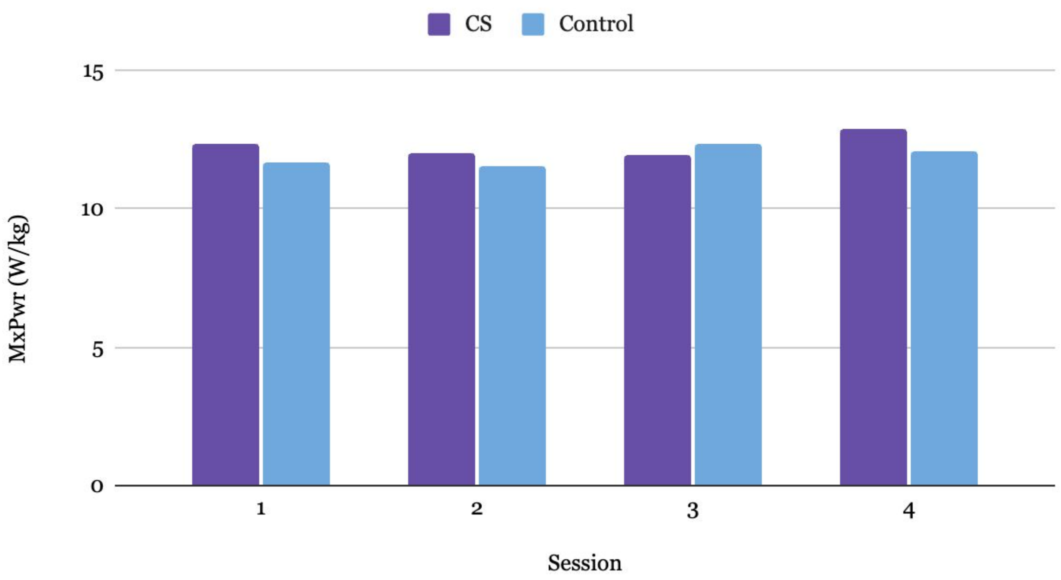
Stage 4: Evaluate- Test of Between-Subjects Effects for JmpHght

Measure: QuadPkFrce						
Transformed Variable: Average						
Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Intercept	150997.331	1	150997.331	4121.852	<.001	0.997
Sleeve	2.989	1	2.989	0.082	0.779	0.006
Error	512.867	14	36.633			

- This table presents the results of between-subjects ANOVA for the variable JmpHght. In this analysis, the intercept is highly significant (p < .001), indicating that there is a significant overall effect on JmpHght when all other variables are held constant.
- The effect of Variable is not significant, as indicated by the p-value (p = .788). Additionally, the partial eta squared value (.005) suggests that the effect size of the CS on JmpHght is very small, and therefore **insignificant.**

Results: *Hypothesis 4*

Stage 4: Evaluate- Estimated Marginal Means of MxPwr



- This bar graph compares the means of MxPwr between the control leg and the CS leg across the four sessions show that a similar pattern occurred between the four sessions for both legs
- Overall, across all sessions, the mean MxPwr increased slightly more for the CS than the control leg, supporting hypothesis 4 which stated that the CS variable ***may*** improve MxPwr by session 4.

Results: *Hypothesis 4*

Stage 4: Evaluate- Test of Between-Subjects Effects for MxPwr

Measure: MEASURE_1						
Transformed Variable: Average						
Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Intercept	9341.464	1	9341.464	572.761	<.001	0.976
Sleeve	2.645	1	2.645	0.162	0.693	0.011
Error	228.333	14	16.31			

- The intercept term represents the estimated mean of the dependent variable (MxPwr) when all independent variables are set to zero.
- In this analysis, the intercept is highly significant ($p < .001$), indicating that there is a significant overall effect on MxPwr when all other variables are held constant. The partial eta squared value (0.976) suggests that a vast proportion of the variance in MxPwr can be attributed to this intercept term. The effect of the CS is **NOT** significant ($p = .693$).

Results: *Hypothesis 5*

Stage 5: Assess

Table 6: Session 1-4 Soreness Survey averages and Standard Deviations

Session	Avg or SD	2. Rate how sore your RIGHT quadricep is right now (1= not sore at all, 10=extremely sore)		3. Rate how sore your LEFT quadricep is right now (1= not sore at all, 10=extremely sore)		4. Rate the impact of the soreness in your RIGHT quad on your daily activities and overall well-being (1=no impact, 10=severe impact)		5. Rate the impact of the soreness in your LEFT quad on your daily activities and overall well-being (1=no impact, 10=severe impact)		6. Rate how sore your RIGHT hamstring is right now (1= not sore at all, 10=extremely sore)		7. Rate how sore your LEFT hamstring is right now (1= not sore at all, 10=extremely sore)		8. Rate the impact of the soreness in your RIGHT hamstring on your daily activities and overall well-being (1=no impact, 10=severe impact)		9. Rate the impact of the soreness in your LEFT hamstring on your daily activities and overall well-being (1=no impact, 10=severe impact)	
		CS	Cntrl	Cntrl	CS	CS	Cntrl	Cntrl	CS	CS	Cntrl	Cntrl	CS	CS	Cntrl	Cntrl	CS
	Avg	3.25	5.00	2.50	3.50	3.25	2.25	2.50	1.50	1.50	3.25	2.25	2.25	2.25	2.50	2.25	1.25
1	SD	3.86	2.58	3.00	2.08	2.22	2.50	2.38	1.00	0.58	2.63	1.89	1.50	1.50	3.00	1.50	0.50
	Avg	3.75	5.00	3.75	3.75	2.75	3.25	2.25	2.25	2.75	5.50	3.75	4.25	2.50	3.25	2.50	2.25
2	SD	2.36	2.58	2.75	1.71	1.26	2.63	1.50	0.96	1.71	2.80	2.22	1.26	1.73	2.63	1.73	0.96
	Avg	1.75	3.50	1.75	2.75	1.75	2.50	1.50	1.75	1.50	5.25	1.75	4.25	1.50	3.75	1.25	2.75
3	SD	0.50	3.11	0.96	1.26	0.50	3.00	0.58	0.96	0.58	2.63	0.50	1.89	0.58	3.20	0.50	2.36
	Avg	1.25	3.50	1.25	3.75	1.50	2.50	1.25	1.75	1.50	3.75	1.50	3.00	1.50	2.75	1.75	2.75
4	SD	0.50	3.11	0.50	1.26	0.58	3.00	0.50	1.50	1.00	2.36	1.00	1.41	1.00	2.06	1.50	2.06

Results: *Hypothesis 5*

Stage 5: Assess

Table 6: Session 1-4 Soreness Survey averages and Standard Deviations

Session	Avg or SD	2. Rate how sore your RIGHT quadricep is right now (1= not sore at all, 10=extremely sore)		3. Rate how sore your LEFT quadricep is right now (1= not sore at all, 10=extremely sore)		4. Rate the impact of the soreness in your RIGHT quad on your daily activities and overall well-being (1=no impact, 10=severe impact)		5. Rate the impact of the soreness in your LEFT quad on your daily activities and overall well-being (1=no impact, 10=severe impact)		6. Rate how sore your RIGHT hamstring is right now (1= not sore at all, 10=extremely sore)		7. Rate how sore your LEFT hamstring is right now (1= not sore at all, 10=extremely sore)		8. Rate the impact of the soreness in your RIGHT hamstring on your daily activities and overall well-being (1=no impact, 10=severe impact)		9. Rate the impact of the soreness in your LEFT hamstring on your daily activities and overall well-being (1=no impact, 10=severe impact)	
		CS	Cntrl	Cntrl	CS	CS	Cntrl	Cntrl	CS	CS	Cntrl	Cntrl	CS	CS	Cntrl	Cntrl	CS
	Avg	3.25	5.00	2.50	3.50	3.25	2.25	2.50	1.50	1.50	3.25	2.25	2.25	2.25	2.50	2.25	1.25
1	SD	3.86	2.58	3.00	2.08	2.22	2.50	2.38	1.00	0.58	2.63	1.89	1.50	1.50	3.00	1.50	0.50
	Avg	3.75	5.00	3.75	3.75	2.75	3.25	2.25	2.25	2.75	5.50	3.75	4.25	2.50	3.25	2.50	2.25
2	SD	2.36	2.58	2.75	1.71	1.26	2.63	1.50	0.96	1.71	2.80	2.22	1.26	1.73	2.63	1.73	0.96
	Avg	1.75	3.50	1.75	2.75	1.75	2.50	1.50	1.75	1.50	5.25	1.75	4.25	1.50	3.75	1.25	2.75
3	SD	0.50	3.11	0.96	1.26	0.50	3.00	0.58	0.96	0.58	2.63	0.50	1.89	0.58	3.20	0.50	2.36
	Avg	1.25	3.50	1.25	3.75	1.50	2.50	1.25	1.75	1.50	3.75	1.50	3.00	1.50	2.75	1.75	2.75
4	SD	0.50	3.11	0.50	1.26	0.58	3.00	0.50	1.50	1.00	2.36	1.00	1.41	1.00	2.06	1.50	2.06

Results: *Hypothesis 5*

Stage 5: Assess

Table 6: Session 1-4 Soreness Survey averages and Standard Deviations

Session	Avg or SD	2. Rate how sore your RIGHT quadricep is right now (1= not sore at all, 10=extremely sore)		3. Rate how sore your LEFT quadricep is right now (1= not sore at all, 10=extremely sore)		4. Rate the impact of the soreness in your RIGHT quad on your daily activities and overall well-being (1=no impact, 10=severe impact)		5. Rate the impact of the soreness in your LEFT quad on your daily activities and overall well-being (1=no impact, 10=severe impact)		6. Rate how sore your RIGHT hamstring is right now (1= not sore at all, 10=extremely sore)		7. Rate how sore your LEFT hamstring is right now (1= not sore at all, 10=extremely sore)		8. Rate the impact of the soreness in your RIGHT hamstring on your daily activities and overall well-being (1=no impact, 10=severe impact)		9. Rate the impact of the soreness in your LEFT hamstring on your daily activities and overall well-being (1=no impact, 10=severe impact)	
		CS	Cntrl	Cntrl	CS	CS	Cntrl	Cntrl	CS	CS	Cntrl	Cntrl	CS	CS	Cntrl	Cntrl	CS
	Avg	3.25	5.00	2.50	3.50	3.25	2.25	2.50	1.50	1.50	3.25	2.25	2.25	2.25	2.50	2.25	1.25
1	SD	3.86	2.58	3.00	2.08	2.22	2.50	2.38	1.00	0.58	2.63	1.89	1.50	1.50	3.00	1.50	0.50
	Avg	3.75	5.00	3.75	3.75	2.75	3.25	2.25	2.25	2.75	5.50	3.75	4.25	2.50	3.25	2.50	2.25
2	SD	2.36	2.58	2.75	1.71	1.26	2.63	1.50	0.96	1.71	2.80	2.22	1.26	1.73	2.63	1.73	0.96
	Avg	1.75	3.50	1.75	2.75	1.75	2.50	1.50	1.75	1.50	5.25	1.75	4.25	1.50	3.75	1.25	2.75
3	SD	0.50	3.11	0.96	1.26	0.50	3.00	0.58	0.96	0.58	2.63	0.50	1.89	0.58	3.20	0.50	2.36
	Avg	1.25	3.50	1.25	3.75	1.50	2.50	1.25	1.75	1.50	3.75	1.50	3.00	1.50	2.75	1.75	2.75
4	SD	0.50	3.11	0.50	1.26	0.58	3.00	0.50	1.50	1.00	2.36	1.00	1.41	1.00	2.06	1.50	2.06

Results: *Hypothesis 5*

Stage 5: Assess

Table 6: Session 1-4 Soreness Survey averages and Standard Deviations

Session	Avg or SD	2. Rate how sore your RIGHT quadricep is right now (1= not sore at all, 10=extremely sore)		3. Rate how sore your LEFT quadricep is right now (1= not sore at all, 10=extremely sore)		4. Rate the impact of the soreness in your RIGHT quad on your daily activities and overall well-being (1=no impact, 10=severe impact)		5. Rate the impact of the soreness in your LEFT quad on your daily activities and overall well-being (1=no impact, 10=severe impact)		6. Rate how sore your RIGHT hamstring is right now (1= not sore at all, 10=extremely sore)		7. Rate how sore your LEFT hamstring is right now (1= not sore at all, 10=extremely sore)		8. Rate the impact of the soreness in your RIGHT hamstring on your daily activities and overall well-being (1=no impact, 10=severe impact)		9. Rate the impact of the soreness in your LEFT hamstring on your daily activities and overall well-being (1=no impact, 10=severe impact)	
		CS	Cntrl	Cntrl	CS	CS	Cntrl	Cntrl	CS	CS	Cntrl	Cntrl	CS	CS	Cntrl	Cntrl	CS
	Avg	3.25	5.00	2.50	3.50	3.25	2.25	2.50	1.50	1.50	3.25	2.25	2.25	2.25	2.50	2.25	1.25
1	SD	3.86	2.58	3.00	2.08	2.22	2.50	2.38	1.00	0.58	2.63	1.89	1.50	1.50	3.00	1.50	0.50
	Avg	3.75	5.00	3.75	3.75	2.75	3.25	2.25	2.25	2.75	5.50	3.75	4.25	2.50	3.25	2.50	2.25
2	SD	2.36	2.58	2.75	1.71	1.26	2.63	1.50	0.96	1.71	2.80	2.22	1.26	1.73	2.63	1.73	0.96
	Avg	1.75	3.50	1.75	2.75	1.75	2.50	1.50	1.75	1.50	5.25	1.75	4.25	1.50	3.75	1.25	2.75
3	SD	0.50	3.11	0.96	1.26	0.50	3.00	0.58	0.96	0.58	2.63	0.50	1.89	0.58	3.20	0.50	2.36
	Avg	1.25	3.50	1.25	3.75	1.50	2.50	1.25	1.75	1.50	3.75	1.50	3.00	1.50	2.75	1.75	2.75
4	SD	0.50	3.11	0.50	1.26	0.58	3.00	0.50	1.50	1.00	2.36	1.00	1.41	1.00	2.06	1.50	2.06

Results: *Hypothesis 5*

Stage 5: Assess

Table 5: Qualitative Answers from CS Comfort Survey

2. Rate how easy it was to put on the CS prototype by yourself. Additional Comments	"Had to do it seated, but could get it aligned with some practice"
	"Somewhat hard to align"
	"I like how it was adjustable within the sizes"
	"it was really easy to put on. I like how it felt and how it mimicked the feel of tape. The material was super comfortable and I think it would be easy to wash and look after"
	"very soft, very comfortable, easy to self administer"
	"I needed a little help to get it to be tight enough to have enough compression"
4. Did you feel that the compression sleeve inhibited your ability to run at all? Explain.	"No, felt very comfortable running in the sleeve"
	"Not at all. I feel like it helped to keep my legs fresher for longer!"
	"No it felt really natural while I was running"
6. Do you have any additional comments based on the comfort of compression?	"It slipped during the first sprint, but after I adjusted it, it stayed in place for the rest of the protocol."
	"It was perfect and I like how I was able to adjust the pressure of the sleeve with the velcro."
	"Was slipping a bit, but very comfortable"
7. Do you have any additional comments based on the overall compression sleeve (style, design, etc)?	"I liked how it was adjustable and I could readjust it by alternating the velcro pieces."
	"Sleeve shifted down while running, but not completely off."
	"The design was clever and I liked how I could adjust it to myself. I like that it couldn't really be seen and that it blended in and if i wore leggings no one could tell I would be wearing it I would like it in different colors too so i can plan my outfits with it!"
	"Style and design were very nice"
	"I liked that it was black. The middle of the two straps gapped a little bit, but I think it was smart to have two parts to tighten the sleeve. Once I started sweating, it started to fall a little bit, but not an extensive amount. I really liked how it felt when I was running"

Discussion

- Despite lack of significant findings regarding the compression sleeve (CS) there are implications to consider
- Studies by Xue et al. (2023) and Kanik et al. (2019) demonstrate reduced quadricep muscle soreness with KT tape and CS intervention.
- Foundational evidence suggests potential for a CS to reduce DOMS with design or technique adjustments to mimic KT tape effects.
- Even if the CS design does not alleviate DOMS, it may still offer other benefits like improved circulation, muscle stabilization, or injury prevention
- Results could also provide insights into how female athletes respond differently to certain recovery interventions compared to male athletes.

Future Research

- Mixed results indicate factors beyond CS may influence soreness levels.
- Highlights complexity of soreness perception in athletic contexts.
- Focusing solely on user in medical device design might not optimize efficacy.
- User insights often experience-based rather than scientifically or data-driven.
- UCD framework may need additional elements for effective CS design.
- Additional insight from healthcare professionals, athletic trainers, or coaches suggested.

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