RAE2026

Posture Correction Girdle on Adolescents with Early Scoliosis

Prof. Joanne Yiu-wan Yip

MCO1

11.2025

Content

Title: Posture Correction Girdle on Adolescents with Early Scoliosis

Description

Adolescent Idiopathic Scoliosis (AIS) is a prevalent spinal condition in adolescents that progresses during puberty and leads to three-dimensional deformities. Early-stage AIS, defined by a Cobb angle of 10°–20°, is traditionally managed through periodic observation. Rigid bracing indicated for curves with a Cobb angle of 20°~40°, often causes discomfort, resulting in poor compliance and an increased risk of curve progression. Hence, a multidisciplinary research programme was initiated in 2012 to develop a posture correction girdle (PCG) for mild AIS. This programme was supported by the Innovation and Technology Fund (ITF) (ITS/237/11, $1.3M, 2012-2014) and the General Research Fund (GRF) (152061/15E, $495,728, 2016~2018), both submitted in the Research Assessment Exercise 2020 (RAE2020). Building on previous findings, additional funding from The Hong Kong Polytechnic University internal seed grants ($2M, 2019-2022), the Lee Hysan Foundation ($3M, 2021~2026) and the Research Impact Fund (RIF) (P0044974, $5M, 2024~2028) has supported advanced development between 2020 and 2025.

From 2020 onward, the programme integrated engineering and biomedical techniques to refine the PCG. Finite element models were developed to simulate tissue biomechanics and optimise corrective force distribution. Large-scale screenings in Hong Kong schools recruited participants for 3D body scanning and iterative wear trials. Insights from objective data and feedback informed a redesigned sizing system, pattern construction, and material upgrades that enhance comfort. The PCG integrates custom Inertial Measurement Unit (IMU) sensors for real-time posture tracking and temperature monitoring. Corrective forces are applied via elastic straps, plastic bones, and ethylene-vinyl acetate (EVA) padding. Clinical evaluations have demonstrated significant immediate curve reduction (mean 87.5%) and promising outcomes indicating curve correction over nine-month. Research outputs include patents (ZL 2023 3 0553931.4), publications, and conference presentations. Industry partnerships, fostered through exhibitions, workshops, and public talks, support clinical validation and translation. These efforts advance brace-mediated rehabilitation strategies for early-stage AIS intervention.

Personal Profile: Prof. Joanne Yip

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Prof. Joanne Yip is Professor and Associate Dean (Industrial Partnership) at the School of Fashion and Textiles, The Hong Kong Polytechnic University. She specialises in developing innovative textile-based medical devices for AIS, integrating smart materials and biomechanics to improve brace effectiveness and their quality of life. She pioneers textile braces for AIS, which has led to the following developments:

MCO 1: PCG for adolescents with mild scoliosis (Cobb angles of 10°–20°). This device provides a crucial early-intervention option for a patient group that previously had no active treatment beyond observation. Its innovations include integrated sensors for real-time posture monitoring and scalable fitting protocols.

MCO 2: ATB for adolescents with moderate scoliosis (Cobb angles of 20°–40°). It is certified as a Class II medical device in Mainland China (clinically proved to effectively treat AIS), which provides a breathable, comfortable, flexible alternative to traditional braces. She has been instrumental in driving these projects from methodological development to clinical application to the commercialisation of the products, coordinating among healthcare providers, manufacturers, and government agencies from Mainland China and Hong Kong. Her work has been recognised with gold medals at the Silicon Valley International Invention Festival (2019, 2024) and the International Exhibition of Inventions Geneva (2023). Together, these multicomponent outputs advance understanding of nonrigid orthotic systems, establish new methodological frameworks for integrating biomechanics and textiles, and provide empirical evidence that supports early intervention in AIS management.

Research Timeline

This study is cross-disciplinary, spanning textile materials science, intimate apparel design, biomechanical engineering, and biomedical engineering.

Previous studies

Before RAE2020

- ✓ Problem identification
- ✓ Material selection and testing
- ✓ PCG prototyping
- ✓ Initial wear trials

This MCO

2021

- ➢ Refinement of the PCG
- ➢ Development of a new sizing system
- ➢ Systematic design for user-friendly fitting

2022

- ➢ Sensor and app development
- ➢ Certificate application for further commercialisation

2023

- ➢ School screening and participant recruitment
- ➢ Wear trials
- ➢ Paper publication

2024

- ➢ Application and commercialisation phase
- ➢ Showcased at exhibitions and competitions
- ➢ Licensing

2025

Research Profiles of Coinvestigators

Prof. Kit-Lun YICK

Professor, SFT, PolyU
Members of RISports, PolyU

Expertise:
- Fashion production technology.
- Anthropometry measurement and comfort evaluation.

Role in the programme:
Prof. Yick provides expert advice on iterative design trials to enhance both the functionality and aesthetic appeal of the PCG. She leads the evaluation of garment fit and comfort, thus ensuring the device meets user needs.

Dr Sun-Pui NG

Assoc. Div. Hd. (SEHS) & Assoc HoR, Division of Science, Engineering and Health Studies, PolyU

Expertise:
- Stress and failure analysis of composite materials.

Role in the programme:
Dr Ng is responsible for conducting finite element modelling (FEM) of spinal biomechanics. He leads the simulation and optimisation of corrective force distribution in soft braces, thus supporting the development of effective and safe interventions.

Mr Chi Yung TSE

Certified Prosthetist Orthotists, Centre for Orthopaedic surgery

Expertise:
- Orthotic intervention and rehabilitation applications.

Role in the programme:
Mr Tse oversees the clinical validation of the PCG design. He provides guidance on the application of corrective forces and develops strategies to improve patient compliance with the wearable device.

Dr Brian Y. Chen

Associate Professor and Doctoral Programme Director, Engineering and Applied Science, Lehigh University

Expertise:
- Interactive, analytical algorithms.

Role in the programme:
Dr. Chen leads the development of posture data analytics algorithms and the integration of IMU sensor data for real-time feedback systems. His work enables advanced monitoring and adaptive feedback for users of the PCG.

Research Questions

1. How can the RAE2020 prototype PCG be refined in terms of material durability, resistance to fading, comfort, wearability, and scalable mass-production design to enhance its generalisability and facilitate commercialisation for a wider adolescent population?

2. Can the anatomically based sizing system for the PCG ensure optimal fit, comfort, thermal management, and biomechanical effectiveness for adolescents in Hong Kong with early-stage AIS, and how does validate fit influence both user comfort and the brace's capacity to deliver corrective forces across diverse body shapes?

3. To what extent does the refined PCG improve posture and spinal alignment in adolescents with early-stage AIS, as observed through wear trials?

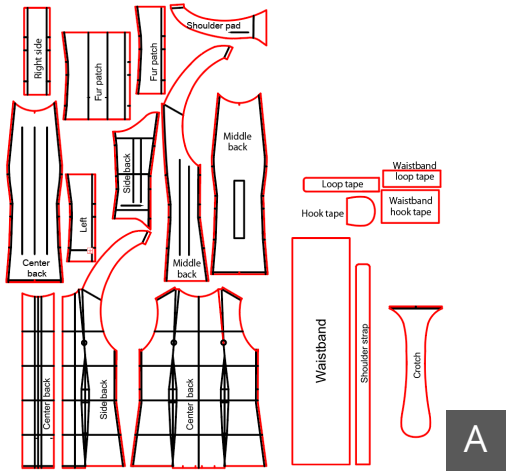
4. How can the IMU sensor-integrated PCG, coupled with a smartphone app for real-time posture monitoring and feedback, be refined to achieve accurate and reliable continuous measurement of posture correction in adolescents with early-stage AIS?

Research Outputs

Category	Details
Product	1) Refined PCG.
Academic papers	2a) Cheung M-C, Law D, **Yip J**, Cheung JPY. Adolescents' Experience during Brace Treatment for Scoliosis: A Qualitative Study. *International Journal of Environmental Research and Public Health*. 2022; 19(17):10585. https://doi.org/10.3390/ijerph191710585 [1] 2b) Liu, P. Y., Zhang, J., Wan, K. W. F., Yu, H. T. H., Lau, K. L. K., Cheung, M. C. K., Chen, B.Y ., & **Yip, J.** (2025). Evaluating the Impact of Soft Bracing and Textile Engineering in Enhancing Postural Control and Proprioception in Adolescent Idiopathic Scoliosis. *Journal of Industrial Textiles*, 55, 15280837251313520. https://doi.org/10.1177/15280837251313520 [2]
Conference papers	Ye, Z., **Yip, J.**, Cheung, J., Liang, R., Zhang, J., Li, X., Tong, K. (2023). Posture correction girdle with intelligent padding system to dynamically adjust the pressure distribution and correct the scoliotic spine. In: Jay Kalra and Nancy Lightner (eds) Healthcare and Medical Devices. AHFE (2023) International Conference. AHFE Open Access, vol 79. AHFE International, USA. http://doi.org/10.54941/ahfe1003468 [3] Liu, P. Y., **Yip, J.,** Chen, B., He, L., Cheung, J., Yick, K., Ng, S. (2022). Immediate effects of posture correction girdle on adolescents with early scoliosis. In: Jay Kalra and Nancy Lightner (eds) Healthcare and Medical Devices. AHFE (2022) International Conference. AHFE Open Access, vol 51. AHFE International, USA. http://doi.org/10.54941/ahfe1002104 **[The paper was selected as Best Student Paper Award at the AHFE conference 2022]**. [4]
Patent	China Patent: "Correction Girdle Design Patent": CN Patent No: ZL 2023 3 0553931.4; Correction Girdle Design Patent Certificate (Patent No: ZL 2023 3 0553931.4, Application Date: 28 August 2023. Authorisation Announcement Date: 12 March 2024) [5]

Research Outputs

Refinements to the PCG's materials and design pattern (2021–2022)



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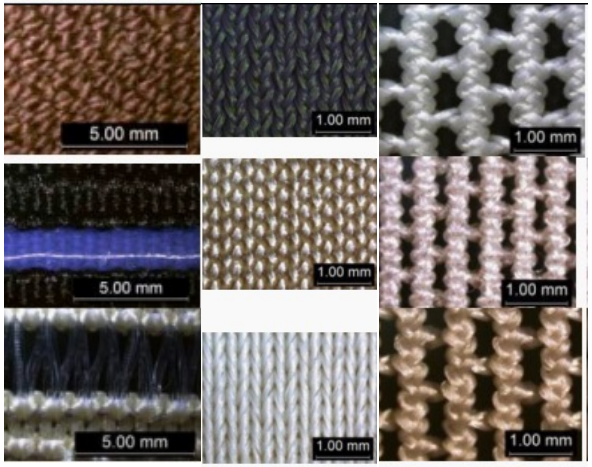

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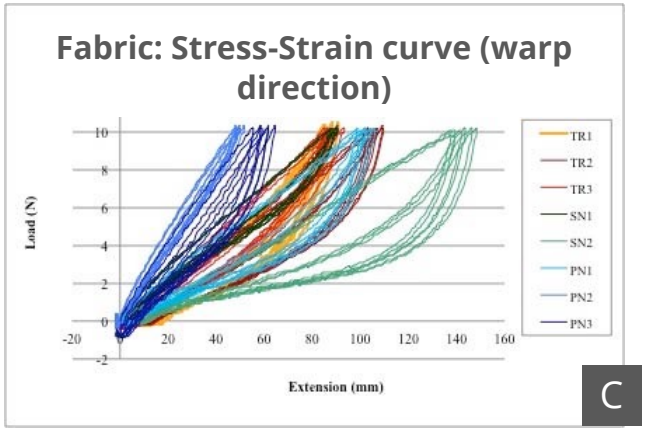

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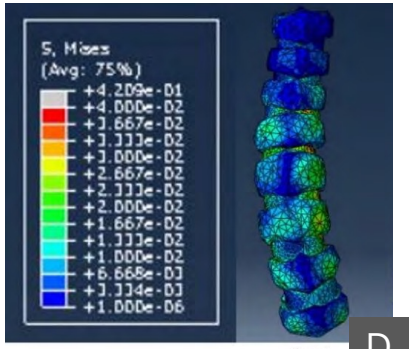


D

E F

A. Refined PCG pattern development: three front zippers enable one girdle size to accommodate a wider range of body shapes and support mass commercialisation.

B. Selected main fabrics and accessories to enhance PCG effectiveness and comfort.

C. Fabric testing was conducted to evaluate the behaviour of different materials, such as stress-strain analysis, air and moisture permeability, and dimensional stability.

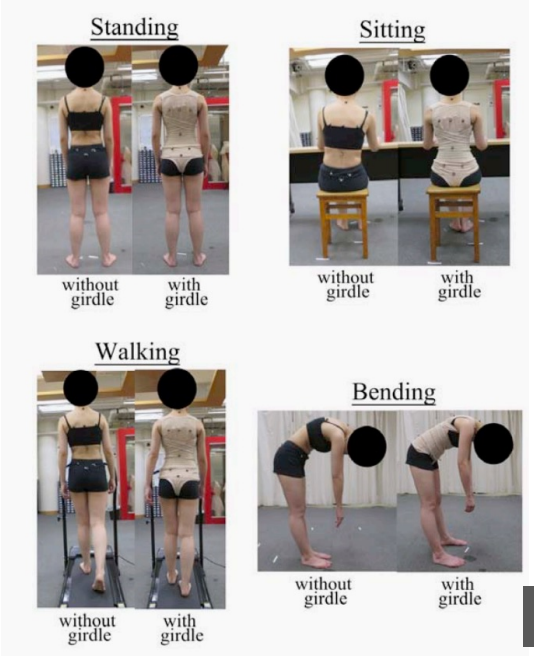
D. Developed FEM to analyse spinal biomechanical responses to various PCG designs.

E. Identified and tested newly sourced supporting materials and resin bones.

F. EVA padding insertion is a key factor that contributes to posture correction by generating point-pressure forces tailored to individual cases.

Research Outputs

A series of tests for refinements to the PCG (2021–2022)



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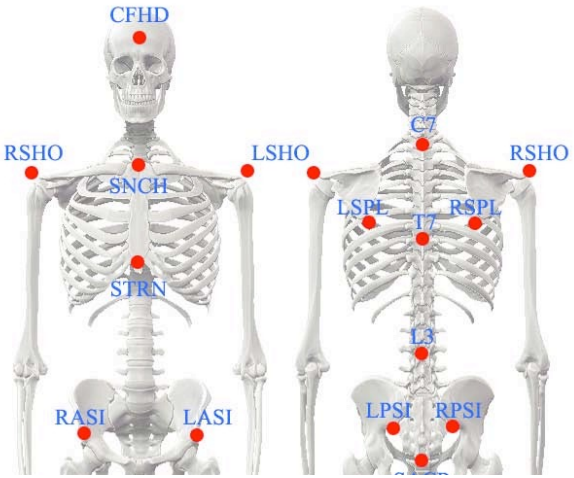

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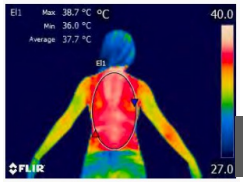

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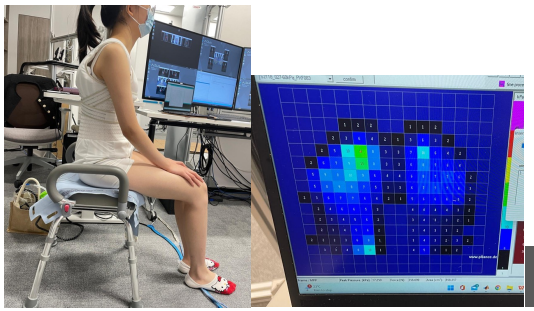

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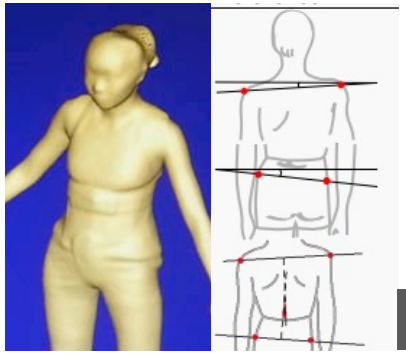


D

F

A. In the study, both static and dynamic postural phases were evaluated. During motion capture, subjects performed a series of tasks designed to simulate daily activities, including standing, walking, sitting, and bending.

B. Locations of reflective markers used for motion capture in Figure A.

C. After completing the motion capture, subjects were given a 2-hour break to acclimate to wearing the device. Then a 30 mins sitting pressure was measured. [3]

D. 3D body surface topography assessment using structured-light scanning and postural kinematic angle analysis.

E. Thermal testing conducted to compare out-of-brace and in-brace conditions.

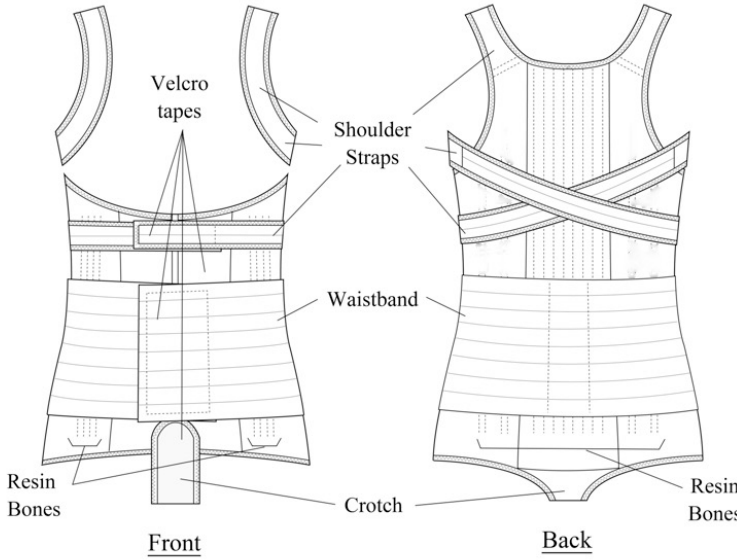
F. Pressure sensors used to evaluate brace–body interaction pressures.

Research Outputs

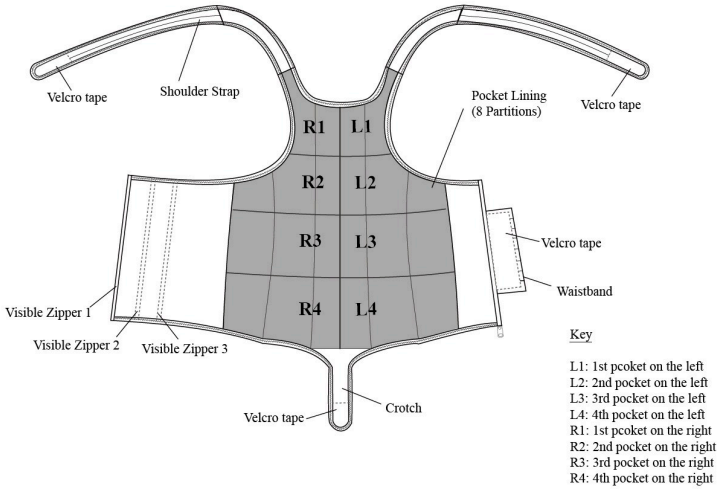
Detailed refinements of the PCG (2021–2022)

- **PCG** for mild curvature AIS adolescents (Cobb's angle : 10°–20°)
- The PCG is a tight-fitting, vest-like undergarment that spans the shoulders to the pelvis. Its design incorporates **resin bones**, **adjustable straps**, and **customisable EVA foam pads** placed in pocket linings to balance posture, alleviate strain, and apply targeted corrective pressure based on individual spinal curvature.
- This **noninvasive, pre-intervention treatment** employs an **invisible** posture-correcting design to reduce or prevent spinal curve progression, prioritising high compliance through discreet, breathable materials and customisable biomechanical support.

PCG



Front and back views



Inside view and pocket-lining partitions.

Research Outputs

Detailed refinements of the PCG (2021–2022)

A

B

C

D

A. 3 zippers allow one girdle size to cover a wider range of under-bust, waist, and high-hip circumferences, thus accommodating adolescent growth and fitting individuals with varying waist sizes. This design supports mass customisation, reduces the need for frequent replacements, and shortens delivery time. Rounded strap ends also minimise rolling at the corners.

B. Velcro was added to eliminate the free-end design of straps, thus preventing shifting and enabling more accurate, adjustable corrective force tailored to individual spinal imbalances.

C. Markings spaced 2 cm apart were added to the straps to guide more systematic tension adjustment.

D. To improve aesthetics and appeal to adolescents, the modified girdle features a neater look by hiding stitch lines at the shoulder seams, back, and side panels.

Research Field and Key References

AIS is a three-dimensional spinal deformity that affects 2%–3% of adolescents worldwide, with significant implications for posture, mobility, and long-term health [6]. Internationally, the management of AIS has been led by research groups in North America, Europe, and Asia, focusing on both rigid and flexible bracing solutions [7].

Global Research Landscape and Key Developments:

Treatment/Intervention	Target Cobb Angle	Effectiveness	Key Features/Outcomes
Rigid Bracing	20°–45°	Prevents progression in 56%–92% of cases; less evidence for 10°–20°	Effective in preventing progression; 35% improved, 46% stable, 19% worsened. [8-11]
Nighttime Bracing	20°–40°	Comparable to full-time bracing for moderate curves; case reports show improvement in mild curves	Similar effectiveness; provides better compliance, superior in-brace correction. [12, 13]
Exercise-Based Therapy	10°–20° and above	Can reduce the Cobb angle and improve quality of life; best when combined with bracing	Slight reductions in spinal curvature, improved trunk rotation, and enhanced QoL. However, effect sizes are generally small. [14-17]
Observation	10°–20°	Standard for low-risk, non-progressive curves	The 'watch-and-wait' approach for AIS carries a risk of long-term curve progression; it is not associated with greater pain, disability, or lower quality of life than bracing. [18, 19]

Most studies and clinical guidelines recommend bracing for adolescents with Cobb angles ≥20° who demonstrate documented progression or are at high risk of progression, whereas observation and physiotherapeutic scoliosis-specific exercises are generally advised for curves between 10° and 20°.

Research Field and Key References

Global Research Landscape and Key Developments:

- **Rigid bracing:** The Milwaukee and Boston braces, developed and refined by teams in the US and Europe, remain the gold standard for moderate to severe AIS [20]. These braces are effective in halting curve progression but are associated with discomfort, restricted mobility, and poor compliance [21].
- **Flexible bracing:** In response to compliance challenges, flexible braces such as the SpineCor system (developed in Canada and France) have been introduced to improve comfort and wearability. However, their long-term efficacy is still debated [22].
- **Textile-based and commercial solutions:** Recent years have witnessed increased interest in less restrictive textile-based solutions for mild scoliosis and postural correction. Groups in Italy and Asia have explored early intervention and soft bracing [22] , while commercial posture correctors (e.g. Babaka U9, S3®, and various women's posture correctors) are widely available; however, these lack clinical validation and targeted biomechanical correction [23, 24].

Boston Brace [21]

[Image]

Image not included. Please contact the author for permission to view or reuse.

Babaka U9 [23]

Women's Posture Corrector [24]

Research Advancements

This research contributes original elements to the field of AIS management

- **Application of functional intimate apparel design to medical bracing:**

The project applies principles and techniques from intimate apparel design (e.g. advanced textile materials and garment engineering for fit and support) to develop a brace for early-stage AIS (Cobb angle of 10°–20°) in adolescents aged 8–16 years. This represents a distinct approach in the medical device sector compared to traditional orthotic solutions.

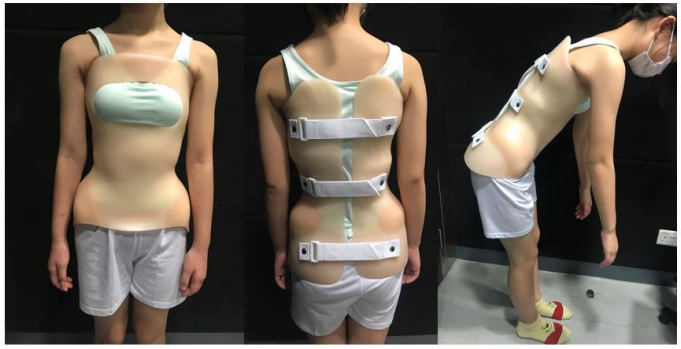
- **User-centred design for enhanced wearability:**

The developed posture correction girdle employs targeted corrective forces (via EVA padding, elastic straps, and plastic bones) to control posture and mitigate curve progression. Its design prioritises mobility, comfort, and aesthetics, thus aiming to improve wearability and compliance as a preventive intervention for young patients.

- **Integration of real-time monitoring capability:**

The research incorporates smart sensor technologies (e.g. IMU sensors) into the brace for real-time monitoring of spinal curvature and posture. This enables continuous feedback for patients and clinicians, thus supporting the potential for early detection of curve progression and facilitating personalised care based on objective data.

Collectively, these elements represent a distinct approach to early-stage AIS management, thereby offering a wearable solution positioned between passive observation and rigid bracing.



Traditional rigid brace

PCG's design

Research Methods, Prototypes, and Materials

Design process 1: Completion of initial problem definition and market research report

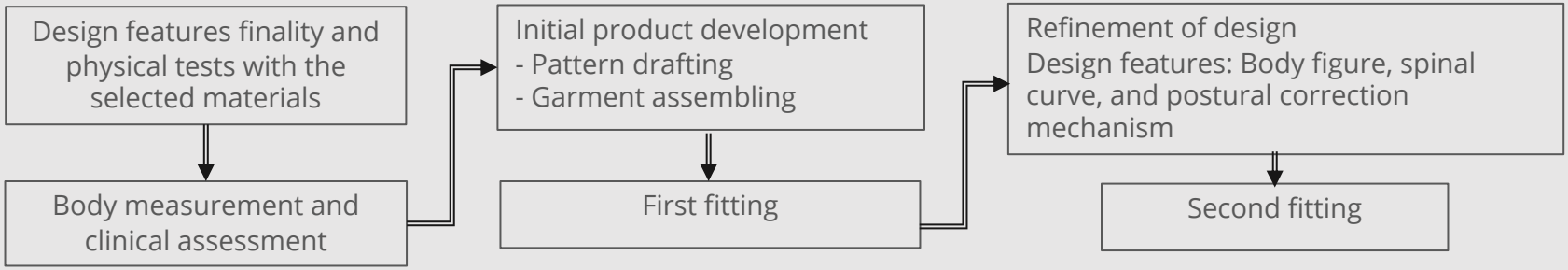
Problems

a) Impracticable corrective force mechanism
b) Inappropriate materials selection and application
e) Aesthetic and convenience issues
d) Bad fitting of the garment
e) Potential health issues

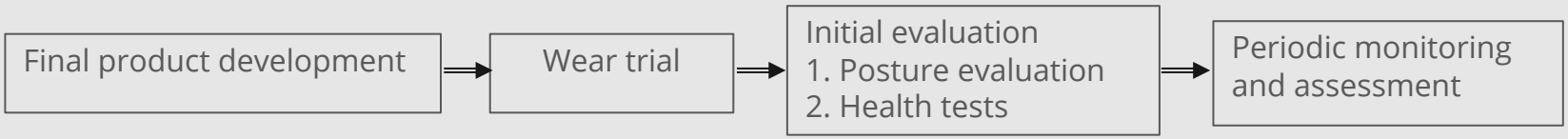
Design criteria

a) Workable corrective force mechanism
b) Appropriate material application
c) Colour, aesthetic, and psychological refinements
d) Good fit of the garment
e) Elimination of health detriments

Design process 2: Creative exploration



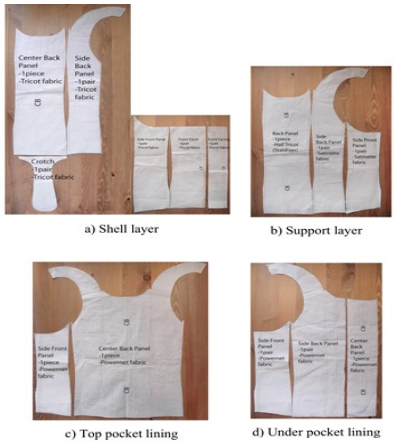
Design process 3: Implementation



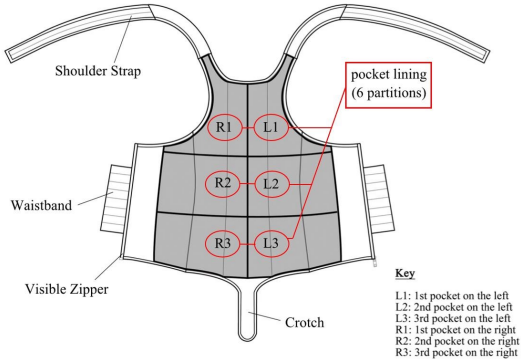
Research Methods, Prototypes, and Materials

Old version of pattern pieces (before 2020)

- Twenty-six pattern pieces for the construction of the posture correction girdle, excluding accessories, such as Velcro tape.
- Shell layer (tricot): 11 pieces.
- Including one pair of shell panels for the centre front, one pair of shell panels for the side front, one pair of shell panels for the side back, one shell panel for the centre back, two crotch panels, and one pair of front-facing panels.



Design pattern of old PCG version



Six partitions with lined pockets on the old PCG version

Problems identified in the old PCG version

Centre front zipper of the original design

Squared ends and curling of shoulder straps

Pilling on tricot fabric of the original design

Stitch lines on the surface of the girdle

Research Methods, Prototypes, and Materials

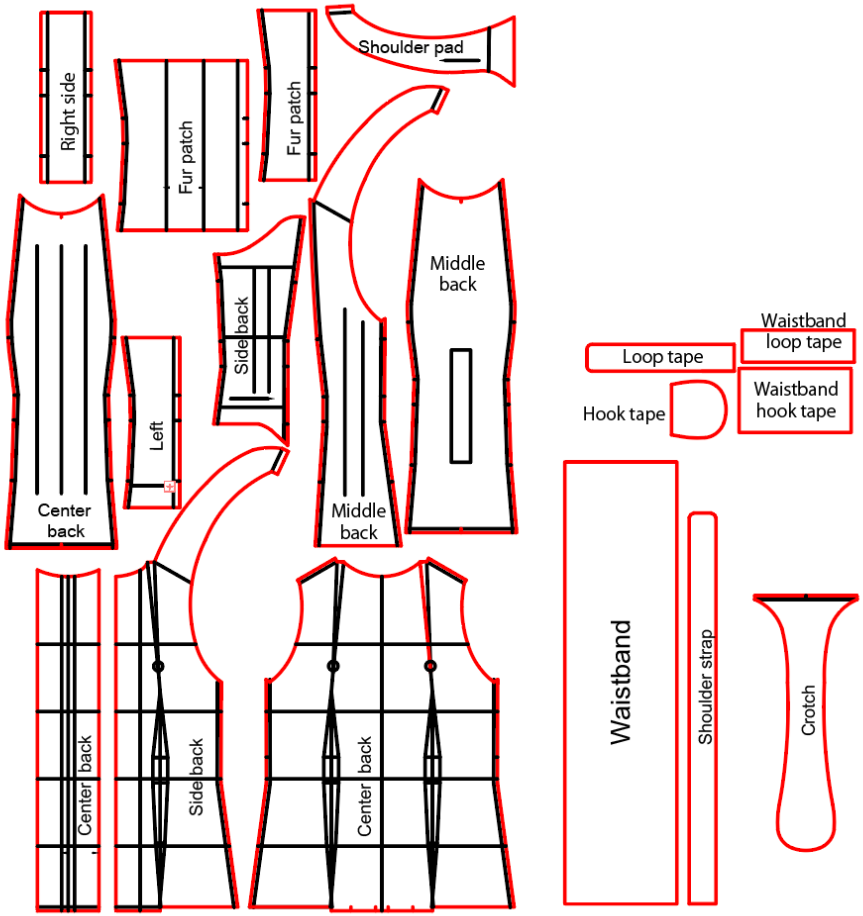
Product Design and Development

Refined version of pattern pieces for PCG (2021)

- The newly developed pattern block includes center front, side front, centre back, side back, shoulder, crotch, and zipper panels. The entire girdle comprises 32 pattern pieces (excluding the three elastic straps for the waistband and shoulder straps). Details of the pattern pieces and material applications for the modified posture correction girdle are presented in the table below.
- Apart from the newly selected shell fabric and the new elastic strap used for the waistband and shoulder strap, all other fabrics, elastic straps, and accessories follow the original version of the PCG.

The refined PCG builds on old version's foundation by

- ✓ **expanding functionality through modular additions (zipper, straps).**
- ✓ **optimising materials for user comfort and durability.**
- ✓ **refining biomechanical support with additional panels for critical zones.**



The new pattern block for the modified version of the PCG

Research Methods, Prototypes, and Materials

Material selection criteria and testing

Fabric:

- ❑ High strength, high recovery, and high breathability: Warp-knit fabric made of synthetic fibre is preferable due to its sustainable rigidity.
- ❑ Smooth surface and good hand feel: Tricot (shell layer)
- ❑ Flexible but sufficiently firm: Stabiliser and satinette (middle layer)
- ❑ Elastic fabric with good recovery and high air permeability: Powernet or mesh (inner layer)

Accessories:

- ❖ High strength, high recovery, and high breathability: Elastic straps
- ❖ Adjustable and convenient: Fastening
- ❖ High strength: Resin bones
- ❖ Lightweight with sufficient hardness and thickness: EVA foam padding

Ten kinds of fabrics were selected to test their physical and comfort properties. The tests were conducted on materials used for the PCG.

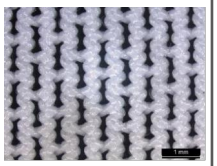
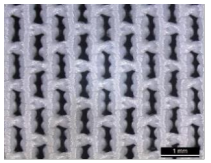
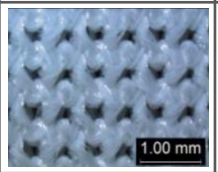
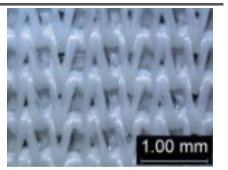
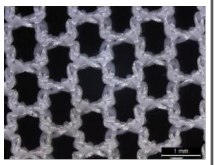
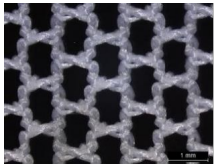
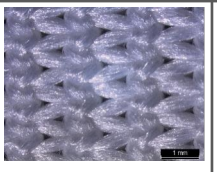
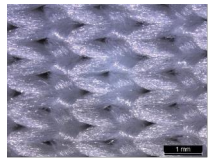
Physical and comfort tests conducted on different materials used for the PCG

	Mechanical Properties		Comfort Properties		Durability
Materials / Tests	**Strength Test (BS4952; ASTM DS169-98; ASTM DS170; Chatillon Push /Pull tester)**	**Stretch and Recovery Test (BS4952)**	**Air Permeability Test (KES-F8 Air Permeability Test)**	**Moisture Permeability Test (ASTM E96)**	**Washing Test (AATCC Test Method 135)**
1) Fabrics					
a) Tricot	✓	✓	✓	✓	✓
b) Powermet / Mesh	✓	✓	✓	✓	✓
d) Satinette	✓	✓	✓	✓	✓
2) Accessories					
a) Elastic strap	✓	✓	✓	✓	✓
b) Velcro fastening strap	✓	X	X	X	X
c) Plastic bone	✓	X	X	X	X

Research Methods, Prototypes, and Materials

Final selected materials:

- **Skin comfort and biocompatibility:** 100% cotton and cotton blends were utilised for the primary structure to ensure the brace feels soft and is non-irritating against the skin.
- **Breathability and moisture management:** Selecting fabrics with high breathability and wicking properties to enhance thermal regulation during sleep and improve long-term user compliance.
- **Mechanical performance:** Ensuring the material possesses excellent elasticity and recovery to maintain consistent corrective pressure, provide a secure fit, and guarantee product durability over time.

Layer	Panel Name	Final Chosen Materials	Microscopic View	
			Technical Face	Technical Back
Shell	Side front and back panel	Powernet		
Shell	Centre back panel			
Shell & Middle	Crotch panel			
Middle	Side front panel	Satinette		
Middle	Side back panel			
Inner	Centre front panel (left and right)	Powernet		
	Side front panel (front and back)			
	Narrow centre back panel			
	Entire back panel			
Straps	Waist band	Elastic strap		
	Shoulder straps	Elastic strap		

Research Methods, Prototypes, and Materials

Subject selection: School-screening programme

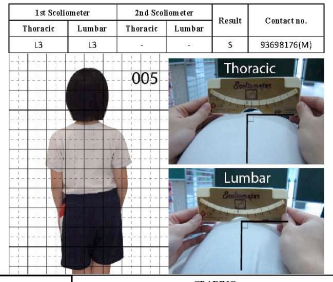
The programme was conducted in primary and secondary schools to provide a simple spinal examination service. The spinal examinations were performed by a professional prosthetist-orthotist (P&O). A school screening programme, initiated in 2020, in Hong Kong assessed AIS prevalence among 3,209 students. Initial examinations identified 642 cases (20%) of students showing signs of scoliosis, from which participants were recruited for subsequent wear trials.

Poster designed for the school-screening programme

Screening Grading (Subject 5)

Student name	Age	Birth date	Height (cm)	Weight (Kg)	BMI	Result of BMI
陳綽潔	10	26/03/2002	138	30.3	15.91	正常

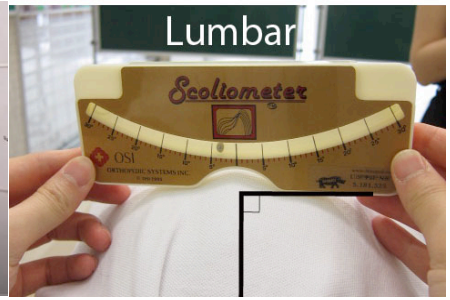
1st Scoliometer		2nd Scoliometer		Result	Contact no.
Thoracic	Lumbar	Thoracic	Lumbar		
L3	L3	-	-	S	93698176(M)



	GRADING		
	Good	Fair	Poor
Head Tilt Left Right		√	
High Shoulders Left Right		√	
Spinal Curve Left Right		√	
High Hip Left Right		√	

Information and data-record form used for school screening programme

Adam's forward bend test



Scoliometer

- Adam's forward bend test, combined with a scoliometer, is a widely used method for assessing spinal asymmetry and detecting potential scoliosis.
- It measures the angle of trunk rotation (ATR) in degrees.
- An **ATR of 5°** or more typically indicates the need for further evaluation, including EOS low-dose X-ray radiograph imaging.

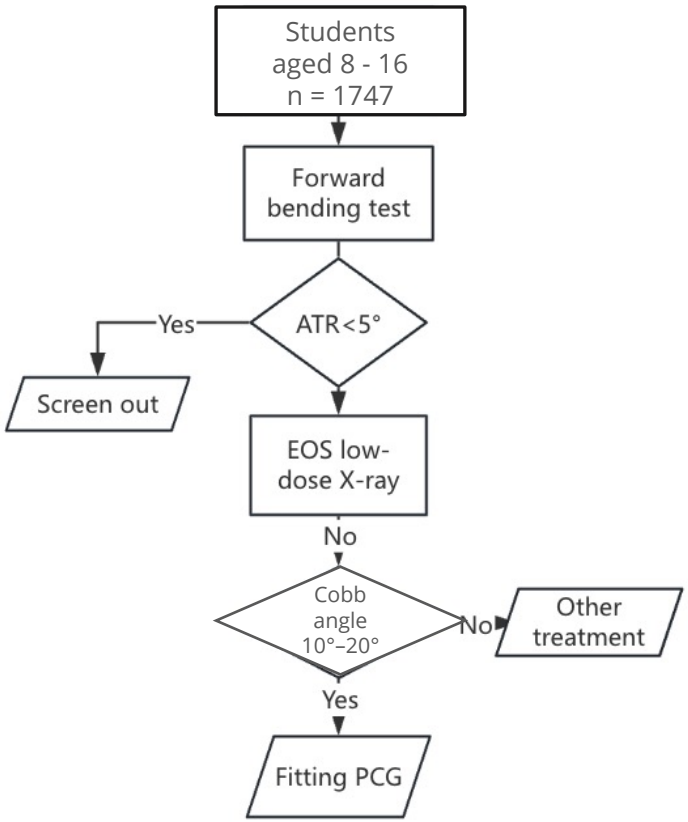
Research Methods, Prototypes, and Materials

Subject selection

Inclusion criteria:

- Females aged 8–16 years
- Diagnosed with early-stage AIS, that is, Cobb's angle of 10°–20°
- Risser grade of the iliac crest ≤ 3, indicating skeletal immaturity
- Pre-menarcheal or within one-year post-menarche
- Physically and mentally able to adhere to the girdle protocol
- Able to read and speak English or Chinese for effective communication

Students queuing up to be checked for scoliosis



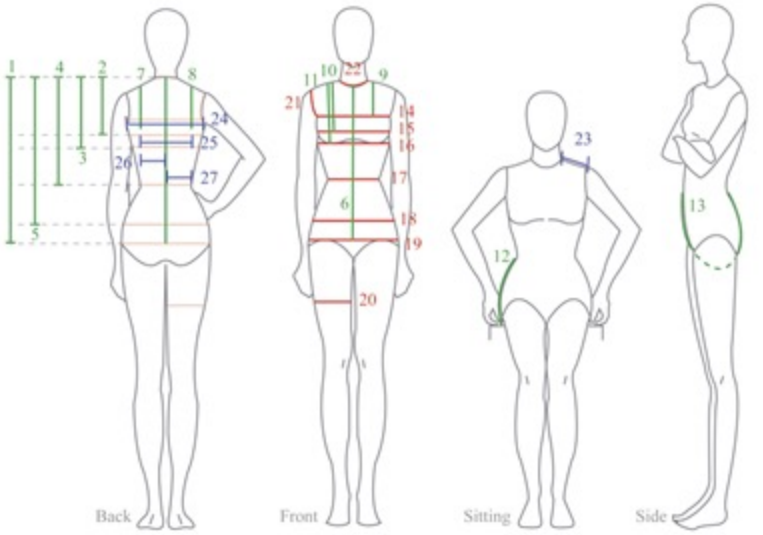
Screening flow chart

Research Methods, Prototypes, and Materials

Key body measurement items and methods

Body measurements of the human subjects need to be obtained before pattern-drafting and garment-making.

As the fit of the posture correction girdle is important, **27 body measurement items** were identified for making the posture correction girdle.

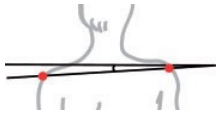
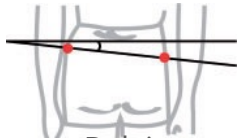
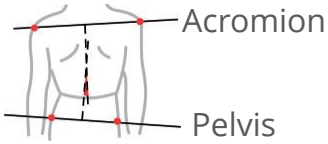
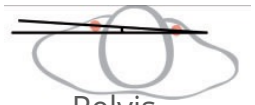
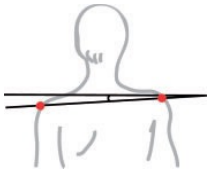
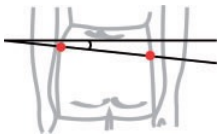
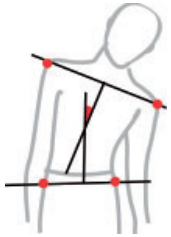


Key body measurement items and methods

Type	No.	Measurement Item	Remarks
Length	1	Centre back length	Vertically measure from nape to hip level.
	2	Nape to bust	Vertically measure from nape to bust level.
	3	Nape to underbust	Vertically measure from nape to underbust level.
	4	Nape to waist	Vertically measure from nape to waist level.
	5	Nape to pole	Vertically measure from nape to pole's level.
	6	Centre front length	Vertically measure from neck base to hip level.
	7	Shoulder to left scapular	Vertically measure from shoulder seam to scapular level at the back (left side).
	8	Shoulder to right scapular	Vertically measure from shoulder seam to scapular level at the back (right side).
	9	Shoulder to chest	Vertically measure from shoulder seam to chest level in the front.
	10	Shoulder to bust	Vertically measure from shoulder seam to bust level in the front.
	11	Shoulder to underbust	Vertically measure from shoulder seam to underbust level in the front.
Girth	12	Crotch depth	Sit on a firm chair, feet flat on the floor. Measure from waist to chair seat.
	13	Crotch length	Measure from waist in back, through legs to waist in the front.
	14	Chest	Horizontally measure chest circumference.
	15	Bust	Horizontally measure bust circumference.
	16	Underbust	Horizontally measure underbust circumference.
	17	Waist	Horizontally measure waist circumference.
	18	Pelvis	Horizontally measure pelvis circumference.
	19	Hip	Horizontally measure hip circumference.
	20	Thigh	Horizontally measure thigh circumference.
	21	Armhole	Measure around the armhole.
	22	Neck	Measure around the neck base.
Width	23	Neck to shoulder	Measure from neck base to shoulder point.
	24	Across back	Horizontally measure directly across the back from left underarm to right underarm.
	25	Left scapular to right scapular	Horizontally measure from left scapular to right scapular.
	26	Left scapular to centre back	Horizontally measure from left scapular to centre back.
	27	Right scapular to centre back	Horizontally measure from right scapular to centre back.

Research Methods, Prototypes, and Materials

Measurement of posture angle

Standing (frontal)	 Acromion  Pelvis  Acromion Pelvis		Angle between the lines that pass through the markers on the shoulders and pelvis in the frontal plane.
Standing (horizontal)	 Acromion  Pelvis  Scapula		Angle between the line that passes through the markers on the scapula and the horizontal line in the horizontal plane
Sitting (sagittal)	 Thoracic angle  Lumbar angle	**Bending (Frontal)**	 Angle between the lines that pass through the nape and tailbone before and after forward bending.
Walking (frontal)	 Acromion  Pelvis		
Walking (horizontal)	 Acromion  Pelvis	**Bending (Horizontal)**	 Angle between the lines that pass through the markers on shoulders and pelvis in horizontal plane

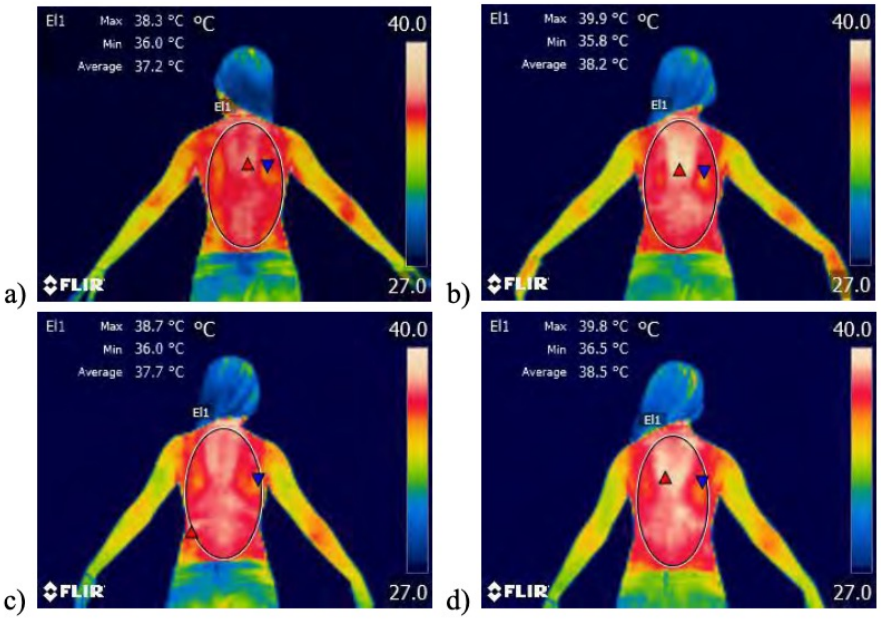
Research Methods, Prototypes, and Materials

Skin surface temperature measurement

Thermal comfort is a primary determinant of user compliance. By employing an infrared thermal camera, an objective and quantitative assessment of material performance can be obtained and used to evaluate whether the modified girdle's new materials or structural refinements improve breathability and reduce heat buildup compared to the previous version.

Infrared thermal camera

Temperature and humidity sensors



The body temperature of subjects was measured

a) before donning the original girdle,

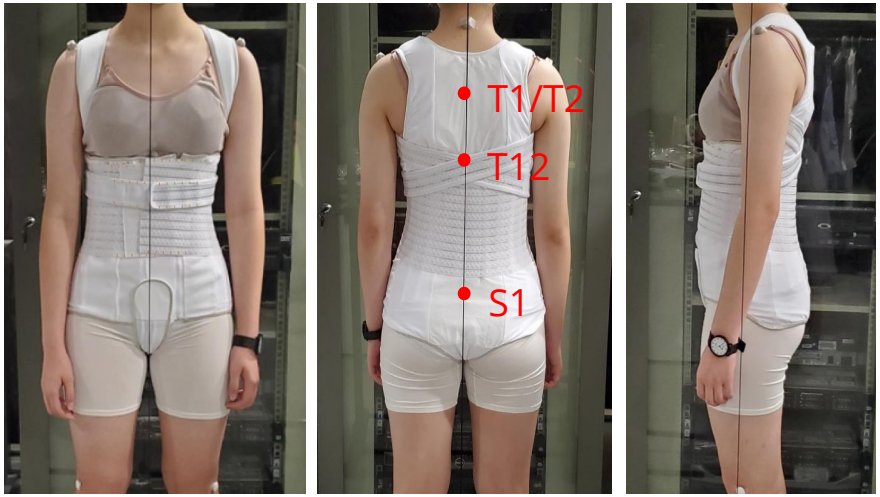
b) after donning the original girdle,

c) before donning the modified girdle, and

d) after donning the modified girdle.

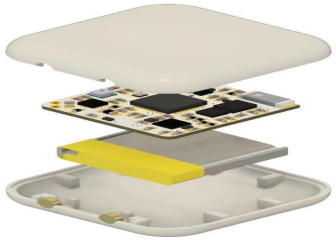
Research Methods, Prototypes, and Materials

Sensor devised on the girdle to monitor subjects' compliance and posture

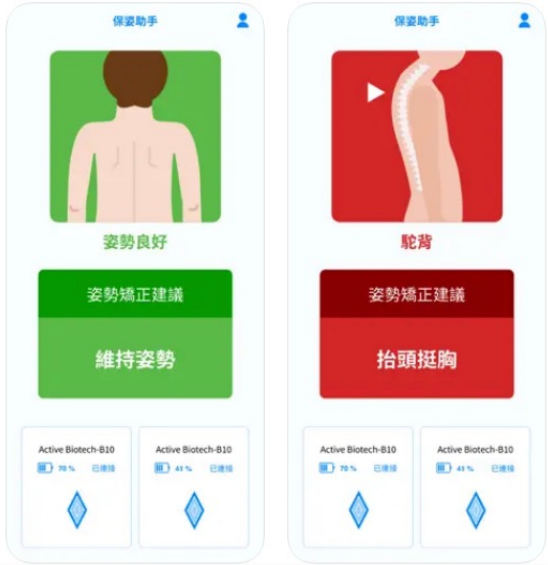


Front, back, and side views of the posture correction girdle on a subject, showcasing IMU sensors (indicated by red dots) installed along the spine.

Insert the sensor into the specially designed pocket.



IMU sensor integrated into the girdle to monitor compliance and posture
(Size: 24 mm x 24 mm x 7 mm)



Smartphone app designed to remind subjects when their posture begins to slouch
SRRC Certificate Code: 24J310N8R413 (2024)

- ✓ Collect data using sensors
- ✓ Determine whether the posture is correct
- ✓ Provide alerts for incorrect posture
- ✓ Long-term continuous monitoring

Research Outcomes and Findings

Key research findings for refining the PCG to enhance its generalisability and facilitate commercialisation for a wider adolescent population

- The refined PCG design, with adjustable zippers and anatomically informed patterning, accommodates diverse adolescent body shapes and improves user comfort and compliance.
- Material selection and fabric testing identified combinations that maximise breathability and flexibility without compromising corrective function.
- FEM analysis provided evidence for the biomechanical effectiveness of different design iterations, thereby supporting data-driven design refinement.
- Customisable EVA padding enables individualised posture correction, thus addressing both the physical and psychological needs of adolescent users.

Research Outcomes and Findings

- Developed a three-tiered main size system (S, M, L), each with two subsizes, based on the measured spine length and waist circumference.
- The new sizing system accommodates anatomical variation, thereby ensuring a better fit and improved comfort for adolescent users.
- Pilot fitting trials confirmed that the system improved user satisfaction and compliance compared to standard garment sizing.

Main size	Subsize	C7 to pelvis (cm)	Waist circumference (cm)		
			Min.	Mid.	Max.
S	(I)	33.1–38	50	55	59.9
	(II)	33.1–38	60	67	74
M	(I)	38.1–43	50	55	59.9
	(II)	38.1–43	60	67	74
L	(I)	43.1–48	50	55	59.9
	(II)	38.1–43	60	67	74

Research Outcomes and Findings

Body temperature increases after donning girdles:

Parameter	Old version PCG	After 30 mins	Refined PCG	After 30 mins
Average temperature increase (°C)	+0.77 ± 0.84	+3.44 ± 0.90	+0.27 ± 0.20	+3.31 ± 0.74

The refined PCG demonstrated a substantially lower immediate thermal load upon donning (+0.27°C vs. +0.77°C) and a slightly reduced temperature increase after 30 minutes (+3.31°C vs. +3.44°C) compared to the old version.

Skin humidity comparison:

Parameter	After 30 mins (Worn old version PCG)	After 30 mins (Worn refined PCG)
Average humidity increase (%)	+8.99 ± 6.80	+8.19 ± 6.81

After 30 mins of wear, the old version PCG design resulted in an increase in the average skin humidity by 8.99 %. In comparison, the modified PCG demonstrated a lower average increase of 8.19%, which is a reduction of 0.8%.

Research Outcomes and Findings

Posture improvement

A two-hour wear trial demonstrated general **reductions in posture imbalance during habitual standing** for all subjects when wearing the girdle.

Specific posture improvements were observed in

- acromion/pelvis angle in the frontal plane.
- acromion/pelvis angle in the horizontal plane.
- lumbar angle in the sagittal plane.

Category	Measurement	Pre-Wear Trial (Without Girdle)	Post-Wear Trial (With Girdle)	p Value (Effect Size)
		Mean±SD	Mean±SD	
Cobb angle	Cobb angle (°)	15.775 ± 2.63	11 ± 4.55	
Posture angle	Frontal			
	1. Acromion (°)	2.54 ± 1.01	1.75 ± 0.67	0.11 (d = 0.92)
	2. Pelvis (°)	1.63 ± 0.65	0.71 ± 0.53	0.08 (d = 1.56)
	3. Acromion/pelvis (°)	2.46 ± 1.50	1.04 ± 0.74	0.05 (d = 1.58)
Posture angle	Horizontal			
	4. Acromion (°)	3.09 ± 0.91	1.92 ± 0.91	0.18 (d = 1.29)
	5. Pelvis (°)	2.82 ± 2.63	2.57 ± 2.95	0.9 (d = 0.29)
	6. Scapula	2.34 ± 1.59	1.09 ± 1.17	0.23 (d = 0.90)
	7. Acromion/scapula (°)	3.97 ± 2.37	3.0 ± 1.04	0.59 (d = 0.54)
	8. Acromion/pelvis (°)	4.28 ± 1.82	1.04 ± 0.74	0.05 (d = 0.42)
Posture angle	Sagittal			
	9. Thoracic angle (°)	152.24 ± 3.31	158.62 ± 2.13	0.08 (d = -2.29)
	10. Lumbar angle (°)	149.76 ± 4.68	155.98 ± 3.18	0.03 (d = -1.55)

Analysed results of the posture parameters [4]

Research Outcomes and Findings

Immediate improvement

Comparison of the results between ‘with PCG’ and ‘without PCG’ conditions after two-hour wear trials

Subject No.	0M (pre-treatment)	0M (with PCG)
001	14.8° (T), 16.1° (L)	8° (T), 7° (L)
002	12°	10° (T), 12° (L)
003	11.1° (T), 15.1° (L)	10.5° (T), 14.1° (L)
004	12.6°	5.9°
005	14.1° (T), 19.4° (L)	11.2° (T), 15.1° (L)
006	8.6° (T), 13° (L)	6° (T), 7.6° (L)
007	10.1° (T), 13.1° (L)	5.1° (T), 7.9° (L)
008	13.7° (T), 17.5° (L)	7.5° (T), 15.2° (L)

Immediate Cobb’s angle reduction was found in 87.5% (7/8) of the subjects.

The average correction for the thoracic curvature is approximately 4.1°, and the average correction for lumbar curvature is approximately 9.1°.

Without PCG (Thoracic 14.8°, Lumber 16.1°)

With PCG (Thoracic 8°, Lumber 7°)

The following immediate change in Cobb’s angle was found for subject 1:
→ thoracic angle 14.8° and lumber angle 16.1°
→ thoracic angle 8° and lumber angle 7°

Research Outcomes and Findings

Time-to-time improvement

Comparison of the results of pretreatment (0 months), 3M (3 month), 6M (6 month), and posttreatment (9 months)

- 100% (8/8) of the subjects were found to have a reduction in the Cobb's angle after wearing the PCG for 9 months.
- The average correction for thoracic curvature was approximately 4.9°, and the average correction for lumbar curvature was approximately 2.7°.
- 62.5% (5/8) of the subjects experienced a Cobb angle reduction of over 5°, which indicated remarkable improvement.

	Thoracic curvature (°)					Lumber curvature (°)				
Subject No.	0M (pretreatment)	Differences (Post – Pre)				0M (pretreatment)	Differences (Post – Pre)			
		0M (with PCG)	3M (without PCG)	6M (with PCG)	**9M (without PCG)**		0M (with PCG)	3M (without PCG)	6M (with PCG)	**9M (without PCG)**
1	14.8	-6.8	-1.1	-5.3	**-2.7**	16.1	-9.1	1.2	-9.2	**-2.1**
2	12	-2	-1.4	-6.5	**-3**		12	0	0	**0**
3	11.1	-0.6	-2	-2	**-3.7**	15.1	-1	-5.1	-2.1	**-6**
4	12.6	-6.7	-4.2	-3.7	**-2.3**		0	0	0	**0**
5	14.1	-2.9	-3.6	-6.3	**-5.2**	19.4	-4.3	-1	-2.3	**-1.4**
6	8.6	-2.6	-4.5	-4.8	**-6.8**	13	-5.4	-4.7	-7.4	**-6**
7	10.1	-5	3.8	-5.5	**-8**	13.1	-5.2	-13.1	2.9	**-4.1**
8	13.7	-6.2	-4.2	-7.7	**-7.8**	17.5	-2.3	-1.2	-2.9	**-2.6**

Research Outcomes and Findings

An example from Subject 1, from pretreatment to nine months of wearing PCG

Subject	0M (pretreatment)	0M (with girdle)	3M (without girdle)	6M (with girdle)	9M (without girdle)
001	14.8° (T), 16.1° (L)	8° (T), 7° (L)	13.7 °(T), 17.3°(L)	9.5 °(T), 6.9 °(L)	12.1 °(T), 14 °(L)

Zero-month (pretreatment)
Cobb angle:
14.8° (T), 16.1° (L)

Zero-month (with girdle)
Cobb Angle:
8° (T), 7° (L)

Three-month (without girdle)
Cobb Angle:
13.7 °(T), 17.3°(L)

Six-month (with girdle)
Cobb Angle:
9.5 °(T), 6.9 °(L)

Nine-month (without girdle)
Cobb Angle:
12.1 °(T), 14 °(L)

Research Findings

- **Successfully designed a PCG** for children aged 10–13 years with Cobb angles ranging from 10° to 20° of AIS. This PCG is reported to have high compliance, flexibility, noninvasiveness, and psychological satisfaction, thus making it an effective tool for preventing spinal progression. The PCG can be customised for each subject according to their specific spinal condition.
- Conducted comprehensive and systematic **nine-month wear trials**, collected and analysed the data, and drew conclusions.
- **Proved effectiveness of postural imbalance reduction:** PCG can generally reduce postural imbalance in different planes, which is particularly evident in reducing the imbalance in the frontal alignment between the shoulders and pelvis as well as the rotation between the shoulders and pelvis.
- **Proved effectiveness of immediate Cobb angle reduction:** Subjects were found to have immediate Cobb angle reduction by 87.5% (7/8). The average correction for thoracic curvature was approximately 4.1°, and the average correction for lumbar curvature was approximately 9.1°. The greatest immediate correction was found in Subject 1, who had a double curve, reducing the thoracic angle of 14.8° and lumbar angle of 16.1° to 8° and 7°, respectively.
- **Proved long-term effectiveness of Cobb's angle reduction :** After completing the nine-month PCG wear trial, 100% of the subjects were found to have a reduction in the Cobb angle. The average correction for thoracic curvature was approximately 4.9°, and the average correction for lumbar curvature was approximately 2.7°. Moreover, 62.5% (5/8) of the subjects experienced a reduction in the Cobb angle by more than 5°, which indicated remarkable improvement.
- Children were considered 'mouldable' because their posture could be corrected using different methods, such as providing them with the PCG as a reminder. Subjects learned good posture habits by using the PCG and carried this over into their daily lives.

Research Dissemination

Category	Details
Academic papers	• Cheung M-. C., Law, D., **Yip, J.**, Cheung, J. P. Y. (2022). Adolescents' experience during brace treatment for scoliosis: A Qualitative Study. *International Journal of Environmental Research and Public Health,* 19(17), 10585. https://doi.org/10.3390/ijerph191710585 [1]
	• Liu, P. Y., Zhang, J., Wan, K. W. F., Yu, H. T. H., Lau, K. L. K., Cheung, M. C. K., Chen, B. Y., & **Yip, J.** (2025). Evaluating the impact of soft bracing and textile engineering in enhancing postural control and proprioception in adolescent idiopathic scoliosis. *Journal of Industrial Textiles*, 55. https://doi.org/10.1177/15280837251313520 [2]
Conference papers	• Ye, Z., **Yip, J.**, Cheung, J., Liang, R., Zhang, J., Li, X., Tong, K. (2023). Posture correction girdle with intelligent padding system to dynamically adjust the pressure distribution and correct the scoliotic spine. In: Jay Kalra and Nancy Lightner (eds) Healthcare and Medical Devices. AHFE (2023) International Conference. AHFE Open Access, vol 79. AHFE International, USA. http://doi.org/10.54941/ahfe1003468 [3]
	• Liu, P. Y., **Yip, J.,** Chen, B., He, L., Cheung, J., Yick, K., Ng, S. (2022). Immediate effects of posture correction girdle on adolescents with early scoliosis. In: Jay Kalra and Nancy Lightner (eds) Healthcare and Medical Devices. AHFE (2022) International Conference. AHFE Open Access, vol 51. AHFE International, USA. http://doi.org/10.54941/ahfe1002104 **[The paper was selected as Best Student Paper Award at the AHFE conference 2022]** [4]
Patent	• China Patent: "Correction Girdle Design Patent": CN Patent No: ZL 2023 3 0553931.4; Correction Girdle Design Patent Certificate (Patent No: ZL 2023 3 0553931.4, Application Date: 28 August 2023. Authorisation Announcement Date: 12 March 2024) [5]

Research Dissemination

Exhibitions/Interviews

Category **Details**

Events	Amount	Number of people	Description
Public events	4	Approximately 100	• The International Scoliosis Awareness Day events held on 25 June 2022, 24 June 2023, 22 June 2024, and 8 June 2025 were a collaborative effort between prominent educational institutions and healthcare associations in Hong Kong.
Training sessions, educational workshops, and seminars	3	Over 100	• Visited The First Affiliated Hospital of Sun Yat-sen University, Guangzhou, Guangdong Province. Doctors, P&O specialists, and experts from various hospitals in mainland China attended. • Gave a presentation to clinicians/doctors in 2024 Guangdong Province for Public Welfare Training Programme & 'Spine Health Awareness' Across 100 Cities. • Gave a presentation at the 2025 Digital Intelligence-Empowered Scoliosis Academic Conference, which was attended by approximately 100 doctors from cities across mainland China.
Expert consultants	2	Over 30	• Gave a presentation and held discussions with doctors and clinicians at Nanjing Drum Tower Hospital. • The University of Hong Kong Shenzhen Hospital specialises in spinal development and a spectrum of related disorders, including the management of complex scoliosis cases, kyphosis, and other spinal deformities. The collaborations aim to enhance the PCG by leveraging this clinical expertise to address real-world challenges encountered during its practical use on AIS subjects.

Research Dissemination
Exhibitions/Interviews

Category **Details**

Events	Amount	Number of people	Description
Exhibitions	1	Almost 10,000 buyers	• International exhibition • A poster on PCG was presented at the 2025 Design Research Impact and Global Insights Colloquium Cum Exhibition.
Competitions	3	Over 300	• Gold Medal with Congratulations of the Jury was received in the 48th International Exhibition of Inventions Geneva, 2023 • Asia International Innovative Invention Exhibition, Hong Kong, 20–23 June 2023 (Gold Medal)
Symposia and colloquia	1	Over 200	• Travelled to Zhongshan, Guangdong Province, to attend the 2024 Guangdong Province Rehabilitation Medicine-Spine Rehabilitation Academic Annual Conference-Flexible Correction Technology Training Programme.
Production line	1		• Established a fully operational production line.
Licensing agreement	1		• The PCG has been licensed to Bao Zi Ti Biotechnology (Guangzhou) Co., Ltd. for commercial sale.

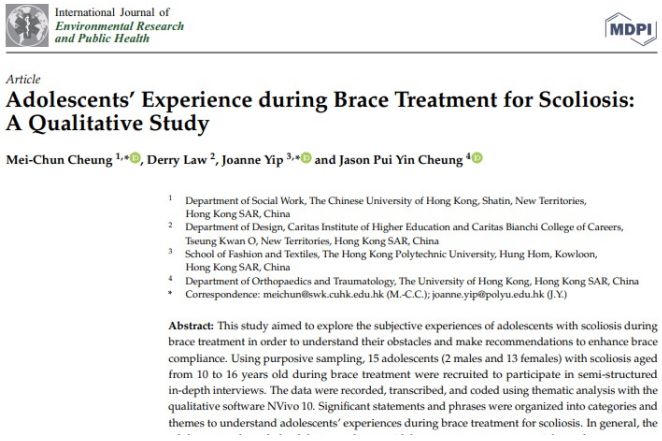
Research Dissemination

Media Reports

- https://www.stheadline.com/edu-news/3240256/ [25]
- https://www.polyu.edu.hk/sc/media/media-releases/2023/0429_polyu-wins-record-breaking-number-of-awards-at-geneva-inventions-expo/ [26]
- https://www.hkcd.com/content_app/2023-05/04/content_1398597.html [27]
- https://hk.news.yahoo.com/share/41ca72e8-8143-3b66-af8d-356730b80a51 [28]
- https://inews.hket.com/article/3519159/ [29]
- https://news.mingpao.com/pns/%E6%95%99%E8%82%B2/article/20230505/s00011/1683218695352 [30]
- https://today.line.me/hk/v2/article/Qwyrg9z [31]
- https://www.bastillepost.com/hongkong/article/12739314/ [32]
- https://www.mtl-sft.com/news/hong-kong-polytechnic-university-researchers-win-gold-award-for-medical-textile-inventions/ [33]
- https://polyu.me/3R3r82g [34]
- https://mp.weixin.qq.com/s/0lFNNaKE-5YhZArSZ9gtzg [35]
- https://www.polyu.edu.hk/publications/pulse-polyu/issue/202309/polyu-in-the-news/prof-joanne-yip-introduces-scoliosis-treatment-system [36]

Research Outputs

Academic papers



International Journal of *Environmental Research and Public Health*

MDPI

Article

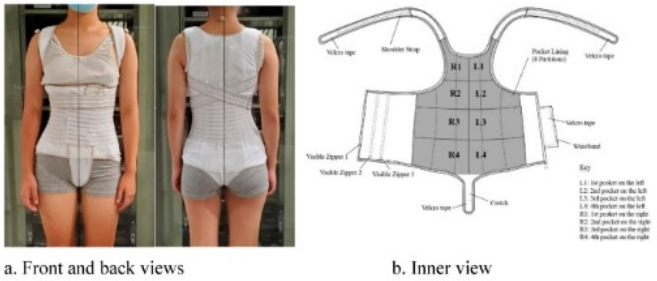
Adolescents' Experience during Brace Treatment for Scoliosis: A Qualitative Study

Mei-Chun Cheung [1,*], Derry Law [2], Joanne Yip [3,*] and Jason Pui Yin Cheung [4]

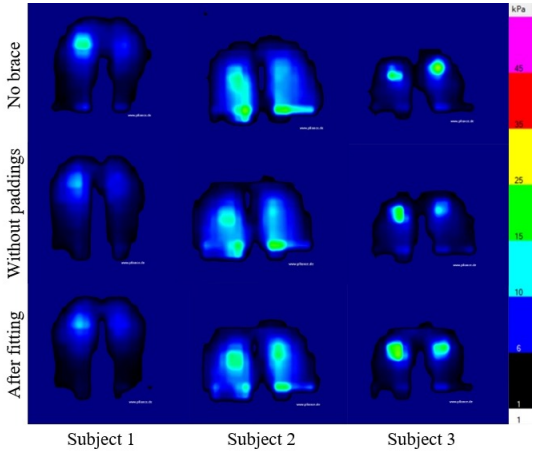
[1] Department of Social Work, The Chinese University of Hong Kong, Shatin, New Territories, Hong Kong SAR, China
[2] Department of Design, Caritas Institute of Higher Education and Caritas Bianchi College of Careers, Tseung Kwan O, New Territories, Hong Kong SAR, China
[3] School of Fashion and Textiles, The Hong Kong Polytechnic University, Hung Hom, Kowloon, Hong Kong SAR, China
[4] Department of Orthopaedics and Traumatology, The University of Hong Kong, Hong Kong SAR, China
* Correspondence: meichun@swk.cuhk.edu.hk (M.-C.C.); joanne.yip@polyu.edu.hk (J.Y.)

Abstract: This study aimed to explore the subjective experiences of adolescents with scoliosis during brace treatment in order to understand their obstacles and make recommendations to enhance brace compliance. Using purposive sampling, 15 adolescents (2 males and 13 females) with scoliosis aged from 10 to 16 years old during brace treatment were recruited to participate in semi-structured in-depth interviews. The data were recorded, transcribed, and coded using thematic analysis with the qualitative software NVivo 10. Significant statements and phrases were organized into categories and themes to understand adolescents' experiences during brace treatment for scoliosis. In general, the

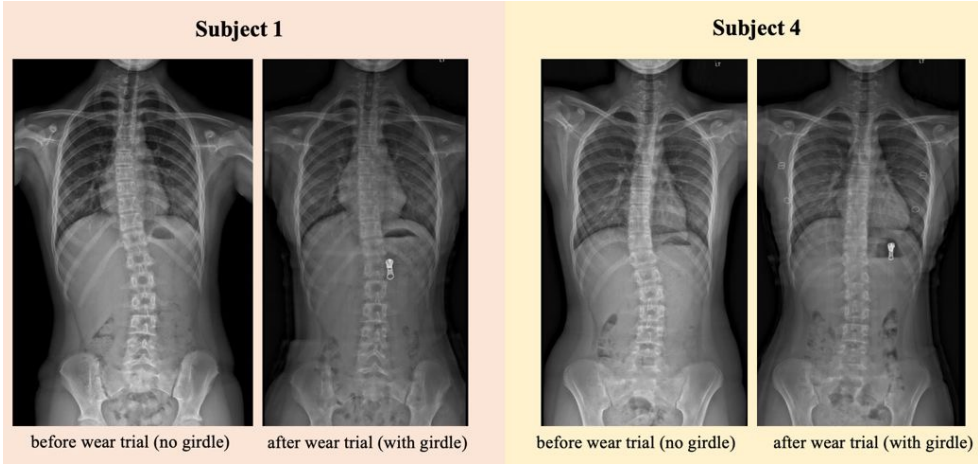
Cheung M-. C., Law, D., **Yip, J.**, Cheung, J. P. Y. (2022). Adolescents' experience during brace treatment for scoliosis: A qualitative study. *International Journal of Environmental Research and Public Health,* 19(17), 10585. https://doi.org/10.3390/ijerph191710585 [1]



Liu, P. Y., Zhang, J., Wan, K. W. F., Yu, H. T. H., Lau, K. L. K., Cheung, M. C. K., Chen, B. Y., & **Yip, J.** (2025). Evaluating the impact of soft bracing and textile engineering in enhancing postural control and proprioception in adolescent idiopathic scoliosis. *Journal of Industrial Textiles*, 55, 15280837251313520. https://doi.org/10.1177/15280837251313520 [2]



Ye, Z., Yip, J., Cheung, J., Liang, R., Zhang, J., Li, X., Tong, K. (2023). Posture correction girdle with intelligent padding system to dynamically adjust the pressure distribution and correct the scoliotic spine. In: Jay Kalra and Nancy Lightner (eds) Healthcare and Medical Devices. AHFE (2023) International Conference. AHFE Open Access, vol 79. AHFE International, USA. http://doi.org/10.54941/ahfe1003468 [3]



Liu, P., **Yip, J.**, Chen, B., He, L., Cheung, J., Yick, K., Ng, S. (2022). Immediate effects of posture correction girdle on adolescents with early scoliosis. In: Jay Kalra and Nancy Lightner (eds) Healthcare and Medical Devices. AHFE (2022) International Conference. AHFE Open Access, vol 51. AHFE International, USA. https://doi.org/10.54941/ahfe1002104 [4]

Research Outputs

Design patent

Correction Girdle Design Patent Certificate (Patent No: ZL 2023 3 0553931.4, Application Date: 28 August 2023 Authorisation Announcement Date: 12 March 2024) [5]

证书号第8530103号

外观设计专利证书

外观设计名称：束身衣

设　计　人：叶晓云

专　利　号：ZL 2023 3 0553931.4

专利申请日：2023年08月28日

专　利　权　人：立刚健生物科技(香港)有限公司;叶晓云;廖栢尧

地　　址：中国香港新界白石角科学园西大街17号17W大厦6楼620室

授权公告日：2024年03月12日　　授权公告号：CN 308501086 S

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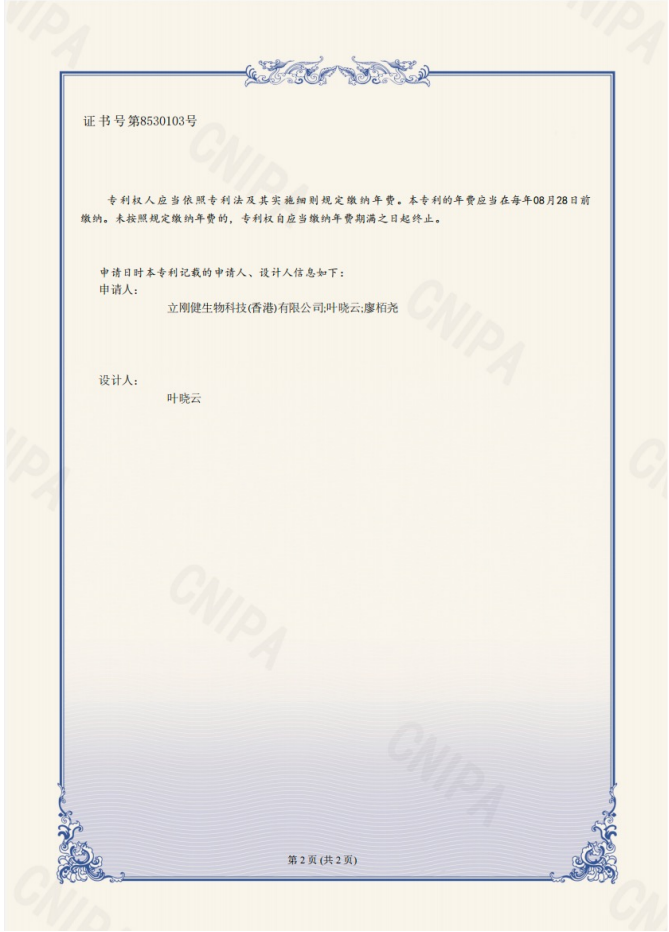
局长
申长雨

国家知识产权局
2024年03月12日

第1页(共2页)

其他事项参见续页



证书号第8530103号

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申请日时本专利记载的申请人、设计人信息如下：
申请人：
立刚健生物科技(香港)有限公司,叶晓云,廖栢尧

设计人：
叶晓云

第2页(共2页)

Research Dissemination

Public events

A. International Scoliosis Awareness Day was held on 25 June 25 2022. Experts from HKU Department of Orthopaedics and Traumatology, Hong Kong Scoliosis Awareness Group, Hong Kong Academy of Orthopaedic Surgeons and Hong Kong Physiotherapy Association, etc. attended the event.

B. International Scoliosis Awareness Day held on 8 June 2025

C. International Scoliosis Awareness Day held on 22 June 2024

D. Poster of International Scoliosis Awareness Day held on 25 June 2022

E. Poster of International Scoliosis Awareness Day held on 24 June 2023

Research Dissemination

Training sessions, educational workshops, and seminars

A & B: Educational workshop to explain the design principles, usage methods, and applications of the PCG to doctors at the First Affiliated Hospital of Sun Yat-sen University in Guangzhou.

C. A presentation on the research regarding the effects of the flexible brace on posture and proprioception at the 2025 Digital Intelligence-Empowered Scoliosis Academic Seminar.

D. The seminar was attended by approximately 100 doctors specialising in orthopaedics, surgery, and rehabilitation from various cities across Mainland China.

Research Dissemination

Expert consultants

Presentation at the Nanjing Drum Tower Hospital

This presentation outlined the clinical and development rationale of a specialised PCG aimed at improving the noninvasive management of early adolescent scoliosis through ergonomic design and guided support.

Presentation at The University of Hong Kong–Shenzhen Hospital

Prof. Yip presented the comfort-focused PCG that supports spinal alignment in adolescents with early scoliosis; she emphasised practical integration into daily life and conservative treatment plans.

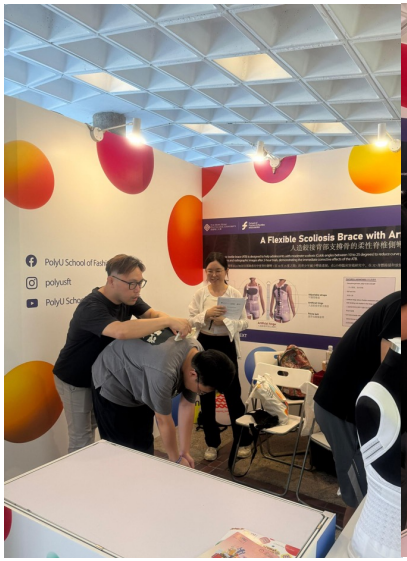
Research Dissemination

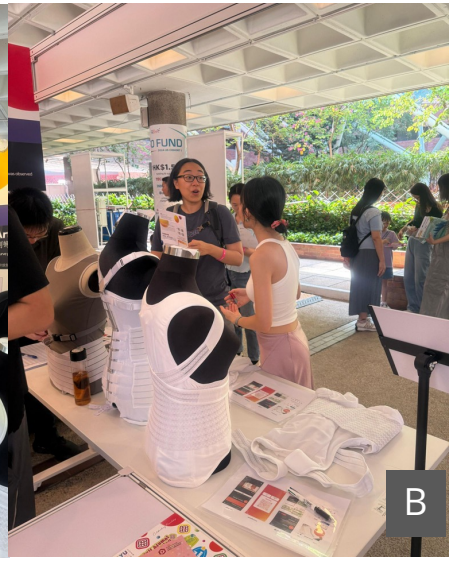
Expert consultants

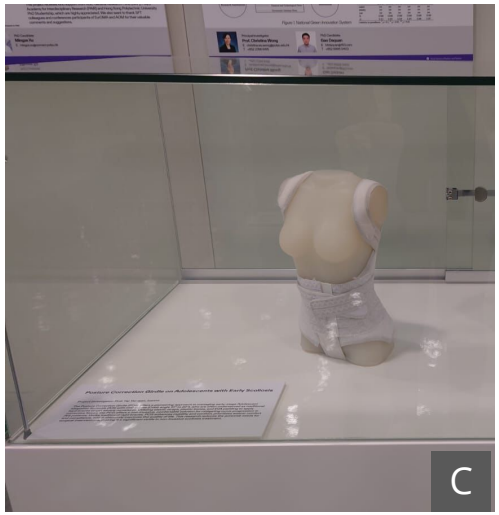
Presentation to clinicians/doctors in The First Affiliated Hospital of Sun Yat-sen University, Guang Zhou, Guang Dong Province

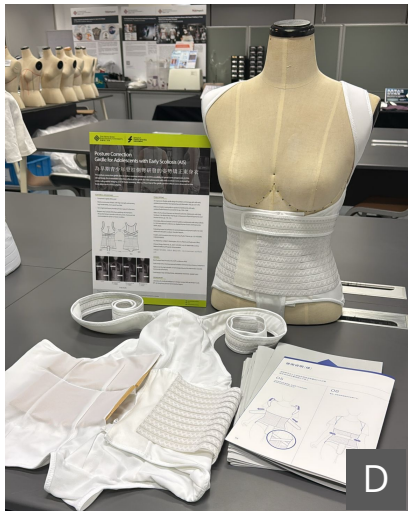
Research Dissemination

Exhibitions









A. The PCG was exhibited at the PolyU Zhongshan Life Science Park, where Prof. Yip introduced the PCG to visitors and government officials.

B. During PolyU Alumni Coming Day, visitors came to see the PCG exhibition.

C. A PCG mini model was displayed at the School of Fashion and Textiles, PolyU.

D. Municipal leaders from Shanghai, China, visited Prof. Yip's lab to view the PCG.

E. The PCG was also featured in a newspaper article that highlighted the innovation.

F. PCG's poster was presented at the 2025 Design Research Impact and Global Insights Colloquium Cum Exhibition.

Research Dissemination

Competition

The 48th International Exhibition of Inventions Geneva
(Gold Medal with the Congratulations of Jury)

DIPLÔME

Inventions Geneva

SALON INTERNATIONAL DES INVENTIONS

GENÈVE

Après examen, le Jury International a décidé

de remettre à: Yiu Wan Joanne YIP, T.H. Alex MAK, Wai Sum LO, Hoi Yan CHEUNG, Pak Yiu LIU, Ruixin LIANG, Jun ZHANG, Jingyi MA, Y. Brian CHEN, Kit Lun YICK

pour l'invention: Conception assistée par l'IA de vêtements fonctionnels pour le traitement de la scoliose

MÉDAILLE D'OR
GOLD MEDAL
GOLDMEDAILLE

Avec les félicitations du jury
With the congratulations of the jury
Mit höchsten Empfehlungen des Preisgerichtes

Genève, le 28 avril 2023

Le Président du Jury: David Taji

Le Président du Salon: Jean-Luc Vincent

Gold Medal with the Congratulations of Jury: AI-Assisted Design of Functional Clothing for Scoliosis Treatment

Research Dissemination

Symposia and colloquia

A. Prof. Yip was photographed with experts and doctors at the Guangdong Province Rehabilitation Medicine - Spine Rehabilitation Academic Annual Conference & Flexible Correction Technology Training Programme.

B. She delivered a presentation on the mechanism of spinal correction using the PCG.

C. The PCG was also exhibited to clinicians and doctors at the 2024 Guangdong Province Public Welfare Training, introducing its design and clinical applications.

D. Prof. Yip's team attended the conference to demonstrate the product and engage with medical professionals.

Research Dissemination

Licensing agreement

PolyU Technology and Consultancy Co. Limited
理大科技及顧問有限公司

To:
保姿体生物科技（广州）有限公司 中國广东省广州市越秀区中山二路 54,56号汇隆大厦15楼自编04单元 Attn: Prof. Joanne Yip Co-founder and Director

Date	Invoice No.
27 June, 2024	LINV23-0087

INVOICE

Ref. No.	Description	Amount
LA23-445 (SFT)	Product Name / Technology: Posture Correction Girdle for Adolescents with Early Scholiosis Inventors: Prof. Joanne YIP Yiu-wan, Prof. YIC Kit-lun, Prof. Marcus YUEN Chun-wah, Ms LIU Pak-yiu and Dr LAW Ka-ming Other remarks (if any): One-time non-refundable license fee	HKD 10,000.00
	Total	HKD 10,000.00

THIS PAYMENT IS DUE UPON PRESENTATION.

Payment Options

Bank Transfer
Bank Name: Hang Seng Bank Limited
Bank Address: 83 Des Voeux Road Central, Hong Kong
HKD Account Number: 024-239-857212-001
HKD Account Number: 024-222-015547-001
Account Name: PolyU Technology and Consultancy Co. Ltd.
Swift Code: HASEHKHH
Please email remittance to ptec.admin@polyu.edu.hk and indicate our Invoice No. LINV23-0087 and Ref. No. LA23-445 (SFT)

Cheque
Please make a crossed cheque payable to "PolyU Technology and Consultancy Co. Ltd." and forward to the address below.

FPS
FPS ID (HKD and CNY only): 165441346

E. & O. E.

In 2024, the PCG was licensed to Bao Zi Ti Biotechnology (Guangzhou) Co., Ltd. for sale, thus marking a significant milestone in our efforts to bring cutting-edge solutions to the market.

东莞永健康复器具有限公司

生产工艺流程

文件编号	TCP510101XAS001	文件版本	A
产品名称	PCG	页号	1 of 3
准　备	PE工程师:	批准	日期
会　签	生产会签:		
	项目会签:		
	品质会签:	生效日期:	

适用产品

项次	产品名称/型号	产品编号
1	PCG 姿势矫正衣,S码	50010219
2	PCG,姿势矫正衣,M码	50010220
3	PCG 姿势矫正衣,L码	50010221
	以下空白姿势矫正衣	

版本	修改记录	修改日期
A	始发版本	2023/10/5

Additionally, we have established a fully operational production line in Mainland China in partnership with Dongguan Yongjian Rehabilitation Devices Co., Ltd.

Research Dissemination

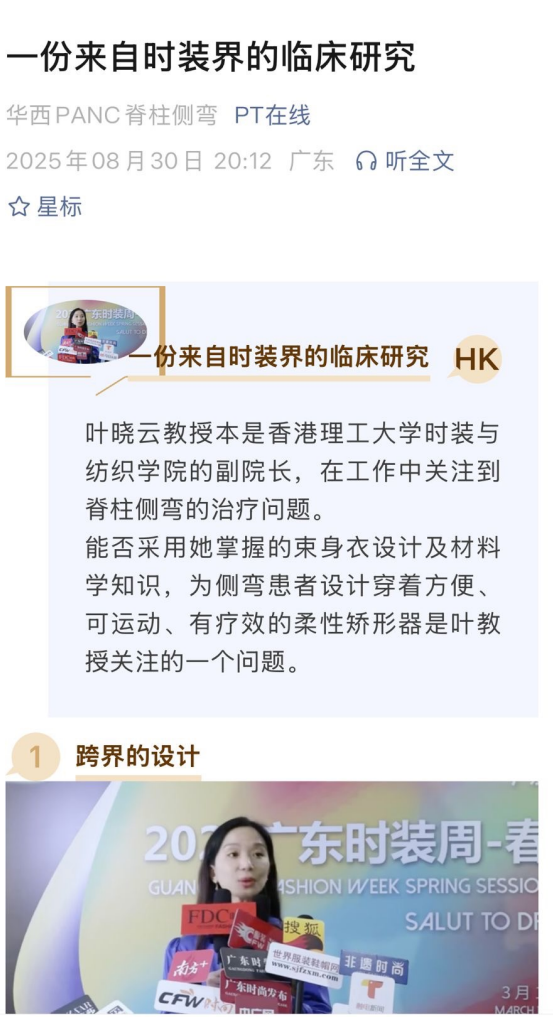
Media and newspaper reports

[Media report]

Original screen capture removed for copyright reasons. Please refer to the citation provided.

Prof. Joanne Yip introduces PCG on HOY TV

https://polyu.me/3R3r82g [34]



The Huaxi PANC Scoliosis WeChat public account reported on the soft brace designed and developed by Prof. Yip for the treatment of AIS, acknowledging its contributions to the field of rehabilitation as well as affirming the rapid development and transformation of the industry, which was driven by interdisciplinary research and innovation. It reached 250 reads after 10 days of publication (30 August 2025). [35]

Research Dissemination

Competition awards

Media and newspaper reports: The 48th International Exhibition of Inventions Geneva (Gold Medal with Congratulations of the Jury)

1.星岛网：理大PolyImpact科创理念 日內瓦国际发明展放异彩 [36]

2. 香港商報網 ：理大日內瓦國際發明展摘31獎 為歷年之最 [27]

3. yahoo：理大奪日內瓦國際發明展多個獎項 歷來最多 [28]

4.香港经济日报：【揚威海外】理大28項發明奪日內瓦發明展獎項　助治療脊柱側彎、減慢兒童近視加深 [29]

5.明报：理大研功能衣矫脊柱侧弯 服装设计不止靓唔 [30]

6.东网：理大研相機登陸火星 防控鏡片助抑近視 功能服裝治療脊柱側彎 [37]

7.晴报：創科發展｜理大在日內瓦發明展囊括31獎 兒童近視防控片奪特別大獎 [34]

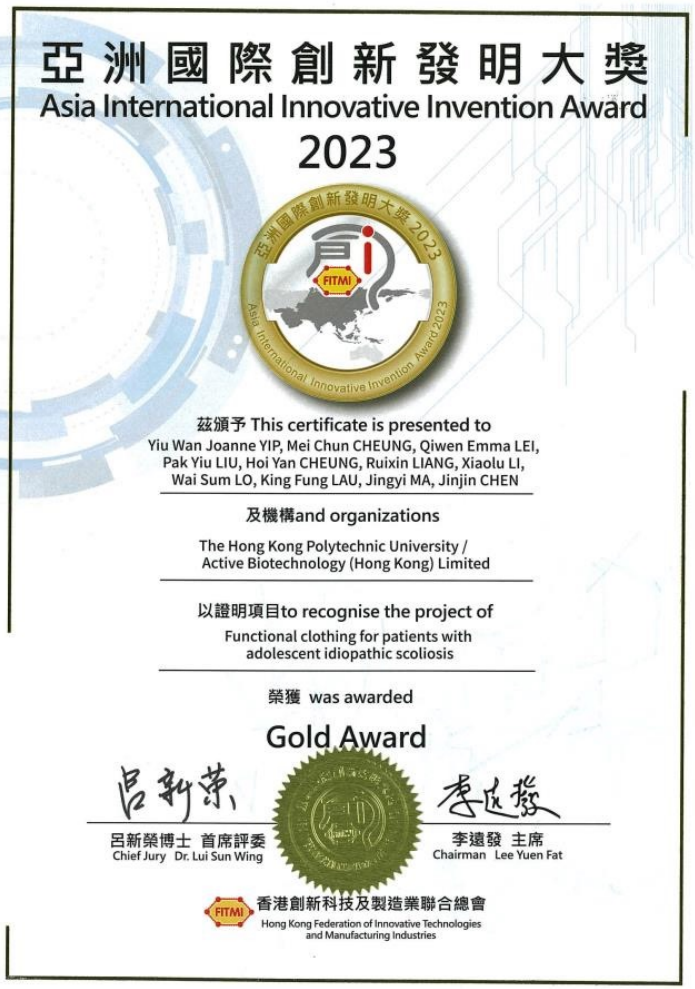
香港經濟日報: 理大28項發明奪31獎揚威日內瓦

AI輔助設計功能服裝治脊柱側彎 [29]

Research Dissemination

Competition awards

Asia International Innovative Invention Exhibition (Gold medal)



亞洲國際創新發明大獎
Asia International Innovative Invention Award
2023

茲頒予 This certificate is presented to
Yiu Wan Joanne YIP, Mei Chun CHEUNG, Qiwen Emma LEI,
Pak Yiu LIU, Hoi Yan CHEUNG, Ruixin LIANG, Xiaolu LI,
Wai Sum LO, King Fung LAU, Jingyi MA, Jinjin CHEN

及機構and organizations
The Hong Kong Polytechnic University /
Active Biotechnology (Hong Kong) Limited

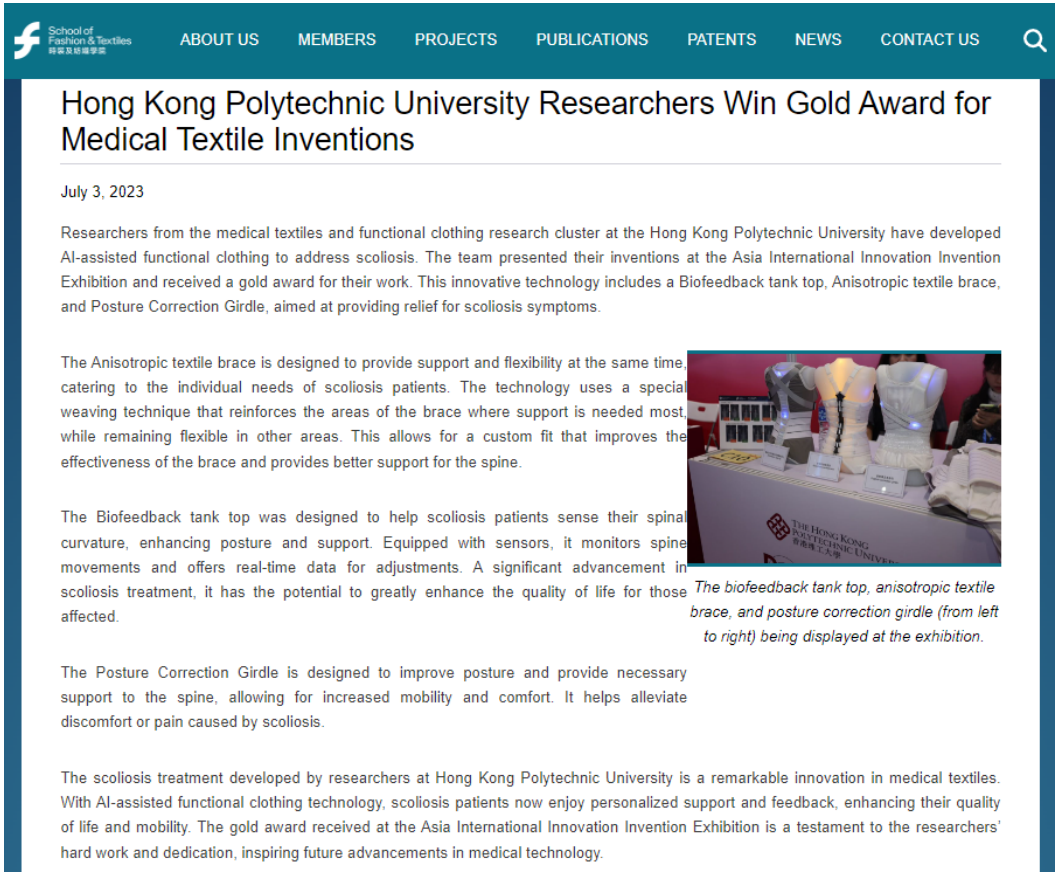
以證明項目to recognise the project of
Functional clothing for patients with
adolescent idiopathic scoliosis

榮獲 was awarded
Gold Award

呂新榮博士 首席評委
Chief Jury Dr. Lui Sun Wing

李遠發 主席
Chairman Lee Yuen Fat

香港創新科技及製造業聯合總會
Hong Kong Federation of Innovative Technologies
and Manufacturing Industries



School of Fashion & Textiles
ABOUT US MEMBERS PROJECTS PUBLICATIONS PATENTS NEWS CONTACT US

Hong Kong Polytechnic University Researchers Win Gold Award for Medical Textile Inventions

July 3, 2023

Researchers from the medical textiles and functional clothing research cluster at the Hong Kong Polytechnic University have developed AI-assisted functional clothing to address scoliosis. The team presented their inventions at the Asia International Innovation Invention Exhibition and received a gold award for their work. This innovative technology includes a Biofeedback tank top, Anisotropic textile brace, and Posture Correction Girdle, aimed at providing relief for scoliosis symptoms.

The Anisotropic textile brace is designed to provide support and flexibility at the same time, catering to the individual needs of scoliosis patients. The technology uses a special weaving technique that reinforces the areas of the brace where support is needed most, while remaining flexible in other areas. This allows for a custom fit that improves the effectiveness of the brace and provides better support for the spine.

The Biofeedback tank top was designed to help scoliosis patients sense their spinal curvature, enhancing posture and support. Equipped with sensors, it monitors spine movements and offers real-time data for adjustments. A significant advancement in scoliosis treatment, it has the potential to greatly enhance the quality of life for those affected.

The biofeedback tank top, anisotropic textile brace, and posture correction girdle (from left to right) being displayed at the exhibition.

The Posture Correction Girdle is designed to improve posture and provide necessary support to the spine, allowing for increased mobility and comfort. It helps alleviate discomfort or pain caused by scoliosis.

The scoliosis treatment developed by researchers at Hong Kong Polytechnic University is a remarkable innovation in medical textiles. With AI-assisted functional clothing technology, scoliosis patients now enjoy personalized support and feedback, enhancing their quality of life and mobility. The gold award received at the Asia International Innovation Invention Exhibition is a testament to the researchers' hard work and dedication, inspiring future advancements in medical technology.

Posture correction girdle being displayed at the exhibition.
https://www.mtl-sft.com/news/hong-kong-polytechnic-university-researchers-win-gold-award-for-medical-textile-inventions [33]

References

1 Cheung, M. C., Law, D., Yip, J., & Cheung, J. P. Y. (2022). Adolescents' experience during brace treatment for scoliosis: A qualitative study. *International Journal of Environmental Research and Public Health*, 19 (17), 10585. https://doi.org/10.3390/ijerph191710585

2 Liu, P. Y., Zhang, J., Wan, K. W. F., Yu, H. T. H., Lau, K. L. K., Cheung, M. C. K., ... & Yip, J. (2025). Evaluating the impact of soft bracing and textile engineering in enhancing postural control and proprioception in adolescent idiopathic scoliosis. *Journal of Industrial Textiles*, 55, 15280837251313520.

3 Ye, Z., Yip, J., Cheung, J., Liang, R., Zhang, J., Li, X., Tong, K. (2023). Posture correction girdle with intelligent padding system to dynamically adjust the pressure distribution and correct the scoliotic spine. In: Jay Kalra and Nancy Lightner (eds) Healthcare and Medical Devices. AHFE (2023) International Conference. AHFE Open Access, vol 79. AHFE International, USA. http://doi.org/10.54941/ahfe1003468

4 Liu, P. Y., Yip, J., Chen, B., He, L., Cheung, J., Yick, K., Ng, S. (2022). Immediate effects of posture correction girdle on adolescents with early scoliosis. In: Jay Kalra and Nancy Lightner (eds) Healthcare and Medical Devices. AHFE (2022) International Conference. AHFE Open Access, vol 51. AHFE International, USA. http://doi.org/10.54941/ahfe1002104

5 Correction Girdle Design Patent: CN Patent No: ZL 2023 3 0553931. Application Date: 28 August 2023 Authorisation Announcement Date: 12 March 2024.

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