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Development of a Continuous Loop Polyester Braid with Controlled Splice Performance

Executive Summary

A development programme was undertaken to engineer a continuous loop braided assembly with a 40” circumference capable of delivering the performance characteristics of a high-strength co-braided construct while improving consistency and manufacturing reliability.

The objective was to create a closed-loop textile architecture that maintained uniform mechanical behaviour throughout the structure, including across the splice interface, while supporting repeatable production.

The programme focused on optimisation of braid construction, splice methodology, and process control to achieve controlled strength, flexibility, dimensional stability, and consistent loop geometry.

Through iterative refinement of braid architecture and loop formation methods, the project established a repeatable manufacturing framework for continuous loop braided assemblies.

The Challenge

Continuous loop braided structures introduce additional complexity compared with linear braided products because structural consistency must be maintained throughout the full loop, including across the splice region.

The splice area can become a source of variability, influencing geometry, load distribution, and mechanical response.

Key engineering challenges included:

- Achieving continuous loop formation without compromising structural integrity
- Maintaining uniform mechanical behaviour through the splice region
- Controlling loop diameter and dimensional stability
- Ensuring balanced load distribution around the full loop
- Minimising variability introduced during post-processing
- Preserving flexibility and handling characteristics

The development required careful integration of a braid architecture and splice design to ensure the final assembly behaved as a continuous structure in both form and function.

Engineering Objectives

The programme focused on:

- Developing a stable continuous loop braid architecture
- Achieving consistent splice geometry and mechanical behaviour
- Maintaining controlled strength and flexibility
- Preserving dimensional stability across the full loop circumference
- Establishing repeatable manufacturing conditions
- Supporting scalable production capability

Development Approach

Braid Construction

Two braid construction variants were developed based on defined performance targets.

Polyester-based yarn systems were combined with supporting reinforcement fibres to achieve the required balance of:

- Tensile performance
- Flexibility
- Dimensional stability
- Handling characteristics

Critical process variables included:

- Carrier configuration
- Yarn selection

- Braid balance
- Picks per inch (PPI)
- Structural symmetry

These parameters were tightly controlled to maintain consistent loop formation and predictable handling behaviour.

Splice & Loop Formation

A dedicated splice methodology was developed to enable continuous loop formation without introducing localised performance variation.

Development focused on:

- Maintaining mechanical continuity through the splice interface
- Controlling geometry within the splice region
- Supporting uniform load transfer
- Minimising process-induced variability

The splice design was progressively refined to ensure the loop performed as a continuous braided structure rather than a joined assembly.

Validation & Performance Assessment

Performance was evaluated against defined dimensional and mechanical criteria to confirm structural consistency.

Validation activities included:

- Runnage consistency assessment
- Braid load evaluation
- Elongation under load
- Diameter verification
- Picks per inch (PPI) measurement

Testing confirmed stable mechanical behaviour across both braid variants and demonstrated consistency through the splice region.

Process Control & Repeatability

Repeatable manufacturing performance was established through defined process controls including:

- Standardised braid setup conditions
- Parameters control and operating windows
- Controlled yarn handling and tension management
- Defined splice formation methodology
- Post-processing standardisation

These controls reduced variability between builds and supported scalable production capability.

Engineering Outcome

The project successfully demonstrated the feasibility of producing continuous loop braided assemblies with controlled splice integrity and repeatable mechanical performance.

Key engineering outcomes included:

- Stable continuous loop formation
- Controlled splice behaviour
- Uniform load distribution across the full assembly
- Repeatable braid geometry and dimensional control
- Improved manufacturing consistency
- Production-ready process capability

The programme reinforced the importance of integrating braid architecture and splice engineering when developing advanced closed-loop textile structures.

Application Relevance

Orthopaedics & Sports Medicine

Suitable for loop-based fixation systems requiring controlled load transfer and consistent structural behaviour.

Surgical Loop Devices

Applicable to braided loop assemblies where dimensional control and repeatable performance are critical.

Minimally Invasive Device Systems

Supports compact braided structures requiring controlled flexibility and predictable deployment characteristics.

Implantable Textile Structures

Relevant to reinforcement and fixation constructs requiring repeatable geometry and mechanical stability.

Key Takeaways

- Continuous loop performance depends on both braid architecture and splice design
- Splice integrity directly influences load distribution and dimensional stability
- Controlled process windows improve manufacturing repeatability
- Closed loop assemblies require integrated structural and process engineering
- Repeatable loop formation supports scalable medical textile production

"The development demonstrated that continuous loop performance is achieved when the splice behaves as part of the structure – not as a transition point."

Contact Corza Medical today

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