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Development of a Silk-Based Braided Assembly Across USP Suture Sizes

Executive Summary

A development programme was undertaken to engineer a silk-based braided assembly capable of achieving established USP suture size formats while maintaining consistent performance and manufacturing stability.

The objective extended beyond dimensional matching and focused on creating a braid architecture that could support repeatable mechanical behaviour, controlled handling characteristics, and scalable production across multiple size variants.

Using silk in combination with high-performance reinforcement fibres, the programme established a structured approach to translating an alternative material platform into a controlled braided format suitable for medical textile applications.

Through optimisation of braid construction, material configuration, and finishing processes, the project demonstrated repeatable production across multiple braid sizes.

The Challenge

Introducing an alternative fibre into an established product format created challenges that extend beyond dimensional conversion.

Silk exhibits different processing and mechanical behaviour compared with conventional synthetic braid systems and therefore required careful architectural control to maintain functional consistency.

Key engineering challenges included:

- Achieving controlled diameter across multiple USP size formats
- Maintaining mechanical reliability across scale changes
- Balancing flexibility with structural integrity
- Preserving braid consistency during finishing operations
- Managing process stability through dyeing and coating stages
- Establishing a scalable production workflow

The programme required coordinated management of material behaviour and braid architecture to achieve consistent outcomes.

Engineering Objectives

The programme focused on:

- Developing controlled braid constructions across USP sizes
- Preserving dimensional consistency throughout the size range
- Balancing handling characteristics and mechanical performance
- Establishing stable manufacturing conditions
- Supporting scalable production capability
- Demonstrating repeatable assembly formation

Development Approach

Braid Construction

A series of tailored braid architectures were developed to achieve target sizes formats while controlling structural behaviour.

Silk-based yarn systems were combined with reinforcement fibres to balance handling and mechanical performance.

The resulting constructions were engineered to deliver:

- Controlled diameter
- Balanced flexibility and strength
- Consistent braid integrity
- Stable handling characteristics

Carrier configuration and yarn selection were refined across the size range to

maintain both dimensional and functional consistency.

Material Configuration

Multiple structural configurations were evaluated to optimise performance across the assembly portfolio.

Development variables included:

- Carrier count (8, 6, and 4-carriers)
- Silk denier selection
- Reinforcement fibre format (twisted and untwisted)
- Core-supported and coreless constructions

This flexible configuration strategy enabled controlled tuning of both tactile and mechanical performance.

Manufacturing Process

A controlled end-to-end manufacturing workflow was established to support repeatability.

Key stages included:

- Yarn preparation and winding
- Braiding
- Skeining
- Discharge dyeing
- Wind stretching
- MED2174 coating application
- Final measurement and inspection

Each stage was optimised to preserve fibre integrity and minimise process variability.

Validation & Performance Assessment

Performance assessment focused on confirming dimensional consistency and manufacturing stability.

Validation activities included:

- Diameter verification against target sizes ranges
- Runnage assessment
- Break load evaluation
- Handling assessment
- Coating uniformity inspection

Testing confirmed stable braid formation and repeatable process performance across the developed configurations.

Process Control & Repeatability

Repeatable manufacturing performance was achieved through defined process controls during:

- Standardised braid setup conditions
- Controlled yarn preparation methods
- Managed process sequencing
- Finishing and coating control
- Inspection and verification procedures

These controls supported consistent output and scalable manufacturing capability.

Engineering Outcome

The programme demonstrated that alternative material systems can be translated into established product formats through coordinated control of construction and process.

Key engineering outcomes included:

- Controlled braid formation across multiple sizes
- Stable integration of silk-based architectures
- Consistent dimensional performance
- Balanced handling and mechanical response
- Repeatable manufacturing capability

The resulting framework established a pathway for introducing alternative textile materials while maintaining production reliability.

Application Relevance

General Surgery

Suitable for soft tissue approximation and closure applications requiring controlled handling characteristics.

Cardiovascular Surgery

Relevant to ligation and secure textile structures requiring consistent formation.

Orthopaedic Surgery

Applicable to soft tissue fixation and reinforcement applications requiring predictable performance.

Ophthalmic & Microsurgery

Supports fine braided structures requiring controlled dimensions and handling.

Gastrointestinal Surgery

Relevant to closure and ligature applications requiring repeatable textile performance.

Key Takeaways

- Material substitution requires architectural redesign rather than direct replacement.
- Braid construction is a primary lever for controlling performance.
- Alternative fibres can be integrated into established product formats.
- Process stability is essential for repeatable manufacturing.
- Controlled finishing supports scalable medical textile productions.

"Introducing new materials successfully depends on controlling how the structure behaves – not simply matching dimensions."

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2755 Canyon Boulevard, 1st Floor
Boulder, CO 80302