DESIGNING HYPOTUBE SHAFTS

Design Characteristics of Hypotube-Based Shafts

Design of the optimum shaft for your minimally invasive device requires balancing a number of performance characteristics - pushability, trackability, torqueability, kink performance, transition and deflation time. Achieving the best performance in one characteristic can often directly affect other characteristics. Creganna has the experience and expertise to assist you in making these critical design decisions.

Pushability

Pushability is the measurement of a devices ability to transmit a longitudinal force from the proximal end of a device to the distal end. It is usually measured as a ratio of input force at the proximal end to output force at the distal end.

Why is pushability important?

When a pushing movement and force is applied to the proximal end of a shaft, an equal movement and force should be transmitted to the distal end. The higher the transmission of force to the distal end, the easier the physician can navigate the device to reach the intended target.

How can pushability be increased?

- By maximising the cross-sectional area of the device.
- By maximising the modulus of elasticity by using a stiffer material.
- By maximising tensile strength.

Trackability

Trackability describes a devices ability to travel or track through tortuous anatomy to its ultimate destination. Trackability is influenced by a number of factors such as shaft flexibility, the friction between a device and its surrounding environment and column strength – the ability of the device to withstand axial forces without compression or stretch.

Why is trackability important?

Trackability is a measure of what the user will feel when manipulating the device. It determines how freely the device reaches the ultimate destination. Low tracking forces will allow for easier manipulation and positioning.

Creganna's FlexiShaft metal hypotube maximises trackability

How can trackability be improved?

- By selecting a low friction outer layer or coating.
- By reducing the modulus of elasticity.
- By reducing the wall thickness of the device.
- By reducing the outer diameter of the shaft.

Creganna's EzGlide range of metal hypotubes with a polymer jacket are a popular choice when high lubricity is a key design requirement.

Torqueability

Torqueability is a measure of the ability to transmit a rotational displacement along the length of the device.

Why is torqueability important?

Guiding a device through tortuous anatomy requires a certain amount of torsional manipulation. A device with good torqueability, one that responds well distally to proximal rotational manipulation, makes navigation much easier.

How can torqueability be increased?

- By maximising the polar moment of inertia of the hypotube.
- By maximising the shear modulus using a stiffer material.

Kink Performance

Kink resistance is a devices ability to maintain its cross-sectional profile during compressive deformation.

Why is kink performance important?

When a device is bent around a small enough radius, a permanent kink can result, which can compromise the internal lumen and reduce other mechanical properties, for example push and torque. A severe kink can lead to a device break, which may require surgical intervention.

How can kink performance be improved?

- By maximising wall thickness.
- By improving the ductility of the material.

Transition

Distal transition refers to the change in stiffness from the proximal shaft to the distal shaft, which is needed to transmit push distally.

Why is transition important?

In general there is a large difference in stiffness between proximal shafts, which are designed for pushability and distal shafts, which are designed for trackability. If there is no transition in stiffness between the proximal and distal shaft, the device will exhibit poor transmission of push and torque forces. It will also be prone to kinking at the transition point.

How can transition be improved?

- By increasing the flexibility of the distal end of the shaft.
- By removing some of the material from the distal end of the shaft.
- By adding a component of intermediate stiffness to the transition area.

Creganna provides a broad range of shapes and form features to facilitate the attachment of transitioning elements.

Deflation Time

Deflation time refers to the length of time required for an angioplasty balloon to deflate. The deflation time of a balloon is determined by the inner diameter of the hypotube shaft.

Why is deflation time important?

During angioplasty a balloon is inflated within the artery to widen the arterial lumen. This inflation action temporarily restricts blood flow downstream. Rapid deflation is critical to resume blood flow downstream and avert any long term damage from lack of blood supply.

How can deflation time be decreased?

- By increasing the internal diameter of the hypotube shaft.

Other Design Considerations for Hypotube Based Shafts

- Creganna has in depth experience in metallurgy, polymer engineering and composite technologies. Our **materials science** team offer advice on decisions, such as suitability of material types, properties and alternatives.
- All Creganna hypotube shafts and associated components are manufactured in a **pyrogen controlled environment**.
- Creganna can provide complete **biocompatibility** data on all our products.

- Femoral and brachial **exit markers** on the hypotube shaft assists the physician in navigation and placement of a minimally invasive device. Creganna provides a broad range of exit marker solutions for all hypotube-based device shaft.

- Creganna has a range of capabilities to design, manufacture and assemble proximal hypotube shaft components, such as luers, strain reliefs and deployment handles.