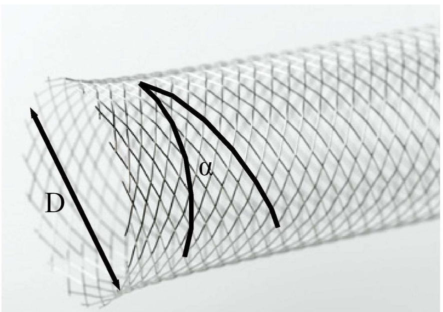
around 45° it is possible to reduce the cover rate variation to 4%. Cover rate for braided stent doesn't vary as much as it does for laser cut, in a compliant environment. The pressure distribution applied on tissues, remain thereof close to constant. However, the braided stents undergo length variations of around 30 % over the cardiac cycle. This phenomenon is to be considered when assembling the different stents parts.

4.3.2 Radial pressure

In order to minimize stress in the stent's surrounding tissues, it is essential to limit the value of the pressure applied by the stent on the implantation environment. The geometrical parameters, which characterize the structure of the braid must be set in accordance with the pressure that is to be applied on the tissues. We therefore establish, in the following section, the relationship between the mechanical behavior of the braid and its geometrical characteristics. Two configurations are considered : braided stent with both free ends and non free ends.

4.3.2.a Stent with free ends

The model adopted for this configuration is proposed by Ravi [RAV.04]. Each wire part of the braid is considered as a curved beam to which we apply the Kirchhoff–Love theory equations.



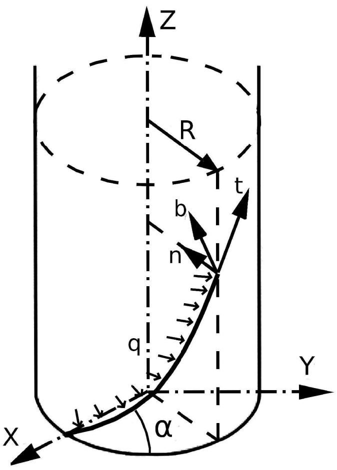


Fig.II.16_ Kirchoff-Love model

In that model, the trajectory described by the neutral axis is a circular helix. In Figure II.16 are represented the efforts applied in each section (S) of the helix.

The model works with following assumptions:

- Braid wire parts undergo :
  - Pure bending torque (around an axis perpendicular to the cylinder surface)

$$M_b = EI(\rho - \rho_0) \qquad (34.2)$$

  - Pure torsion torque (around the wire neutral axis)

$$M_t = GI_0(\tau - \tau_0) \qquad (35.2)$$

In which ρ and τ represent respectively the curvature and torsion at the considered point, while ρ_0 and τ_0 represent the curvature and torsion before deformation.

- The curvature ρ and torsion τ of a circular helix characterized with an angle α and a basis circle radius R are constant and can be written:

$$\rho = \frac{\cos^2\alpha}{R} \quad \text{and} \quad \tau = \frac{\cos\alpha \sin\alpha}{R} \qquad (36.2)$$

- The braid is characterized with constant wire radius

$$\frac{\cos\alpha_0}{R_0} = \frac{\cos\alpha}{R} \qquad (37.2)$$

The index $_0$ corresponds to the stent's state at rest

- Material respects the Hooke law

Pressure applied to the stent is modeled with a distributed force q applied on each wire part. q correspond to the pressure efforts defined per unit of height and reported to the effective length of the wire parts as well as to the number of wire parts n involved in the braid. The distributed load q can be written :

$$q = p(\pi D)\frac{1}{n}\frac{H}{L} = p\frac{\pi D \sin\alpha}{n} \qquad (38.2)$$

H = stent's height

L = wire part length

p = radial pressure acting on the stent

The simplified resolution of the Kirchhoff-Love equations allows obtaining a relationship between pressure p, the braid geometrical characteristics and the stent's diameter D=2R.

$$P = \frac{nEI}{2\pi} \cdot \left(\frac{\cos\alpha_0}{R_0}\right)^4 \cdot \frac{1}{\sin\alpha}\left[(1 - \frac{R_0}{R}) - \frac{1 - \frac{\sin\alpha_0}{\sin\alpha}}{1+\nu}\right] \qquad (39.2)$$