HoopForce-RadialForce-Pressure Derivation

Blockwise Engineering LLC
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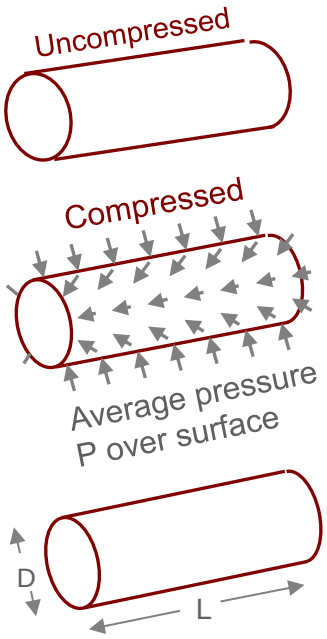
What Is Radial Force?

Radial Force (RF) is the average pressure over the surface of the compressed object times the surface area of the object.

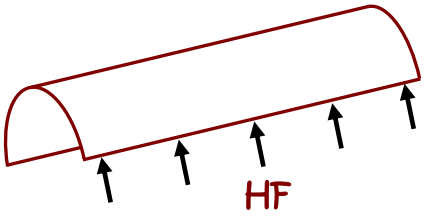
(When the device is compressed by a segmented radial compression mechanism, RF is also equal to the sum of the forces on each die tip, perpendicular to the tip surface.)



$$P = \frac{Force}{Area} = \frac{RF}{\pi DL}$$

What Is Hoop Force?

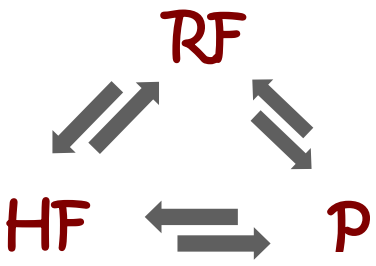
Hoop Force (HF) is the total compressive force in one wall of a tubular object like a stent.



Can be likened to the tension in a barrel hoop.

Hoop force is related to radial force:

$$HF = \frac{RF}{2\pi}$$



We prefer to use RF

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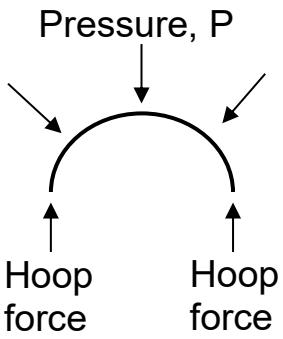
Relating Radial Force and Hoop Force

The relationship between pressure and radial force is:

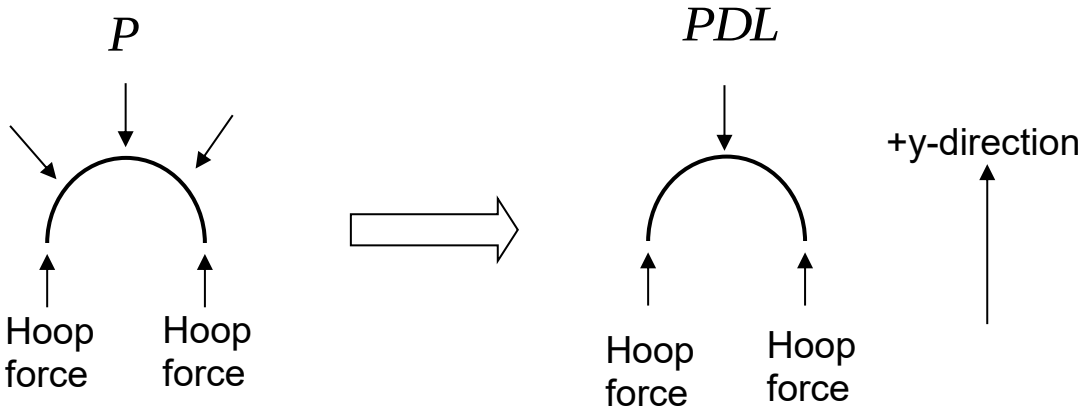
$$P = \frac{RF}{\pi DL} \qquad \text{equation (1)}$$

To relate radial force to hoop force, make a free-body diagram on half of the stent.



The net force in the vertical (y) direction must sum to zero, i.e. the hoop force balances the pressure.

The pressure acts on the **projected area** DL, where D = diameter and L = length.



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The force balance gives: $2HF = PDL$ equation (2)

Combining equations (1) and (2):

$$HF = \frac{RF}{\pi DL}\frac{DL}{2}$$

$$HF = \frac{RF}{2\pi}$$