INDICES FOR AAA GEOMETRY QUANTIFICATION

One-Dimensional (1D) Size Indices

All diameter measurements were computed according to the hydraulic diameter definition:

$$\mathrm{D} = \frac{4 * \mathrm{Area}}{\mathrm{Perimeter}}$$

D_{max}: Maximum transverse diameter of the AAA sac (in mm)

D_{ave}: Average transverse diameter of the AAA (in mm)

D_{min}: Minimum transverse diameter of the AAA (in mm)

$D_{neck,p}$: Proximal neck diameter immediately below the renal arteries (in mm)

$D_{neck,d}$: Distal neck diameter (in mm)

H: Height of AAA (in mm)

L: Centerline length of AAA (in mm)

H_{neck}: Height of AAA neck (in mm)

L_{neck}: Centerline length of AAA neck (in mm)

H_{sac}: Height of AAA sac (in mm)

L_{sac}: Centerline length of AAA sac (in mm)

H_b: Bulge height (in mm)

d_c: Distance between the lumen centroid and the centroid of the cross section where D_{max} is located (in mm)

$d_{c,max}$: The maximum distance between the lumen centroid and the centroid of the cross section along the central line (in mm)

Wall Thickness Indices

TH_{min}: minimum wall thickness (in mm)

TH_{max}: maximum wall thickness (in mm)

TH_{ave}: average wall thickness (in mm)

TH_{Dmax}: average wall thickness where D_{max} is located (in mm)

TH_{mode}: mode of the wall thickness (in mm)

TH_{median}: median of the wall thickness (in mm)

TH_{minvar}: minimum variance of wall thickness

TH_{maxvar}: maximum variance of wall thickness

$TH_{medianvar}$: median variance of wall thickness

$TH_{modevar}$: mode variance of wall thickness

$TH_{meanvar}$: mean variance of wall thickness

P_{below}: percentage of thickness below the average thickness (in %)

P_{above}: percentage of thickness above the average thickness (in %)

2D Shape Indices

DHr: Diameter-Height ratio; DHr is an expression of the fusiform shape of the AAA sac,

$$\mathrm{DHr} = \frac{\mathrm{Dmax}}{\mathrm{H}}$$

DDr: Diameter-Diameter ratio

$$\mathrm{DDr} = \frac{\mathrm{Dmax}}{\mathrm{Dneck,p}}$$

Hr: Height ratio; Hr is an assessment of the relative neck height in comparison with the AAA height,

$$\mathrm{Hr} = \frac{\mathrm{Hneck}}{\mathrm{H}}$$

BL: Bulge Location; BL provides a measure of the relative position of the maximum transverse dimension with respect to the neck,

$$\mathrm{BL} = \frac{\mathrm{H_b}}{\mathrm{H}}$$

β: Asymmetry factor

$$\beta = 1 - \frac{\mathrm{d_c}}{\mathrm{Dmax}}$$

β_{min}: Minimum asymmetry factor along the central line

$$\beta_{\mathrm{min}} = \min(1 - \frac{\mathrm{d_{c,all}}}{\mathrm{D}})$$

where $d_{c,all}$ is distance between the lumen centroid and the centroid of the cross section along the central line, and D is the hydraulic diameter at the same cross section

T: Tortuosity

$$\mathrm{T} = \frac{\mathrm{L}}{\mathrm{d}}$$

where d is the Euclidean distance from the centroid of the cross section where $D_{neck,p}$ is located to the centroid of the cross section at the AAA distal end.

C_{ave}: average lumen compactness

C_{min}: minimum lumen compactness

C_{max}: maximum lumen compactness

where compactness is defined as:

$$C = \frac{\text{Perimeter}^2}{4 * \pi * \text{Area}}$$

3D Size Indices

V: Vessel volume (in mm^3)

S: Vessel surface area (in mm^2)

3D Shape Indices

IPR: isoperimetric ratio

$$IPR = \frac{S}{V^{2/3}}$$

NFI: non-fusiform index

$$NFI = \frac{\frac{S}{V^{2/3}}}{\frac{S_{fusiform}}{V_{fusiform}{}^{2/3}}} = \frac{IPR}{IPR_{fusiform}}$$

Second Order Curvature Based Indices

GAA: Area averaged Gaussian curvature (in mm^{-1})

$$GAA = \frac{\sum_{\text{all elements}} K_j S_j}{\sum_{\text{all elements}} S_j}$$

MAA: Area averaged Mean curvature (in mm^{-2})

$$MAA = \frac{\sum_{\text{all elements}} M_j S_j}{\sum_{\text{all elements}} S_j}$$

GLN: L2-norm of the Gaussian curvature

$$GLN = \frac{1}{4\pi} \sqrt{\sum_{\text{all elements}} S_j . \sum_{\text{all elements}} \left(K_j^2 S_j\right)}$$

MLN: L2-norm of the Mean curvature

$$MLN = \frac{1}{4\pi} \sqrt{\sum_{\text{all elements}} \left(M_j^2 S_j\right)}$$