### Supplementary tables

#### Supplementary table 1. Patient demographics, AVM characteristics and treatment parameters

| Sex          |        |
|--------------|--------|
| Male         | 19 (63%) |
| Female       | 11 (37%) |

| Age at treatment (years) | 12 – 65 (mean 44, median 46.5) |

| Symptoms at diagnosis |        |
|-----------------------|--------|
| Asymptomatic          | 6 (20%) |
| Headache              | 11 (37%) |
| Neurological deficit  | 11 (37%) |
| Seizure               | 10 (33%) |
| Hemorrhage            | 6 (20%) |
| Tinnitus              | 3 (10%) |

| Prior treatment of AVM |        |
|------------------------|--------|
| No                     | 26 (87%) |
| Radiation therapy      | 0      |
| Embolization           | 3 (10%)¹ ² |
| Surgery                | 1 (3%)  |

| Size of nidus          |        |
|------------------------|--------|
- <3 cm 14 (47%)
- 3-6 cm 10 (33%)
- >6 cm 6 (20%)

Location

- Cortical 26 (87%)
- Subcortical 25 (83%)
- Ventricular 7 (23%)
- Corpus callosum 1 (3%)
- Frontal 8 (27%)
- Temporal 7 (23%)
- Parietal 13 (43%)
- Occipital 8 (27%)
- Basal ganglia 3 (10%)
- Internal capsule 2 (7%)
- Cerebellar hemisphere 3 (10%)
- Vermian 1 (3%)
- Deep cerebellar nuclei 1 (3%)
- Brain stem 0

Aneurysm
|                          |       |
|--------------------------|-------|
| **Flow related**         | 4 (13%) |
| **Intranidal**           | 1 (3%)  |
| Feeding arteries         |       |
| - 1                      | 4 (13%) |
| - 2-3                    | 8 (27%) |
| - > 3                    | 18 (60%) |
| Venous drainage          |       |
| - Single draining vein   | 8 (27%) |
| - Superficial drainage only | 18 (60%) |
| - Deep drainage only     | 1 (3%)  |
| - Both superficial and deep drainage | 11 (37%) |
| Spetzler-Martin score    |       |
| - 1                      | 6 (20%) |
| - 2                      | 10 (33%) |
| - 3                      | 6 (20%)  |
| - 4                      | 5 (17%)  |
| - 5                      | 3 (10%)  |
| Target volume at radiation | <1 – 62 ccm (mean 10.3, median 6.5) |
| Number of fractions | Count |
|---------------------|-------|
| 2 fractions         | 27 (90%) |
| 5 fractions         | 3 (10%) |

| Radiation dose per fraction (physical Gy) | Count |
|------------------------------------------|-------|
| 7 – 12 mean (11.2, median 12.0)          | 3 (10%) |
| 7 Gy                                     | 2 (7%) |
| 10 Gy                                    | 9 (30%) |
| 12 Gy                                    | 16 (53%) |

| Total radiation dose (physical Gy)       | Count   |
|------------------------------------------|---------|
| 20 – 35 (mean 24.2, median 24.0)        |         |

1 – Target embolization for reduction of AVM nidus prior to proton radiation therapy
2 – Two patients underwent embolization for flow related aneurysms but the AVM nidus was not treated prior to proton radiation therapy
### Supplementary table 2. Morbidity and outcomes

| Additional treatment of AVM |  |
|----------------------------|---|
| - No                       | 28 (93%)$^1$ |
| - Radiation therapy        | 1 (3%) |
| - Embolization             | 1 (3%) |
| - Surgery                  | 0 |

| AVM-related hemorrhage after proton radiation therapy |  |
|------------------------------------------------------|---|
| - No                                                  | 28 (97%) |
| - Yes                                                 | 1 (3%)$^2$ |

| Post-radiation symptoms requiring treatment with corticosteroids | 7 |

| Change in nidus based on DSA (n 22$^3$) |  |
|-----------------------------------------|---|
| - No                                    | 0 |
| - Partial obliteration                  | 8 |
| - Total obliteration                    | 14 |

| Change in nidus based on MRI (n 28$^4$) |  |
|-----------------------------------------|---|
| - No                                    | 0 |
| - Partial obliteration                  | 14 |
| - Total obliteration                    | 14 |

| Survival |  |
|----------|---|
|          |            |            |
|----------|------------|------------|
| - Yes    | 27 (90%)   |            |
| - Death due to other causes | 3 (10%)  |            |
| - Death due to AVM | 0   |            |

1 – One patient did undergo embolization for two flow related aneurysm but the AVM was not additional treated

2 – One patient developed hemorrhage from the residual nidus, the patient had received additional treatment and nidus had been partially embolized one year prior to the hemorrhage

3 – Twenty-two patients underwent post-treatment DSA

4 – In two patients nidus was not visible on pre-treatment MRI