

FUNCTIONAL OUTCOME OF ELDERLY PATIENTS TREATED FOR ODONTOID FRACTURE. A MULTICENTER STUDY

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Background: Treatment of odontoid fractures in the elderly is still debatable since both conservative and surgical options present advantages and disadvantages in terms of functional outcome.

Methods: 147 patients with odontoid fracture underwent a cervical CT scan. Fractures were classified according to the Anderson and D'Alonzo and the Roy-Camille classifications. Philadelphia type collar was always positioned soon after the spine trauma and kept as a treatment whenever acceptable. Halo-vest, anterior odontoid screw

Table 1: Pre-treatment patients' characteristics

| | Collar | Halo | Anterior screw | C1-C2 posterior arthrodesis | Occipito-cervical fixation | Total |
|------------------------------|----------|----------|----------------|-----------------------------|----------------------------|-----------|
| <i>Age: 65-79</i> | 10 (22%) | 12 (54%) | 19 (63%) | 17 (57%) | 13 (65%) | 71 (48%) |
| <i>Age: 80+</i> | 35 (78%) | 10 (46%) | 11 (37%) | 13 (43%) | 7 (35%) | 76 (52%) |
| <i>ASA: 1-2</i> | 10 (23%) | 9 (41%) | 10 (33%) | 8 (27%) | 8 (40%) | 45 (31%) |
| <i>ASA: 3</i> | 33 (75%) | 13 (59%) | 18 (60%) | 20 (67%) | 10 (50%) | 94 (64%) |
| <i>ASA: 4</i> | 1 (2%) | 0 | 2 (7%) | 2 (6%) | 2 (10%) | 7 (5%) |
| <i>CCI: 2-5</i> | 28 (62%) | 14 (64%) | 22 (73%) | 23 (77%) | 10 (50%) | 97 (66%) |
| <i>CCI: 6-8</i> | 17 (38%) | 8 (36%) | 8 (27%) | 7 (33%) | 10 (50%) | 50 (34%) |
| <i>mRS-pre: 0-3</i> | 35 (78%) | 21 (95%) | 14 (47%) | 13 (43%) | 20 (100%) | 103 (70%) |
| <i>mRS-pre: 4-5</i> | 10 (22%) | 1 (5%) | 16 (43%) | 17 (47%) | 0 | 44 (30%) |
| <i>Dislocation ≤ 3 mm</i> | 30 (67%) | 20 (91%) | 19 (63%) | 15 (50%) | 11 (55%) | 95 (65%) |
| <i>Dislocation > 3 mm</i> | 15 (33%) | 2 (9%) | 11 (27%) | 15 (50%) | 9 (45%) | 52 (35%) |

fixation, C1-C2 posterior arthrodesis and occipito-cervical fixation were the other treatments adopted.

On admission ASA score, modified Rankin scale (mRS-pre) and Charlson Comorbidity Index (CCI) were assessed. 12-15 months after treatment a second modified Rankin scale (mRS-post) together with Neck Disability Index (NDI) and Smiley Webster Pain Scale (SWPS) were administered to estimate functional outcome. Fracture healing process was evaluated at 12 months through a cervical CT scan. Dynamic cervical spine x-rays were obtained whether necessary. Chi square/Fisher exact test and logistic regression were performed for statistical analysis.

Results: 79.8% of patients showed a good outcome according with NDI. No significant differences were observed between patients of 65-79 years and ≥ 80 years ($p=0.81$). CCI greatly correlated with mRS-post, with higher indexes

Table 2: Analysis of factors affecting outcome in relation to NDI

| Logistic regression analysis: dichotomous NDI | p | HR | 95% C.I. for HR Lower | 95% C.I. for HR Upper |
|--|--------|---------|-----------------------|-----------------------|
| <i>Age ≥ 80</i> | 0,827 | 0,816 | 0,132 | 5,036 |
| <i>Charlson Comorbidity Index: 6 or 7 or 8</i> | 0,054 | 6,745 | 0,964 | 47,189 |
| <i>ASA 3</i> | 0,277 | 2,362 | 0,501 | 11,129 |
| <i>ASA 4</i> | 0,747 | 0,538 | 0,012 | 23,413 |
| <i>mRS-pre: 4 or 5</i> | 0,0001 | 34,783 | 4,993 | 242,322 |
| <i>Anderson D'Alonzo Classification 2</i> | 0,946 | | | |
| <i>Anderson D'Alonzo Classification 3</i> | 0,738 | 1,43 | 0,176 | 11,607 |
| <i>Anderson D'Alonzo Classification 2 + other fractures of cranio-vertebral junction</i> | 0,94 | 1,065 | 0,207 | 5,469 |
| <i>Treatments: cervical collar</i> | | | | |
| <i>halo vest</i> | 0,34 | 5,334 | 0,172 | 165,684 |
| <i>odontoid anterior screw fixation</i> | 0,001 | 178,707 | 9,235 | 3458,295 |
| <i>posterior arthrodesis (Harms)</i> | 0,0001 | 312,288 | 13,858 | 7037,527 |
| <i>occipito-cervical stabilization</i> | 0,032 | 32,581 | 1,355 | 783,318 |

reported in 68.8% of cases characterized by good outcomes ($p=0.05$).

mRS-pre strongly correlated with NDI ($p<0.000001$) and with mRS-post ($p=0.04$).

Logistic regression analysis showed that CCI, mRS-pre and all the surgical procedures were associated with worse NDI, while both C1-C2 posterior arthrodesis and occipito-cervical stabilization were associated with worse mRS-post.

Conclusions: mRS-pre and CCI represented two strong independent predictive values respectively for functional outcome and for post-treatment degree of disability regardless of the treatment chosen. Compared to conservative immobilizations, all the surgical techniques for odontoid fractures revealed no advantages in the elderly in terms of functional outcome, with this latter being often unconnected to fracture healing attitude.

Table 3: Analysis of factors affecting outcome in relation to SWPS

| Logistic regression analysis: SWPS | p | HR | 95% C.I. for HR Lower | 95% C.I. for HR Upper |
|--|--------|--------|-----------------------|-----------------------|
| <i>Age ≥ 80</i> | 0,72 | 0,802 | 0,241 | 2,67 |
| <i>Charlson Comorbidity Index: 6 or 7 or 8</i> | 0,681 | 0,793 | 0,263 | 2,39 |
| <i>ASA 3</i> | 0,154 | 2,25 | 0,738 | 6,863 |
| <i>ASA 4</i> | 0,364 | 2,884 | 0,293 | 28,396 |
| <i>mRS-pre: 4 or 5</i> | 0,0001 | 10,371 | 2,961 | 36,319 |
| <i>Anderson D'Alonzo Classification 2</i> | 0,37 | | | |
| <i>Anderson D'Alonzo Classification 3</i> | 0,313 | 0,436 | 0,087 | 2,185 |
| <i>Anderson D'Alonzo Classification 2 + other fractures of cranio-vertebral junction</i> | 0,229 | 0,479 | 0,145 | 1,588 |
| <i>Treatments: cervical collar</i> | | | | |
| <i>halo vest</i> | 0,149 | 3,343 | 0,648 | 17,236 |
| <i>odontoid anterior screw fixation</i> | 0,007 | 8,18 | 1,754 | 38,143 |
| <i>posterior arthrodesis (Harms)</i> | 0,05 | 4,458 | 0,958 | 20,745 |
| <i>occipito-cervical stabilization</i> | 0,02 | 8,283 | 1,399 | 49,032 |

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Table 4: Analysis of factors affecting outcome in relation to mRS-post

| Logistic regression analysis: mRS-post | p | HR | 95% C.I. for HR Lower | 95% C.I. for HR Upper |
|--|----------|-----------|------------------------------|------------------------------|
| <i>Age ≥80</i> | 0,05 | 3,189 | 0,998 | 10,188 |
| <i>Charlson Comorbidity Index: 6 or 7 or 8</i> | 0,184 | 2,045 | 0,712 | 5,872 |
| <i>ASA 3</i> | 0,786 | 0,856 | 0,278 | 2,633 |
| <i>ASA 4</i> | 0,368 | 0,362 | 0,04 | 3,305 |
| <i>mRS-pre: 4 or 5</i> | 0,217 | 2,105 | 0,645 | 6,868 |
| <i>Anderson D'Alonzo Classification 2</i> | 0,9 | | | |
| <i>Anderson D'Alonzo Classification 3</i> | 0,796 | 1,201 | 0,301 | 4,787 |
| <i>Anderson D'Alonzo Classification 2 + other fractures of cranio-vertebral junction</i> | 0,755 | 0,831 | 0,26 | 2,658 |
| <i>Treatments: cervical collar</i> | | | | |
| <i>halo vest</i> | 0,239 | 2,954 | 0,487 | 17,92 |
| <i>odontoid anterior screw fixation</i> | 0,131 | 3,675 | 0,678 | 19,904 |
| <i>posterior arthrodesis (Harms)</i> | 0,002 | 12,97 | 2,625 | 64,095 |
| <i>occipito-cervical stabilization</i> | 0,002 | 16,55 | 2,696 | 101,616 |