Atlas fracture case series

A total of 14 patients, including 11 males and three females, were enrolled from January 2017 to March 2019 who underwent occipitocervical fusion assisted by the 3D-printed screw-rod auxiliary system were reviewed, and with an average age of 53.21 ± 14.81 years, an average body mass index (BMI) of 23.61 ± 1.93 kg/m2 . The operation time, blood loss and radiation times during the operation were recorded. The maximum fracture displacement values of pre- and post-operation were measured based on CT imaging. All screw grades were evaluated after surgery. The occipital-cervical 2 (O-C2) angle and occipitocervical inclination (OCI) angle of pre-operation, post-operation and the last following-up were measured. The dysphagia scale 3 months after surgery and at the last follow-up, the Neck Disability Index (NDI) 3 months after surgery and at the last follow-up were assessed.

Results: All patients were completed the surgery successfully. There was no patient with severe dysphagia or aggravation of nerve injury. The follow-up was from 12 to 14 months, and with an average of 12.5 months. The average surgery time, average blood loss and average radiation times for the 14 patients were 112.14 min, 171.43 mL and 5.07 times, respectively. There was a significant difference in maximum fracture displacement between pre- and post-operation values ($P < 0.05$). A total of 56 screws were inserted in 14 patients, among them, three screws were classified as grade 1, and the other screws were classified as grade 0. There was a significant difference in the O-C2 between pre-operation and 3 days after operation ($P = 0.002$); There was a significant difference in OCI angles between pre-operation and 3 days after operation ($P < 0.05$); there was no significant difference in the O-C2 or OCI angle between 3 days after the operation and the last follow-up ($P = 0.079$; $P = 0.201$). The dysphagia scales of two patients were assessed as mild at 3 months after surgery, and the others were assessed as normal at 3 months after surgery. All patients' dysphagia scores returned to normal at the last follow-up. The average NDI and average neck Visual Analogue Scale (VAS) scores at the last follow-up were 2.53 and 8.41, respectively.

Conclusion: It can objectively restore the OCI to normal with few post-operative complications under the assistance of a screw-rod auxiliary system to perform occipitocervical fusion for unstable atlas fractures and atlantooccipital joint instability [1)].

In a retrospective study, consecutive patients diagnosed with a fracture of the atlas between 01/2008 and 07/2018 were analyzed. Data on epidemiology, concomitant injuries, fracture patterns and complications were obtained by chart and imaging review.

Results: In total, 189 patients (mean age 72 years, SD 19; 57.1% male) were treated. The most frequent trauma mechanism was a low-energy trauma (59.8%). A concomitant injury of the cervical spine was found in 59.8%, a combined C1/C2 injury in 56.6% and a concomitant fracture of the thoraco-lumbar spine in 15.4%. When classified according to Gehweiler, there were: 23.3% type 1, 22.2% type 2, 32.8% type 3, 19.0% type 4 and 1.1% type 5. Treatment of isolated atlas fractures (n = 67) consisted of non-operative management in 67.1%, halo fixation in 6.0% and open surgical treatment in 26.9%. In patients with combined injuries, the therapy was essentially dictated by the concomitant subaxial cervical injuries.

Conclusions: Atlas fractures occurred mainly in elderly people and in the majority of the cases were associated with other injuries of the head and spine. Most atlas fractures were treated conservatively. However, surgical treatment has become a safe and valid option in unstable fracture patterns involving the anterior and posterior arch (type 3) or those involving the articular surfaces (type 4) [2)].

The surgical management of unstable C1 injuries by occipitocervical and atlantoaxial (AA) fusion compromises motion and function. Monosegmental C1 osteosynthesis negates these drawbacks and provides excellent functional outcomes.

The patients were positioned in a prone position, and cranial traction was applied using Mayfield tongs to restore the C0-C2 height and obtain a reduction in the displaced fracture fragments. An intraoperative, CT-based navigation system was used to enable the optimal placement of C1 screws. A transverse rod was then placed connecting the two screws, and controlled compression was applied across the fixation. The patients were prospectively evaluated in terms of their clinical, functional, and radiological outcomes, with a minimal follow-up of 2 years.

A total of 10 screws were placed in five patients, with a mean follow-up of 40.8 months. The mean duration of surgery was 77±13.96 minutes, and the average blood loss was 84.4±8.04 mL. The mean combined lateral mass dislocation at presentation was 14.6±1.34 mm and following surgery, it was 5.2±1.64 mm, with a correction of 9.4±2.3 mm ($p < 0.001$). The follow-up CT showed excellent placement of screws and sound healing. There were no complications and instances of AA instability. The clinical range of movement at 2 years in degrees was as follows: rotation to the right (73.6°±9.09°), rotation to the left (71.6°±5.59°), flexion (35.4°±4.5°), extension (43.8°±8.19°), and lateral bending on the right (28.4°±10.45°) and left (24.8°±11.77°). Significant improvement was observed in the functional Neck Disability Index from 78±4.4 to 1.6±1.6. All patients returned to their occupation within 3 months.

Successful C1 reduction and fixation allows a motion-preserving option in unstable atlas fractures. CT navigation permits accurate and adequate monosegmental fixation with excellent clinical and radiological outcomes, and all patients in this study returned to their preoperative functional status [3)].

Between January 1996 and October 2001 we treated at the Orthopaedic Department of 3rd Medical Faculty, Carles University in Prague 10 patients with the injury of atlas. Between November 2001 and December 2002 we treated at the Orthopaedic Department and Spondylosurgical Department of the Medical Faculty Motol another 5 patients with the injury of atlas. In 10 cases the fracture of atlas was isolated (anterior arch–once, 4 time Jefferson fracture, twice–fracture of massa lateralis), in 5 cases the fracture was associated with the injury of epistropheus (dens type II/posterior arch–twice, dens type II/Jefferson fracture–once, dens type II/massa lateralis–once, Hangman's fracture type II/posterior atlas arch–once). Teh group of patients included 9 men and 6 women of the average age of 46.6 years (range, 27-85 years). Eight patients were treated conservatively, 7 patients surgically. The most frequent cause of the injury was fall on the head or a severe downward violence in 7 cases, car accident in 4 cases, other causes vere identified in 4 cases. Neurological deficit upon admission was found out only in one patient (Frankel D).

Methods: In isolated injuries of the anterior or posterior arch of atlas we always proceeded conservatively. The cervical spine was fixed for 12 weeks in the Philadelphia collar. One isolated fracture of massa lateralis was also treated conservatively for 12 weeks in the Philadelphia collar. Another case of the same type of fracture was treated surgically by C1-C2 by the Magerl technique supplemented on the intact side by the Gallie wire loop. Two stable Jefferson fractures were treated by the halo vest applied for 12 weeks. Two unstable fractures were handled surgically, once by C1-C2 by the Magerl technique and once by C0-C2 occipitocervical fixation. C1-C2 associated injuries were treated in four cases surgically, three times by a direct dens fixation and once by C1-C2 fixation after

Magerl supplemented with the Gallie wire loop. A patient with the associated Hangman's fracture type II and fracture of the posterior atlas arch refused the surgery and therefore was treated by the halo fixation for 12 weeks. Philadelphia collar was applied to the patients operated on.

Results: In the group of the conservatively treated, 3 patients complained of pain in the upper part of cervical spine and head requiring from time to time the administration of analgesics. All fractures healed within 12 weeks and the functional radiographs showed stable C0-C2 segments. As for complications, during the conservative treatment in one case a pyogenic secretion was recorded around the fixation elements of the halo apparatus requiring its removal after 8 weeks. The patient was further treated by a pelot fixation. In one case it was necessary to adjust twice the halo apparatus due to re-dislocation of the Hangman's fracture (associated Hangman's fracture of type II and posterior atlas arch). In spite of this the injury healed in C2-C3 subluxation, however, the fracture of atlas healed in a favourable anatomical position. In the group of the operated on, 2 patients complained of pain in the upper cervical spine requiring from time to time the administration of analgesics and one patient complained of a marked limitation of the range of motion by 50% (C0-C2 occipitocervical fixation). Also in this group stable C0-C2 segments were found out 12-14 weeks after the surgery.

Discussion: In our group of 15 patients the fracture healed, i.e. stable C0-C1 and C1-C2 segments, in all patients treated both conservatively and surgically. In the group of conservatively treated patients there occurred in one case re-dislocation of the fracture. However, the patient refused the surgery repeatedly. Apart from these case we found in neither group any severe complication. The ratio of conservative and surgical treatment was 8:7.

Conclusion: Based on our own experience and the literary data we believe that suitable for the treatment of stable injuries of the atlas is conservative treatment, i.e. fixation in the Philadelphia collar for 12 weeks. In unstable injuries or intraarticular injures with dislocation we prefer surgical fixation of C1-C2 or C0-C2 in dependence on the type of injury. All associated injuries are indicated for surgical treatment [4].

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