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## CERVICAL SPINE INJURIES

*A Clinical and Radiological Follow-up Study, in Particular with  
a View to Local Complaints and Radiological Sequelae*

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Accepted 14.iii.74

Injuries to the cervical spine have been the subject of numerous studies (Blikra & Ringkjøb 1969, Durbin 1957, Norton 1962, Rogers 1957, Schneider & Kähn 1956). Most of these studies were primarily concerned with the prognosis of any associated injury to the spinal cord.

The prognosis in lesions of the cervical spine without injury to the cord has been discussed less frequently (Cheshire 1969, Janes & Hosshmand 1965, Rogers 1957). Cheshire (1969) dealt extensively with the problems concerning stabilization of spinal fractures with conventional treatment.

In our series of patients with lesions of the cervical spine, who were treated mainly with conventional cranial extension, we have carried out clinical and radiological follow-up studies, in order to evaluate subjective complaints and X-ray changes caused by the spinal fracture itself.

### MATERIAL AND METHODS

The study comprised 71 patients with cervical spine injuries, admitted to the Neurosurgical Department, Copenhagen County Hospital in Glostrup, over a 3½-year period from April 1966 to October 1969.

Age and sex distribution of the primary group appear in Figure 1.

Figure 2 shows the number of lesions found at various levels of the cervical spine. The distribution by level and frequency of lesion corresponds to reports by Durbin (1957), Norton (1963), and Rogers (1957), as does the age curve which shows a preponderance of very young persons.

Seventy-five per cent of the spinal injuries were caused by traffic accidents. In 12 of the patients the cervical spine lesions occurred at two or more levels. Twenty patients had the lesion at C1-2, including the underlying disc, and in 51 patients the lesion was at level C3-7.

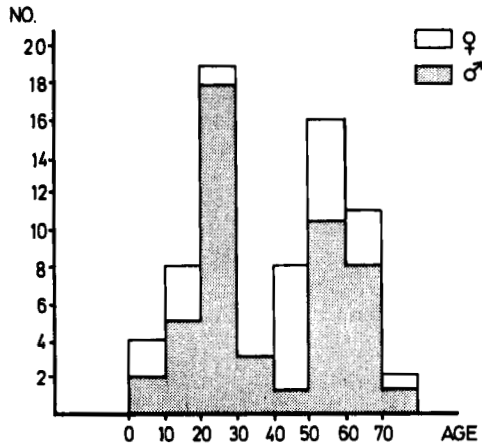


Figure 1. Cervical spine lesions. Age and sex distribution in 71 patients.

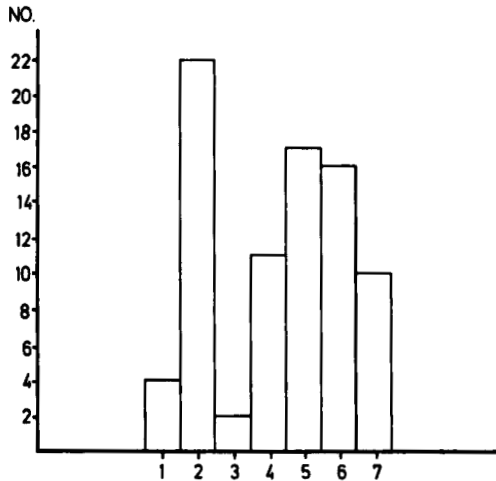


Figure 2. Distribution of cervical spine lesions in 71 patients. 12 patients had lesions at two or more levels.

The studies made by Roaf (1960) and Beatson (1963) on isolated cervical specimens, and Holdsworth's study published in 1963, have contributed greatly to the understanding of the mechanism in lesions of the cervical spine.

Spinal lesions of C3-7 were classified according to the above studies and were correlated with the case histories available and with the presence of skin lesions on the head. In a clinical series such a classification can be extremely difficult and, consequently, we made certain simplifications. We found that in 30 patients with lesions at level C3-7, the lesion presented mainly a rotating element, appearing in the radiograph as subluxation and luxation. Ten patients had flexion lesions

with considerable compression or crushing of the anterior structures of the cervical spine, and 11 patients had extension lesions, where either isolated fractures of the posterior structures of the spine were apparent, or where reliable data were available concerning extension trauma.

At the level of C 3-7, 20 cases of total or severe incomplete tetraplegia were found among 51 patients. Four out of 5 patients with severe comminuted lesions of the cervical body (bursting fractures) had complete or severe incomplete lesions of the cervical cord. Otherwise, the present series did not show any correlation between type of fracture and lesion of the spinal cord.

Seven patients with total tetraplegia survived; one of them recovered completely. In the remaining patients, the condition was stationary. On the other hand, patients with incomplete tetraplegia presented varying improvement.

At the level of C 1-2, there was one case with a doubtful lesion of the spinal cord presenting as hyperreflexia. Apart from this case, no patients with lesions at this level had any signs of lesion of the cord.

The treatment of cervical injury consisted of immobilization. In most of the cases conventional immobilization by cranial extension was applied, using either Blackburn's or Crutshfield's tongs. In two cases of anterior luxation, reposition was done immediately after admission. Anterior fusion was applied in one case, because the patient refused cranial extension. Cranial extension was normally maintained for 4 to 12 weeks.

When mobilization was commenced, radiographic check-up of the cervical spine was usually carried out. Sixteen of the original 71 patients died during the stay in hospital or immediately after. Four died because of tetraplegia associated with respiratory insufficiency, 8 because of complicating cervical concussion, and 4 because of other complicating major injuries, among them lesions of the chest. Also in the series reported by Stadaas & Johannesen (1970), persistent respiratory distress and complicating cerebral concussion resulted in a very high mortality.

#### *Follow-up Study*

This was made between 3 and 6 years after injury. The clinical follow-up included 48 patients, 45 of whom also underwent X-ray examination of the cervical spine. Three patients had died before the follow-up study. In none of these cases was the cause of death connected with the cervical injury. As regards two of the patients, information was obtained second hand, and two patients could not be traced. Thirty-seven of the 48 patients who had been followed up had been treated with cranial extension for 4 to 12 weeks, and of these, 31 had been treated for 9 to 12 weeks. The remaining 11 patients had been treated with cervical brace or brief recumbency.

At the check-up, the patients were asked about local complaints and neurological symptoms. A neurological examination was also performed, and the data given by the patients were assessed.

The radiographs comprised AP, lateral and oblique views of the cervical spine, supplemented by lateral views with the spine in extension and flexion.

## RESULTS

*Clinical Follow-up*

The overall results of this study are shown in Table 1. As regards lesions at level C 3-7, only two patients out of the 29 who reported were completely symptom-free at the time of the follow-up. In particular patients without medullary lesions reported both radicular symptoms and local complaints. The local complaints advanced by 55 per cent were mainly pain in the neck and shoulders and occipital headaches. Some patients had intermittent pain, while others experienced pain daily. Two patients complained of a sensation of instability. Radicular symptoms were present in 58 per cent. Complaints comprised mainly paraesthesia (15 patients), but also localized changes in sensitivity (6 patients) or slight pareses (7 patients), the last symptom being mainly unilateral.

*Table 1. Clinical follow-up in patients with injury to the cervical spine.*

Level of lesion	C 3-7 29 patients	C 1-2 19 patients
Pain in neck and shoulders	10	6
Occipital headaches	8	2
Sensation of instability	2	1
Local complaints, total	16	7
Radicular sequelae		
Paraesthesia	15	3
Sensitivity changes	6	1
Pareses	7	2
Radicular sequelae, total	17	3
Medullary sequelae		
Severe	7	0
Slight	4	2
Completely symptom-free	2	8

In the group with lesions corresponding to C 1-2, almost half the patients were symptom-free, among them most of the children. Local complaints were reported by 7 out of 19 patients or in 37 per cent. Only occasionally were radicular sensations observed with lesions at this level. At the time of the follow-up study, two of these patients presented recently developed localized spondylotic changes in the

lower part of the spine, presumably caused by a lesion at this level, which had not previously been diagnosed. This could have been the cause of the radicular symptoms.

A total of 12 patients, of all those with spinal lesions without medullary deficits, had troublesome complaints daily. One patient presented severe complaints because of avulsion of the brachial plexus. In this case chordotomy was performed later.

In most of the patients the radicular symptoms had been present already during recumbency just after the accident, and had not changed appreciably since. In a few patients the condition became worse after discharge. In one case anterior fusion was carried out, and transient improvement was achieved.

### *Radiological Follow-up*

The overall results of this part of the study are shown in Table 2. Degenerative changes were frequently observed in the radiographs. In 19 out of 29 patients with lesions of C 3-7 spondylosis changes were found, and in 18 a spontaneous fusion between three or more vertebrae was observed. In 15 patients the space between the vertebrae corresponding to the previous level of lesion had diminished. No secondary dislocation had occurred since discharge, but the radiographs, which were taken when the patients began mobilization during the primary admission, revealed increased angular deformity anteriorly corresponding to the site of the lesion in 6 patients. In none of these cases did aggravation of the neurological status occur after mobilization.

*Table 2. Radiographic follow-up of cervical spine.*

Level of lesion	C 3-7 29 patients	C 1-2 19 patients
Disc degeneration	15	2
Spondylosis	19	4
Mobility		
normal	4	11
reduced	6	0
absent	19	3
Instability	0	2

In the patients with spondylosis and/or degeneration of discs, reduced or arrested mobility was observed. Only 4 patients with injury

at the level of C 3-7 had normal mobility of the cervical spine. None of the patients with lesion at this level presented any signs of instability at the follow-up.

In lesions at the level of C 1-2, good mobility and no spondylosis were usually found; see Table 2. In two patients there was pseudarthrosis between the odontoid process and axis, and a maximum sliding of the odontoid process 4 mm anteriorly was observed during flexion. In one of the cases this was due to lack of healing of the odontoid process, whereas, on the basis of the radiograph, it must be presumed in the other case that, prior to the injury, a congenital anomaly had been present with fibrous connection between the axis and the odontoid process. None of the patients complained of any symptoms which might be caused by the pseudarthrosis. A total of 11 patients had fracture of the odontoid.

#### DISCUSSION

It appears from the present series that a considerable proportion of patients without primary medullary lesions will have sequelae, for example, radicular symptoms and local complaints. Even though many of the sequelae recorded were of slight severity only, and did not influence the daily life of the patients, a total of 12 patients, or 34 per cent, without medullary sequelae complained of daily or extremely troublesome symptoms.

Rogers (1957) found a considerably better prognosis in patients with spinal lesions, both in 39 patients treated with posterior fixation and in 38 patients treated exclusively with cranial extension. None of his patients, who were examined as late as 12 years after the accident, presented any local or radiating pains.

Janes & Hooshmand (1965) carried out posterior spondylodesis in 32 patients with persistent subjective complaints such as headache, pain in the neck and shoulders, and paraesthesia. None of these patients presented pronounced X-ray changes after the spinal lesion. In 90 per cent of these cases the complaints disappeared or were alleviated by the operation.

Several authors, among them Braakman (1970), Durbin (1957), Norton (1962), Raynor & Kingman (1968), and Rogers (1957), attached the greatest importance to surgical treatment of the spinal lesion, either in order to change the course of medullary deficits or to stabilize the spine and thereby obtain early mobilization and prevent

abnormal sliding or deformity. Beatson (1963), for example, found that spondylodesis would be indicated in luxations greater than half the body depth, such lesions being unstable. On the other hand, laminectomy is not indicated, apart from cases with progressing medullary deficits (Blikra & Ringkjøb 1969).

In 212 patients treated conventionally, Cheshire (1969) found only 12 patients with instability at radiographic examination of the cervical spine in flexion and extension at the time of mobilization. Increased angle formation was found in 6 of our patients at radiographic examination at the time of mobilization, but none of these patients presented any complaints at this time which might be ascribed to angulation or sliding.

During his follow-up study, Rogers (1957) found spontaneous fusion in 8 out of 33 patients.

Holdsworth (1963) mentioned that in two thirds of the patients with luxation, spontaneous fusion will develop, which corresponds to our findings.

At the C 1-2 level, instability was found in two cases of previous fracture through the odontoid process. According to reports in the literature this is rather frequent, and Rogers (1957) described two cases with non-union. Böhler (1965) also had two cases of non-union among 37 patients with fracture through the odontoid process. He did not find that primary spondylodesis was justified, but applied this method in cases of non-union.

#### CONCLUSION

Following conservative immobilization in cases of spinal lesions at the level of C 3-7, we have never observed aggravation of medullary deficits.

The follow-up study showed that the spine had become completely stable in all cases, and in more than two thirds of the patients fusion of the affected vertebrae had occurred spontaneously.

Healing of fractures of the dens, however, should be carefully checked, since the risk of pseudarthrosis is considerable (two out of 11 patients in our series).

The reason for the high frequency of both radicular and local symptoms in injuries at level C 3-7 is not known, but it might be caused both by incomplete reposition at cranial extension and protrusion of discs and, possibly later on, by development of spondylosis.

Therefore, it would be natural to consider carrying out primary anterior fusion in a greater number of cases.

#### SUMMARY

- 1) Out of 71 patients with primary cervical spine lesions admitted over a period of 3½ years, 52 patients were alive 3 to 6 years after the accident. Of these, 48 patients were followed up.
- 2) The patients were treated mainly with cranial extension and mobilized 4 to 12 weeks after the accident, and in no case did fresh symptoms develop. In 6 cases radiographs taken immediately after mobilization revealed increased angulation anteriorly.
- 3) X-ray examination at the follow-up showed that, in 15 patients out of 29 with lesion at the level of C 3–7, there was degeneration of vertebral discs, and in 19 patients spondylosis had developed. Out of these 19 patients, 18 had definite spontaneous fusion. With a level of lesion at C 2, two cases presented no healing of a fracture through the odontoid process. Out of the 16 patients with a level of lesion at C 2, four had spondylosis between C 2 and C 3.
- 4) The follow-up study revealed stationary local complaints and radicular symptoms in 16 and 17 patients, respectively, out of 29 patients with a level of lesion at C 3–7. Out of 19 patients with a level of lesion at C 2, radicular symptoms were present in 3 and local complaints in 7 patients. Out of the 35 patients without medullary sequelae, a total of 12 complained of daily and embarrassing symptoms.
- 5) It is concluded that conventional immobilization in lesions of the spine at level C 3–7 will produce good stability of the spine in the long run.
- 6) It must be considered whether primary anterior fusion would have reduced the frequency of radicular and local symptoms.

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