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Review article

Conservative Management of Odontoid Peg Fractures, long term follow up

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ABSTRACT

Objective: The aim of the study was to look at the long-term effects of conservative management of odontoid peg fractures.
Methods: We reviewed 48 consecutive patients with type II (32) and 16 type III, odontoid peg fractures. The clinical & radiological outcomes were assessed over an average period of follow up of 8 years. Union rate was determined and we discussed several factors that may affect it. Patients were treated conservatively with an average period of bed rest of 4 weeks followed by bracing for an average of 9 weeks.
Results: Bony union was established in 25 of 32 (78%) type II fractures. Of 7 cases of no bony union 4 were stable probably with fibrous union. 3 remained unstable. In 13 of 16(83%) type III fractures bony union was established. 2 of the 3 with no bony union were considered stable.
Conclusion: Osseous non-union was higher in patients with displacement of >5 mm, but there is no correlation between union and age, gender or angulation of the fracture in both types.

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1. Introduction

Management of odontoid process of axis fractures remain a controversial subject, and arriving at an optimal strategy of treatment is still under discussion.

According to Anderson & D'Alonzo [1] these fractures were classified into three types, I, II & III, based on the position of the fracture. Type III fractures were known to be successfully treated non surgically probably due to the large cancellous bone area; Type II fractures were associated with high rate of non union ranging between 11% to 63%, [1–4] surgical treatment of these fractures was studied extensively with varying results and complications, union rates of 96% were claimed via the surgical route, however controversy still exists as to the optimum treatment of these fractures. Treatment with halo-thoracic bracing resulted in 82% union rate 5. Disruption of blood supply of the odontoid peg after injury was implicated as a possible cause of the high union rate but Govender et al., [6] showed that the blood supply to the odontoid was not disrupted.

In this study we discussed union rates of type II & III fractures after conservative management which includes a period of bed rest with or without skull traction followed by neck immobilisation in orthosis. We are also addressing several factors that may contribute to bony non union of these fractures including initial displacement and angulation, age & gender of patients and type of orthosis.

The relatively long period of follow up allowed us to assess the long term outcome for the united as well as non united fractures, in terms of neck pain especially at site of injury and any restriction of the range of movement. We also assessed neurological change if any during and after treatment and follow up.

2. Patients & methods

We treated conservatively 57 patients with odontoid process fractures at the Midlands centre for spinal injuries between 1984 and 1999; six patients lost to follow up were excluded.

The fractures were classified according to the schema of Anderson & d'Alonzo [1], they were further described according to the amount and direction of displacement and angulation of the

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fracture. Because of the rarity and different clinical picture of type I fractures, 3 patients with this type were excluded.

48 patients were included, there were 24 males and 24 females with an average age of 49.6 years (STD ± 23.4); there were 32 type II and 16 type III odontoid peg fractures. All where examined clinically for other spinal or traumatic injuries, detailed neurological examination was carried out daily during inpatient admission period and at each outpatient follow up attendance. Neurological injury was classified according to Frankel classification of spinal cord injury [7]; 8 patients had neurological injury, one patient had complete paraplegia due to associated 4th thoracic vertebral injury, others had incomplete injuries (Frankel C & D); 16 patients (33%) had associated spinal injury at different levels and 17 (34%) had other body injuries including head injuries.

Outpatient follow up was arranged at 6 weeks, 3 months, 6 months, annually for the first 2 years and bi annually further on; the average period of follow up was 8 years ranging between 1 and 15 years.

Patients were also assessed at follow up for: range of movement of cervical spine, and neck pain using the centre own scoring system (Appendix A).

The stability and status of healing of the fractures were determined radiographic-ally, specific criteria for union is evidence of trabeculation across the fracture site and absence of movement on lateral radiographs made in active flexion and extension. Tomography and/or CT were used when necessary to establish or confirm osseous union of the fracture.

Even if osseous union could not be evidenced, however, a fracture was considered stable if there is no evidence of displacement on active flexion and extension lateral radiographs. All images were reviewed by senior members of the team and a senior radiologist.

3. Treatment

The diagnosis was made using appropriate radiographic studies, including standard antero-posterior, lateral and open mouth views. Computerised tomography (CT) and polytomography where used to confirm the diagnosis, MRI was undertaken in cases of neurological deficit or doubtful fractures.

All patients were treated non-operatively, this included, initial period of bed rest with an attempt at reduction either postural or skull traction for an average of 4.1 weeks (range: 1 to 6 weeks), followed by immobilisation in an orthosis (Minerva jacket, halo jacket or Philadelphia hard collar) for an average period of 6 weeks (range: 1.5 to 16 weeks).

Data from notes and outpatient interviews was compiled into a special form for further analysis using excel spreadsheet and SPSS statistical package. Pearson Chi square test, *t*-test and ANOVA tests were used to compare variables as appropriate.

Table 1
Causes of and mean age at injury.

Cause of Injury	Number of patients	Mean age at injury (years)
Assault	1	32.8
Fall	21	65.4
Road Traffic Accident	22	38.9
Sport Injury	4	29.6
Total	48	49.6

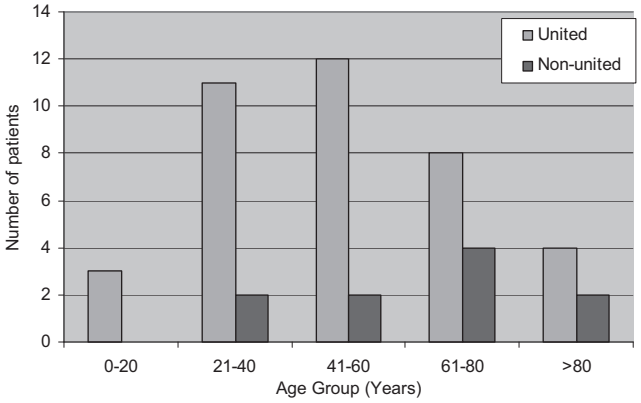

Fig. 1. Number of non-union cases in each age group.

4. Results

4.1. Population

The main causes of injury were road traffic accidents (RTA) (n = 22), falls (n = 21), sport injuries (two rugby, one paragliding and one horse riding) and one patient after an assault.

Falls are the commonest cause of injury in people above 50 years of age (average age at injury was 65.4 years) while RTA was commonest among those below that age (average age at injury was 39 years), the difference was statistically significant, ($p < 0.001$) (Table 1).

Out of 48 patients, 10 patients (20.8%) showed no evidence of bony union on standard x-rays, 6 of them, however, were stable on active dynamic lateral views.

33% of patients of 40 years and older showed no evidence of bony union compared to 13% of those below that age, further more, the average age of patients with united fractures was 48 ± 23 years while those with non-union was 56 ± 25 years, however, these differences were statistically insignificant (p = 0.09 & p = 0.35 respectively). This age difference is particularly evident in type II fractures. (Fig. 1 & Fig. 2)

4.2. Type of fractures and orthosis

7 (21.9%) of 32 type II fractures did not show evidence of bony union, 3 of them were unstable requiring surgery, and 3 (18.8%) of

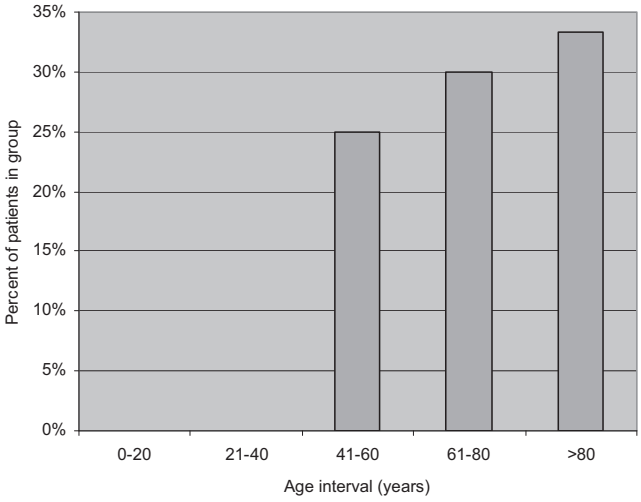

Fig. 2. Type II fractures, percent of non-union cases in each age group.

Table 2
Incidence of non-union per fracture type.

	Osseous Union	Osseous Non-union		
		Stable	Unstable	Total (%)
Type II	25 (78%)	4 (12.5%)	3 (9.4%)	7 (21.9)
Type III	13 (81%)	2 (12.5%)	1 (6.3%)	3 (18.8)

16 type III fractures did not unite; only one of them was unstable (Table 2).

All patients were treated initially in bed for an average period of 3.8 weeks with or without skull traction in an attempt at reduction, this was followed by immobilisation in either Minerva jacket (n = 28), halo vest (n = 3), hard collar (n = 12) and the rest were either in Sterno-Occipito-Mandibular Immobilisation (SOMI) brace (n = 1) or enforced soft collar (n = 4). It is noted that incidence of osseous non-union does not differ significantly between different methods of neck immobilisation following the initial period of bed rest (p = 0.794). (Table 3)

Four patients with unstable non-union were treated for 6 weeks in bed followed by hard collar for an average of 8 weeks in 2 patients, one in a halo vest for 12 weeks after one week in bed, and one in a Minerva jacket for 12 weeks.

We looked at the possible complication of bed rest and there were no reported complications in any of the patients during that period of immobilisation.

4.3. Displacement & angulation

Displacement and angulation of fractures were assessed at the original standard x-ray films. 22 fractures were displaced either anteriorly (11) or posteriorly (11) by 2 mm or more. 6 of these (27.4%) went to osseous non-union, while 4 of 26 undisplaced fractures (15.4%) were radiologically non united, p = 0.04 (Table 4). It is also notable that 6 (60%) of the non united fractures were displaced and that out of 4 unstable non-union fractures, 3 showed evidence of significant displacement.

8 of the fractures were angulated by 10° or more, only one (12.5%) fracture went to stable non-union. (Table 4)

4.4. Neurology, pain & range of movement at follow up

At time of admission to hospital 8 patients had neurological deficit, one patient is completely paraplegic due to associated T4 fracture. 7 patients had minor neurological deficit, at last follow up all but 2 recovered fully; No neurological deterioration occurred during treatment or follow up period.

At follow up 4 patients with unstable non-union, were considered for surgery. One underwent posterior stabilisation, 2 refused and one was unfit for surgery, out of these three, one eventually became stable at 18 months, the other two were unstable but asymptomatic and remain under regular follow up.

Using the centre pain assessment scoring system, 32 patients (67%) reported no pain, 16 patients were scoring mild to moderate (1–4) level of pain (Fig. 3).

7 (70%) of patients with radiologic non union reported no neck pain and 3 (30%) stated that their ache or pain is moderate requiring occasional analgesia (Score 2 & 3).

Examination of the range of cervical spine movement was carried out in all patients at follow up regularly, 59% of patients with united fractures & 70% of those which didn't, showed no restriction of neck movement (Fig. 4).

5. Discussion

Controversy still exist as to the optimum management of odontoid process fracture particularly type II fractures. Osseous union is considered by many as a successful outcome. In this series osseous union was achieved in 80% of fractures treated conservatively. We have also demonstrated that clinical & radiological stability can be achieved in the absence of osseous union most probably by fibrous tissue. In other words fibrous union can be as strong as bony union. Ninety two per cent of all patients achieved stability by osseous or fibrous union. Only four patients (8%)

Table 3
Method of immobilisation, duration of bed rest and incidence of non-union per type of odontoid fracture.

Orthosis	Type	Mean bed rest duration	Osseous union	Osseous non-union	Total
Hard Collar	Type II	4.7 Wks	7	2 (22%)	9
	Type III	4 Wks	2	1 (20%)	3
Halo Vest	Type III	1 Wk	2	1 (33%)	3
Minerva Jacket	Type II	4 Wks	15	4 (21%)	19
	Type III	3 Wks	8	1 (11%)	9
Enforced Soft Collar	Type II	5 Wks	2	1 (33%)	3
	Type III	3 Wks	1	0	1
SOMI Brace	Type II	3 Wks	1	0	1

Table 4
displacement, angulation of fractures and incidence of non-union per type of fracture.

	Union	Displacement			Total	Angulation		Total
		Anterior Displacement	Posterior Displacement	No Displacement		Angulated	None	
		Number (%)	Number (%)	Number (%)		Number (%)	Number (%)	
Type II	Non united	2 (50)	3 (27.3)	2 (11.8)	7	0 (0)	7 (25)	7
	United	2 (50)	8 (72.7)	15 (88.2)	25	4 (100)	21 (75)	25
	Total	4 (100)	11 (100)	17 (100)	32	4 (100)	28 (100)	32
Type III	Non united	1 (14.3)	0	2 (22.2)	3	1 (25)	2 (17)	3
	United	6 (85.7)	0	7 (77.8)	13	3 (75)	10 (83)	13
	Total	7 (100)	0	9 (100)	16	4 (100)	12 (100)	16

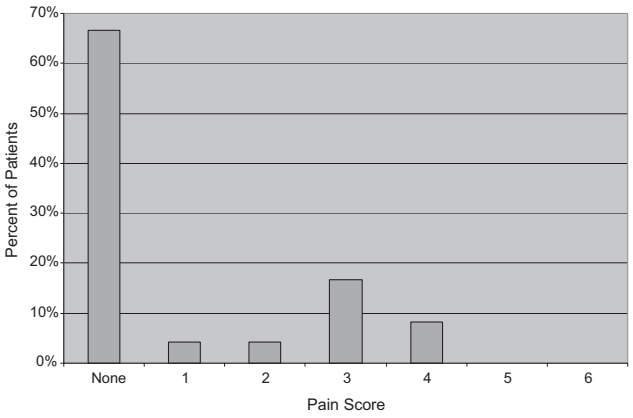

Fig. 3. Pain score at follow up.

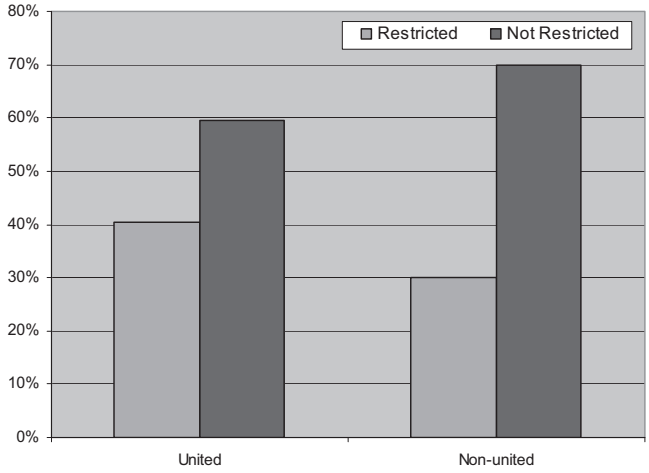

Fig. 4. Restriction of range of movement of the neck.

showed evidence of instability. Three of these were not surgically stabilised but were followed up for several years. None of them showed evidence of clinical or neurological deterioration. These results compare favourably with those of Clark and White [4] who reported that stability was achieved with a halo device in almost 70% of dens fractures. We have demonstrated in this series that in the absence of osseous union, dynamic lateral views of C spine are necessary for assessment of healing.

Govender et al. [6] reported a 46% non-union rate of type II fractures treated with external bracing. Stoney et al. [5] reported 82% union rate after treatment in a halothoracic vest. Koivikko et al. [8] reported that union rate of 46% was achieved in 69 patients treated in a halothoracic vest. Lennarson et al. [9] found that age above fifty years to be a highly significant risk for failure of Halo immobilisation. Govender et al. [6] shown that age above 40 years, fracture displacement and late treatment contribute towards non-union of odontoid type II fractures. Koivikko et al. [8] demonstrated that fracture gap of >1 mm, posterior displacement of >5 mm, delayed start of treatment and posterior redisplacement did correlate with non-union. Greene et al. [10] found that displacement of 6 mm or above had a non-union rate of 86% or above when treated with external immobilisation, they recommended primary surgical stabilisation.

We have observed in this series that there is a higher rate of non-union in patients 40 years or older but this was not statistically significant.

We have shown that fracture displacement is associated with higher risk of non-union in odontoid type II fractures and that type of external immobilisation used for treatment as well as fracture angulation do not correlate with non-union.

Our results demonstrated a possible other measures of outcome of treatment of odontoid fractures namely Clinical assessment of range of movement cervical spine and pain assessment at site of injury, in addition to dynamic lateral views of cervical spine (vide infra). We have demonstrated in this study that even with unstable non-union (3 patients) pain was mild or moderate at follow up.

Also we have shown that neck range of movement was not restricted in 70% of patients with no bony union.

We have demonstrated the successful use of conservative management in a complex group of patients with odontoid fractures, with an average follow up of 8 years. Many centres across the world use operative treatment, including the odontoid anterior screw fixation, as the primary modality, but results are not entirely benign. In pooled studies and analysis, there is a rate of 10% non-union, 5% re-operation, 1.2% hoarsness of voice, and 10% dysphagia with these operative techniques.[14] We think it is important to have a full and frank discussion with the patients about pros and cons of both operative and conservative management, and allow them to make up their own mind. This case series demonstrates that conservative management can give good long term results in these patients.

Conflict of interest

The authors have none to declare.

Appendix A. The Midlands Centre for Spinal Injuries Pain scoring system

0 = no pain
1 = minimal ache – no analgesia
2 = moderate ache – no analgesia
3 = moderate pain – occasional analgesia
4 = moderate pain – regular analgesia
5 = severe pain – regular analgesia
6 = other important features e.g. social behaviour, suicide

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