

# ATLANTOAXIAL ROTATORY FIXATION A CASE REPORT AND PROPOSAL OF A NEW CLASSIFICATION SYSTEM

S. WAEGENEERS, V. VOET, H. DE BOECK, P. OPDECAM

Atlantoaxial rotatory fixation (AARF) remains a relatively rare finding. A case of AARF is reported and the existing Fielding and Hawkins classification is reviewed. Furthermore a new classification system is proposed.

**Keywords :** atlantoaxial fixation ; cervical spine ; injuries.

**Mots-clés :** fixation atloïdo-axoïdienne ; rachis cervical ; traumatismes.

## INTRODUCTION

Atlantoaxial rotatory fixation (AARF) is a relatively rare finding in young adults (2, 9, 10).

According to Fielding and Hawkins (6) AARF can be classified into four types when the atlas-to-dens distance is taken into account.

We present a case of Fielding and Hawkins type I AARF in a 17-year-old male patient following a traffic accident. The inconvenience of the existing classification system is discussed, and a new classification system is proposed.

## CASE REPORT

A 17-year-old white male was seen at the emergency department of our hospital after a fall with his motorcycle in March 1995.

The patient complained of occipital headache and neck pain. Retrograde amnesia was present. Physical examination revealed painful mobilization of his head and neck, a skin abrasion on his face and a contusion of his right thigh. Neurologic examination of the extremities was normal. Xrays

of the cervical spine showed asymmetry of the articular facets of C1 in relationship to the dens on the open mouth view (fig. 1). No fractures could be visualized. These findings were further examined by a CT-scan with reconstruction images of the lateral C1-C2 articulations that clearly showed a posterior atlantoaxial rotatory fixation on the right side (fig. 2). Hence skull traction was applied as an emergency procedure. Four days later a halo vest was adjusted so that mobilization of the patient became possible.

The patient wore his halo vest for three months. A CT-scan with reconstruction made after removal of the halo ring revealed a reduced C1-C2 arti-



*Fig. 1.* — Open mouth view xray.

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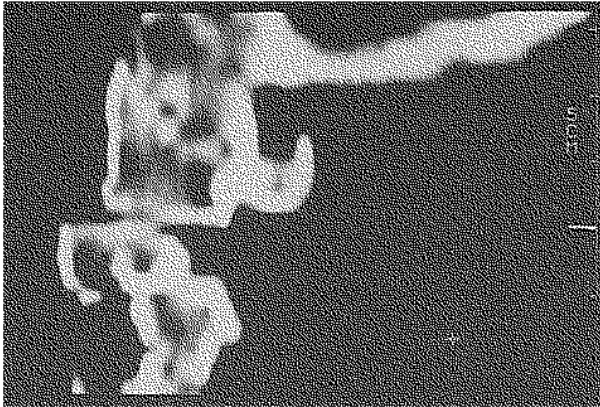


Fig. 2. — Sagittal CT reconstruction image of the right C1-C2 lateral mass.

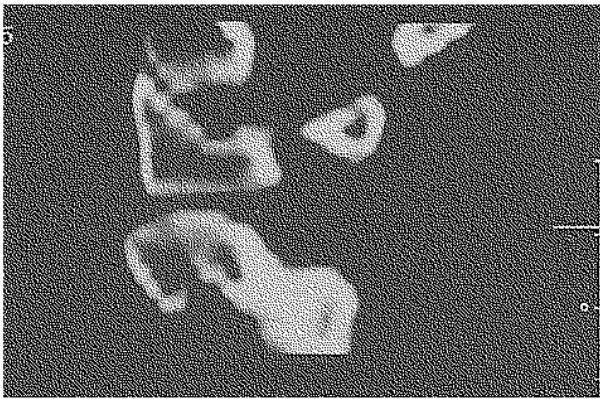


Fig. 3. — Sagittal CT reconstruction made 3 months after trauma.

culation (fig. 3). At examination ten months after the accident the patient was free of symptoms and had nearly normal movement of his head and neck.

## DISCUSSION

Atlantoaxial rotatory fixation (AARF) is a commonly used term to describe a fixed rotatory subluxation of the atlantoaxial joint (5, 6, 7, 10, 11, 12, 13). In 1968 Wortzman and Dewar (15) first used the term Rotary Fixation to determine the fixation of the atlas on the axis in a position normally attained during rotation. From 1977 on, the term AARF was popularized by publications from Fielding *et al.* (6, 7). Apart from the posi-

tion within the normal range of atlantoaxial rotation they especially used the term to determine cases of atlantoaxial subluxation or even dislocation when a rotary fixation of the atlas on the axis did occur (6). In children AARF is often a self-limiting condition related to a viral illness (9, 10). In adults however AARF is a relatively rare finding and is most often of traumatic origin (2, 9, 10). Since the diagnosis of AARF is often difficult to establish, many cases in the past have been overlooked for weeks or even months (3, 8, 10). We therefore recommend that a CT-scan with sagittal reconstruction be done in every doubtful situation where an AARF is suspected but cannot be confirmed by means of conventional radiography.

As for the classification of these types of injuries we must refer to the commonly used classification system with four types of AARF as proposed by Fielding and Hawkins (6) (table I). These authors based their classification on the amount and direction of the midsagittal plane anteroposterior atlantoaxial displacement. Therefore the measurement of the atlas-to-dens interval as can be done on a lateral X-ray of the cervical spine is very important. It is obvious that this classification system was presented at a time when more precise imaging tools were not commonly available. Apart from plain roentgenograms or tomograms the authors had only cineroentgenography to study the presence of an AARF (6). Since then many articles have stressed the importance of multiplanar CT (1, 2, 3, 4, 5, 7, 9, 10, 11, 12) and even of three-dimensional CT (14) in the accurate diagnosis of AARF. Nobody however thoroughly adapted the existing classification system in the light of this new radiographic armamentarium.

Table I. — Fielding and Hawkins classification

Types	Displacement of the atlas	
	Anterior	Posterior
Type I	0-3 mm	Absent
Type II	3-5 mm	Absent
Type III	> 5 mm	Absent
Type IV	Absent	Present

That this has led to confusion can be proven by the evaluation of a case very similar to our case, presented by Levine and Edwards (10). They showed a Fielding and Hawkins type IV AARF with a posterior displacement of only one articular mass. The authors however did not mention whether there was a deficient dens or not. We therefore presume that in fact, just as in our case, the atlas-to-dens distance was within normal limits, and that strictly seen, this case should have been described as a type I AARF.

We dare say that with the additional information provided by computed tomography a more elaborate classification of AARF becomes possible (table II). When an AARF occurs within a normal range of rotation we will call this a **Type O** AARF. If it appears together with an atlantoaxial subluxation we will name it a **Type S** AARF, and together with an atlantoaxial luxation, a **Type L** AARF. When one lateral mass is luxated and the other is subluxed we will call this a **Type LS** AARF when the right lateral mass is luxated or a **Type SL** AARF when the left lateral mass is luxated. All these types (O/S/L/LS/SL) are called **major Types**. Since the atlas and axis each have two lateral masses (which can each undergo anterior, posterior or no displacement at all) the following types of AARF can theoretically occur. As we can see, some of the major types can be further divided into 5 groups (I, II, III, IV, V). Groups I and II are unilateral subluxations or luxations (**Group I** directed anteriorly and **Group II** directed posteriorly). Groups III, IV and V are bilateral subluxation, luxations or a combination of both. In **Group III** the displacement of one lateral mass is directed anteriorly while the other is directed posteriorly. In **Group IV** both lateral masses are displaced anteriorly, and in **Group V** both are displaced posteriorly. Finally each group can be further divided into two subgroups. In **Subgroup C** we will find all cases where a clockwise atlantoaxial rotation took place as seen from above (fig. 4). **Subgroup CC** contains all cases with counterclockwise rotation (fig. 5).

We remark that in Groups IV and V it will be the most displaced lateral mass that is taken into account to determine the kind of rotation ;

when both lateral masses are equally displaced it will be classified as a translatory and not as a rotatory fixation.

The Groups IV and V from major Types LS and SL do not need further specification into subgroups as the attentive reader already will have noted.

When we describe our case in terms of the new classification it is a "Type S II C AARF".

According to the literature nonoperative treatment in a halo vest is recommended in patients who have minimal displacements or whose lesions can be reduced and maintained in the absence of neurologic deficit (2, 6, 10). Since our patient had only a unilateral subluxation without neurologic problems we treated him in a conservative way.

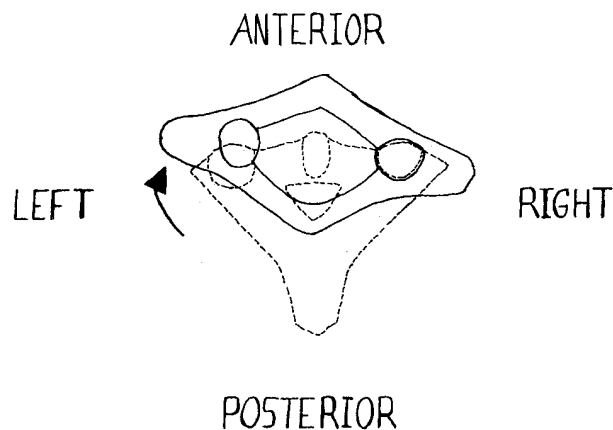


Fig. 4. — Schematic superior view on the atlantoaxial complex : clockwise rotation (C).

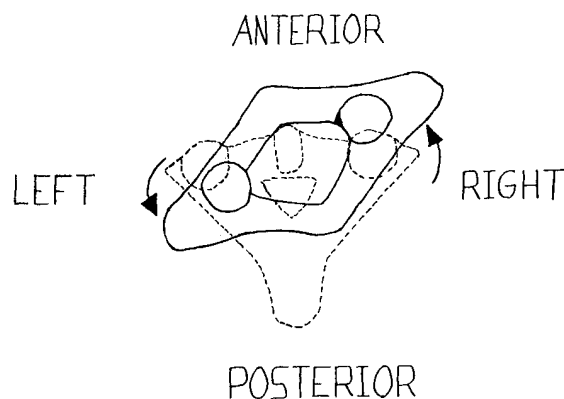


Fig. 5. — Schematic superior view on the atlantoaxial complex : counterclockwise rotation (CC).

Table II. — New classification system of AARF

Types	Lateral masses of the atlas									
	Right lateral mass					Left lateral mass				
		Subluxation		Luxation			Subluxation		Luxation	
	N *	AS *	PS *	AL *	PL *	N *	AS *	PS *	AL *	PL *
Type O	+	-	-	-	-	+	-	-	-	-
Subluxation Types										
Type S I CC	-	+	-	-	-	+	-	-	-	-
Type S I C	+	-	-	-	-	-	+	-	-	-
Type S II C	-	-	+	-	-	+	-	-	-	-
Type S II CC	+	-	-	-	-	-	-	+	-	-
Type S III CC	-	+	-	-	-	-	-	+	-	-
Type S III C	-	-	+	-	-	-	+	-	-	-
Type S IV (C/CC)	-	+	-	-	-	-	+	-	-	-
Type S V (C/CC)	-	-	+	-	-	-	-	+	-	-
Luxation Types										
Type L I CC	-	-	-	+	-	+	-	-	-	-
Type L I C	+	-	-	-	-	-	-	-	+	-
Type L II C	-	-	-	-	+	+	-	-	-	-
Type L II CC	+	-	-	-	-	-	-	-	-	+
Type L III CC	-	-	-	+	-	-	-	-	-	+
Type L III C	-	-	-	-	+	-	-	-	+	-
Type L IV (C/CC)	-	-	-	+	-	-	-	-	+	-
Type L V (C/CC)	-	-	-	-	+	-	-	-	-	+
Lux.-Sublux. Types										
Type LS III CC	-	-	-	+	-	-	-	+	-	-
Type LS III C	-	-	-	-	+	-	+	-	-	-
Type LS IV	-	-	-	+	-	-	+	-	-	-
Type LS V	-	-	-	-	+	-	-	+	-	-
Sublux.-Lux. Types										
Type SL III C	-	-	+	-	-	-	-	-	+	-
Type SL III CC	-	+	-	-	-	-	-	-	-	+
Type SL IV	-	+	-	-	-	-	-	-	+	-
Type SL V	-	-	+	-	-	-	-	-	-	+

\* N : normal  
AS : Anterior subluxation  
PS : Posterior subluxation  
AL : Anterior luxation  
PL : Posterior luxation

As posttraumatic AARF is rare it should be studied very methodically. With the proposal of a new classification system we hope that further confusion in the literature as to the exact specification of a type of AARF can be avoided, and more precise recommendations for appropriate treatment can be given.

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### SAMENVATTING

*S. WAEGENEERS, V. VOET, H. DE BOECK, P. OPDECAM. Atlanto-axiale rotatoire fixatie : Voorstelling van een nieuw classificatiesysteem.*

Atlanto-axiale rotatoire fixatie is vrij zeldzaam. Naar aanleiding van een casus wordt de bestaande Fielding en Hawkins classificatie besproken en wordt een nieuw classificatiesysteem voorgesteld.

### RÉSUMÉ

*S. WAEGENEERS, V. VOET, H. DE BOECK, P. OPDECAM. Fixation atloïdo-axoïdienne rotatoire : proposition d'une nouvelle classification.*

La fixation atloïdo-axoïdienne rotatoire est rare mais non exceptionnelle. Suite à la description d'un cas, la classification de Fielding et Hawkins est discutée et une nouvelle classification est proposée.