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Headmaster Collar Restricts Rheumatoid Atlantoaxial Subluxation

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Study Design. A radiographic study of the effect of a modern orthotic device in the treatment of rheumatoid atlantoaxial subluxation.

Objective. To study the ability of a new open-type collar to restrict atlantoaxial subluxation.

Summary of Background Data. Atlantoaxial subluxation is common in rheumatoid arthritis, and thus, the development of conservative treatments is important. It has been shown that a custom-made stiff collar significantly restricts atlantoaxial subluxation in approximately half of patients with unstable atlantoaxial subluxation.

Methods. In 30 successive patients with rheumatoid atlantoaxial subluxation, lateral view radiographs were taken in flexion, extension, and neutral positions without a collar and in flexion with the Headmaster collar.

Results. The mean atlantoaxial distance during flexion was 7.1 ± 1.8 mm and during extension was 1.0 ± 1.0 mm, and the mean instability was 6.1 ± 2.3 mm. In the 20 cases with the greatest stabilizing effect, the mean atlantoaxial distance during flexion with a collar was 1.1 ± 1.3 mm, whereas in 10 patients with lesser effect it was 6.7 ± 2.5 mm ($P < 0.0001$). The lesser stabilizing effect was associated with the presence of atlantoaxial subluxation in the neutral position.

Conclusion. The Headmaster collar is an effective and useful tool in the conservative treatment of simple unstable atlantoaxial subluxation, but an ordinary custom-made stiff collar is still often needed. These two collars are complementary, and their selection and use must be determined individually. [Key words: atlantoaxial subluxation, collars, orthosis, rheumatoid arthritis, treatment]
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Involvement of the cervical spine is characteristic of rheumatoid arthritis (RA) and may occur in other rheumatic diseases.[2,3,8,14] The most common cervical abnormality in RA is atlantoaxial subluxation (AAS), which develops if the inflammation injures the stabilizing ligaments of the area.[2,3,8] Its prevalence varies between 15% and 70% depending on the patient group studied.[3] In a population-based study, AAS was found in every third RA case.[8] Patients with AAS may be asymptomatic or may have severe pain and occasionally, neurologic symptoms.[2,3] Atlantoaxial subluxation may be complicated (*e.g.*, tetraplegia) and even fatal.[2,3,11]

Cervical collars form an important part of conservative treatment.[6,7,9] It has recently been shown that custom-made stiff collars restrict the instability of AAS in approximately half of cases.[6,7] Unfortunately, many patients refuse to use collars, because they think them ugly, uncomfortably hot to wear, or otherwise inconvenient.[15] A different type of collar, the Headmaster collar (HM; Symmetric Designs Ltd., Salt Spring Island, Canada), is also available. It is a light, open-type collar (Figure 1), and patients often find it convenient, but its ability to stabilize AAS has not been tested. This ability should be demonstrated before it is recommended for patients with RA.

Patients and Methods

The series consisted of 30 successive patients (25 women, 5 men) with unstable AAS treated at the Rheumatism Foundation Hospital, Heinola, Finland. They comprised 26 cases of RA, 2 cases of juvenile-onset RA, and 2 cases of psoriatic arthritis (demographic data in Table 1). All patients were interviewed and examined clinically. Cervical pain was experienced by 22 patients and increased in the flexion position in 19. No patients had neurologic symptoms or signs suggestive of cervical myelopathy.

An HM collar (Figure 1) was adjusted for each patient. The size was selected individually, and the collar was manually adjusted to fit under the mandible according to the instructions of the manufacturer.

Lateral view cervical spine radiographs were taken without the collar both in the neutral position and during flexion and extension. The distance between the posterior aspect of the anterior atlas arch and the anterior aspect of the axis (atlantoaxial distance) was measured, and the patient was included in the series if this distance was 4 mm or more during flexion and 3 mm or less during extension, so that the individual difference between the flexion and extension values (that is, the instability) was 3 mm or more. In addition, a lateral radiograph was obtained in each patient during full flexion while wearing the HM collar, the atlantoaxial distance was compared with the extension value, and the result taken to represent instability with the collar. The effect of the collar was assessed according to the decrease in instability when using the collar compared with instability without the collar.

The shortest distance from the occiput to the most posterior and caudal tip of C6 was measured in all cervical radiographs to evaluate the range of the individual flexion–extension movement and the ability of the collar to restrict the flexion. C6 was selected because C7 was sometimes not visible because of overprojection of the shoulders.

The Mann–Whitney test was used in the statistical analysis. No adjustment was made for multiple testing, but this infor-

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Figure 1. The Headmaster collar.

mation can be obtained by multiplying P by the number of comparisons made.

Results

The mean atlantoaxial distance was 7.1 ± 1.8 mm during flexion and 1.0 ± 1.0 mm during extension, and the mean instability was 6.1 ± 2.3 mm. The atlantoaxial distance during flexion, when the HM collar was worn, had a distribution from normal (≤3 mm) to similar to that seen in flexion without a collar, but in general the stabilizing effect of the collar was good. In the 20 cases forming Group A, the mean atlantoaxial instability with a collar was less than one third of that without a collar (stabilizing effect 5.7 ± 2.3 mm). In 10 cases the stabilizing effect was less (1.1 ± 1.3 mm), and in some cases no effect was observed; together, these cases formed Group B. The mean atlantoaxial distance in the neutral position was significantly less in Group A (1.7 ± 1.8 mm) than in Group B (6.4 ± 3.3 mm; Table 1).

The mean distances between occiput and posterocaudal tip of C6 were shortest in extension (Group A, 8.4 ± 1.3 cm; Group B, 8.3 ± 0.8 cm), approximately equal in the neutral position (Group A, 10.0 ± 1.1 cm; Group B, 9.8 ± 0.8 cm) and in flexion with the collar (Group A, 9.6 ± 1.2 cm; Group B, 9.8 ± 0.9 cm), and longest during flexion without the collar (Group A, 11.9 ± 1.4 cm; Group B, 11.5 ± 0.9 cm). There were no significant differences between Groups A and B (Table 1).

Discussion

Cervical orthoses are a common method for treating several types of neck problems. They are known to relieve symptoms and give a feeling of stability, which helps psychologically, but their ability to stabilize the neck is reported to be limited and depends on the type of orthosis.[1–3,13] Hartman et al[4] and Johnson et al[5] tested several types of orthoses in healthy volunteers and have found that all the orthoses (even the soft collar) significantly restrict maximum motion, but none of them provide total stability.[4,5] Mirza et al[12] reported that even halo apparatus has to be fitted to maximize stability.[12]

The amount of stability needed depends on the disorder treated. The indication for a collar is usually AAS in rheumatic diseases.[2,3,6–9] Most of these patients are treated conservatively.[6–9] Conservative treatment has two goals: to relieve the cervical symptoms and arrest or retard the progressive impairment of the abnormality.[6,7,9] The most severe AAS takes place during flexion, which often increases the symptoms.[6,7,9,10] Constant or repeated full flexion may induce progression of the instability. Thus, patients with unstable AAS should avoid flexion, but other movement dimensions are usually acceptable.[6,7,9]

The main task of a collar in RA is to restrict flexion and thus, the instability of AAS.[6,7] Orthoses have been thought unable to stabilize rheumatoid AAS, based on the classic report by Althoff and Goldie.[1] However, their small series included patients with ankylosed AAS, and in those cases no favorable effect was possible,[6,7] and, as stated earlier, it has been shown that a custom-made stiff collar restricts atlantoaxial instability significantly in approximately half of patients with unstable AAS.[6,7]

Table 1. Demographic Data on Patients, and Mean Atlantoaxial and Occiput C6 Distance Values During Flexion, Extension, and Neutral Position Without a Collar and in Flexion With a Headmaster Collar On

	Stabilizing Effect		
	Good (N = 20) [mean (SD)]	Poor (N = 10) [mean (SD)]	*P* Value Between Groups
Age (yr)	53.2 (11.5)	52.3 (13.6)	NS
Disease duration (yr)	19.0 (11.5)	21.4 (7.3)	NS
Flexion AAd (mm)	6.8 (1.7)	7.9 (1.8)	NS
Extension AAd (mm)	0.8 (1.0)	1.6 (0.8)	NS
AA instability (mm)	6.0 (2.5)	6.3 (1.9)	NS
Neutral AAd (mm)	1.7 (1.8)	6.4 (3.3)	<0.0001
Flexion AAd with collar (mm)	1.1 (0.9)	6.7 (2.5)	<0.0001
Stabilizing effect (mm)	5.7 (2.3)	1.1 (1.3)	<0.0001
O-pC6 in flexion (cm)	11.9 (1.4)	11.5 (0.9)	NS
O-pC6 in extension (cm)	8.4 (1.3)	8.3 (0.8)	NS
O-pC6 in neutral position (cm)	10.0 (1.1)	9.8 (0.8)	NS
O-pC6 in flexion with a collar on (cm)	9.6 (1.2)	9.8 (0.9)	NS

AAd = atlantoaxial distance; Stabilizing effect = the decrease in AA instability when using the collar relative to the value without a collar; O-pC6 = the shortest distance between the occiput and the postero-caudal point of the sixth cervical vertebra (to evaluate the range of the flexion-extension movement).

A custom-made stiff collar is useful in several patients, but compliance with treatment may be poor, because the patient thinks the collar is ugly or inconvenient.[7,15] There are also patients who cannot use a proper stiff collar for other reasons (*e.g.*, patients with a goiter or rash on the neck). Therefore, there is a need for other types of cervical orthoses in patients with rheumatoid AAS.

The HM collar is a rather new innovation in orthotic technology. It is made of a metal ring covered by fabric, which reaches in a special formation from the sternum to the mandible and is kept in place by a wide band behind the neck. The collar is light, open and airy, and looks more modern than ordinary collars (Figure 1). Its form can restrict flexion, but the patient can still perform extension and lateral bending of the neck. However, it may be impossible to put on with severely impaired hands.

It was found in the current study that the stabilizing effect of the HM collar was very similar to the effect of the custom-made stiff collar (reported earlier in a series conducted in the same way in our hospital), and depended on the posture of the atlantoaxial area.[6,7] In cases with poor stabilizing effect (Group B) AAS was usually present in the neutral position. This is easy to understand, because the collar is made to maintain the neutral position of the neck. Naturally, therefore, if maximum AAS exists under those conditions, it cannot be reduced by the collar.[6,7]

Even slight improvement of the neutral posture of the neck may improve the stabilizing effect of a collar.[7] The mean occiput–posterocaudal C6 distance was approximately the same in flexion with the collar as in the neutral position without the collar. This means that a properly fitted and comfortable HM collar probably extends the neck a little and effectively restricts flexion and may explain why the stabilizing effect figures were slightly better in the current study than in a study with a custom-made collar earlier.[6,7] The collar should not extend the head too much from neutral posture, because it may then be inconvenient and impossible to wear.

Patients have often reported in clinical work that the HM collar is more convenient than a stiff collar, especially in warm weather. Its convenience may improve treatment compliance. The ordinary collar often provides a stronger feeling of stability and also warms the posterior muscles of the neck, which may be important in patients with painful tension in the muscles and/or patients with combined cervical deformities.

Guidelines on the conservative treatment of AAS and the use of a collar have been published earlier.[7,9] The HM collar is an effective and useful tool in the conservative treatment of simple unstable AAS, but an ordinary custom-made stiff collar is still often needed, especially in cases with combined cervical disorders. These two collars are complementary, and their selection and use must be determined individually.

We conclude that the HM collar restricts AAS in most unstable cases. A good stabilizing effect is most probable in patients whose neck posture is such that AAS is not present in the neutral position.

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