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Three-dimensional spiral CT scanning in children with acute torticollis

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Abstract Three-dimensional spiral CT scanning is now becoming a common investigation in children who have a history of acute torticollis. In the last year, 21 consecutive children who came to our unit with a history of acute torticollis were assessed using standard plain radiographs and a 3-dimensional spiral CT scan. Ten patients had a history of recent trauma. Spiral CT scanning revealed that 13 children had atlanto-axial rotatory subluxation (AARS). Plain radiographs had only a sensitivity of 33% and specificity of 71% in detecting AARS. Sixteen children were treated using a Halter traction. Four failed to resolve clinically and were put on a halo traction after 3-dimensional CT scanning again confirmed residual AARS. Two children remained symptomatic after halo traction, with persisting rotatory and anterior subluxation on repeat spiral CT. They both underwent a posterior in-situ fusion, with no attempt at open reduction. Plain radiography is limited in investigating acute torticollis in children. Spiral 3-dimensional CT reconstruction has an important role to play in both the investigation and management of children who present with acute torticollis.

Resumé De nos jours l'examen par tomographie informatisée tridimensionnelle en spirale devient une technique d'investigation fréquente chez les enfants qui présentent un passé médical de torticollis aigu. Pendant l'année dernière, les cas de vingt-et-un enfants consécutifs qui se sont présentés à notre unité avec un passé de torticollis aigu ont été évalués à la fois par radiographie simple conventionnelle et par tomographie informatisée tridimensionnelle en spirale. Dix patients (50%) avaient

dans leur passé un trauma récent. L'examen par tomographie informatisée en spirale a révélé que treize de ces enfants (60%) souffraient d'une luxation partielle rotatoire axiale de la vertèbre atloïdienne. Les radiographies conventionnelles n'avaient qu'une sensibilité de 33% et une spécificité de 71% pour la détection de cette affection. Seize enfants ont reçu un traitement par traction en bretelle. Quatre enfants parmi ceux-ci (20%) ne sont pas arrivés à la résolution clinique de leur affection, et sont passés à un traitement par traction en auréole, après la confirmation de la persistance d'une luxation partielle résiduelle par la répétition de la tomographie informatisée tridimensionnelle. Deux des enfants (10%) ont manifesté des symptômes même après cette deuxième période de traction, la persistance d'une luxation partielle rotatoire et antérieure étant visible au moment d'un nouvel examen par tomographie informatisée en spirale. Les deux ont subi une intervention chirurgicale en vue d'une fusion postérieure en place, sans tentative de réduction chirurgicale de la luxation. Notre conclusion, c'est que la radiographie simple connaît des limitations à l'heure de l'investigation du torticollis aigu chez les enfants. La reconstruction par tomographie informatisée tridimensionnelle en spirale a un rôle important à jouer à la fois pour l'investigation et pour le contrôle médical des enfants qui souffrent de torticollis aigu.

Introduction

Atlanto-axial rotatory subluxation is a rare, poorly understood condition which is more prevalent in children [1–3]. Its aetiology is thought to be related to capsular or ligament laxity of the atlanto-axial joint secondary to inflammation or trauma [4, 5]. The principal stabilising ligament of this joint is the transverse ligament, which prevents excessive anterior shift of C1 on C2. The alar ligaments, which predominately prevent excess rotation, are the secondary stabilisers. In the normal atlanto-axial joint, rotation occurs around an eccentrically placed odontoid peg. Excessive rotation, especially if it is com-

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bined with anterior subluxation, can lead to brainstem compression and even vertebral artery occlusion [2].

The majority of acute atlanto-axial rotatory subluxations are short-lived, easily correctable and reduce spontaneously or after a short period of traction. However, late diagnosis is associated with a high incidence of irreducible subluxation, or "rotatory fixation", as described by Fielding and Hawkins [6] in 1977. Atlanto-axial "rotatory fixation" may indicate a compromised atlanto-axial articulation which is potentially unstable and has an associated risk of a neurological deficit or even sudden death. The long-term complications, if untreated, are facial flattening or asymmetry and an associated loss of functional movement of the neck. Rarely, a swan neck deformity can occur when significant anterior subluxation is also present.

Three-dimensional spiral CT allows continuous imaging of a very specific region, whereby this information is then stored in computerised helical formation. It can then be reconstructed in any plane to give excellent bony 3-dimensional information about the atlanto-axial articulation [7]. Accurate focusing of the radiation beam ensures small radiation doses and protects vital neighbouring organs [8]. Hence, serial examinations to confirm a reduction after treatment can be performed with relative safety. The aim of our study was to evaluate the role of 3-dimensional spiral CT scanning both in the investigation and in management of children who have a history of acute torticollis.

Materials and methods

We designed a prospective study in which all children coming to our unit over a period of 1 year beginning in June 1995 with a history of acquired acute torticollis would undergo standard plain radiographs and 3-dimensional spiral CT scanning. In this 1-year period, 21 consecutive patients were fully investigated. There were 11 females in the study group, and the mean age was 6.4 years (range: 1–12 years). Ten patients had a history of recent trauma, while only 2 patients had a preceeding viral infection of the pharynx. The remaining 9 patients had a spontaneous onset with no obvious predisposing cause.

Two children were symptomatic for more than 3 months, 4 for more than 1 week, while the remaining 15 children were symptomatic for less than 3 days. All but 5 children had significant pain at presentation. Three-dimensional spiral CT scanning, using 2-mm bony cuts and standard plain radiographs (anterior-posterior, lateral, and open mouth views), were performed on all children.

The classification system of Fielding and Hawkins [6] for atlanto-axial rotatory subluxation was used. The type I deformity is the commonest, whereby the fixed rotation is within the normal range of atlanto-axial rotation and the transverse ligament is intact. Therefore, no anterior subluxation of the joint occurs, and rotation occurs around the dens, which acts as a pivot. In the type II deformity, there is abnormal anterior subluxation (3–5 mm) and fixed rotation in excess of the normal maximum rotation. In the type III deformity, the anterior subluxation is greater than 5 mm, and in the rarest type, type IV, posterior subluxation of the joint occurs.

A normal 3-dimensional axial and antero-posterior image is shown in Fig. 1. The axial view demonstrates that there is no subluxation of C₁ and C₂, with symmetry of the overlying posterior arches indicating no rotational deformity. The anterior-posterior view reveals that the distance between the lateral masses of C₁

Fig. 1 Diagram of normal atlanto-axial joint viewed from above and antero-posterior open mouth view. C₁ is shaded. Note symmetry of posterior arches of C₁ and C₂

Fig. 2 Type 1 atlanto-axial rotatory subluxation. Asymmetry of posterior arches of C₁ and C₂ with no anterior subluxation, viewed from above. Subluxation of right facet joint and asymmetry of odontoid peg and facet joint distance on the open mouth view

and the odontoid peg is symmetrical. There is no subluxation of the facet joints of C1 on C2. A type I deformity is shown in Fig. 2. Loss of symmetry is evident in both views, with rotation of the posterior arch of C1 on C2, facet joint subluxation on the right side and an asymmetrical peg and facet joint distance.

Results

With three-dimensional spiral CT scanning (Table 1) 8 children had a normal scan. However, 13 children with were diagnosed as having atlanto-axial rotatory subluxation (AARS). Nine had the commonest type I deformity, 3 the type II, and 1 child a type III deformity.

We compared our plain radiographs with the spiral scans CT (Table 2). Thirteen patients had reported "normal" plain radiographs; spiral CT scanning showed that only 5 were normal and that 8 had atlanto-axial rotatory subluxation. Six patients had "abnormal" plain radiographs; 4 of these had confirmed atlanto-axial rotatory subluxation on spiral CT, while 2 were normal. In 2 patients, plain radiographs were uninterpretable; spiral CT revealed that 1 was normal, whereas the other child had atlanto-axial rotatory subluxation. Thus overall, plain radiographs had a sensitivity of 33% and specificity of 71% in detecting atlanto-axial rotatory subluxation.

Five children with minimal pain with a history of acute torticollis and a normal same-day spiral CT scan were treated as an out-patient, with a soft collars. They subsequently had fully resolved in less than 1 week when seen in a review clinic.

The remaining 16 patients were admitted because of the severity of their torticollis and significant pain. All were commenced on Halter traction for a mean duration of 3 days. Three had a normal spiral CT scan but were symptomatic for longer than 1 week at the time of presentation. The remaining 13 patients were diagnosed as having atlanto-axial rotatory subluxation on spiral CT.

All but 4 patients failed to resolve after a period of simple Halter traction; 3 had a Fielding type II rotatory fixation and 1 patient a type III. Two of these patients (1 type II deformity and the single type III) had been symptomatic for a period greater than 3 months. Repeat spiral CT scanning again confirmed residual subluxation, and all 4 patients were commenced on Halo traction for 2 weeks. However, 2 patients, both with symptoms for longer than 3 months, still failed to resolve. Spiral CT scanning again confirmed residual subluxation. These 2 patients underwent a posterior in-situ fusion with no attempt at open reduction in view of the chronicity of their symptoms. Surgery was uncomplicated, and no patient had clinically significant restriction of neck movements post-operatively.

Discussion

Acquired acute torticollis in children is an uncommon clinical condition. The clinician must be suspicious of rotatory atlanto-axial subluxation, especially if there is a

Table 1 3-dimensional CT results

Normal	8 (38%)
AARS	13 (62%)
Type I	9
Type II	3
Type III	1

Table 2 Radiological investigations

X-rays		Spiral CT	
		Normal	AARS
"Normal"	13	5	8
"Abnormal"	6	2	4
"Uninterpretable"	2	1	1

history of a sore throat or minor trauma. More sinister causes such as intracranial posterior fossa tumours, syringomyelia, and upper cervical bone infection or tumours must be kept in mind. Acquired acute torticollis is also described after surgery to the pharynx [9]. Over 50% of the patients in our series had a history of trauma whereas, surprisingly, only 10% had a preceding viral infection of the pharynx, which is low compared to some authors [10, 11].

Plain radiographs are of limited value in evaluating a child with torticollis. Patient non-compliance and technical difficulties often lead to multiple exposures being taken. Even good quality radiographs are difficult to interpret 10% of our X-rays were "uninterpretable."

Three-dimensional spiral CT scanning has significantly improved the imaging techniques of the atlanto-axial articulation. This investigation is more costly than ordinary CT scanning. However, accurate beam focusing and significantly shorter imaging time reduces the radiation doses and makes the technique more tolerable to young children. Also, the ability to perform multi-planer-3-dimensional reconstruction gives excellent bony detail in any required view. Dynamic CT scanning aids further to our understanding of the biomechanics of this joint [12]. We feel these advantages justify the extra cost of investigating this potentially serious condition.

We decided prospectively to investigate all children over a 1 year period so as to rationalise our management regime. Nearly 65% of our patients had atlanto-axial rotatory subluxation on 3-dimensional CT scanning. The majority of these acute subluxations are usually short-lived and reduce spontaneously or after a period of traction. Patients with moderate to severe symptoms and/or a positive spiral CT scan were admitted for a course of Halter traction.

The duration of the torticollis is the most important factor in determining the outcome. Long-standing subluxations are less likely to be reduced by traction alone. Two patients with symptoms for longer than 3 months failed to settle after Halo traction. In-situ fusion was performed for these symptomatic patients with no attempt at

an open reduction, as recommended in the literature [6, 12]. Serial spiral CT scanning was invaluable in monitoring the management of these patients and ultimately deciding the timing for surgical intervention. Loss of rotation was not a significant problem, probably due to lower cervical compensatory motion.

We recommend a treatment plan that is based on the duration of the torticollis. Patients with chronic symptoms longer than 1–2 weeks must be admitted and investigated radiologically, including a spiral CT scan, and then treated appropriately. Patients with symptoms shorter than 3 days should be admitted for a period of Halter traction and then, if they fail to settle, should have a 3-dimensional spiral CT scan. Plain radiographs are of limited value.

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