

AIR IN THE CERVICAL ANNULUS - THE LUCENT CLEFT SIGN

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ABSTRACT

The lucent cleft sign is a sign of soft tissue injury. It was first described as a sign of acute cervical injury but it is neither confined to cases of trauma nor the cervical region. The sign is also seen in degenerative disease and in the lumbar spine. The lucent cleft sign is seen anteriorly, as an area of hyperlucency above the superior end plate of the vertebra. It is the result of a partial tear of the annulus. In complete avulsion, the sign may be absent and the radiograph, completely normal. We report our experience of 15 patients with the lucent cleft sign. Our patients are relatively young (commonest age group 30 - 35 years) and the majority (10 patients) had a history of acute trauma. Four patients had non-specific (3 cervical and one lumbar) aches while in the last patient, the lucent cleft was an incidental finding. Although we only documented the disappearance of the sign in 4 patients, we believe that with healing, the sign will eventually disappear. Although the sign is transient, it is useful as it may be the only sign present in cases of trauma.

Keywords: lucent cleft, soft tissue injury, cervical/lumbar spine, traumatic, degenerative

SINGAPORE MED J 1991; Vol 32: 255-257

INTRODUCTION

The lucent cleft sign was first described by Reymond et al in 1972⁽¹⁾. It is however relatively unknown. It is a radiographic sign of soft tissue injury which may or may not be accompanied by bony injury. It may be the only radiographic sign in ill cases of trauma. The sign is also present in degenerative disc disease.

The aim of this paper is to examine the significance of the lucent cleft as a radiographic sign of cervical disc injury or disease and to attempt to correlate the extent of the injury or disease with the radiographic findings.

The lucent cleft is seen as a small, smooth, elongated hyperlucency above the anterior, superior end plate of the affected vertebra⁽¹⁾.

It was first described in cervical injury but was also seen in injury of the lumbar spine. We describe 13 patients with the lucent cleft sign in the cervical spine and 2 patients with the sign in the lumbar spine are also included for comparison.

SUBJECTS AND METHODS

Fifteen patients with radiographic appearance of air in the annulus (13 cervical and 2 lumbar) were collected over a period of thirty months. These patients were mainly from the Accident and Emergency Department although a few were in-patients of the hospital.

The ages of the patients ranged from 25 years to 60 years. The commonest age group was 30-35 years.

Initially, follow up radiographs were done at approximately 3, 6 and 12 months (3 patients). This was to study the rate of disappearance of this sign as an indication of healing. Later, with more experience, fewer radiographs were done.

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RESULTS

Of the 15 patients, 10 gave a history of acute injury - 5 were involved in road traffic accidents and 5 as a result of a fall. The remaining 5 patients gave no history of trauma and 3 of them complained of stiff neck or neck-ache for a period ranging from days to years. One was an incidental finding in a patient with carcinoma of the mandible and one had lumbar backache for one year.

None of the 15 patients suffered any neurological deficits and there was full range of movements in almost all patients.

In 4 patients, the lucent clefts resolved after a period of 6 to 10 months of follow up (3 from the trauma group and one from non-trauma group).

RADIOGRAPHIC FINDINGS

In all 15 patients, the lucent clefts were seen in the neutral (unextended) lateral radiographs.

Five patients had the lucent cleft only at the C4/C5 level. Six patients had lucent clefts at C4/5 and C5/6 levels (Fig 1) and one had the clefts at C3/4 and C4/5 levels.

Only one patient had lucent clefts at three levels namely at C2/3, C3/4 and at C4/5 intervertebral disc spaces. In all the patients with the lucent cleft in the cervical spine, the C4/5 level was involved. One patient with the sign present in the lumbar level had it at the L1/L2 and L2/L3 levels (Fig 2) and the other had it at L1/L2 level.

It must be stressed that the cervical lucent cleft was the main finding in all the cervical radiographs and that there was no significant auxiliary evidence of degenerative disease or bony injury. This is in contrast with our 2 patients with the lumbar lucent clefts where bony injury was evident.

A summary of the findings is shown in Table I.

DISCUSSION

Anatomy

The intervertebral disc consists of the annulus fibrosus at the periphery and the nucleus pulposus in the central portion. The Sharpey fibres of the annulus attach to the adjacent vertebral bodies and blend in with the cartilaginous plate on both the upper and the lower margins of the nucleus pulposus. In the central part where there is a deficiency of the annulus the nucleus abuts directly on the cartilaginous plates (Fig 3a).

Besides the annulus, other supporting structures are present. The anterior and posterior longitudinal ligaments, although strong, lose much supporting value because of the relatively large size of the cervical intervertebral discs. The interarticular

Fig 1. Lateral cervical radiograph showing the lucent cleft sign at C4/5 and C5/6 levels.



Fig 2. The lumbar lucent cleft sign at L1/2 and L2/3 levels. Note the compression injury to the L1 vertebra.



and interspinous ligaments are of little protective value and the articular processes interlock poorly thus resulting in some degree of free mobility/instability. These features emphasize the prime stabilising roles played by the muscles of the neck and the strong bond that is necessary between the vertebral bodies [which are provided by the intervertebral discs]⁽²⁾ (Fig 3b).

Table I. Cervical Lucent Cleft Sign

Apparent cause	No. of patients	One level	Two levels	Three levels	Resolution
Acute Trauma (69%)	RTA 5				3
	Fall 4	4	4	1	0
No trauma (31%)	4	1	3	0	1

Fig 3a. Schematic representation of attachment of intervertebral disc to vertebral rim by fibrous extensions of annulus fibrosus (Sharpey fibres). Centrally, the nucleus pulposus abuts directly on vertebral cartilaginous plate.

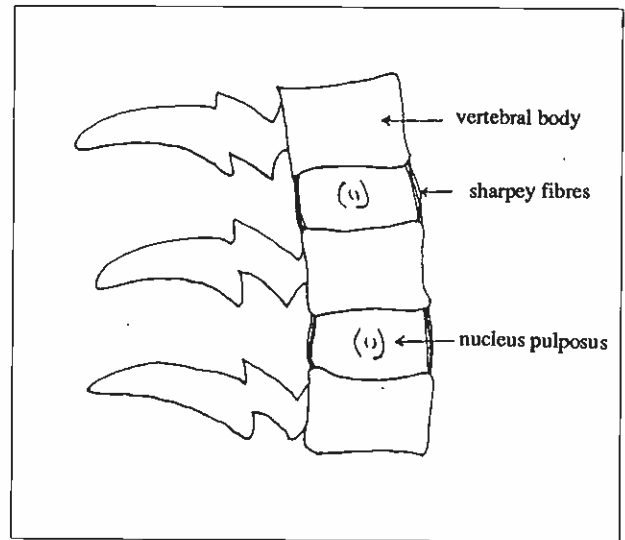
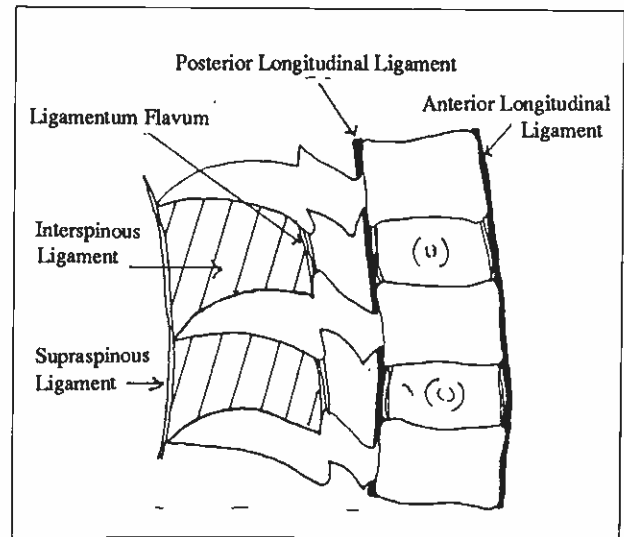


Fig 3b. Illustration of the various ligamentous attachments of the cervical vertebrae.



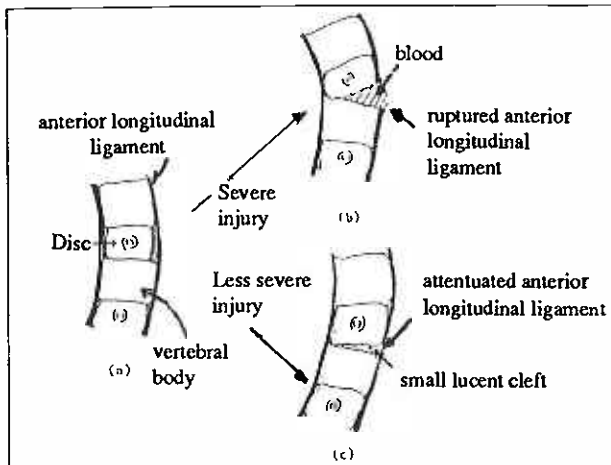
Mechanisms of Injury

Reymond in 1972⁽¹⁾ reported the lucent cleft sign as the result of hyper-extension injury. As the head and neck go into hyper-extension, the spinous processes and articular processes are forced together and act as a fulcrum, causing the anterior longitudinal ligaments to be attenuated. The entire anterior longitudinal ligament may be ruptured. Depending on the

severity of the injury, the disc may or may not be partially or completely avulsed. With sufficient injury, separation then occurs between the cancellous bone of the vertebral body and the adjacent cartilaginous end plate or between the end plate and the disc proper (Fig 4).

Fig 4. The mechanism of the lucent cleft sign.

- (a) Normal anatomy
- (b) Disc completely avulsed from the end plate with rupture of anterior longitudinal ligament. Cleft filled with blood.
- (c) Disc partially avulsed and anterior longitudinal ligament attenuated. Lucent cleft present.



With less severe trauma, where the disc is partially avulsed, the potential space when pulled apart behaves like a joint under stress. Vacuum clefts are well known in synovial joints under stress (Ritro 1955)⁽²⁾. Similarly, with the lucent cleft, with sudden stress, there is a decrease in pressure to below vapour pressure of gases (mainly nitrogen)^(1,3). The nitrogen then diffuses into and fill the cervical annulus and appear lucent radiographically.

With rupture of the anterior longitudinal ligament and complete avulsion of the disc, the lucent cleft is less likely to occur. This is because of local haemorrhage as the cleft would have been filled with blood. Here, the radiograph may be completely normal. Even when there is posterior dislocation of the cervical spine, the cervical radiograph may still appear relatively normal as there is spontaneous reduction. This has been described by several authors^(2,4,5). One such patient had a fatal hyper-extension injury resulting in death⁽²⁾ while another⁽⁵⁾ only had paraplegia. In both patients, the radiographic appearances were normal.

Before the lucent cleft sign is diagnosed, differentiation from the vacuum or pneumatization phenomenon of Magnusson⁽¹⁾ in disc degeneration must be excluded. The vacuum sign of disc degeneration has rugged borders and often extends into the degenerated disc and is not confined solely to the region adjacent to the end plates. There may also be associated hypertrophic bony changes, discal narrowing or eburnation.

From our observation of 13 patients with the cervical lucent cleft sign, the mid and lower cervical spine appear to bear the

main brunt of the force in hyper-extension injury. The commonest levels are C4/5 and C5/6 intervertebral disc spaces. In the non-traumatic group these two levels are also commonly affected. This is probably because maximum mobility occurs at these levels. This can also explain the findings that we have in our 2 patients with the lumbar lucent cleft sign. The mechanism here, however, appears to be flexion rather than hyper-extension (Fig 2).

In our experience, multiple sites of involvement is probably not indicative of more severe injury when compared to a single level. There do not appear to be any significant differences in the symptoms and signs of the patients and the duration before resolution occurs. Only one patient in our study had lucent clefts at three levels (C2/3, C3/4 and C4/5). He was a 30-year old front seat passenger involved in a road traffic accident. He had no neurological deficit, had a full range of neck movements and was treated as an out-patient. Follow-up radiograph at ten months showed complete resolution of the lucent clefts.

Resolution of the lucent cleft is taken as a sign of healing as this disappears with time. It implies that the potential space is being replaced by fibrous tissue and that the disc is now abutting directly against the vertebral body.

There is no significant difference between the patient's age in the traumatic and non-traumatic groups. It is interesting to note that the majority of the patients (13/15) are male and only 2 patients are females. Both the females belong to the non-traumatic group. The first patient is 54 years old and has moderately severe degenerative disease. She complained of neckache for a year. The other patient has carcinoma of the mandible and has minor degenerative changes. All the male patients have minimal degenerative changes. We postulate that this relatively high incidence of lucent clefts in the males may be partly contributed by sporting injuries as well as the nature of their work.

SUMMARY

The lucent cleft is a radiographic sign of soft tissue injury of the spine, resulting from a partial tear of the annulus of the intervertebral disc. There may or may not be associated bone injury. The cleft is seen as an area of lucency anteriorly and above the superior end plate of the vertebra. It may be the only radiographic abnormality to indicate spinal trauma. Although first described as a sign of acute cervical trauma, it is clear that in some cases there is no history of trauma as in 5 of our cases. Degenerative disease appears to be the cause in such cases. Most commonly the cervical spine is affected, but other regions are not exempted; two of our cases had lumbar involvement.

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