THE SAGGING ROPE SIGN: A CRITICAL APPRAISAL

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Certain features of the sagging rope sign recently analysed by Apley and Weintroub (1981) are examined in detail. Evidence is presented to show that the line is a radiological shadow cast by the lateral edge of a severely deformed femoral head rather than a condensation of the spongiosa within the neck. An explanation is offered to explain the common association of the presence of this radiological sign with premature epiphysial fusion.

The sagging rope sign, originally observed by George Perkins and recently described and discussed by Apley and Weintroub (1981), can frequently be observed in the radiographs of patients who have suffered from Perthes’ disease and certain other afflictions of the hip in childhood (Fig. 1). Apley and Weintroub (1981) considered that this curving line extending laterally and superiorly from the inferior border of the neck to the region of the trochanteric fossa was probably brought about by a severe epiphysial ischaemia. They postulated that such an ischaemia might damage the growth plate and render it inactive and then, when healing occurred and the metaphysis recalcified, the line would appear as a condensation within the spongiosa of the neck of the femur at the junction of normal bone and the rarefied metaphysis. They drew an analogy between the line of the sagging rope and the line of arrested growth described by Harris (1933) and frequently seen in the metaphyses of long bones after systemic illnesses in childhood.

We can confirm this interesting radiological abnormality but question the concept of pathogenesis advanced by Apley and Weintroub (1981) and present here evidence to support a different explanation for the line of the sagging rope.

FREQUENCY OF INCIDENCE OF THE SIGN

To learn more about this sign a study was undertaken of 78 patients who had earlier suffered from unilateral Perthes’ disease, who had been kept under observation thereafter, and who were either skeletally mature or were older than 15 years if male and 14 years if female at the time of final follow-up. The average age at primary diagnosis of these patients was 8 years 7 months. The ratio of male to female patients was 5:2, mean age at final follow-up was 15 years, range 11 to 19 years. Thirteen of these 78 patients showed the sagging rope sign and, of these, the end-result was fair in seven and poor in six; these are the two worst of the four end-result grades described by Harrison, Turner and Nicholson (1969). The sagging rope sign was first seen on their radiographs at an average time of 6 years 3 months after primary diagnosis. Premature epiphysial closure was deemed to have taken place in nine of these 13 hips; the criterion used was a fusion involving at least 50 per cent of the physis, taking place at least one year before similar changes in the contralateral normal hip.

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Fig. 1
The sagging rope sign.
EVIDENCE FOR THE LOCALISATION OF THE LINE

Case 1. A man aged 23 years who suffered from multiple epiphysial dysplasia had anteroposterior radiographs taken of his hip in the neutral position and in medial and lateral rotation (Figs 2, 3 and 4). The striking variation in the relationship between the line of the sagging rope and the intertrochanteric line in the various positions makes it impossible to conceive that the former lies centrally within the bone. Stereoscopic anteroposterior radiographs examined with appropriate binoculars showed the sagging rope line to lie in front of the neck of the femur and made this varying relationship with the intertrochanteric line easy to understand.

Case 2. A child aged 15 years required an arthrotomy to remove an intra-articular loose body from the hip nine years after the onset of earlier Perthes' disease. The anteroposterior radiograph revealed a sagging rope sign and, under general anaesthesia before removing the loose body, a needle was slid up the front of the femoral neck until its point almost coincided with the line of the sagging rope on the anteroposterior radiograph (Fig. 5). A lateral radiograph of the hip then revealed the needle touching the anterolateral margin of the femoral head (Fig. 6).

Case 3. A patient aged 36 years required a total hip arthroplasty for osteoarthritis complicating congenital dislocation of the hip; a sagging rope sign was present on the radiograph (Fig. 7). A radiograph of the excised femoral head and neck (Fig. 8) showed that the neck had been sectioned just below the line of the sagging rope and examination of the specimen revealed a palpable ridge on the front of the femoral neck at the lateral edge of the femoral head. This ridge was continuous superiorly with the projecting osteophytic corona which stood proud of the superior and posterior surface of the neck but was sessile anteriorly (Fig. 9). When this ridge was marked with a wire and then a radiograph taken (Fig. 10) it was clear that it coincided with the line of the sagging rope.

CONCLUSION

We have demonstrated that, at least in our three cases, the linear opacity described as the sagging rope sign represents the anterolateral edge of a very deformed femoral head. It is indeed surprising that the margin of the femoral head can lie so far laterally even in young children. It does so when there has been a severe deformation of the femoral capital epiphysis, usually as a result of Perthes' disease but less commonly in our material from congenital dislocation of the hip and
Fig. 7
Case 3. Radiograph taken before total hip arthroplasty.

Fig. 8
Fig. 9
Fig. 10
Case 3. Figure 8—The femoral head removed during the arthroplasty. The marker arrow indicates the line of the sagging rope immediately proximal to the line of the section of the neck. Figure 9—Photograph of the excised upper end of femur. A palpable ridge anteriorly at the junction of head and neck is indicated by the black line. Figure 10—An anteroposterior radiograph of the specimen after placing a wire marker in the position shown by the line in Figure 9. The wire is seen to overlie the line of the sagging rope.

multiple epiphyseal dysplasia. Our review of a series of adolescents who earlier had Perthes’ disease shows the line only to be present in patients with the most severely deformed femoral heads.

Although a majority of patients who show this sign have sustained a premature fusion of the capital femoral epiphysis, this is not the cause of the radiological sign and the line is in no way analogous to Harris’ line of arrested growth. Severe compressive force on a vulnerable capital femoral epiphysis may either deform the head and produce a sagging rope sign or damage the physis and produce a premature fusion, or do both. These two occurrences are independent but frequently associated phenomena.

REFERENCES