The nature of the spondylolytic defect

DEMONSTRATION OF A COMMUNICATING SYNOVIAL PSEUDARTHROSIS IN THE PARS INTERARTICULARIS

John A. Shipley, Catherine A. Beukes

From the University of the Orange Free State, Bloemfontein, South Africa

We injected methylene blue dye into 32 of the facet joints immediately above the defects in 17 consecutive patients with bilateral spondylolysis (34 defects). In 30 of these the dye flowed into a central cavity in the defect of the pars interarticularis and in 20 it passed into the facet joint below the defect. We found macroscopic cavities in 32 of the defects which communicated with the adjacent facet joints and had fibrous capsules. Histological examination showed focal areas of synovial lining consistent with a synovial pseudarthrosis.

In most patients requiring surgery for spondylolysis, the defect is a synovial pseudarthrosis which communicates with the facet joint above it, and less often with the facet joint below it. We suggest that stress fractures of the pars may fail to heal because of the presence of synovial fluid from a nearby facet joint.

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The most probable cause of lumbar spondylolysis is a stress fracture of the pars interarticularis,¹⁻⁷ but the failure to heal needs explanation. Theoretically, healing may be prevented by continued stress at the site of the fracture or an inadequate healing process because the lesion is in pathological or dysplastic bone or displacement of the fragments prevents callus from bridging the defect. Another mechanism was suggested by our observation that the defect in the pars often had a central cavity communicating with the adjacent facet joint, and we considered it possible that some stress fractures of the pars failed to heal because of a communicating synovial pseudarthrosis.

We aimed to determine the frequency of such a central cavity and its communication with a facet joint. We also examined tissue from defects for evidence of synovial proliferation.

Patients and Methods

We studied 17 consecutive patients at operation for bilateral spondylolysis after the failure of conservative treatment. There were 13 men and four women with a mean age of 40.6 years (20 to 50). Eleven patients had grade-I (Meyerding) and five had grade-II spondylolisthesis. One other patient had no displacement.

At operation, we injected the facet joint immediately above the defect with 1 ml of methylene blue. Each pars defect was then dissected and examined for the spread of dye (Fig. 1). Fibrous tissue bridging the defect was excised, with care to obtain areas stained by the dye, and also to avoid the capsule of the facet joint. This tissue was examined histologically.

Results

Facet injection studies. Of the 34 spondylolytic defects in 17 patients, 32 of the facet joints were successfully injected. In 30 of them the methylene blue was found to enter a cavity in the defect, and in 20 the dye had passed through the pseudarthrosis into the lower facet joint. In two defects, leakage of dye from the injection site made it uncertain whether enough had been injected to fill the lower facet joint even if there had been a connection. In only one patient, after adequate injections, was there no dye in the pseudarthrosis on either side.

Pathology. Macroscopically, 16 of the 17 patients appeared to have bilateral synovial pseudarthroses with stained cavities of varying size communicating with the injected facet joint, and fibrous capsules of varying thickness. Two patients showed a thick fibrous septum between the pseudarthrosis and the lower facet joint on both sides.

The one patient with no penetration of dye into the defects had bilateral fibrous pseudarthroses with no apparent cavities: small eburnated areas of bone on both sides of the defects suggested that there had been some articulation.

Histological examination of the capsule of the pseud-

J. A. Shipley, MMed Orth, Principal Specialist

Department of Orthopaedics

C. A. Beukes, MD Anat Path, Principal Specialist

Department of Anatomical Pathology

National Hospital, University of the Orange Free State, Private Bag X 20598, Bloemfontein 9301, Republic of South Africa.

Correspondence should be sent to Dr J. A. Shipley.

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Fig. 1

At an operation for L5 spondylolysis a view of the intact posterior elements shows: 1) the site of injection of methylene blue into the L4-L5 facet; 2) a probe in the defect with passage of methylene blue from the L4-L5 facet; and 3) the L5-S1 facet (S1 marks the sacrum).

Fig. 2

Photomicrograph of the capsule of a typical pars defect showing: 1) loose fibrous tissue; 2) the lining of several layers of synovial cells; and 3) the cavity of the pseudarthrosis.

arthroses showed varying amounts of fibrous tissue and fibrocartilage. In 16 patients there were focal areas of synovial tissue with one or more layers of synovial cells lining the cavities (Fig. 2), indicating the presence of a synovial pseudarthrosis. The patient with no visible cavities showed a normal ligamentum flavum and fibrous tissue in each defect with synovium from the adjacent facet joint.

Discussion

Our study was prompted by the observation that a spondylolytic defect resembled a synovial pseudarthrosis, with a central cavity surrounded by a fibrous capsule which communicated with the adjacent facet joint.

Radiologists recognise that there are connections between a facet joint and a nearby spondylolytic defect, but this does not appear to have been reported by surgeons.

Ghelman and Doherty⁸ described this finding after therapeutic injection of facet joints with contrast to verify intra-articular administration. Maldague, Mathurin and Malghem⁹ reported radiological communication in nine of 11 patients and Park et al¹⁰ described 20 patients in whom facet joint arthrography showed contrast spreading to an adjacent spondylolysis. McCormick, Taylor and Twomey¹¹ reported similar findings in seven patients. Our operative finding of macroscopic communication between a cavity in the pars defect and the adjacent facet joints confirms these radiological reports.

Descriptions of the pathology of these defects are confusing. Roche¹² dissected a single cadaver specimen and found a cavity in one pseudarthrosis enclosed by a fibrous sheath and separated from the nearby facet joint by a septum. Gill, Manning and White¹³ dismissed the pseudarthrosis as a "mass of fibrocartilaginous tissue". Bosworth et al¹⁴ described 15 cases and found the pseudarthrosis to consist of either thin or thick fibrous bands, bone bridges, false joints, or combinations of these. The marked fibrocartilaginous hyperplasia described by Gill et al¹³ was not seen. Wiltse⁶ examined 15 cases and found that a wide gap was usually filled with fibrous tissue resembling ligament, but that a narrow gap often contained eburnated bone and cartilage. McCormick et al¹¹ reported that the spondylolyses in five young male cadavers "resembled osteoarthritic joints": three were lined by sclerotic bone or cartilage, with the fragments separated by a clear space, and two were joined by fibrocartilage. In all five the pseudarthrosis communicated with the facet joint above and in three also with the joint below.

We have shown that a spondylolytic defect usually has a central synovial cavity surrounded by a capsule of fibrous or fibrocartilaginous tissue of varying thickness. We conclude that most patients with a spondylolysis requiring surgical treatment have a synovial pseudarthrosis in the pars interarticularis which communicates with the adjacent superior facet joint and less often with the inferior facet joint of the affected vertebra.

Ghelman and Doherty⁸ have speculated that "the presence of a capsular extension may explain why union of a pars interarticularis fracture is relatively rare". Maldague et al⁹ made a similar suggestion. McCormick et al¹¹ showed histologically that the pars interarticularis is the only structure between the inferior recess of the superior facet joint and the superior recess of the inferior joint, suggesting that a fracture of the pars interarticularis establishes communication between these facet joints. We have confirmed that a fracture of the pars interarticularis commonly extends into the adjacent facet joint or joints, and suggest that synovial fluid may prevent healing and lead to persistent synovial pseudarthroses.

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