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SPONDYLOLYSIS AND SPONDYLOLYSTHESIS

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Despite the numerous clinical and experimental contributions about spondylolysthesis, a number of problems still remain. A periodic review of the subject is therefore justified in order to clarify the progress, however modest, that has been achieved over the years, and to consolidate the knowledge about the complex subject of orthopaedic pathology.

Our examination of recent literature, as well as the experience gained from surgeons who have been devoting themselves to the study and treatment of this skeletal disease for a long time—(the initial studies of one of us go back as far as 1956)—have led us to concentrate here on certain more significant aspects of the disease which have now become clearer.

We shall therefore discuss: a) the importance of stress in the etiology of lysis, b) the mechanism of slipping, c) therapeutic indications and methods applied.

Among the various theories put forward to account for the origin of the lysis, the one we consider the most probable is that of a condition of chronic overweight, which leads to the type of injury known as a "duration fracture".

In support of such a theory, there do in fact exist both theoretical considerations, demonstrable by photoelastography and by calculating the distribution of the weighting forces, as well as clinical observations of cases demonstrating this theory which recently have been reviewed by various authors.

Extremely significant are the cases in which it has been possible to radiographically document the appearance of lysis in previously healthy people. In recent years, more than 10 cases have occurred in which the lysis appeared after a lumbar-sacral fusion at the level of the vertebra above the fusion.

Equally important are those cases in which the lysis appeared following a serious dorsal kyphosis followed by hyperlordosis.

We have investigated athletes who practice sport activities with continuous and heavy loads applied on the lumbar spine postured in hyperlordosis: viz. diving, weight-lifting and wrestling, and, in various cases, we have been able to demonstrate the appearance of either a mono- or a bilateral lysis.

These observations, which until a few years ago had passed almost unnoticed, have convinced us of the importance of stress (meant both in its static sense and also more probably in the dynamic sense) in the origin of the lysis. Whether the giving way should occur on a base altered by a trophic defect (as Holits and Jaeger maintain) or on a displasic base (as Brocher maintains) has been impossible to determine.

The stressing action of the weight, and certain physical activities, causing lysis, may help explain the mechanism of slipping.

According to accepted theories, slipping of the olisthetic vertebra occurs during childhood and adolescence and then stops at adulthood.

Even here the accepted opinions must be revised in view of the fair number of recent observations of slipping worsening in adulthood.

Undoubtedly, worsening of the olisthesis after the age of 20 is rare, but it is certainly not as exceptional as Taillard maintained until a few years ago.

It is more difficult to explain why slipping should stop once it has been started by the yielding of the elastic properties of the disc-capsule-ligament system.

From the biomechanical studies we have carried out we maintain that slipping may take place according to two mechanisms:

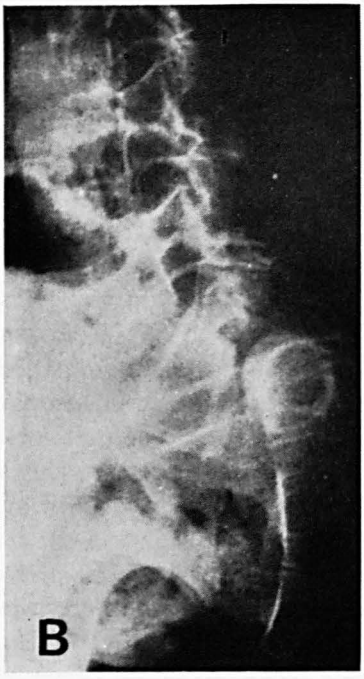
a) By overcoming the hysteresis of the posterior ligaments and of the disc as a result of a repeated or sufficiently powerful traumatic action, or by a process of degeneration of the disc, with gradual loss of its elastic properties which oppose slipping.

The first mechanism might be used to explain the olisthesis which we have observed in adult athletes whose discs show no radiographic signs of degeneration.

In both cases, slipping would stop on reaching a state of compensation which is elastic in the first case and absolutely plastic in the second.

The maintenance of an elastic state explains, in our opinion, the resistance to the stressing action which we have noticed in athletes who continue to pursue a fair amount of sports activity without suffering any further worsening of the olisthesis.

Figure 1. A) 4th degree spondylolisthesis (spondyloptosis) of fifth lumbar vertebra in a 16-year-old girl. B) Maximum flexion and (C) extension do not cause further slipping.



That the olisthesis might worsen in adulthood should be considered in the choice of treatment as a possible, even rare, occurrence, in the presence of certain conditions. Consequently, the type of treatment must be conditioned not only by the symptomatology and the age of the patient, but also by other considerations such as: the radiographic appearance of the discs in functional tests, the value of the tangential pushing force which acts on the olisthesic vertebra, the value of the lumbar index, the inclination angle of the sacrum, the condition of the abdominal muscles, the patient's work and the sports he practices, and, for women, the likelihood of future pregnancies.

Apart from the kinesiological and orthopaedic treatment which must always be attempted in the presence of a symptomatic spondylolisthesis, we wish to discuss in detail the different types of surgical treatment.

The surgical treatment of spondylolisthesis must pursue a triple aim:

1) Amelioration of the painful symptoms.
2) Reconstruction of the functional alignment of the spine by reduction of slipping.
3) Complete and definite stabilization.

It is not always possible, by surgery, to fulfill all three of these aims and the choice of the primary aim to be fulfilled, by one or the other type of operation, is entrusted to the personal experience of the surgeon.

Three different types of operation are available to relieve the most common symptoms of spondylolisthesis: lumbar sciatica, neurological troubles, and progressive slipping of the vertebra.

1) Posterior element excision.
2) Excision and fusion.
3) Reduction and fusion.

First of all, the choice of treatment is determined by the age of the patient, and on these grounds we distinguish between three groups:

1) Young people up to the age of 20.
2) Young adults between 20 and 35 years of age.
3) Adults over 35 years of age.

These three groups have been classified on the basis of the likelihood that the spondylolisthesic vertebra will slip and of the physical activities carried out in each age group.

In the first group, where the possibility of a worsening is the greatest, surgery aims at stabilization.

Operations involving posterior element excision are to be completely avoided because of the risk of worsening.

Operations involving a wide excision associated with fusion are also not recommended, especially in patients under the age of 15, both for the above reason and because of the risk that the laminectomy might induce kyphosis in the involved part of the spine.

We consider that, in this group of patients, the operation to be chosen is determined by the necessity for reduction of slipping, followed by stabilization, which to be valid must come about through a double fusion, intersomatic by an anterior approach and sacro-transversal by a posterior one.

The reduction of slipping resolves, in 90 per cent of the cases, all neurological symptomatology whether algic or paralytic, while if only simple lumbago exists, which is resolvable even by stabilization alone, we still believe that reduction should be performed in order to restore the balance of physiological forces.

In the second group, as demonstrated, we must consider the possibility of a worsening of the spondylolisthesis, even though this is rare. In this period of life the person is at the peak of his physical and sporting activities, which may cause lysis and slipping. In women this is the period of prospective pregnancy, which through the weight increase, the hyperlordotic posture, and the lassitude of the ligaments may cause a worsening of the slipping.

Thus, in cases of spondylolisthesis of the 3rd and 4th degree, with roots symptomatology, we consider it advisable to attempt a reduction in most cases, but the chances of ameliorating the symptoms are worse than for the younger group.

A successful reduction should be followed by a stabilization operation which, in women, is effected by anterior and posterior fusion. In

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Figure 2. A) The myelogram carried out with a radio-opaque hydrosoluble medium (dimerix) shows a total arrest at the sub-arachnoidal space corresponding to the slipped vertebra. The patient is suffering from a bilateral paresis in the lower limbs. B) The conservative reduction performed with the patient under total anesthesia was very successful and is maintained with the help of a plaster jacket. The neurological symptoms have disappeared. C) The myelogram performed with the patient braced with the plaster jacket shows the full patency of the vertebral lumen.

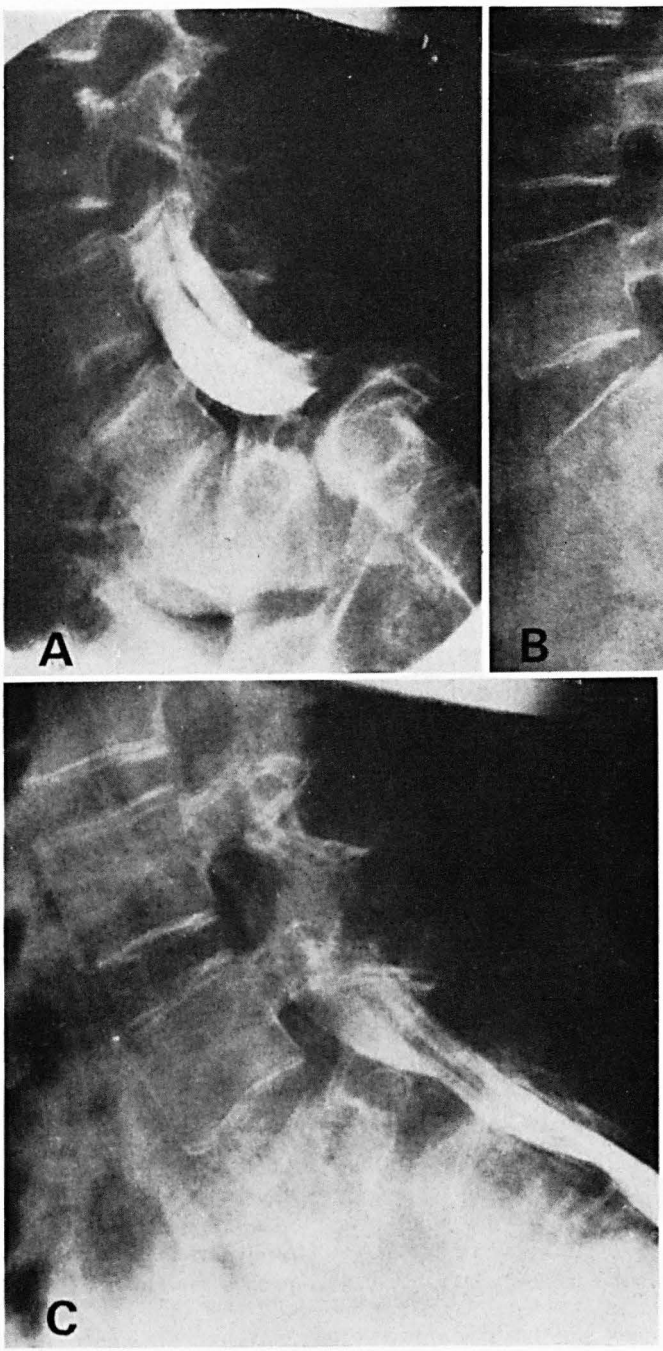

Figure 2.

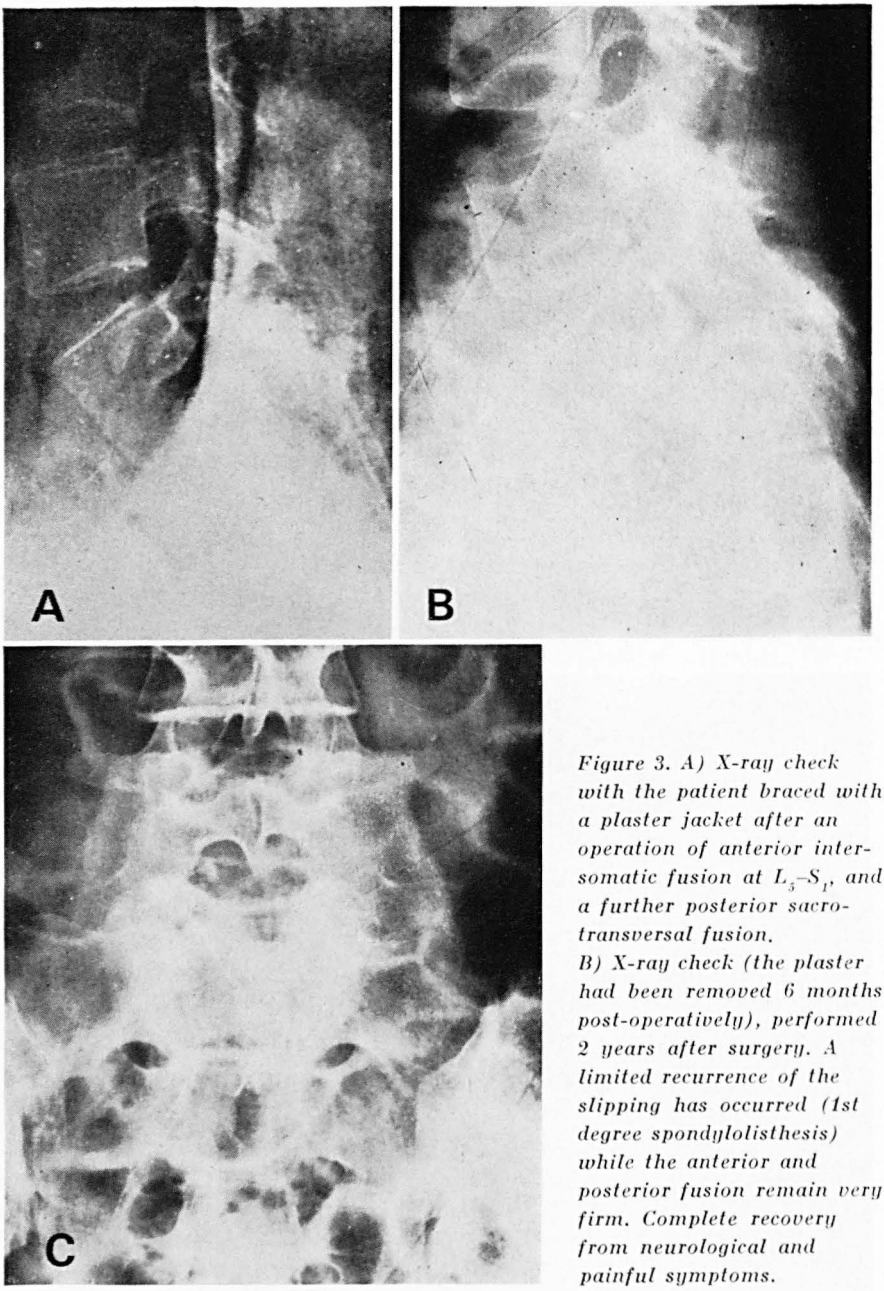

Figure 3. A) X-ray check with the patient braced with a plaster jacket after an operation of anterior intersomatic fusion at L_5–S_1, and a further posterior sacro-transversal fusion.
B) X-ray check (the plaster had been removed 6 months post-operatively), performed 2 years after surgery. A limited recurrence of the slipping has occurred (1st degree spondylolisthesis) while the anterior and posterior fusion remain very firm. Complete recovery from neurological and painful symptoms.

men, we prefer to avoid the anterior fusion because of the risk of lesions in the pre-sacral plexus, and perform only a posterior fusion, which Monticelli carries out by connecting the inter-articular fusion to the sacro-transversal and then strengthening the facets between them, with a bone graft aided by screws.

When reduction does not give positive results, or in cases where lengthy treatment as in fusion reduction is considered inadvisable, we prefer to perform a radiographic study to identify the cause of the pain, followed by an enlarged laminectomy with sacro-transversal fusion.

When it is necessary to remove the entire posterior arch, we prefer to adopt Marino-Zuco's technique by which the normal width of the vertebral lumen is restored while maintaining the position of the arch.

In the few cases in which it is necessary, we perform Gill's operation in connection with intersomatic fusion by a posterior approach, or intertransversal fusion.

In the third group of patients, in whom a progression in slipping is not a threat, Gill's operation is the most suitable one, because it provides the best results, restoring the patient to active life in the shortest possible time.

SUMMARY

On the basis of our own experience and the most up-to-date reports, we present some of the most controversial features of spondylolysis and spondylolisthesis.

In particular, the importance of stress in the etiology of the lysis has been revealed by research carried out on athletes practicing strenuous sports.

It has also been shown how the slipping of the olisthesic vertebra does not necessarily cease around the age of 20, but may continue, under certain conditions, even in the young adult.

Finally, advice on treatment is given in relation to the various surgical techniques, emphasizing the importance of the reduction of slipping, and giving directions on the use of this technique, and its limitations.

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