

Martina Hansens Hospital, Sandvika, Norway.

PELVIC GIRDLE RELAXATION FROM AN ORTHOPAEDIC POINT OF VIEW

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The term pelvic relaxation is related to certain conditions during and after pregnancy, and implies that the joints and ligaments have a reduced ability to accomplish their function as supporting structures. There is widespread acceptance that the relaxation is due to a specific high-molecular hormone, relaxin, which is present in the serum of various pregnant mammals including women. Its chemical composition is not yet defined (Cohen 1963, Steinetz 1963).

The firmness of the pubic symphysis and the tension of the capsule and ligaments of the sacroiliac joints are decreased in pelvic relaxation. Consequently, a sliding movement and an instability may occur in the pelvic joints.

Morphological changes of these joints during pregnancy appear as a physiological condition without clinical symptoms. Occasionally, these changes dispose to pain and in this way become pathologic. Meanwhile, the transition between physiological and pathological relaxation is rather indistinct.

The communications in the obstetrical literature about pathological relaxation vary regarding the incidence of this condition. Berezin (1954) reports a frequency of 0.4 per cent in pregnancy and 0.2-0.3 per cent during and after parturition. Skajaa (1929), Walde (1962) and Genell (1949) have published an incidence of 16 per cent, 0.5-3 per cent and 1 per cent, respectively, in their materials of pregnant women.

Little has so far been reported about this condition from an orthopaedic point of view. For this reason the following study has been carried out with special emphasis on the morphological, biomechanical, clinical and therapeutic problems. The hormonal aspects of the disorder will not be discussed in this paper.

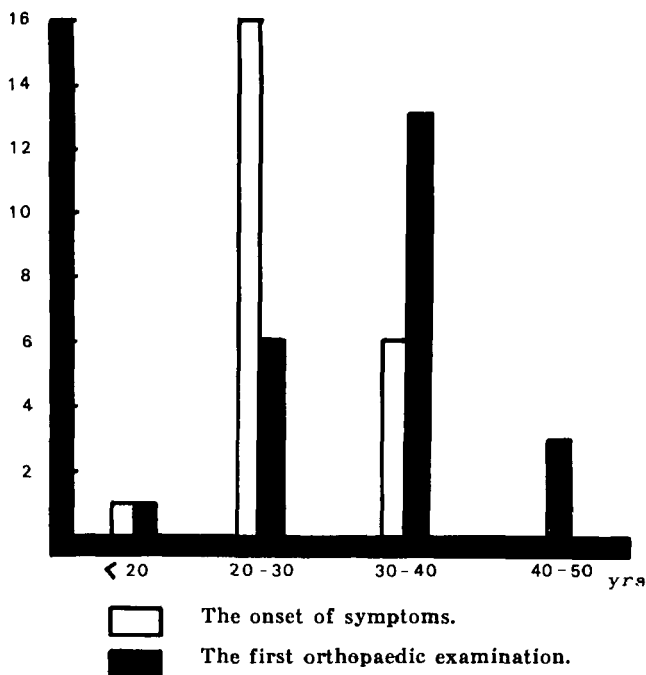


Figure 1. Age distribution of 23 patients with pelvic relaxation.

MATERIAL AND METHODS

During the period 1951-1971 23 patients have been treated in Martina Hansens Hospital with the diagnosis of pelvic relaxation, 17 as inpatients and 6 as out-patients.

The records were reviewed with particular attention being paid to positive statements of any back pain or gynaecological disease before the first pregnancy and possible information pointing towards psychoneurotic behaviour. All patients with a doubtful diagnosis of pelvic relaxation were excluded from the material.

The age distribution of the patients at the onset of symptoms and at the first examination at the hospital is given in Figure 1.

The majority (19 out of 23 women) were referred to our department from the obstetrician with a strong suspicion of their having pelvic relaxation, some of them with severe symptoms. Ten patients came for orthopaedic treatment within a time period of 3 months from the preceding delivery, 4 patients came between 6 and 12 months and the remaining 9 between 12 and 18 months after delivery.

Table 1 presents the first appearance of symptoms in relation to the number of pregnancies or times in labour. The symptoms showed a tendency to begin from the 28th to the 35th week of the pregnancy and in the course of 48 hours after the parturition. In 16 cases there were unequivocal symptoms of relapses of pelvic relaxation during altogether 33 later pregnancies. The recidivations were noticed at

a constantly earlier time from pregnancy to pregnancy, and also with an increasing intensity. The remaining 7 women have passed through only one pregnancy up to the time of follow-up.

In 6 cases a sterilization was performed in the post-partum period and an artificial abortion was provoked 4 times in 3 women. A family disposition was encountered in only 2 cases.

Table 1. First appearance of symptoms of pelvic relaxation in relation to pregnancy and labour.

During pregnancy:	19	<table border="0"> <tr> <td rowspan="3" style="font-size: 3em; vertical-align: middle;">}</td> <td>1st:</td> <td>10</td> <td rowspan="6" style="font-size: 3em; vertical-align: middle;">}</td> <td>week 16-19:</td> <td>2</td> </tr> <tr> <td>2nd:</td> <td>7</td> <td>week 20-23:</td> <td>3</td> </tr> <tr> <td>3rd:</td> <td>2</td> <td>week 24-27:</td> <td>2</td> </tr> <tr> <td></td> <td></td> <td>week 28-31:</td> <td>3</td> </tr> <tr> <td></td> <td></td> <td>week 32-35:</td> <td>7</td> </tr> <tr> <td></td> <td></td> <td>week 36-40:</td> <td>2</td> </tr> </table>	}	1st:	10	}	week 16-19:	2	2nd:	7	week 20-23:	3	3rd:	2	week 24-27:	2			week 28-31:	3			week 32-35:	7			week 36-40:	2
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After 1st labour:	3																											

Table 2. The treatment of 23 women with pelvic relaxation.

Conservative		15
Operative		
Arthrodesis of both s. i. joints	4	}
Arthrodesis of both s. i. joints + symphyseodesis	2	
Symphyseodesis	2	
		8

Treatment

This is listed in Table 2. Active exercises, bed rest with a broad pelvic sling, crutches and a sacroiliac belt or a firm supporting corset constitute the most important conservative measures in this material. The conservative treatment lasted on an average for 4 months.

Arthrodesis of the sacroiliac joints was done by Smith-Petersen's method. By chiselling out a rectangular bone piece 4×2×3 cm in size, the ear-shaped joint was completely opened. After removal of the cartilage from the sacral side of the joint and also from the bone block, the latter was replaced and countersunk to come into close contact with the cancellous bone of the sacrum. In addition, bone chips from the iliac bone were packed into the interspaces surrounding the block to promote the osteogenesis.

The postoperative regimen consisted of vigorous isometric contractions of the gluteal muscles from the second day. The patient was permitted to sit in a wheelchair or walk carefully with crutches, swinging-through and weightbearing on both legs simultaneously from the seventh postoperative day. A 4-point gait was started after 8-10 weeks and the crutches were discarded about 14 weeks postoperatively.

The symphysis was approached through a transverse incision, the fibrocartilage resected into bleeding bone and a suitable bone graft from the iliac crest fitted into the defect, supplemented with bone chips on the posterior side. Then usually immobilisation was carried out with 1-2 staples or plates. The aftertreatment was as described above apart from bed rest for 2-3 weeks.

There were no serious postoperative complications. Histological examination of the cartilage of the pelvic joints was made in only 2 cases.

Follow-up examination

All the patients were examined clinically and 21 roentgenologically from 1 to 21 years after the final ambulatory treatment or their discharge from the hospital, the average observation time being 6 years.

Both the original and follow-up roentgenograms were studied with special regard to the separation and vertical mobility of the symphysis, a possible sclerosis and irregularity of the pubic bones and any signs of a widening or para-articular sclerosis of the sacroiliac joint.

Measurement was made of the width of the symphysis at the narrowest space and the vertical shift, made up of the total of the differences in levels between the upper borders of the pubic bones with the patient standing on the right and left leg alternately. The X-rays should be taken with a 8 cm wooden block under the foot and the unloaded leg hanging freely. An ordinary A-P view of the sacroiliac joint was usually supplemented by stereoscopic and tangential projections.

Table 3. Clinical symptoms and signs of relaxation in 23 patients.

Pain and tenderness of the s. i. joint (one or both)	23
Pain and tenderness of the symphysis	23
Pain and tenderness of the adductor muscle	12
Difficulties in walking	14
Positive Trendelenburg's sign	10

RESULTS

Clinical follow-up

Initially, the main symptoms of pelvic relaxation were spontaneous pain and tenderness by direct or indirect pressure localized to the pelvic joints, as indicated in Table 3. About one half of the patients complained of pain and tenderness in the inguinal region and in the medial part of the thigh, which was probably due to increased strain upon the adductor muscles because of the pelvic instability. Characteristically, the pain was provoked by any active movement, either by moving the legs, ascending or descending stairs, changing position in bed or lifting heavy objects. In cases of severe involvement, the patient

moved in a hesitating manner with a waddling, goose-like gait and short steps and kept the lower extremities tight together and a little internally rotated.

A very important clinical observation in 10 cases was a bilateral positive Trendelenburg's sign, and during this examination 3 patients experienced a snapping sound in the symphysis while a vertical symphyseal movement could be demonstrated by palpation.

Table 4. Roentgenological findings of pelvic relaxation in 21 patients at the time of the first orthopaedic examination.

Symphyseal width	2-5 mm: 19
	> 10 mm: 2
Symphyseal shift	< 5 mm: 18
	> 5 mm: 3
Para-artic. sclerosis and widening of s. i. joints	3
Osteochondral changes of the symphysis	1

Roentgenological follow-up

The results are enumerated in Table 4. Previous investigations have shown that all pregnancies normally are connected with an increased width and shift of the symphysis (Farbrot 1952, Heyman & Lundqvist



Figure 2. Female, aged 52 years, symphyseodesis and arthrodesis of sacroiliac joints in 1951 and reoperations of all joints 2 years later because of non-union. Roentgenological ankylosis and fair result at follow-up.



Figure 3. Female, aged 47 years, symphyseodesis with autologous bone block in 1962 nine months after third delivery. Solid ankylosis and good result.

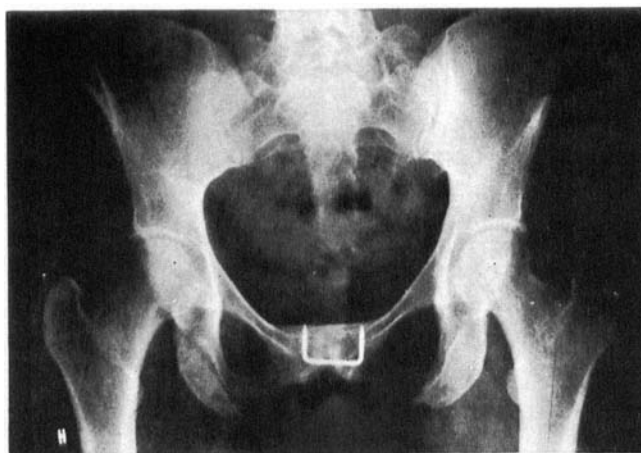


Figure 4. Female, aged 44 years, symphyseodesis in 1964 with bone block and 1 staple one year after fourth delivery. Good result.

1932, Roberts 1934, Thorp & Fray 1938). In the present material a separation of more than 10 mm and a vertical mobility of more than 5 mm are listed as pathologic. These changes together with sclerosis and widening of the sacroiliac joints were able to confirm the diagnosis based on clinical judgement in only 4 patients. In other words, the X-rays are mostly normal in pelvic relaxation at the time of the first orthopaedic examination.

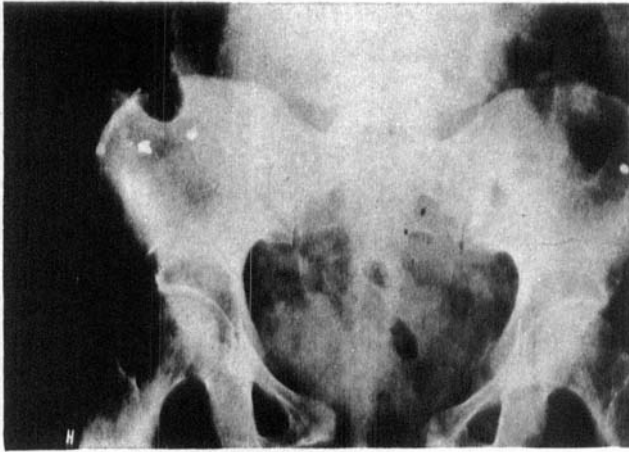


Figure 5. Female, aged 43 years, a 6 cm width at symphysis pubis 4 days after fifth delivery in 1967. Conservative treatment.

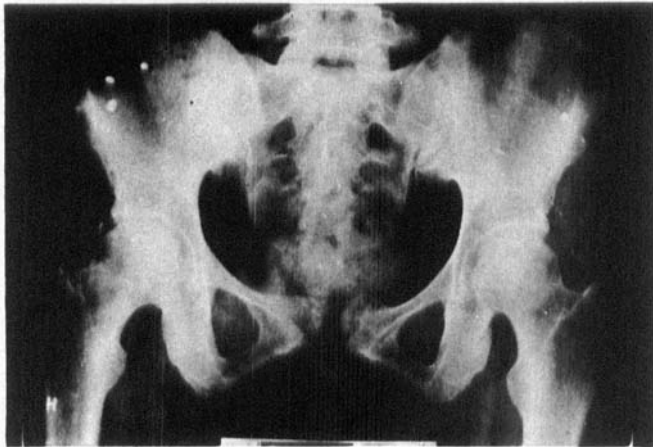


Figure 6. 1½ cm distance between the pubic bones at follow-up. Disabling pain and pelvic instability. Poor result.

One patient revealed non-union of both sacroiliac joints and the symphysis 2 years after the operations and was reoperated in all three pelvic joints with a roentgenologically successful result (Figure 2). Six of the remaining 7 operated patients showed signs of ankylosis of the joints (Figures 3 and 4). As regards the sacroiliac joints, it should be emphasized that the transformation and incorporation of the bone block continues for a rather long time. The process of union may be

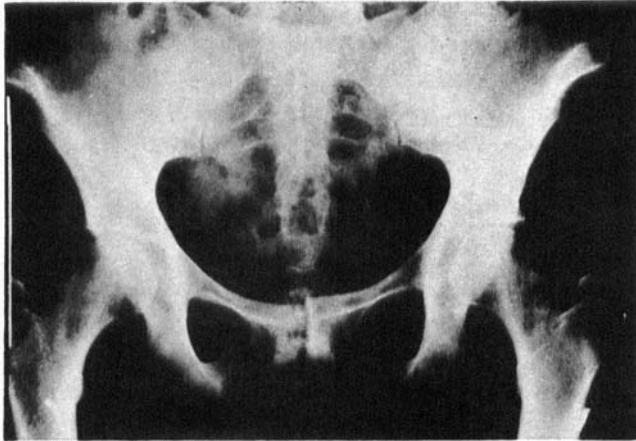


Figure 7. Female, aged 40 years, osteoarthritic changes of the symphysis and a vertical mobility of 7 mm. Poor result after conservative treatment.

followed roentgenologically for 10 years until the stage of solid fusion is reached.

On follow-up, the state of the patients was classified according to the following criteria:

Good—17 patients.

Symptom-free or slight pain during the first days of menstruation, pelvic stability, roentgenological ankylosis of pelvic joints, independent of sacroiliac belt or corset, normal working ability.

Fair—3 patients

Pain on heavy housework and on walking long distances, pelvic stability, solid ankylosis, periodically dependent on external pelvic support and/or physiotherapy.

Poor—3 patients

Pain on light effort and on walking short distances, pelvic instability, non-union or doubtful ankylosis, disability insurance owing to previous relaxation.

Two of the patients with a poor final result have been conservatively treated. A 43-year-old woman with marked clinical and roentgenological symptoms was offered an arthrodesis of the pelvic joints, but refused operative treatment (Figures 5 and 6). A 40-year-old patient revealed, as well, positive roentgenological signs, and a symphyseodesis is planned at a later time because of pain and pelvic instability (Figure 7). Lastly, a 45-year-old woman presented non-union of both sacroiliac

joints. A bilateral rearthrodesis seems not to be indicated because of moderate complaints in spite of the operative failure.

One of the 3 women belonging to the group "fair" has had 4 operations on the pelvic joints (Figure 2). The remaining 2 patients have only been conservatively treated.

DISCUSSION

After post-mortem examinations of the symphysis some authors (Eymer & Lang 1929, Haslhofer 1930) have drawn attention to the appearance of irregular fissures in the fibrocartilage and to alterations of the osteochondral junction. These changes are similar to an osteoarthritic process, as indicated roentgenologically in one of our patients (Figure 7). The subchondral bone tissue is further found to be partially penetrated with subsequent open communication between the bone marrow and the cartilage. This facilitates an invasion of the cartilage from the bone marrow with its abundance of cells and capillaries. Yet, this seems to be a rather rare occurrence and of a definitely pathologic nature.

The symphysis is a synchondrosis with fibrocartilaginous union between the pubic bones while the sacroiliac joints constitute an amphiarthrosis. The pelvic joints are reinforced by strong ligaments which permit only slight motion. The articular surfaces of the sacroiliac joint lie farther apart anteriorly than posteriorly, and therefore the sacral bone tends to displace forwards and downwards into the pelvis during weightbearing. The interosseous and posterior sacroiliac ligaments counteract this tendency by becoming taut and forcing the ilia more closely together.

The efficiency of this locking mechanism is impaired in some women in whom the sacroiliac joint lies in the sagittal rather than in the more oblique plane. Besides, the articular surfaces are more even in females than in males and permit a slightly greater range of motion during physiologic as well as pathologic conditions. Thus, anatomical variations of the female sacroiliac joint very likely play a certain role in pelvic relaxation.

The analysis of this material gave no evidence for the view that women with a "male looking" pelvis or coxa valga may show a predisposition to pelvic relaxation, as indicated in the literature (Seyss 1964). All the patients revealed a "female looking" pelvis as judged by the roentgenograms and a neck-shaft angle within normal limits.

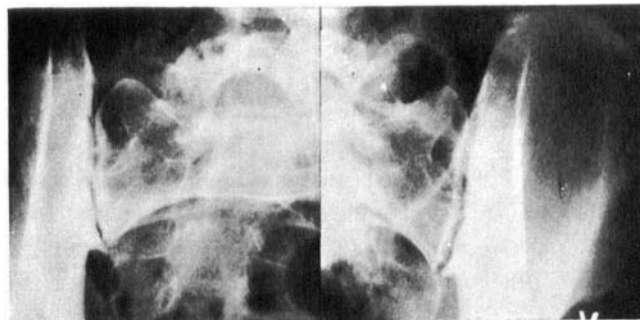


Figure 8. Female, aged 40 years, arthrodesis of all pelvic joints after eighth delivery. Preoperative widening and para-articular sclerosis of sacroiliac joints.

Biomechanics

The forces acting on the pelvic joints should also be taken into consideration. Pauwels (1965) has calculated the relative magnitude and direction of the forces which affect the sacroiliac joints and the symphysis in one- and two-leg support. The forces were calculated for the plane of the pelvic girdle as well as for the plane perpendicular to it.

According to these calculations the resultant forces will cause a preponderance of tensile stress in the symphysis during weightbearing on both legs, even if a certain compressive component is acting in the sacroiliac joints to maintain equilibrium, with compressive forces in the proximal and tensile in the distal portion. During one-leg support in gait, strong shearing forces are acting on the symphysis simultaneously in two opposite vertical directions.

It is supposed that the histological structure of the symphysis consists chiefly of fibres which slope in all directions between the two pubic ends to equalize the shearing forces and horizontal fibres to eliminate the tensile stress. Besides this, the cartilage of the joints tend to resist and take up the compressive stress.

Hormonal influence (Manning et al. 1965) and increased stress during pregnancy and labour may be responsible for possible histochemical changes of the cartilage of the pelvic joints. Oestrogen and relaxin cause depolymerization of hyaluronic acid (Hall 1956) and compressive, shearing and tensile forces constitute a chronic trauma increasing the concentration of hyaluronidase or an enzyme akin to it. This interferes with the humoral conditions needed for pelvic stability and very likely also plays a certain role as a pathogenetic factor in pelvic relaxation.

Diagnosis

As regards the clinical problems, it is important to realize that the diagnosis may be difficult, especially if too much time has elapsed since the delivery. Obviously, it would be a great advantage if the orthopaedic surgeon could be consulted as soon as possible in the post-partum period to get an early and personal impression of the severity of the condition and to rule out possible diagnostic errors.

The review of the present material has made clear that several diseases may contribute to diagnostic difficulties. Dorsalgia from insufficiency of the back muscles, leg length discrepancy or a psychosomatic mechanism may easily be incorrectly diagnosed as pelvic relaxation.

Another source of diagnostic error seems to be static lumbosacral pain because of increased strain upon the back muscles. The centre of gravity during pregnancy is influenced by increasing weight and abdominal distension. The effect of the stretched abdominal muscles is decreased from a biomechanical point of view. Usually, the back pain disappears during the puerperium and bears no relation to pelvic relaxation.

Degenerative diseases, spondylolisthesis and benign bone tumours of the lumbar spine and dysplasia of the hip joint have also proved to be actually mistaken diagnoses in our material. Vertebral osteoporosis in the puerperium, spondylitis and an asymmetric transitional vertebra seem to be less frequent causes of mistakes.

Special interest is attached to the question as to whether there is any pathogenetic relation between pelvic relaxation and disc herniation. There is indeed a certain structural and functional similarity between the pelvic joints and the intervertebral discs. It is reasonable to suppose that the discs also will be exposed to hormonal influence and increased biomechanical strain during pregnancy.

Five of our 23 patients have been treated for disc herniation, the symptoms appearing in connection with pregnancy and delivery. Walde (1962) reports that 13 out of 137 patients with relaxation were treated for disc herniation in an obstetrical material. Erics & Sjøvall (1963) maintain that lumbo-ischialgia is rather infrequent in pregnant women. From a diagnostic point of view it is important to realize that disc changes may ensue during pregnancy and closely resemble pelvic relaxation. In addition, the 4th and 5th lumbar roots have a rather close anatomical relationship to the sacroiliac joint and may be ir-

ritated by a pelvic instability giving rise to sciatica. Thus, the clinical pictures may be very similar.

Occasionally, the x-rays reveal a para-articular sclerosis of the sacroiliac joint in the medial and distal part of the ilium, as in 3 of our patients (Figure 8). Bársony & Polgár (1928) directed attention to these roentgenological changes and gave them the term *osteitis condensans ilii*. Later, several authors have reported this condition (Matsumaru 1966, Rendich & Shapiro 1936, Rojkó & Farkas 1960, Shipp & Haggart 1950).

This densifying reaction of the iliac bone seems to appear as a late manifestation in some women who have borne several children. The compressive forces in the distal part of the joint together with anatomical variants should be taken into consideration in this connection. The sclerosis, as such, apparently produces no clinical symptoms. However, it should also be remembered that Mb. Bechterew, Paget's disease, tuberculosis and primary osteoarthritis may give rise to similar roentgenological changes.

Therapy and prognosis

In most cases the symptoms disappear either spontaneously or with appropriate conservative measures during the first weeks after delivery and rarely last more than 4 months.

The material seems to indicate that the occurrence of symptoms in younger age groups, first time relaxation and early treatment after delivery constitute favourable prognostic factors. Besides, the patients usually made a quicker recovery from their first relaxation than after possible relapses. It is also emphasized that our 3 patients with the first appearance of relaxation after delivery recovered after a relatively short period of conservative treatment.

The symphyseal width and vertical mobility are not the decisive factors in the development and degree of involvement of pelvic relaxation. However, a symphyseal width of more than 10 mm and a shift more than 5 mm combined with widening and para-articular sclerosis of the sacroiliac joints have a tendency to cause a delayed convalescence. The prognosis is more doubtful in such cases treated conservatively and an operation is recommended.

Occasionally, the convalescence may also be delayed in some cases with marked back pains and normal x-rays. The symptoms are rather diffuse in these chronic cases; i. e. complaints lasting for more than 6 months after delivery. The clinical picture appears to be rather com-

plex, the original relaxation symptoms contributing only one component. Static disturbances, insufficiency of the back muscles and psychoneurotic features are prominent. The prognosis is also doubtful in such cases, and a surgical intervention is not recommended.

From an anatomical point of view it is probable that the symphyseal shift is due mainly to increased mobility of the sacroiliac joints. Therefore, in most cases where an operative treatment is indicated, it is reasonable to arthrodesis the sacroiliac joints first as a one-stage procedure. Persistent pain and instability of the symphysis requires a symphyseodesis.

A 22-year-old patient in the material with a bilateral arthrodesis of the sacroiliac joints has gone through one delivery without complications. However, the remaining 7 women were operated upon at a mean age of 35 years after the cessation of their childbearing. At any rate, it is recommended that an arthrodesis of all three pelvic joints be postponed until that time.

SUMMARY

The morphological, biomechanical, clinical and therapeutic problems of pelvic relaxation from an orthopaedic point of view are discussed in this paper.

A total of 23 patients have been treated in Martina Hansens Hospital during the period 1951–1971, 15 conservatively and 8 operatively. At follow-up, 17 patients belonged to the group "good", 3 were judged as "fair" and 3 as "poor".

Conservative treatment gives a successful result in the majority of cases. With lasting symptoms from relaxed sacroiliac joints a bilateral arthrodesis as a first stage procedure is recommended. Persistent instability and pains of the pubic symphysis require a symphyseodesis.

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