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WILL PLANE FILM EXAMINATION OF LUMBAR SPINE BE A RELIABLE METHOD TO EXCLUDE OR DISCLOSE RUPTURED DISCS?

A plane film examination of 1055 lumbar intervertebral discs is compared with discographic discovery such as discogram and verified past history pain

By

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INTRODUCTION

Previous examinations show that plane film examination of the lumbar spine gives sources of error when excluding or disclosing disc degenerations. These examinations are based upon section material, (*Friberg*, 1947, *Friberg & Hirsch*, 1950) cases operated on for lumbar herniated disc (*Malmros*, 1942, *Norlén*, 1944, *Waris* 1948, *Rövig*, 1949) and discographed cases *Perey*, 1951, *Grassberger & Seyss*, 1955, *Witt*, 1954, *Norlander, Salén & Unander-Scharin*, 1958). Despite this, plane film examination of the lumbar spine tends to become one of the most common examinations (*Larsson*, 1958) and it is also believed that this examination may serve as a guide to determine the origin of pain (*Vara & Waris*, 1951 and 1952, *Brailsford*, 1955). On the basis of this I have found it appropriate to study further the reliability of this method for use in lumbar disc degeneration. Plane film examination will be compared with discographic findings such as discograms and verified past history pain. This investigation differs from earlier ones as much as it comprises all the lumbar disc levels.

SERIES

The series includes 279 cases, 147 males (16–66 years) and 132 females (14–65 years) with low back pain and/or sciatica. In 80 cases there were no signs of the nerve root being involved. Comparative exa-

minations between plane film and discography could be carried out on 1055 lumbar discs and their distribution of level is given in Fig. 1. In 392 of these discs there is a rupture causing symptoms according to the discograms. The distribution of level of the discs is as follows: L1 9, L2 19, L3 53, L4 153 and L5 158.

TECHNIQUE

The mode of exposing film in plane film examination and discography is as follows: front view (anterior-posterior), front view 15° cranial, oblique view rotated 30° to the right and the left respectively. The same technique is used for a special view of the lumbo-sacral disc and lateral view of the four cranially situated lumbar discs and one lateral view of the lumbo-sacral disc. All exposures have been carried out with the patient in a recumbent position. The general opinion (*Knutsson*, 1942, 1944, 1957, *Severin*, 1943, *Epstein*, 1955) is that disc degeneration is present if, on plane film examination, one or several of the following changes can be observed: narrowing of the intervertebral space or collapsed disc, marginal spines or spondylitis deformans, sclerosis of adjacent vertebral surfaces with outward bending of the vertebral margins calcified patches, retroposition and vacuum phenomenon. In view of this, my series has been studied at plane film examination.

At discography transdural puncture technique has been carried out as described earlier (*Lindblom*, 1948, *Fernström*, 1960). Classification of the discogram was performed in accordance with *Fernström* (1960) viz.:

Normal discogram: The demarcation of accumulated contrast between the nucleus pulposus and the annular ligament should be distinct. Their should be no ruptures.

The early stage (ES): The nucleus pulposus can be studied on the discogram and there is a rupture in the annular ligament.

The late stage (LS): The contours of the nucleus pulposus have disappeared and there are ruptures in the annular ligament.

Partial rupture (PR): Rupture of the annular ligament which does not reach the surface of the disc.

Complete rupture (CR): Rupture of the annular ligaments which reach the surface of the disc with a local accumulation of contrast medium (subligamentous or perineural) or epidural leakage in which case the contrast medium spreads over several disc levels.

Intervertebral disc which shows a rupture on the discogram (partial

or complete) and which at puncture or contrast medium injection causes pain identical with the past history pain can be regarded as the origin of pain (*Lindblom*, 1948, 1950, *Cloward & Buzaid*, 1952, *Cloward*, 1952, 1953, 1955, 1959 and *Fernström*, 1960). That type of rupture has here been called painprovoking rupture (PPR). Whether or not this rupture shows nerve root compression cannot be determined on the discogram (*Fernström*, 1960) but is of no importance to this investigation as nerve root compression is unnecessary (*Cloward*, 1959, *Fernström*, 1960) for the onset of invalidating pain.

RESULTS

1. *Frequency and distribution to level of degenerated or ruptured discs verified by plane film and discography.*

1055 lumbar discs have been examined. The distribution is seen in Fig. 1. According to the plane film there were in 555 (52.6%) discs signs of degeneration, but discography showed a rupture in 1024 (97%) discs. The discogram shows the following types: normal 31 (3%), early stage 464 (43.9%), late stage 560 (53.1%), partial rupture 520 (49.7%) and complete rupture 504 (47.7%). The distribution of level (indicated in % of number of examined discs per level) of plane film—and discographic findings is illustrated in Fig. 1.

2. *Discogram of discs which according to plane film are normal.*

In 500 discs there were no signs of discs degeneration according to plane film. The distribution of level is seen in Fig. 2. The discogram in these discs shows the following types: normal 25 (5%), early stage 322 (64.2%), late stage 153 (30.2%), partial rupture 383 (76.6%) and complete rupture 92 (18.4 %). The distribution of level (indicated in per cent of number of examined discs per level) of discographic findings is seen in Fig. 2.

3. *Discogram of discs which according to plane film are degenerated.*

In 555 discs there were signs of degenerated discs according to plane film. The distribution of level is seen in Fig. 3. The discogram in these discs shows the following types: normal stage 6 (1.1%), early stage 142 (25.6%), late stage 407 (73.3%), partial rupture 137 (24.1%) and complete rupture 412 (74.8%). The distribution of level (indicated in

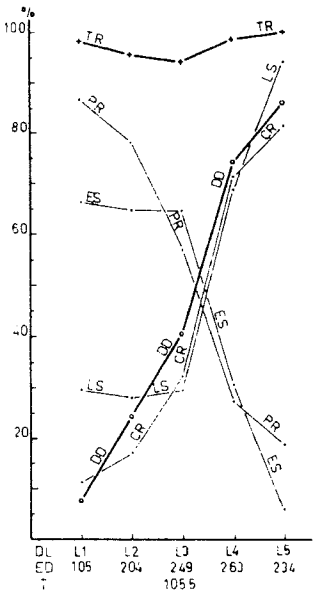

Fig. 1.

Distribution in percentage (%) of lumbar disc degeneration in relation to disc level (DL). Total (T) of 1055 examined discs (ED). DD = degenerated disc verified by plane film (o—o—o). TR = total number of ruptured discs verified by discography (+—+—+). Types of discograms (·—·—·—·) as early stage (ES), late stage (LS), partial rupture (PR) and complete rupture (CR).

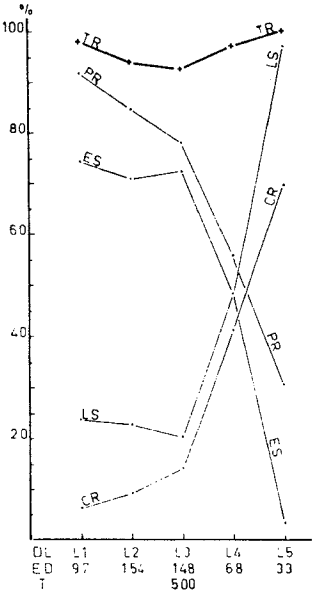

Fig. 2.

Distribution in percentage (%) of discographic findings in relation to disc level (DL) in lumbar discs which according to plane film lack signs of disc degeneration, total (T) of 500 examined discs (ED). TR = total no. of ruptured discs verified by discography (+—+—+). Types of discograms (·—·—·—·) as early stage (ES), late stage (LS), partial rupture (PR) and complete rupture (CR).

per cent of examined discs per level) of discographic findings is given in Fig. 3.

The six discs showing normal discograms only revealed slipping of the ventral surface on the plane film as a sign of disc degeneration.

4. *Frequency and distribution to levels of pain-producing ruptures verified by discography and its relation to degenerated discs verified by plane film.*

In 1024 lumbar discs the discograms revealed ruptures and in 392 (38.3%) there were painproducing ruptures (PPR). The distribution of level (indicated in per cent of examined discs per level) of disc dege-

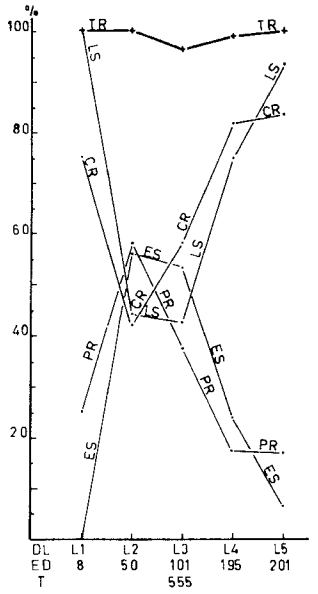

Fig. 3.

Distribution in percentage (%) of discographic findings in relation to disc level (DL) in lumbar discs which according to plane film show signs of disc degeneration, total (T) of 555 examined discs (ED). TR = total no. of ruptured discs verified by discography (+—+—+). Types of discograms (·—·—·—·) as early stage (ES), late stage (LS), partial rupture (PR) and complete rupture (CR).

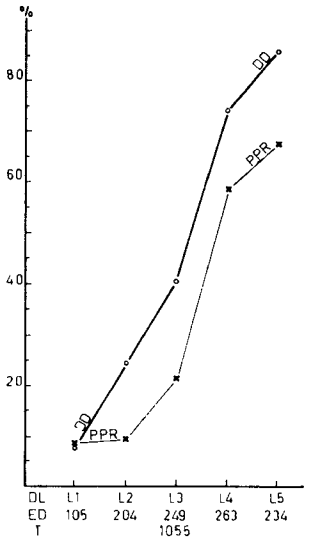

Fig. 4.

Distribution in percentage (%) of degenerated discs (DD) according to plane film (o—o—o) and pain-provoking ruptures (PPR) verified by discography (×—×—×) in relation to disc level (DL). Total (T) of 1055 examined discs (ED).

neration (according to plane film) and pain-producing rupture are tabulated in Fig. 4.

5. *Pain-producing ruptures verified by discography which according to plane film show normal discs.*

Of the 500 normal discs according to plane film, 89 (17.8 %) have pain-producing ruptures according to discography. These constitute 22.7% of all demonstrated pain-producing ruptures. The distribution of level (indicated in per cent of examined discs per level) of the 89 pain-producing ruptures is given in Fig. 5.

In 19 cases all lumbar discs are normal according to the plane film.

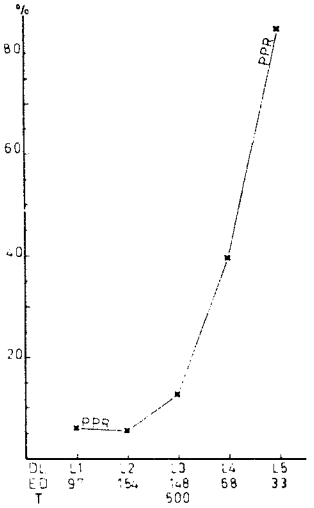

Fig. 5.

Distribution in percentage (%) of pain-provoking ruptures (PPR) verified by discography (×--×--×) in relation to disc level (DL) in lumbar discs which according to plane film lack signs of disc degeneration, total (T) of 500 examined discs (ED).

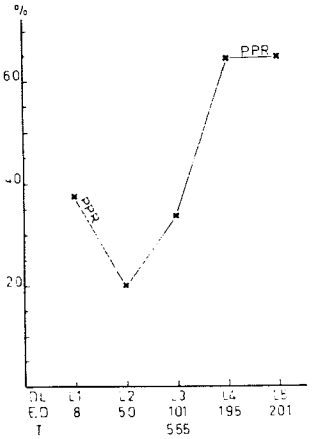

Fig. 6.

Distribution in percentage (%) of pain-provoking ruptures (PPR) verified by discography (×--×—×) in relation to disc level (DL) in lumbar discs which according to plane film show signs of disc degeneration, total (T) of 555 examined discs (ED).

In these cases discography revealed 26 pain-producing ruptures in total, 7 cases of which had multiple ruptures of that kind.

6. *Pain-producing ruptures verified by discography of discs which according to plane film are degenerated.*

Of 555 degenerated discs according to plane film 303 (60 %) had pain-producing ruptures according to discography. The distribution of level (indicated in per cent of examined discs per level) of pain-producing ruptures is given in Fig. 6.

DISCUSSION

Before beginning the discussion of the results of the investigation it should be pointed out that my series regarding the occurrence of discographically verified disc ruptures (97%) does not differ from other investigations (*Lindblom*, 1950, *Sieber*, 1952, *Friedman & Goldner*, 1955) where the figure has been given as 79–96 per cent.

My investigation shows that with plane film degeneration of the disc can only be revealed in approximately 50 per cent of the number of discs concerned. This verifies the fact that plane film is not reliable as a method of examination when disclosing degeneration of the discs —furthermore, this has been proved at sections (*Friberg*, 1947, *Friberg & Hirsch*, 1950). According to *Walk* (1953) grave degenerative changes are usually found at discography in intervertebral discs which according to plane film show signs of discs degeneration. My examination shows that there is a similar course of the curves, representing the occurrence of disc degeneration, verified by plane film and grave degenerative changes (late stage and complete rupture) revealed by means of discography. (Fig. 1). This points to the necessity of massive changes in the disc before changes occur which on the plane film are interpreted as disc degeneration.

It is not uncommon that the height of the lumbo-sacral disc is reduced on the plane film (*Hampton & Robinson*, 1936) and, according to *Knutsson* (1937) this change is of no clinical importance. *Williams & Fullenlove* (1956) believe that there can be no disc degeneration in the lumbo-sacral disc until its height is reduced to 50 per cent or more than the above-lying disc. My investigation (Fig. 1) shows that according to discography there are degenerative changes in all lumbo-sacral discs, but that plane film lacked signs of disc degeneration in 14 per cent. (Fig. 1). The source of error in plane film could no doubt have been much greater here if I had determined the lumbo-sacral disc according to *Fullenlove*. My investigation (Fig. 4) also shows that it is more common with grave degenerated changes (late stage and complete rupture) in the lumbo-sacral disc. Consequently, it must be expected that this disc will have a lowered height more often as compared with others. In view of this a lowered lumbo-sacral disc on a plane film must always be a sign of disc degeneration. Perhaps it may be considered remarkable that my series does not show one single normal lumbo-sacral disc, but other examinations (*Friedman & Goldner*, 1955) show similar conditions with respect to that level with a normal disc in 4 per cent only.

According to *Friberg & Hirsch* (1950) a normal disc on a plane film does not exclude grave degenerative changes. This has further been verified by discography (*Grassberger & Seyss*, 1955, *Nordlander, Salén & Unander-Scharin*, 1958). My investigation shows similar conditions and that this phenomenon is most usual in the two caudal discs. (Fig. 2).

If there are any signs of disc degeneration on plane film, the discogram will always show a rupture (*Lindblom*, 1951, *Grassberger & Seyss*, 1955, *Walk*, 1953). My investigation (Fig. 3) shows similar conditions and that there are usually also grave degenerative changes (late stage and complete rupture). This is most pronounced in the two caudal discs. My investigation furthermore shows that if, on the plane film, there is only slipping ventral surface, the discogram may be normal in one or two cases.

In series subjected to operation (*Malmros*, 1942, *Wiberg*, 1943, *Waris*, 1948, *Rövig*, 1949, *Björkesten*, 1954, *Knutsson & Wiberg*, 1958) lumbar herniated discs are usually to be found in the two bottom lumbar discs. Disc ruptures giving symptoms, in my series, are located similarly. (Fig. 4). Investigations based upon plane film show that disc degeneration need not cause pain (*Biström*, 1954, *McRae*, 1956, *Lindholm & Pingoud*, 1957). My investigation shows that disc ruptures caused symptoms in fully 1/3; also there were asymptomatic ruptures in all levels, however, most common in discs with the most cranial position. (Figs. 1 and 4).

It is not uncommon that a herniated disc giving symptoms originates from a disc which according to plane film is normal (*Rövig*, 1949, *Norlén*, 1944 and others) and according to *Williams & Fullenlove* (1956) this occurs in 33 per cent. My series shows symptoms from ruptured discs in fully 1/5 of normal discs as revealed in plane film and as a rule found in the two bottom discs (40–85%). (Fig. 5).

Hirsch (1951) has pointed out that a degenerated disc demonstrated on plane film does not need to be the cause of pain. My series shows that there are disc ruptures causing symptoms in 2/3 of the discs which , according to plane film show signs of degeneration. There is a certain variation with respect to level and the discs in a caudal location more often have disc ruptures giving symptoms as compared to other levels. (Fig. 6).

The investigation shows that plane film is a method of examination which, no doubt, has sources of error when it is a matter of revealing or excluding lumbar disc degeneration and consequently ruptures giving symptoms. This is also the reason why correlation cannot be demonstrated between pain and disc degeneration in cases examined with plane film. Papers have also been published (*Vara & Waris*, 1952, *Brailsford*, 1955) where plane film examination serves as a basis for conclusions regarding disc degeneration and existing pain. In view of my results these investigations must lack scientific importance.

As the sources of error in plane film are known with respect to disc degeneration and further that the film causes rather large doses of irradiation to the genes (*Larsson*, 1958) there is reason to restrict the use of this examination. This is especially important as the examination tends to become one of the frequently used roentgenologic examinations (*Larsson*, 1958). Of course plane film examination must be carried out if, in connection with existing pain, spondylitis or a tumour cannot be excluded. (*Jelsma*, 1944, *Burns & Young*, 1947, *Tomey, Poppen & Husley*, 1950, *Vara & Waris*, 1952, *Odell & Key*, 1955 and *Fernström*, 1956). But even in these diseases plane film examination is an unreliable method of examination. (*Lachman & Whelan*, 1936, *Sjöquist*, 1942, *Eiselberg*, 1952, *Bokström*, 1953, *Felländer*, 1955).

SUMMARY

Plane film and discography have been employed to examine 1055 lumbar discs in cases of low back pain and/or sciatica. The examination shows that plane film examination does not exclude sources of error as regards disclosure and exclusion of degenerated discs and, as a sequel, ruptures giving symptoms. It is then found that according to plane film, normal disc does not exclude grave degenerative changes with ruptures giving symptoms; that, according to plane film, degenerated discs does not need to be the cause of pain and that a lowered lumbo-sacral disc always implies degeneration. Due to the results of the examination and because of the plane film examination causing rather severe irradiation damage to the genes, it is necessary to be careful not to use this examination for cases with low back pain and/or sciatica unless spondylitis or a tumour is suspected.

RESUME

Le film plan et la discographie ont été utilisé pour examiner 1055 disques lombaires dans des cas de douleurs lombaires et/ou de sciatiques. L'enquête prouve que l'examen au film plan n'exclut pas les sources d'erreur en ce qui concerne la découverte et l'exclusion de disques dégénérés et, en tant que séquelles, les ruptures donnant des symptômes, Il a été constaté, au moyen du film plan, qu'un disque normal n'exclut pas de graves altérations dégénératives avec ruptures donnant des symptômes, que des disques dégénérés ne causent pas forcément des douleurs et qu'un disque lombosacré assombri indique toujours une

dégénération. Etant donné les résultats de cette enquête et du fait que l'examen au film plan peut présenter un grave danger d'irradiation pouvant influer sur les gènes, il convient d'être très prudent et de ne pas l'utiliser dans les cas de douleurs lombaires et/ou de sciatiques à moins de soupçonner la présence d'une spondylite ou d'une tumeur.

ZUSAMMENFASSUNG

Planigraphie und Diskographie wurden angewendet um 1055 Lendenwirbelzwischenscheiben in Fällen von Lumbago und Ischias zu untersuchen. Die Untersuchung zeigt, dass die Planigraphie Fehlerquellen hinsichtlich der Entdeckung und Ausschliessung von degenerierten Zwischenwirbelscheiben und folgenden symptomgebenden Scheibenbrüchen nicht ausschliesst. Man fandt daher das eine gemäss der Planigraphie normale Zwischenwirbelscheibe schwere degenerative Veränderungen mit symptomverursachendem Bruch nicht ausschliesst, dass ferner eine gemäss der Planigraphie als degeneriert zu bezeichnende Bandscheibe nicht Schmerzen hervorzurufen braucht und dass eine verschmälerte Zwischenscheibe immer eine Degeneration bedeutet. Wegen der Ergebnisse dieser Untersuchung und da die Planigraphie ziemlich schwere Bestrahlungsschäden der Keimdrüsen verursacht, erscheint es notwendig vorsichtig mit dieser Art der Untersuchung bei Lumbago und/oder Ischias zu sein, vorausgesetzt, dass nicht der Verdacht auf Spondylitis oder Tumor besteht.

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