ON CERVICAL MOBILITY

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The work described here was prompted by our interest in the pathogenesis of spontaneous cervical subluxation in rheumatoid arthritis. Anatomical studies of rheumatoid cervical spines (Ball, 1958) had revealed destructive inflammatory lesions in the disks and posterior spinal joints, but not in the ligamenta flava; segmental ankylosis, erosion of certain ligamentous attachments, and disk degeneration were also encountered. Before attempting a pathogenetic synthesis of these various morphological findings, it seemed desirable to investigate the distribution of mobility in the cervical spine, secondly, the role of the above-mentioned structures in the control of movement, and, thirdly, the effect on mobility of disk degeneration and segmental immobilization.

Material and Methods

The material consisted of 21 *post mortem* specimens of the cervical spine: twelve were considered to be healthy, and four showed only simple disk degeneration; of two other specimens removed from subjects with ankylosing spondylitis, one was radiologically normal and the other was severely affected by the disease; of the remaining three specimens, one was grossly involved by rheumatoid arthritis, one showed evidence of past polyarthritis in the form of old bony ankylosis between the sixth and seventh vertebral bodies, and one (from a patient who had suffered from Reiter's disease) showed only a localized ossification of the soft tissues on the ventral aspect of the second and third vertebrae.

Measurement of Flexion-Extension Mobility

The cervical spine was removed by separating the occipital condyles from the skull with a chisel and then transecting the spine between the second and third dorsal vertebrae. Measurements were made on the fresh specimen which was kept moist with saline throughout the procedure. After removing muscle groups, a steel pin was inserted into the anterior surface of each of the bodies of C2 to D1 inclusive. An additional pin several inches long was inserted into the body of the axis. A line was tied to the anterior arch and another to the posterior

arch of the atlas. The bodies of D1 and D2 were then fixed in a clamp so that the spine and the pins lay in a horizontal plane about 1 in. above the surface of a table covered with graph paper. The line attached to the anterior arch of the atlas was led over a pulley to a cloth bag which carried the load. The pulley, which could be rotated in the vertical plane, was carried at one end of a rigid metal bar, the other end of which was pivoted beneath the lower end of the specimen so that the bar could be swung through nearly 360°. This arrangement (Fig. 1) enabled the direction of the load to be varied. The direction in which maximum movement was obtained was determined by watching the shadow of the long pin (in the axis) cast by a distant light source. When maximum movement in anteflexion had been achieved for a given load, a radiograph was taken of the specimen.

Fig. 1.—Diagram illustrating method of measuring flexion-extension mobility.

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The load was then removed. The bar and pulley were rotated to the posterior side, and the line attached to the posterior arch of the atlas was led over the pulley as before. The load was re-applied and, the position of maximum movement in retroflexion having been obtained, a second radiograph was taken. Care was taken to maintain conditions as near static loading as possible. The two radiographs were used to measure the angular movement about each of the six disks. With the pin inserted into D1 as a reference, the difference between the angle subtended by the pin in C7 in retroflexion and ante-flexion gave the angular movement of C7 on D1. The angular movement of the pin in C6 was then measured; the difference between this angle and that calculated for C7 gave the movement of C6 on C7, and so on for each disk level. In most cases the whole process of loading and x-raying the specimen was done in duplicate; occasionally mobility was measured three or four times. In most normal and some abnormal specimens, mobility measurements were repeated after removal of (a) the spinous processes, laminae, and intervening elastic ligaments (here referred to as the posterior segments), and (b) after removal of the posterior segments and posterior spinal joints (PSJs) from C2 to C7 inclusive. The part remaining after removal of the posterior segments and PSJs is referred to here as the disk apparatus (DA); it included the vertebral bodies, the intervening disks and the anterior and posterior common ligaments.

In some experiments the effect was measured of the incision of various structures, such as the disk or the capsules of the corresponding PSJs, on the mobility.

Segmental Immobilization

The effect of segmental immobilization or reduced movement on cervical mobility was studied in (a) pathological specimens, (b) a normal specimen in which part of the cervical spine was immobilized by a steel bar bolted to the vertebral bodies, and (c) in a model of the cervical spine in which wooden blocks and solid rubber blocks represented vertebrae and disks respectively.

Ligamentous Extensibility

In selected cases the posterior segments of C2 to C7 inclusive were removed *en bloc*. After inserting marker pins into the spinous processes of C2 and C7, the laminae and spinous process of the axis were fixed in a clamp and increasing traction was applied to the laminae of C7 so as to stretch the ligaments longitudinally. Radiographs were taken at each load increment between 150 g. and 4 kg. The extensibility was estimated by measuring the difference between the length at 250 g. and 4 kg. and expressing the result as a percentage of the length at 250 g.

Results

In both healthy and abnormal specimens, it was found that most of the angular movement in flexion-extension occurred with relatively small loads of up

to about 2 kg., further load increments producing only relatively slight increases in movement (Fig. 2).

Fig. 2.—Effect of load on flexion-extension mobility in a healthy specimen (●—●), an atypical arthritic (x—x), and a rheumatoid specimen (○—○).

Loads greater than 4 kg. (the approximate weight of the head) were not practical because they were apt to result in the collapse of the vertebral body fixed between the jaws of the clamp.

Table I (opposite) presents the results of repeated estimates of the overall mobility produced by a load of 4 kg. in nine normal specimens, and in the same specimens after removal of the posterior segments and again after removal of the posterior segments and PSJs. It will be seen that in each case the initial estimate tended to be somewhat less than the second or third measurement. The reason for this systematic error is not known. Nevertheless, there was a surprisingly good order of reproducibility, the difference between the first and second measurements of total mobility in the whole spine, for example, varying between 0° and 4.5°, i.e. less than 5 per cent. To facilitate further comparisons, first estimates alone will be given.

Normal Spine

Overall Mobility.—In the normal spines (Tables I and IV) this ranged from 65.5° to 110.5° with a load of 4 kg. This remarkable variability persisted after removal of the posterior segments and the PSJs. Thus, the disk apparatus itself exhibits the order of mobility characteristic of the intact specimen. The results also indicate that variation in mobility may occur in both young and elderly adult

TABLE I
FLEXION—RETROFLEXION MOBILITY (°) AT 4-kg. LOAD IN NORMAL SPINES

Case No.	Sex	Age (yrs)	A	B	C
			Untreated Specimen	A after Removal of Posterior Segment	B after Removal of Posterior Spinal Joints
1	M	70	65.5 65.5 65.5	73.5 75.5 76	94 96
2	M	25	77.5 81 82 82.5	90.5 94.5 95	96.5 98 96
3	M	22	83.5 86 86.5	100 102.5	—
4	M	49	87.5 90.5 91	102 103	—
5	F	42	93 95	111 110.5	129 133.5
6	M	40	94.5 98	110 113	125.5 133
7	F	43	98.5 103 108	115 116.5	126.5 127.5
8	F	55	109 111 110.5 109.5	—	—
9	M	22	110.5 111	—	—

in-patients, though the series is obviously too small to exclude a relationship between mobility and age. The variation in mobility suggested either differences in length or extensibility of the fibrous and elastic structures resisting angular movement in the sagittal plane. The latter possibility was tested by measuring the extensibility of the isolated posterior segments in a group of twelve cases among which the overall spinal mobility varied between 20° and 110.5° with a 4-kg. load. Of the twelve spines, seven were normal; the remaining five included one case of rheumatoid arthritis with a much reduced mobility

due to ankylosis of the PSJs, a case of “past polyarthritis” in which low mobility was due mainly to ankylosis of the bodies of C6 and C7, and a radiologically normal cervical spine from a case of ankylosing spondylitis. The results (Table II and Fig. 3) show that the extensibility of the posterior segments is variable; they also indicate that there is

TABLE II
RELATION OF OVERALL CERVICAL MOBILITY TO EXTENSIBILITY OF CERVICAL ELASTIC LIGAMENTS

Per cent. Extension (0.25-4 kg.)	Total Movement (°) of Intact Spine	Condition of Spine
3.4	20.5	Rheumatoid arthritis
12.6	58	Past polyarthritis
8.3	65.5	Normal
9.1	75.5	Disk degeneration
9.5	78	Ankylosing spondylitis
9.5	77.5	Normal
12	83.5	Normal
9.7	87.5	Normal
16	90	Disk degeneration
20	94.5	Normal
18.2	98.5	Normal
27	110.5	Normal

Fig. 3.—Relationship of total flexion-extension mobility of cervical spine to extensibility of isolated elastic ligamenta flava in twelve cases.

a direct relationship between the overall mobility of the intact spine and the extensibility of the posterior elastic ligaments. If the logarithmic values of per cent. extensibility are used in the calculation, $r = +0.90$ as compared with $r = +0.80$ if the arithmetic values of per cent. extensibility are used. The two correlation coefficients do not differ significantly from each other, but the difference of either from zero is highly significant ($P < 0.001$). The cause of the variation in extensibility of elastic ligaments remains unknown. It is not due to change in cross-sectional area of the ligaments; the least extensible ligament was in fact thinner than the rest. Histologically, all the ligaments appeared to be healthy and closely similar when stained for collagen and elastic fibres and metachromatic material, except for the least extensible ligament in which the fibrous tissue between the elastic fibres was less prominent.

The overall mobility was increased after removal of the posterior segments, and further increased after the additional removal of the PSJs (Table I and Fig. 4).

In most cases the increased movement occurred mainly in ante flexion. The degree of ante flexion was also increased at a given disk level if the corresponding disk apparatus was completely transected, all other structures (PSJs and posterior segments) remaining intact (Table III).

Comparison of radiographs taken respectively in ante flexion and in retro flexion indicated that in healthy spines angular movement tends to be accompanied by a horizontal movement of the vertebral bodies relative to one another (Figs 5

Fig. 4.—Flexion-extension mobility at each disk level in a healthy specimen (o—o), in the same specimen after removal of the posterior segment (x—x), and in the same after removal of posterior segment and posterior spinal joints (o—o).

TABLE III
EFFECT OF SECTION OF DISK APPARATUS ON MOBILITY IN ANTEFLEXION WITH A 4-kg. LOAD

Spine		Angle (°) between Vertebrae				
		C6/7	C5/6	C4/5	C3/4	C2/3
A fixed at C7	Untreated ..	6	9	12	7	6
	After section of C4/5 disk ..	6	9	15.5	7.5	6
B fixed at C5	Untreated ..	—	—	14	0	6
	After section of C3/4 disk ..	—	—	13	3	6

and 6, opposite). The amount of forward and backward shift varied somewhat from case to case and

TABLE IV
DISTRIBUTION OF CERVICAL MOBILITY AT 4-kg. LOAD

Case No.	Sex	Age (yrs)	Total Mobility	Mobility at Disk						Condition of Spine
				C2/3	C3/4	C4/5	C5/6	C6/7	C7/D1	
1	M	70	65.5	4.5	7	16	14	17	7	Normal
2	M	25	77.5	9.5	11.5	12.5	19	17.5	7.5	
3	M	22	83.5	6	12	18	18	17.5	12	
4	M	49	87.5	10	17.5	18	19	14	9	
5	F	42	93	12	20	18.5	17.5	18.5	6.5	
6	M	40	94.5	10	16.5	17.5	24	16.5	10	
7	F	43	98.5	10	14.5	17	24.5	19	13.5	
8	F	55	109	11	19	28	25	14.5	11.5	
9	M	21	110.5	12.5	18	18	21	24	17	
Mean (Cases 1 to 9)			90.9	9.5	15.1	18.1	20.2	17.6	10.4	Normal
10	M	55	90	6.5	16.5	18	21.5	16	11.5	Disk Degeneration
11	M	50	70	5	18	11	11	11	14	
12	M	69	75.5	9	20	13	20.5	4.5	8.5	
13	M	65	—	—	—	—	18.5	3	11	
14	M	45	79.5	1.5	9	19.5	17	21	11.5	Reiter's Syndrome
15	M	65	58	9	14.5	9.5	15	0.5	9.5	Old Past Polyarthrititis
16	M	63	10	10	0	0	0	0	0	Ankylosing Spondylitis

Fig. 5.—X rays of disk apparatus, showing slight horizontal movement during flexion and extension in (a) a male aged 25 years and (b) a male aged 70 years.

Fig. 6.—X rays showing maximum degree of horizontal movement during flexion and extension encountered in healthy specimens. The horizontal movement is the same in the disk apparatus and the whole specimen.

from one disk level to another. It was barely discernible in Cases 1 and 2 in which the range of angular mobility was relatively small; in the remainder a variable shift of up to 1 mm. either side of the neutral position occurred. The horizontal component of movement in flexion and extension

was not altered by removal of the posterior segments and PSJs (Fig. 6).

Distribution of Angular Movement.—This follows a regular pattern (Table IV, previous page) in normal cervical spines, angular movement at the first (C2/3)

and sixth (C7/D1) disks being about the same and invariably less than movement at the other disks (Table IV and Fig. 11, below, p. 436). In one specimen from a young adult, movement at the 3rd, 4th, and 5th disks was about the same, but in most specimens angular mobility was greatest between C5 and C6. Removal of the posterior segments and the PSJs had no appreciable effect on the distribution of angular mobility. The distribution of movement in the model differed from that observed in the specimens in that angular movement in the model increased linearly from the first to the fifth disk.

Disk Degeneration

The overall mobility and distribution of movement in four cases of simple disk degeneration are shown in Table IV. The radiological appearances of the affected disks are shown in Figs 7 to 10. It will be seen that, as the disk narrows and osteophytes develop, its angular mobility is reduced; and removal

of the posterior segments and PSJs failed to restore the mobility to normal. Thus, in advanced disk degeneration, the disk apparatus itself had little angular mobility. Moreover, it may be stable to loads of up to 4 kg. In Case 12 (Fig. 9) the degenerate and relatively immobile C6/7 disk apparatus survived a load which in retroflexion caused avulsion of the apparently healthy C5/6 disk above it.

In Case 13 (Fig. 10*a, b*, opposite) there were two degenerate disks, one of which (C5/6) had normal angular mobility, whereas in the other (C6/7) angular mobility was greatly reduced. Fig. 10*b*, an x ray of a central sagittal slab of this spine, shows more clearly the differences in the bony anatomy between the mobile and immobile degenerate disks. At the anterior upper margin of C6 the normal bevel is exaggerated and there are no osteophytes. The posterior upper margin of C6 is abnormal in being bevelled, and the bevelled outline is apparently due to the combined effect of some flattening of the upper posterior rim and the production of a wedge-shaped osteophyte on the upper posterior surface

(Fig. 7)

(Fig. 8)

Fig. 7.—Slight narrowing of C6/7 disk without osteophyte formation. Mobility at this level was within the normal range.

Fig. 8.—Moderate narrowing of C4/5, C5/6, and C6/7 disks with osteophyte formation. Mobility was reduced at the affected levels.

Fig. 9.—Severe narrowing with osteophyte formation at the C6/7 disk where angular mobility is grossly reduced and horizontal movement during flexion and extension is absent.

Fig. 10.—(a) Disk apparatus in flexion and extension. There is exaggerated horizontal movement at the degenerate but mobile 4th disk. At the degenerate 5th disk both angular and horizontal movements are much reduced.

(b) Central sagittal slab section of degenerate disks shown in Fig. 10(a).

of the vertebral body. In contrast, the antero-posterior diameter of the upper surface of C7 is greatly increased by the absence of an anterior bevel, and by the development of bony projections at the anterior and posterior rims at the level of the vertebral plate. The opacities in the C6/7 disk

space were shown by x-ray examination and histological sections of serial blocks to be due to discontinuous focal ossifications of the upper and lower vertebral cartilaginous plates. Another difference between the mobile and fixed degenerate disks in Case 13 is illustrated in Fig. 10a, which shows that there was a considerable horizontal movement forwards and backwards of C5 on C6 during flexion and extension; but no perceptible horizontal movement occurred at the C6/7 level where there was only 3° of angular movement. This horizontal movement in the mobile degenerate C5/6 disk was palpably different from that observed in normal spines in that it could be appreciated and produced manually in the fresh specimen with little effort.

Segmental Immobilization

When the upper, middle, or lower part of the wood and rubber model of the cervical spine was immobilized by a rigid metal bar, it was found that the angular mobility in the unfixed parts remained virtually unaltered. This occurred with both a low (500 g.) and a high load (2 kg.). In one experiment, fixation of the upper four blocks reduced the overall mobility by precisely the amount which these four blocks had moved before fixation; restoration of the original overall mobility required a 50 per cent. increase in load. Thus, for a given load, segmental immobilization in the model resulted in reduction in overall angular movement, but no increase in stress (as judged by angular movement) on the unfixed segments.

Experimental immobilization of the upper four disks in a healthy human cervical spine reproduced the above findings, movement in the 5th and 6th disks remaining unchanged. The fixation resulted in a reduction of the overall mobility from 100° to 31° with a 2-kg. load. When the load was doubled the overall mobility was increased only from 31° to 38°.

Examples of naturally occurring segmental immobilization and/or segmental reduction in mobility were encountered in cases of disk degeneration, Reiter's disease, past polyarthritis, and ankylosing spondylitis. It will be seen (Table IV and Fig. 11a and b, overleaf) that reduced movement in the upper, middle, or lower cervical spine was not apparently associated with definite evidence of increased mobility at unaffected disk levels. In Case 11 the overall reduction in mobility due to disk degeneration of the third, fourth, and fifth disks may have amounted to 20°, but it is doubtful whether there was any increase in angular movement at the remaining disk levels; similar findings were obtained

Fig. 11.—Effects of segmental reduction in mobility.

in Case 21, in which movement at the C6/7 disk was completely absent due to old bony ankylosis. The most striking example, however, was seen in Case 16, a male aged 63 years whose ankylosing spondylitis had probably been inactive for many years. In spite of the complete absence of movement at the second to sixth disks inclusive and a completely stable atlanto-axial joint, movement at the first disk (which was apparently healthy) was virtually the same as the mean normal.

Discussion

With the first dorsal vertebra fixed in a clamp, a static load of 4 kg. applied to the atlas produced a mean angular deflexion between anteflexion and retroflexion of 90·9° in healthy *post mortem* specimens. This movement was distributed as follows, the figures in brackets being comparable values obtained by Kottke and Mundale (1959) from radiological measurements in 78 living young men:

- C2/3, 9·5 (11);
- C3/4, 15·1 (16);
- C4/5, 18·1 (18);
- C5/6, 20·2 (21);
- C6/7, 17·6 (18);
- C7/D1, 10·4 (not measured).

The close agreement as regards overall mobility and its distribution suggests that the method used in the present study reproduced *in vivo* conditions of loading during full flexion and extension of the neck.

A considerable range of flexion-extension mobility (65·5° to 110·5°) was encountered in healthy specimens. It seems unlikely that this was due to differences in the length of ligamentous structures because

the variation persisted after removal of the posterior segments and the PSJs, and there was no demonstrable variation in the height of the disks. An alternative explanation is that the extensibility of the ligaments was variable. Confirmation of this possibility—at least for the elastic ligaments—was obtained by direct measurement of the isolated posterior segments, and by the observed positive correlation between the degree of extensibility of posterior segments from individual cases and the overall mobility of the intact spine from which they were derived.

In the normal specimens, the variation in mobility is presumably a consequence of differences in individual habits of cervical movement during life. In certain abnormal spines, reduced mobility was obviously due to inflammatory ankylosis of the PSJs. In such cases it seems reasonable to suppose that the reduced ligamentous extensibility was the effect, not the cause, of the reduced cervical mobility. The present findings suggest the possibility that ligamentous structures are capable of reversible changes in extensibility; and it may be that this mechanism in part explains the stiffness which characteristically follows temporary immobilization of a joint, and the improvement that may follow persistent efforts to increase the range of movement. Just how ligamentous extensibility alters is not known. In the present experiments it was clearly not due to changes in thickness, since the cross-sectional area of the least extensible ligament was less than all the others examined. Histologically, five ligaments of widely varying extensibility were similar as regards the appearance of the fibrous and elastic elements. A thorough histochemical examination might of course be more rewarding. Nevertheless,

the absence of gross structural differences suggests the speculation that physico-chemical changes in intermolecular cross-linkages (Gotte, Stern, Elsdén, and Partridge, 1963) may be involved, these being weakened (or prevented from forming) by the repeated application of stress in the longitudinal axis of a ligament and strengthened in their absence. In this connexion it is perhaps relevant to mention some recent observations of Partington (1964), who found that the equilibrium water uptake of rat-tail tendon increased with increasing stress—a result that could be due to shearing of cross-linkages.

The disk apparatus, the capsule of the PSJs, and the posterior segments all resist forward flexion. Section or removal of any of these results in some increase in angular mobility. This suggests that all three structures are in phase when the spine is fully flexed. Their physical properties are consonant with this interpretation. Thus the posterior segment, the most extensible of the three, is furthest from the fulcrum; the disk and common posterior ligament, probably the least extensible, are nearest to the fulcrum; the capsule of the PSJs, which is essentially a woven fibrous fabric, lies in an intermediate position. The fact that the variation in mobility in healthy specimens is virtually unaffected by removal of the posterior segments and PSJs also argues for the co-ordinated functional activity of these structures and the disk apparatus. The above conclusion is important from a pathological point of view, because it implies that a weakness in any one of these structures might lead to increased stress in the others.

The present findings indicate that disk degeneration characteristically leads to progressive loss of mobility at the affected level and the development of osteophytic outgrowths above and below the disk in the plane of the vertebral plates, the diameters of which are thereby increased. The osteophytes grow into the outer part of the disk annulus and into the common ligaments, effectively reducing their length and thus countering the effect of vertical disk collapse. Collapse of the disk may be assumed to lead to some increase in the vertical stress transmitted through the PSJs and to thus promote the development of osteo-arthritis and osteophytosis in them, changes which are likely to contribute to the stabilization of the affected segment. The severely degenerate disk is virtually immobile and may remain so after removal of the posterior segments and PSJs; this implies that the anterior and posterior common ligaments are not involved in the degenerative process. The severely degenerate disk apparatus itself is, in fact, remarkably stable to

loading in flexion and extension, but according to Roaf (1960) it is abnormally susceptible to torsional stress.

Sometimes, apparently, narrowing of the disk and osteophyte formation may be associated with abnormal mobility in which angular movement occurs with insignificant loads and is accompanied by an exaggerated horizontal movement. The single example of this type of degenerate disk encountered in the present study differed from the immobile type in that the upper anterior and posterior margins of the vertebra below the affected disk were bevelled as though they had been worn away.

In specimens in which part of the cervical spine was partially or completely immobilized, experimentally or by disease processes, the overall mobility was reduced, there being no clear evidence of a compensatory increase in mobility in the unaffected parts. Since, in some of the pathological specimens there was good reason to suppose that the segmental immobilization had been present for some considerable time, it would seem that patients prefer to accept the limitation rather than make any effort to overcome it. The reason for this may well be that the effort is not worth while, since in a human cervical spine the overall mobility of which had been experimentally reduced from 100° to 31°, a 100 per cent. increase in load increased the mobility by only 7°. The pathological significance of segmental immobilization would seem to be that the remaining mobile segments are at risk of being exposed to excessive stress in a sudden voluntary, involuntary, or passive attempt to extend the range of movement, but provided this does not occur segmental immobilization is not intrinsically harmful.

Summary

The mobility of healthy unfixed specimens of human cervical spines in the sagittal plane varied between 65° and 110° when subjected to a static load of 4 kg.

The variation in mobility was attributed to differences in the extensibility of the controlling ligaments. Direct measurements indicated that the extensibility of the ligamenta flava varied considerably and was positively correlated with the overall mobility of the spine from which it was derived.

The distribution of cervical movement followed a regular pattern, angular deflexion being invariably less at the C2/3 and C7/D1 levels than elsewhere.

Disk degeneration was associated with progressive

restriction of movement at the affected level.

Segmental immobilization was not associated with increased mobility of the unaffected parts but, because of the overall reduction in the range of movement in the neck, the latter may be exposed to excessive stress through attempts to increase the range.

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Sur la mobilité cervicale

RÉSUMÉ

La mobilité des spécimens sains et sans entrave des épines cervicales humaines dans le plan sagittal varie entre 65° et 110° lorsqu'on les soumet à une charge statique de 4 kg.

Les variations de la mobilité sont attribuées à des différences d'extensibilité des ligaments en contrôle. Des mesures directes indiquent que l'extensibilité des ligaments jaunes varie considérablement et se rapporte

directement à la mobilité générale de l'épine correspondante.

La distribution du mouvement cervical a une forme régulière, la déflexion angulaire étant invariablement moindre aux niveaux C2/3 et C7/D1 qu'ailleurs.

La dégénérescence du disque est associée à une restriction progressive du mouvement au niveau affecté.

L'immobilisation segmentaire n'est pas associée à une mobilité augmentée des parties libres mais, en raison de la réduction générale de l'étendue du mouvement du cou, celui-ci peut être soumis à une fatigue excessive par des efforts tendant à augmenter cette étendue.

La movilidad cervical

SUMARIO

La movilidad de los especímenes sanos y sin trabas de espinas cervicales humanas en el plano sagital varia entre 65° y 110° cuando llevan una carga estática de 4 kg.

Las variaciones de la movilidad se atribuyen a diferencias de extensibilidad de los ligamentos que la controlan. Medidas directas indican que la extensibilidad de los ligamentos amarillos varia considerablemente y está en correlación positiva con la movilidad general de la espina de la cual deriva.

La distribución del movimiento cervical toma una forma regular, siendo la deflexión angular invariablemente menor a los niveles C2/3 y C7/D1 que en otras partes.

La degeneración del disco se ve asociada con una restricción progresiva del movimiento al nivel afectado.

La inmovilización segmentaria no se ve asociada con movilidad aumentada de las partes libres pero, en vista de la reducción general de la extensión del movimiento del cuello, éste puede sufrir fatiga excesiva a consecuencia de tentativas para aumentar esta extensión.