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Adjustment and the central nervous system

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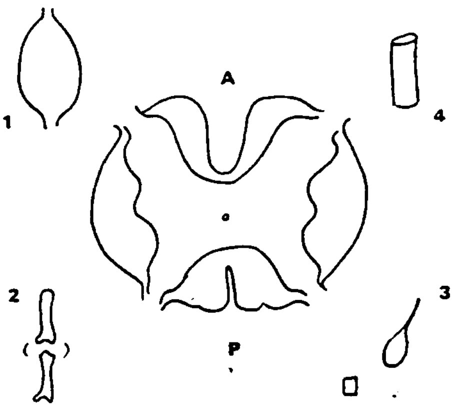
For the purpose of this text we shall divide the central nervous system into four parts: muscular, articular, cutaneous and vascular (Fig. 1). Discussion of the four aspects will be preceded by a short anatomical review of the medulla oblongata.



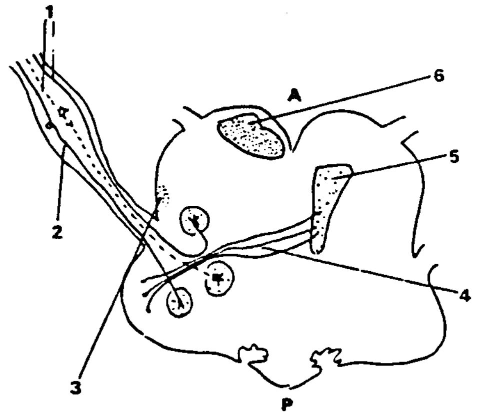
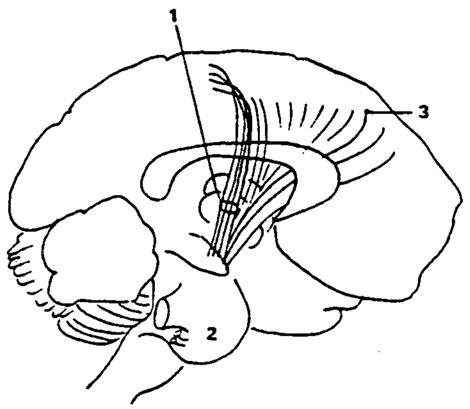


Figure 1. (*left*) The four aspects of the central nervous system. 1, muscular; 2, articular; 3, cutaneous; 4, vascular.

Figure 2. (*right*) A tranverse section of the medulla oblongata. 1, outgoing motor and parasympathetic vagus nerve; 2, incoming vagus nerve; 3, anterior spinocerebellar tract; 4, decussatio lemniscorum; 5, ascending medial lemniscus; 6, descending corticospinal tract.



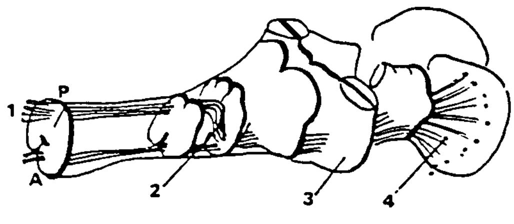


Figure 3. (*left*) The pathway of the Betz motor axons. 1, corticospinal tract; 2, pons; 3, Betz motor cells.

Figure 4. (*right*) The decussation of the main lateral corticospinal tract. 1, main lateral corticospinal tract; 2, decussatio; 3, pons; 4, internal capsule.

Middle medulla oblongata

A tranverse section of the medulla oblongata taken at the upper border of the foramen magnum, shows descending, ascending, incoming and outgoing tracts (Fig. 2). The Betz motor cells, located in the precentral gyrus of the motor cortex, send their axons down through the internal capsule, through the pons, then, after passing through the medulla oblongata, they become the anterior pyramidal or corticospinal tract (Fig. 3) where most of the fibres intersect with the main lateral corticospinal tract (Fig. 4). Further down these fibres make synaptic contact with the motor cells in the anterior horns of the medulla

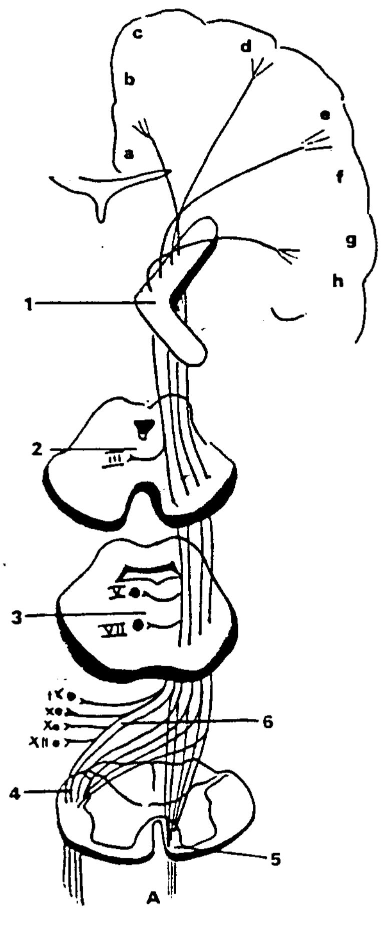


Figure 5. The pathways to the motor end-plates. 1, internal capsule; 2, basis pedunculi; 3, pons; 4, lateral corticospinal tract; 5, direct pyramidal tract; 6, decussation of pyramids. a, toes; b, knee; c, hip; d, elbow; e, thumb; f, eyelid; g, lips; h, tongue.

spinalis and so terminate in the motor endplates of the appropriate muscles (fig. 5). (In its pontile portion the corticospinal tract projects numerous branches to the cranial nerves of the opposite side for the face, eye and throat muscles.)

The sensory fibres from the muscle structures (Golgi tendon organs and muscle spindles) then re-enter the posterior horns and make synaptic connections with the ascending anterior and lateral posterior spinocerebellar tracts and the spino-olivary cerebellar tract (Fig. 6). From the cerebellum, fibres extend to the posterior central sensory gyrus, closing the circuit. The cerebellar connections provide upper neuron conscious reflex proprioception.

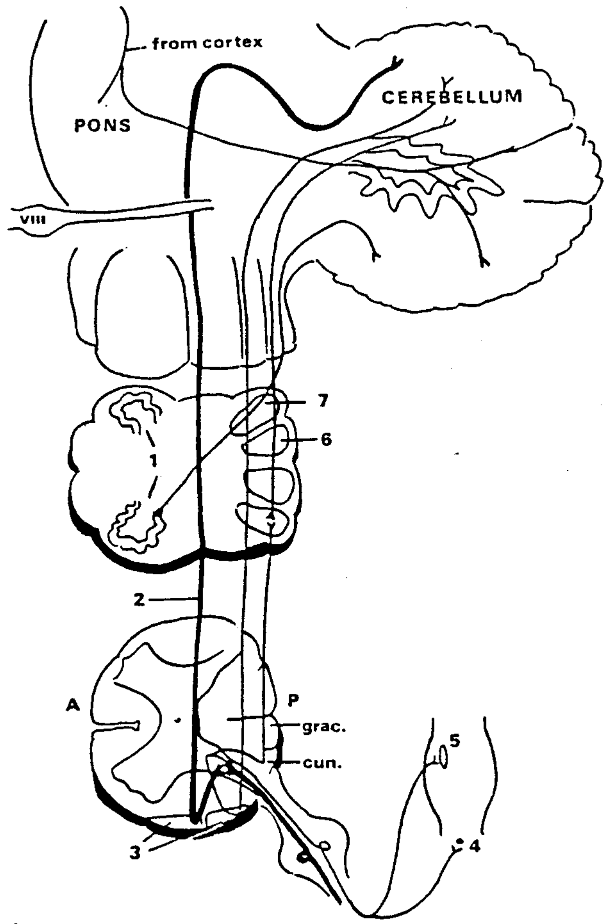


Figure 6. The synaptic connections of the Golgi tendon organs and muscle spindles. 1, inferior spino-olivary cerebellar tracts; 2, pain and temperature fibres; 3, anterior and posterior spinocerebellar tracts; 4, Golgi tendon organs; 5, muscle spindles; 6, nucleus gracilis; 7, nucleus cuneatus.

The tension in the articular capsules is transmitted by the sensory fibres to the tracts of Goll and Burdach (gracilis and cuneatus). At the level of the medulla oblongata, the Goll and Burdach tracts become the crossed fibres of the medial lemnisci and pass through the internal capsule finally reaching the posterior central sensory gyrus (Fig. 7) to become part of the great sensory motor circuit.

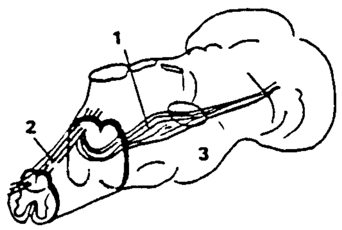


Figure 7. The Goll and Burdach tracts become the crossed fibres of the medial lemniscus. 1, medial lemniscus; 2, Goll gracilis and Burdach cuneatus; 3, pons.

Just as the sympathetic motor cells are located in the horns of the medulla spinalis, the parasympathetic motor cells are located in the medulla oblongata. For example, the parasympathetic motor cells to the vascular structures innervated by the vagus nerve travel to the larynx, stomach etc, and the sensory fibres carry the information back in. These sensory and motor parasympathetic structures are then relayed with collaterals along with the other structures of the medulla oblongata which have just been described.

The primary motor cells of the autonomic nervous system (sympathetic and parasympathetic) are located in the mammillary body which is beneath the hypothalamus. The pain, temperature and light sensations which come from the skin, travel up the spine via the anterior and lateral spinothalamic tracts and by way of the thalamus reach the posterior gyrus of the cerebrum.

Note. Sensory fibres entering the posterior horn of the medulla spinalis to relate to the longitudinal spinothalamic fibres also connect with the reticular system about which very little is known.

1. Muscular

When the Achilles tendon, triceps tendon or Masseter muscle tendon is stretched by the blow of a reflex hammer, the Golgi tendon organs are stimulated which produces a muscle contraction (Fig. 8). This movement is controlled by the muscle spindles and gamma

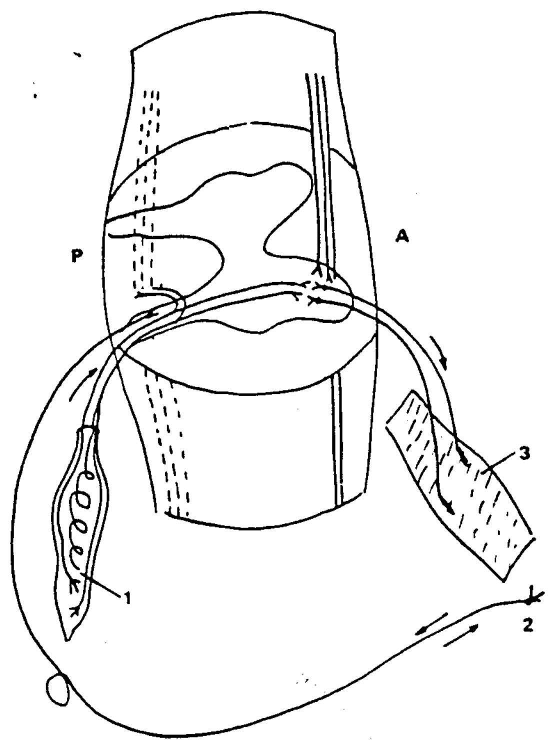


Figure 8. Muscle contraction by Golgi tendon organ stimulation. 1, muscle spindle; 2, Golgi tendon organ; 3, muscle.

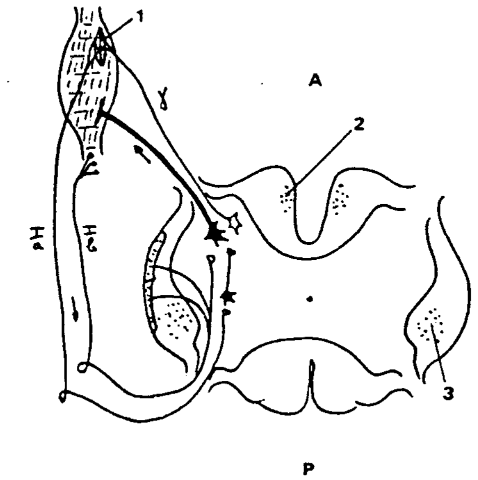


Figure 9. Muscle and spindle stretching. 1, muscle spindle; 2, anterior direct pyramidal (corticospinal) tract; 3, lateral corticospinal tract.

motor fibres. The gamma motor fibres come from the cerebellum and extrapyramidal structures. Indeed, muscle stretching produces spindle stretching and firing of the Ib fibres which inhibit the motor neuron at the same level (Fig. 9).

In a case of cerebellar lesion there will be a rebound and/or pendular phenomenon. In a case of substantia nigra discolouration there will be a Parkinsonian tremor. Normally the gamma fibres from the cerebellum and extrapyramidal structures control the action of the motor neurons, but in the two cases described (cerebellar lesion and Parkinsonism) the gamma fibres are disturbed, the muscle tensions are not checked properly and therefore rebound, tremor and such phenomena occur. Lesions of the corticospinal tracts above the motor cells will produce spastic type symptoms called upper motor neuron lesion. When the lesion is beneath the motor cell a lower motor neuron lesion is demonstrated by muscle flascidity, as in polio and nerve section.

The preceding section was necessarily intricate in order that we may further appreciate the key to our daily work—the adjustment. When a multifidus muscle is tightened into a knot, relaxation can be produced by separating its insertions but a spastic reaction is more likely. When the muscle insertions are separated rapidly as in the adjustment, the spindles are too slow to react and the tonus of the muscle drops alleviating this muscular type of subluxation. This is a local phenomenon, but it has its central implications (medullary and cerebral). For example, if an intertransverse muscle happens to be hypertonic, by overstretching the antagonistic muscles, adaptation will follow and the tense muscle will relax partially. The combination of stretching the antagonistic muscle whilst at the same time specifically adjusting the hypertonified muscle is one of the subtleties of the adjustment.

2. Articular

Tension of the articular capsules is conveyed by the deep sensibility fibres to the posterior horn of the medulla spinalis, through the tracts of Goll and Burdach to the thalamus and on to the cerebral hemispheres (Fig. 10). These 'deep sensibility fibres' also convey feelings of deep pressure, vibratory osseous sensations and proprioception (Romberg) sensations. An overstretched capsule will normally produce a local defensive muscular contraction,

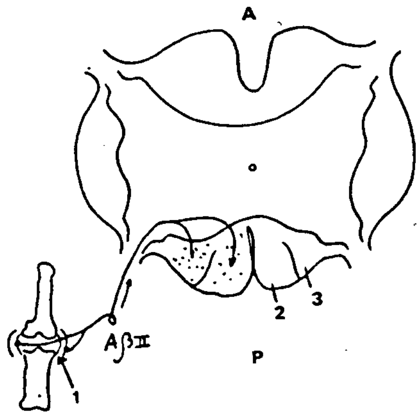


Figure 10. Tension conveyance of the articular capsules. 1, articular capsule (Wyke receptors); 2, Goll; 3, Burdach.

but if the overstretching happens too fast the protective mechanisms will be too weak or too slow and the capsule will be torn.

The 'deep sensibility fibres' convey vibratory sensations which are disturbed in cases of diabetes and/or anaemia. Although the conscious perception of a capsular fixation and the sensation of vibration are conveyed by the same fibres, one can say from experience that freeing a fixation (subluxation) stops perception of that fixation.

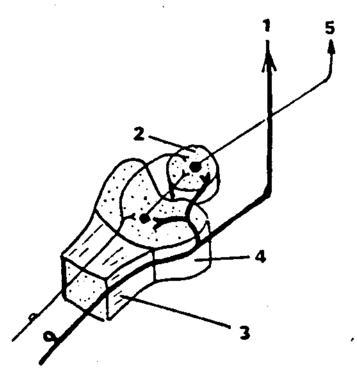
Does the adjustment normalize a disturbed sensation of vibration? To show the intricacy of the phenomenon, we can say that a capsular fixation often produces oedema and ischaemia in the corresponding zone. Research into the hypothesis of a vascular-capsular reflex is in progress.

3. Cutaneous

Deep pressure sensation is transmitted to the posterior horn of the medulla spinalis and then relayed via the Goll and Burdach tracts to the higher structures (Fig. 11). Light touch in the same way enters the medulla spinalis, but its fibres cross to the opposite side and join the anterior spinothalamic tract (Fig. 12). Similarly, burning sensations are related to the lateral spinothalamic tract (Figs. 11 and 12). Both anterior and lateral spinothalamic tracts ascend the medulla oblongata, reach the thalamus (as their name suggests), and from the thalamus the information reaches the posterior central gyrus of the sensory cortex. Deep pressure fibres convey impulses at the speed of 50 m/sec; light touch fibres at 70 m/sec and pain and temperature fibres at 1 m/sec.

'Melzack's portal theory' suggests that, at the level of the posterior horn, some information is allowed to pass whereas other information is blocked; the gate is closed. You withdraw a finger from a candle flame (this is a local segmental reflex), but you escape from a house fire (this is a central reflex). The normal local reaction to stepping on a pin is flexion of the hip, knee and foot and extension of the toes. Toe extension is present normally in neonates, but when myelinization of the motor tracts is fully developed, the toes show the normal flexion reflex. Extension of the toes is then a sign of motor tract disturbance (the Babinski sign).

The rationale of this discussion about the speed of nerve conduction, Melzack's gate theory, transverse and longitudinal collaterals, demonstrates that a great number of phenomena are understood, however, their intricacy forbears any conclusions.



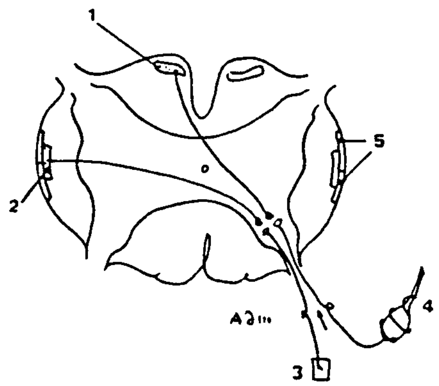


Figure 11. (*left*) The pathways of deep pressure, pain and temperature sensations. 1, Goll gracilis and Burdach cuneatus tracts (deep pressure route); 2, nucleus proprius; 3, marginal zone of Lissauer; 4, substantia gelatinosa Rolando; 5, spinothalamic tract (pain and temperature route), ▬▬ Thick faster fibres block the nucleus proprius.

Figure 12. (*right*) The light touch, pain and temperature pathways. 1, anterior spinothalamic tract; 2, lateral spinothalamic tract; 3, pain and temperature fibres; 4, light touch fibres; 5, anterior and posterior lateral spinocerebellar tracts.

A whiplash injury often tears part of the medulla spinalis and breaks vertebral bodies. The tear in the medulla produces the symptoms of syringomyelia or an upper motor neuron lesion depending on the site. Traction applied to these vertebrae corrects the fracture, but increases the gap in the medulla. The scar formation that follows then acts as a block to normal conduction (Fig. 13). The treatment can then be worse than the lesion. As was previously suggested the adjustment closes Melzack's gate and acts on the little known reticular formation, the adjustment also produces some kind of traction on the medulla. One may therefore only speculate about the answer to the question—how far reaching is the effect of the adjustment?

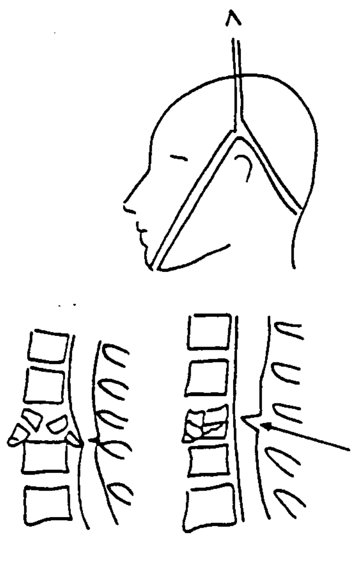


Figure 13. Scar formation in the medullar gap (arrow).

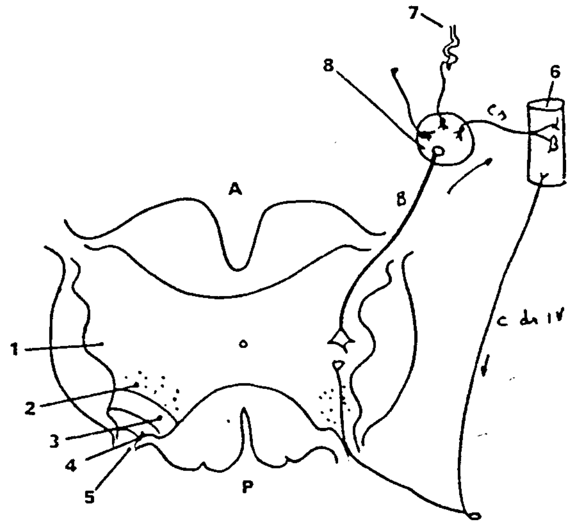


Figure 14. The neurovascular circuit. 1, lateral horns; 2, reticular formation; 3, nucleus proprius; 4, tract of Rolando; 5, tract of Lissauer; 6, vascular structures; 7, sweat gland; 8, sympathetic ganglion.

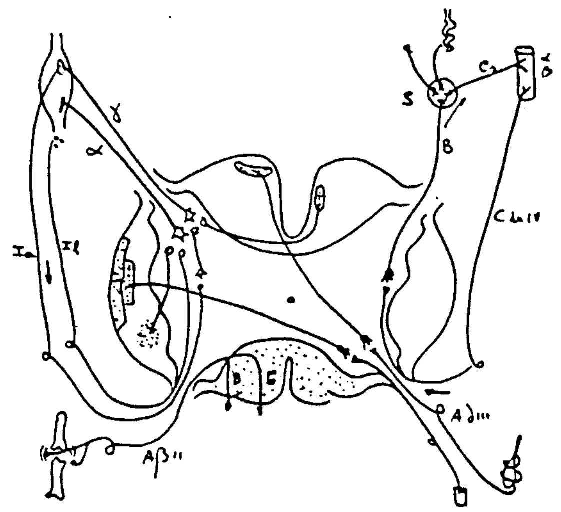


Figure 15. Most of the pathways involved in a subluxation.

	Efferent motor	Afferent
Thick fast fibres	Aα	AIa
55m/sec		Ib
		AβII
	Aγ	
1 m/sec	B	AδIII
Thin slower fibres	Cη	CδIV

4. Vascular

The autonomic nerve fibres emanate from the mammillary body beneath the hypothalamus. These parasympathetic and sympathetic nerve fibres project branches to the pons and medulla oblongata and further down in the medulla spinalis they reach the lateral horns. The lateral horns are located in the thoracic part of the medulla spinalis. From these lateral horns the sympathetic preganglionic myelinated B fibres reach the sympathetic ganglia (Figs. 14 and 15). What happens in these ganglia is still speculative. Beyond the ganglia the non-myelinated postganglionic C fibres travel to the vascular structures where they connect with the alpha and beta chemical receptors. An everyday example of a local reflex is seen in the parlour of a hand lifted from cold water. The adjustment acts on the sympathetic and parasympathetic system and allows the re-equilibration of many patients who had resisted other types of so-called 'appropriate' treatment.

The tough sheath of dura mater is attached to the foramen magnum and continues around the cerebral structures and the trigeminal nerve (at its emergence through the foramen lacerum and ovale, the trigeminal nerve projects fibres to the dura mater). The dura mater terminates with each nerve root when it passes into the intervertebral foramina. With flexion of the head the spinal curve becomes longer on the dorsum. Consequently the medulla, the IVth ventricle and the dura mater become stretched. So a nerve root irritated, but symptomless can be stimulated by forced flexion of the head, indeed this stretches the dura and the medulla through its attachments with the dentate ligaments (Fig. 16). Chronic anterior body fixations and kyphosis will obviously elongate

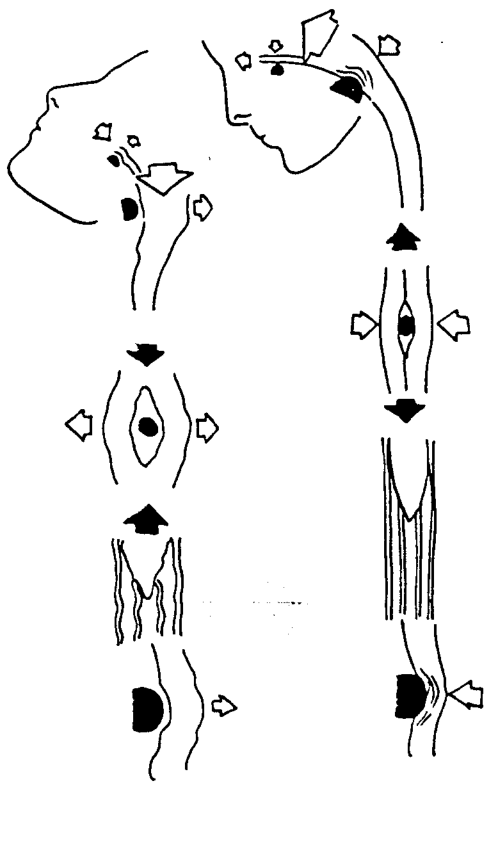


Figure 16. Impinging bodies (●) in extension and flexion.

the medulla and dura mater even further. So a nerve root containing all the aforementioned nerve fibres (muscular, capsular, cutaneous, vascular) when irritated can be stimulated by cervical flexion and more so when there are anterior body fixations.

Conclusion

The medulla, the cerebrum, the portal theory of Melzack and the reticular formation in the medulla oblongata have all been discussed. It is clear from that discussion that, as chiropractors, by normalizing, helping the self-adaptive capacities of the body and by giving a homeopathic push to the body, we allow nature to find its balance and the patient to secure some type of healthy equilibrium.

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