Corrective Yoga of Spine: Physiological, Anatomical as well as Graphical Representation

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ABSTRACT: Our heritage has leaded us several ways of life style keeping our body and mind good. Yoga is one of the ways of life style migrated from our ancestors. The beauty of yoga is to take care of our personality on the basis of physical, mental, spiritual and social aspects where the physical part is by rhythmic yogic *āsanas* in which *prāṇāyāma* plays a vital role. There exists interdependence among various components of yogic approaches for benefits. Yoga – state of union between two opposite poles viz., *Śiva*[1] (शिव) and *Śakti*[2] (शक्ति), i.e., body and mind in wider sense individual and universal awareness; process of uniting opposing forces in the body and mind in order to realise the spiritual[3] essence of beings.

According to *Aṣṭāṃga Yoga of Sage Patañjali* (अष्टाङ्गयोग - मुनि पतञ्जलि):

अथ योग अनुशासनम् ॥ १/१
योगः चित्त वृत्ति निरोधः ॥ १/२
तदा द्रष्टुः स्वरूपेअवस्थनम् ॥ १/३
Atha Yoga anuśāsanam | I/1
Yoga chitta vṛitti nirodhaḥ | I/2
Tadā draṣṭuḥ svarūpe avasthanam | I/3

Yoga should be operated in disciplined way to control way to functioning mind. After that one can reach to the true state.

Yoga indicates us to realise deep inside us which is true-self. To that aspect we must know our anatomy to give rise the core concepts of yoga.

Indian context, yoga encompasses two essential functions *Prāṇa*[4] and *Apāna*[5] on every aspect of life from cell to organism.

[1] *Śiva* is eternal consciousness of cosmos where cosmic consciousness is universal spirit.
[2] *Śakti* is his creative power.
[3] The word comes from Latin word *spiritus* meaning breadth, animating, sensitive or vital principal of an individual.
[4] *Pra* + *an* = a prefix meaning before + verb meaning breathe, to blow and to live. It is used for nourishment in living beings by vital air (inhalation of air). Universally, it is manifestation of all creative forces of life.
[5] It is derived from *apa* means away, off. *Apāna* is action by air eliminating waste from the body (exhalation of air).

The breath is related with *Prāṇa Śakti* (प्राण-शक्ति) i.e., life force or energy but *Prāṇa* is more than breath. *Prāṇa Śakti* is present in the physical body in the form of heat, energy and brilliance [Page.14, 154 / Ref.5].

In living person *Prāṇa* plays a vital role where air enters through the passage, called Trachea. It is a continuous process for each respiration where Breath is crude sign of life. *Prāṇa* is the vitality which is very difficult to define but easy to understand as it is external respiration whose outward manifestation occurs in the chest. Another kind of respiration called tissue-respiration occurs in the cell-membrane. At the cell level energy-bonding and its utilisation done by process of helical linking in presence of heat and can be estimated by:

$$E_b = \frac{1}{2} m.v^2 = 1\frac{1}{2} k.\mathrm{T}$$

where E_b = Bonding Energy, k = Universal Gas Law Constant = 1.38×10^{-23}Joules per Calorie [Boltzmann's Constant], m = Molecular Mass, v = Velocity consumed, T = Absolute Temperature [Page.118 / Ref.6].

External Respiration is either way of transport system of Oxygen & Waste-Gas. This random motion of air molecules constitutes additional Energy.

Combination of anatomical representation of some poses of yoga on the aspect of spine with mathematical representation will be shown.

KEY-WORDS: *Cakrāsana, Catenary, Dhanurāsana, Hyperbola, Parabola.*

INTRODUCTION: Yoga teaches us essential activities for our health and happiness which already exist in our body-systems. Yoga is unification of breath and mind.

According to *Haṭha Yoga Pradipikā* (हठ योग प्रदिपिका) [Ref.1]:

दुग्धांबुवत्संमिलितावुभौ तौ तुल्यक्रियौ मानसमारूतौ हि ।
यतो मरूत्तत्र मनः प्रवृत्तिर्यतो मनस्तत्र मरूत्प्रवृत्तिः ॥४/२४॥

Dugdhāṅbuvatsaṅmilitāvubhau tau tulyakriyau mānasamārūtau hi |
Yato marūttatra manaḥ pravṛttiryato manastatra marūtpravṛttiḥ ||IV/24||

Mind and *Prāṇa* are like combination of milk and water (which are inevitable). Both of them perform activities. Where there is *Prāṇic* movement or activity unified with mind (consciousness) activity and vice-versa [Page.499 / Ref.5].

We have a mind and a body depending on inhaling and exhaling. Therefore, we will be immensely benefited and able to think more clearly and move efficiently on the basis breathing effortlessly. This the proper way of yoga practice: to establish integration of mind, breath and body [Page.11 / Ref.9].

Aṣṭāṃga Yoga of Sage Patañjali (अष्टाङ्गयोग - मुनि पतञ्जलि) says:

योगाङ्गानुष्टानादशुद्धिक्षये ज्ञानदीप्तिगविवेकख्यातेः २/२८

Yogāṃgnuṣṭānādaśuddhikṣaye jñānadīptigavivekakhyāteḥ II/28

Practice of Yoga initiate to destroy impurities (Both physical and mental), light of awareness dawns and discriminating intellect (Sharpness of awareness) born.

Ancient concepts on yoga are removal of obstacles that impede the natural functioning of our systems. Yoga is accompanied by *Āsanas* [Page.4 / Ref.10].

According to *Haṭha Yoga Pradipikā* (हठ योग प्रदिपिका):

कुर्यात्तदासनं स्थैर्यमारोग्यं चांगलाघवम् ॥१/१७॥

Kuryāttadāsanaṅ sthairyamārpgyaṅ cāṅgalāghavam ||I/17||

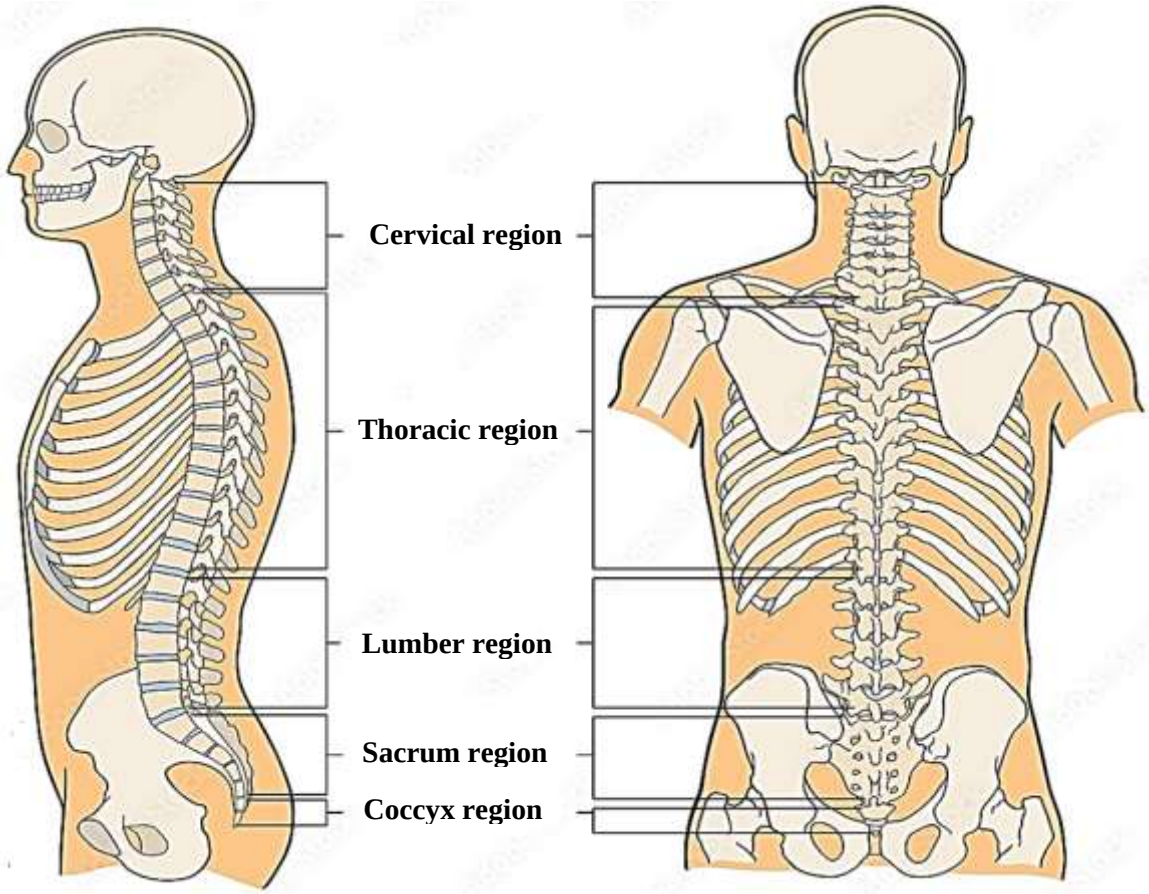
Practising the *Āsanas* one gets steadiness (firmness) of the body and mind; disease-less and flexibility of limbs [Page.67 / Ref.5].

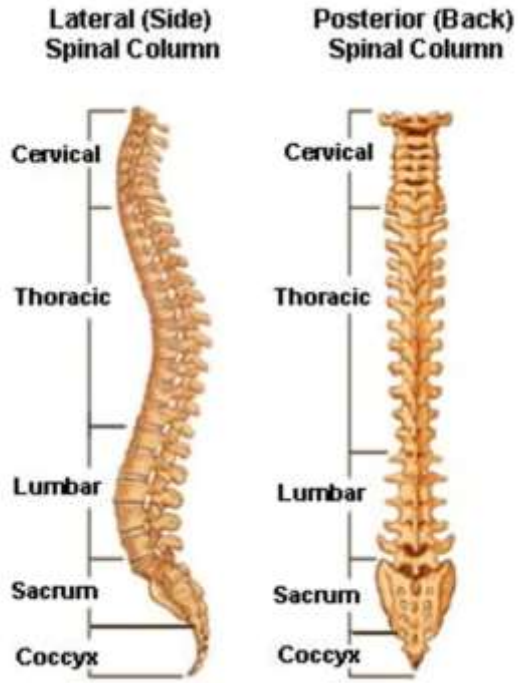
Āsana signify the postures. *Yoga Āsanas* or Yoga Poses aimed towards attaining strength, balance and steadiness. Classifications of *Āsanas*:

a) ***Cultural or Corrective Āsanas***: Correcting postural defects, improper muscles tones etc.
   (1) Corrective *Āsana: Cakrāsana* (चक्रासन)*, Dhanurāsana* (धनुरासन)
   (2) *Cultural Āsana:* 1) That work through and on spine + visceral organs; 2) That works through skeletal muscles, ligaments and joints. Examples: *Bhujaṃgāsana* (भुजङ्गासन), *Uṣtrāsana* (उष्ट्रासन)
b) ***Relaxing Āsanas****:* That need not to work for extension / contraction of muscles i.e., body is in deep relaxation which are: *Śavāsana* (शवासन), *Makarāsana* (मकरासन).
c) ***Mediative Āsanas****:* These postures increase concentration and help in meditation which are *Padmāsans* (पद्मासन)*, Siddhāsana* (सिद्धासन)*, Svāstikāsana* (स्वास्तिकासन) / *Sukhāsana* (सुखासन).
d) ***Respirated Āsana****:* Wilful regulation of respiration develops vital energy developing awareness of mind and helps to control over mind.

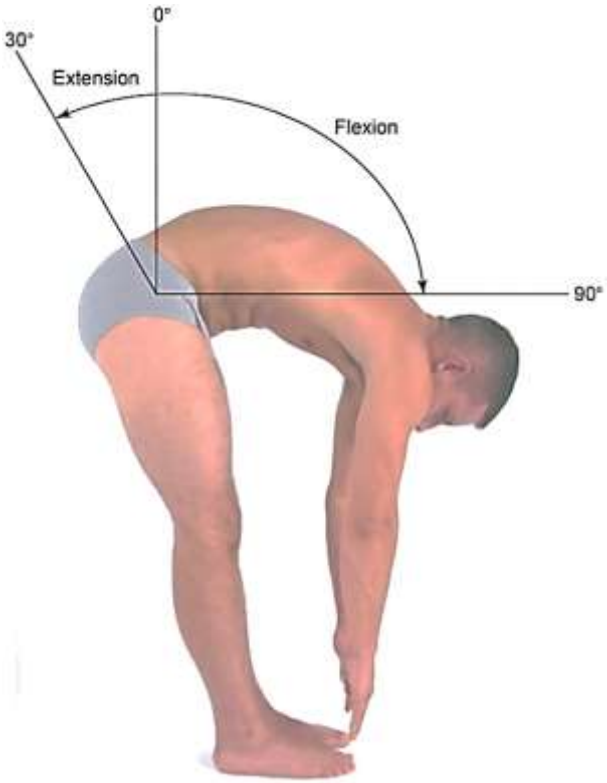
MATERIAL AND METHOD: We consider only Corrective Āsanas i.e., *Cakrāsana, Dhanurāsana.*

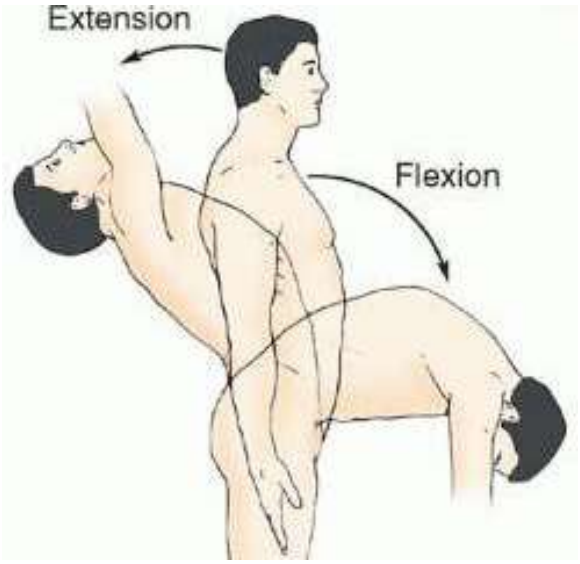
As we are considering the YOGA of spine, we have to demonstrate the flexibility in flexion and extension of spine where (a) In *Cakrāsana* flexion of spine is essential and (b) In *Dhanurāsana* extension of spine is essential.

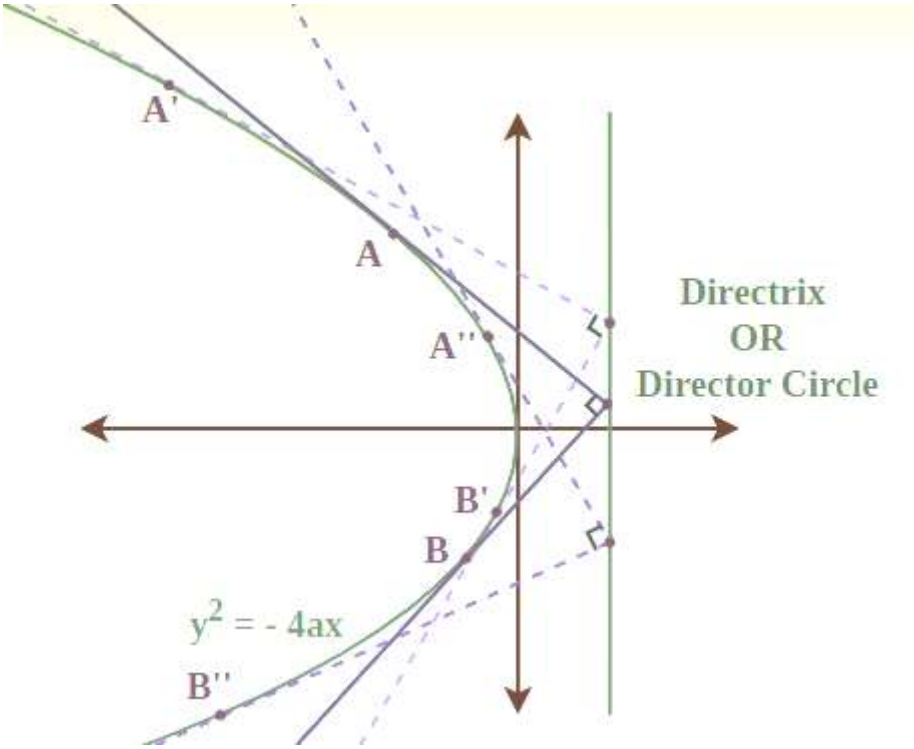




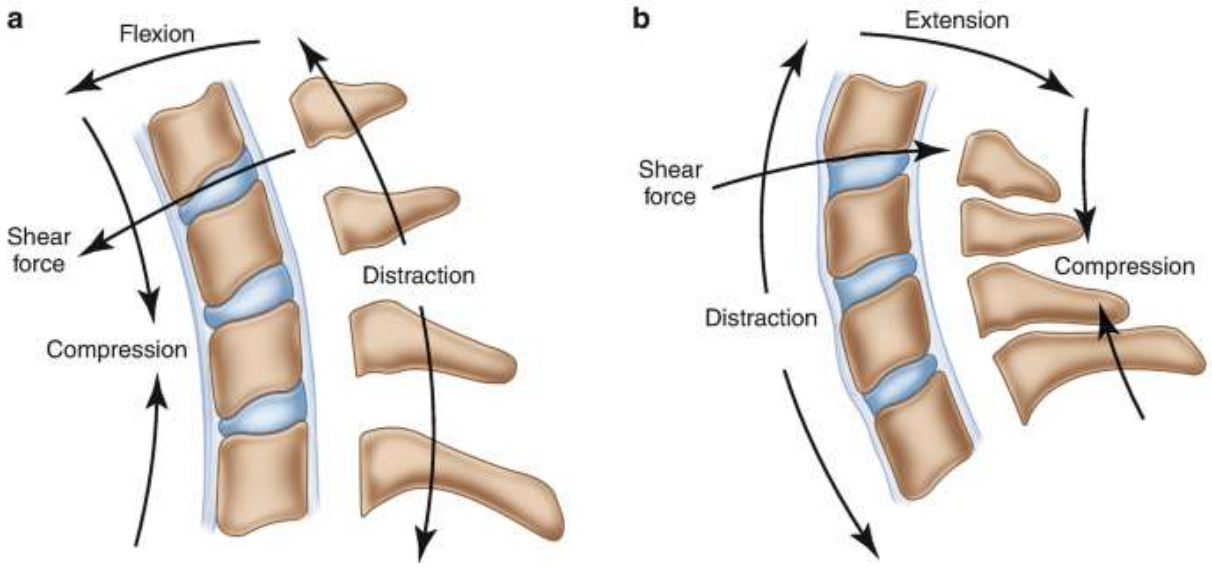
Figures showing the human spine in the shape of inverted 'S' but is keeps a human being erected.



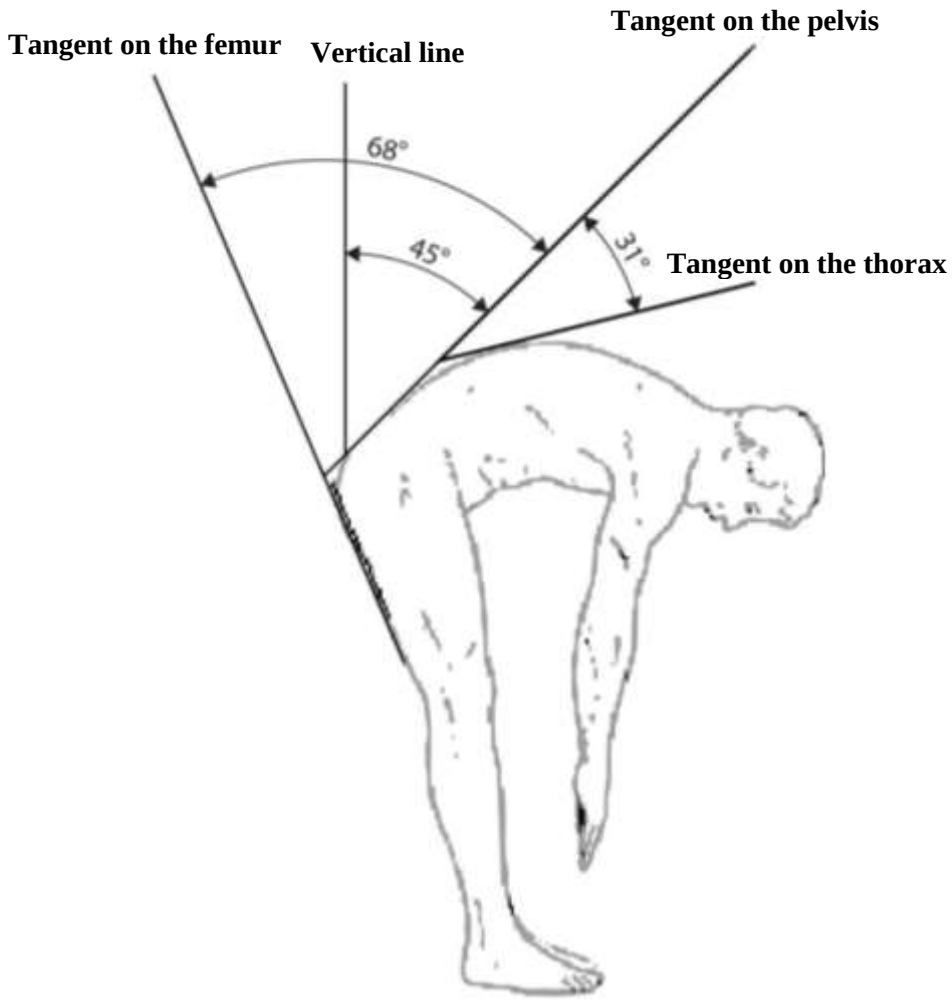


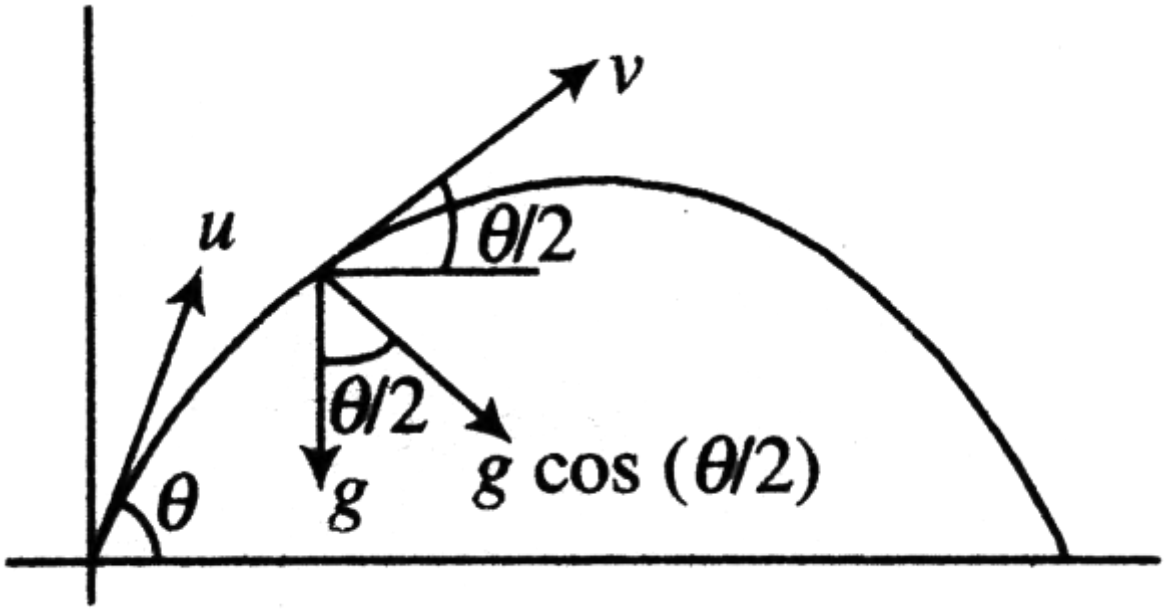


Flexion is 90^0 which also can be demonstrated by PARABOLA creating 90^0 angles on the directrix by the tangents. We also that extension is very less than flexion.

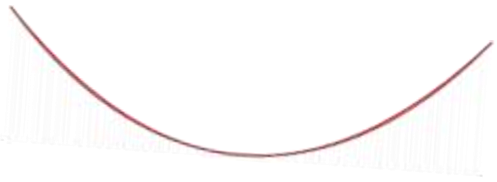


Figures showing FLEXION and EXTENSION of spine accompanied with compressions.

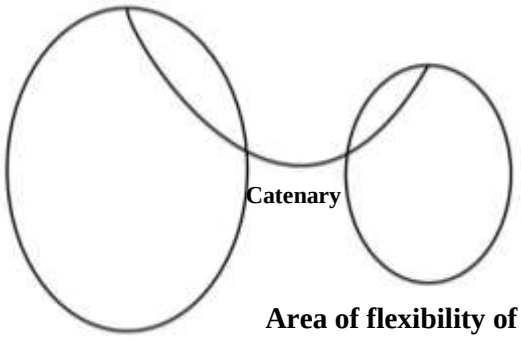




Above figures shows that curving in flexion of spine follows the curve PARABOLA.



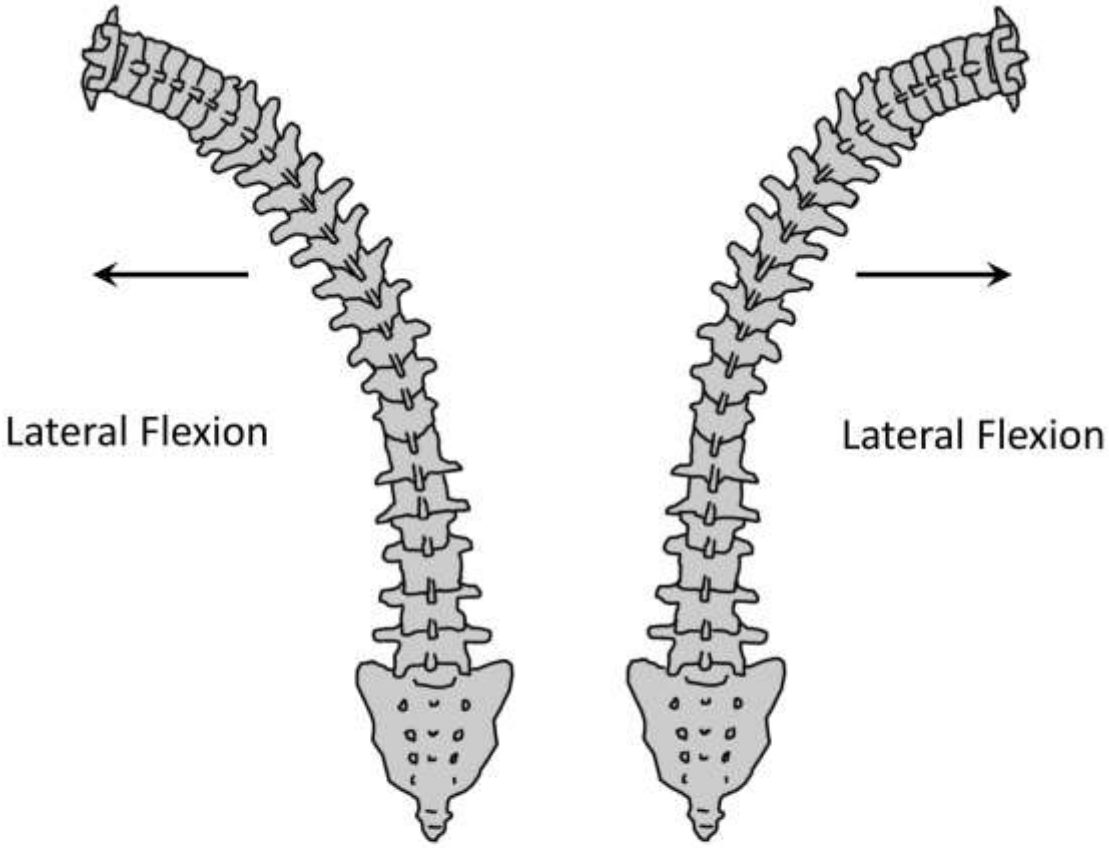
Catenary

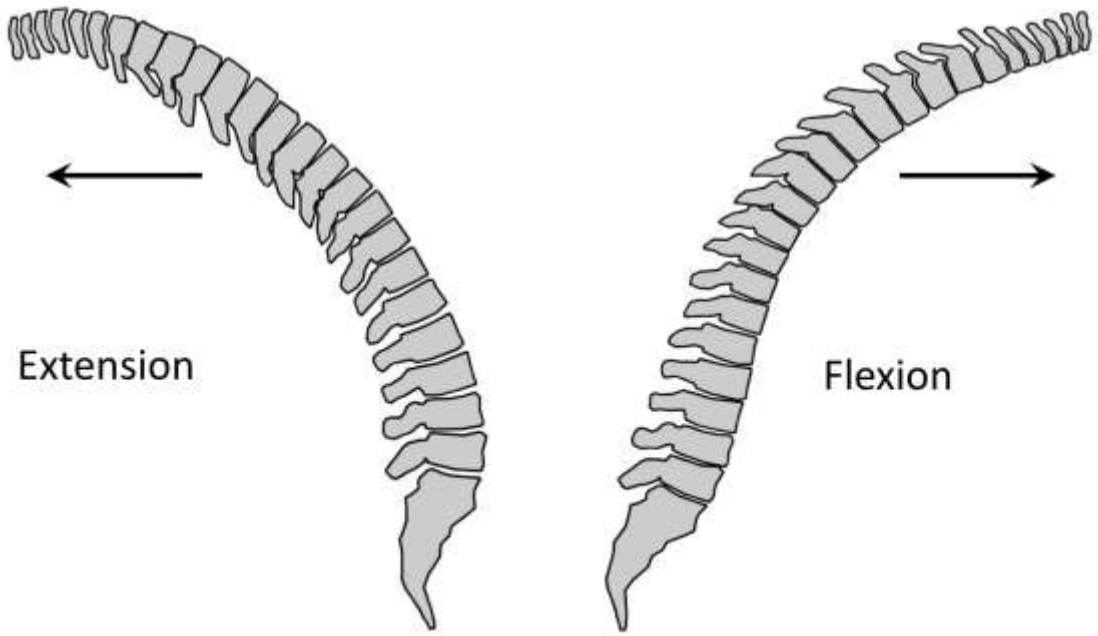


Area of flexibility of lower part of body

Area of flexibility of upper part of body

Catenary is formed by a perfectly flexible inextensible chain of uniform density hanging from two supports not in same vertical line. is the locus of the focus of a parabola rolling along a straight line. It may be formed between two different circular disks. This forms at the DHANURĀSANA upper part of the body i.e., spine is more flexible than the lower part (comparatively rigid) where circles (disks) indicate the span of spine in upper and lower parts of human spine in extension.


Lateral Flexion
Lateral Flexion


Extension
Flexion

Corrective Āsanas: A) **CAKRĀSANA / ŪRDHVA DHANURĀSANA**[6]: [Upward Bow Pose] Symmetrical back-bending pose by arms support.

It is full backbend and inversion pose which brings head below the level of heart so that it can improve the strength and flexibility of back i.e., spine.

(a) Strongly stretches the frontal muscles of the body.
(b) Lumbar spine possesses greater capacity of extension than thoracic spine as it binds with ribs where lumbar-spine got the capacity of hyperextension but it should under even curve keeping tally in curvature with thoracic-spine which is smooth-curve i.e., parabola to allow heart to pumps for delivering more blood to muscles.
(c) Strengthens shoulder to support deep backbend as well as elevation of the body to put shoulder-joints and spine in a unique position to keep people tight and flexible.
(d) Hands are kept slightly wider than shoulder distance to relax head and neck.
(e) Feet are kept hip-distance-apart for squeezing thighs parallel.
(f) Ultimately total curve must have smooth bending as parabola i.e., not having sharp bending.

Fig.1: Operating Poses of CAKRĀSANA from beginning

Place the palms near the shoulders with fingers pointing down – then lift the *pelvis* – push the hands on the floor – straighten the *elbows* to complete the posture – let the head hang passively[7]. For spinal flexibility efficiency of *triceps brachii* muscles are essential for this posture as shoulders are

[6] Cakrāsana (चक्रासन) literally - Wheel Pose or Ūrdhva Dhanurāsana (ऊर्ध्वधनुरासन) literally- Upward-Facing Bow Pose. It is a backbend to expose the great flexibility to the spine. The name Cakrāsana = चक्र *Cakra* (wheel) + आसन *āsana* (posture or seat) or, Ūrdhva Dhanurāsana = ऊर्ध्व *ūrdhva* (upwards) + धनु *dhanura* (a bow). In acrobatics and gymnastics this body position is called bridge.

[7] If (a) one has limited strength but a lot of flexibility within the body – posture can be achieved easily; (b) one having a lot of strength with limited flexibility – for posture achievement needs push with additional force; (c) one having both limited then posture will be challenging – push on the floor to be isometrical.

against the floor at the extreme position of upper extremities[8] *triceps brachii* extend forearms. Here iliopsoas and rectus femoris act as extensile ligaments to hyperextension of hips. Consequently, backward bending capacity of spine and hips improved and one is able to lift on fingertips and balls of feet to assume this posture easier. With flexibility the posture becomes Cakrāsana.

The wheel posture requires a combination of sacroiliac nutation, moderate hip hypertension, 90^0 lumbar extension and enough strength in arms to push up into the posture.

Prone i.e., supine backbends created by the spine moving into extension where several muscles are responsible for this action.

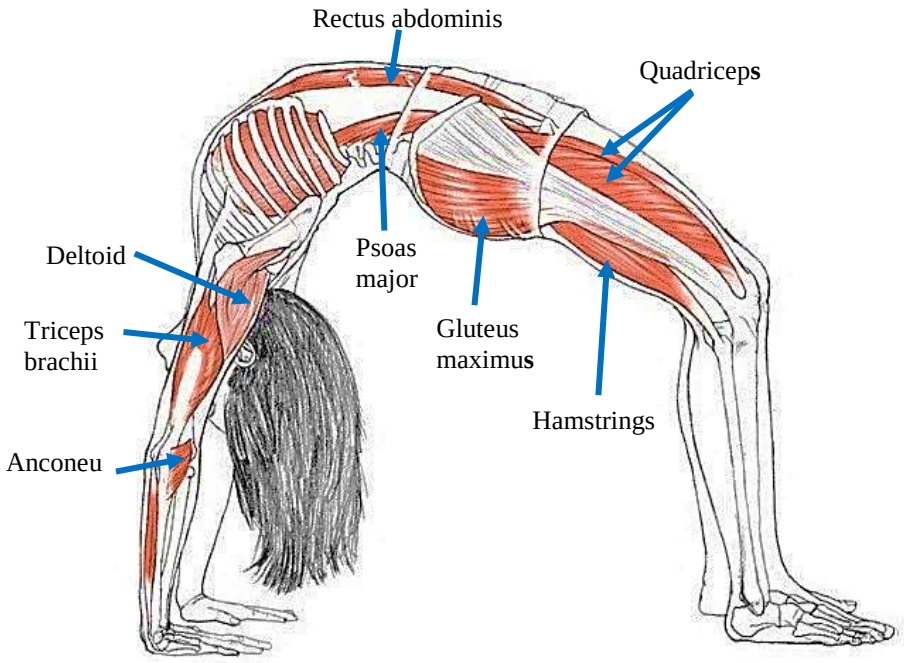


Fig.2: Symmetrical back-bending arm support pose

Fig.2: Lifting the spine into a backbend against gravity to perform a prone (face down) position It's a rich pose that has numerous benefits: [Page.249 / Ref.2].

(a) Lengthen the spine: maximise the extension of spine by *spinal extensors*.

(b) Lift the head from the floor by the effect of *Rectus capitis posterior, obliquus capitis superior*.

(c) Stabilise and protect shoulder joint by *Rotator cuff deltoid*.

(d) Flex shoulder by *Biceps brachii* and *anterior deltoid*.

(e) Extend elbow with the help of *Triceps brachii*.

(f) Pronate forearm with *Pronator quadratus* and *teres*.

(g) Integrity of hands maintained by Intrinsic muscles of wrist and hand.

(h) Extend hip by *Hamstrings* and *gluteus maximus*.

(i) Hip extended, adduct and internally rotated by *adductor magnus, gracilis*.

(j) Knee extended by *Articularis genu* and *vastii*.

This uplifting because they open up heart and chest, helping breathe deeper. This pose stretches for the chest and shoulder muscles, as well as the hip flexors. It also strengthens the hamstrings and spinal extensors to make spinal flexibility and improvement of muscular strength. This is energy-

[8] Wrists extended 90^0 and elbows fully flexed.

boosting pose stretches your chest and lungs, strengthens your arms, wrists, legs, buttocks, abdomen and spine. In breathing only inhalation and exhalation are allowed because heart should pump properly to give supply of blood to the active muscles. [Page,316 / Ref.1]

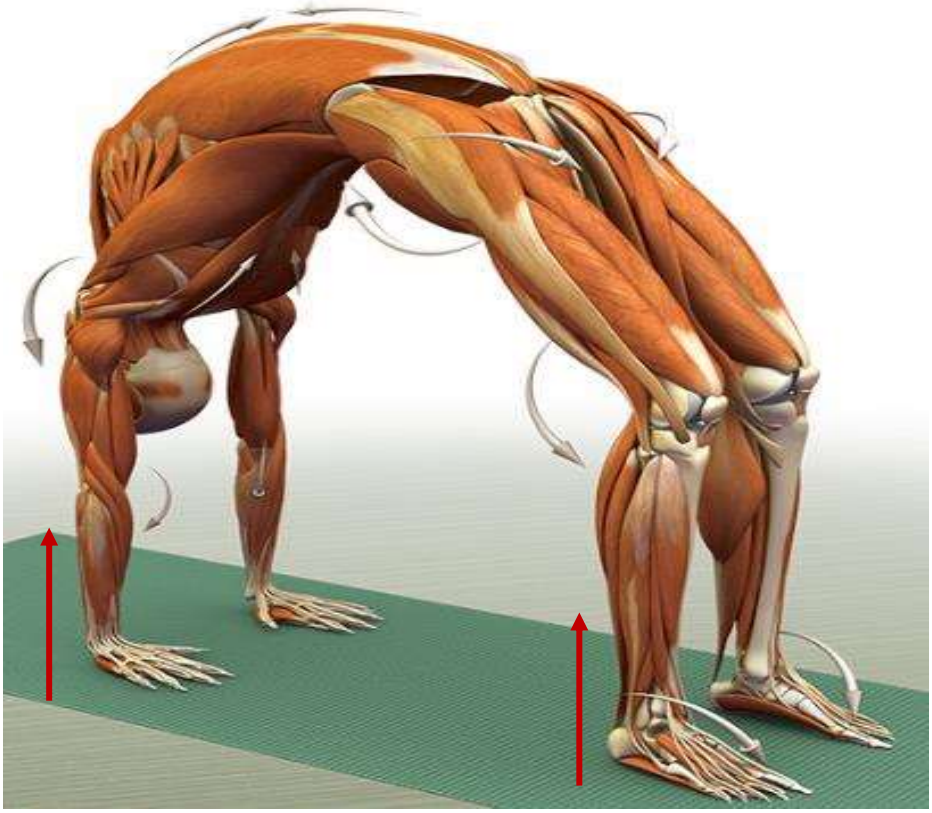


Fig.3: Muscle activities in Cakrāsana

As this the

Fig.3: Muscles are moving along the arrows and we see that muscles are inter-balancing where some under rotational force and some are translational force. Total uniform body-weight is divided to absorb by Ground reaction force (indicated by chocolate arrows upwards). Muscles activity are (a) Shoulders flex and abduct; (b) elbows extend; (c) Fore-arms pronate (d) Wrists extend; (e) hips extend, internally rotate, and adduct (f) Knees extend; (g) Feet pronate; (h) Trunk extends [Page.3 / Ref.3]

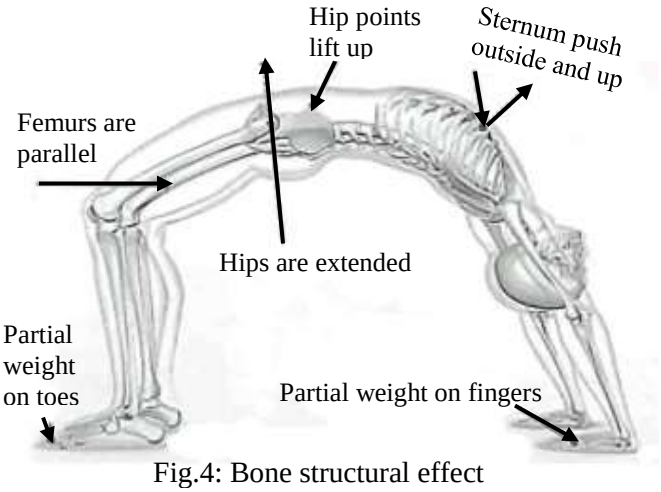


Fig.4: Bone structural effect

Fig.4: Hands are spread out of shoulder-bone[9] length to avoid titling of the body whereas legs are kept straight as because things rotate inward to absorb tilting and bending of body forms smooth curve to support internal opposite forces in upper as well as lower part of the body [Page.141 / Ref.8]

[9] Clavicle

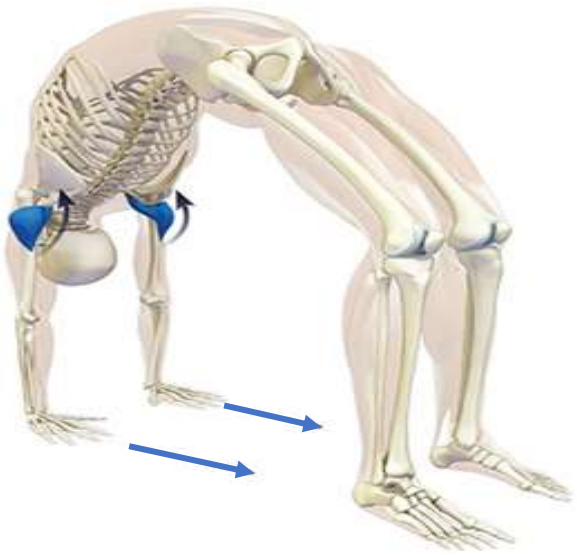


Fig. 5: This is to attempt to drag the hands towards the feet on the mat to draw the chest forward. Anterior portion of the *deltoids* to extend the shoulders [Page.4 / Ref.3].

Fig. 6: Hip is extension where knee is flexed and feet are fixed on the mat attempting to draw the feet towards the hands contracts the hamstrings and aids to extend the hips. Here hamstrings act as flexors of the knee. Stretch on the *psoas* and its synergists (the *rectus femoris, pectineus, and adductors longus and brevis*) [Page.8 / Ref.3].

Fig. 7: Relation between frontal part and backward part of spinal column: Extension (chocolate) and contraction (blue) at the upper part of the body. Contraction of *erector spinae* and *quadratus lumborum* help to extend the spinal column (back), opening the front of the body and focusing the stretch on the abdominal muscles (front) [Page.5 / Ref.3]

Fig. 8: Internal rotation of thigs (femur) due to contraction of muscles (blue) also effect the rotation of hip. It causes feet away to balance the hip-up. Attempt to drag the feet apart (abduction) but feet are fixed on the mat. This is due to *tensor fascia lata* and *gluteus medius*. This is balanced by counteracting the external rotation moment created by the *gluteus maximus*. Abduct the hips also internally rotates them [Page.25 / Ref.3].

Fig. 9: Internal rotation of legs stabilise feet going away. Balanced by adductors synergize the *gluteus maximus* in externally rotating the hips [Page.25 / Ref.3].

Fig.10: In this pose weight through legs press the balls of the feet by engaging *peroneus longus* and *brevis* to well place the feet on the mat [Page.25 / Ref.3].

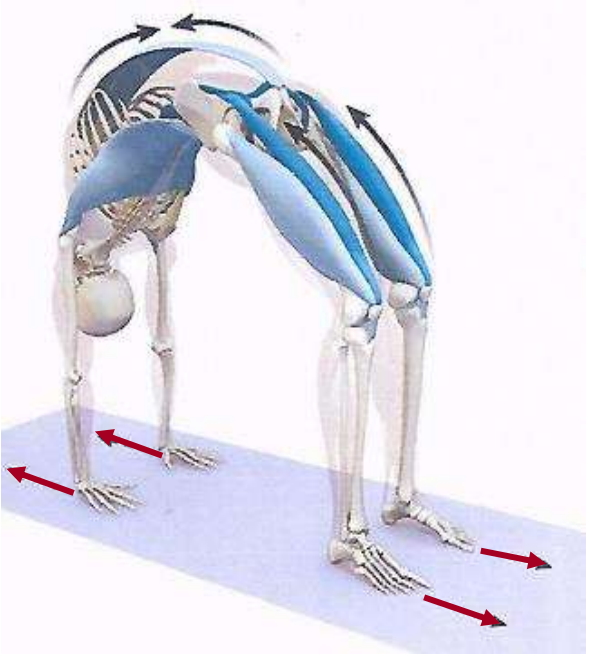


Fig.11: Due to stretching of *rectus abdominis, psoas* and *rectus femoris* on the anterior part of *pelvis* and this intent to keeps hands away from feet [Page.22 / Ref.3].

Fig.12: Extension of hip-joint. Contraction of *Gluteus maximus* makes efficient extension of hips and tilt the *pelvis* down [Page.24 / Ref.3].

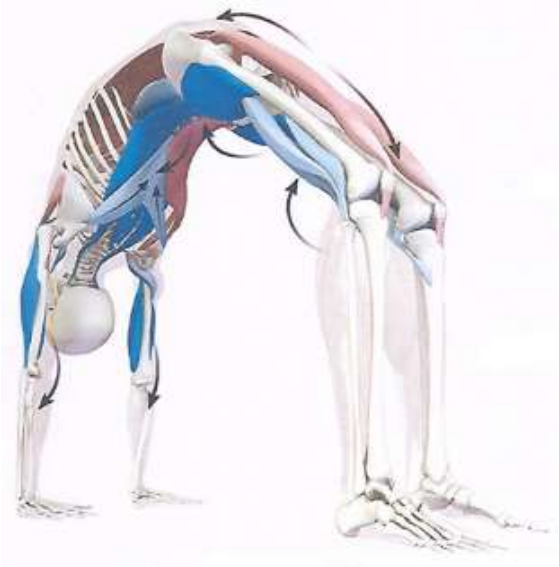


Fig.13: Breath is steady, body is in balance and contraction of *erector spinae, gluteus maximus* and *hamstrings* [Page.22 / Ref.3].

On the basis of above cumulative figures, we came to the following approach.

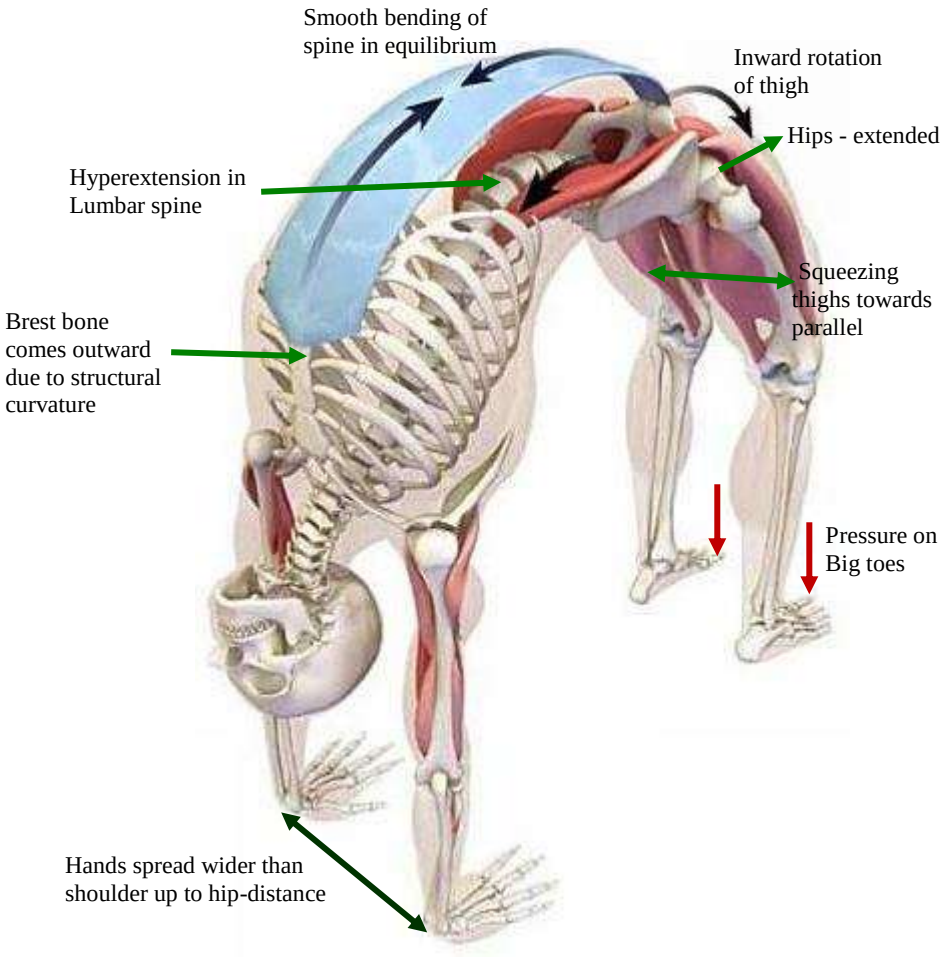


Fig.14: Anatomical support of CAKRĀSANA pose

Fig.14: Anatomical stability, due structural arrangement has been expressed.

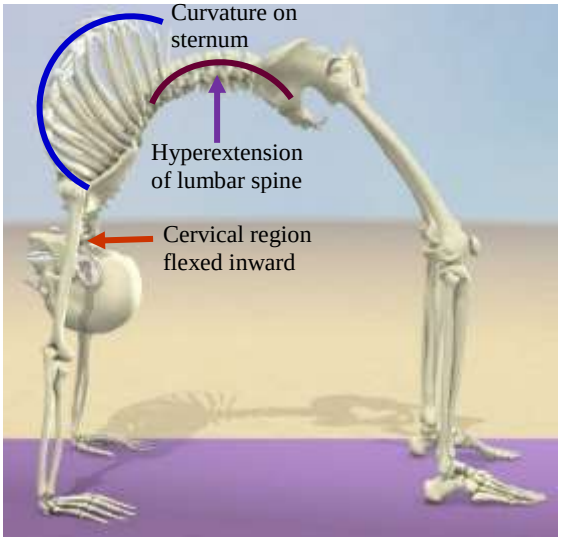


Fig.15: Hyperbolic Curve in Lumbar region

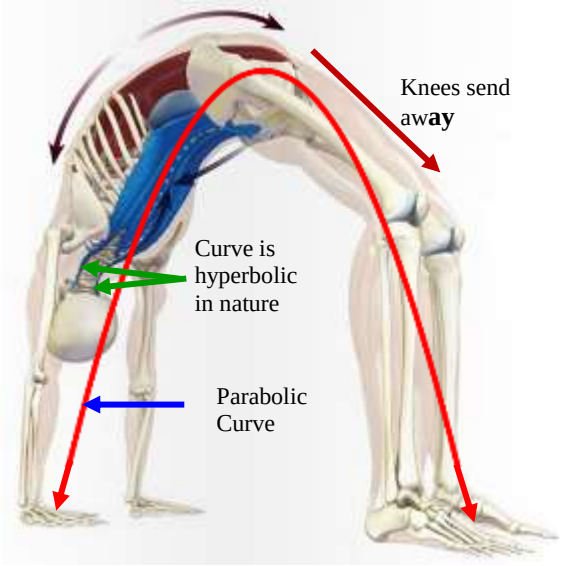


Fig.16: Curves on the pose

Fig.16: Cervical part is concave hyperbolic curve. Smooth turning of body makes its curvature in parabolic[10] nature.

Smoothness of the curve indicates inactive and dormant body will be active to work in exact way which means corrective Āsanas.

Corrective Āsanas: B) **DHANURĀSANA[11]:**

According to *Haṭha Yoga Pradipikā* (हठ योग प्रदिपिका):

पादांगुष्ठौ तु पाणिभ्यां गृहीत्वा श्रवणावधि ।
धनुराकर्षणं कुर्याद्धनुरासनमुच्यते ॥१/२५॥

Pādāṅguṣṭhau tu pāṇibhyāṅ gṛhītvā śravaṇāvadhi |
Dhanurākarṣaṇaṅ kuryāddhanurānamucyate ||I/25||

Hold the toes with hands and pull them up near to the ears, then total structure looks like bow. This is called *Dhanurāsana*.

According to *Gheraṇḍasaṅhitā*[12] (घेरण्डसंहिता):

प्रसार्य पादौ भुवि दण्डरूपौ करौ च पृष्ठं धृतपादयुग्मम्।
कृत्व धनुस्तुल्यविवर्तितांगं निगाय योगी धनुरासनं तत्॥२/१८॥

Prasārya pādau bhuvi daṇḍarūpau karau ca pṛṣṭhaṅ dhṛtapādayugmam |
Kṛtvā dhanustulyavivartitāṅgaṅ nigāya yogī dhanurāsanaṃ tat ||II/18||

Extend legs on the ground like sticks, as well as the arms, both feet are held from behind and the body is moved like a bow. This is called bow pose [Page.20 / Ref.4].

According to commentary of Brahmānanda[13] on *Haṭha Yoga Pradipikā* (हठ योग प्रदिपिका – भाष्य ब्रह्मानन्द) on Dhanurāsana:

गृहीताङ्गुष्ठम् एकं पाणिं प्रसारितं कृत्वा गृहीताङ्गुष्ठम् इतरं पाणिं कर्णपर्यन्तम् आकुञ्चितं कुर्याद् इत्य अर्थः॥
Gṛhītāṃguṣṭham ekaṅ pāṇiṅ prasāritaṅ kṛtvā gṛhītāṃguṣṭham itaraṅ pāṇiṅ karṇaparyantam ākuñcitaṅ kuryād itya arthaḥ ||

The meaning of Dhanurāsana is as follows: Extending one hand to hold the big toe, one should draw it as far as the ear, similarly other big toe is held.

According to *Haṭhābhyāṣapaddhati* (हठाभाष्यपद्धति):

हस्तद्वयेन पादद्वयाग्रे गृहीत्वा एकैकं पादाङ्गुष्ठं कर्णयोः स्पृशेत्॥५१॥

Hastadvayena pādadvayāgre gṛhītvā ekaikaṅ pādṃāguṣṭhaṃ karṇayoḥ spṛśet || 51 ||

Grasp the toes of the feet with both hands to stretch the big toes, one at a time, on the ears.

According to *Jyotsnā* (ज्योत्स्ना) of Verse 25 of Hatha-Yoga:

This Āsana is performed as shape of bow by holding the big toes of the feet with the hands and alternately putting them up to the corresponding ears is known as Dhanurāsana ||25||

Explanation by Śrī Brahmānanda: धनुरासन माह – पादाङ्गुष्ठौ त्विवि। पाणिभ्यं पादयोरङ्गष्टौ गृहित्व श्रवणावधि कर्णपर्यनतं धनुष आकर्षणं यथा भवति तथा कुयात्। गृहीताङ्गुष्ठमेकं पाणिं प्रसारितं कृत्वा गृहीताङ्गुष्ठमितरं पाणिं कर्णपर्यन्तमाकुञ्चितं कुर्यादित्यर्थः। एतद्धनुरासनमुच्यते॥२५॥ *Dhanurāsana māha - pādāṃguṣṭhau tviti | Pāṇibhyāṅ pādayoraṃguṣṭau gṛhītvā śravaṇāvadhi karṇaparyantaṅ dhanuṣa ākarṣaṇaṅ yathā bhavati Tathā kuryāt | Gṛhītāṃguṣṭhamekaṅ pāṇiṅ prasāritaṅ kṛtvā gṛhītāṃguṣṭhamitaraṅ pāṇiṅ karṇaparyantamākuñcitaṅ kuryādityarthaḥ | Etaddhanurāsanamucyate* ||25|| Dhanurāsana is explained

[10] The parabola is locus of a point in that plane that are equidistant from both the directrix and the focus.
[11] धनुरासन *Dhanurāsana* literally mean *Bow pose* which is a back bending Āsana in yoga. The name comes from the Sanskrit words धनुर (dhanur) meaning bow and आसन (āsana) meaning posture.
[12] The book was of 18th century.
[13] He was in mid-nineteenth century.

- *Pādāṃguṣṭhau tu iti.* Hold the big toes of the feet with the two hands and then pulling up to the ear just like pulling a bow-string. Catch hold of the big toe of one foot with one hand then holding the other big toe with the otherhand pull it up to ear. This is known as Dhanurāsana ||25|| [Page.82 / Ref.7].

It has been categorised in three stages (1) **Saral Dhanurāsana (Easy Bow-Pose)**[14] (2) **Dhanurāsana (Bow-Pose)**[15]**,** (3) **Pūrṇa Dhanurāsana (Active Bow-Pose)**[16]**.**

Fig.17: Easy Bow-pose in the form of catenary

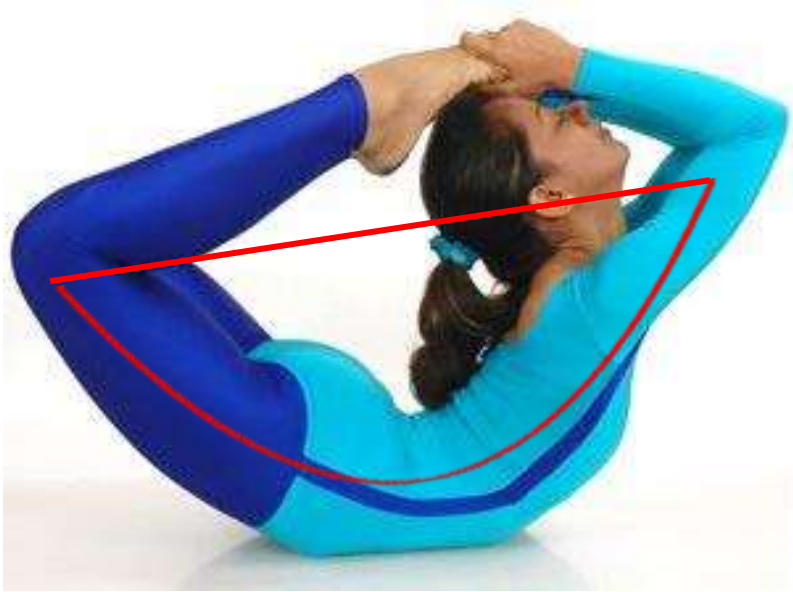


Fig.18: Bow-pose in normal stage, bow as catenary

[Page.64 / Ref.11]

[14] Lie flat on the stomach with forehead resting on the floor – bend the knees and hold both ankles - separate the knees – inhale while slightly raising the knees, head and chest at the same time pull the feet away from the hands and upwards – the whole body should move simultaneously into the psture – inhale while lowering the body and relaxing on the floor [Fig.17].

[15] Along with activities of 13 – raise legs, head and chest as high as possible – hold the breath – exhaling and slowly come down [Fig.18].

[16] Hold the toes of feet and twist the elbow outward and upward – breathing normally – slowly release the posture when exhaling [Fig.19].

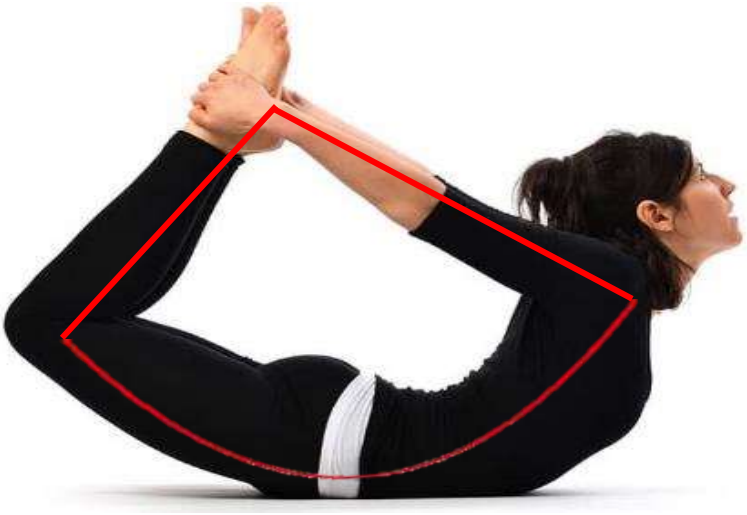


Fig.19: Active Bow-pose when arrow is tiggered, bow in catenary

We have considered the curve as Catenary[17] as because forces are at the ends.

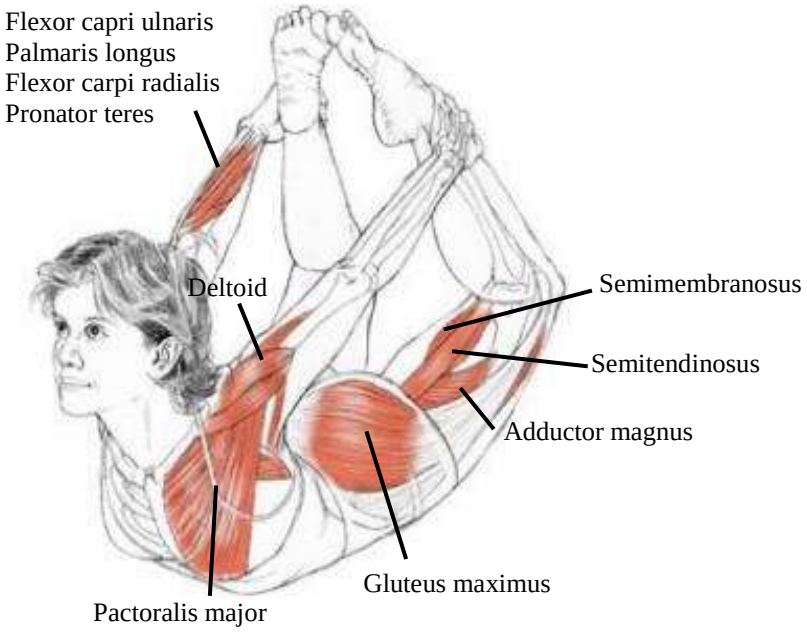


Fig.20: Symmetrically prone backward-bending

[Page.216 / Ref.2]

[17] It is a curve that describes the shape of a flexible hanging chain or cable — the name derives from the Latin *catenaria* (means chain). Any freely hanging cable or string assumes this shape, also called a *Chainette*, if the body is of uniform mass per unit of length.

Fig.21: All regions of the body work together to stretch the entire front side of the body. For extension of upper extremities *pectoralis major*, *anterior deltoids*, *biceps* and *brachialis* muscles are effective. For arching stretching of *rectus abdominis* is responsible [Page.26 / Ref.3].

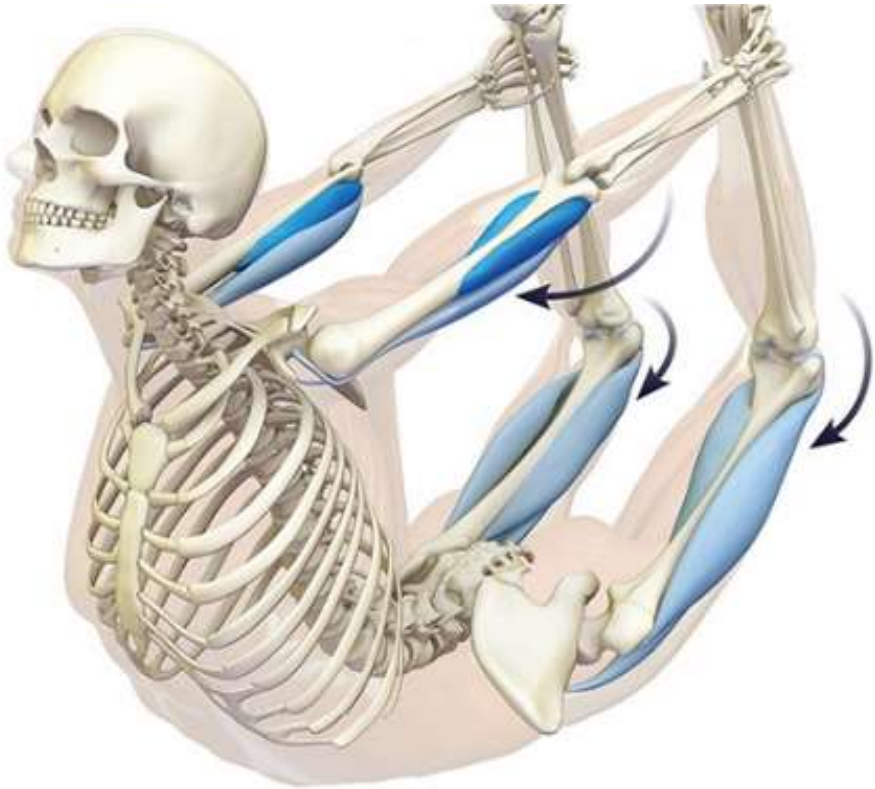


Fig.22: Spine is fully extended, bend the elbows by contracting the *biceps* and *brachialis* muscles while engaging the *quadriceps* to straighten the knees. Spine bends at *cervical* and *lumbar* region where thoracic restricted by ribs.

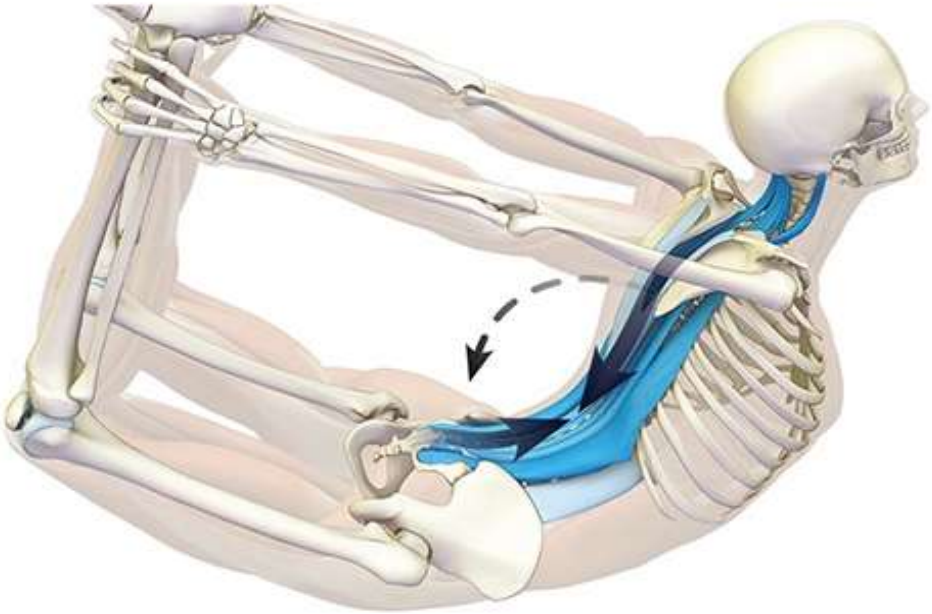


Fig.23: Vertebral column extends by *erector spinae* and *quadratus lumborum*. Shoulders appears away from the neck by lower *trapezius*. Curving back spine indicate loosening the string of the bow and tightening of string of the bow due to extension of the spine [Page26/ Ref.3].

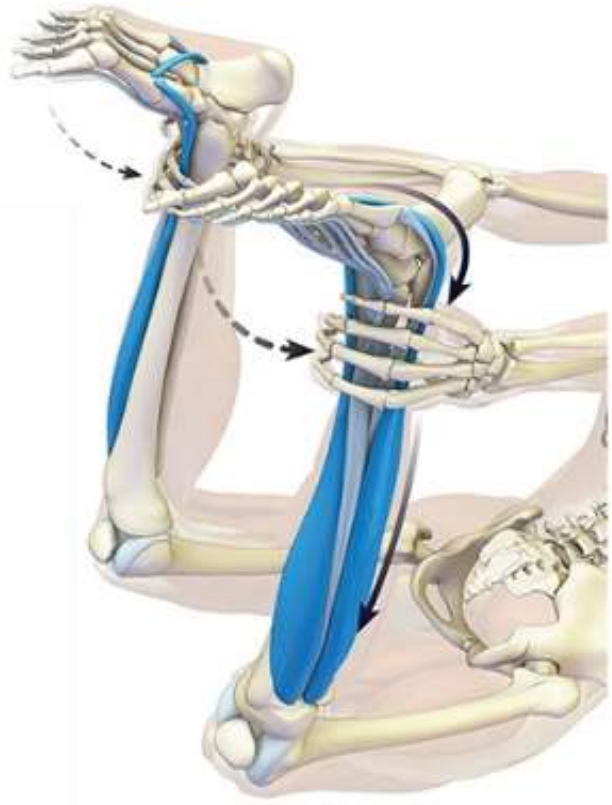


Fig.24: *Tibialis anterior* and *extensors hallucis* and *digitorum longus* used to dorsiflex the ankles; contraction of *peroneus longus* and *brevis* muscles on the sides of the lower legs to evert them. These actions create a lock for the hands to more firmly grip the ankles.

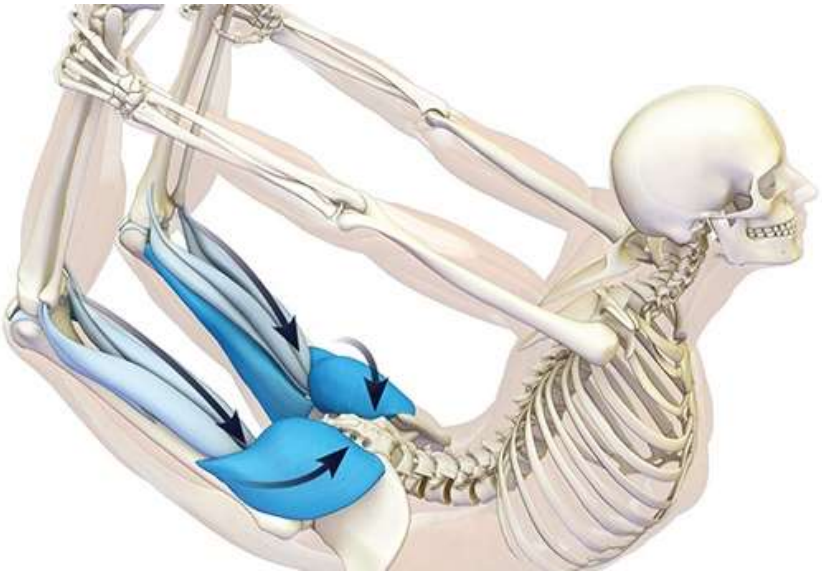


Fig.25: When spine is extended fully then elbows bend by contraction of biceps and brachialis muscles while quadriceps to straighten the knees.

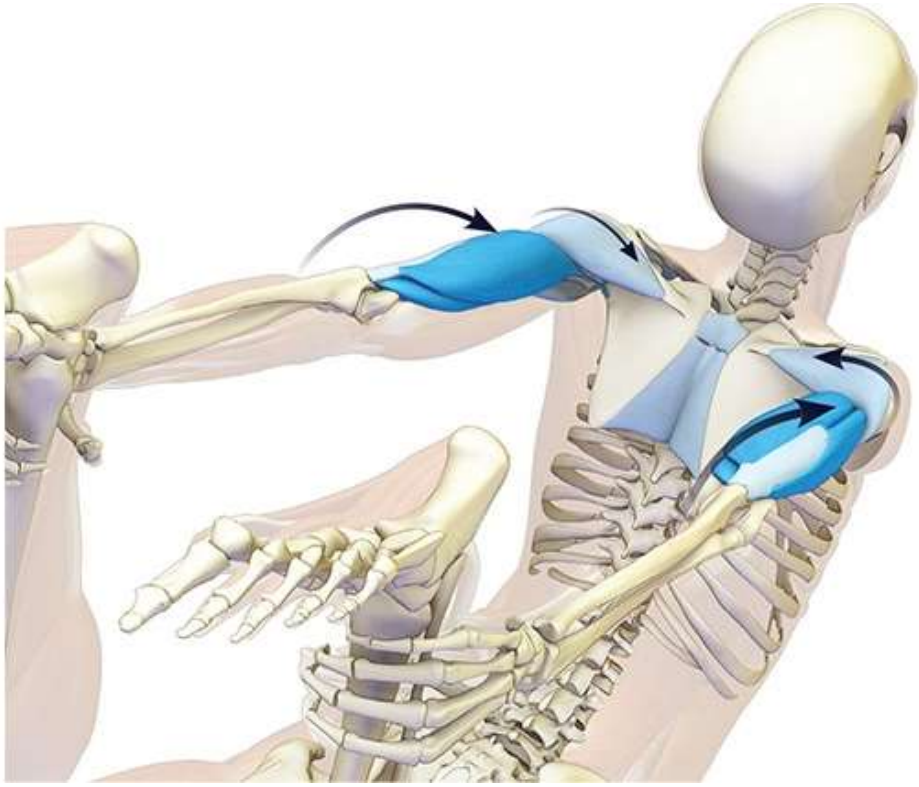


Fig.26: *Rhomboids* draw the shoulder blades toward the midline extend the upper arm bones (humeri) up and back, away from the trunk and this pose lift the arms; where *triceps* to straighten the *elbows*. Note how the actions of the *rhomboids*, *posterior deltoids*, and *triceps* combine to lift the legs and deepen the stretch.

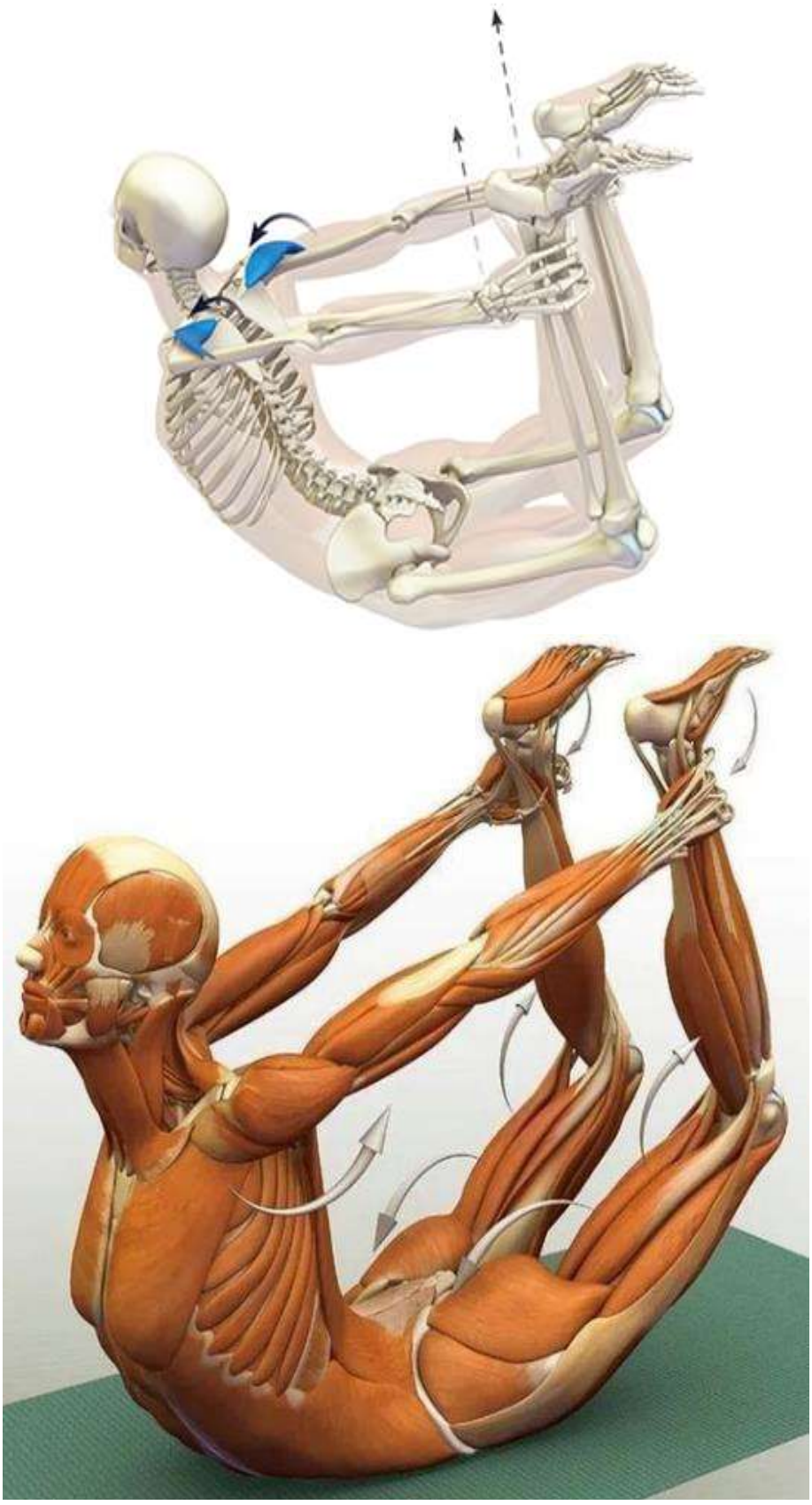


Fig.28: Total activities are: (a) Shoulders extend; (b) Elbows extend; (c) Forearms pronate; (d) Hips extend, internally rotate, and adduct; (e) Knees flex; (f) Ankles dorsiflex (extend); (g) Trunk extends [Page.65 / Ref.3].

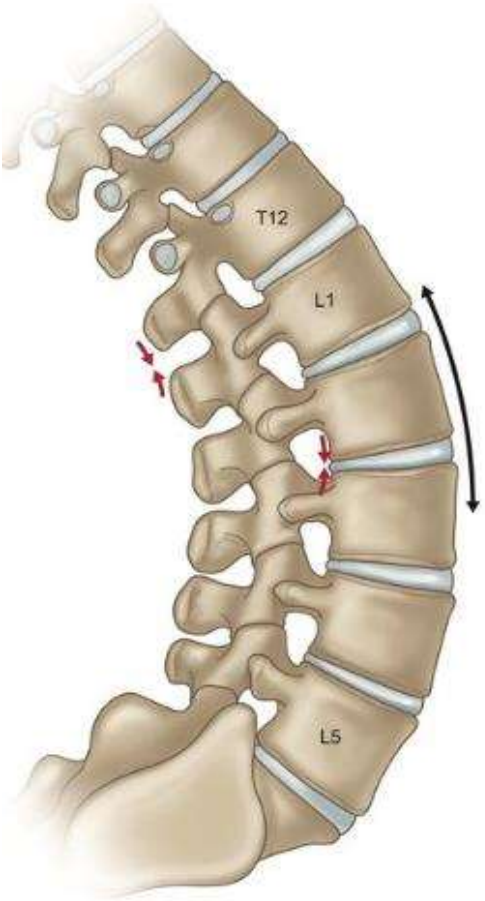


Fig.29: In correction Yoga, Lumbar vertebrae plays an important role.

In this posture lumbar region is fully extended where hips are hyperextended. To bend the knees and grasp the ankles; stretch and tension at the quadriceps maintain strong connection between ankles and shoulders having unconventional stress of quadriceps femoris muscles on gluteal muscles to lift the thighs during extension of hip-joints. In this pose the lumbar region is extended 90^0 where the hips are hyperextended.

Backward bending compresses the vertebral arches together posteriorly spreading the front surfaces of the vertebral bodies apart anteriorly and forward bending pull vertebral arches slightly apart compressing inter vertebral discs in front. This movements complex is stabilised by ligaments.

Wheel pose starts with lying supine, feet flat on the floor keeping hips as close as possible, palms near the shoulders with fingers pointing down. Then lift the pelvis by hands pushing on the floor straightening the elbows and allowing head to hang passively. In this case (a) if one has limited strength but plenty of flexibility – it can be demonstrated easily; (b) if one has a lot of strength but limited flexibility then the posture to be performed by force; (c) if one has both strength and flexibility limited then posture will be challenging, push on the floor be isometrical [Page.3 / Ref.10].

Bow posture obviously concentrated to knees. Knees extended and its components part fit together and protect the joint from torques and impacts from all directions where internal and external supporting ligaments loose to accommodate flexion and superimposing of tension. The pose starts with flexion at knee-joint then forced into extension for prone-posture for lifting to bow by the use of erector spinae muscles, hamstrings and coming up of respiratory and pelvic diaphragm to form the bow posture.

RESULT: (A) The Cakrāsana pose (wheel pose) is one of the dynamic whole-body postures. It activates the body from head to toe by full circular expression on backbends giving average spinal flexibility; extensibility of muscles, ligaments; lifting the body on finger-tips and balls of feet to organise hyperextension of hip. (B) The Dhanurāsana (Prawn-pose / bow-pose): it is activated deepening the action of spine, increasing hip extension, activation of hamstring and quadriceps, hands grasping ankles, alignment of legs at hips and action of feet.

Backbend depends on several factors which are combination of (i) Strength in the back and hip extensor muscles where strength in the muscles stabilise the backbend; (ii) Flexibility in the hip flexors and external rotators where flexibility in the muscles along the front of the body that will need to stretch the chest, abdomen and the front of the thigh and (iii) in the joints of the spine itself.

In normal breathing – inhalation either lift one more to reach fully into the posture – exhalation relax from the posture – reduce tension.

It is truly comfortable in the pose at ease with steady breath and practicing produces long term sustainability in mind.

A relatively SMOOTH CURVE that moves evenly through the whole spine, without any one part of the spine becoming a ‘hinge’ from which all of the extension takes place.

Back-bending postures can be categorised into two groups: (1) Upward Backbends-Those in which we are lifting the spine into a backbend against gravity, performed from a prone (face down) position i.e., *Ūrdhva Dhanurāsana* (Wheel Pose) where Prone backbends require more strength in the back extensor muscles (to work against the pull of gravity). Because of this, the prone backbends are the best ones to practice in order to create maximum strength in the muscles of the back that will then assist and support all of the backbends and (2) Supine Backbends / Prawn Backbends - Those in which gravity assists the backbend, performed from a supine (face up) position i.e., *Dhanurāsana*. At start to lie in prone-pose, knees to be flexed and to grasp the ankles. Quadriceps femoris muscles play essential role to create this posture. Initially, they are mild stretched when knees are flexed. Then shortening concentrically against the resistance of arms and forearms creating tension to pull the body to form arc. Here quadriceps play – extend knee-joints from flexed position – lift thighs – create tension to draw into bow due to contraction of quadriceps isometrically.

CONCLUSION: Smooth curves indicate the initiation of smooth fluid[18]-flow within the body under these postures. A relatively SMOOTH CURVE that moves evenly through the whole spine, without any one part of the spine becoming a 'hinge' from which all of the extension takes place. Yoga is considered to be the living science under the experience and experiments on the basic truth of this science by the succession of experts. *Yoga is that art and science which is calculated to ensure an individual's perfect health for the body and is infinite happiness for the mind and perfect spiritual development for the soul.*

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[18] Fluid indicates secretive fluid, blood and respiratory air.

TRANSLITERATION CHART:

Sanskrit	Transliteration	Sanskrit	Transliteration	Sanskrit	Transliteration
अ	A, a	आ	Ā, ā	इ	I, i
ई	Ī, ī	उ	U, u	ऊ	Ū, ū
ऋ	Ṛ, ṛ	ए	E, e	ऐ	Ai, ai
ओ	O, o	औ	Au, au	क	K, k
ख	Kh, kh	ग	G, g	घ	Gh, gh
ङ	Ṃ, ṃ	च	C, c	छ	Ch, ch
ज	J, j	झ	Jh, jh	ञ	ñ
ट	Ṭ, ṭ	ठ	Ṭh, ṭh	ड	Ḍ, ḍ
ढ	Ḍh, ḍh	ण	Ṇ, ṇ	त	T, t
थ	Th, th	द	D, d	ध	Dh, dh
न	N, n	प	P, p	फ	Ph, ph
ब	B, b	भ	Bh, bh	म	M, m
य	Y, y	र	R, r	ल	L, l
व	V, v	श	Ś, ś	ष	Ṣ, ṣ
स	S, s	ह	H, h	ं	ṅ
ः	ḥ	ँ	ṁ		