

BIOMECHANICS OF MOVEMENT

Categorization of *asanas* according to the traditional way

1. PASCHIMATANA - FORWARD BENDS – STRETCHING THE WEST

The ancients practiced facing the rising sun, and so forward bending meant ‘stretching the west’.

Intention:

- Stretch and strengthen the back of the spine (deeper muscles), lumbo-sacral spine, upper back, shoulder girdle, neck, pelvic girdle, legs (especially hamstrings)
- Strengthen the abdominal muscles (which contract as we bend forward)
- Gently compress the abdominal organs, provide visceral massage, stretches the kidney area – stimulating the functions of these organs

Technique:

- The key is the ability to control the lumbo-pelvic rhythm
- Abdominal contraction on exhale – at the initiation of exhalation, contract abdominal muscles (at the insertion into the pubic bone). This will check excessive forward rotation of the pelvis, and promote progressive reversal of the lumbar spine, maximizing the stretch of the lower back.
- If there is a deep lumbar curve and/or loose hips – lift pubic bone slightly upward at the beginning of the forward bend and focus on stretching low back
- As you proceed in the forward bend, contract abdominal muscles from pubic bone to navel
- Bend knees progressively (as much as necessary to maximize stretching the low back without strain)
- Avoid the tendency to collapse the rib cage over the belly as you bend forward by lengthening between the chest and belly on inhalation – maintain length throughout the forward bend (especially if thoracic curve is excessive)
- If flattened thoracic curve – allow it to round slightly as you bend forward
- Coming up from the forward bend – lead with the chest from initiation of inhale, pulling the entire thoracic cavity away from the abdomen and stretching the solar plexus area. Maintain partial abdominal contraction on the way up, preventing the pelvis from rotating excessively forward, to protect low back from strain (particularly in standing postures). This will also help elevating the rib cage and reducing excessive thoracic curve.
- Avoid arching the neck in the process of forward bending (lifting chin while bending forward). Instead, tuck the chin in gently toward the throat while moving the head slightly backward, till ears are aligned above the shoulders – helps straighten thoracic curve, increases the stretching of the muscles of the upper back and neck. Raising arms overhead, in coordination with the movement of the thoracic cavity on inhale. This will help extension of spinal curves. Arm position can be adapted to minimize stress or maximize effect.
- In general, it is important to allow arms and/or head to follow the lead of the spine, instead of them leading.

Note:

- Forward bends can be done supine, kneeling, standing, and seated
- Supine and kneeling postures are generally simple, stable, and safe
- Standing postures – allow greatest range of motion, and, therefore, are usually safe and good for warming up and working large muscles of the spine, pelvis, and legs.
- Seated postures – are most restricted. While they allow the deepest stretching, they also are the greatest risk to musculature and ligament of the spine, shoulders, pelvis, and legs

Common Risks:

- Increased cervical arch, jutting chin forward, shoulder and neck tension, collapsing chest to belly, excessive arm movement
- Lumbo-sacral joint – pivoting from lumbar spine, rather than lifting from upper back when coming out of it
- Sacro-iliac joint - excessive forward pelvis rotation
- Muscles and ligaments of the hip joints – rotating hips, knees, feet excessively inward or outward

2. PURVATANA – BACKWARD BENDS – STRETCHING THE EAST

As a part of the sunrise practice, the ancients called backward bending ‘stretching the east’

Intention:

- Stretch and strengthen front of the torso, shoulder and pelvic girdles, legs
- Strengthen the musculature of the back – sometimes this is more important than the stretching
- Stretch and strengthen the iliopsoas muscles, diaphragm and intercostals, anterior muscles which bind the shoulder girdle to the spine, anterior muscles of the legs
- Strengthen superficial and deep muscles of the back, which contract as we bend backward
- Strengthen posterior muscles of the shoulder girdle and stretch abdominal organs, relieving visceral compression, gently compress the kidney area, stimulating its functions
- Stretch anterior muscles of the neck and throat (thyroid and thymus glands)

Technique:

- The key is the ability to control proportional relation between lengthening and flattening the thoracic curve and deepening the lumbar curve – thoraco-lumbar rhythm
- Thoracic spine – limited capacity for arching backward, while lumbar spine can arch deeply – therefore the technique is expanding the chest on an inhale while maintaining abdominal contraction initiated on exhale
- On an inhale expand the chest and lift the ribs, thereby lengthening the thoracic spine and stretching front of torso. As chest expands, open shoulders and pull them back and down.
- On exhale, as volume of air is reduced in the lungs, if you have normal or excessive thoracic curve, in order to flatten it, contract muscles of upper back, pull shoulders back and push mid-thoracic forward. If thoracic curve is already flattened, focus on vertical extension of the spine and avoid pushing the mid-thoracic forward.
- On all successive inhales, maintain slight abdominal contraction, to prevent excessive forward rotation of pelvis and compression on the low back
- On successive exhales, use increased abdominal contraction to stabilize pelvic-lumbar relationship
- Focus on arching the upper back. Allow head to rise away from shoulders, creating space in between cervical vertebrae
- Keep the chin level, or even slightly tucked in – to enhance the lengthening of the cervical spine – lift it only toward the end of inhale in order to stretch front of neck and throat
- The range of backward extension in the hips and shoulders depends on many factors. If arms and legs are used as levers to create the back arch, there is risk to the shoulder and hip joints. So, to avoid injury, we must be careful not to apply excessive muscular force – as we are able to open the chest and stretch the front of the abdomen and pelvis, risk to the shoulders and hips can be minimized

Note:

- Back bends can be done prone, kneeling, standing, and seated

Common Risks:

- Lumbo-sacral and cervical strain - excessive arching in the lumbar spine, collapsing the neck backward (from top of the neck)
- Leading with head, or initiating back bend with musculature of the neck
- Shrugging shoulders towards the ears where arms are bearing significant portion of body weight
- Rounding shoulders forward, inhibiting expansion of upper chest
- Hyperflexing the shoulder joints
- When weight of upper torso is supported on the top of the head, increased risk of strain to cervical muscles and ligaments, and disc compression. Avoid if weak neck .
- Weak wrist joints

3. PARIVRITTI – TWISTS - REVOLVING

Intention:

- Twisting postures create rotation between the vertebral bodies of the spine
- Builds strength and flexibility in the deep and superficial spinal and abdominal musculature, maintains elasticity of the intervertebral discs and ligaments
- Alternately compress and stretch each hemisphere of the chest, stimulating respiratory function
- Alternately compress and stretch the mid torso – where the kidneys, adrenals, liver, gall bladder, pancreas, spleen, and stomach are located, and also the intestines, stimulating absorption, digestion, and elimination.
- Adjust relationship between shoulder and pelvic girdles and the spine
- Strengthen and stretch deep and superficial musculature that bind the head, shoulders, arms, and the pelvis and legs to the spine

Technique:

- The key is the ability to control spinal rotation from the musculature of the abdomen and spine, rather than through the force of leverage generated by the musculature of the shoulders and arms/or pelvis and legs – one can carefully apply this leverage to enhance the rotation of the spine but not to generate the rotation
- Rotation at lumbar spine is limited, so twisting of the lower abdomen is therefore generated either by stabilizing the pelvis and rotating the spine, by stabilizing the spine and rotating the pelvis, or by rotating both in opposite directions
- Rotation in thoracic spine is greater than in the lumbar – especially lower thoracic and thoraco-lumbar joint. Twisting of mid-torso is generated either stabilizing the pelvic-lumbar area and shoulder-thoracic area, by stabilizing the shoulder-thoracic area and rotating the pelvic-lumbar area, or by rotating both in opposite directions
- Cervical spine has greatest ability for rotation and twisting of the neck is generated by stabilizing the shoulder and rotating the head, or by rotating both in opposite directions
- Therefore the most important is the technique of abdominal contraction – at the initiation of the exhale, contract abdominal muscles (at their insertion into the pubic bone) to stabilize the pelvic-lumbar relationship, and at the same time initiate rotation
- Maximize vertical extension of the spine if you have a deep lumbar curve (by pulling pubic bone slightly upward)
- As you continue to twist, continue contraction of the abdominal muscles (from pubic bone to rib cage), emphasizing trunk rotation
- Lengthen between chest and belly if there is a tendency to collapse the rib cage over the belly as you twist. In lengthening the spine, there is a natural ‘unwinding’ of the twist, creating space between the vertebrae – allows to twist more deeply on successive exhales

Note:

- Twists can be done supine, standing, kneeling, and seated

Common Risks:

- Initiating twists from the muscles of the shoulder and/or pelvis without enough engagement of the abdominal muscles – limits spinal rotation
- Reducing the effects of spinal, shoulder, or pelvic rotation by moving the stabilized part of the body in the direction of the twist – however, sometimes displacement of the opposing structures may be helpful
- Collapsing the chest over the belly
- Any pre-existing conditions of the spine, (excessive curvature, compression of discs, etc) risk of injury is high. Risks can be minimized by adequate preparation, avoiding excessive force when using arms and legs as levers, and lengthening the spine on inhalation
- Risk to sacroiliac, hip, knee joints - in standing twists, where they are bearing weight and in seated twists, where the arms and legs are used as levers. To minimize the risks to these joints in standing twists, keep the hip, knee, and ankle in vertical alignment, avoiding excessive internal or external rotation
- Generate all twists from the abdomen, rather than forcing it with leverage from arms and legs

4. PARSVA – LATERAL BENDS – WORKING THE SIDES

There are 2 distinct classes of lateral bends –

First Class: *Torso is bent to the side*

Intention:

- Laterally stretch the torso from the shoulder to the hip joint, and to laterally flex the spine
- Stretch and strengthen and stabilize musculature of shoulder girdle, hip joints, front of the pelvis, inner thighs
- Alternately stretch and compress deep spinal muscles, intervertebral ligaments and discs, intercostals muscles and connective tissues binding the ribs
- Restore balance to asymmetries of the spine, shoulders, pelvis
- Stretch and compress lungs and organs of the torso, (kidneys, liver, intestines) stimulating their functions

Second Class: *One leg is abducted and rotated outward*

Intention:

- Stretch and strengthen musculature of the front of the pelvis, hip joints, groin, and inner thighs – pelvic opening actions
- Stretch lateral portion of the torso and structures of the shoulder girdles
- Increase circulation to the perineal floor and stimulates functions of the reproductive organs

Technique:

- Capacity for pure lateral bend is limited, therefore, rare in daily activity – for example, if you reach over to roll down the window on the passenger side with your left hand, normal tendency is for the hips to move backwards and rotate left and as the your chest and shoulder move forward and rotate left. But if we keep the shoulders and back flat against the seat while doing this action, bending sideways, it is pure lateral bend – if you restrict displacement and rotation, you will significantly limit the range of motion, but maximize lateral flexion
- The key is the ability to control the proportional relationship between pure lateral bending and natural displacement and rotation (as mentioned above) – and key for this control is the combined techniques of inhale and exhale
- At the initiation of exhalation, contract the abdominal muscles to check forward rotation of pelvis, and lengthen the lumbar spine, at the same time beginning the lateral bend
- If there is deep lumbar curve, pull pubic bone slightly upward to check the pelvis moving backward
- On successive exhalations, rotate the top of shoulder slightly backward, keeping shoulders in vertical alignment, to maintain the lateral movement
- On inhale, lengthen the spine, pull chest up and away from the belly, pull shoulders down and back, flatten thoracic curve, as in a backward bend – lengthening spine creates more space between the vertebrae, increasing the potential for lateral flexion without compressing the spinal discs. It also inhibits the tendency to move the chest and shoulders forward and prevents compression of the spinal discs laterally
- Extending arm, on the side being stretched, up over the head and forward on inhale increases stretching of musculature and connective tissues of the rib cage and torso – keep arm in line with shoulder and torso to maximize the effect

Note:

- Lateral bends can be done supine, standing, kneeling, and seated

Common Risk:

- Stress to the sacroiliac, hip, and knee joints – in standing and kneeling postures that are weight-bearing, and in standing, seated, and kneeling postures that use arms and levers to deepen lateral stretch – minimize risk by keeping hip, knee, and ankle in vertical alignment and avoiding excessive internal and external rotation
- Internally rotating the knee and ankle and/or collapsing the arches
- Rotating pelvis forward, displacing the pelvis backward and/or laterally
- Rotating shoulders forward, displacing shoulder forward
- Excessive arching of lumbar spine
- Collapsing chest over belly, increasing thoracic curve

5. LENGTHENING THE CORE – EXTENSION – *means and goal of asana Practice*

In the yogic concept extension refers to lengthening and straightening the spine, creating maximum space between the vertebral bodies and integrating the spinal curves.

Intention:

- Lengthening spine enable us to move more deeply in forward bends, back bends, twists, and lateral bends – their practice results in a more naturally lengthened spine
- Significant movement of spine here is extension, bringing spine to maximum vertical alignment
- Movement in these postures is limited, but they build strength and elasticity in the superficial and deep musculature, ligaments, connective tissues of spine and rib cage
- Strengthen diaphragm and abdominal muscles
- Improve postural alignment and structural integration
- Postural alignment reduces stress on the muscles and organs and improves digestion, respiration, and circulation
- Some postures stretch arms and/or legs away from torso, facilitating extension of spine, stretching and strengthening muscles and ligaments that bind them to the spine, creating more space in the shoulder and hip joints – improves peripheral circulation
- Simple but most challenging – for example, it is very challenging to sit still with a focused mind and extended spine for several minutes without feeling discomfort or tightness in the back, neck, shoulders, hips, knees – this can reveal imbalances in our structure
- Can be used as diagnostic tools – giving direction to forward bends, back bends, twists, lateral bends
- Sign of progress – ability to remain in simple extended postures for longer periods of time and the gradually bringing more awareness to subtler aspects of the spine, breath, energy – experiencing stillness and centeredness
- Natural curvatures of the spine are essential – however there is always some irregularities in the spine and therefore extension postures will help the spinal curves move in reciprocal relation to each other

Technique:

- The key is to integrate the spinal curves is combined techniques of inhale and exhale
- Initiate inhale in the upper portion of chest, emphasizing natural lifting and expansion of rib cage. Tuck the chin slightly in and move head slightly backward, to lengthen neck, as chest expands and upper ribs lift forward and up (upper thoracic starts to straighten)
- If thoracic curve is exaggerated then move chest slightly forward to flatten it, and if the thoracic spine is flattened, focus on extending the spine and don't push chest forward
- As the air is drawn into the lungs, follow the downward movement of the diaphragm to the abdomen and lengthen lumbar spine. If lumbar curve is reversed, rotate pelvis forward to regain natural curve, and if the lumbar curve is exaggerated, use abdominal contraction, at the initiation of the exhale, to pull the pubic bone upward and to flatten the lumbar spine
- On exhale, as the diaphragm moves upward, keep the chest lifted, pull shoulders down and back, increase extension of spine
- Maintain partial contraction of lower abdomen through successive inhales, stabilizing lumbar-pelvic relationship, increasing lift of the rib cage, and furthering extension of spine
- Initiate movement from deeper musculature with breath and avoid forcing the spine with other muscles to minimize risk of injury

Note:

- Extension can be practiced in supine, prone, standing, kneeling, and seated postures

Common Risks:

- Excessive forward or backward rotation of pelvis
- Collapsing chest over belly, jutting chin forward, collapsing head backward
- Rounding of shoulders, hyperflexing shoulders
- Risk of strain on lumbo-sacral spine, sacroiliac ligaments, excessive spinal disc compression
- Risk of strain on hip and knee joints where there is external or internal rotation
- Possibility of strain to the musculature of upper back, shoulders, neck

6. VIPARITA – INVERSION – ACTIVE REVERSAL

Turning the body upside down for efficient functioning of our entire physiology

Intention:

- Tones vital organs
- Stimulates endocrine glands
- Build strength and elasticity in superficial and deep musculature, ligaments, connective tissues of spine, rib cage
- Strengthen diaphragm and abdominal muscles, and muscles that bind the shoulder and pelvic girdles to the spine
- Improve posture and overall structural integrity, reducing stress to muscles, organs of the torso, improving digestion, respiration, and circulation
- Achieve active reversal effect – reversing effects of gravity
- Deepening respiratory rhythm

Technique:

- The key to achieving active reversal effect is the ability to remain in the inverted posture for a length of time without stress to the structure
- To minimize stress, we have to be able to bring the natural curves of the spine, as well as any lateral curves, into maximum vertical alignment, relative to the different base in each posture – this can be achieved with the combined techniques of inhale and exhale
- Proper sequencing, preparation and compensation, and establishing maximum vertical alignment while in the postures, will minimize risks

Note:

- Any posture in which legs are raised above the head or in which the head moves below the waist provides inversion effect
- Supine extension postures with legs raised, as well as standing forward bends, downward dog posture, and the arm balances give some of the inversion effect
- Postures in which inversion is the primary effect are limited to headstand (sirsasana) and its variations, and shoulder stand (sarvangasana) and its variations

Common Risks:

- Vertebral column is like a pyramid – cervical spine structures give the head great mobility and less stability. Moving downward the vertebral structures become progressively larger to support the increased weight and giving the pelvis great stability and relatively less mobility. In inverted postures, therefore, greatest demands are placed upon the most fragile and least stable portion of the spine
- Most significant risk, therefore, is strain to the muscles, ligaments, nerves of the neck, as well as intervertebral disc compression
- Risk of strain to the lumbar spine and compression of spinal discs
- Risk is cumulative – become manifest years into the practice
- A certain degree of strength, stability, and functional integration is very important to avoid injury

Contraindications for Headstand and Shoulder Stand:

- Severe asymmetries or severe scoliosis
- Weakness in any or all areas of the spine and surrounding musculature
- Chronic forward thrust of neck, or flattened cervical spine
- Long neck and weak upper back
- Smaller upper torso and large lower torso
- Severe lumbar lordosis / Disc problems
- High blood pressure
- Glaucoma
- Obesity
- Head colds or sinus blockage
- During menstruation
- During pregnancy

7. VISESA – BALANCE – ACCOMPLISHING THE PECULIAR

Balance postures are organized into two distinct classes –

First Class: *Leg Balances (standing on toes or on one foot)*

Intention:

- Develop a focused mind and improve the body's overall strength and structural integration – especially feet, legs, hips
- Refine the way we hold and move our body weight

Second Class: *Arm balances (standing on the hands, forearms and hands)*

Intention:

- In addition to the benefits mentioned above, they emphasize strengthening the muscles of the arms and shoulders, as well as the low back, abdomen, and pelvis

Note:

- Both classes give us a sense of increased mastery over our body
- Promote a feeling of lightness and well-being, tend to boost self-confidence
- The intention of both the classes is to maintain the position for longer periods of time without stress or strain, and develop a focused and stable mind through this accomplishment

Technique:

- Mechanical perspective – structure of the body is a weight support and transference mechanism. When we are standing, base of support is the feet; when seated, base of support is buttocks and legs; when lying down, base of support is the full length of the body. In general, larger the base, greater the stability. In balance postures the base is characteristically smaller and relatively unstable. Stability is further compromised because, in most balance postures, weight of the body is not in vertical alignment above the base
- Leg balance postures – lifted leg is extended in front, behind, or to the side of the line vertically above the supporting foot
- Arm balance postures – torso and legs are also extended in front, behind, or to the side of the supporting hands, or forearms and hands
- The key to accomplishing balance postures is the ability to achieve equilibrium on an unstable base, using the displaced body weight as a counter-balance
- Excessively tight ligaments/muscles – difficult to move the bodyweight sufficiently to create the counterbalancing effect necessary to maintain postures. Excessively loose ligaments/muscles – difficult to stabilize joints through which the bodyweight is transferred
- Developing the strength, flexibility, and stability through regular practice is essential
- Combined techniques of inhale and exhale helps make subtle adjustments of torso, arms, and legs and are required to achieve balance
- Eyes are a key to our ability to maintain equilibrium – should be focused on a point out in front of us. This facilitates special awareness, and helps to keep the mind present
- All postures involve elements of forward bending, back bending, twisting, lateral bending, extension, and/or inversion

Common Risks:

Leg Balances:

- Lateral or backward displacement of hips
- Collapsing of the chest over the belly, twisting of torso
- Compression or strain in low back, shear stress in hip, knee, ankle, or sacroiliac joints
- Inward or outward rotation of supporting leg
- Jutting chin forward, or collapsing the head backward, strain on neck and shoulder muscles

Arm Balances:

- Collapsing chest over belly, increasing thoracic kyphosis (except inverted back bend)
- Significant risk to wrists, elbows, shoulders, neck, and upper back
- Elevating shoulders towards the ears – upright postures
- Sinking of the pelvis into the arms – inverted forward bends and twists
- Increasing excessively the lumbar curve – inverted back bends

Reference Source – Yoga for Wellness, by Gary Kraftsow