General Concepts:

There are many ways to approach Spinal Passive Mobility Testing, and the process can be made quite simple or very complex. The conclusions should be very similar regardless of what system is used. The goal is primarily to identify stiff and/or symptomatic spinal segments in a way that would then direct the choice of mobilization treatment technique to restore that motion, decrease pain and improve function.

Purpose of Passive Mobility Testing

- assist in further developing / analyzing your clinical hypothesis – support or negate
- assist in the clinical decision making process to guide the development of management strategies
- direct the specific choice of manual therapy technique → to restore motion / modulate pain
- identify region / level / direction to inform treatment choices
- compare to AROM
- assess the quality and quantity of through range segmental motion compared to above/below, side to side
- identify stiff spinal segments / identify hypermobile spinal segments
- determine the irritability / end feel (EF) / reproduction of symptoms
- establish patient comfort / apprehension / trust regarding a hands on approach

Purpose of Passive Physiological Intervertebral Movements (PPIVMs):

- assess the global passive motion of the complete segment
- physiological / osteokinematic motion around an axis
- identify the restricted level
- get a sense of irritability, joint picture, through range motion quality and quantity, EF
- determine which movements including combinations of movements are restricted or reproduce symptoms i.e. multiple planes / coupling patterns
- guide treatment choices

Purpose of Passive Accessory Intervertebral Movements (PAIVMs):

- arthrokinematic motion or joint glide along a joint plane of motion
- focus more specifically on the articular component (Z joint) more so with unilateral PAIVMs
- get a sense of irritability, joint picture, through range motion quality and quantity, EF
- determine which directions of glides are restricted
- guide treatment choices

Important features of Spinal Passive Mobility Testing:

- Localized, segmental
- Explores through the entire range of motion
- Achieves end of segmental range to assess end feel

Localization:

Segmental localization is an important feature of mobility and stability testing as well as during treatment. There are many ways to localize motion to a segment, and different situations will require varying degrees of localization. The circumstances will dictate the approach, but the technique may also have to be adjusted according to the response of that patient's spine to the motion imparted and the ability of the therapist to appreciate the local segmental motion.

1) **Localization** – segmental localization of a movement can be achieved by carefully producing the movement about the appropriate axis of motion for that joint, stopping when the end feel is appreciated or when motion of the adjacent bone is perceived. This is commonly the method of localization used for PPIVM assessment.
2) **Stabilization –** some circumstances require more control of the adjacent vertebra to better feel the motion being tested. In these situations, the adjacent vertebra can be lightly stabilized to be able to focus the motion to the desired segment. This is commonly done in regions that are more mobile, for example when testing rotation at the AA joint it is often helpful to lightly stabilize C2 when moving the atlas either as a PPIVM or PAIVM.
3) **Fixation –** absolute fixation is less commonly required for mobility testing. It is more often utilized for stability testing in order to obtain a true stress on the structures being tested. It can also be used for some treatment techniques to be able to obtain a stretch on the structures at end range. It is commonly used in manipulation, although locking is also employed for those techniques. Fixation may also be indicated when there is an irritable or hypermobile segment near by that needs to be protected from unwanted movement.

PPIVM:

Definition: assessment of the passive osteokinematic motion available at a spinal segment. These are movements that the patient would be able to perform independently. The motion is assessed by the therapist to determine if the amount of passive physiological mobility is normal, hypomobile or hypermobile. Joint mobility (quality and quantity), irritability, as well as end feel can be assessed with these procedures.

- fully assess the segmental physiological / osteokinematic motion
- include bilateral flexion / extension
- assessing side flexion (SF)/rotation as uniplanar motions or coupled in neutral is optional and assessment can move directly into triplanar mobility testing
- a complete PPIVM assessment includes combined triplanar motions

Combined PPIVM's:

Although we often consider that we are biasing the motion to one side or the other with the triplanar PPIVMs, it is important to remember that it is still the whole motion segment that we are assessing. The tripanar motions will consider the motions of flexion or extension combined with side flexion and rotation. These motions are thought to produce more flexion/tension/opening or extension/compression/closing on one side or the other. The disc, joints (facet, UV, interbody), muscles, nerve, dura and bony architecture can all contribute to loss of motion either through compression or tensioning of any of these structures.

Terminology: Combined PPIVM's can be named in various ways:

Ipsilateral coupling: SF/ rotate to same side i.e. right SF and right rotation

Contralateral coupling: SF/rotate to opposite sides i.e. right SF and left rotation

The following terms can be used to describe the simple ipsilateral coupled SF/rotation motion into flexion & extension in both the cervical and thoracic spine.

right unilateral flexion: combined flexion / left SF / left rotation → tension biased to the right; flexion biased to the right, maximum flexion on the right

right unilateral extension: combined extension / right SF / right rotation → compression biased to the right; extension biased to the right, maximum extension on the right

→ flexion or extension is accentuated on the right side but does not mean that it is only the right facet joint that can't flex/tension that is restricting that motion, we are evaluating the ability of the whole segment to move in that combined triplanar direction

"Open / Close": As the facet joints really do not 'open' and 'close', but rather glide along the joint surfaces, it is best to save these two terms to describe potential changes in the space of the intervertebral foramen (IVF) and not refer to flexion as opening and extension as closing.

The T spine can also couple contralaterally and these combined movements should be considered at Level 3, particularly if the mechanism of injury or active movement testing suggests this.

PAIVM:

Definition: assessment of the passive arthrokinematic accessory glide or joint play motions available at a spinal segment. Although part of normal joint motion, these movements cannot be actively performed by the patient. The motion is palpated by the therapist to determine if the amount of accessory joint glide is normal, hypomobile or hypermobile. Joint mobility (quality and quantity), irritability, as well as end feel can be assessed with these procedures.

- can be thought of as accessory joint glides or joint play
- Note: over pressure of a PPIVM ***does not*** = a PAIVM as the glide should assessed through its entire range, not just at the end of movement
- for the most part with a few exceptions PAIVMs are performed in lying
- assessed in neutral to determine quantity and quality of motion as well as plane of the joint
    - then position toward the restricted range & re-assess especially for very mobile joints (i.e. AA)
    - not at the very end of range or there would be no glide left
    - when comparing the glide from side to side, must be at the same point in range

Mobility Testing for Each Spinal Region *(as expected at the exams)*

Upper C Spine:

CV Joints: The triplanar motion coupling for the CV joints is coupled contralaterally regardless of which movement initiates the motion, as per the generally consistent findings of biomechanical studies in that region. See CV biomechanics section

PPIVMs

OA joint:

- bilateral F/E - uniplanar
- SF/contralateral rot in neutral– biplanar – optional
- combined SF/contralateral rot in flexion and in extension – triplanar
    - to assess max flexion/extension of the right and left joints as well as focus to other structures unilaterally
    - **Right unilateral flexion** = flexion / left SF/right rotation → biases (or max) flexion on the right
    - **Right unilateral extension** = extension / right SF/left rotation → biases (or max) extension on the right
    - Again, it is not only the right OA joint that could be causing this triplanar motion restriction; it could be any structure within the motion segment

AA joint:

The AA joint couples contralaterally and when the transverse ligament is intact, flexion creates a very small amount of posterior glide and extension creates a small amount of anterior glide (Oda et al, 1991). It is best **not** to use the terms maximum or unilateral flexion/extension for this joint as the primary motion is definitely rotation. Instead we look for a rotation (with slight contralateral SF) PPIVM restriction, and then assess anterior and posterior glides as PAIVMs to determine a more right or left side restriction.

- bilateral F/E as a rocking motion – uniplanar
- Rotation:
    - Cervical Flexion Rotation Test (CFRT)
      and/or
    - lightly stabilize C2 spinous process in neutral and rotate C1 and/or head around a vertical axis to assess the quantity and quality of AA rotation in each direction (allow the conjunct contralateral SF to occur)
- it is optional to assess uniplanar SF at the AA joint

**** Instructor note:**

<u>Level 2</u> → teach

OA

- bilateral F/E
- SF (with slight contra rotation) in neutral
- repeat in flexion and extension

AA

- Bilateral F/E
- CFRT in supine and/or localized rotation PPIVM in supine or sitting

<u>Level 3</u> → review Level 2

teach:

OA combined tri-planar motion

- maximum flexion - F/SF away / rot towards
- maximum extension - E/SF towards / rot away

PAIVMs

These can be done as either a direct glide of the cranial vertebra or relative glide of the caudal vertebra, in prone or supine, using thumbs or football grip.

OA Joint:

- bilateral posterior glide (consider bilateral anterior glide is indicated for that case)
- unilateral anterio-medial / posterior-lateral glides
    - perform in neutral and into restricted range
- optional to assess isolated lateral glide at the OA joint

AA Joint:

- unilateral anterior / posterior glides
    - perform in neutral and into restricted range
- optional to assess lateral glide at the AA joint

**** Instructor note:**

<u>Level 2</u> → teach

OA Joint:

- bilateral posterior glide (football hold)
- unilateral posterior glide (football hold)
- unilateral anterior glide (football hold or relative post glide C1)

AA Joint:

- unilateral anterior glide (direct ant glide C1)
- unilateral posterior glide (A/P C1)
- assess in neutral

<u>Level 3</u> → teach

- both PA & AP options at both OA & AA joints as direct and relative glides in supine & prone
- assess in neutral and then move towards restricted barrier

<u>mid-C spine</u>:

PPIVMs

- Must include bilateral F/E - uniplanar
- Uniplanar SF
  - can be assessed in neutral / flexion / extension
- Optional to assess ipsilateral coupled SF/Rot in neutral - biplanar
- Combined ipsilateral coupled SF/rot with flexion and with extension
  - **maximum (unilateral) flexion** = F + SF away + rotation away
  - **maximum (unilateral) extension** = E + SF toward + rotation toward

**** Instructor note:**

<u>Level 2</u> → teach

- bilateral F/E
- pure sideflexion in neutral
- combined ipsilateral coupled SF/rot in neutral

C. Kennedy, compiled from Orthopaedic Division Instructors' Meeting 2015/ 2016

- repeat in flexion and extension

<u>Level 3</u> → review Level 2

teach

- combined triplanar motion
  - F/ ipsilateral SF/rot (maximum/unilateral flexion)
  - E/ ipsilateral SF/rot (maximum/unilateral extension)

PAIVMs

- directional arthrokinematic/accessory glides in supine:
  - lightly stabilize caudal vertebra on opposite side to focus to specific level (not necessary to fully fix)
  - anterior/superior glide along the plane of the joint for flexion
  - posterior/inferior/medial glide along the plane of the joint for extension (thru lamina or anterior tubercle)
  - lateral glide with a slight inferior vector (as compared to the stability test)
  - straight anterior and posterior glides applied more medially (previously thought to focus more to the UVJ)
    - explore the plane of maximal restriction by adding various proportions of the vectors of the triplanar motion
- P/A joint play in prone:
  - Central on the spinous process (SP)
    - can also be directed cranial / caudal / medial / lateral / diagonal
  - Unilateral on the articular pillar
    - straight P/A
    - can also be directed - cranially / caudally / medial / lateral / diagonal
  - no stabilization of adjacent vertebra required

**** Instructor note:**

<u>Level 2</u> → review P/A's in prone from Level 1 (straight and directed cranial/caudal)

Teach

- in neutral
  - anterior superior glide
  - posterior inferior glide
  - lateral glide in neutral

<u>Level 3</u> → review Level 2

Teach

- along the oblique axis in the plane of the Z joints
    - anterior superior glide
    - posterior inferior glide with a medial component
    - lateral glide with an inferior component
    - repeated in restricted range of F/E
- explore various planes of movement to determine the most restricted motion
    - straight A/P glide applied more medially (at the plane of the UVJ)
    - i.e. left lateral glide with a combined posterior / inferior vector on the right or anterior / superior vector on the left

** consult the UVJ document for further guidance

T spine:

PPIVMs

- must include bilateral F/E - uniplanar
- combined ipsilateral coupled SF/rot with flexion and with extension
    - **maximum unilateral flexion** = F + SF away + rot away
    - **maximum unilateral extension** = E + SF toward + rot toward
    - assists in assessing maximum flexion/extension of the facet joint but must also consider other structures such as: costal elements, disc, muscle, neural/dural
- combined contralateral coupling SF/rot
    - the thoracic spine can couple either ipsilaterally or contralaterally during trunk movement, and so contralateral coupling should also be considered
    - this could be performed in neutral or in F/E depending on the context of the patient presentation/mechanism of injury

** not all combinations of motion need to be assessed

Costal element

- palpate osteokinematic rib motion
    - posterior roll during: inspiration / trunk extension / ipsilateral rotation
    - anterior roll during: expiration / trunk flexion / contralateral rotation

**** Instructor note:**

Level 2 → teach

- bilateral F/E
- uniplanar rotation
- uniplanar SF
- maximum (unilateral) flexion – F/rot/SF away from side being assessed
- maximum (unilateral) extension – E/rot/SF toward side being assessed

costal:

- palpate rib motion during
    - inspiration / expiration
    - spinal flexion / extension

Level 3 → review Level 2

Teach

- combined end range triplanar PPIVMs including contralateral coupling
- palpate rib motion during trunk rotation

PAIVMs

- not just as an overpressure of the PPIVM in sitting
- usually done in prone – in neutral → then into range if required
- no fixation of the adjacent vertebra is required (may be useful in some situations)
- accessory glides: P/A's
    - unilateral on the transverse process (TVP)
        - straight P/A
        - directed cranial (as per arthrokinematic anterior-superior glide for flexion)
        - directed caudal (as per arthrokinematic inferior glide for extension)
            - option – extension can be assessed as an ant/sup glide of the caudal vertebra under the stabilized cranial vertebra to produce a relative posterior-inferior glide
    - optional
        - central on SP, can be directed cranial/caudal
        - transverse pressures on the SP as rotation
- costal elements
    - P/A over the rib angle
    - superior and inferior glides
        - stabilize the TVP to focus the motion to the CTV joint

**** Instructor note:**

<u>Level 2</u> → teach

- unilateral on the TVP
    - straight P/A
    - cranially directed (as per anterior superior for flexion)
    - caudally directed (as per inferior for extension)
- optional
    - central on SP (directed cranial / caudal)
    - transverse pressure on SP
- costal
    - P/A rib spring medial to the rib angle

<u>Level 3</u> → review Level 2

Teach

- cranial/caudal directed P/A's performed with spine positioned into the restricted range
- option to create relative extension – anterior superior glide of caudal vertebra
- superior/inferior glides in upper CTVJ
- slightly oblique plane for lower cage due to joint orientation → ILA/ PMS glides

L spine:

Lumbar Spine: the normal biomechanics of coupled motion in the lumbar spine during active movement is inconsistent, variable from level to level, in positions of flexion or extension and across individuals. It is therefore difficult to dictate the most appropriate combined motions to use for assessment. The presentation of the patient may help to guide this. We can however, passively combine the 3 planes of motion to load (either tension or compression) more maximally to structures on one side or the other of the spine. This can aid us in identifying the stiff and or symptomatic segment as well as the direction of most marked restriction. It is important to remember that the whole motion segment is moving during PPIVM testing, and multiple structures may be stressed, even if there is a focus on one side of the spine.

PPIVMs

- must include bilateral F/E - uniplanar
    - encourage using the legs thru hip F/E to produce bilateral F/E in the lumbar spine
    - if using the pelvis, ensure that the angular physiological motion of F/E is actually achieved, not just pulling SP's apart
- optional to assess uniplanar or combined SF/rot in neutral
- must include triplanar combined SF/rot (not just uniplanar SF) in both flexion and in extension about an oblique axis to explore the motion of the whole segment
- as we draw the pelvis forward or move the trunk back to impart motion, rotation will be produced as a constant – in the case of left side lying this would be right rotation
- the most common assessment approach considers testing more flexion/tension or extension/compression of the top side of the lumbar spine as related to the more popular treatment techniques
- for example, in left side lying:
    - **right unilateral flexion** of top side of the spine (max flexion or tension)
      → position the lumbar spine into some **flexion, add right rotation and left SF** (caudal along the line of the femur)
    - **right unilateral extension** of the top side of the spine (max ext or compression)
      → position the lumbar spine into some **extension, add right rotation and right SF** (cranial towards the operator's umbilicus)

→ this simplified system that biases the stress to the uppermost side of the spine would allow students to have a uniform initial approach to mobility testing, ideal for Level 2, leading to direct treatment techniques

- depending on a number of factors including; mechanism of injury, findings on active movement testing, patient presentation patient/therapist size, comfort, … consideration of other coupled motion could be indicated, for example
    - may be able to achieve more maximal flexion of a Z joint by placing the stiff joint down and coupling ipsilateral SF/rot when positioned in flexion
    - the patient's presentation or mechanism of injury may be suggestive of a problem with contralateral coupling in extension and so those movements could be assessed as a triplanar motion with the stiff side on the bottom

→ this could be introduced at Level 3 and reinforced with case-based scenarios would then also lead to discussion/instruction & practice of indirect techniques.

**** Instructor note:**

<u>Level 2</u> → teach

- bilateral F/E
- combined rotation / SF in neutral
- repeat in position of flexion and extension – for max F/E of top side
    1) position in flexion, rotate with SF contralateral to rotation
    2) position in extension, rotate with SF ipsilateral to rotation
- leading to direct treatment techniques

<u>Level 3</u> → review Level 2

Teach

- explore other triplanar combined motion options related to coupling patterns and patient scenario presentations leading to indirect treatment techniques

PAIVMs:

- not as an overpressure of the PPIVM in side lying
- done in prone – in neutral → may position into range if required
- no fixation of the adjacent vertebra is required
- accessory glides: P/A's
    - unilateral on TVP
        - directed cranial (as per anterior-superior for flexion)
        - directed caudal (as per inferior for extension)

- option - extension can be performed as an ant/sup glide of the caudal vertebra under the fixed cranial vertebra to produce a relative posterior-inferior glide

- optional
  - central on SP, can be directed cranial/caudal
  - transverse pressures on the SP

**** Instructor note:**

<u>Level 2</u> → teach

- unilateral on the TVP
  - straight P/A
  - cranially directed (as per anterior superior glide associated with flexion)
  - caudally directed (as per inferior glide associated with extension)
- optional
  - central on SP (directed cranial / caudal)
  - transverse pressure on SP

<u>Level 3</u> → review Level 2

Teach

- P/A's performed with spine positioned into restricted range
- option to create glide associated with relative extension – anterior superior glide of caudal vertebra

SIJ

Passive Physiological Motions:

- innominate rotation → anterior and posterior in side lying (or supine)
- sacral nutation / counter-nutation in prone

**** Instructor note:**

<u>Level 2</u> → teach

- innominate rotation
  - anterior
  - posterior
- sacral motion
  - nutation
  - counternutation

<u>Level 3</u> → review Level 2

Passive Accessory Glides:

- the joint play motions can be assessed in either supine or prone and does not have to include both as long as anterior, posterior, cranial and caudal are all assessed
- it is not known which glides of the innominate relate to which physiological movements at the SIJ or if we can differentiate between the long or short arms of the joint
- the accessory glides are not just palpating the joint as the innominate is moved through its physiological motions of anterior and posterior rotation, they are more direct translational glides
- prone
  - anterior glide sacrum (for nutation / posterior rotation)
    - stabilize the ASIS with a dorsal force
    - P/A lateral sacral base just medial to PSIS
  - posterior glide sacrum (for counter-nutation / anterior rotation)
    - hand placements at ipsilateral PSIS / contralateral ILA
    - stabilize one / P/A on other - either are acceptable and create the same motion at the SIJ
  - could also perform cranial and caudal glides of the innominate relative to the sacrum in this position
- supine

- palpate at SIJ sulcus
- assess joint play during translational motion of the innominate
    - posterior glide thru ASIS
      (can't move it anterior in this position – so must do that in prone)
    - cranial and caudal through the leg (or ischial tuberosity for cranial)

**** Instructor note:**

<u>Level 2</u> → teach

- supine innominate glides
    - posterior
    - cranial
    - caudal
- prone sacral glides
    - anterior
    - posterior

<u>Level 3</u> → review Level 2

- prone cranial/caudal glides
- sidelying options