Military Acute Concussion Evaluation 2 (MACE 2) Training

Instructor's Guide

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Lesson Plan

- Please allow between 45 and 90 minutes to complete entire lesson plan depending on number and skill set of participants.
- Be sure all equipment is set up and working before the training session.
- Count out and prepare MACE 2 workbooks and pocket guides in advance.
- Suggested additional equipment for the VOMS tests:
  - Targets for near point convergence test. The target tool requires a single character 14 pt. font-size letter as a focal point (the "A" on the last page of MACE 2 pocket guide shows the correct target dimensions) affixed to a handle; tongue depressors make ideal handles.
  - Tape measures for near point convergence test. If *metric* tape measures are not available, there is a rule with cm increments on the edge of the MACE 2 pocket guide's last page that can be used.
  - Metronomes for the VOR and VMS. Any of the free metronome apps for cell phones or computers that are readily available on-line can be used.

NOTE: A specialty provider trained and familiar with the VOMS should be involved in VOMS exam training participants.

Activity	Learning Tools Needed
Introduction	MACE 2 Instructor's Guide
MACE 2 Lecture/Review, including activities	PowerPoint Slides, MACE 2 Instructor's Guide, MACE 2 Workbook, MACE 2 pocket guide
1. **Practice Activity 1: Red Flags and Concussion Screening** (small group work or individual work)	MACE 2 Workbook, MACE 2 pocket guide
2. **Practice Activity 2: Cognitive Exam - Part 1** (small group work or individual work)	MACE 2 Workbook with, MACE 2 pocket guide
3. **Practice Activity 3: Neurologic Exam**	MACE 2 Workbook , MACE 2 pocket guide
4. **Practice Activity 4: Cognitive Exam - Part 2**	MACE 2 Workbook, MACE 2 pocket guide
5. **Practice Activity 5 -9: VOMS**	MACE 2 Workbook, MACE 2 pocket guide, targets, tape measures, cell phones
6. **MACE 2 Clinical Case: Summative Assessment**	MACE 2 Workbook, MACE 2 pocket guide
Lecture (conclusions/questions)	PowerPoint Slides, MACE 2 Workbook, MACE 2 Instructor's Guide, MACE 2 pocket guide

Clinical Case Scenario:
When to Use the MACE 2

Directions

The following activities provide an opportunity to practice applying the MACE 2 to a clinical case scenario. Read the assessment activity, then turn and discuss with a partner how to best answer the activity questions. *Use the MACE 2 to answer the questions in the "Practice Activities" sections, and write answers on the MACE 2 pocket guide where applicable.*

A twenty-six-year old service member (SM) was leading his platoon on foot patrol. An improvised explosive device (IED) detonated about 15 feet behind him. The blast impact caused the SM to fall, dislodge his protective head gear and hit his head on the ground.

The SM remembered a flash of light and awakening to the corpsman shaking him. He took a while to get up, and had trouble walking and keeping his balance. His face showed no expression, as if he didn't care about, or understand, what was happening. He remained "out of it" for several more minutes, and then was able to complete the MACE 2 exam. The corpsman determined there were no Red Flags, but continued monitoring for Red Flags throughout the exam. The SM remembered all of the events surrounding his injury. Witnesses state he was "out" for about 30 seconds or so.

Practice Activity 1 *Red Flags and Concussion Screening*

After completing Practice Activity 1, the participant will understand how to:

1. Complete the initial concussion screening from the MACE 2 exam.
2. Recognize Red Flags and need for immediate evacuation to higher level of care.

Activity 1 Question: Red Flags

Based on the clinical case scenario above, please complete the MACE 2 Concussion Screening to determine if there were any Red Flags. Defer MACE 2 if any Red Flags are present. Immediately consult higher level of care and consider urgent evacuation, according to evacuation precedence/Tactical Combat Casualty Care (TCCC).

Are there any Red Flags present?_____Negative for all Red Flags_____

KEY RED FLAGS (initially and throughout the Mace 2):

- ☐ Deteriorating level of consciousness
- ☐ Double vision
- ☐ Increased restlessness, combative or agitated behavior
- ☐ Repeat vomiting
- ☐ Results from structural brain injury detection device (if available)
- ☐ Seizures
- ☐ Weakness or tingling in arms or legs
- ☐ Severe or worsening headache

Activity 1 Questions: Concussion Screening

Based on the clinical case scenario, please complete the MACE 2 Concussion Screening to determine if there was both an injury event and an alteration of consciousness.

1. Description of the incident

A. Record the event as described by the service member or witness.
(Use open-ended questions to get as much detail as possible.)

KEY QUESTIONS:

- Can you tell me what you remember?
- What happened?
- Who were yo last with?

B. Observable signs- were there any visual clues for concussion observed when the injury occurred?
KEY OBSERVABLE SIGNS (visual clues that suggest a concussion may have occurred):

- ☑ Lying motionless on the ground
- ☑ Slow to get up after a direct or indirect blow to the head
- ☑ Disorientation, confusion, or inability to respond appropriately to questions
- ☑ Blank or vacant look
- ☑ Balance difficulties, stumbling, or slow labored movements
- ☐ Facial injuries after head trauma
- ☐ Negative for all observable signs

C. Record the type of event _Explosion/Blast occurred approximately 5 meters from the SM__
KEY EVENTS- choose all that apply:

☐ Blunt object	☐ Sports injury	☐ Gunshot wound
☐ Fall	☐ Assault	☑ Explosion/blast (Estimated distance **~5m**)
☐ Fragment	☐ Motor vehicle crash	☐ Other

D. Was there a blow or jolt to the head?____YES_____
(Was there a head injury event?)

KEY QUESTIONS:

- ☐ Did your head hit any objects?
- ☑ Did any objects strike your head?
- ☐ Did you feel a blast wave? (A blast wave that is felt striking the body/head is considered a blow to the head.)
- ☐ Did you have a head acceleration or deceleration?

2. Alteration of Consciousness or Memory (AOC/LOC/PTA)

A. Was there alteration of consciousness (AOC)? _____YES_____

(AOC is temporary confusion or "having your bell rung.")

KEY QUESTIONS:

- Where you dazed, confused, or did you "see stars" immediately after the event?
- Did you feel like you were in a fog, slowed down or "something was not right"?

If yes, for how long? _several_minutes__0___seconds

B. Was there a loss of consciousness (LOC)? _____YES_____

(*LOC is temporarily passing out or blacking out.)*

KEY QUESTIONS:

- Did you pass out or black out?
- Is there a period of time that you cannot account for?

If yes, for how long? _____around 30 seconds___

C. Was there post traumatic amnesia (PTA)? _____NO_____

(Post Traumatic Amnesia is a problem remembering part or all of the injury events.)

KEY QUESTIONS:

- Is there a period of time that you cannot account for?
- What is the last thing you remember before the event?
- What is the first thing you remember after the event?

If yes, for how long? _____Not applicable___

D. Was the AOC, LOC or PTA witnessed? ____YES_____

If yes, for how long? _several (AOC)_minutes~30 (LOC)seconds

(If yes, name a witness.)

TIPS FOR ASSESSMENT

- Ask witness to verify AOC/LOC/PTA and estimate duration

Activity 1 Questions: Symptoms

3. Symptoms

Record the screening exam results using the information below.

Findings:
The SM complains of headache and ringing in the ears; no other complaints noted**.**

3. Symptoms
Common symptoms after a concussion are listed below. For this event, check all that apply.

- ❑ Headache
- ❑ Dizziness
- ❑ Memory problems
- ❑ Balance problems
- ❑ Nausea/vomiting
- ❑ Difficulty concentrating
- ❑ Irritability
- ❑ Visual disturbances
- ❑ Ringing in the ears
- ❑ Other _____
- ❑ **Negative for all symptoms**

What are the symptom MACE 2 results?

a. No symptoms
b. 1 or more symptoms

Record results (see page 13 of MACE 2 pocket guide under SYMPTOM RESULTS).

Activity 1 Questions: Concussion History

4. History

During your MACE 2 examination, you ask the SM about prior concussions in the past 12 months, headache or migraine disorders, and about any previous behavioral health concerns.

Findings:
SM reveals being diagnosed with one other concussion in the past 12 months. Denies history of headaches, migraines or any behavioral health issues.

Record concussion history results and then take appropriate action.

A. During the past 12 months have you been diagnosed with a concussion, not counting this event?
   a. Yes
   b. No
   c. Unknown
   If yes, how many? _____1_____

B. History of diagnosed/treated headache disorder or migraine
   a. Yes
   b. No

C. History of depression, anxiety or other behavioral health concerns
   a. Yes
   b. No

Activity 1 Questions: Concussion Screening Results

Do you **continue** or **stop** the MACE 2? _____Continue_____

Why? ____YES to 1D, 2A, 2B, and 2D_____

STOP, REFER TO LECTURE SLIDES AND CONTINUE PRESENTATION

Practice Activity 2 *Cognitive Exam - Part 1*

After completing Practice Activity 2, based upon the previous clinical case scenario and findings, participants will understand how to:

1. Complete the Cognitive Exam – Part 1
2. Score each section of the Part 1 exam: Orientation and Immediate Memory

5. Orientation

Score 1 point for each correct answer.

Activity 2 Question: Orientation

Record the orientation total score using the information below. Correct response must be within one hour of actual time.

Examiner (from MACE 2 script):
"What month is this?"
"What is the date or day of the month?"
'What day of the week is it?"
"What year is it?"
"What time do you think it is?"

Findings:
The SM was able to state the correct month, day of month, year, day of the week, but wasn't sure of the time of day.

What is the orientation total score? _____4/5_____

6. Immediate Memory

Choose one list (A-F) and use that list for the remainder of the MACE 2. Use the Trial 1, 2 and 3 scripts provided on MACE 2 in the "Immediate Memory" section.

- Read all five words to the patient.
- Allow time for the patient to respond.
- Circle the response for each word for each trial.

Repeat two more times (*three times total*), even if the service member scores perfectly on any trials.

Trial 1 Script:

"I am going to test your memory. I will read you a list of words and when I am done, repeat back to me as many words as you can remember, in any order."

Trial 2 and 3 Script:

"I am going to repeat that list again. Repeat back to me as many words as you can remember, in any order, even if you said them before."

Activity 2 Question: Immediate Memory

Record immediate memory total score using the information below.

Examiner (from MACE 2 Script):
Trial 1 Script:
"I am going to test your memory. I will read you a list of words and when I am done, repeat back to me as many words as you can remember, in any order."
Elbow, Apple, Carpet, Saddle, Bubble

Trial 2 and 3 Scripts:
"I am going to repeat that list again. Repeat back to me as many words as you can remember, in any order, even If you said them before."
Elbow, Apple, Carpet, Saddle, Bubble

Findings

The SM was able to repeat the following using list F:

- Trial 1 - Elbow, Apple, Carpet, Saddle, Bubble
- Trial 2 - Apple, Elbow, Carpet, Saddle, Bubble
- Trial 3 - Elbow, Saddle, Apple, Bubble

What is the immediate memory total score? _____14/15_____

STOP, REFER TO LECTURE SLIDES AND CONTINUE PRESENTATION

Practice Activity 3 *Neurological Exam*

Following Practice Activity 3, participants will be able to:

1. Complete the Neurological Exam from the MACE 2 pocket guide
2. Score and record the Neurological exam based upon presented findings

Activity 3 Questions

Practice the neurological exam on a partner if directed by the instructor. Based upon the findings below, record the neurological assessment as "Normal" or "Abnormal".

Findings:

Throughout the exam the SM's speech is fluid and he has no difficulty naming objects.

His grip strength is equal bilaterally and he is able to stand with his eyes closed with no drifting of either arm.

With eyes closed using his right leg, he *can* stand on one leg for 10 seconds, but is *unable* to stand on only his left leg with his eyes closed. The SM is also unable to walk a straight line, heel-to-toe with his arms at his side.

His pupils are equal upon examination, reactive to light and tracking smoothly and equally.

7. Speech Fluency

The speech is fluid.
This response is: __Normal_

8. Word Finding

No difficulty naming objects.
This response is: _Normal__

9. Grip Strength

The grip is bilaterally equal. This response is: _____Normal__

10. Pronator Drift

The SM can stand with eyes closed and no drifting of either arm.
This response is: _Normal_

11. Single Leg Stance

Able to stand on right leg with eyes closed 10 sec; unable to stand on left leg with eyes closed.
This response is: __Abnormal__

MACE 2 - Military Acute Concussion Evaluation

NEUROLOGICAL EXAM

7. Speech Fluency
- ☐ Normal
- ☐ Abnormal

- Speech should be fluid and effortless
  – no pauses or unnatural breaks.
  – Stuttering or struggling to speak is abnormal.

8. Word Finding
- ☐ Normal
- ☐ Abnormal

- Assess difficulties with word finding:
  – Difficulty in coming up with the name of an object or grasping to find words is abnormal.

9. Grip Strength
- ☐ Normal
- ☐ Abnormal

- Assess grip strength. Grip strength should be strong and equal bilaterally.
  – Unequal or weak grip strength is abnormal.

10. Pronator Drift
- ☐ Normal
- ☐ Abnormal

- Direct service member to stand with eyes closed and arms extended forward, parallel to the ground with palms up. Assess for five to 10 seconds:
  – Any arm or palm drift is abnormal.

11. Single Leg Stance
- ☐ Normal
- ☐ Abnormal

- Remove shoes if possible. Have service member stand on one leg, arms across chest, hands touching shoulders, eyes open initially. Once service member is balanced, have them close their eyes and time for 15 seconds how long they can maintain their balance. Repeat test with opposite leg.
  – Loss of balance on either leg before eight seconds is abnormal.

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12.Tandem Gait

The SM is unable to walk a straight line, heel-to-toe with arms at side.
This response is: ____Abnormal__

13.Pupil Response

The eyes are equal and reactive to light and tracking.
This response is: ____Normal___

14.Eye Tracking

Eyes track smoothly and equally.
This response is: ____Normal____

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NEUROLOGICAL EXAM - Continued

12. Tandem Gait
- ☐ Normal
- ☐ Abnormal

❑ Remove shoes if possible. Have service member take six steps one foot in front of the other, heel-to-toe, with arms at side
- Stumbling or shifting feet is abnormal.

13. Pupil Response
- ☐ Normal
- ☐ Abnormal

❑ Pupils should be round, equal in size and briskly constrict to a direct, bright light.
- Unequal pupil size, dilation or constriction delay is abnormal.

14. Eye Tracking
- ☐ Normal
- ☐ Abnormal

❑ Both eyes should smoothly track your finger side-to-side and up and down.
- Unequal, irregular or delayed eye tracking is abnormal.

NEUROLOGICAL EXAM RESULTS (Questions 7-14) ☐ All Normal ☐ Any Abnormal

COGNITIVE EXAM

15. Concentration

A. Reverse Digits

Read the script and begin the trial by reading the first string of numbers in Trial 1.

Circle the response for each string.
- If correct on string length of Trial 1, proceed to the next longer string length in the same column.
- If incorrect on string length of Trial 1, move to the same string length of Trial 2.
- If incorrect on both string lengths in Trials 1 and 2, **STOP** and record score as zero for that string length. Record total score as sum of previous correct trials.

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Neurological MACE 2 Score

Based upon the above results,
what is the MACE 2 neurological exam result?

All Normal (+)_____ Any Abnormal (-)____

Note: If all the sections are normal, check the normal box. If any one of the sections is abnormal, check the abnormal box.

STOP, REFER TO SLIDES AND CONTINUE PRESENTATION

Practice Activity 4 Cognitive Exam - Part 2

Following Practice Activity 4, participants will be able to:

1. Complete the Cognitive Exam Part 2 from the MACE 2 pocket guide.
2. Score and record the Cognitive Exam Part 2 based upon presented findings.

Activity 4 Questions: Concentration

Record the reverse digits score using the information below.

15. Concentration

(15A) Reverse Digits

Examiner (from MACE 2 script):
"I am going to read you a string of numbers. When I am finished, repeat them back to me backward. That is, in reverse order of how I read them to you. For example, if I said 7-1-9, then you would say 9-1-7."

Findings:
Using List A, the SM answered:

- 3-digit string: 3-9-4
- 4-digit string: 4-1-8-3
- 5-digit- string: 1-7-9-2-6
- 6-digit string : 3-6-5-3-7-1;
  Trial 2: 8-4-2-7-5-6

As you can see from above, the SM answered the 3, 4 and 5-digit strings correctly in Trial 1, but was unable to recall the 6-digit string correctly. When the SM tried the 6-digit sting again in Trial 2, he could not recall it accurately either.

List A			
Trial 1	Trial 2 (if Trial 1 is incorrect)	Incorrect	Correct
4-9-3	6-2-9	0	1
3-8-1-4	3-2-7-9	0	1
6-2-9-7-1	1-5-2-8-5	0	1
7-1-8-4-6-3	5-3-9-1-4-8	0	1

REVERSE DIGITS SCORE (16A) ___/4

What is the reverse digits score? _____3/4_____

(15B) Months in Reverse Order

Record months-in-reverse-order score using the following information:

Examiner (from MACE 2 script): "Now tell me the months of the year in reverse order. Start with the last month and go backward. So you'll say: December, November….Go ahead"

Findings:
The SM stated, "December, November, October, September, August, July, June, May, April, March, February, January"
What is the months-in-reverse-order score? _____1/1_____

Concentration Total Score

What is the Concentration Total Score? _____4/5_____

16. Delayed Recall

The SM was able to remember all the words in list F (we used list F in the Immediate Memory section earlier).

Activity 4 Questions: Delayed Recall

What is the delayed recall total score so far? _____5/5_____

Practice Activity 5 *Vestibular/Ocular-Motor Screening-Smooth Pursuits*

NOTE: A specialty provider trained and familiar with the VOMS should be involved in training participants in the VOMS examination

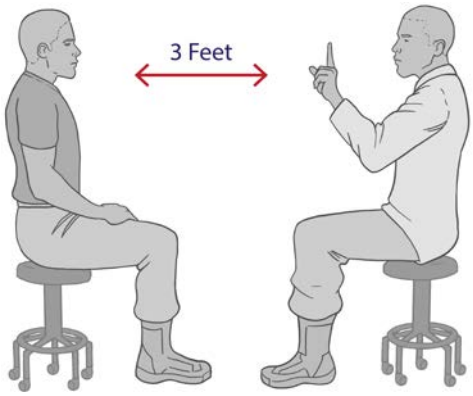
Assuming the patient has no contraindications, find a partner to practice performing these VOMS tests.

17A) Baseline symptoms

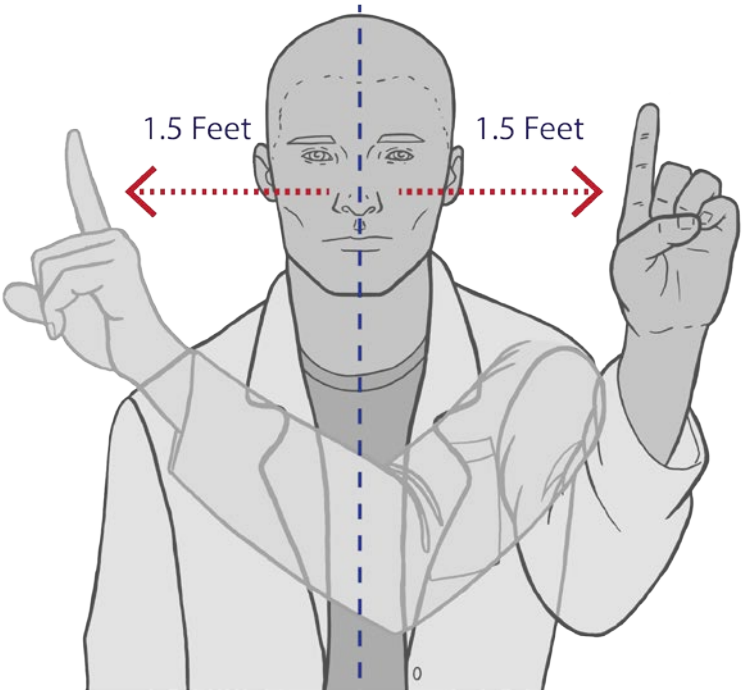
First, ask the patient to rate their headache, dizziness, nausea and fogginess (HDNF) on a scale of 0 to 10 to establish a baseline. Record in VOMS Scoring Chart (page 12 of 14 in pocket guide).

17B) Smooth Pursuits

- Sit facing the patient.
- Hold your finger tip 3 feet from the patient.

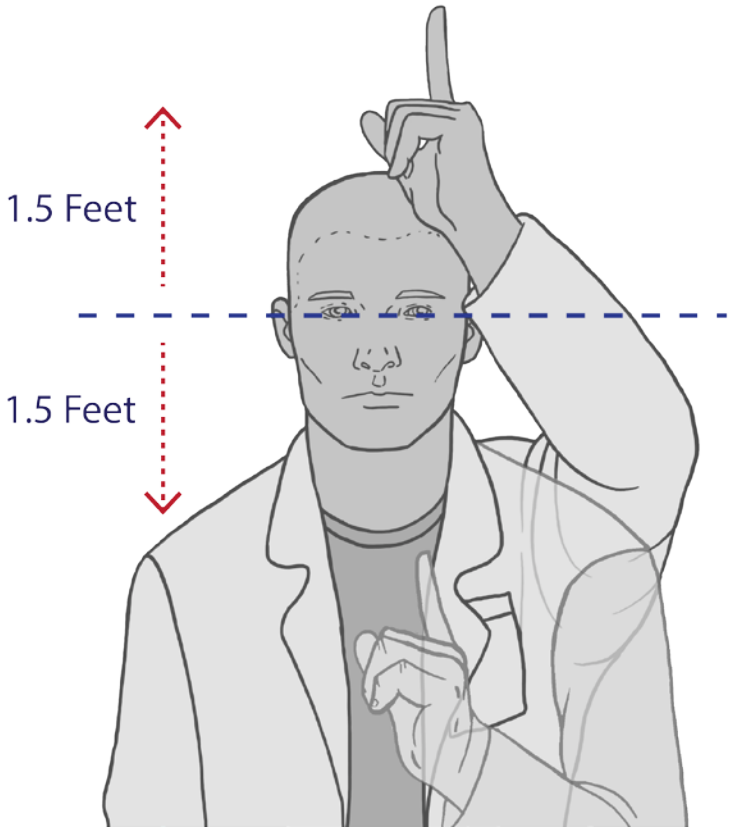


- With the patient focused on your finger tip, smoothly move your finger left 1.5 feet. Then move your finger 3 feet to the right (it should take about 2 seconds). Perform twice.



- With the patient focused on your finger tip, smoothly raise your finger 1.5 feet from the horizontal midline, and then lower your finger 1.5 feet from the midline (it should take about 2 seconds to move 3 feet). Perform twice.

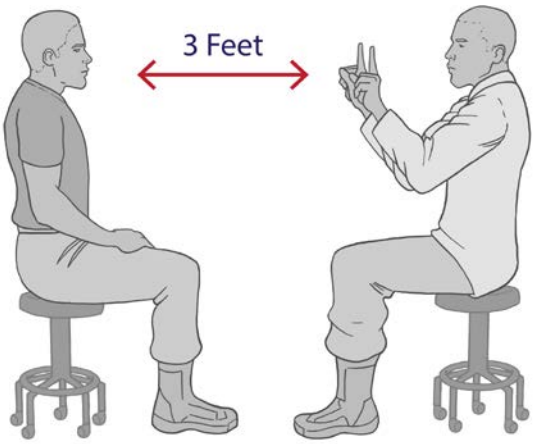
- Have the patient rate headache, dizziness, nausea and fogginess on a scale of 0 to 10. Record the results.



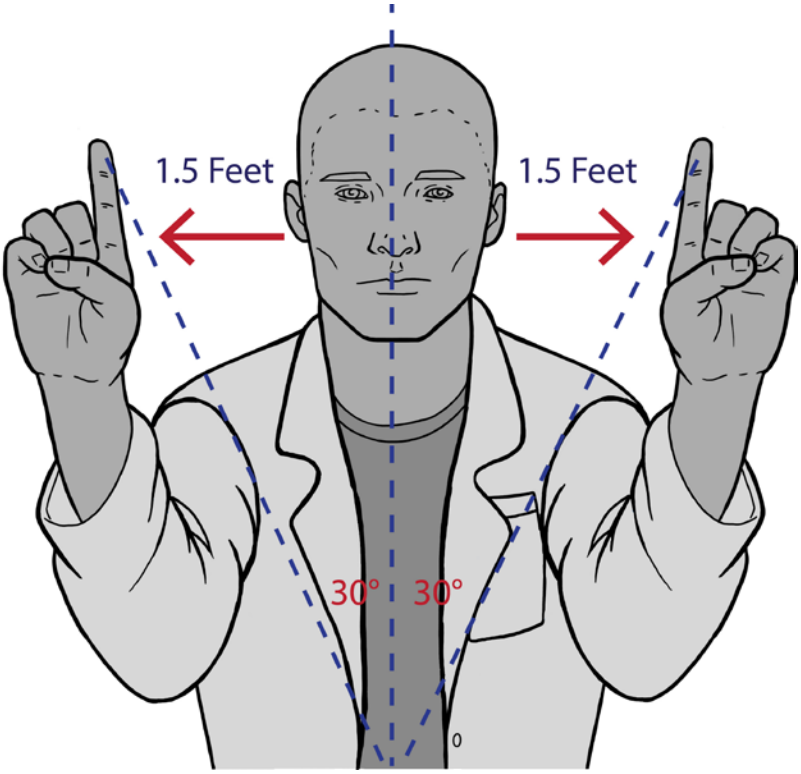
Practice Activity 6 *Vestibular/Ocular-Motor Screening-Saccades*

17C1) Saccades– *Horizontal*

- Sit facing the patient about 3 feet away.

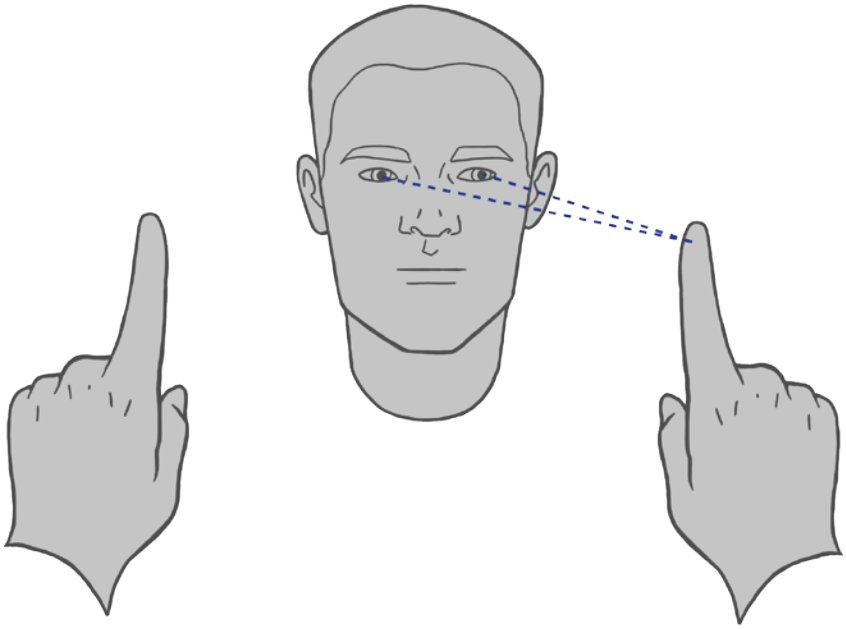


- Hold your left hand finger 1.5 feet from the vertical midline and your right hand finger 1.5 feet from midline, (so that the patient must gaze 30° left and 30° right).



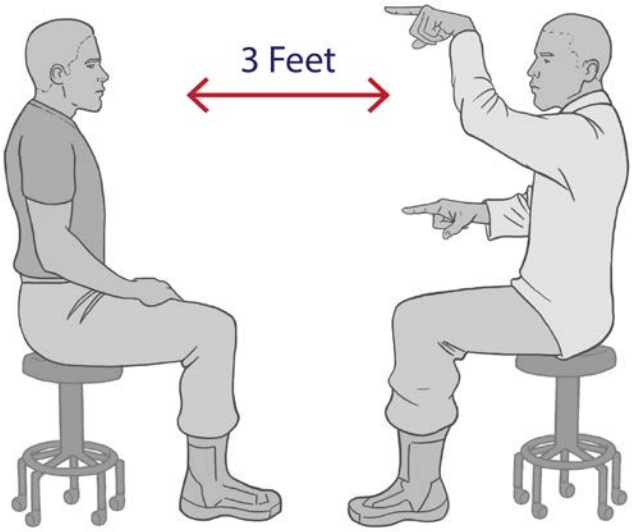
- Ask the patient to move their eyes from point to point as quickly as possible. Perform 10 times.

- Have the patient rate headache, dizziness, nausea and fogginess on a scale of 0 to 10. Record the results.

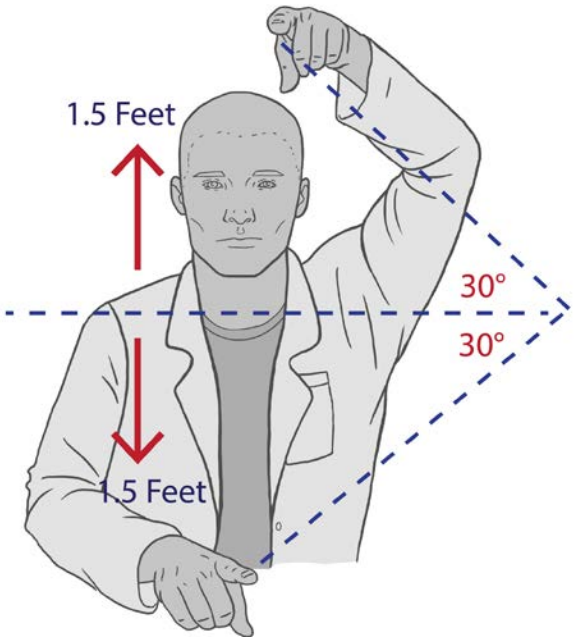


17C2) Saccades– Vertical

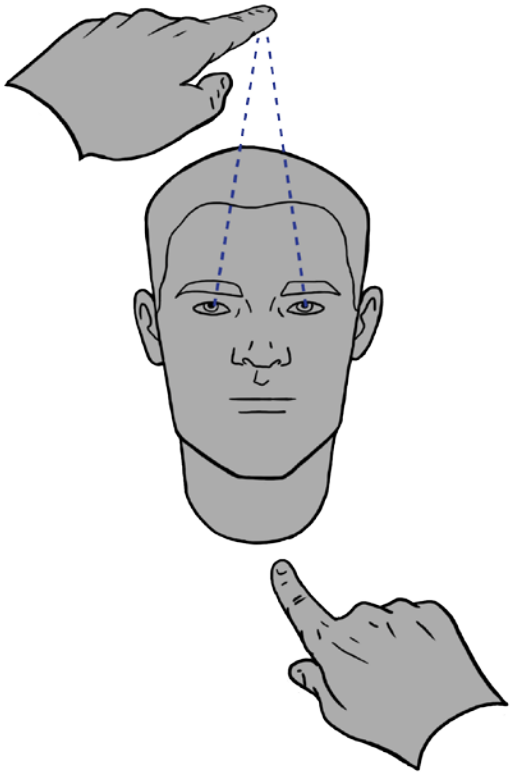
- Face the patient, sitting about 3 feet away.



- Hold one finger 3 feet below the other, so that the patient gazes 30° up and 30° down.



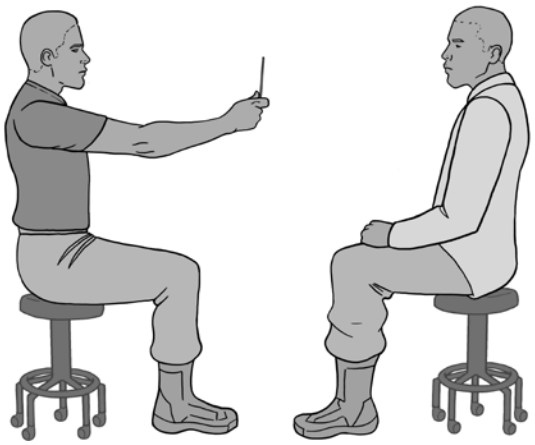
- Ask the patient to move their eyes from point to point as quickly as possible. Perform 10 times.
- Have the patient rate headache, dizziness, nausea and fogginess on a scale of 0 to 10. Record results.



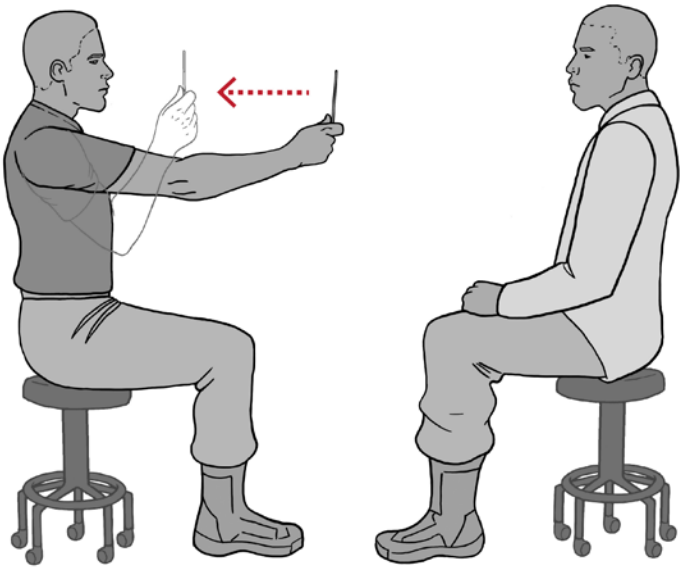
Practice Activity 7 *Vestibular/Ocular-Motor Screening-Convergence*

17D) Convergence *(near point)*

- Sit down facing the patient.
- Ask the patient to focus on the target, holding it about an arm's length from their nose.



- Ask the patient to slowly move the target toward the tip of their nose and to stop when they see two distinct images, or stop them if you notice an outward deviation of the eye.
- Measure the distance between the nose and the target, and record it in centimeters. Repeat two more times.
- Have the patient rate headache, dizziness, nausea and fogginess on a scale of 0 to 10. Record the results.

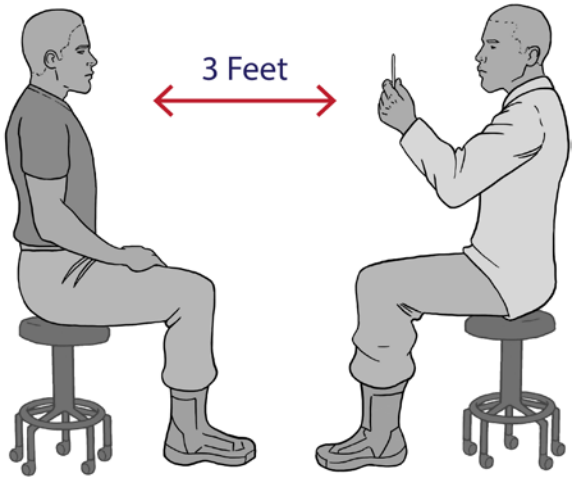


Convergence points greater than or equal to 5 centimeters are considered abnormal.

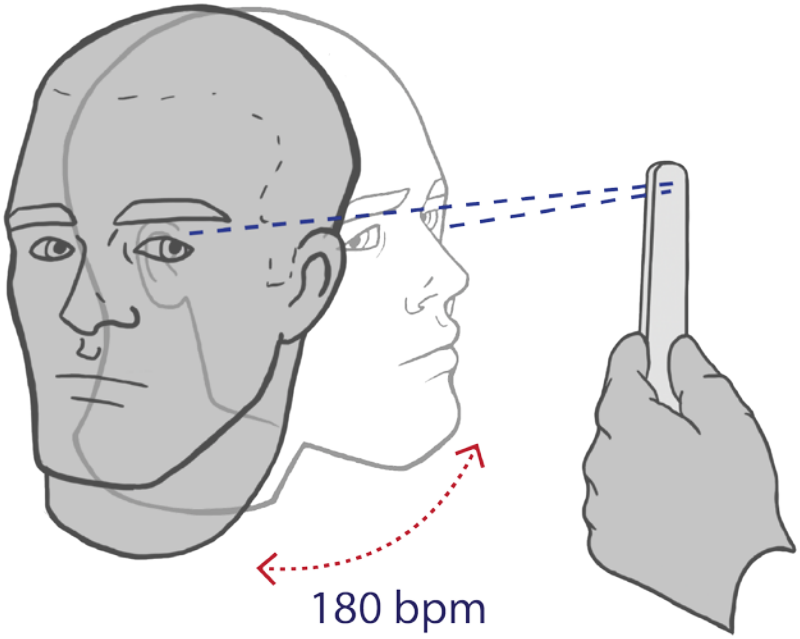
Practice Activity 8 *Vestibular/Ocular-Motor Screening-Vestibular-Ocular Reflex (VOR)*

17E1) Vestibular-Ocular Reflex- *Horizontal*

- Sit facing the patient.
- Set the metronome to 180 beats per minute (bpm).
- Hold the target 3 feet from the patient.



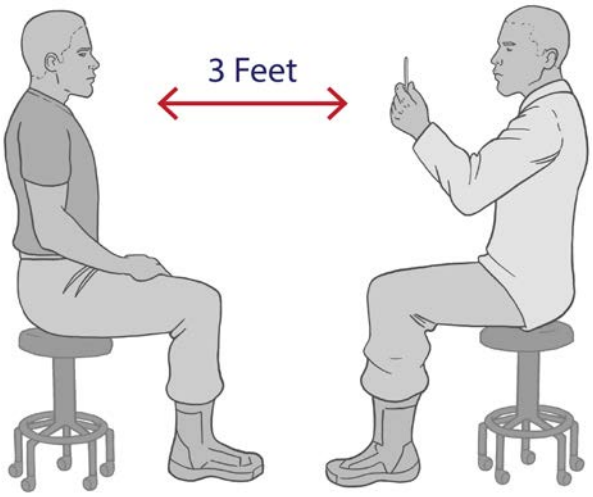
- While focusing on the target, ask the patient to turn their head from 20° left to 20° right 10 times, in time to the metronome beat.



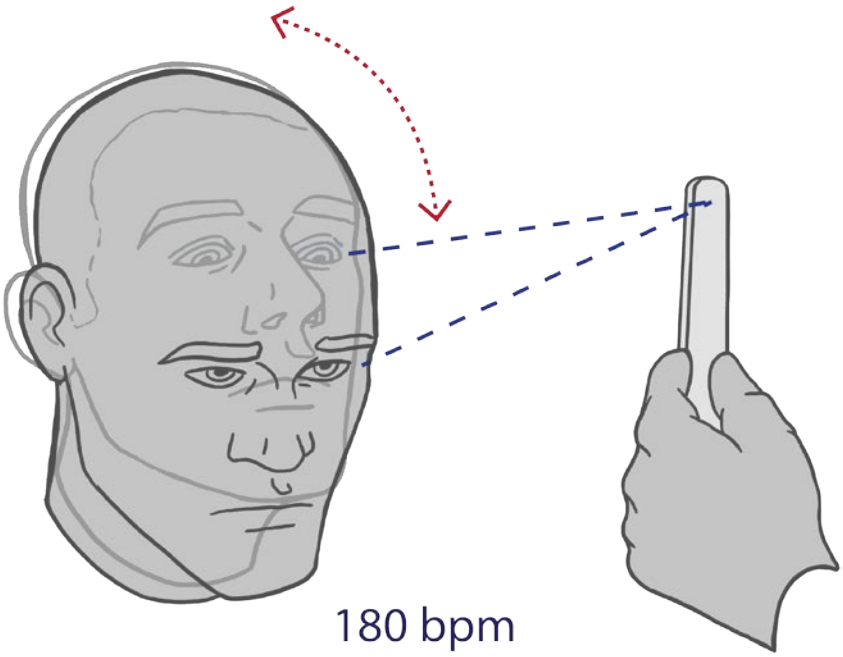
- Wait 10 seconds then have the patient rate headache, dizziness, nausea and fogginess on a scale of 0 to 10. Record results.

17E2) Vestibular-Ocular Reflex- Vertical

- Sit facing the patient.
- Set the metronome to 180 bpm.
- Hold the target 3 feet from the patient.



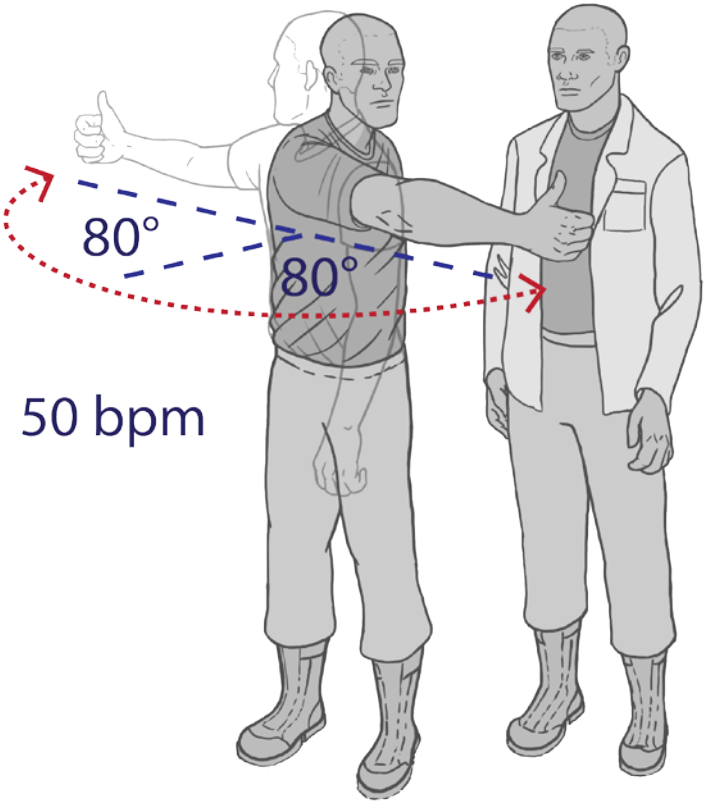
- While focusing on the target, ask the patient to nod their head from 20° down to 20° up 10 times, in time to the metronome beat.
- Wait 10 seconds then have the patient rate headache, dizziness, nausea and fogginess on a scale of 0 to 10. Record results.



Practice Activity 9 *Vestibular/Ocular-Motor Screening-Visual Motor Sensitivity (VMS)*

17F) Visual Motion Sensitivity (VMS) Test

- Ask the patient to stand with their feet shoulder width apart, facing a busy area.
- Stand next to the patient, slightly behind them.
- Set the metronome to 50 bpm.
- Have the patient stretch their arm out in front of them and focus on their thumb.



- Ask the patient to twist their head and trunk as a unit from 80° right to 80° left in time to the metronome beat. Perform five times.
- Have the patient rate headache, dizziness, nausea and fogginess on a scale of 0 to 10. Record results.

****STOP, REFER TO LECTURE SLIDES AND CONTINUE PRESENTATION***

Clinical Case Scenario:

Summative Assessment

Twenty-two year old SM engaged in physical fitness training when he fell from the pull up bar and hit his face on the ground. The medic conducts an initial evaluation 30 minutes after injury.

Screen Results

Observable signs: 3 cm diameter bruise to left cheekbone, confusion during questioning.

AOC or Memory: SM does not recall how he was injured and reports "seeing stars."

Symptoms: Slow speech. Unsteady gait. Complaints of HA and dizziness

Concussion History: Had two other concussions in the last 12 months.

Positive Screen/Exam Findings

After the positive concussion screen, the medic/corpsman proceeds with the MACE 2 exam (starting on page 5 of 14 of the pocket guide).

MACE 2 Exam Findings

Cog 1: Missed one orientation question. Incorrectly stated two words in each immediate memory trial.

Neuro: Slow and delayed speech. Unsteady balance on single leg stance and tandem gait.

Cog 2: Unable to correctly state the months backwards. Reverse Digits: he was able to get to four digits, then failed on five digits. Could not remember three of the delayed recall words.

VOMS: 8 cm for convergence and symptoms provocation of +2 (out of 10) on two visual tests.

Case Scenario Questions

EXAM SUM-
Record the data for correct MACE 2 documentation.

Cognitive Summary

Orientation Total Score - Q5	4/5
Immediate Memory Total Score (all 3 trials) - **Q6**	9/15
Concentration Total Score (Sections A and B) - **Q15**	2/5
Delayed Recall Total Score - Q16	2/5
COGNITIVE RESULTS ≤ 25 is abnormal	17/30

NEUROLOGICAL RESULTS (Q 7-14)	[X] Abnormal (+)	[ ] Normal (-)
SYMPTOM RESULTS (Q 3)	[X] 1 or more symptoms (+)	[ ] No symptoms (-)
HISTORY RESULTS (Q 4A-4C)	[X] Positive (+)	[ ] Negative (-)
VOMS RESULTS (Q 17)	[X] Abnormal (+) / [ ] Normal (-)	[ ] Deferred
MACE 2 RESULTS	[X] Positive (+)	[ ] Negative (-)

Question 1

What are the service member's MACE 2 results?

MACE 2 is Positive

Question 2

What would be the next steps after completing the MACE 2 in this scenario?

The provider should:

1. Document MACE 2 results in the Electronic Health Record (EHR) with coding instructions
2. Initiate 24-hour rest
3. Refer to CMT card for the management recommendations based on the MACE 2 results. After 24-hour rest period, evaluate for starting the Progressive Return to Activity (PRA) following the guidance of the PRA clinical recommendation, since this is the third concussion in a 12-month period.