

NeuroTrace Study Guide

Domain: Domain III – EEG Patterns & Clinical Correlation

Section: EEG Artifacts: Recognition & Differentiation

Style: Pattern-based, applied, exam-oriented

1. Core Principles (Must Know)

Artifact Origin

- **Artifacts originate outside the brain**
- Non-cerebral signals that contaminate EEG
- Can be physiologic (body-generated) or non-physiologic (technical)
- Must be distinguished from true cerebral activity

Artifact Types

- **Physiologic artifacts:** Generated by body (eye movement, muscle, ECG)
- **Non-physiologic artifacts:** Technical (60 Hz, electrode pop, movement)
- Both can mimic pathology
- Recognition prevents misdiagnosis

Artifact Recognition Relies On

- **Morphology** (shape and appearance)
- **Distribution** (where it appears)
- **Reactivity** (how it responds to changes)
- **Montage behavior** (how it changes with montage)

Key Principle

- **Cerebral activity obeys neurophysiologic rules; artifacts do not**
- True cerebral activity has consistent characteristics
- Artifacts often violate neurophysiologic rules
- Use this principle to distinguish artifact from pathology

Practical Application

- Always assess for artifacts before interpreting pathology
 - Compare findings across montages
 - Observe reactivity to patient behavior
 - Understand artifact characteristics
-

2. Common Physiologic Artifacts

Eye Movement (EOG)

Characteristics

- **Slow rolling eye movements**
- **Frontal predominance** (maximum at Fp1, Fp2)
- **Phase reversal near FP electrodes**
- Bilateral, often synchronous
- Correlates with eye position

Recognition

- Maximum at frontal pole electrodes
- Phase reversal between Fp1/Fp2 and adjacent electrodes
- Slow, rolling morphology
- Changes with eye position
- Suppressed with eyes closed

Clinical Correlation

- Normal during wakefulness
- May mimic frontal slowing
- Can obscure frontal abnormalities
- Documented as normal variant

ABRET Application

- Must distinguish from frontal slowing
- Eye movement is artifact, not pathology
- Observe EOG channels if available
- Note reactivity to eye position

Muscle (EMG)

Characteristics

- **Fast, irregular activity** (20-100+ Hz)
- **Increased with movement** (jaw clenching, talking, head movement)
- **Suppressed during sleep** (muscle tone decreases)
- High frequency, low amplitude (when filtered)
- Often asymmetric

Recognition

- Fast, spiky appearance
- Irregular, non-rhythmic
- Increases with movement
- Maximum near muscle groups (temporal, frontal)
- Suppressed during sleep

Clinical Correlation

- Common during wakefulness
- May mimic fast activity (beta)
- Can obscure underlying activity
- Often seen in anxious or agitated patients

ABRET Application

- Must distinguish from fast cerebral activity
- Muscle is artifact, not pathology
- Observe reactivity to movement
- Note suppression during sleep

Aliasing Risk

- High-frequency muscle may alias if sampling inadequate
- Aliased muscle can appear as slow activity
- Always verify sampling rate for fast activity

ECG (Pulse Artifact)

Characteristics

- **Rhythmic waveform time-locked to heart rate**
- Regular, repeating pattern
- Often seen near temporal electrodes (carotid pulse)
- QRS complex visible
- Rate matches heart rate (60-100 bpm typical)

Recognition

- Regular, rhythmic pattern
- Time-locked to heart rate
- Maximum at temporal electrodes (T3, T4, T5, T6)
- QRS morphology visible
- Rate matches pulse

Clinical Correlation

- Common in all patients
- More prominent in certain positions
- May mimic periodic patterns
- Usually not clinically significant

ABRET Application

- Must distinguish from periodic patterns
- ECG is artifact, not pathology
- Observe correlation with pulse
- Note temporal distribution

Sweat Artifact

Characteristics

- **Very slow baseline drift**
- Irregular, wandering baseline
- **Increased with temperature or anxiety**
- Affects multiple channels
- Can obscure all activity

Recognition

- Very slow baseline movement
- Irregular, non-rhythmic
- Widespread distribution
- Correlates with sweating
- May be temperature-related

Clinical Correlation

- Common in warm environments
- More common in anxious patients
- Can make interpretation difficult
- May require environmental adjustment

3. Common Non-Physiologic Artifacts

60 Hz Interference

Characteristics

- **Regular sinusoidal pattern** (60 Hz in US, 50 Hz elsewhere)
- **Linked to poor impedance or grounding**
- Affects all channels or specific channels
- Continuous, regular pattern
- Not time-locked to patient

Recognition

- Regular 60 Hz oscillations
- Continuous, not intermittent
- Maximum in high-impedance channels
- Not affected by patient behavior
- Technical in origin

Clinical Correlation

- **Technical artifact, not pathology**
- Indicates impedance or grounding problem
- Can obscure cerebral activity
- Requires technical correction

Corrective Action

- Check electrode impedance
- Verify ground connection
- Improve electrode contact
- Check for electrical interference sources

ABRET Application

- Must recognize as technical artifact
- Not a cerebral pattern
- Requires technical correction
- Understand impedance relationship

Electrode Pop

Characteristics

- **Sudden high-amplitude transient**
- Brief, sharp deflection
- **Poor electrode contact** (drying paste, loose electrode)
- Often repetitive
- Affects single channel or few channels

Recognition

- Sudden, brief deflection
- High amplitude
- Sharp, spiky appearance
- Often repetitive
- Channel-specific

Clinical Correlation

- **Technical artifact, not pathology**
- Indicates electrode problem
- May mimic spikes
- Requires electrode correction

Corrective Action

- Re-prep skin at electrode site
- Reapply electrode with fresh paste
- Check electrode connection
- Verify impedance

ABRET Application

- Must distinguish from true spikes
- Electrode pop is artifact
- Note channel-specific nature
- Understand corrective actions

Movement Artifact

Characteristics

- **Irregular baseline shifts**
- **Associated with patient movement**
- Widespread or localized
- Correlates with movement
- Non-rhythmic

Recognition

- Irregular baseline movement
- Correlates with patient movement
- Widespread distribution
- Non-stereotyped
- Movement-related

Clinical Correlation

- Common in all patients
- More common in children, agitated patients
- Can obscure activity
- May require patient cooperation

Corrective Action

- Encourage patient to remain still
- Reposition patient if needed
- Use movement sensors if available
- Document movement in technical report

4. Artifact vs Epileptiform Activity

Feature	Artifact	Epileptiform
Reactivity	Changes with movement/behavior	Persists

Distribution	Often widespread	Focal
Morphology	Irregular, non-stereotyped	Stereotyped, consistent
Montage behavior	Inconsistent across montages	Consistent across montages
Clinical correlation	No correlation with symptoms	Correlates with clinical findings
Frequency	Variable	Consistent
Amplitude	Variable	Consistent
Field	May be widespread	Focal field

Key Distinctions

True Epileptiform Activity

- **Persists across montages** (consistent appearance)
- **Stereotyped morphology** (consistent shape)
- **Focal distribution** (localized field)
- **Correlates with clinical findings** (seizure semiology)
- **Follows neurophysiologic rules** (appropriate field, polarity)

Artifacts

- **May change with montage** (inconsistent appearance)
- **Irregular morphology** (variable shape)
- **May be widespread** (not localized)
- **No clinical correlation** (not related to symptoms)
- **Violates neurophysiologic rules** (inappropriate field, reactivity)

ABRET Application

- Given pattern → identify artifact vs epileptiform
- Use montage comparison to distinguish
- Observe reactivity to patient behavior
- Correlate with clinical findings

5. Montage & Sensitivity Clues

Artifact Often

- **Changes with montage** (different appearance in different montages)
- **Exaggerated by high sensitivity** (appears larger with higher sensitivity)
- **Inconsistent localization** (different location in different montages)
- **Widespread distribution** (affects multiple channels)
- **Reactive to technical changes** (changes with settings)

True Cerebral Activity

- **Persists across montages** (consistent appearance)
- **Maintains morphology** (same shape in different montages)
- **Consistent localization** (same location across montages)
- **Focal distribution** (localized field)
- **Not reactive to technical changes** (unchanged by settings)

Practical Application

- Always compare findings across montages
- Verify sensitivity settings
- Observe how pattern changes with montage
- Use montage comparison to confirm true activity

ABRET Emphasis

- Montage comparison is essential
- Artifacts change with montage
- True activity persists across montages
- Sensitivity affects artifact appearance

6. Common ABRET Exam Traps

Trap 1: Mislabeling Muscle Artifact as Fast Activity

- **Reality:** Muscle is artifact, not cerebral fast activity
- Muscle increases with movement, cerebral activity doesn't
- Muscle suppresses during sleep, cerebral activity persists
- Must observe reactivity to distinguish

Trap 2: Confusing Eye Movement with Frontal Slowing

- **Reality:** Eye movement is artifact, not frontal pathology
- Eye movement changes with eye position, slowing doesn't
- Eye movement has phase reversal at FP, slowing doesn't
- Must observe EOG channels and reactivity

Trap 3: Assuming Rhythmicity Implies Cerebral Origin

- **Reality:** Artifacts can be rhythmic (ECG, 60 Hz)
- Rhythmicity alone doesn't indicate cerebral origin
- Must consider source and distribution
- ECG and 60 Hz are rhythmic but artifacts

Trap 4: Ignoring Clinical Context

- **Reality:** Clinical context helps distinguish artifact from pathology
- Artifacts don't correlate with clinical findings
- True pathology correlates with symptoms
- Always consider clinical presentation

Trap 5: Not Comparing Montages

- **Reality:** Must compare findings across montages
- Artifacts often change with montage
- True activity persists across montages
- Single montage interpretation is incomplete

7. Clinical Correlation

Artifact Misinterpretation Can Lead To

- **False epilepsy diagnosis** (artifacts mistaken for spikes)

- **Unnecessary treatment** (medications for artifact)
- **Incorrect localization** (artifact mistaken for focal activity)
- **Missed pathology** (artifacts obscuring true abnormalities)

Pediatric EEGs

- **Especially artifact-prone** (movement, muscle, eye movement)
- Children move more, creating more artifacts
- Normal variants can mimic artifacts
- Requires careful artifact recognition

Best Practice

- Always assess for artifacts first
- Compare findings across montages
- Observe reactivity to patient behavior
- Correlate with clinical findings
- Document artifacts in technical report

Clinical Impact

- Accurate artifact recognition prevents misdiagnosis
- Good technique reduces artifacts
- Proper documentation helps interpretation
- Artifact recognition is essential skill

8. Case-Based Example

Scenario

Clinical Setting: Routine EEG for seizure evaluation

EEG Finding: Rhythmic frontal delta activity

Clinical Concern: Possible frontal lobe dysfunction

Pattern: 2-3 Hz rhythmic slowing, maximum frontal

Hidden Issue

- **Eye movement artifact** (not cerebral slowing)
- Patient has nystagmus or eye movements
- Eye movement creates rhythmic frontal activity
- Mistaken for frontal slowing

Correct Action

1. **Observe EOG channels** (if available) - should show eye movement
2. **Check reactivity** - activity changes with eye position
3. **Compare montages** - activity may change with montage
4. **Correlate with clinical** - no clinical findings support frontal dysfunction
5. **Reassess** - recognize as artifact, not pathology

Teaching Point

- **Always assess artifact before diagnosing pathology**
- Eye movement can mimic frontal slowing
- EOG channels help identify eye movement
- Reactivity and montage comparison help distinguish

ABRET Application

- Given rhythmic frontal activity → consider eye movement
 - Observe EOG channels and reactivity
 - Compare across montages
 - Correlate with clinical findings
-

9. Exam Readiness Checklist

Use this checklist to verify your understanding:

- Can identify common artifacts (eye movement, muscle, ECG, 60 Hz, electrode pop)
 - Can differentiate artifact vs pathology (morphology, distribution, reactivity)
 - Can use montage behavior effectively (artifacts change, true activity persists)
 - Can apply corrective actions (impedance, electrode contact, patient positioning)
 - Understand that artifacts originate outside the brain
 - Know that artifacts can be physiologic or non-physiologic
 - Recognize that artifacts often change with montage or sensitivity
 - Understand that true cerebral activity persists across montages
 - Know that artifact misinterpretation can lead to misdiagnosis
 - Can identify ABRET exam traps related to artifacts
-

10. Internal Cross-Links

Workflow

- **Electrodes & Impedance:** Poor impedance causes artifacts (60 Hz, electrode pop)
- **Amplifiers & Sensitivity:** Sensitivity affects artifact appearance
- **Montages & Referencing:** Montage comparison helps identify artifacts
- **Artifacts & Troubleshooting:** General troubleshooting for artifacts

Patterns

- **Epileptiform Discharges:** Must distinguish from artifacts (electrode pop, muscle)
- **Normal Patterns:** Artifacts can obscure normal patterns
- **Focal Abnormalities:** Artifacts can mimic focal findings

Cases

- **Artifact recognition simulations:** Cases teaching artifact identification
- **Apparent epileptiform activity:** Cases where artifact mimics pathology
- **Pediatric EEG noise:** Cases with movement and muscle artifacts
- **Technical setup errors:** Cases involving technical artifacts

Quizzes

- **EEG artifact MCQs:** Questions on artifact identification and differentiation
 - **Artifact vs pathology:** Questions requiring artifact recognition
 - **Corrective actions:** Questions on troubleshooting artifacts
-

Study Tips

1. **Memorize artifact characteristics:** Morphology, distribution, reactivity
 2. **Learn montage behavior:** Artifacts change, true activity persists
 3. **Practice recognition:** Given pattern, identify artifact vs pathology
 4. **Understand corrective actions:** Impedance, electrode contact, patient positioning
 5. **Remember the principle:** Cerebral activity obeys rules, artifacts don't
 6. **Know the traps:** Muscle as fast activity, eye movement as slowing
 7. **ABRET focus:** Expect questions on artifact identification and differentiation
-

End of Study Guide

For additional practice, complete quiz questions tagged: artifact, emg, eog, ecg, 60hz, electrode-pop