



Transcutaneous Oximetry Site Selection Primer

Testing settings:

A. Diseased great (or other) toe; amputation or bone biopsy contemplated

TCOM question: Expectation of amputation/biopsy site healing (per secondary intention or skin flap primary coverage)?

Principal determinant: Health and perfusion status of respective dorsal and plantar metatarsal and digital arteries.

Principal site selection: Single electrode placed immediately proximal and lateral (medial if fifth toe) to the toe (space between metatarsals), dorsally..

Findings: ≥ 40 mmHg, normal exam, reasonable expectation of healing from an oxygen-dependent perspective.

< 40 mmHg, abnormal exam, potential for delayed healing vs. healing failure, as a probability issue (re: Padberg FT, *et al.* 1996, see page 5).

Follow-up TCOM question, if abnormal exam: At what level do tissue oxygen levels normalize? Question relates principally to a potential better first choice amputation level.

Principal determinant: Health and perfusion status of the tarsal and plantar arteries, medially and laterally. It is anticipated that the perfusion status of the very distal tibial vessels will be indirectly assessed at this level.

Secondary site selection: If foot width foot permits, two adjacent (medial and lateral) electrodes mid-dorsum. Use a single mid-dorsal electrode in those with narrow feet.

Note: From a practical standpoint there is value in assessing this level at the same time as the proximal toe site (i.e. all three sites simultaneously).

Findings: ≥ 40 mmHg, normal exam. Consider intra-operative quality (bleeding) of tissues with regard to a more direct direct Ray vs. transmetatarsal amputation.

< 40 mmHg, abnormal exam. Ablative procedures within the foot (toe, Ray, Ray revision, transmetatarsal), are likely to involve healing complications under present state of perfusion.

Next TCOM question, if abnormal exam: At what level do tissue oxygen levels normalize?

Principal determinant: Health and perfusion status of the anterior and posterior tibial arteries and the fibular (peroneal) artery.

Site selection: Two electrodes place approximately 10 cm below the knee, medially and laterally (proximal calf), two additional electrodes at the distal calf, medially and laterally. This mapping schematic offers a comprehensive assessment throughout the length of these vessels as they may be diseased at their respective take-off points or become so at various points distally.

Findings: ≥ 40 mmHg, normal exam. These data suggest a below knee amputation would be expected to heal (should this level be considered), further arterial testing recommended to corroborate these findings.

< 40 mmHg, abnormal exam. Additional arterial testing recommended corroborating TCOM findings and identifying potential flow augmentation options. Abnormal readings occurring either medially or laterally suggest involvement of respective tibial vessels.

B. Non-healing toe amputation

TCOM question: Is healing complicated from an oxygen-dependent perspective? If yes, at what level would any revision be expected to heal in the absence of flow augmentation options? If no, work up for other deficient wound healing etiologies.

Principal determinant: Health and perfusion status of respective dorsal and plantar metatarsal and digital arteries.

Site selection: Proceed as in 'A' above.

C. Plantar surface wound

TCOM question: Is this healing deficiency related, entirely or in part, to hypo-perfusion/local hypoxia?

Principal determinant: Health and perfusion status of the arteries within the foot. Depending upon the location of the lesion, this may involve the plantar, tarsal, metatarsal or digital arteries, alone or in any combination. A finding of hypoxia may also represent a large vessel inflow abnormality. An oxygen challenged would help localize any related disease.

Principal site selection: Two mid-dorsal sites, medially and laterally. A single mid-dorsal site for those with narrow feet.

Findings: ≥ 40 mmHg: normal exam; work up for other deficient wound healing etiologies.

< 40 mmHg: abnormal exam: assess the tibial and peroneal arteries, per 'A' above.

D. Compromised transmetatarsal amputation

TCOM question: Is the skin flap vs. guillotine healing complication hypoxia-mediated?

Principal determinant: Health and perfusion status of the plantar, tarsal, tibial and peroneal arteries.

Site selection: Two adjacent (medial and lateral) mid-dorsal electrodes immediately proximal to the amputation site. A single mid-dorsal Avoid assessing the plantar skin flap itself. Consider simultaneous assessment of the previously referenced ('A' above) four lower extremity sites.

Findings: ≥ 40 mmHg adjacent to the amputation site; normal exam, work up for other deficient wound healing etiologies.

< 40 mmHg adjacent to the amputation site; abnormal exam, local small vessel or large vessel mediated? (per tibial and fibular artery findings). Continue as in 'A' above regarding large vessel(s) insufficiency and possible flow augmentation option.

E. Compromised below knee amputation

TCOM question: Is healing complication (either posterior skin flap ischemia, surgical site dehiscence; open guillotine or skin grafted guillotine amputation) hypoxia-mediated?

Principal determinant: Health and perfusion status of the vessels that perfuse the amputation site/remaining extremity.

Site selection: Two or three (depending upon volume of tissue/size of patient extremity and number of electrodes available) equally spaced electrodes above and below the amputation site, in close proximity to the area of breakdown.

Findings: ≥ 40 mmHg across all electrodes, normal exam. Work up for other deficient healing etiologies.

Values ranging from 30 mmHg to 40 mmHg represent a, borderline exam. Place two electrodes 10 cm above the knee medially and laterally with the objective of determining the healing potential of a distal AKA should the present level not be salvageable. Recommend additional arterial testing. Values found to be consistently less than 40 mmHg represent an abnormal exam. Undertake above knee testing, as above. Recommend additional arterial testing.

F. Lower extremity wound

TCOM question: Is the healing complication hypoxia-mediated?

Principal determination: Health and perfusion status and the tibial and fibular arteries, their respective muscle branches, communicating branches and collateral vessels.

Site selection: Several (number dictated by extent of lesion) circumferentially spaced electrodes placed as close as possible to the skin envelop injury on as healthy tissue as possible.

Findings: ≥ 40 mmHg: normal exam, work up for other deficient healing etiologies.
< 40 mmHg at one or more sites, abnormal exam.

G. Mandibular osteoradionecrosis and its prophylaxis

The evolution of radiation treatment planning and dose delivery for cancers of the head, neck and floor of the mouth has been such that one can no longer expect to replicate the transcutaneous oxygen tension gradients that Marx had so eloquently described. This statement holds true for patients who have undergone either intensity-modulated radiation therapy (IMRT) or image-guided radiation therapy (IGRT). IMRT was first used in the late 1990's and became commonly available by the mid 2000's. Conventional external beam radiotherapy, usually delivered in two bilateral ports, created damaging effects within the microvasculature of the skin overlying the mandible that were commonly detectable in subsequent years via transcutaneous oxygen tension testing. IMRT and IGRT involve a great many more portals that serve to distribute the radiation dose over a larger tissue volume, thereby producing a 'skin-sparing' effect.

TCOM mapping of the skin surface overlying the mandible was used as a risk assessment screening tool when surgical procedures were planned within or through previously irradiated tissue beds. This screening capability has been lost with the advent of modern skin-sparing radiation delivery techniques.

H. Soft tissue (commonly chest wall) risk assessment; planned interventions within or through previously irradiated tissue beds

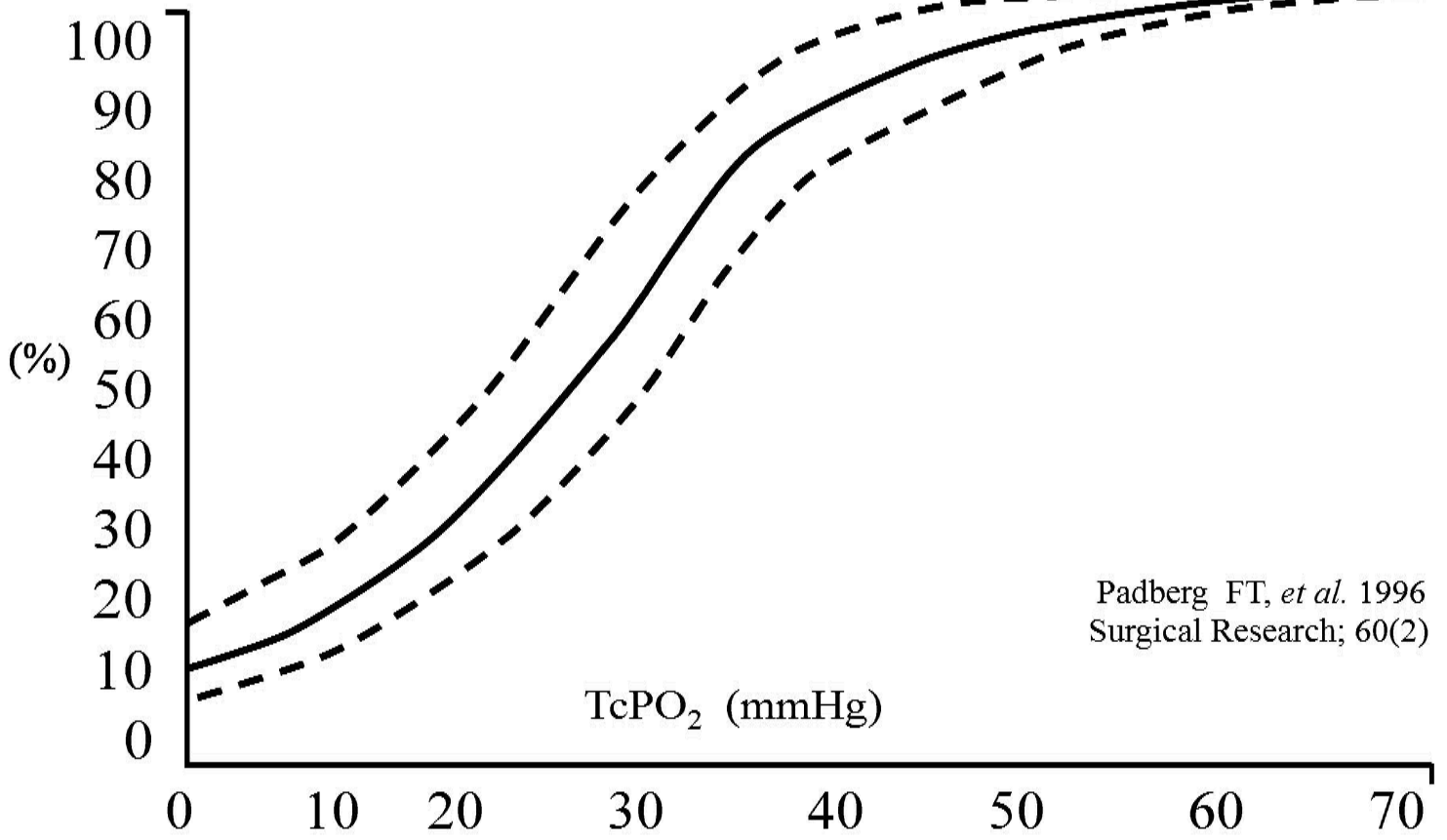
TCOM question: What is the likelihood of post-operative healing complications?

Principal determinant: Evaluation for late effects of radiation on the microvasculature of non-target tissues, principally a progressive obliterative endarteritis with resulting loss of vasculature density, hypoperfusion and local hypoxia.

Site selection: The skin overlying the planned surgical site and within the previous radiation portal. The portal can be identified by accessing the XRT planning photograph. It may also be readily discernable from any resulting hyper-pigmentation. Several electrodes, placed two to three cm's apart along one tangent of the portal.

Findings: ≥ 40 mmHg, normal exam, reasonable expectation of primary healing.
< 40 mmHg, abnormal exam, potential for post-operative healing complications based again on the probability curve (page 5). Consider peri operative HBO therapy.

Probability of Healing



Padberg FT, *et al.* 1996
Surgical Research; 60(2)