CHAOS & CLUES

An Algorithm for the Diagnosis of Malignancy (any type) in Pigmented Skin Lesions by Dermatoscopy[1,2]

Cliff Rosendahl[a] Alan Cameron[a] Philipp Tschandl[b] Agata Bulinska[a] Jean-Yves Gourhant[c] Harald Kittler[b]

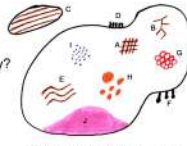## Revised Pattern Analysis[1,2]
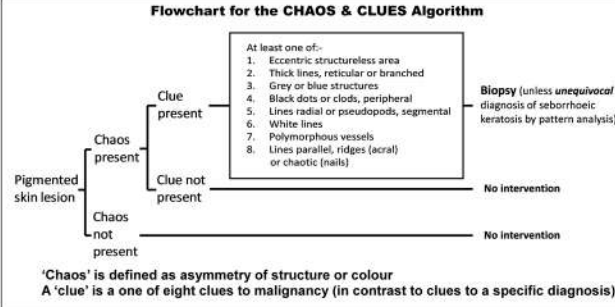
Pattern + Colours + Clues = Diagnosis

A pattern is formed by multiple repetitions of basic structures

1. Is there one pattern or more than one pattern?
2. Is there one colour or more than one colour?
3. Are pattern and colours combined symmetrically or asymmetrically?
4. What is the differential diagnosis based on 1-3 above?
5. Are there clues to a specific diagnosis?

Basic Structures

Line - reticular (A), branched (B), parallel (C), radial (D) and curved (E):
A two-dimensional continuous object with length greatly exceeding width, extending in one direction
Pseudopod (F): a line with a bulbous end
Circle (G): a curved line equidistant from a central point
Clod (H): any well circumscribed solid object larger than a dot, with any shape
Dot (I): an object too small to have a discernible shape
**Structureless** (J): an area with none of the basic structures dominating

This is a diagrammatic representation of all of the basic structures in revised pattern analysis

Flowchart for the CHAOS & CLUES Algorithm

Pigmented skin lesion

Chaos present → Clue present →
At least one of:-
1. Eccentric structureless area
2. Thick lines, reticular or branched
3. Grey or blue structures
4. Black dots or clods, peripheral
5. Lines radial or pseudopods, segmental
6. White lines
7. Polymorphous vessels
8. Lines parallel, ridges (acral) or chaotic (nails)
→ **Biopsy** (unless *unequivocal* diagnosis of seborrhoeic keratosis by pattern analysis)

Chaos present → Clue not present → **No intervention**

Chaos not present → **No intervention**

'Chaos' is defined as asymmetry of structure or colour
A 'clue' is a one of eight clues to malignancy (in contrast to clues to a specific diagnosis)

Exceptions
(Malignant lesions which sometimes don't exhibit CHAOS)[2]

1. Changing lesions on adults or very small lesions with clues to malignancy
2. Lesions with dermatoscopic grey structures on the head or neck
3. Nodular lesions (includes Spitzoid lesions, nodular melanoma and melanoma metastases)
4. Lesions on palms or soles (acral) with a parallel ridge pattern


This is an example of a facial lentigo maligna with the CLUE of 'grey structures' (circles) but without CHAOS
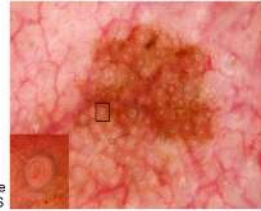
CHAOS

Is there CHAOS?

CHAOS is defined as asymmetry of structure or colour. Irregularity of shape does not matter. Perfect symmetry is not expected in nature and is not required. Look at the overall pattern. With experience this can be assessed at **scanning** speed. There is no need to decide whether the lesion is melanocytic. If **CHAOS** is **not** present move to the next lesion (note exceptions). If **CHAOS** is present **STOP** and **EXAMINE** for one of 8 **CLUES** to malignancy.
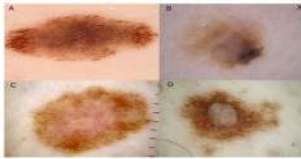
Scan these four lesions for the presence of CHAOS. Note that A, C and D are symmetrical (by pattern and colour). Irregularity of shape does not matter.

Differential Diagnosis of Pigmented Skin Malignancies
(Not critical because CHAOS & CLUES leads to biopsy anyway)

With very few exceptions the only malignancy with lines reticular is melanoma

Absence of lines reticular gives a differential of all 3 pigmented malignancies. Serpentine vessels eliminate pigmented Bowen's disease (pBD) and dot vessels eliminate BCC. This is a melanoma

Lines radial, located centrally within a lesion and joined at a common base are specific for BCC

In this BCC the lines radial, converging, are thicker. This corresponds to the 'leaf-like' structures of metaphorical terminology

'One pattern structureless' is the most common pattern of pBD (present in 48%) and an eccentric hypo-pigmented structureless area is another common finding[4]

Dots, either pigmented or as vessels, arranged in lines especially at the periphery, are a common feature of pBD (present in 21%)[4]

CLUES

Is a CLUE to malignancy present?

1. Eccentric structureless area
2. Thick lines, reticular or branched
3. Grey or blue structures
4. Black dots or clods, peripheral
5. Lines radial or pseudopods, segmental
6. White lines
7. Polymorphous vessels[3]
8. Lines parallel, ridges (palms or soles) or chaotic (nails)

1. Eccentric structureless area (any colour except skin colour) (melanoma)

2. Thick lines reticular (arrow) (melanoma)

3. Grey dots (melanoma)

3. Grey or blue structures (basal cell carcinoma [BCC])

4. Black dots or clods, peripheral (melanoma)

5. Lines radial or pseudopods; not a clue to malignancy in this case because 'circumferential' rather than 'segmental' (Reed naevus)
Lines radial   Pseudopod

6. White lines (melanoma)
(image courtesy of Peter Bourne)
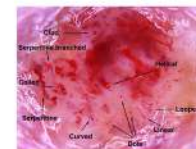
7. Polymorphous vessels
Although this BCC is not pigmented it is included here because it includes almost every vessel type (helical vessel added as inage manipulation by author CR)

8. Lines parallel, ridges (sole) (melanoma)
(image courtesy of Jean-Yves Gourhant)

8. Lines parallel, chaotic (nail): varying in width, interval and colour; an arrow marks the location of a melanoma in the nail matrix (thumb) concealed by the proximal nail fold

Evaluation of CHAOS & CLUES

1. Assessment of 463 consecutive pigmented lesions: dermatoscopy and clinical diagnostic accuracy[5]
Cliff Rosendahl, Alan Cameron, Philipp Tschandl, Harald Kittler

Sensitivity (any malignancy): 90.6%
Specificity: 62.7%
If chaos and clues point to malignant lesions but seborrhoeic keratosis/solar lentigo/lichen planus like keratosis can be diagnosed with confidence by pattern analysis.
Sensitivity (any malignancy): 90.6%
Specificity: 77.4%

2. Assessment of 128 consecutive melanocytic lesions by 3 dermatoscopists comparing 3 point system, 7 point checklist, ABCD method, Menzies method and Short Pattern Analysis (Chaos & Clues)[6]
Philipp Tschandl, Alan Cameron, Cliff Rosendahl, Harald Kittler

Refer to Receiver Operating Curve (ROC) graph opposite. Diagnostic accuracy is calculated as Area Under the Curve (AUC)

ROC Threshold

The 95%-Confidence intervals of the AUC of all 5 Algorithms overlap. Therefore all algorithms, including the new short pattern analysis, are considered equal in diagnostic accuracy.

Exclusion of Seborrhoeic Keratoses by Pattern Analysis

Clues to Seborrhoeic Keratosis

1. Multiple orange clods
2. Multiple white clods
3. Thick curved lines
4. Sharply demarcated border over total periphery
5. Multiple grouped similar lesions

Remember: malignant lesions may have orange and white clods and melanomas may be located among grouped seborrhoeic keratoses. Weigh the clues. If clues to malignancy are present and the diagnosis of seborrhoeic keratosis is equivocal perform a biopsy!
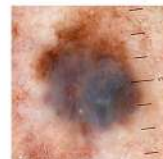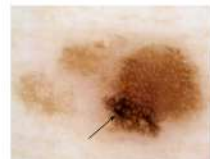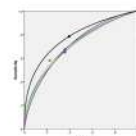

Seborrhoeic keratosis

Melanoma

References

(1) Kittler H. Dermatoscopy: introduction of a new algorithmic method based on pattern analysis for diagnosis of pigmented skin lesions. Dermatopathology: Practical & Conceptual. 2007 13, 1.
(2) Kittler H, Rosendahl C, Cameron A, Tschandl P. Dermatoscopy 2011. Facultas Verlags- und Buchhandels AG facultas.wuv Universitätsverlag, Austria
(3) Kittler H, Riedl E, Rosendahl C, Cameron A. Dermatoscopy of unpigmented lesions of the skin: a new classification of vessel morphology based on pattern analysis. Dermatopathology: Practical & Conceptual. 2008 14,4.
(4) Cameron A, Rosendahl C, Tschandl P, Riedl E, Kittler H. Dermatoscopy of pigmented Bowen's disease. J Am Acad Dermatol April 2010.
(5) Rosendahl C, Tschandl P, Cameron A, Kittler H. Diagnostic accuracy of dermatoscopy for melanocytic and nonmelanocytic pigmented lesions. J. Am. Acad. Dermatol. 2011 Jun;64(5):1068–73.
(6) Tschandl P, Cameron A, Rosendahl C, Kittler H. Presented at the 2nd International Congress of the International Dermoscopy Society, Barcelona, Spain, November 2009.

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