PIPADOR REVISION

MRCOG Part 1 Revision Notes

Ring Chromosomes and Isochromosomes

CELL BIOLOGY • LECTURE 116

VISUAL EXAMINATION REVISION NOTES

2026 Edition

MRCOG Part 1 Revision Notes

Lecture 116: Ring Chromosomes and Isochromosomes

Cell biology • Visual revision edition — completes the cytogenetics core (Lectures 102–116)

COLOUR CODE USED THROUGHOUT THESE NOTES

RING	ISOCHROMOSOME	MARKER	CANCER / p ARM	EPILEPSY / OTHER

LEARNING OBJECTIVES — tick off as you go

- ☐ Describe ring formation and why rings are mitotically unstable.
- ☐ Explain isochromosome formation and the key examples (i(Xq), i(21q), i(12p), i(17q)).
- ☐ Recognise the main ring syndromes.
- ☐ Characterise marker chromosomes, including Pallister–Killian and cat-eye syndromes.
- ☐ Choose the right test and counsel on recurrence.

1 Ring Chromosomes

IN ONE LINE: *Both ends break off, the sticky ends join into a circle — so a ring = two terminal deletions PLUS a chromosome that misbehaves at every cell division (mosaicism, 'ring syndrome' growth failure).*

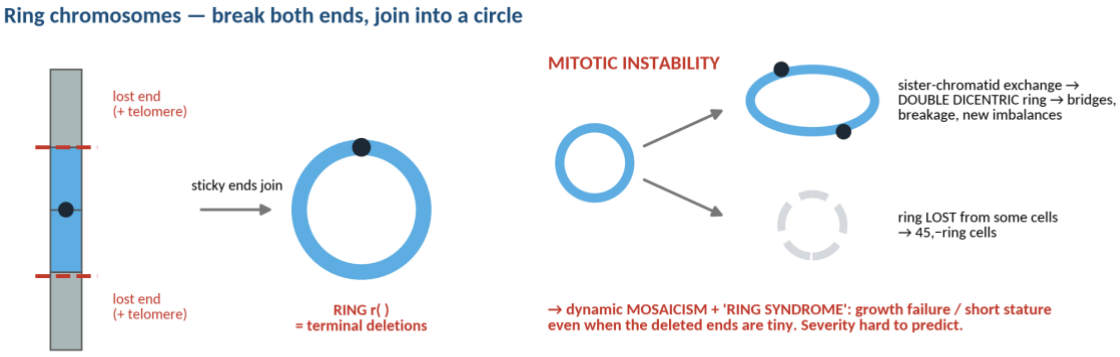


Figure 1. Ring formation and mitotic instability.

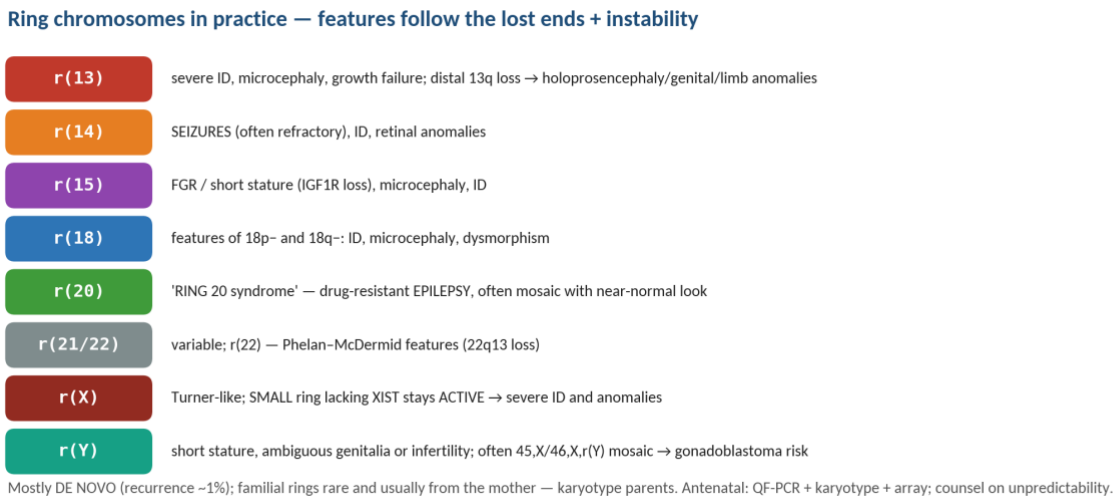


Figure 2. Ring chromosomes in practice.

2 Isochromosomes

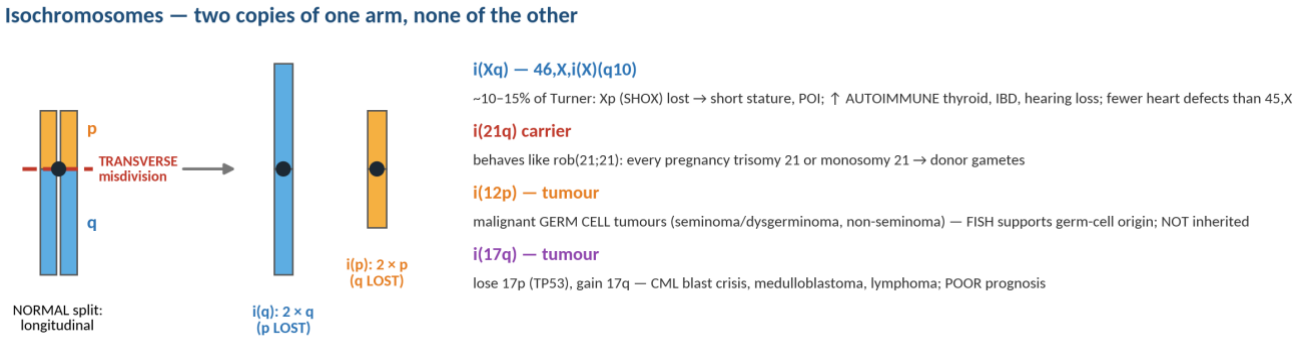


Figure 3. Isochromosome formation and key examples.

MNEMONIC / MEMORY HOOK

'ISO = I've Same-arms Only' — two copies of one arm, the other arm lost. i(Xq) in Turner; i(12p) in germ cell tumours.

Acquired iso	Cancer	Meaning
i(12p)	Malignant germ cell tumours (seminoma, dysgerminoma, non-seminomatous)	Diagnostic — supports germ cell origin (not in mature teratoma)
i(17q)	CML blast crisis, medulloblastoma, lymphoma	Poor prognosis (TP53 loss)
i(6p)	Retinoblastoma	Progression
i(9p)	Some AML/ALL	Variable

3 Marker Chromosomes and Detection

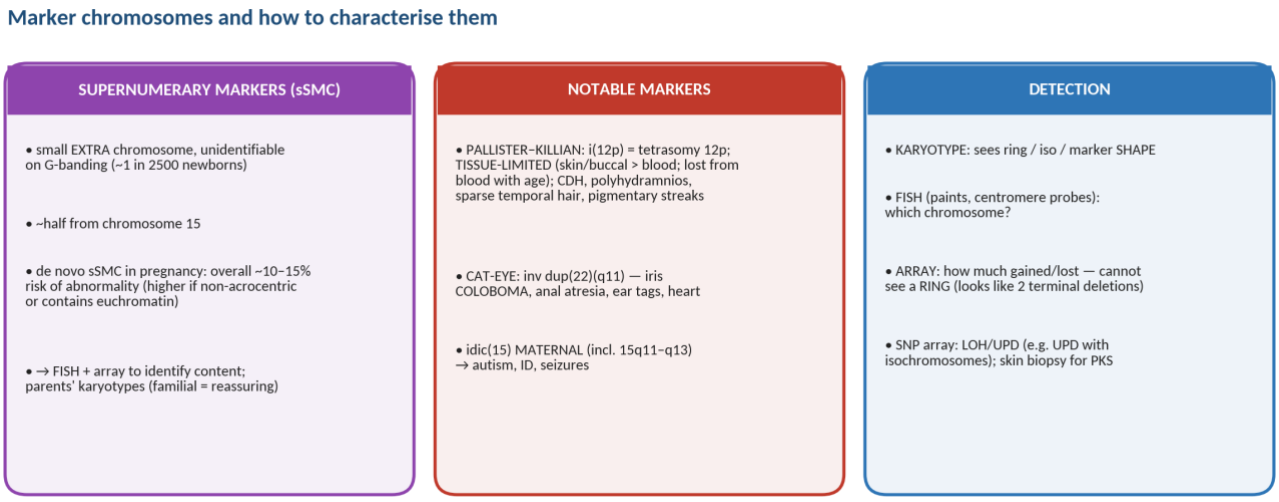


Figure 4. Markers and detection.

- **Counselling**: rings are mostly de novo (recurrence ~1%; rare familial rings, usually maternal); i(Xq) is de novo; tumour isochromosomes are somatic and not inherited. Antenatal ring/marker → identify content (FISH + array), test parents, counsel on a range of outcomes; Pallister–Killian is often first found on amnio/CVS (CDH, polyhydramnios).

> ★ **PEARL**
>
> **Microarray cannot see a ring (it shows only the lost ends) — karyotype sees the shape, FISH the identity.**
>
> **Pallister–Killian = tetrasomy 12p from an i(12p) marker; tissue-limited — normal blood karyotype does not exclude it (test skin/buccal or prenatal samples).**

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Numbers to know

~10–15% Turner with i(Xq)	**~1 in 2500** sSMC in newborns	**~50%** sSMC from chr 15	**~10–15%** De novo sSMC abnormal risk
~1% Recurrence (de novo ring)	**12p × 4** Pallister–Killian	**22q11** Cat-eye marker	**17p lost** i(17q) — TP53

HIGH-YIELD CHECKLIST

- ☐ Ring = breaks at both ends + rejoining → terminal deletions.
- ☐ Ring instability → dicentric rings, loss, mosaicism, 'ring syndrome'.
- ☐ r(14), r(20): epilepsy; r(15): growth failure (IGF1R); small r(X) without XIST: severe.
- ☐ Isochromosome = transverse centromere split → 2 × one arm.
- ☐ i(Xq): ~10–15% Turner; autoimmunity; fewer heart defects.
- ☐ i(21q) carrier → like rob(21;21).
- ☐ i(12p): germ cell tumours; i(17q): CML blast crisis, poor.
- ☐ sSMC ~1 in 2500; half from 15; identify content.
- ☐ Pallister–Killian (tissue-limited i(12p)); cat-eye (22q11); maternal idic(15).
- ☐ Karyotype = shape, FISH = identity, array = dosage, SNP = UPD.

Self-assessment — cover the right-hand column

Question	Answer
What is lost when a ring forms?	Both terminal segments (telomeres)
Why do rings cause mosaicism?	Mitotic instability (dicentric rings, loss)
Ring associated with drug-resistant epilepsy?	Ring 20 (also ring 14)
How does an isochromosome form?	Transverse misdivision of the centromere
Isochromosome in Turner syndrome?	i(Xq)
Isochromosome in germ cell tumours?	i(12p)
Prognosis with i(17q)?	Poor (TP53 loss)
Cause of Pallister–Killian syndrome?	Mosaic tetrasomy 12p (i(12p) marker)
Extra material in cat-eye syndrome?	22q11
Can microarray show a ring structure?	No — only the imbalance

5 References

- Gardner RJM, Amor DJ. Chromosome Abnormalities and Genetic Counselling. 5th ed. 2018.
- Liehr T. Small Supernumerary Marker Chromosomes (sSMC). Springer; sSMC database.
- Gravholt CH et al. Clinical practice guidelines for Turner syndrome. Eur J Endocrinol 2017.