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The Na'vi species, an explanation for stripes and could humans possibly have them?

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Abstract
This paper will give an overview to why there are two different colours of skin present in the Na'vi indigenous species that live on Pandora. The sequel film named 'The Way of Water' shows a second tribe on Pandora named the *Metkayina* which have a turquoise green colour instead of the traditional blue skin tribe called the *Omaticaya* tribe. However, both tribes also have stripes present which could be linked to Blaschko lines which are present in humans due to a result of foetus cell development in the womb, visible in people with mosaic skin conditions.

Keywords: *Film; Biology; Blaschko lines; Mosaicism; Checkerboard; Phylloid; Avatar*

Introduction
In 2009 20th Century Fox released Avatar a film set in the 22nd century where humans colonize a gas giant in the Alpha Centuari star system named Pandora to mine a mineral called *unobtanium* [1]. This could cause the possible threat of extinction to the indigenous tribe of Na'vi which are a humanoid species with bright blue skin and stipes inhabiting Pandora. In the sequel one family is forced to relocated from the jungle moons to Pandoras eastern seaboard. This is where the *Metkayina* clan lives in the great barrier reefs and swim underwater along with their spiritual interspecies called *tulkun* however they have a different appearance of green skin [2, 3].

Na'vis are around 9 to 10 meters tall compared to humans which are on average 5 to 6 feet. They also have legs, feet, mouths, and expressions recognisable to humans. The main difference between the Na'vis and the human's species is the pointed ears, tails, and striped skin along with a tendril feature protruding from the back of their hair feeding directly into the brain (Fig.1). This tendril allows them to connect with other organisms via electrochemical signals like transferring thoughts and memories. In the sequel film we see new avatars introduced with green skin and stronger thicker arms which links to their evolution and adaptation to an aquatic lifestyle.


Figure 1 – Shows two members of the Na'vi species with visible stripes [1].

Blaschko's Lines
One explanation for the stripes which we see on the Na'vi could be Blaschko lines. These lines are also present in humans but are not commonly expressed. They are lines of normal cell development in the skin and are visible in people with skin conditions or chimeras [4]. This is where different cell lines have different genes present. First discovered in 1901 by Alfred Blaschko a Berlin dermatologist who saw the patterns of lines and placed them onto a model of the human body. Shortly afterwards in 1945 a Russian scientist names Zlotnikov was conducting research based on a 24-year-old woman with a unilateral growth across her left side of her body, concluding

this was due to a mutation in the cleavage stage of cell development. Other scientists afterwards have expanded the map of the lines over the body to include the face, neck and head linking the hypothesis of the origins of Blaschko lines to mosaicism (Fig 2). The lines also follow the pattern of tissue growth which happens in embryogenesis. These lines however are not unique to humans and are very much present in animals with mosaicism [4].

Mosaicism

Another valid explanation is mosaicism. Mosaicism happens when someone has two or more genetically different sets of cells in their body. If the number of abnormal cells is bigger than the number of normal cells this can cause disease which affects tissues on a cellular level. Blaschko's line represents a classic pattern of cutaneous mosaicism. Cutaneous mosaicism is a genetic mutation with characteristics of specific patterns on the skin including Blaschko broad lines, checkerboard pattern, phylloid pattern and even more [5].

Checkerboard pattern

This pattern is shown by alternating areas of pigmentary disturbance with breaks or interruptions at the midline region, which gives it a checkerboard appearance [6] (Fig. 4). Some examples of this are systematised nevus splius, a characteristic categized by multiple pigmented spots within a pigmented patch normally associated with complex birth defects [7]. Another example would be X-linked congenital generalized hypertrichosis another rare skin disease characterised by hair overgrowth on the entire body in males and asymmetric hair overgrowth in females [8].

Phylloid pattern

The last possible explanation is phylloid patterns. This pattern shows a more leaf like appearance due to the feature of elongated oval and asymmetrical patches (Fig. 4). Those who have this Phylloid pattern also have other physical impairments such as craniofacial anomalies and musculoskeletal anomalies like brachydactyly where some toes and fingers are shorter than normal due to a gene mutation affecting bone growth [9]. We can also see that phylloid hypomelanosis is a good example of this pattern due to the swirled patches and very prominent oval shapes.

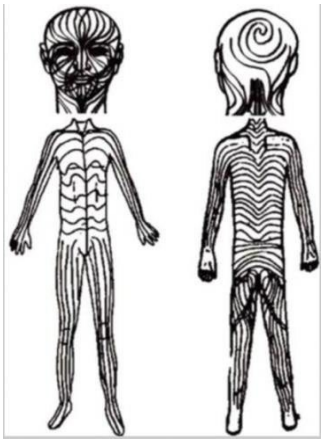

Figure 2 – Diagram of Blaschko lines characterizing mosaicism [5].

Figure 3 – Blaschko lines visible on a human [10].

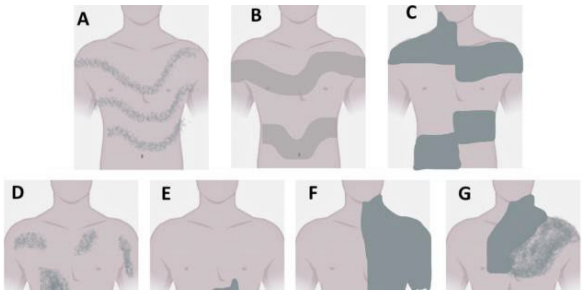

Figure 4 – Showing different Patterns of cutaneous mosaicisms: a) Narrow bands Blaschko lines; b) Broad bands Blaschko lines; c) Checkerboard pattern; d) Phylloid pattern; e) Patchy pattern without midline separation; f) Lateralization pattern and g) Sash-like pattern [6].

Conclusion

In conclusion I would say the best possible explanation for why members of the Na'vi species stripes have would be the Blaschko lines as during embryogenesis when the primitive line enables symmetry in the embryonic disk, cells gather on the midline and grown in transversal direction from here. The cells produce V shapes on the back along with thick broad bands of hyperpigmentation. These broad lines and shapes can be seen to cover the whole body of avatars almost identical to humans with Blaschko lines (Fig. 3).

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