

SURGERY

Red for danger? The effects of red hair in surgical practice

Jonathan D Barry and coworkers discuss whether surgeons and anaesthetists should fear patients with red hair

Traditionally, surgeons and anaesthetists regard red haired patients with some trepidation because of their reputation for excessive bleeding, a reduced pain threshold, and an, albeit anecdotal, increased tendency to develop hernias.

An estimated 1% to 2% of the general population worldwide has the phenotype for red hair, increasing to between 2% and 6% in the northern hemisphere.¹ The typical phenotype associated with red hair is fair skin, freckles, and light coloured eyes. This coloration results from high levels of the red pigment pheomelanin and reduced levels of the dark pigment eumelanin. Red haired people are also sensitive to ultraviolet light.² Despite several validated methods to stratify surgical risk and outcome on the intensive care unit, such as the American Society of Anaesthesiology score³ and the acute physiological and chronic health evaluation score,⁴ none take into account the effect of red hair. We discuss the magnitude of risk posed to clinicians by patients with red hair.

A brief history of red hair

Red hair is referred to several times in ancient literature. Xenophanes, a Greek philosopher and poet, mentioned the blue eyes and red hair of the Thracians. Boudica, the Celtic queen of the Iceni, was described by the Roman historian Dio Cassius as “tall and terrifying in appearance . . . a great mass of red hair . . . over her shoulders.” Homer included several red haired mythical characters in his epic poem *The Iliad*, particularly Achilles, whose fate is the stuff of legends.

Several notable paintings depict Judas with red hair, such as the *Kiss of Judas* by Giotto di Bondone³ and *The Last Supper* by Carl Heinrich Bloch.⁴ In Jacopo da Ponte Bassano's depiction of the last supper, one of the disciples, who is asleep on the table in front of Jesus, has red hair (fig 1). Jesus appears to be admonishing



Fig 1 | Detail of Jacopo da Ponte Bassano's *Last Supper*, 1542 (oil on canvas); Galleria Borghese, Rome

this disciple (probably Judas) with the back of his hand, although no firm conclusions can be drawn from this.

The unwelcome stereotype of someone with red hair continues in modern times, as recently highlighted by the deputy leader of the Labour Party Harriet Harman with her controversial reference to the chief secretary to the Treasury Danny Alexander as the “ginger rodent” (fig 2, extreme left).⁵

Objective assessment of the behaviour of people with red hair is complicated by the ability to artificially colour hair.

Methods

We carried out a literature search through Google using the terms “redhair”, “pain”, and “surgery”. All relevant scientific or otherwise related papers identified were extracted for review.

Genetics

The genetic basis of red hair was identified in 1997 in association with the melanocortin-1 receptor (MC1R) located on chromosome 16. Two copies of a recessive gene on chromosome 16 changes the MC1R protein leading to the red hair phenotype. Overall, 80% of people have the MC1R gene variant.² The alleles identified (Arg-151Cys, Arg160Trp, Asp294His, and Arg142His) on MC1R are recessive for red hair phenotype,⁶ although the HCL2 gene present on chromosome 4 may also be related.⁷

Clinical effects

Many anecdotes have been recounted about the clinical behaviour of people with red hair. Reports of increased tendencies to bleed are, perhaps, apocryphal although some studies have sought to elucidate the link between red hair phenotype and haemorrhage.

Haemorrhage

One study attempted to show a link between red hair and bleeding after tonsillectomy (together with full moons and Friday the 13th).⁸ The incidence of post-tonsillectomy bleed was almost 7% but this was indistinguishable from that of the control group. In another study, the bleeding tendencies between 50 women (half of whom had red hair and half black or brown hair) by using objective coagulation testing did not differ, despite the red haired women reporting significantly more subjective bruising in the perioperative period.⁹

Endometriosis

An association was observed between natural red hair and the incidence of laparoscopically con-



Fig 2 | Little bleeders?

firmed endometriosis in women with no known infertility.¹⁰ This was the only association found (including parity, race, and body mass index) at 10 year follow-up.

Anaesthesia

More conclusive perhaps is the relation between red hair and requirements for anaesthesia. Mice carrying mutant MC1R and humans with red hair (both with non-functional MC1Rs) were shown to have a reduced sensitivity to noxious stimuli and an increased responsiveness to opiate based analgesia.¹¹

One study focused on the increased need of patients with red hair for anaesthetic agents during surgery.¹² This study was limited by its small sample size but showed that the need for desflurane was significantly higher in patients with red hair than in the group with other coloured hair. Moreover, this study showed that of the cohort of 10 patients in the red haired group, nine were either homozygous or compound heterozygous for mutations on the MC1R gene.

Supplementary work by these authors in a larger study population looked at the difference in local anaesthetics requirements between people with red hair and a control group of people with black or brown hair.¹³ Subcutaneous lidocaine (lignocaine) was significantly less efficacious in the red haired cohort. That cohort were also more sensitive to the perception of pain from cold and heat than the control group. The authors postulated that the dysfunction of the MC1R gene associated with red hair triggers the release of more of the α -melanocyte stimulating hormone that stimulates these cells, but this particular hormone also stimulates a brain receptor related to pain sensitivity (both of these hormones are derived from the same precursor molecule pro-opiomelanocortin).¹²

Hernias

Possibly the most difficult association to identify is the postulated increase in the rate of hernia formation in people with red hair. Collagen synthesis may be implicated in the cause of hernia formation,¹⁴ although we could find no firm links between red hair phenotype and hernia development in our literature search. Research

on brittle cornea syndrome has, however, shown a link between this autosomal recessive condition and red hair.¹⁵ Further work from Israel has shown the gene for brittle cornea syndrome to be on chromosome 16 (16q24)—the chromosome responsible for red hair. What are the chances of that? Probably 46 to 1.¹⁶ Indeed, the authors had previously identified the brittle cornea syndrome to be located on chromosome 16 close to the MC1R gene for hair.¹⁷ It follows that red hair may be associated with increased rates of hernia formation, but in all honesty it would be difficult to prove.

Conclusion

Despite sporadic reports to the contrary, the clinical implications of red hair phenotype remain questionable. Red hair phenotype may confer an increased requirement for anaesthetics but is associated with no greater operative risk than the remainder of the population. It would seem that the reputation of people with red hair for having increased perioperative risk is without any basis in fact and should only be used as an excuse of last resort by surgeons defending problematic bleeding or recurrent hernias.

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Middle ear instrument nomenclature: a taxonomic approach

You say “alligator;” we say “crocodile.” **John Phillips and colleagues** would prefer “gharial”

Starting from a common origin in the early 17th century, the divergent evolution of the English language between North America and Great Britain holds a great deal of interest for linguists, but is a source of confusion to the unwary traveller.¹ An example of such confusion arose when the lead author of this article, trained in the UK as an otolaryngologist, found that his use of the term “crocodile forceps”—referring to the commonly used surgical instrument used to perform delicate middle ear surgery—met with bewilderment in US and Canadian hospitals (fig 1). There, as it turned out, the term “alligator forceps” was prevalent.

To avoid such communication problems, biologists maintain strict rules relating to their formal nomenclature. The earliest binomial for an organism, published within or since Carl Linnaeus’s *Species Plantarum* (1753; for plants) or the first volume of his 10th edition of *Systema Naturae* (1758; for animals), is by international convention considered to be the only valid name.² On further investigation, however, an organism can be reclassified as

belonging to a different genus, whereupon its scientific name can properly be changed.

In the interests of scientific clarity, a dispassionate investigation of the correct terminology for these forceps is clearly long overdue. We address this important issue both through establishing priority of nomenclature within the literature and through original investigations of jaw morphology. Modern crocodyli-forms within the suborder Eusuchia appeared in the Cretaceous period³; this group includes the 23 extant species of alligators, crocodiles, caimans, and gharials. We chose to restrict our comparative focus to the two species living in the continental United States: the American crocodile, *Crocodylus acutus*, and the American alligator, *Alligator mississippiensis*. Both species inhabit Florida, where they are likely to be familiar to local clinicians.

Methods

We sought the earliest post-1758 uses of the terms “crocodile forceps” and “alligator forceps” using a web based literature search concentrating on medical textbooks and catalogues. We obtained representative speci-

mens of the forceps in question (Microfrance Incorporated, Medtronic Xomed, Jacksonville, FL; n=13 models), and we compared measurements with those obtained from adult and juvenile skulls of *C acutus* (n=8) and *A mississippiensis* (n=12), from the collections of the University Museum of Zoology, Cambridge and the Natural History Museum, London. Snout width was measured between the positions of the most caudal teeth, while snout length was measured from the midpoint of the line connecting these teeth to the most rostral point on the snout. For the forceps, these measurements were made from the point of articulation at the most posterior tooth. Snout ratio was defined as snout length divided by snout width. We also counted the numbers of teeth in the upper jaws.

Results

The first use of the term “alligator forceps” recorded in the *Oxford English Dictionary* comes from Knight’s *New Mechanical Dictionary*,⁴ an American publication. We were able to extend the use of this term back to 1875, where it features in the urological work of



Fig 1 | Hartmann Alligator Micro-Forceps, model MCO13B. Manufactured by Microfrance Incorporated. Medtronic Xomed, Jacksonville, FL (reproduced with permission)

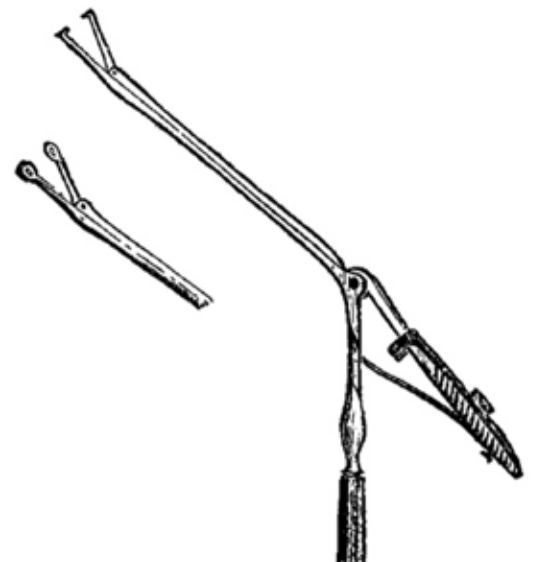


Fig 2 | “Crocodile lever ring forceps” as illustrated by MacNaughton Jones (1889). Reprinted with permission from the *Lancet*



Fig 3 | Dorsal view of the skulls of *C acutus* (spec. no. R6053; left) and *A mississippiensis* (spec. no. R6301; right), to illustrate the differences in snout morphology. Scale bar represents 10 cm. Specimens from the University Museum of Zoology, Cambridge

WT Helmuth, professor of surgery in the New York Homeopathic Medical College.⁵ Alligator forceps were frequently referred to in the American urological literature after this date,^{6,7} and later appeared in otolaryngological sources from the other side of the Atlan-

tic.⁸ The term “crocodile forceps” was in use at the same period, again first appearing in the American urological literature in 1875⁹ and later the British otolaryngological literature.¹⁰ US army surgeons used modified versions of the forceps to remove arrowheads



Fig 4 | Dorsal view of the skull of a juvenile gharial, *Gavialis gangeticus* (spec. no. R5793). Scale bar represents 10 cm. Specimen from the University Museum of Zoology, Cambridge

from wounds.¹¹ The forceps were manufactured at around this time by companies including those of Louis Mathieu in Paris and George Tiemann and Company in New York. Nomenclature was evidently labile at first—some authors used both “crocodile” and “alligator” to describe the forceps⁸⁻¹³ (fig 2)—but over time “alligator” became much the more popular term worldwide: a Google search generated 67 600 hits for “alligator forceps” but only 5560 hits for “crocodile forceps”.

Turning to the morphology (fig 3), the mean snout ratio in *C acutus* was 2.19 (SD 0.24, n=8); in *A mississippiensis* it was 1.59 (0.28, n=12). In the Microfrance forceps it was 5.58 (1.53, n=13 models). The number of teeth in the upper jaw of *C acutus* ranged from 17 to 19 (modal number 19), in *A mississippiensis* from 14 to 21 (20), and in the forceps it ranged from 11 to 27 (11).

Discussion

Our literature search suggests that the terms “alligator forceps” and “crocodile forceps” appeared at around the same time, but “alligator” has become the preferred term worldwide. However, our morphological comparison shows that the snout ratio and the modal tooth number of the forceps are actually closer to that of the crocodile than to the alligator. The tooth number was very variable in the forceps, however, and is therefore not very informative.

Notably, even the lowest snout ratio observed in the forceps (4.69) was still almost twice the maximum found in any American crocodile (2.59). Such a long, pointed snout is actually more reminiscent of that of the gharial (*Gavialis gangeticus*), a rare crocodylian found on the Indian subcontinent (fig 4). In his study of crocodylian snout evolution Brochu states, “Some crocodyliform snouts resemble a pair of toothed forceps,”¹⁴ referring the reader to an illustration of the fossil gavialoid *Thoracosaurus*. Some important differences remain, however; notably the fact that in the forceps it is the upper jaw that moves, whereas in crocodylians—despite Aristotle’s assertions to the contrary in his *History of Animals*—it is the lower.

As Wilkinson has argued, the rule of priority must be flexible when applied to scientific ideas, which evolve over time.¹⁵ Mindful of this, and of the potential for offending the sensibilities of clinicians on one side of the Atlantic or the other, we propose that the ethnologically neutral and morphologically more accurate alternative name of “gharial forceps” should be introduced for these vital implements—subject to confirmation following a more detailed study.

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The IKEA pencil: a surprising find in the NHS

Better than methylene, Bonney's blue, and felt tipped skin markers

It seems that the IKEA pencil has developed quite a following. A customary Google search identified a Facebook page entitled "IKEA pencil stealing appreciation" with 55 563 members as of the time of writing.¹ It appears that pocketing a few pencils during your shopping trip is considered normal. YouTube² has over 60 videos dedicated in some way to the little brown pencil, and 500 of them have been used to create a chair.³

As popular as these pencils are, we were still a little surprised to be handed one halfway through a surgical case. The use of a pencil to mark osteotomy cuts in

craniofacial and maxillofacial surgery is well established, proving superior to methylene, Bonney's blue, and felt tipped skin markers that struggle to transfer an ink mark to bone, or are washed away by irrigation or tissue fluids.^{4,5} Sterilisation, originally achieved with 18 hours of dry heat,⁶ is now performed by autoclaving, making a pocketful of IKEA pencils from one shopping visit last for many months—important in the current financial climate. The only problem is that on repeated sterilisation even the hardiest of pencil splits. Ours proceeded to extrude its graphite core before it was even removed from the protective wrapper. We have

solved this problem by wrapping silicon cuffs around the pencil—maybe we could suggest this to the designers at IKEA?

Despite this, pencils remain a safe and reliable method of marking bone, making the Argos pen safe for now, at least.

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Contributors: KAE and SRW-S were equally bemused by multiple broken pencils; KAE wrote the initial draft with revision by SRW-S. KAE and SRW-S share responsibility for the position of guarantor.

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