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Where did flying reptiles come from?

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Abstract

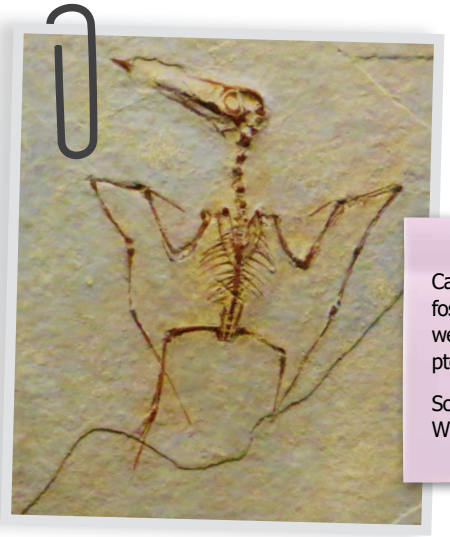
Have you heard of flying dinosaurs named pterodactyls [terr-oh-dak-tlz]? Well, you may be surprised to hear that they are not technically dinosaurs. Pterodactyls, part of the group pterosaurs [terr-oh-sorz], were reptiles. They were related to dinosaurs, which are also reptiles, but do not belong to that group.

Pterosaurs were the first vertebrates that were able to fly by flapping their wings. This makes them all the more interesting. Have you ever thought about how it is possible that some animals started to fly? How did they get their wings? The general answer is: evolution.

But here the mystery deepens. For a long time it seemed like there was a huge evolutionary gap between pterosaurs and most other animals. How did they come about? By looking at fossils, we found out that lagerpetids [la-jer-pe-tids] (a small group of non-flying reptiles) are close relatives of pterosaurs. Finding out about lagerpetids told us a bit about how pterosaurs started to fly.

Introduction

Could dinosaurs fly? Well, not exactly. *Pterodactyls*, which are probably what you think of if someone says 'flying dinosaurs' were in fact another group of *reptiles*. They are part of a group called *pterosaurs*. Some pterosaurs evolved to become the biggest flying animals ever, with wingspans of around 10 meters. Before them, some *vertebrates* were able to glide through the air, but pterosaurs were the first ones that could fly by flapping their wings.



Cast of a pterodactyl fossil. Pterodactyls were just one type of pterosaur.

Source: Ghedoghedo on Wikimedia Commons

Reptiles, dinosaurs, pterosaurs - What's the difference?

Well, dinosaurs and pterosaurs were both types of reptiles. One thing that made dinosaurs special is the way their legs were positioned under their bodies, giving them an upright kind of stance. This meant they used up less energy while moving around than other reptiles did. By contrast, alligators today, for example, have legs that sprawl out to the side. But they are all reptiles!

To be able to fly, they needed a very specific body. Their bones were hollow like birds' are today. (In fact, pterosaurs' bones were even more hollow than birds' are.) This reduced their weight, so their wings could lift them off the ground.

In fact, the whole skeletal body plan of pterosaurs was highly specialized. Their wings were attached to their bodies by a bone that was actually one very long finger!

But their specialized bones also have a disadvantage for us scientists today. Early pterosaurs were small and their bones

were so hollow that they easily broke. So instead of being *fossilized*, they were mostly destroyed over time. This means that we do not have very many well-preserved skeletons from the first pterosaurs to study. So it's hard to know exactly how pterosaurs developed their amazing flying abilities. Where did they get those from?

Well, they probably inherited some useful features from their ancestors. But until now, we couldn't work out who those ancestors were. It is likely that the pterosaurs' ancestors also had hollow bones, which were also destroyed over time. No bones leave us with a mystery!

So who are the closest relatives of pterosaurs? Maybe they could help us understand how vertebrates took to the skies. Our research offers a solution to this mystery because, thanks to new discoveries and techniques, for the first time we had enough fossils to analyze entire skeletons from another group: *lagerpetids*. It turns out they are close relatives of pterosaurs!

Methods

We looked at lagerpetid fossils. These fossils were from bones such as backbones, *limbs*, and skulls. We analyzed the bones with an *X-ray scanner* (Fig.1). Then we compared them to bones of other animals in a huge database.

We counted all the similarities between lagerpetid and other animal skeletons. The more similarities the bones showed, the more closely the animals must have been related. We focused on the similarities that evolved more recently in the different animals. They would tell us which ones were truly closely related.

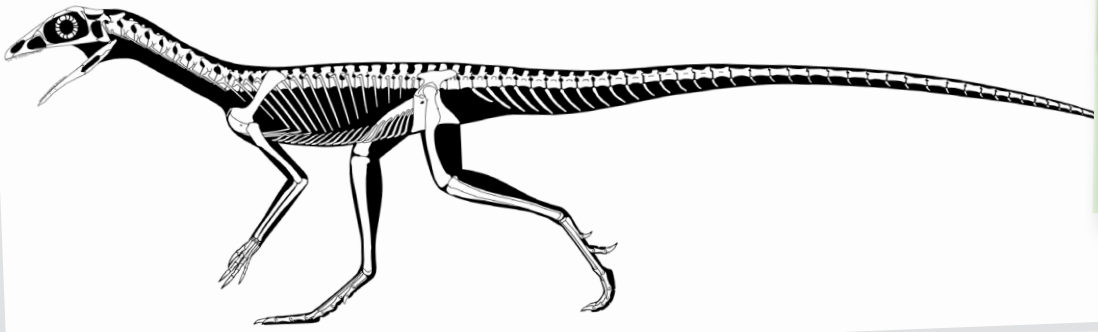


Figure 1: This is what an x-ray scan of a lagerpetid would look like!

Results

Using a computer, we found at least 33 similarities between the bones of lagerpetids and pterosaurs. These similarities were located across the entire skeleton. There were many more similarities than with any other animal. We concluded that lagerpetids and pterosaurs must be closely related.

The bony structure of the inner ear was very complex in both groups (Fig. 2A). This is interesting as this feature is believed to be important for balance. Better balance is probably one of the reasons pterosaurs were able to fly and lagerpetids were so light-footed.

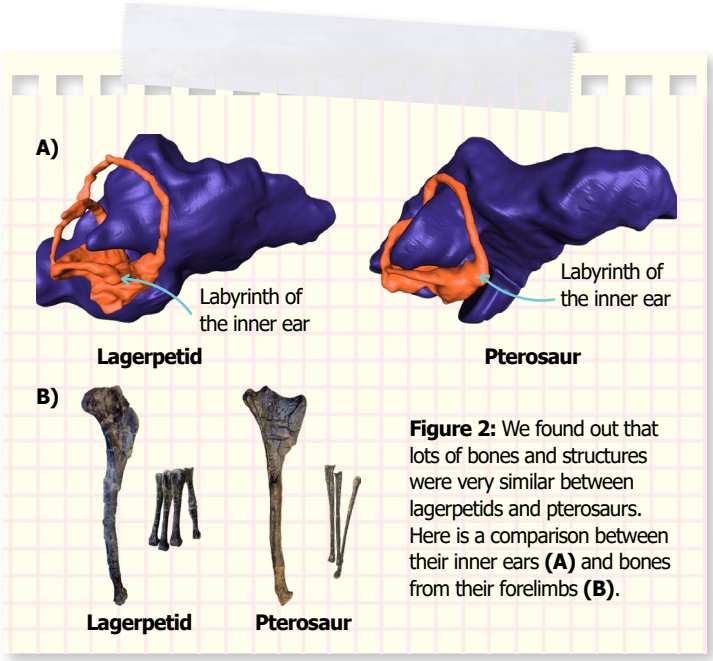


Figure 2: We found out that lots of bones and structures were very similar between lagerpetids and pterosaurs. Here is a comparison between their inner ears **(A)** and bones from their forelimbs **(B)**.

Discussion

Although pterosaurs and lagerpetids don't look very similar, parts of their skeletons are very similar. As well as in the inner ear and brain, we found lots of similarities in the different animals' forelimbs (front arms and wings) (Fig.2B). Both groups had very mobile forelimbs. Perhaps lagerpetids inherited these 'clever' forearms from their ancestors, while pterosaurs developed the same 'clever' traits into their amazing wings.

As both animal groups share so many features, we can assume that they have a common ancestor. It's unlikely that both groups developed all these traits separately from each other at the same time.

Lagerpetids used their inherited traits to develop a very quick and light-footed way of moving on the ground. Pterosaurs developed the same features into an ability to fly. This enabled pterosaurs to become the first flying vertebrates.

In fact, pterosaurs and lagerpetids' special inner ears are very similar to birds'. But birds didn't come from pterosaurs (they evolved from dinosaurs, in fact). Instead, birds evolved this similar feature because of a similar evolutionary pressure: the advantage of flight.

Conclusion

As you can see, *evolution* doesn't happen all at once! It takes a lot of time and many steps for new animals to develop. Both the pterosaurs and the lagerpetids inherited features that could have led to being able to fly. But only pterosaurs developed these features into wings.

Try to think of that the next time you learn about an animal – could two very different looking animals actually have a lot in common? Knowing that can tell us a lot about evolution and how different animals came to be.

Glossary of Key Terms

Evolved – developed into something new.

Evolution – continuous development of already existing features into new ones over time from generation to generation. Characteristics that help the species to survive are more likely to be passed on.

Fossilized – Some materials, like bones, teeth, and excrement (poop) for example, do not rot away after an animal dies but are preserved and slowly turn to stone. The better the bones are preserved, the better we can reconstruct how the animals must have looked.

Lagerpetids [la-jer-pe-tids] – an extinct group of reptiles. They were not able to fly and lived on the ground. Most of them were quite small and very agile. They probably looked like a crossover between a small dinosaur and a lizard.

Limbs – extensions of a body, like arms, or legs, or wings.

Pterodactyls [terr-oh-dak-tlz] – the pterodactyl, or Pterodactylus, was the first member of the group of pterosaurs whose skeleton was discovered. Sometimes the name pterodactyl is also used for the whole group of pterosaurs.

Pterosaurs [terr-oh-sawz] – an extinct group of reptiles. They were the first reptiles able to actively fly. We know they existed because we have found their fossilized skeletons in the ground.

Reptiles – reptiles are animals mostly covered by scales. For example, lizards, turtles and crocodiles belong to this group.

Vertebrates – a very large group of animals. They all have one thing in common: a backbone. We humans are vertebrates, as well as reptiles, amphibians, and others.

X-ray scanner – X-rays are a form of radiation. X-rays can go through materials that ordinary light cannot, such as your skin or muscles, showing bones and other things inside the body. Therefore they can be used to take a clear picture of your bones – or of a fossil. But be careful! Too many X-rays at a time can also damage your body.

Check your understanding

1. Which group of animals is most closely related to pterosaurs?

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2. How did the researchers find out which other animals lagerpetids were related to?

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3. Explain two features which enabled pterosaurs to fly and how they might have done so.

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4. If you compare how tall you are to how wide a pterosaur's wings reach, roughly how many times would you fit into the wingspan of the largest pterosaurs?

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5. We learned that evolution is a slow but continuous development and that closely related animals have more similarities. Can you think of other animals that could be related to each other? What about any examples of animals that don't look like each other but could still be related?

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