Improved Efficiency of Medical Imaging Probe

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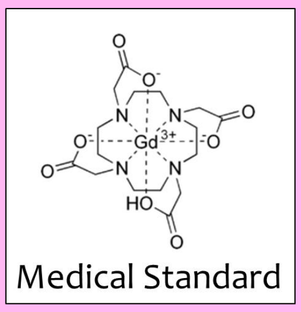
The Peacock Group has developed a new MRI imaging probe with the potential to drastically improve the identification of disease compared to the current standard. This new design uses a miniature protein which binds to an active metal.

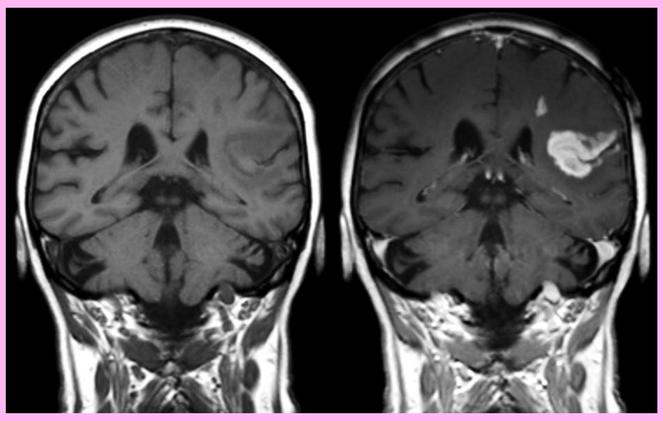
MRI is a technique commonly used in hospitals to look inside the body without the need for invasive surgery.

Contrast agents can be injected to allow for easier diagnosis of disease.

Factors affecting contrast agents:
1. Rate of tumbling (peptide length)
2. Association with water

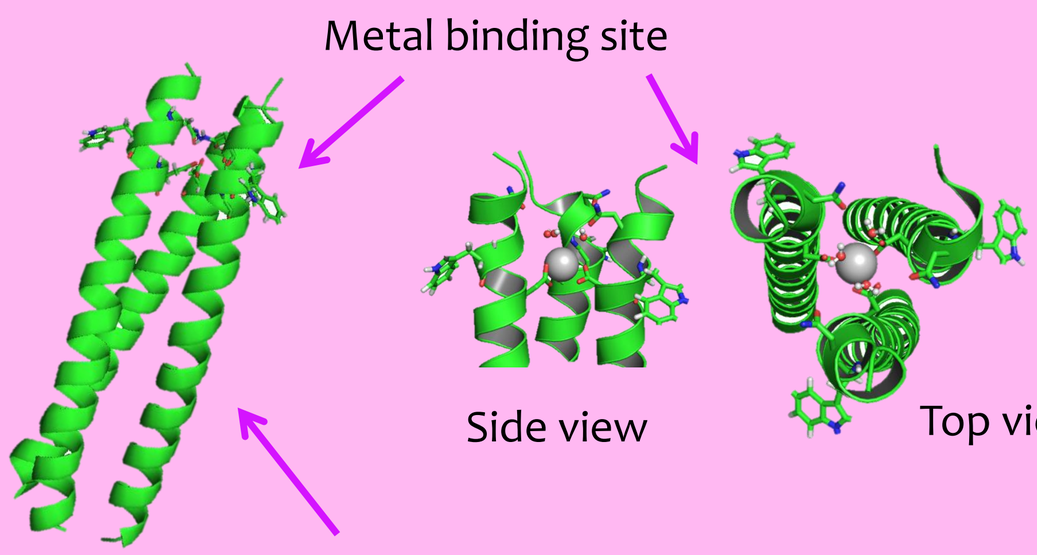


Medical Standard



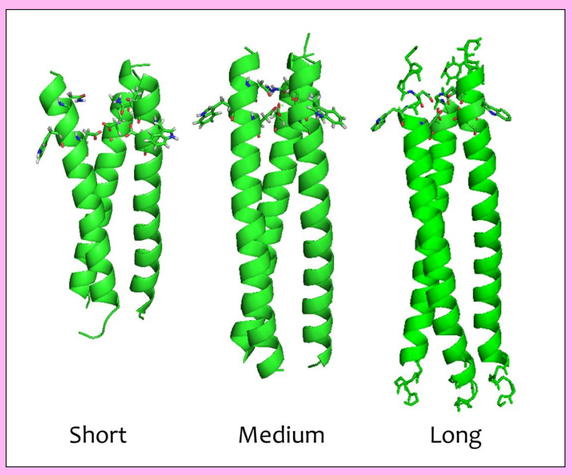
Peptide design

Each amino acid was selected to drive the formation of the coiled coil structure or to form a metal binding site for an MRI active metal. In this system the metal is gadolinium.



Ac-G-IAANEWKDAAIEQKIAAIEQKIAAIEQKIAAIEQK-G-NH2

1. Investigating peptide length



An increase in peptide length causes an increase in folding. This means the peptide is more stable and can bind a metal more tightly. This is important as on its own gadolinium is highly toxic.

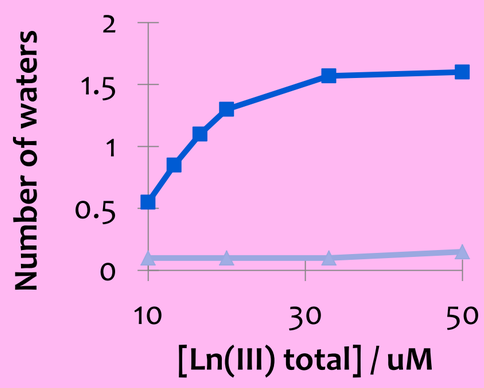
MRI has shown that the efficiency increases as peptide length increases. However there is no difference between the medium and long peptide

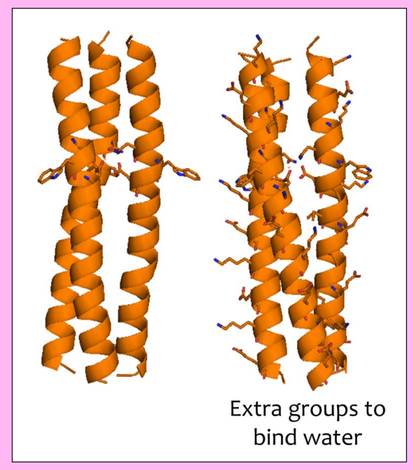
Peptide	Efficiency r2 / mM-1 s-1
Medical Standard	16.8 ± 0.5
Short	54.1 ± 1.0
Medium	92.5 ± 11.0
Long	82.7 ± 1.9

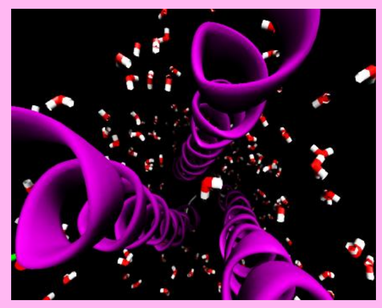
2. Investigating water association

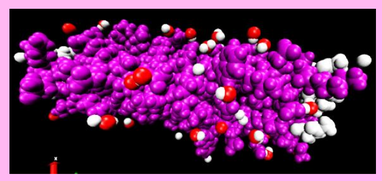
Water can associate with the outside of the peptide or with the metal in the middle of the peptide. Here we investigate what happens if more water bonding groups are added to the outside of the structure.

The modification in structure causes no significant change in peptide folding or how tightly the metal is bound.









But the new peptide has more water coordinated to the metal centre.

Computational simulations show one water molecule in the centre of the coil and many coordinated to the outside.

This results in an increase in efficiency of the new peptide.

Peptide	Efficiency r2 / mM-1 s-1
Medical Standard	16.8 ± 0.5
Original peptide	27.2 ± 0.6
New peptide	65.7 ± 0.6

Longer length = slower tumbling
= higher efficiency

More H-bonding groups = more water binding
= higher efficiency

Acknowledgments
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