Magnetically Motivated Changes in Cell Cytoskeleton

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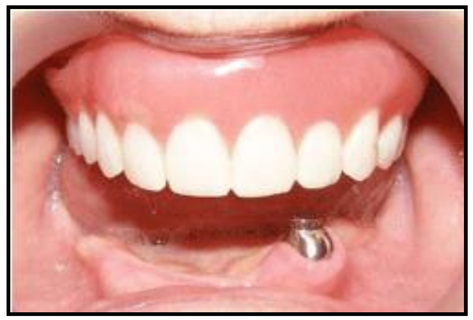
CONCLUSIONS AND IMPLICATIONS

Exposing an epithelial cell to a magnetic force is associated with reduced levels of ERM proteins. We suggest that this leads to cytoskeleton detachment from the cell surface, which would alter cell cortex. A change in cell cortex would lead to an inability of epithelial cells to effectively divide to make more of themselves.

In this regard, the magnetic force needed to hold dental implants in place may lead to difficulty healing the area, particularly in patients with comorbidity.

BACKGROUND

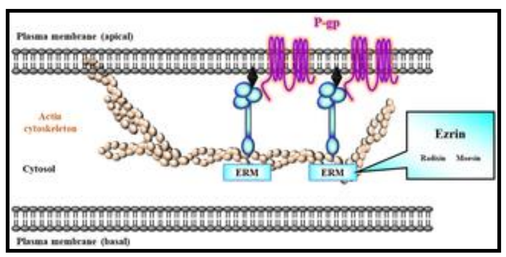
Magnets are used to hold prosthetics, such as dentures, in place[1]. However, the effect of these levels of magnetic force on nearby cells is unknown. Recent studies have shown that cells are able to move toward a magnet[2]. Cytoskeleton, particularly actin filaments, are involved in cell motility[3]. Our hypothesis is that magnetic force would impact actin filament architecture.



Picture of Magnet Retained Denture [corpus id 19897105]

OBJECTIVES

The study presented here looked at how magnets impact ERM proteins, which attach actin filaments to the surface of the cell.

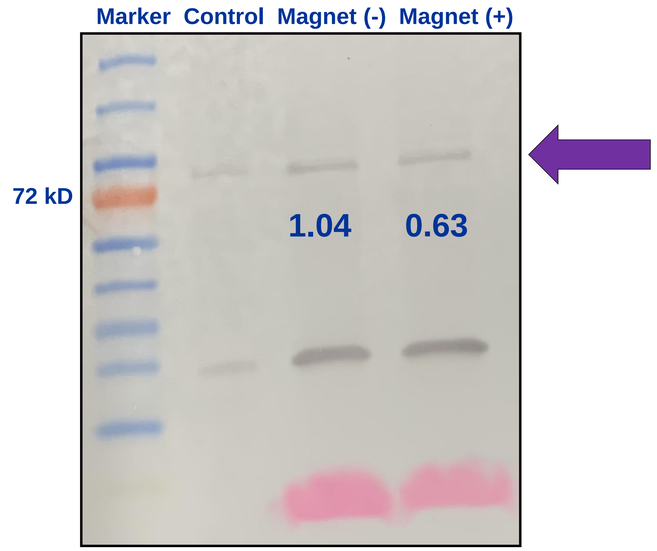


Picture of ERM proteins attaching cytoskeleton to plasma membrane [doi.org/10.1371/journal.pone.0250889.g008***]***

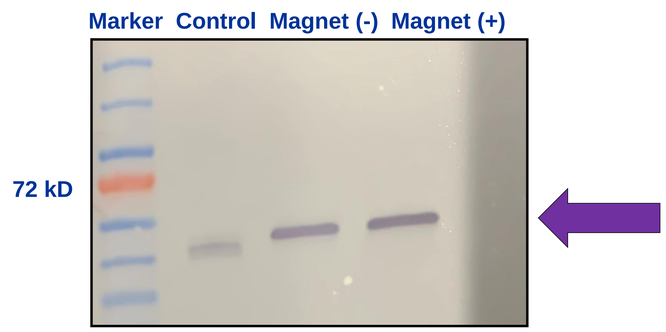
ERM PROTEIN LEVELS

Immunoblot showing protein levels in epithelial cells without magnetic force (-) or with magnetic force exposure (+). (A) ERM proteins. (B) Beta-actin loading control. Marker shows protein sizes (kD). Arrow points to ERM band at 80kD or actin band at 42kD. Control is HeLa lysate from BioRad. Band densities adjusted to loading control shown as numbers by ERM band.

A. Ezrin – Radixin – Moesin (ERM)



B. Beta-Actin (loading control)



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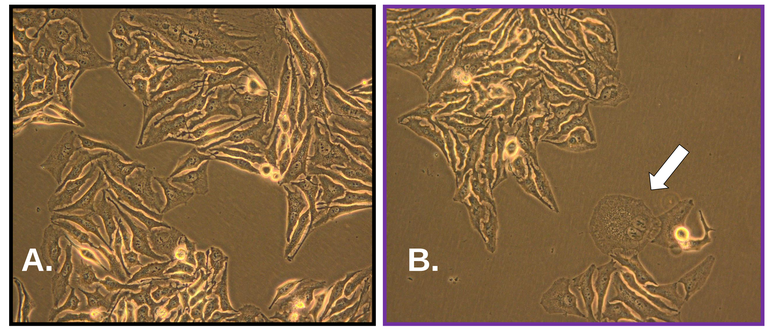
References

1. Lew W-Z, et al., *Cells.* 2021; 10:2662. doi.org/10.3390/cells10102662.
2. Zablotskii V, et al. *BioEssays.* 2018; 40:1800017. doi: 10.1002/bies.201800017.
3. Pollard, TD and JA Cooper, *Science*. 2009; 326(5957): 1208. doi: 10.1126/science.1175862.

MICROSCOPE PICTURES

Pictures were taken of epithelial cells not exposed to magnetic force (A) or exposed to magnetic force (B). Cells near a magnetic force tended to be swollen with less distinct edges. In some cases, cells in the middle of cell division by mitosis were overly large.



METHODS

Cells. HeLa (ATCC-CCL-165), a human epithelial cell line were grown in culture at 37˚C with 5% CO_2.

Magnetic Force. HeLa were placed on a magnetic-free table [magnet (-)] or exposed to neodymium magnet for 15 minutes at ~200 mTesla [magnet (+)], which was measured with a Gaussometer. Magnetic force similar to those used for dental implants.

Microscope. Micrographs were documented using CellSens imaging software using an inverted, Olympus CKX41 outfitted with phase contrast and an InfinityHD digital camera.

Immunoblot. Total protein extracted with RIPA buffer with protease inhibitors, quantified with Biuret, separated by vertical gel electrophoresis (BIO-RAD mini protean), and transferred to PVDF.

Immunoblot using antibodies from Cell Signaling. Primary antibody, rabbit anti-human ERM (80kD) and secondary antibody, goat anti-rabbit from Opti-4CN substrate kit (BIO-RAD) followed after mild stripping with monoclonal primary antibody, mouse anti-human beta-actin (42kD), and secondary antibody, goat anti-mouse from Opti-4CN substrate kit. NIH Image J used to quantify band densitites.