Purpose: To assess the effect of additives regarding their influence onto small bowel distension in conjunction with MRI.

Materials and methods: Different oral contrast agents were used for MRI: water alone and in combination with mannitol, metamucil, locust bean gum, and combined mannitol and LBG. Small bowel filling was quantified on coronal 2D TrueFISP images by manual measurement of bowel diameters.

Results: The ingestion of water spiked with LBG and mannitol showed the best distension of the small bowel.

Conclusion: Small bowel MRI in conjunction with the oral application of water for bowel distension can be improved by adding different substances which lead to decreased water resorption.

Introduction
Advances in MRI including the implementation of high performance gradients and the availability of new oral contrast agents have led to an increasing use of MRI for the evaluation of abdominal diseases. MRI of the small bowel has become an established method for the assessment of inflammatory bowel diseases [1]. Good distension of the intestine is crucial for small bowel imaging. By applying contrast agents via a nasoduodenal tube, sufficient bowel distension is achievable [2], but this procedure is often perceived as traumatizing by patients due to its invasive character.

The mere oral administration of water without intubation is non-invasive and well accepted. Unfortunately this procedure is often associated with a rapid resorption of water in the small bowel which diminishes bowel distension. Certain additives can inhibit water resorption [3]. This study assesses the effect of different osmotic and non-osmotic substances regarding their influence onto small bowel distension.

Methods
Ten healthy volunteers without any history of gastrointestinal pathology underwent 5 separate MR imaging exams on different days. Each of the 50 exams was performed following an eight hour fast. The subjects received the following substances p.o. for bowel contrast: water alone, water spiked with mannitol (2.5%), water with metanucil (0.7%), water with locust bean gum (LBG, 0.2%), water with mannitol and LBG (0.2%), and water with locust bean gum (LBG, 0.2%) or water with mannitol (2.5%) and LBG (0.2%). Concentrations of the additives were chosen in a manner to avoid negative side-effects such as diarrhea. Oral ingestion of the respective substance, administered in a blinded and random fashion, began 45 minutes prior to the exam. For enhanced gastric emptying, 50mg erythromycin were administrated intravenously. Spasmolytic agents were not applied. Coronal 2D images were collected in the prone patient position with a TRUEFISP sequence (TR/TE/Fi 3.2/1.6/70°) using a 1.5 T scanner (Sonata, Siemens). The acquisition time amounted to 16 sec. Small bowel filling was quantified by manual measurement of 15 small bowel diameters and calculating an average value.

Results
All contrast agents resulted in homogeneously high signal intensity within the small bowel on TRUEFISP images. The mere ingestion of water resulted in significantly less small bowel luminal water and less bowel distension compared to the ingestion of water spiked with any of the four additives (p < .05, fig 1+2). Comparing the four additives, the ingestion of water spiked with the combination of LBG and mannitol showed the best distension of the small bowel (average bowel diameter 23.7 mm) compared to 21.3 mm with mannitol, 19.9 mm with LBG, and 16.6 mm with Metanucil (fig 3). Side-effects were not reported following the consumption of any contrast agent.

Discussion
MRI of the small bowel in conjunction with the oral application of water for bowel distension can be improved by adding either osmotic or viscosity-modifying substances. This leads to decreased water resorption and thus enhanced bowel distension. Of the commercially available additives, both the osmotic agent mannitol as well as the thickener locust bean gum resulted in a significantly better bowel distension compared to the mere administration of tap water. Since the mechanism of both additives for small bowel distension are different, the combination of LBG and mannitol led to an even better distension and was considered best for small bowel MRI in conjunction with the oral application of contrast agents.

Fig 1+2: Coronal TrueFISP sequence of the abdomen. Both water and a solution containing mannitol and locust bean gum show a homogenous high signal intensity throughout the small bowel. The oral contrast agent in figure 2 provides significantly better distension of the intestine than mere water.

Fig 3: Results of bowel distension for different oral contrast agents. All solutions provide better small bowel distension than water. Best results were achieved with a solution containing a combination of locust bean gum and mannitol (mean small bowel diameter 23.7mm)

References