

## Modern Tablet Film Coatings and Influence on Ease of Swallowing

### OBJECTIVE

To investigate whether film coated tablets have shorter mean esophageal transit times and lower incidences of transit delays than those of uncoated tablets, or comparably sized hard gelatin or soft gelatin capsules. A pilot scintigraphic study was undertaken to investigate the esophageal transit of tablets and capsules in healthy volunteers.

### STUDY DESIGN

#### Design

Oral dosage forms can be readily radiolabelled with a non-absorbed marker by drill and fill (tablets) or puncture and seal (capsules). The technique does not destroy the integrity of the tablets or capsules and does not interfere with the contact surface.

The study was carried out with the subject seated as (Figure 1). The administration with a minimum amount of water has been previously shown to discriminate between ease of swallowing for different capsules.<sup>1</sup> It is not permissible or desirable to repeatedly dose subjects with radioactivity and therefore the study was divided into two cohorts.

#### Shape

There is clinical evidence that the surface to mass ratio of a tablet may be an important risk factor in esophageal adhesion. One of the first bisphosphonates, alendronate 10mg, which was a round shallow convex tablet was associated with a high incidence of esophagitis. It is presumed that the larger surface area contributed to bioadhesion.<sup>2</sup> To our knowledge; there have been no reported comparison of the larger dosage forms featuring quite modest changes in geometry. It is therefore of interest to compare caplet and capsule shapes and the effect of coatings.

### METHODOLOGY

#### Measurement of Esophageal Transit Using Gamma Scintigraphy

- Capsules vs. caplets; and uncoated vs. coated caplets and oval tablets.
- 48 volunteers
- ODFs were radio labelled with <sup>99</sup>Tc taken with 30 ml water.
- Dynamic scanning was conducted for 10 minutes.
- Images were taken every 0.5 sec for the first 30 seconds and every 15 sec thereafter.
- 30 sec. static image was taken at 30 min. post-dose to confirm formulation was in the stomach.

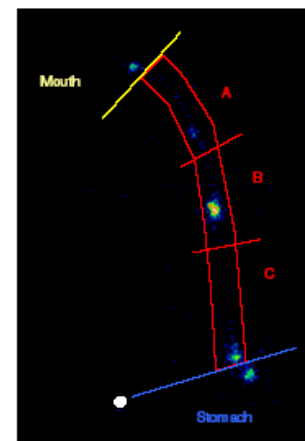
Figure 1



Angle 80°

### Scintigraphic Analysis

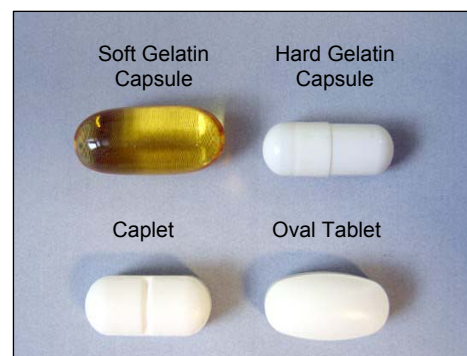
- The total dynamic scan was used to present an overview of the transit time, plus specific areas were noted to show the mouth, esophagus and stomach.
- The esophagus was further divided into 3 Regions of Interest - each representing one third of the esophagus. This was used for further analysis of the dynamic scan.
- Median transit time and the incidence of slow transit (> 15 sec) across evaluable subjects were determined.



Time →

### Oral Dosage Forms Studied

- Hard gelatin capsule: White, opaque, size 0 filled with poloxamer 188.
- Soft gelatin capsule: Commercially available cod liver oil capsules.
- Caplet: placebo
- Oval tablet: placebo
- All dosages weighed ~ 1,000 mg

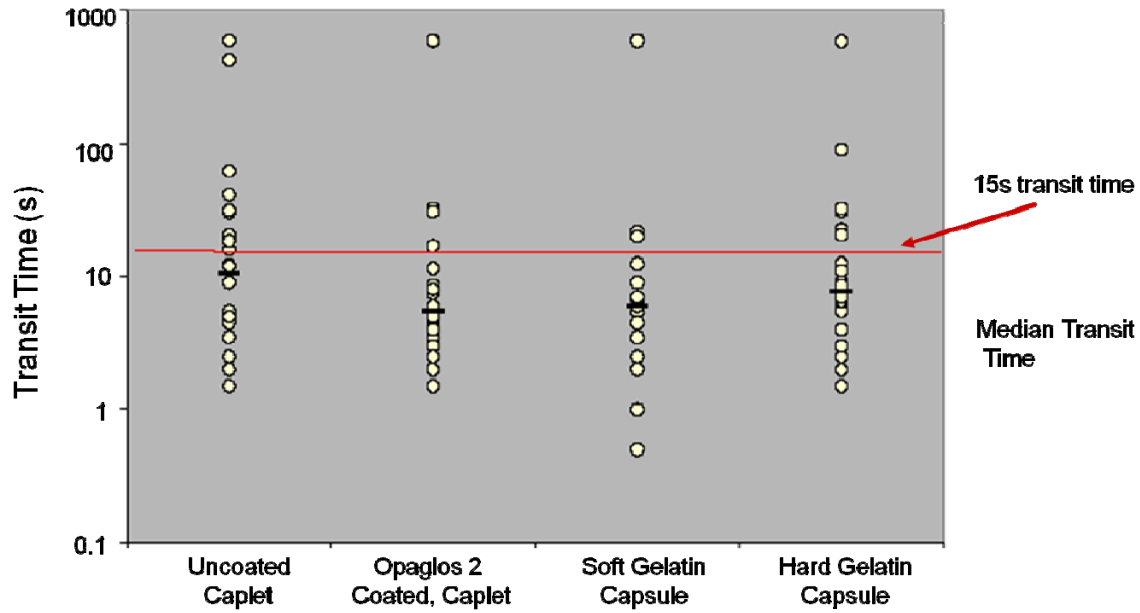


Oval tablets and caplets were either uncoated or coated with one of three clear film coatings (Opadry® 03B19222, Opadry II 85F19250 or Opaglos® 2 97W19196).

### RESULTS

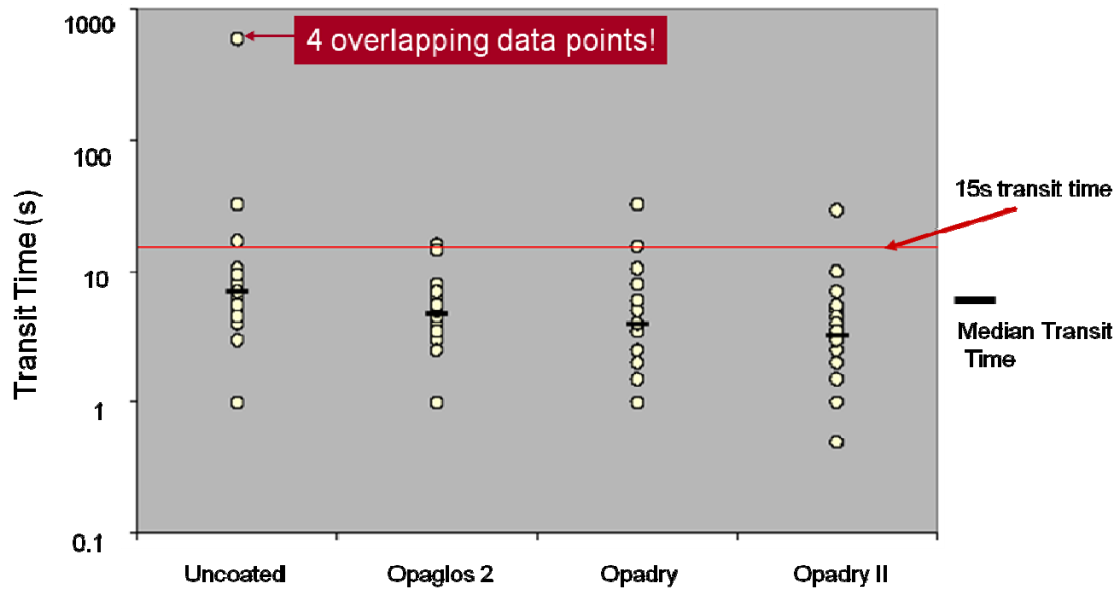
Group	Formulation	Shape	n	Mean Transit (sec.)	Slow Transit (#) (i.e. ≥ 15 sec.)
A	Hard Gelatin	Capsule	23	13.7 ± 18.6	6
A	Soft Gelatin	Capsule	18	6.8 ± 5.8	4
A	Uncoated	Caplet	21	14.7 ± 16.2	9
A	Opaglos® 2	Caplet	19	5.2 ± 3.6	6
B	Uncoated	Oval	19	7.6 ± 6.9	6
B	Opaglos 2	Oval	24	8.1 ± 8.6	1
B	Opadry®	Oval	24	5.8 ± 6.5	2
B	Opadry® II	Oval	24	4.5 ± 5.7	1

**Transit Times for Part A: Capsules and Caplets**



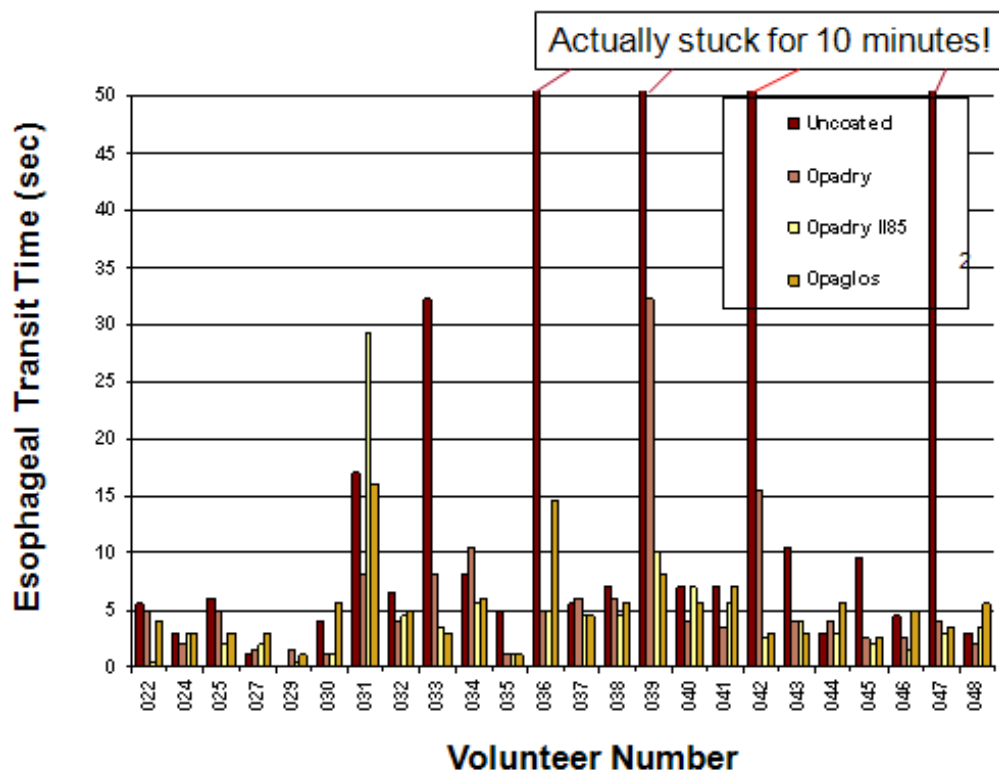
Non-parametric ANOVA showed no significant difference in transit times.

**Transit Times for Part B: Coated and Uncoated Oval Tablets**

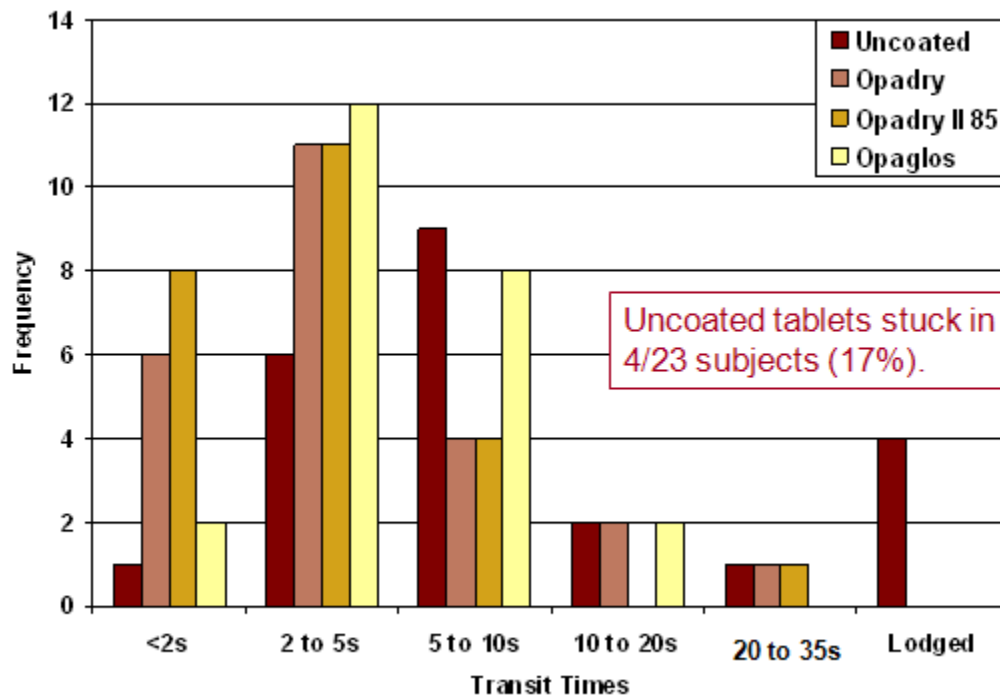


Non-parametric ANOVA showed a significant difference in transit times between uncoated and coated oval tablets as a group.

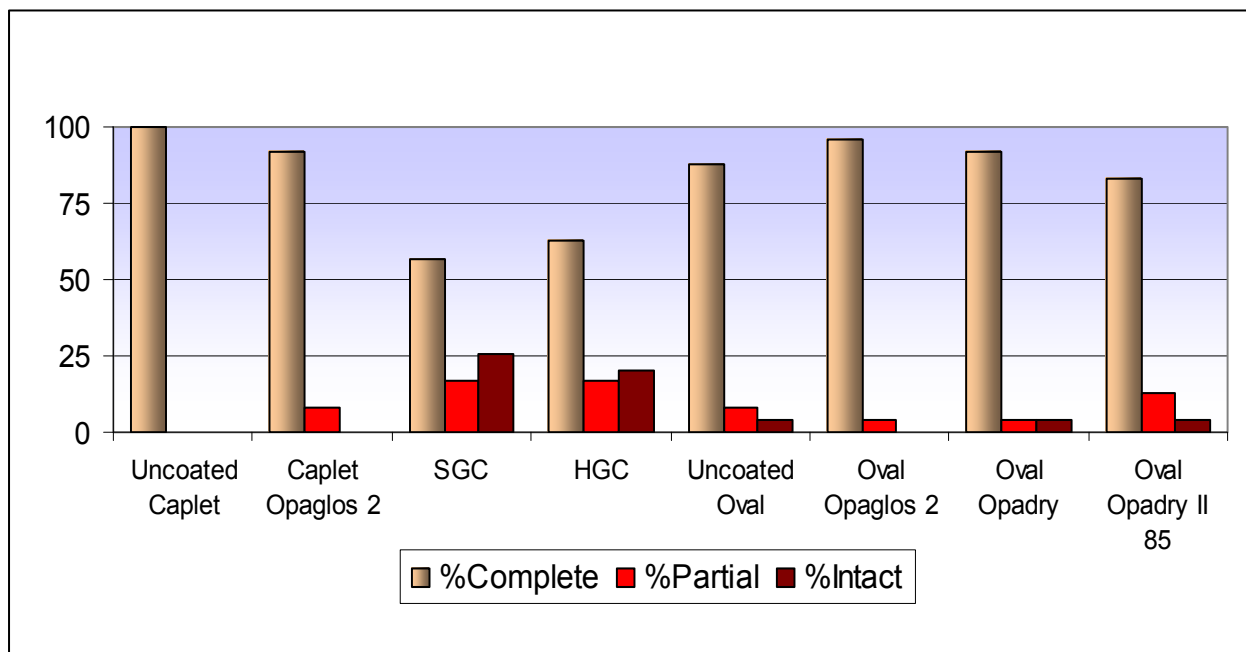
Part B: Individual Subject Data



Part B: Distribution of Total Transit Time



## Extent of Disintegration of Dosage Forms in Stomach, 30 min after Swallowing



## CONCLUSIONS & IMPLICATIONS

Coatings improve the ease of esophageal transit of oval tablets and prevent lodging of oval tablets in the esophagus. Uncoated, oval tablets arrested in the esophagus in 17% of the subjects; whereas, there was no significant sticking of coated, oval tablets in any of the subjects.

- Shape is also a key determinant of transit time: oval shaped tablets had faster transit times and a lower incidence of slow transit (> 15 s) than caplets. It is suggested that caplets have a greater surface area in contact with the esophagus than comparably sized oval tablets, which increases the propensity for caplets to stick.
- Capsules have a greater incidence of disintegration delays. Although the majority of caplets and oval tablets had completely disintegrated at 30 minutes, a significant number of hard gelatin capsules (5 out of 24) and soft gelatin capsules (6 out of 21) were still intact. Dysphagia (or difficulty in swallowing) is associated with many medical conditions including stroke, Parkinson's, AIDS, thyroidectomy, head and neck radiation therapy, and other neurological disorders. This condition is prevalent, and the reported incidences are (3):
  - 35% of the general population
  - 30–40% of elderly institutionalized patients and 18–22% of all persons in long-term care facilities.

In the dysphagic patient who has difficulty swallowing medication, the differences we have observed may be amplified, since dysphagia increases the likelihood of solid oral dosage forms lodging in the esophagus. The adhesion can lead to inflammation and stricture if the drug is a local irritant.

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## REFERENCES

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2. DeGroen, et. al. 1999. N. Eng. J. Med. 335:1016-1021.
3. Sastry S, Nyshadham J and Fix J. 2000. PharmaceuticalScience & Technology Today (Vol. 3, No. 4).

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