



## HYPOTHYROIDISM

### A novel, futuristic method of thyroid hormone treatment

#### BACKGROUND

The thyroid gland is responsible for making the thyroid hormones, T<sub>3</sub> and T<sub>4</sub>. Hypothyroidism, or an underactive thyroid, is a common medical condition that requires replacement of the thyroid hormones. Levothyroxine (synthetic T<sub>4</sub>) is the most commonly prescribed form of thyroid hormone treatment. However, there has been growing interest to understand the risks and benefits of also replacing T<sub>3</sub>, along with T<sub>4</sub>, in patients with hypothyroidism as some patients do not feel well on T<sub>4</sub> alone. Although more data are needed regarding the potential concerns of T<sub>3</sub>, it is thought that approximately 5–7% of T<sub>3</sub> and 93–95% of T<sub>4</sub> may be a safe ratio for those who desire T<sub>3</sub>. Currently, T<sub>3</sub> and T<sub>4</sub> treatments are available as either synthetic or animal-derived formulations. The animal-derived products (desiccated thyroid extract) contain approximately 25% T<sub>3</sub> and 75% T<sub>4</sub> in a single pill. Synthetic T<sub>3</sub> and T<sub>4</sub> are only available as two separate prescription pills.

Thermal inkjet printing is a form of 2D printing which may have interesting uses within the pharmaceutical industry. It can deliver very precise amounts of a one or more substances through the use of a special type of printing. Thus, it can potentially produce a highly personalized combined single pill of synthetic T<sub>4</sub> and T<sub>3</sub> (in any desired ratio of the two thyroid hormones). This study reports the potential use of 2D-printed T<sub>4</sub> and/or T<sub>3</sub> gel films as a novel, futuristic form of personalized thyroid replacement therapy.

#### THE FULL ARTICLE TITLE

Alomari M et al. Printing T<sub>3</sub> and T<sub>4</sub> oral drug combinations as a novel strategy for hypothyroidism. *Int J Pharm* 2018 Jul 29;549(1-2):363-369.

#### SUMMARY OF THE STUDY

This article describes that commonly-used dosages of T<sub>4</sub> and/or T<sub>3</sub> were able to be successfully printed onto gel films. The amounts of actual T<sub>4</sub> and T<sub>3</sub> in the gels were fairly close to those being delivered from the inkjets. The gels contained minimal water, and they were stable up to a very high temperature.

#### WHAT ARE THE IMPLICATIONS OF THIS STUDY?

This is the first study to report how thyroid hormones may be synthetically produced into a single combined T<sub>4</sub>+T<sub>3</sub> pill using 2D printing. This technology has been reported also for a few other medications in the research setting only. This technology is not yet FDA-approved and has yet to be used commercially on a large scale. However, it is an interesting concept and may offer the ability to titrate thyroid hormone replacement therapy very precisely and in a highly-personalized form of medical therapy.

— Angela M. Leung, MD, MSc

#### ATA THYROID BROCHURE LINKS

Hypothyroidism (Underactive): <https://www.thyroid.org/hypothyroidism/>

Thyroid Hormone Treatment: <https://www.thyroid.org/thyroid-hormone-treatment/>





## HYPOTHYROIDISM, continued

### ABBREVIATIONS & DEFINITIONS

**Hypothyroidism:** A condition where the thyroid gland is underactive and doesn't produce enough thyroid hormone. Treatment requires taking thyroid hormone pills.

**Levothyroxine (T<sub>4</sub>):** the major hormone produced by the thyroid gland and available in pill form as Synthroid™, Levoxyl™, Tyrosint™ and generic preparations.

**Thyroid hormone therapy:** patients with hypothyroidism are most often treated with Levothyroxine in order to return their thyroid hormone levels to normal. Replacement therapy means the goal is a TSH in the normal range and is the usual therapy. Suppressive therapy means that the goal is a TSH below the normal range and is used in thyroid cancer patients to prevent growth of any remaining cancer cells.

**Desiccated thyroid extract:** thyroid hormone pill made from animal thyroid glands. Currently desiccated thyroid extract is made from pig thyroids and is available as Armour Thyroid™ and Nature-Throid™.

**Thyroxine (T<sub>4</sub>):** the major hormone produced by the thyroid gland. T<sub>4</sub> gets converted to the active hormone T<sub>3</sub> in various tissues in the body.

**Triiodothyronine (T<sub>3</sub>):** the active thyroid hormone, usually produced from thyroxine.

**Triiodothyronine (T<sub>3</sub>):** the active thyroid hormone, usually produced from thyroxine, available in pill form as Cytomel™.

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