



# MCT Oil Ketogenic Diet for the Management of Epilepsy



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## Disclosures






- Consultant - Nutricia North America as a Keto Ambassador



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## Objectives



-  Describe the MCT oil diet and its history
-  Discover the **benefits of MCT oil diet**, its mechanism and debunk myths
-  **Identify patients** who are ideal candidates for the MCT oil diet for epilepsy
-  **Calculate and implement** an MCT oil meal plan
-  **Discuss** other reasons for using MCT oil

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# 1. MCT oil diet

History

Mode of action



## What is the MCT Oil ketogenic diet?



- Uses substantial amount of medium chain triglycerides (MCT oil)
- Based on percentages of calories vs. ratio's!  
- (ex. 30-60% MCT oil, 10% carb, 12% protein or 2 x RDA, 18-48% fat). Total fat=70-80%\*
- Calories needed based on RDA's or individual nutrition requirements
- No Fluid restriction necessary to achieve ketosis
- No food scale needed if desired; focused on household measures

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## Birth of the MCT oil ketogenic diet



In 1971, Huttenlocher et. al. developed a new form of the ketogenic diet.

The MCT Oil Diet had **an advantage to its predecessor**, the 4:1 Classic ketogenic diet (cKD), because it claimed to be:

As efficacious

Easier to prepare

Less restrictive

More palatable because more carbs and protein were allowed

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## Development of the MCT oil ketogenic diet



Huttenlocher (1971):  
60% MCT oil Diet

Schwartz (1989):  
Radcliffe Diet:  
30-40% MCT, 15% CHO

Trauner/San Diego Team(1994):  
Slightly modifies but  
similar to 30 % MCT oil

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## Modification of the MCT oil ketogenic diet



Similar to The Radcliffe Diet, in 1994 the San Diego Team further modified it:

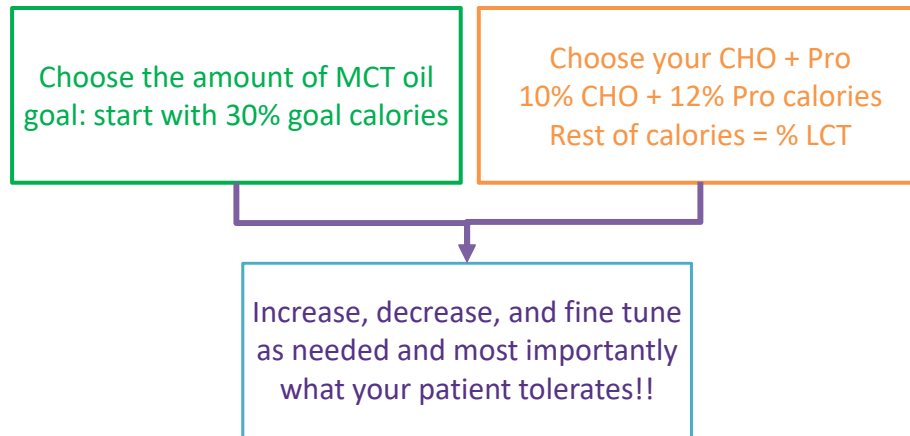
Nutrient	% of caloric intake
MCT oil*	30%
Protein	10-15%
Carbs	5-15%
Long Chain Fats*	45-55%

MCT oil is increased individually to up to 45%, as needed, and as tolerated to higher % during fine tuning stages

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Trauner. Neurology. 1985;35:237

## Another way to look at it:



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## What is MCT oil?



- Medium chain fatty acid esters of glycerol.
- Small water-soluble lipids: 6-12 carbon atoms: C-8 and C-10 (Caprylic and Capric) acids.
- Derived from fractionated coconut oil, palm kernel oil or camphor tree drupes
- Ketogenic – producing acetoacetate and beta-hydroxybutyrate
- Increased ketone production yields more ketones per kilocalorie of energy compared to LCT

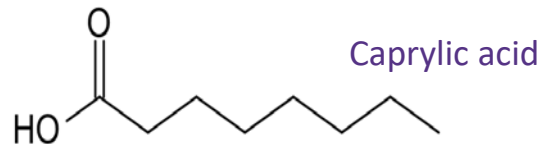


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## What is MCT oil?



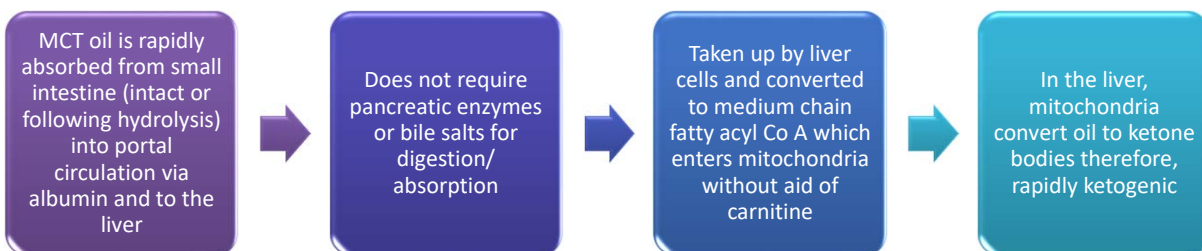
- Bland, tasteless oil
- C-8 = oily liquid
- Nutritionally, it contains no EFA and has a caloric density of 8.3 kcal/g or 7.7 kcal/mL
- Pure MCT Oil brands: ex. (Premium MCT Gold®, NOW®, Nestlé®, etc.)
- Emulsified form: Liquigen® and Betaquik™
- Also found in a powdered form



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## How does MCT oil make ketones quickly?



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## How keto inducing is the MCT oil diet?



### Urine ketone level

- shown to be equal to the cKD diet and increased compared to the LGIT and modified Atkins diet.<sup>1</sup>

### Serum acetoacetate and $\beta$ -OHB levels

- shown to be decreased compared to the cKD diet after 3, 6, and 12 months on diet<sup>2</sup>
- Studies demonstrate a wide range in individual serum acetoacetate and  $\beta$ -OHB values; where some individuals on MCT diet levels exceeded those in the cKD diet.<sup>2</sup>

In my experience, a 30-50% MCT oil diet can achieve a serum  $\beta$ -OHB at levels between 3-6mmol/L or moderate to large on a urine ketone strip.

cKD = Classic KD,  $\beta$ -OHB = Beta-hydroxybutyrate

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1. Liu, et al. Biomed J. 2013;36:9-15.; 2. Neal, et al. Lancet Neurology. 2008;7:500-6.

## 2. Benefits, limitations and myths about the MCT oil diet



## Benefits of MCT oil diet



More carbohydrates:  
~5-10% increased →  
palatability.

More protein: ~10-15%  
from total daily calories  
or 2 X RDA for age

More room for nutrient  
rich foods, including  
fruits, vegetables and  
other “super” foods

Can add 3 mL/TID  
enterally in ICU when  
high carbohydrate  
containing meds  
cannot be decreased

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## Benefits of MCT oil diet



Need fewer  
micronutrient  
supplements.<sup>1</sup>  
Have better growth  
compared to cKD.

Fewer incidents of renal  
stones, hypoglycemia,  
ketoacidosis, low bone  
density and growth  
retardation.

Cholesterol and TG levels  
not as affected as in the  
cKD.

Constipation not as  
common with MCT oil  
Ketogenic diet

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1. Liu. Epilepsia. 2008;49 Suppl 8:33-6.



## Side effects of the MCT oil diet



Too much MCT oil or too quick!



MCT oil should therefore be introduced into the diet gradually



GI symptoms may include:

- abdominal pain/cramping,
- diarrhea,
- irritability
- nausea, vomiting

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Huttenlocher, et al. Neurology. 1971;21:1097-103.; Neal, et al. Lancet Neurology. 2008;7:500-6.  
Liu. Epilepsia. 2008;49 Suppl 8:33-6.; Sucher. Nutrition in Clinical Practice. 1986;1:146-50.

## Limitations of the MCT oil diet



- **Corrosive** to some plastics (g-tube tubing and balloons – necessary to flush tube well with water).
- Regular MCT oil **separates** from most formulas or liquids.
- **LOW smoke point**: Cannot heat or cook with MCT oil like other LCT fats.
- **Fewer dietitians** trained to use the MCT oil ketogenic diet for epilepsy.
- **Less recipes** and resources found for those on MCT oil diet.
- **May be expensive** as not many insurances may cover the MCT oil.

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## Common misconceptions of the MCT oil and ketogenic diets



*“ It is not a healthy diet”*

*“ It is difficult to follow”*

*“ Too much MCT oil can’t be tolerated”*

*“ MCT oil has no EFA’s and may cause EFA deficiency”*

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## MCT oil has no EFA’s: Should I be worried?



- No effect as the MCT oil only comprises about 40% of total calories.
- 20-30% of calories are from other fats including EFA’s.
- If going higher, ~60-70% may need to supplement with EFA (1-2% of total calories).

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## To supplement or not...



- May decrease fat soluble vitamins A and E, and magnesium.
- Assess serum magnesium levels at least once/yr.



Therefore, like all medical ketogenic diets: The MCT oil ketogenic diet must be supplemented with vitamins, minerals and trace elements.

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Christodoulides, et al. J Hum Nutr Diet. 2012;25:16-26.  
Sucher. Nutrition in Clinical Practice. 1986;1:146-50.



*"...Because the higher carbohydrate and protein allowances in the MCT diet may make it more acceptable and suitable for some children to follow, it is important that this protocol is not viewed as inferior on the basis of anecdotal claims.."*

*-- EG Neal 2008*

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### 3. Selecting the ideal candidate



#### Selecting an ideal candidate for the MCT oil diet



Choose MCT  
oil diet for:

Any drug-resistant intractable  
epilepsy condition, Glut-1 or  
PDHD patient

Choose MCT  
oil diet for:

A child or adolescent with a  
larger appetite; or those that  
prefer more carbohydrates

Choose MCT  
oil diet for:

Patients with multiple food  
allergies

## Selecting the ideal candidate for the MCT oil diet



Choose MCT  
oil diet if:

A whole foods or blended diet is  
desired (PO or g-tube fed)

Choose MCT  
oil diet if:

Patient on Classic KD (3:1 or 4:1)  
and desires a more liberal  
approach

Choose MCT  
oil diet if:

Patient prefers to use household  
measures versus a food scale

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## Selecting the ideal candidate for the MCT oil diet



Choose MCT  
oil diet if:

Patient has pre-existing  
hyperlipidemia

Choose MCT  
oil diet if:

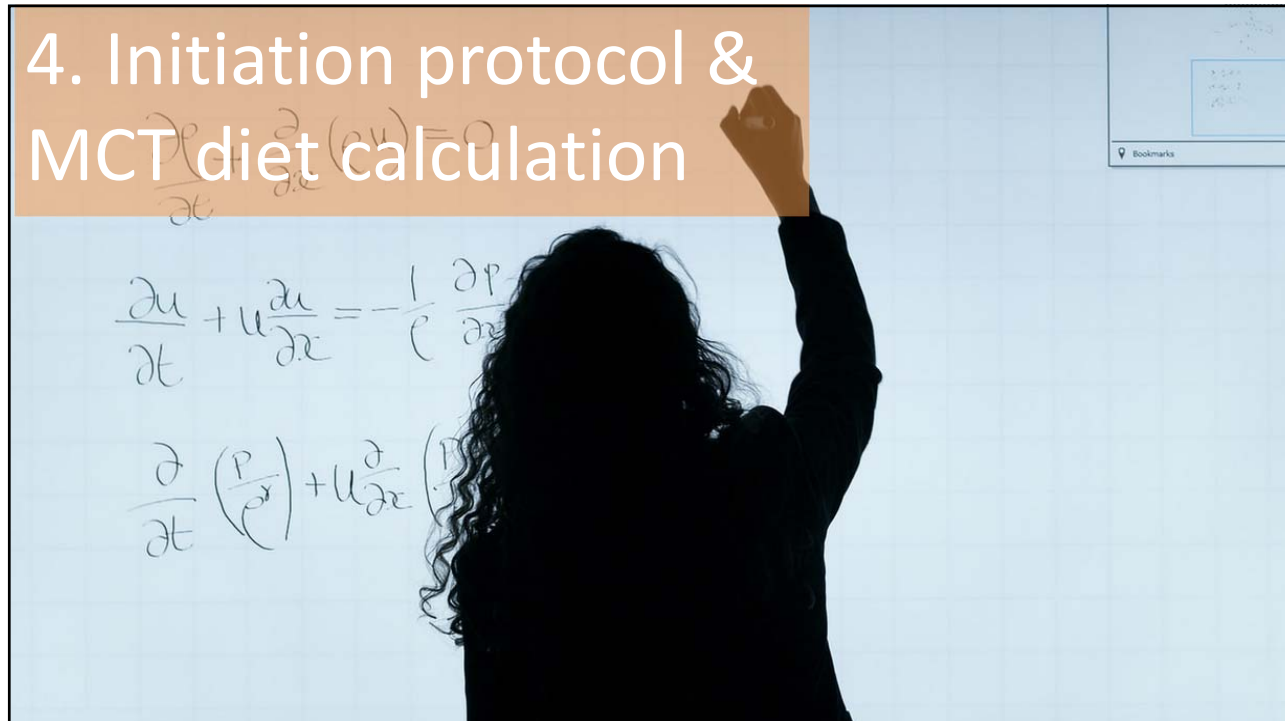
Patient has pre-existing chronic  
constipation

Choose MCT  
oil diet if:

Patient needs a boost in ketones  
or extra calories

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## 4. Initiation protocol & MCT diet calculation



### So WHY even use the MCT oil diet?



- Add more VALUE to what you offer
- Increase client/patient satisfaction
- One size does not fit all approach - Individualize!
- More options provided, more success!
- Innovate!

## Initiation protocols



Will vary from hospital to hospital

Fasting vs. Non-fasting

Inpatient initiation vs. Outpatient

Individualized approach is best!

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## Adding MCT oil – Low and slow for tolerance



### Outpatient: Low and Slow



- 0.25 g/kg/day divided evenly into meals/snacks  
or
- 5-10% of total calories for first week then increase weekly or every 3-5 days.
  - Ex: a 50 kg teen at 1800 kcal/day (30% MCT oil goal = 65 g/day or 21.5 g/meal). Start at 5% kcal = 3.6 g/meal or 4 g/meal.

### Inpatient: more aggressive



- MCT can be started at 0.5 g/kg/day divided into 3 daily doses and can be increased by 1- 1.5 g/kg/day as tolerated.
  - Day 1: Keto shake at 1/3 strength with 1/3 MCT oil on day 1.
  - Day 2: 2/3 strength keto shake increasing MCT oil gradually.
  - When patient able to tolerate full strength formula will transition to solids by day 3-4 with goal MCT oil or as tolerated.

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Neuromuscular Disorders of Infancy, Childhood, and Adolescence. Elsevier; 2014.

## How to calculate an MCT oil diet



Calories	Establish caloric need according to RDA, nutrition status and individual needs.
MCT oil	Provide 30-60% of total calories from MCT oil
Protein	Establish protein needs to meet RDA X 2 (10-15% +)
Carbohydrate	Provide 5-10% of total calories from CHO.
Other fats	Provide remainder calories from other dietary fat source (MCT + fat= 70-80% total fat)
Fluids	Establish fluid goal.

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## Spreadsheet: Calculating an MCT oil diet



- Calorie prescription: \_\_\_\_\_
- \_\_\_ % MCT = \_\_\_ kcal/8.3g = \_\_\_ gm MCT oil/14 = \_\_\_ TBSP + tsp OR \_\_\_ kcal/7.7mL = \_\_\_ mL MCT oil.
- \_\_\_ % CHO = \_\_\_ kcal/4 = \_\_\_ g carb/day
- \_\_\_ % Pro = \_\_\_ kcal/4 = \_\_\_ g pro/day
- \_\_\_ % Fats = \_\_\_ kcal/9 = \_\_\_ g fat/day
- Fluid goal: Holliday-Segar method

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## Not to worry!



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## Ex. 12 year old at 40 kg, healthy PO fed.



- Calorie prescription: 1600 kcal
- 30% MCT = 480 kcal/8.3 g = 57.8 gm MCT oil/14 = 4 TBSP + 0.5 tsp OR 480 kcal/7.7mL = 62.3 mL MCT oil.
- 10% CHO = 160 kcal/4 = 40 g carb/day
- 18% Pro = 288 kcal/4 = 72 g pro/day
- 42% Fats= 672 kcal/9 = 74.6 g fat/day
- Fluid goal: 1500 mL + 20mL/kg x20 = 1900 mL
- Total fats = 72%

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## Making a meal plan – 1600 kcals.



### PER MEAL X 3

	Per meal x 3
MCT oil	20.7 mL
Carbohydrate	13.3 g
Protein	24 g
LCT Fat	24.8 g

Divide macros evenly including MCT oil for each meal.

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## 5. Meal plan examples



## 16 year old case



- 16 year old
- PMH: Seizure disorder, autism, multiple allergies (eggs, dairy, peanuts, corn, soy, pork, shellfish, tomatoes, legumes, peas, kale, etc.)
- Limited oral intake but very good appetite
- Presented on a limited low carb diet
- Needed seizure control, not in ketosis
- RX: MCT oil diet



This photo is representative of a typical patient

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## MCT oil diet applied



- 40% MCT oil diet of 2000 kcals

Per DAY	%	value
MCT oil	40%	104 mL or 96.4 g
Carbohydrate	10%	50 g*
Protein	20%	100 g
LCT Fat	30%	67 g

\*preferably low Glycemic Index

- Increase MCT slowly
- Establish tolerance

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## MCT oil diet for 16 year old meal plan



3 meals + 2 snacks

	Per meal	Per snack
MCT oil	30 mL	6 mL
Carbohydrate	15 g	2.5 g
Protein	28 g	13 g
LCT Fat	20 g	5 g



**Meal ex:** 2 TBSP MCT oil, 1 low-carb tortilla (4 g net carbs) + 1.25 cups raw spinach (1.5 g carb) + 5 TBSP beans or lentils (9.5 g carb) + 4 oz chicken breast + 4 tsp olive oil

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## SAY WHAT? Can you make this easier?



Classic Ketogenic Diet



MCT Ketogenic Diet

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## 11 year old girl



- On classic KD (3:1 ratio) but struggled with further decreasing carbs under 30 g/day.
- Was comfortable at 40 g CHO/day.
- 40 g carb/day on 1500 kcals not possible on a 3:1 ratio goal
- Applying an MCT oil diet approach would help: simply by keeping ratio at 1.5:1 or lower and calculating 30-40% of total calories as MCT oil.

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## 11 year old girl



- Plan → Lower the ratio
1. Calculate macros as percentages
    - 1500 kcal at 1.5:1 ratio
      - 128.5 g fat (77%), 40.71 g protein (11%), 45 g carb (12%)

	%	value
MCT oil	0%	0 mL
Carbohydrate	12%	45 g
Protein	11%	40.71 g
LCT Fat	77%	128.5 g

2. Set an MCT goal 30-40% of calories
  - **2 options:**

1. **Calculate by Full%**

**35%** of 1500 kcal = 525 kcal/8.3 kcal/g = **63.2 g MCT oil/day**, rest is 42% LCT fats = 630 kcals/9 = 70 g fat/day.

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## 11 year old girl



### 2. Divide total fat in ½ to get your MCT total

Take ½ the fat (128.5g/2) and convert to MCT oil = 64.25g X 9 kcal = 578.25 kcal/8.3 = **69.6 g MCT oil/day (38.5%)**

- MACROS Per Day:

Per day	value
MCT oil	69.6 g
Carbohydrate	45 g
Protein	40.7 g
LCT Fat	64.2 g

- Protein can be increased as you lower the ratio, increase MCT, decrease carb, or decrease LCT fat as MCT oil increases.
- Goal: MCT tolerance! Target ketone levels! Patient satisfaction! Seizure control.

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## Meal planning



Divide MCT oil evenly into all daily meals and snacks: start low!!



Use food exchange lists and household measurements, KetoDietCalculator, MyKetoPlanner, keto calculating spreadsheet or other carb counting/keto app and can weigh meals in grams or oz.



All foods and carbs allowed except concentrated sweets and sugars



MCT oil can be used alone, in grilling, baking, blended or in low heat cooking.

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## MCT oil in recipes



- Bland, tasteless oil
- Can be mixed into other fats (MCT mayo or salad dressings).
- Versatile cooking methods: low heat cooking, baking or grilling
- Mixes well with some keto formulas
- Works very well with home blended, whole foods KD
- Emulsified MCT oil: Liquigen® or Betaquik®
  - will mix in well into formulas and any keto drink and also offers additional benefits to the acceptance and palatability of MCT oil itself.
- Most importantly it is as effective as cKD in treating intractable epilepsy!



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## More great reasons for MCT oil



- ✓ Produces more ketones per calorie compared to long chain fats
- ✓ Can be used in all ketogenic diets types (Classic, MAD, LGIT)
- ✓ Increases carbohydrate allotment in the diet
- ✓ May help with bowel regimen
- ✓ Can be used in fat bombs
- ✓ In LGIT, addition of MCT oil can help to transition off to more higher GI carbs
- ✓ Increase adherence by liberalizing carbs/protein
- ✓ Alternative way to transition from cKD to MCT oil Diet
- ✓ Add as supplement when many carb containing meds or supplements are inevitable.

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## More great reasons for MCT oil Diet!



- Individualized approach to diet therapy, offering more diet options: MCT diet, cKD, LGIT and MAD to promote more adherence and patient satisfaction
- If patient is unhappy with current diet switching from one diet to another is a better option than quitting too soon!
- It is easy to switch to an MCT oil diet from LGIT, MAD or cKD-just fit in MCT oil into the diet
- Start by adding MCT oil gradually into the pts current regimen.
  - Add small amount to snack.
- Tolerance: Start small and low

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## Conclusion



The success of any diet is based upon compliance or adherence  
→ MCT medical ketogenic diet can increase adherence and satisfaction

There are now several ketogenic diets effective in the management of intractable epilepsy – let's use them!

MCT oil allows for wider variety of food options → less restrictive diet

Many uses for MCT oil

“One diet does not fit all approach”

An MCT oil diet adds **VALUE** to your practice!  
**OFFER An MCT Oil Diet!**

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