

A RAG Based System for TMD Patient Support

Lalitha Srihitha Prayaga

Introduction:

This assignment implements a Retrieval-Augmented Generation (RAG) pipeline designed to answer patient questions about Temporomandibular Disorders (TMDs). The knowledge base was created by scraping authoritative health information from MedlinePlus, specifically the health topic Temporomandibular Disorders.

Domain:

Medical / Dental: Focused on the temporomandibular joints (TMJs), related disorders, causes, symptoms, diagnosis, and treatments.

Audience: Patients and public seeking concise, evidence-based answers without medical jargon.

The scraped content includes

- Definitions and classifications of TMDs.
- Causes, risk factors, and prevalence statistics.
- Symptoms and diagnostic approaches.
- Treatment options, both conservative and surgical.
- Warnings about possible complications and the need for specialist consultation.

The dataset is stored locally in Markdown format and used as the sole source of truth for the RAG pipeline.

1. Approach:**Retrieval Process**

Data Collection: Content was scraped from the MedlinePlus TMDs page using requests library to get the webpage content and beautiful soup4 was employed to parse and extract necessary information. Markitdown converted the HTML content to markdown format.

Text Chunking: The scraped text was split into overlapping chunks to optimize retrieval accuracy.

Embedding Generation: Each chunk was embedded using the mxbai-embed-large model from Ollama, producing high-dimensional vectors representing semantic meaning.

Vector Storage: Embeddings were stored in a persistent ChromaDB vector database for fast semantic search.

Generation Process

Query Input: A user enters a question in natural language (e.g., “What are the main symptoms of TMD?”).

Relevant Chunk Retrieval: The query is embedded and compared to stored embeddings to retrieve the top-k relevant chunks.

Prompt Construction: Retrieved chunks are inserted inside <EXCERPT></EXCERPT> tags and passed to the phi3: latest LLM in Ollama with a custom system prompt that ensures only provided information is used.

Answer Generation: The LLM generates a concise, evidence-based response limited to the retrieved excerpt content.

2) Examples:

I have provided with 10 questions:

- "Why does my jaw click and hurt when I chew?",
- "What's the most likely reason I'm having this jaw pain?",
- "Does putting ice or heat on the side of my jaw help? Which should I try first?",
- "What pain reliever can I buy without a prescription for quick relief right now?",
- "Should I try not to yawn wide or open my mouth big?",
- "What signs should I watch for that mean my jaw problem is getting worse?",
- "What can I do at home today to calm the pain (soft foods, gentle jaw moves, rest)?",
- "Could stress or clenching my teeth be causing this?",
- "Do night guards or mouth splints really help with jaw pain?",
- "Do people usually need surgery for this, or does it get better with simple treatments?"

It gave accurate answer to the questions which it knows and incomplete or partial answers for the questions which it didn't know. This is that **question: "What's the most likely reason I'm having this jaw pain?", Answer: "I don't know based on the given information, I will need some more information to give an accurate answer. Temporomandibular disorders (TMD) can be caused by a variety of factors including genetics, psychological and life stressors, as well as how someone perceives pain. Without additional details about your symptoms or medical history, it's challenging to**

pinpoint the exact reason for your jaw pain. If you suspect TMD due to these common causes, I recommend consulting with a healthcare provider who can perform a thorough examination and possibly order imaging studies like an x-ray, MRI, or CT scan if needed. They will be able to provide a more accurate diagnosis based on your specific situation.”
Refer Appendix for all the Q/A.

3) Reflections:

Without RAG, phi3\ latest answers only from what it learned during training, which might be outdated or not fully reliable. This can cause it to give guesses, off-topic replies, or explanations that aren't always clear and evidence-based for patients. With RAG, it uses only trusted MedlinePlus information. If it doesn't have an answer, it says so clearly. This makes the responses shorter, easier to understand, accurate, and in line with trusted health guidelines.

Key Insight:

RAG significantly reduces hallucinations and ensures all medical responses are source-verified. However, its scope is limited to the coverage of the underlying knowledge base meaning that expanding or updating the scraped data directly improves system performance.

References

National Institute of Dental and Craniofacial Research. (2024, May 7).

Temporomandibular disorders. *MedlinePlus*. U.S. Department of Health and Human Services, National Institutes of Health.

<https://medlineplus.gov/temporomandibulardisorders.html>

APPENDIX

QUESTION: Why does my jaw click and hurt when I chew?

ANSWER:

Answer: The clicking sound you hear from your jaw while chewing is often due to a temporomandibular joint (TMJ) disorder, which affects the muscles that control jaw movement. This can lead to pain in the chewing muscles and/or jaw joint when opening or closing your mouth. It's important to consult with a healthcare provider for an accurate diagnosis and appropriate treatment plan.

=====

QUESTION: What's the most likely reason I'm having this jaw pain?

ANSWER:

I don't know based on the given information, I will need some more information to give an accurate answer. Temporomandibular disorders (TMD) can be caused by a variety of factors including genetics, psychological and life stressors, as well as how someone perceives pain. Without additional details about your symptoms or medical history, it's challenging to pinpoint the exact reason for your jaw pain. If you suspect TMD due to these common causes, I recommend consulting with a healthcare provider who can perform a thorough examination and possibly order imaging studies like an x-ray, MRI, or CT scan if needed. They will be able to provide a more accurate diagnosis based on your specific situation.

=====

QUESTION: Does putting ice or heat on the side of my jaw help? Which should I try first?

ANSWER:

Answer: Applying cold to your face can temporarily relieve pain by reducing inflammation, while applying warmth may relax tight muscles. It's common for patients and providers to alternate between ice and heat or use them simultaneously as part of a self-care routine. However, if you have not been advised specifically on this matter in your treatment plan, it is best to start with the method that has provided relief before—either cold or warmth can be tried first based on personal preference for pain management during flare-ups. Always ensure any application of heat does not exacerbate symptoms and consult a healthcare provider if you're unsure about using these methods safely, especially since TMD treatments are individualized to each patient's condition.

QUESTION: What pain reliever can I buy without a prescription for quick relief right now?

ANSWER:

Answer: Over-the-counter nonsteroidal anti-inflammatory drugs (NSAIDs) like ibuprofen are commonly used to provide fast and effective pain relief. They work by reducing inflammation, which can help alleviate the discomfort associated with temporomandibular joint dysfunction or TMD symptoms. However, it's important to follow the dosage instructions on the package and consult your healthcare provider if you have any underlying medical conditions or are taking other medications.

=====

QUESTION: Should I try not to yawn wide or open my mouth big?

ANSWER:

Answer: Yes, it is often recommended for individuals with temporomandibular disorders (TMDs) to avoid yawning widely and keeping the jaw closed as much as possible. This can help reduce strain on the jaw joint and muscles associated with TMD symptoms.

=====

QUESTION: What signs should I watch for that mean my jaw problem is getting worse?

ANSWER:

Answer: Signs indicating your temporomandibular disorder (TMD) may be worsening include increased pain in the chewing muscles and/or jaw joint, more frequent or severe episodes of stiffness limiting movement or locking of the jaw, heightened levels of uncomfortable clicking or popping sounds when opening or closing your mouth that are not alleviated by over-the-counter pain relievers like ibuprofen. Additionally, if you start experiencing new symptoms such as tinnitus (ringing in the ears), hearing loss, dizziness, changes in how upper and lower teeth fit together when biting down on foods or objects that were previously comfortable for chewing, these could also suggest a worsening of your condition. It's crucial to consult with your healthcare provider if you notice any significant escalation in symptoms so they can reassess your treatment plan and make necessary adjustments.

=====

=====

QUESTION: What can I do at home today to calm the pain (soft foods, gentle jaw moves, rest)?

ANSWER:

Answer: To help manage your TMD pain at home today, consider following these steps. Start by eating soft foods that require minimal chewing and are easy on your jaw muscles, such as yogurt, mashed potatoes, or oatmeal with added milk for consistency. Avoid hard, crunchy, or chewy items like nuts, chips, and raw vegetables to prevent strain. Gently stretching and moving your jaw can also promote relaxation; try opening and closing your mouth slowly without causing pain. If you're experiencing any discomfort or if the exercises feel too intense, take breaks as needed to rest your muscles. Remember not to clench your jaw tightly during these activities; instead, focus on gentle movements and relaxation techniques like deep breathing to help ease tension in your face and neck area.

=====

QUESTION: Could stress or clenching my teeth be causing this?

ANSWER:

Answer: Yes, psychological factors such as stress and behaviors like jaw clenching can contribute to the development of temporomandibular disorders (TMDs). These activities may lead to muscle tension and strain in the jaw area, which over time could result in TMD symptoms.

=====

QUESTION: Do night guards or mouth splints really help with jaw pain?

ANSWER:

Answer: Night guards and mouth splints may provide some relief for individuals experiencing temporomandibular disorder (TMD) symptoms, but their effectiveness can vary from person to person. According to the provided text on treatments for TMDs, while these devices are commonly used by patients with jaw pain:

* They should not be designed to permanently change your bite or cause further issues in your mouth's alignment and functioning (as mentioned under "An intraoral appliance").

* It is important that the patient inform their provider if using a night guard worsens their symptoms. This suggests monitoring by healthcare professionals can help determine whether these devices are beneficial for an individual case of TMD pain relief or not.

=====

QUESTION: Do people usually need surgery for this, or does it get better with simple treatments?

ANSWER:

Answer: Many cases of temporomandibular disorders (TMDs) can be managed and improve without the need for surgery. Initial treatment often includes eating soft foods, applying heat or cold to alleviate pain, doing gentle jaw exercises, taking over-the-counter NSAIDs like ibuprofen for pain relief, and avoiding activities that strain the jaw such as clenching, chewing gum, and nail biting. If these measures do not provide sufficient relief, healthcare providers may suggest additional treatments which can include physical therapy to strengthen and stretch the jaw muscles or cognitive behavioral therapy (CBT) for stress management related to TMD symptoms. In some cases where conservative treatment fails, surgery might be considered as a last resort after thorough evaluation by specialists in treating TMDs.