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The Effect of OMT on Abdominal and Thoracic Motion and Its Potential Impact on Liver Health in MASLD/MASH

Jenny Lu OMS-IV, Yue Jiao Jiang OMS-IV, Raul Franco Jr. OMS-IV, Anh Nguyen OMS-IV, Mark Szkolnicki OMS-IV, Grace Williams OMS-IV, Ha Young Cho OMS-IV, and Mikhail Volokitin DO.

Touro College of Osteopathic Medicine, Harlem

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Abstract

Metabolic dysfunction-associated steatotic liver disease (MASLD) and metabolic dysfunction-associated steatohepatitis (MASH) are increasingly prevalent conditions that can lead to liver dysfunction, inflammation, and fibrosis. While traditional treatments focus on lifestyle modification and pharmacologic interventions, osteopathic manipulative treatment (OMT) offers a unique approach to improving physiological function through enhancing mobility and circulation. This literature review explores the potential role of OMT in improving thoracoabdominal motion and its subsequent impact on liver health, specifically in patients with MASLD and MASH.

OMT techniques such as diaphragmatic release, rib raising, and thoracic spine mobilization have been shown to enhance diaphragmatic function, venous return, and lymphatic drainage, all of which are crucial for maintaining optimal liver perfusion and reducing congestion. By improving thoracic and abdominal mobility, OMT may indirectly benefit liver function by promoting better circulation, reducing fluid buildup, and decreasing systemic inflammation. Although limited studies exist directly linking OMT to liver health, this review synthesizes existing research on OMT's effects on thoracoabdominal mobility and explores the theoretical mechanisms through which these benefits could be extended to liver function in MASLD/MASH patients. Further research is needed to evaluate the clinical impact of OMT on liver disease outcomes. Still, the physiological rationale provides a promising area for future investigation in osteopathic and liver health care.

***Corresponding author:** Jenny Lu OMS, Touro College of Osteopathic Medicine, Harlem, New York, USA.

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Introduction

Metabolic dysfunction-associated steatotic liver disease (MASLD) is characterized by steatosis in more than 5% of hepatocytes in individuals with metabolic risk factors, such as obesity and type 2 diabetes mellitus, in the absence of excessive alcohol consumption

(≥30g/day for men, ≥20g/day for women). Histologically, MASLD is indistinguishable from alcoholic fatty liver disease, with the key differentiating factor being the absence of significant alcohol intake [1].

MASLD encompasses a spectrum of liver disease, ranging from simple hepatic steatosis to its more severe form, metabolic dysfunction-associated steatohepatitis (MASH). MASH is characterized by necroinflammation and a more rapid progression of fibrosis compared to milder forms of MASLD. Interest in the progression, diagnosis, management, and treatment of MASLD and MASH has grown exponentially in recent years, as MASLD has become the most common chronic liver disorder. It is now a leading cause of liver-related mortality worldwide, with the potential to progress to cirrhosis, hepatocellular carcinoma, and the need for liver transplantation. Additionally, MASLD is closely linked to metabolic syndrome and type 2 diabetes mellitus, conditions that are rising in prevalence in the U.S [1].

The global prevalence of MASLD varies. In the U.S., estimates range from 25.6% to 31.3%, based on data from the National Health and Nutrition Examination Survey (NHANES) [2].

While the exact mechanisms underlying MASLD and its progression to MASH remain unclear, it is believed to result from a combination of genetic and environmental factors. Current theories center on variations of the "two-hit hypothesis," which suggest that excessive dietary intake of fats and sugars contributes to increased fatty acid release from adipose tissue and de novo lipogenesis in the liver. These metabolic disruptions activate pathways that lead to cellular injury and inflammation. The resulting hepatic inflammation contributes to hepatocellular damage and fibrosis, driving the progression from MASLD to MASH [3,6].

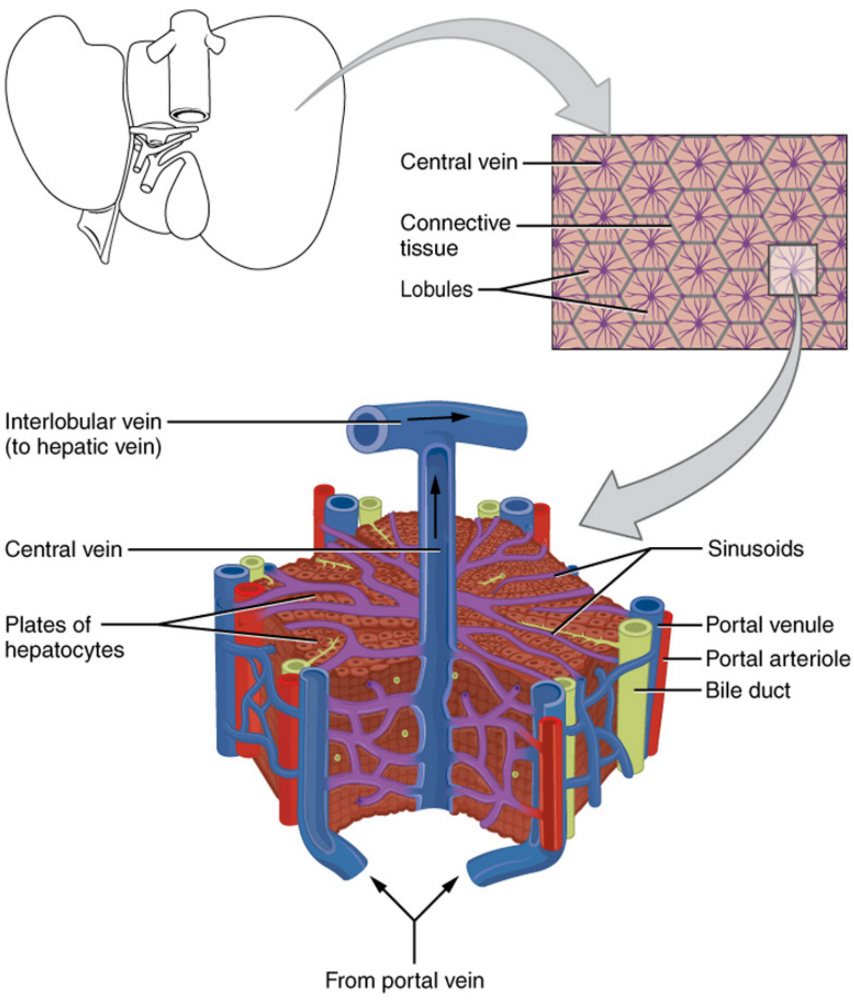


Figure 1: This figure is a structure of a healthy liver lobule. Reference:

Mechanisms of Thoracoabdominal Motion in Liver Function

Current management of MASH and the more severe form of MASLD is managed mainly through diet and weight management, there is no current FDA-approved medication therapy for MASH or MASLD. Pharmacological treatments are in the process of being used to lessen the effects of MASH and MASLD, however, all are still under consideration [3]. Thus, it would be of interest to explore other avenues of therapy to optimize the management of therapies in hopes of decreasing the likelihood of the progression of MASLD to MASH. This is a significant thing to consider, especially given the increasing prevalence of MASLD in the context of increasing rates of end-stage liver disease, liver cancer, metabolic syndrome, and type 2 diabetes mellitus. An example of another avenue that has yet to be explored in patients with MASLD and MASH is the effect of osteopathic manipulative treatment (OMT).

Osteopathic manipulative treatment or osteopathic manipulative medicine, or as commonly abbreviated as OMT, is widely used by osteopathic physicians to improve movement, circulation, and function which may help relax muscles, enhance blood flow, and enhance lymphatic flow [4]. While current literature and patient accounts illustrate the improvement of symptoms and improvement of chronic disease with the help of OMT, there has been minimal literature on the effects of OMT within the context of liver diseases such as MASLD and MASH. The relationship between the liver and thoracic and abdominal mobility has not been explored in depth yet. On its own, there has been literature illustrating the impact of OMT techniques on improving thoracic and abdominal mobility through techniques such as rib raising, diaphragmatic release, liver pump and thoracic/lumbar spinal manipulation. Improvement of thoracic and abdominal mobility consequently improves overall circulation and organ function [4]. For this reason, researchers hypothesize that OMT techniques that improve thoracoabdominal motion may enhance liver health by optimizing circulation and function in patients with MASLD/MASH patients.

In order to establish the connection between thoracoabdominal motion and liver health, the role of the diaphragm in facilitating venous return must be explored The diaphragm is the primary respiratory muscle that acts as a natural pump that aids in venous blood flow. A pressure gradient is created during inhalation and this encourages venous blood flow from abdominal organs, such as the liver, towards the heart. Specifically, the portal vein, which carries blood from digestive organs to the liver, partially relies on the pressure gradient created by the diaphragm in order to maintain adequate blood flow. Thus, the rhythms of the diaphragm's contraction and relaxation play an essential role in optimizing blood circulation to the liver in order to ensure that it receives its supply of oxygen and nutrients. For this reason, it is hypothesized that impaired thoracoabdominal motion and impaired diaphragmatic motion may be a potential contributor to liver congestion and may further exacerbate the progression of MASLD to MASH [5-7].

For individuals with conditions like MASLD or MASH, impaired diaphragmatic movement, from factors like obesity or poor posture, can lead to reduced venous return, contributing to blood congestion in the liver and worsening hepatic perfusion issues [5-7]. In other words, factors of obesity and poor posture may limit mobility in the rib cage and thoracic spine, which may then consequently affect the function of organs such as the liver. Within the context of osteopathic medicine, the aforementioned may apply to patients with thoracic, lumbar and/or rib somatic restrictions. Techniques like diaphragmatic breathing exercises, rib raising, and thoracic mobilization are often recommended to improve diaphragmatic function and, in turn, venous return and liver perfusion [4,5,7]. These techniques may be beneficial for MASLD/MASH patients, as they enhance circulation and help alleviate liver congestion, which is associated with improved liver health and function. By supporting venous return, the diaphragm's movement contributes significantly to hepatic circulation, helping the liver maintain its vital roles in detoxification, metabolism, and immune regulation. This makes diaphragmatic function an important focus for therapies aimed at improving liver health.

OMT Techniques for Improving Thoracoabdominal Mobility

Rib Raising

Rib raising is an osteopathic manipulative treatment (OMT) that enhances thoracic mobility and influences autonomic function. This technique involves gently lifting and rotating the rib heads while maintaining fascial attachments. With the patient in a supine position, the physician applies rhythmic ventral pressure at the costotransverse junctions to elevate the ribs, targeting the sympathetic chain ganglia to improve mobility and alleviate somatic dysfunction [8].

Beyond musculoskeletal benefits, rib raising modulates the autonomic nervous system and supports venous and lymphatic circulation. By increasing rib mobility, it helps regulate sympathetic nervous system activity, reducing inflammation and restoring autonomic balance. Because sympathetic signaling influences the liver, rib raising may benefit patients with metabolic dysfunction-associated steatotic liver disease (MASLD) and metabolic dysfunction-associated steatohepatitis (MASH) [9].

Improved rib mobility optimizes diaphragmatic movement, enhancing venous and lymphatic circulation. This reduces hepatic congestion and may slow MASLD and MASH progression. Effective diaphragmatic motion facilitates lymphatic and venous drainage, alleviating hepatic stasis—an important factor in liver disease pathophysiology [8,9].

The liver receives sympathetic innervation from the celiac plexus, influenced by thoracic spinal segments T6-T9. Increased sympathetic activity contributes to MASLD and MASH progression by promoting hepatic steatosis, inflammation, and fibrosis. Chronic sympathetic overactivity has been linked to increased triglyceride accumulation and structural nerve alterations impairing liver function [10]. By reducing sympathetic outflow, rib raising may help decrease hepatic triglyceride accumulation and improve liver function, though direct clinical evidence remains limited.

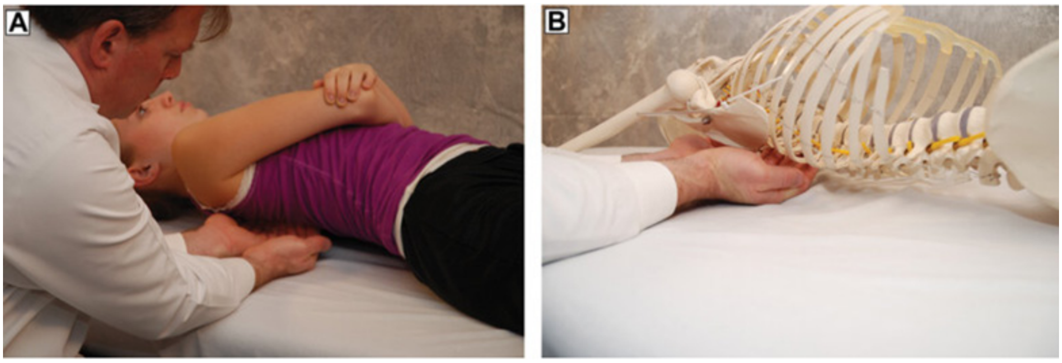


Figure 2: Rib raising in bedridden patient

Diaphragmatic Release

Diaphragmatic release is another OMT technique focused on improving the diaphragm's mobility and function. The technique enhances respiratory efficiency, promotes venous return from the lower body, and supports lymphatic drainage. The procedure is performed with the patient in a supine or upright position. The physician applies gentle pressure superiorly under the lower thoracic cage, synchronizing with the patient's breathing cycle to release diaphragmatic restrictions [11].

When diaphragmatic movement is unrestricted, the pressure differential generated by the diaphragm during breathing enhances venous and lymphatic return. This pressure differential helps prevent hepatic congestion, reducing the risk of MASLD and MASH. The diaphragm's action promotes the forward movement of fluids from the lower extremities, mitigating congestion of inflammatory mediators and metabolic waste, which are contributors to liver dysfunction. Enhanced diaphragmatic function also influences the liver and adjacent abdominal organs. The rhythmic pressure created by the diaphragm's motion can decrease hepatic stasis, thereby minimizing the inflammatory processes associated with liver diseases. Such mechanical facilitation of circulation is essential in managing liver health and function [12,13].

Liver Pump

The liver pump is an OMT technique aimed at promoting venous and lymphatic circulation through the liver while reducing congestion. The practitioner rhythmically compresses and releases the liver area in coordination with the patient's breathing. This technique enhances lymph formation and reduces edema, thereby improving cellular nutrition and liver function [14]. Liver manipulation through pumping techniques can relieve fascial restrictions, decrease inflammation, and enhance liver mobility. These benefits can ameliorate conditions like right upper quadrant pain and digestive symptoms, such as constipation, which are often associated with hepatic dysfunction. The enhanced blood and lymphatic flow can also support detoxification processes and liver regeneration, making OMT a valuable adjunctive therapy for managing MASLD and MASH [15].

Potential Impact of Improved Motion on Liver Health in MASLD/MASH

Reduction of Inflammation through OMT techniques like rib raising, diaphragmatic release, and liver pumping have shown the potential to reduce systemic inflammation. Studies on fibroblast activity indicate that mechanical strains, similar to those used in OMT, can modulate the release of inflammatory mediators, offering therapeutic benefits for chronic inflammatory diseases. By targeting the autonomic and lymphatic systems, OMT can provide a holistic approach to managing liver health and preventing the progression of conditions like MASLD and MASH [16].

Existing Literature Supporting OMT in Abdominal and Thoracic Function

The lymphatic system plays a crucial role in maintaining organ health in the human body. In healthy individuals, the lymphatic system collects the excess interstitial fluid that accumulates around cells and tissues and filters it back into the bloodstream. When the lymphatic system is not working properly, it can lead to edema, which in turn impairs cellular function limiting nutrient and oxygen exchange. The lymphatic system also participates in immune surveillance and pathogen clearance, metabolic waste and toxin removal, and regulation of inflammatory responses. The hindrance of any of those aspects of the system can lead to poor organ health [17].

Osteopathic manipulative treatment (OMT) is shown to enhance lymphatic flow and circulation, which can support systemic health by promoting the movement of fluids and waste products. Techniques such as lymphatic pump, rib raising, and thoracic mobilization work by creating rhythmic pressure changes that help move lymphatic fluid, aiding in toxin clearance and reducing congestion. By supporting the drainage of excess interstitial fluid back into the circulation, there is reduced edema and improved functions of organs. We also see an increase in immune surveillance and toxin/waste removal. This regulation of our inflammatory and immune response leads to better overall health [17-19].

Chronic Inflammatory Disease (CID) refers to a group of disorders characterized by persistent, long-term inflammation in the body. Over time, this sustained inflammatory response can lead to tissue damage and impact various organ systems. Improving abdominal and thoracic mobility provides benefits such as enhanced respiratory function leading to better lung expansion as well as diaphragmatic movement. Osteopathic techniques have been shown to be statistically significant in acutely increasing diaphragmatic mobility and motion in healthy volunteers [19,20].

There is also some evidence showing an immediate increase in peak expiratory flow (PEF) in healthy individuals. These studies show that OMT has beneficial effects in acutely improving respiratory function via diaphragmatic mobility increases as well as peak expiratory flow. These benefits were seen not only in healthy individuals but those suffering from chronic illnesses; OMT was shown to provide improvement in patients with chronic obstructive pulmonary disease (COPD). In a study done with 20 stable COPD patients, exercise capacity during a six-minute walk test was measured by comparing OMT and pulmonary rehab vs soft touch and pulmonary rehab. Improvement was noted in both with a larger increase in the OMT group. There was also a noted increase in forced expiratory volume in 1 second (FEV1) and a decrease in residual volume in the OMT group [16,21]. This yet again showcased the acute benefit of OMT in improving thoracic mobility with a subsequent effect on respiratory function.

A study published on peripheral arterial disease (PAD) showcased whether six months of OMT, in combination with lifestyle modifications and pharmacological therapy, would improve endothelial function and functional performance in patients with PAD and intermittent claudication. The only significant changes noted were in the OMT group, which also saw significantly improved health scores (p <0.05). OMT was also effective at increasing brachial blood flow and stimulating the vagal system in patients with heart failure, showing a greater flow-mediated dilation (FMD) and peak diameter at the brachial artery in those who received a single session of OMT. This shows us that OMT has the potential of inducing a positive acute and time course vascular effect [16,21,22].

OMT was also shown to be effective in patients suffering from irritable bowel syndrome (IBS). A reported reduction in abdominal distention and abdominal pain as well as significant improvement in self-reported diarrhea was noted amongst 30 patients affected by IBS. In another study across six months, there was a significant decrease in functional bowel disorder severity index in an OMT group compared with the standard care group [16,22].

The complexity of chronic diseases varies drastically; while OMT has potential proven benefits in other chronic diseases, there is little research done on the benefits of OMT on liver cirrhosis. Liver cirrhosis is a chronic liver disease with a complex list of causes that vary by demographic. In the Western world, the most common etiologies are alcoholism, viral hepatitis, and, increasingly, metabolic dysfunction-associated steatotic liver disease (MASLD) accounting for close to 30% of cases [23]. Cirrhosis is the 10th leading cause of death in the United States with 54,803 reported deaths in 2022 (FastStats - Leading Causes of Death, 2022); death rates vary by state but generally fall between 6-20 per 100,000. Cirrhosis is a major risk factor for the development of hepatocellular carcinoma, and this incidence was noted to have tripled from 1975 to 2005 [24-26].

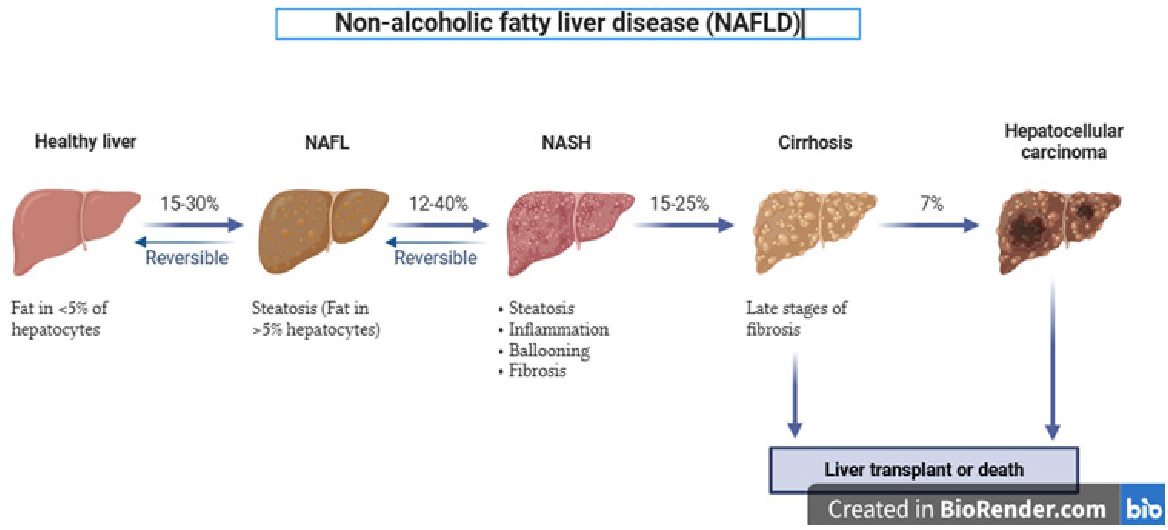


Figure 3: The non-alcoholic fatty liver disease (NAFLD) spectrum represents a progressive liver disease beginning with a healthy liver and advancing through several stages as depicted in reference [23-26]. Image created with BioRender.com.

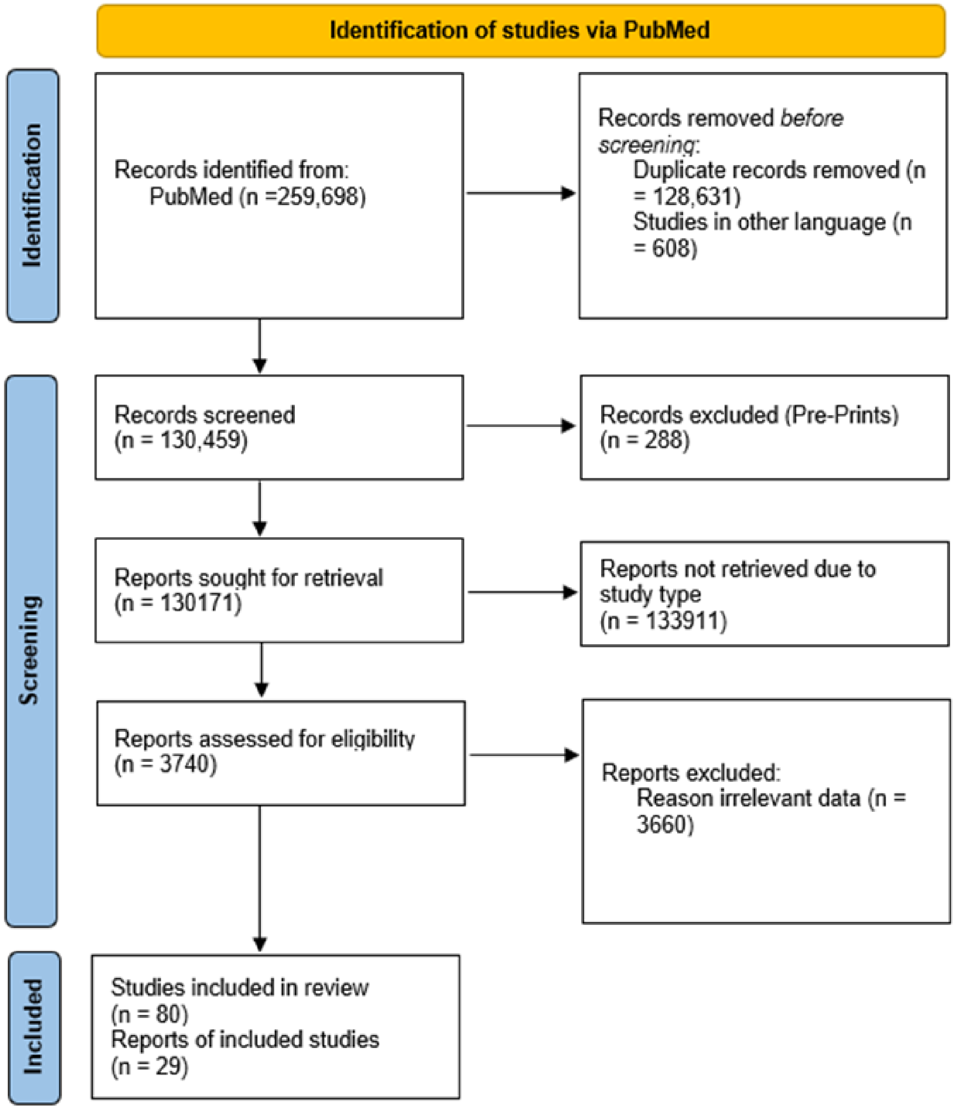
Liver cirrhosis is characterized by the progressive degeneration and necrosis of healthy liver tissue with fibrotic tissue leading to impaired liver function. This process occurs as a result of long-term, repeated liver damage. Over time, as healthy liver cells are damaged and replaced with fibrotic tissue, the liver becomes unable to regenerate effectively. This fibrosis is a pathological process in the evolution of chronic liver diseases to cirrhosis. As cirrhosis progresses, complications arise from the liver's reduced ability to process nutrients, toxins, and drugs. This process also leads to a disruption in blood flow through the liver, contributing to complications such as portal hypertension. In response to portal hypertension, there is a systemic release of hormones leading to vasodilation, particularly in abdominal circulation. This can result in reduced blood flow to organs as well as circulatory dysfunction. This can eventually lead to the formation of varices in areas such as the esophagus, rectum, and stomach that can rupture and cause life-threatening bleeding. Portal hypertension can affect the spleen, causing splenomegaly and leading to hematological issues. Cirrhosis disrupts the production of albumin, causing fluid regulation issues, particularly fluid leaking from blood vessels into the abdominal cavity, leading to ascites. This can result in breathing difficulties due to pressure on the diaphragm [27].

In advanced cases, cirrhosis can lead to liver failure or liver cancer, making early diagnosis and management essential. Current treatment focuses on addressing the underlying cause and managing symptoms to slow progression to avoid the most extreme of remedies, a liver transplant. By facilitating circulation through techniques that reduce thoracic and abdominal congestion, OMT may indirectly alleviate some of the circulatory burden associated with cirrhosis. This treatment could potentially aid in managing conditions such as ascites and the effects of portal hypertension, enhancing hepatic perfusion and reducing the strain on compromised liver tissue. OMT has been shown to augment lymphatic flow, which can improve circulation and potentially improve immune response. Additionally, the liver itself produces a substantial amount of lymph, contributing between 25% and 50% of lymph flow through the thoracic duct, which suggests that improved lymphatic drainage through OMT may directly benefit hepatic function by alleviating congestion and supporting detoxification processes. This can be supplemented by working on improving abdominal and thoracic mobility, which has been shown to aid in other chronic diseases, demonstrating a direct benefit of OMT in circulation as well as respiration and improving organ function and dysfunction, making it a viable treatment option to reduce the effects of liver cirrhosis.

Methods

This literature review involved a systematic search of English-language articles with full-text accessibility, sourced from databases such as Scopus, NIH, PubMed, and Google Scholar. The search was restricted to publications from the year 2000 onward. The primary objective was to examine the potential role of osteopathic manipulative treatment (OMT) in enhancing thoracoabdominal mobility and its implications for liver health, particularly in patients with Metabolic Dysfunction-Associated Steatotic Liver Disease (MASLD) and Metabolic Dysfunction-Associated Steatohepatitis (MASH).

Table 1: PRISMA flow diagram for new systematic reviews which included searches of databases



Search terms included combinations of keywords such as "liver health," "MASLD," "MASH," "osteopathic manipulative treatment," "thoracoabdominal mobility," "circulation," and "inflammation." Advanced search strategies utilized Boolean operators like "AND" and "OR" to combine terms and optimize the relevance of results. The search prioritized high-quality, peer-reviewed evidence, focusing on clinical studies, randomized controlled trials, observational studies, and comparative research. Preprints were excluded to maintain rigor, and only free full-text articles were considered.

Table 2: PICO Model Applied to the Systematic Review

Patient/Client Group	"Non-Alcoholic Fatty Liver Disease (NAFLD)" or "Non-Alcoholic Steatohepatitis (NASH)" or "Metabolic Dysfunction-Associated Steatotic Liver Disease (MASLD)," or "Metabolic Dysfunction-Associated Steatohepatitis (MASH)," "liver cirrhosis" or "Hepatocellular Carcinoma" or "chronic somatic dysfunction"
Intervention	"osteopathic medicine" or "osteopathic technique" or "somatic dysfunction treatment"
Comparison	"Control group" or "lifestyle modification" or "pharmacologic interventions"
Outcomes	"Improved thoracoabdominal mobility" or "enhanced liver perfusion" or "reduced systemic inflammation" or "overall liver function improvements"
Study	"Systematic reviews" or "randomized control trials"

Table 3: Summary Table of Studies Included in the Present Systematic Literature Review and Narrative Description.

Study details	**Study design**	**Target group**	**Outcome measure**	**Summary of findings**	**Link**
Guo et al. (2022)	experimental, controlled with a control group	comprehensive transcriptomic analysis with male C57BL6J mice from Shanghai Research Center; NAFLD group of mice with high sucrose and high fat diet for 12 weeks, NASH group of mice with same diet for 28 weeks, normal group with control chow diet	RNA extraction and transcriptome analysis from liver and quadriceps muscles, and detailed analysis on liver morphology	Increased lipid deposition in both NASH and NAFLD groups in liver and quadriceps muscle. Additionally, significant increase in inflammatory genes were increased, while skeletal muscle functionality was reduced in quadriceps muscle from NAFLD and NASH mice compared with their controls.	4
Henderson et al. (2010)	placebo-controlled, experimental, interventional, pilot study	23 participants recruited, 14 completed the study (7 in each group)	saliva samples; salivary flow rate, alpha amylase activity and cortisol levels	subjects with rib raising had a statistically significant decrease in alpha amylase activity immediately after (p=0.014) and 10 minutes after (p=0.008) after the procedure. Placebo group didn't have a statistically significant change in alpha amylase activity at either time point. No statistically significant changes in salivary cortisol levels and flow rate in either group.	7

Balzan et al. (2014)	interventional, experimental, controlled with placebo group	8 male healthy subjects above the age of 45 years, 9 male heart failure patients from Hospital de Clinicas de Porto Alegre	FVC and FEV1 by spirometer for resting lung function, cardiopulmonary exercise testing with 12 lead ECG on treadmill, esophageal and gastric pressure, femoral venous blood velocity in femoral vein and variables of central hemodynamic were measured through PhysioFlow	At rest, healthy subjects had higher central hemodynamics (stroke volume, cardiac output), femoral venous blood flow (p<0.05) during abdominal breathing. However, abdominal breathing didn't improve central hemodynamics but an improvement in femoral venous blood flow was seen in the heart failure group.	9
Kim et al. (2022)	prospective, interventional	12 volunteer participants with venous symptoms (4 men, 8 women) median age 27 years	blood flow velocity and volume in common femoral vein with duplex ultrasound and wash-out time of 99Tc-MAA with radioisotope venography were measured in supine and standing positions before and after practicing diaphragmatic deep breathing	in supine position, blood flow velocity of both common femoral vein significantly increased after diaphragmatic breathing, and so did flow volume of right common femoral vein (p=0.043). In standing position, the blood flow velocity of the left common femoral vein significantly increased (p=0.029). The wash out times were significantly shorter with diaphragmatic breathing than with normal breathing (p<0.05)	10
Uva et al. (2015)	experimental	11 healthy subjects recruited among laboratory personnel who volunteered (3 women, 8 men); mean age 25 +/- 7 years	blood shift volume changes between trunk and extremities (Vbs)	compared to pre-exercise baseline levels, during exercise (spontaneous breathing mode), 160 mL of blood were pulled into the trunk from the extremities. During abdominal mode when patients breathed predominantly using diaphragm and abdominal muscles, average of 225 mL of blood was pulled out of trunk into the extremities, and during rib cage mode, 478 mL was pulled from trunk to extremities; abdominal exercises	11

				with the action of diaphragm and abdominal muscles can shift blood from extremities, indicating their role "auxiliary heart".	
Mirajkar et al. (2023)	interventional, experimental	10 subjects (4 female, 6 male) from in and around Sri Sri University. Patients with grade 1 or grade 2 fatty liver and overweight people with symptoms of fatty liver were included; mean age of 27.7 +/- 8.21	SGOT/SGPT (liver enzyme) scores, and ultrasonography before and after OMT	symptoms of fatty liver were greatly reduced, with improvement in patients' digestive systems. SGOT/SGPT scores also returned to normal after OMT	13
Cicchitti et al. (2015)	cross sectional, meta-analysis	8 databases searched in January 2014 by 2 independent reviewers for study selection and data extraction; 10 studies were included with a total of 386 subjects; subjects included had medical conditions classified as chronic inflammatory disease, of either gender and any age	meta analysis to quantify effectiveness of OMT in patients with chronic inflammatory disease (CID) such as IBS, COPD and asthma, compared with other types of medicine or usual medical care	inconsistent data on effect of OMT in treatment of medical conditions associated with CID	14
Mancini et al. (2019)	randomised, double blinded, prospective, controlled with placebo, interventional	67 healthy participants with mean age 40.4 +/- 14.5 years; experimental group n=22 received osteopathic manipulation and placebo n=22 had	diaphragmatic motion gradient was measured using ultrasonography, and score was assigned by the operator evaluating the change in diaphragm	statistically significant increase in diaphgragmatic motion in healthy participants	19

		a light touch approach	mobility after the intervention		
Stepnik et al. (2020)	randomised, controlled with placebo, interventional	30 healthy males and females between ages of 18 and 50, 15 were randomly assigned to placebo and 15 to the experimental group; experimental group included 15 females aged 19-42, placebo group consisted of 15 females aged 25-46	measurement of FEV1, FVC and PEF (peak expiratory flow)	no significant differences between experimental and placebo groups in pulmonary parameters including FVC and FEV1 before and after OMT	20
Amatuzzi et al. (2021)	randomised, interventional, controlled with placebo	20 patients with heart failure between 50 to 60 years old	flow mediated dilation at the brachial artery, hemodynamic measures and heart rate variability were assessed in 3 periods (baseline, immediately after the intervention, and 15 minutes after the intervention)	OMT group had a greater flow mediated dilation compared with the placebo group	21

Discussion and Implications

OMT helps MASH by moving lymph fluid through lymphatic techniques, such as the liver pump. These techniques are important for removing waste and inflammatory mediators from the liver, leading to reduced edema and inflammation. They also aid in bringing macrophages and Kupffer cells to the damaged area to fight pathogens, supporting the healing and recovery process [28].

In addition, OMT benefits MASH by manipulating the autonomic nervous system through sub-occipital release techniques. This technique affects the vagus nerve, which dampens sympathetic activity and stimulates the parasympathetic system, including functions related to the liver, thereby aiding bile production and liver metabolism [29].

The above techniques mentioned are simple to perform and can be easily done in a primary care office by osteopathic providers. This is significant because OMT has the potential to provide many benefits to patients with liver disease in only minutes. This includes decreasing inflammation, regulating the autonomic system, decreasing congestion and increasing lymphatic drainage, to name a few. In the case of patients with MASLD, OMT can potentially impact the progression of MASLD to MASH in a positive way by reducing the hepatic inflammation that drives the hepatocellular damage and fibrosis. As mentioned, the treatment of MASLD is still in progress and limited presently to lifestyle modifications and pharmacologic interventions. By implementing the practice of OMT, it can serve as an important management and treatment for these patients as their disease progresses.

However, current research on the impact of osteopathic manipulative treatment (OMT) on MASH remains limited. Due to the importance in managing and treating MASLD and MASH patients, there is a pressing need for rigorous clinical trials employing randomization, large sample sizes, and objective outcomes, such as liver enzyme measurements and histopathological assessments, to elucidate the therapeutic potential of OMT [30].

Future research should investigate the synergistic effects of osteopathic manipulative treatment (OMT) when integrated with multidisciplinary interventions, including pharmacological therapies, dietary modifications, and structured exercise programs. Given the multifactorial nature of MASH and the lack of a universally accepted cure, a comprehensive, holistic approach is imperative [31].

Osteopathic physicians should conduct thorough patient assessments that address lifestyle, diet, physical activity, and mental well-being. Collaborative care with other healthcare providers, such as physicians and nutritionists, is crucial to optimize patient outcomes. Additionally, implementing OMT techniques, including the liver pump, rib raising, and suboccipital release, during office visits can further support liver health.

Conclusion

In summary, OMT such as the liver pump and rib raising release may offer therapeutic benefits for liver diseases like MASH. These techniques aim to facilitate the movement of stagnant lymph fluid around the liver, aiding in the removal of inflammatory cytokines, which is crucial for liver healing [29,32]. Consequently, by addressing these structural imbalances, these techniques can potentially aid in delaying progression of MALD to MASH as well as other serious consequences such as hepatocellular carcinoma and the need for liver transplantation. This is significant because these techniques can aid in the healing process without resorting immediately to pharmacologic means as well as invasive procedures. In fact, both osteopathic providers and non-osteopathic primary care physicians can be taught these techniques to promote the body's own self-healing progress with regards to patients' liver function. However, given the rising prevalence of liver diseases such as MASH and the current lack of a standardized treatment protocol, further clinical research on the efficacy of OMT in this context is warranted.

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