

A Framework of Chuna Manual Therapy Techniques based on Radiological Diagnosis

방사선 진단에 기반한 추나요법 술기 체계

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연구 목적 추나요법은 한의사가 경혈점과 연조직을 자극하거나, 관절을 교정하여 신체 기능 장애를 해결하는 수기요법이다. 특히 척추에 대해서는 표준 운동학적 관점에 따라 측굴과 회전이 동시에 일어나는 짝운동이 강조되며, 척추에서의 움직임 제한도 측굴과 회전이 동시에 일어나는 것으로 간주한다. 하지만 여러 연구에서 짝운동 패턴과 일치하지 않는 변위 사례가 존재하는 것으로 나타났다. 임상 현장에서 단순 방사선 영상 진단에 근거하여 치료를 하는 사례가 늘어나고 있다. 본 연구는 요추 변위에 대한 방사선 진단 기반의 추나 치료 술기를 체계화하고 전문가 자문을 통해 합의를 도출하는 것을 목적으로 하였다.

연구 방법 방사선 진단에 기반한 요추 변위 치료 술기를 다룬 연구를 확인하기 위해 국내외 데이터베이스에서 문헌 검색을 수행하였고, 추나의학 교과서 및 수기 의학 관련 문헌을 함께 검토하였다. 만들어진 표준 치료 술기 초안에 대해 조건을 만족한 추나요법 전문가 5명이 9점 척도를 사용하여 평가하였으며, 전문가 3명 이상이 7~9점 사이의 점수를 부여하고 전체 평균 점수가 7점을 초과하는 경우 해당 술기를 최종 확정하였다.

연구 결과 초기 검색된 2,098편의 논문 중 2편이 선정 기준을 충족하여 표준 치료 술기에 포함되었다. 연구진은 치료 술기를 단순변위와 복합변위 각각에 대한 기본 및 심화 술기로 분류, 정리하였다. 단순변위는 양측성 굴곡, 양측성 신전, 측굴 및 회전 변위로 분류하였고, 복합변위는 신전-회전-동측 측굴, 굴곡-회전-동측 측굴, 측굴-대측 회전 변위로 분류하여 각각에 대한 술기를 표준화하였다. 전문가 합의 과정을 거쳐 양측성 신전 변위에 대한 심화 술기를 제외하고, 대부분의 술기에서 합의를 이뤄 술기를 확정하였다.

결론 본 연구에서는 요추 변위에 대한 방사선 진단 기반 추나요법 술기의 체계를 전문가 합의 과정을 통해 구축하였고, 다양한 변위 패턴에 대한 포괄적인 치료 방법을 제시하였다. 향후 각 변위 유형별 술기의 효과를 검증하기 위한 임상 연구가 필요하다.

주제어 Bone malalignment, Chuna manual therapy, Lumbar vertebrae, Radiography, Spinal manipulation

1. Introduction

Chuna manual therapy (CMT) is a form of Korean medicine in which practitioners use their hands or body to stimulate a patients' musculoskeletal structures. CMT is categorized as a Korean physical therapy, and is primarily aimed at improving the physiological and pathological conditions of the body by stimulating acupoints,

pressure points in the fascia, or adjusting joints manually¹⁾. CMT is applied to spinal segments that exhibit segmental dysfunction, a condition that can anomalously alter the surrounding proprioception and lead to various disorders²⁾. By resolving these abnormal conditions through joint mobilization techniques or high-velocity low-amplitude techniques, somatosensory integration can be normalized, postural control can be enhanced, and

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neuromuscular system recovery may be facilitated^{3,4)}. In CMT, joint mobilization techniques are the primary treatment modality, whereas high-velocity low-amplitude techniques are employed to address severe segmental dysfunction that does not respond to the initial interventions⁵⁾. Procedurally, joint mobilization techniques are considered basic CMT techniques, whereas manual therapy utilizing high-velocity low-amplitude techniques is classified as advanced CMT¹⁾.

The lumbar spine, the lowest part of the vertebral column, has larger vertebral bodies to support the body's weight. Numerous soft tissues, including surrounding muscles and ligaments, are essential for lumbar stability, particularly during limb movements. The human body anticipates limb movements by recruiting trunk muscles to maintain trunk stability⁶⁾. Motor control occurs in response to sudden loads on the spine, relying on various proprioceptive organs such as muscle spindles, Golgi tendon organs, joint receptors, and cutaneous receptors located around the waist⁷⁾. Therefore, segmental dysfunction of the lumbar joints may cause various musculoskeletal disorders, including low back pain, which can further impact limb joint mobility. To address these dysfunctions, the diagnostic framework in CMT encompasses dynamic and static diagnosis (Appendix file 1). Currently, diagnostic methods based on plain radiographic imaging are established for flexion, extension, lateral bending, rotation malposition, and listhesis of the spine¹⁾. In CMT practice, malposition refers to positional abnormalities of vertebral bodies, while listhesis refers to linear displacement (anterolisthesis, retrolisthesis, or laterolisthesis) of vertebral bodies^{8,9)}.

In CMT, coupled motion, where lateral bending and rotation of the spine occur simultaneously, is emphasized from a standard kinesiological perspective. According to this concept, when rotation is restricted in a vertebral body, lateral flexion restriction is also presumed, guiding dynamic diagnosis and treatment¹⁾. However, previous

studies have indicated that numerous cases of displacement exist that do not fully conform to established coupled motion patterns within static diagnostic systems, particularly within CMT radiological diagnosis⁹⁾. Moreover, recent literature presents conflicting evidence regarding manual therapy approaches. While some research suggest that non-specific techniques may be more effective¹⁰⁾, others indicate that significant neurophysiological changes in somatosensory evoked potentials only occur when manipulating clinically identified dysfunctional segments¹¹⁾. This observation, combined with conflicting evidence about the significance of specific vertebral targeting, underscores the complexity of spinal biomechanics and the challenges in developing standardized approaches. Despite the evolving understanding and limited research evidence regarding the relationship between radiological malposition and specific manual techniques, CMT practitioners rely on these diagnostic findings in their clinical decision-making. Therefore, there is a need to develop treatment methodologies based on static diagnostic system, particularly those used in CMT radiological diagnosis.

We aimed to conduct a comprehensive review of CMT techniques for the lumbar spine described in the literature. Additionally, we sought to establish treatment strategies aligned with the static diagnostic system through expert consultation, and where existing techniques were insufficient, to develop new methods under expert consensus.

II. Methods

A. Study design and research question

This study employed a triangulation design, integrating a literature review with expert consultation methods to systematize treatment techniques for lumbar malposi-

tion based on CMT radiological diagnosis. The main clinical question of the research was: "What are the treatment techniques for lumbar malposition based on CMT radiological diagnosis?" This question was specified using the PICOS framework as follows:

- P (Population): Patients with lumbar malposition confirmed by radiological examination
- I (Intervention): Treatment techniques based on CMT or manual therapy
- C (Comparison): Not applicable (this study focuses on systematizing treatment techniques)
- O (Outcomes): Not applicable (this study did not measure specific clinical outcomes)
- S (Study designs): All types of studies and literature that describe treatment techniques in detail

B. Database selection and search

We searched international (MEDLINE via PubMed, Embase, and Cochrane Library), and Korean databases (Research Information Sharing Service (RISS), ScienceON, DBpia, Korean Association of Medical Journal Editors (KAMJE), Korea Citation Index (KCI) via Web of Science, and Oriental Medicine Advanced Searching Integrated System (OASIS)) to identify literature documenting treatment of malposition based on CMT radiological diagnosis. The final search was performed on September 24, 2024. Search strategies were designed to include diagnostic and treatment methodologies related to manual medicine, including CMT. These have been listed in Appendix file 2.

C. Study selection criteria

1. Inclusion criteria

(i) Studies that described treatment techniques wherein CMT or manual therapy was performed based on radiological examination outcomes for lumbar malposition.

2. Exclusion criteria

- (i) Studies that did not diagnose malposition based on radiological examination results
- (ii) Studies where the diagnosis and treatment focus was outside the lumbar spine
- (iii) Studies that did not detail the techniques employed
- (iv) Grey literature of non-regular academic publications (letters, conference posters, theses, news articles, etc.)

D. Literature selection and data extraction

In the primary screening, irrelevant literature was excluded by reviewing titles and abstracts. A secondary screening involved a full-text review to identify the final studies. Two authors independently conducted the inclusion and exclusion process; in cases of disagreement, decisions were made through discussion with a third party. The process of literature identification, screening, and selection is illustrated in Fig. 1.

Given the limited number of studies that met inclusion criteria from the database search, standard educational materials and expert-approved literature were included as additional sources to complement the research scope and for comprehensive technique analysis. Accordingly, the CMT textbook¹⁾, the regular workshop textbook from the CMT academy educational program conducted by the Korean Society of Chuna Manual Medicine for Spine & Nerves (KSCMM)⁵⁾, and the Korean medicine rehabilitation textbook¹²⁾ were selected as additional literature to review existing lumbar CMT techniques. Although classified as grey literature, these standard educational materials and textbooks maintain higher academic standards due to their approval by academic societies or institutions through academic quality control processes. Manual medicine-related texts (including osteopathic and chiropractic literature) published in Korea

providing descriptions of malposition corresponding to the CMT diagnostic system, and their treatment methods, were also included^{13,14}. Additional target literature was included based on the consensus of three authors.

Treatment techniques derived from the selected literature were synthesized into a draft of treatment protocols in alignment with CMT radiological diagnosis of lumbar malposition. Content organization was conducted by two members of the Academic Committee of KSCMM.

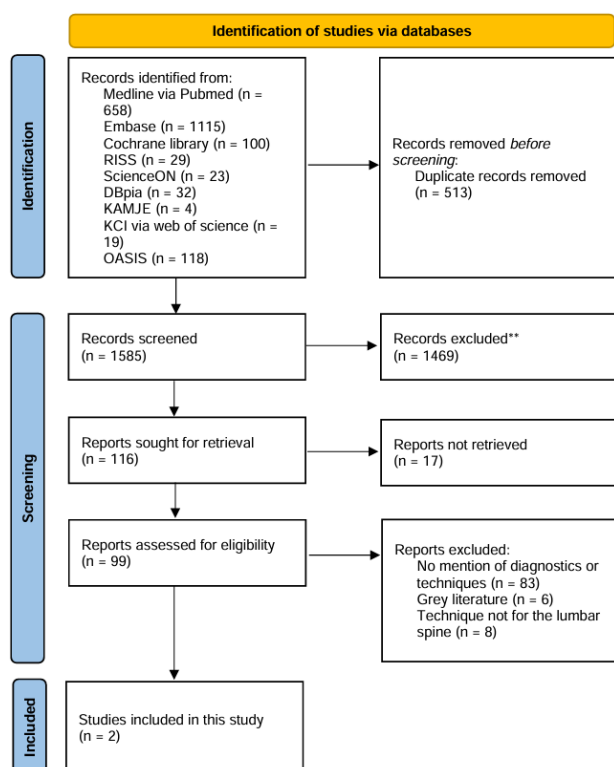
E. Expert consultation on treatment techniques

This study's objective was to systematize treatment techniques performed based on CMT radiological diagnosis for lumbar malposition. Expert consultation was facilitated based on the draft compilation of treatment techniques derived from the literature review. In this study, experts were defined as Korean medicine doctors

performing CMT in clinical practice, serving as educational committee members within KSCMM, belonging to either the academic committee or the CMT professors' council, and having >10 years of clinical experience. These criteria ensured participation of experts with deep understanding of both theoretical and practical aspects of CMT. Five experts were recruited.

These experts evaluated the organized techniques on a 9-point scale and provided additional comments for each technique. During their assessment, the experts considered multiple aspects of each technique, including clinical applicability, safety, effectiveness, reproducibility, and alignment with CMT radiological diagnostic principles. Specifically, they evaluated whether each technique could be safely implemented in clinical settings, whether it effectively targeted the diagnosed malposition, and whether it could be consistently reproduced by other practitioners. This comprehensive evaluation approach sought to ensure that the agreed-upon techniques would be theoretically sound and practically viable in real clinical scenarios.

Agreement levels were defined as follows: 1 point indicated "strongly disagree," 5 points indicated "neutral," and 9 points indicated "strongly agree"¹⁵. A technique was confirmed when three or more out of the five experts rated it between 7 and 9 points, indicating agreement, and the average score across all five experts also exceeded 7 points. For techniques that did not achieve consensus in the initial consultation, modification suggestions were collected, and three authors revised the techniques through discussion. A second consultation was initiated, during which the scores assigned by other experts during the first consultation were disclosed. This iterative evaluation and feedback process was designed to facilitate consensus formation among the experts. Techniques were subsequently finalized based on the collected opinions. Techniques not confirmed in this second consultation were deemed inappropriate and discarded.



KAMJE, Korean Association of Medical Journal Editors; KCI, Korea Citation Index; OASIS, Oriental Medicine Advanced Searching Integrated System; RISS, Research Information Sharing Service
** Records excluded based on title and abstract screening

Fig. 1. Flowchart depicting study selection process.

III. Results

A. Literature search results

The database searches yielded 658 articles from MEDLINE (via PubMed), 1,115 from Embase, 100 from Cochrane Library, 29 from RISS, 23 from ScienceON, 32 from DBpia, 4 from KAMJE, 19 from KCI via Web of Science, and 118 from OASIS, totaling 2,098 articles (Fig. 1). After the exclusion of 513 duplicate studies, primary screening was conducted on 1,585 articles, resulting in the exclusion of 1,469 irrelevant studies. Among the remaining 116 studies, 17 were excluded due to inaccessible full texts, leading to a review of 99 full texts and the selection of two studies.

B. Lumbar treatment techniques presented in studies and literature

The two selected studies were case reports of Korean medicine complex treatment including CMT for patients with scoliosis^{16,17}. These utilized the lateral bending-rotation technique, one of the lumbar flexion-distraction techniques, for lumbar complex malpositions characterized by either left lateral bending with right rotation malposition or right lateral bending with left rotation malposition. Therefore, the lateral bending-rotation technique was incorporated as a technique for treating lumbar lateral bending with contralateral rotation malposition and included in the draft compilation of techniques. Beyond this, studies relating to CMT based on radiological diagnosis of the lumbar spine were markedly limited, leading to the selection of appropriate techniques from the additionally included literature^{1,5,12-14} based on the authors' consensus to organize the draft.

C. Results of expert consultation

Expert consultation was conducted based on the draft

of techniques that was systematically developed through comprehensive literature review. This draft was created by synthesizing treatment techniques from the two included studies, standard educational materials (the CMT textbook¹), the regular workshop textbook from the CMT academy⁵), and the Korean medicine rehabilitation textbook¹²), and other manual medicine-related texts^{13,14}) that described malpositions corresponding to the CMT diagnostic system. The content organization was performed by two committee members from the Academic Committee of KSCMM, who categorized the techniques according to the type of malposition based on CMT radiological diagnosis principles.

Most techniques evaluated during the expert consultation met the pre-established consensus criteria. However, the advanced CMT technique for bilateral extension malposition was not confirmed. This technique involved the spinous process thrust technique utilizing the hypothenar area, and experts provided feedback indicating challenges in applying flexion force to the target segment. Consequently, the basic CMT technique for treating lumbar flexion in the sitting position, as established during the first consultation, was preferred, resulting in the exclusion of the advanced technique from the final compilation.

D. CMT techniques for simple malposition

1. Basic CMT techniques for simple malposition

Simple malposition of the lumbar spine includes bilateral flexion, bilateral extension, lateral flexion, and rotation malpositions. Basic techniques from existing CMT were selected for bilateral flexion malposition and rotation malposition^{1,5}). Currently, CMT has not delineated distinct techniques for bilateral extension and lateral flexion malpositions. Techniques for bilateral extension malposition were described by adapting information from osteopathic medicine literature¹³). For lateral flex-

ion malposition, the lateral flexion technique, a component of the Cox flexion-distraction technique (Cox technique) currently used in CMT, was considered applicable and thus organized and described¹⁾. Detailed descriptions of the techniques are presented in Table I and Appendix file 3.

2. Advanced CMT techniques for simple malposition

In CMT, applying the coupled motion concept, wherein spinal translation and rotation movements occur in relation to one another—specifically rotation and lateral flexion around other axes—has resulted in a dearth of advanced CMT techniques targeting rotation or lateral flexion malpositions¹⁾. Therefore, for these lacking techniques, we adapted relevant techniques from osteopathic and chiropractic sources outside the CMT system.

For lateral flexion malposition, the posture setup is as follows: In individuals with a normal body type, a side-lying position inherently induces contralateral bending of the lumbar spine, establishing a lateral flexion posture. However, in cases where the desired lateral flexion is unattainable due to body type abnormalities, such as obesity, lateral flexion may be assisted by either pulling the patient's lower arm toward the head or employing the Cox table function to elevate the pelvic area and below. Additionally, in a side-lying position, variations in arm positioning can be tailored according to the patient's flexibility and body size¹⁴⁾.

For rotation malposition, the posture setup involves positioning the joint to be corrected upward while the patient is in a side-lying position, flexing and laterally bending the patient to induce crosswise rotation at the dysfunction level. Subsequently, the trunk can be later-

Table I. Basic Chuna Manual Therapy Techniques for Simple Malposition

	Patient position Malposition type	Physician position	Contact point and hand form	Treatment direction	Notes
Bilateral flexion malposition (Fig. A1)	Sitting position, both hands holding opposite shoulders	Stands behind the patient	Main hand: palm contacting the inferior segment's spinous process Support hand: embracing patient's both arms to fix upper body Main hand applies translational pressure from the posterior to anterior direction to address extension restriction barrier	Patient exerts force to bend the trunk while physician resists	Perform three repetitions per set with contraction, rest, and relaxation phases
Bilateral extension malposition (Fig. A2)	Sitting position, either holding opposite shoulders or extending arms between legs	Stands in the front diagonal position, with a fencing stance	One hand fixes shoulder while the opposite axillary region fixes the patient's other shoulder Fingers contact interspace between malpositioned segments for movement detection Flex the patient's trunk until malpositioned segment separates	Patient exerts force to extend while physician resists	Perform three repetitions per set with contraction, rest, and relaxation phases Apply weight while flexing the patient's trunk with posterior translation to encourage separation of the malpositioned segment
Rotation malposition (Fig. A3)	Side-lying position with rotated side down, upper leg placed in the popliteal space of lower leg	Stands in front of the patient, with a fencing stance	Caudal hand: fingers grasp upper leg's popliteal space Cranial hand: palm contacts the anterior shoulder	Both cranial and caudal hands press downward to rotate and distract	Can create distraction by applying and releasing force with the caudal hand
Lateral flexion malposition (Fig. A4)	Prone position with ankles fixed by a belt	Stands at the opposite side of the Cox flexion- distraction table	Cranial hand's palm fixes superior segment's spinous process	Support hand operates table handle to move the pelvic section laterally	Cox table required Perform appropriate number of repetitions at 4-s intervals, a minimum of four times per segment Move between lateral and center positions to avoid symptom aggravation

ally bent appropriately to promote distraction at the targeted joint. For the resistance technique, the lower arm is pulled anteroinferiorly to induce lateral bending toward the table, while for the assistance technique, the lower arm is pulled anterosuperiorly to induce lateral bending away from the table¹⁴⁾.

Detailed descriptions of these techniques are presented in Table II and Appendix file 4.

E. CMT techniques for complex malposition

1. Basic CMT techniques for complex malposition

Complex malpositions arise when two or more simple malpositions, such as flexion, extension, lateral flexion, and rotation malpositions, coexist. In conventional CMT, based on the coupled-motion concept, CMT techniques have only been established for non-neutral dysfunctions including extension-rotation-ipsilateral lateral flexion malposition and flexion-rotation-ipsilateral lateral flexion malposition, and neutral dysfunction including lateral flexion-contralateral rotation malposition^{1,5,12)}. Therefore, for complex malpositions beyond those previously established, we devised a method of applying multiple simple malposition CMT techniques and sought expert consultation. This method also reached consensus among experts and was confirmed. The literature showed that applying the lumbar flexion-distraction technique with rotation technique for lateral flexion-contralateral rotation malposition was feasible, and this technique was documented. The lateral decubitus lumbar treatment technique, traditionally used in CMT, and the sitting lumbar treatment technique used in osteopathy, were confirmed through expert consultation and are described in Table III and Appendix file 5.

2. Advanced CMT techniques for complex malpositions

The advanced CMT techniques for complex malpositions include methods for extension-rotation-ipsilateral lateral flexion, flexion-rotation-ipsilateral lateral flexion, and lateral flexion-contralateral rotation malpositions. Before performing advanced CMT techniques for non-neutral dysfunction malpositions, including extension-rotation-ipsilateral lateral flexion and flexion-rotation-ipsilateral lateral flexion malpositions, the following posture should be adopted:

- 1) Position the patient in lateral decubitus with the rotation side downward.
- 2) While palpating the malpositioned segment, push the patient's upper body forward/backward to create flexion/extension at the segment, and flex/extend the lower limb by holding the ankle of the lower leg to effectuate segmental flexion/extension and establish the desired posture.
- 3) Place the patient's upper foot at the popliteal area of the lower leg.

For advanced CMT techniques addressing neutral dysfunction malposition (lateral flexion-contralateral rotation malposition), the following posture should be adopted:

- 1) Position the patient in lateral decubitus with the rotation side downward.
- 2) Pull the patient's lower arm anteroinferiorly to create lateral flexion and rotation of the lumbar spine.
- 3) Place the patient's upper foot at the popliteal area of the lower leg.

Detailed descriptions of these techniques are presented in Table IV and Appendix file 6.

Table II. Advanced Chuna Manual Therapy Techniques for Simple Malposition

Malposition type	Patient position	Physician position	Contact point	Patient contact point	Hand form	Treatment direction	Notes
Bilateral flexion malposition (Fig. B1)	Side-lying position with pillow under the head or cervical portion of the table elevated. Lower leg placed in the popliteal space of lower leg	Stands in a fencing stance, forming a 45° angle with the patient's facial plane, and contacts and supports the patient's thigh with caudal-side thigh	Caudal hand contacts the pisiform area, with fingers angled toward the spine	Contact upper portion of superior vertebra's spinous process	Support hand contacts the patient's upper shoulder joint and overlaps patient's hands	Thrust anteroinferiorly to induce the extension of vertebra	Can thrust anterosuperiorly when contacting inferior vertebra's spinous process under portion
Rotation malposition (Fig. B2)	Side-lying position with rotated side down, pillow under the head or cervical portion of the table elevated. Lower extremity extended, upper leg placed in the popliteal space of lower leg	Stands in a fencing stance, forming a 45° angle with the patient's facial plane, contacts and supports the patient's thigh with caudal-side thigh, or supports the patient's leg between thighs	Caudal hand contacts the pisiform area, with fingers parallel to the spine	Contact the mammillary process of inferior vertebra	Support hand contacts the patient's upper shoulder joint and overlaps patient's hands	Thrust anterosuperiorly to induce rotation and distraction at the facet joint	Excessive posterior rotation of the shoulder can generate excessive force on the targeted segment
Lateral flexion malposition (opened wedge side approach) (Fig. B3)	Side-lying position with the laterally flexed side down. Place a pillow under the head or elevate the cervical section of the table. Lower the trunk portion of the table to induce lateral flexion. Extend the lower extremity, and place the upper leg in the popliteal space of lower leg	Stands in a fencing stance, forming a 45° angle with the patient's facial plane. Contacts and supports the patient's thigh with caudal-side thigh, or supports the patient's leg between thighs	Caudal hand contacts the pisiform area, with fingers parallel to the spine	Contact the mammillary process of inferior vertebra	Support hand contacts the patient's upper shoulder joint and overlaps patient's hands	Thrust anteriorly, medially, and superiorly. Close opened wedge	Gently pulling the shoulder down with the support hand can effectively generate lateral flexion. Instead of lowering the trunk portion of the table, raise the pelvic portion to assist lateral flexion
Lateral flexion malposition (closed wedge side approach) (Fig. B4)	Side-lying position with the opposite side of lateral flexion down. Place a pillow under the head or elevate the cervical section of the table. Add a cushion under the lower back. Extend the lower extremity, and place the upper leg in the popliteal space of lower leg	Stands in a fencing stance, forming a 45° angle with the patient's facial plane. Contacts and supports the patient's thigh with caudal-side thigh, or supports the patient's leg between thighs	Caudal hand contacts the pisiform area, with fingers parallel to the spine	Contact the mammillary process of superior vertebra	Support hand contacts the patient's upper shoulder joint and overlaps patient's hands	Thrust anteriorly and superiorly. Open closed wedge	Instead of placing the cushion under the lower back, lower the pelvic portion of table to assist lateral flexion

Table III Basic Chuna Manual therapy Techniques for Complex Malpositions

Malposition type	Patient position	Physician position	Contact point and hand form	Treatment direction	Notes
Extension-rotation-ipsilateral lateral flexion malposition (Fig. C1)	Lateral decubitus position with rotation side downward	Takes a fencing stance in front of the patient	Flexes the patient's trunk to create flexion at the malpositioned segment Checks rotational movement while pushing the shoulder backward with the physician's forearm Creates lateral flexion by lifting both legs through the ankle of lower leg	Patient applies force to lower legs toward the treatment table while the physician resists	Perform 3 sets of contraction, rest, and relaxation phases
Flexion-rotation-ipsilateral lateral flexion malposition (Fig. C2)	Lateral decubitus position with rotation side downward	Takes a fencing stance in front of the patient	Extends the patient's trunk to create extension at the malpositioned segment Checks rotational movement while pushing the shoulder backward with the physician's forearm Patient maintains rotation by holding the table edge Creates lateral flexion by lifting the upper leg toward ceiling while embracing it	Patient applies force to lower legs toward the treatment table while the physician resists	Perform 3 sets of contraction, rest, and relaxation phases
Lateral flexion-contralateral rotation malposition (Described with the example of left lateral flexion-right malposition) (Fig. C3)	Sitting position Left hand holds the right shoulder	Stands behind the patient Left arm passes through the patient's left axilla to hold the right shoulder, thereby controlling the upper trunk	Right thumb contacts the apex of right convex lumbar curve in the anteromedial direction	While translating contact point laterally to the left side with the right thumb Controls the upper trunk to induce rotation barrier through left lateral flexion-left rotation Patient resists right lateral flexion force for 3-5 s	Repeat 3-5 times Each repetition enters new right lateral flexion-left rotation barrier through left translation
Lateral flexion-contralateral rotation malposition (Described with the example of left lateral flexion-right rotation malposition) (Fig. C4)	Prone position Ankles fixed with a belt	Stands at the side of the pelvic portion of the Cox flexion-distraction table	Fixes superior vertebra's spinous process with thenar and hypothenar eminence or thumb and index finger proximal interphalangeal joint of headward hand	Operates table handle to move pelvic section rightward then down and back to neutral with support hand Movement performed in circular motion	Requires the Cox table Repeat the movement appropriately, at least four times per segment, at 4-s intervals

Table IV. Advanced Chuna Manual Therapy Techniques for Complex Malpositions

Malposition type	Patient position	Physician position	Contact point	Hand form	Treatment direction
Extension-rotation-ipsilateral lateral flexion malposition (Fig. D1)	Lateral decubitus position with the rotation side downward	Takes a fencing stance in front of the patient	Manipulating hand's (caudal hand) forearm contacts the ilium Support hand's (cephalic hand) forearm contacts the axillary region	Palpates target segment group to monitor movement	Support hand rotates the trunk posteriorly Manipulating hand pulls the ilium anterosuperiorly Applies sudden correction using body weight
Flexion-rotation-ipsilateral lateral flexion malposition (Fig. D2)	Lateral decubitus position with the rotation side downward	Takes a fencing stance in front of the patient	Manipulating hand's (caudal hand) forearm contacts the ilium Support hand's (cephalic hand) forearm contacts the axillary region	Palpates target segment group to monitor movement	Support hand rotates the trunk posteriorly Manipulating hand pulls the ilium anterosuperiorly Applies sudden correction using body weight
Lateral flexion-contralateral rotation malposition (Fig. D3)	Lateral decubitus position with the rotation side downward	Takes a fencing stance in front of the patient	Manipulating hand's (caudal hand) forearm contacts the ilium Support hand's (cephalic hand) forearm contacts the axillary region	Palpates target segment group to monitor movement	Support hand rotates the trunk posteriorly Manipulating hand pulls the ilium anteriorly Applies sudden correction using body weight

IV. Discussion

This study represents the first systematic effort to organize and validate CMT techniques for the lumbar spine based on radiological diagnosis through expert consultation, effectively employing data triangulation and methodological triangulation from a methodological perspective. Triangulation, a method used to overcome fundamental biases arising from single methods or single data sources and to enhance the credibility and validity of research findings, was implemented in this study by integrating two approaches: literature review and expert consensus, thereby strengthening the depth and balance of the research¹⁸⁾. An extensive literature search was conducted to compile techniques based on radiological diagnosis, and Korean databases were included to ensure comprehensiveness, given that CMT constitutes a manual therapy administered by Korean medicine doctors. The search strategies were formulated to broadly encompass various manual medicine modalities, integrating chiropractic and osteopathy techniques, facilitating a diverse inclusion of methodologies. Furthermore, an expert group comprising practitioners actively employing CMT in clinical settings was assembled, and the consultation process systematically captured practical evidence reflecting real-world clinical scenarios. This methodological integration aligns with the emphasis in existing triangulation research on understanding phenomena through diverse datasets and demonstrated the effect of mutually complementing the limitations of single approaches.

Currently, among the CMT techniques applied to the lumbar spine, methodologies addressing lateral flexion and rotation malpositions, and those for complex malposition, are described according to the coupled motion concept, which states that rotation and lateral flexion are treated in conjunction, influenced by muscles, ligaments, intervertebral discs, and facet joints. However, evidence

regarding how pathology in these structures impacts coupled motion is lacking, and the coupled motion patterns detailed in various textbooks lack corroborating literary evidence¹⁹⁾. Furthermore, inconsistencies in coupled motion patterns have emerged in several studies, with most reporting angles of $<2.5^\circ$, which appear negligible for practical diagnosis²⁰⁾.

In actual CMT radiological diagnosis of the lumbar region, the potential exists for rotation and lateral flexion to occur independently or deviate from established patterns. Accordingly, this study organized basic and advanced CMT techniques for simple malposition, to establish techniques that addresses all lumbar malpositions without being constrained by the coupled motion concept. For complex malpositions, in addition to the existing coupled motion methodologies, CMT may utilize multiple simple malposition techniques to address atypical complex malpositions in which lateral flexion and rotation do not occur simultaneously. Expert consensus for the application of multiple techniques was achieved through expert consultation, representing a strength of this study and highlighting limitations inherent in the current CMT theory concerning spinal joint movement. Future research is warranted to investigate the physiological and pathological movements of the spine, ascertain potential vertebral malpositions, and advance the CMT diagnostic framework concerning vertebral bodies. Additionally, among the organized techniques, those for simple rotation and simple lateral flexion malpositions represent either spinal distraction techniques that impose force on multiple segments or methodologies derived from other manual medicine practices. Hence, developing specialized techniques for these conditions is essential.

Patients with low back pain showed a tendency toward increased erector spinae reflex latency in resisting sudden external forces, which indicates the presence of segmental structural instability²¹⁾. Particularly in cases of

spinal pain, even minimal forces can cause injury owing to surrounding muscles being unable to function properly following prolonged strain or abnormal load distribution to ligaments²²⁾. Therefore, accurate diagnosis of the affected segment and malposition prior to executing CMT is important, as the risk of adverse effects could potentially increase when treatment is not performed to the correct segments with appropriate directional force. However, existing manual diagnosis has limitations in accurately and consistently determining segments and malposition⁹⁾, highlighting the advantages of radiological examination. CMT radiological examination can accurately diagnose lumbar malposition and precisely identify the segment for treatment and direction of force using only two radiographs—L-spine AP and lateral views—with minimal radiation exposure^{8,9)}. Furthermore, radiographic examination aids in discerning contraindications for manual therapy and assessing the condition of the patient's spine. However, while techniques based on the static diagnostic system using X-ray examination had not been clearly organized, making direct clinical application difficult, this study has successfully established such techniques.

Expert consultation involved comprehensive assessments across various aspects of each technique, including effectiveness, feasibility, safety, and reproducibility as assessed from the perspective of experts' accumulated clinical experience. Evaluations focused particularly on whether the techniques could appropriately apply force to patients in clinical settings, effectively correct diagnosed malpositions, and be consistently reproduced by other clinicians. During this process, some techniques were not agreed upon and were discarded because they were difficult to apply appropriate force to the displaced segment in actual clinical environments or were considered to potentially pose risks to patient safety if improperly applied. This study did not employ more formalized expert consensus methodologies such as the Delphi tech-

nique or focus group interviews. This methodological choice was made in consideration of practical constraints related to research resources and study design. Given the limited pool of experts with deep understanding and clinical experience in CMT methodology, and considering their time constraints and geographical dispersion, an approach through individual evaluations and feedback was deemed more efficient and practical for obtaining substantive results than conducting repetitive Delphi rounds or intensive focus groups. Instead, this study enhanced the qualitative level of selected experts by applying strict criteria, including membership in the educational committee, academic committee, or CMT professors' council of KSCMM, and more than 10 years of clinical experience. Methodological approach was strengthened through 9-point scale evaluations, specific feedback, and subsequent modification and re-evaluation processes. This approach enabled a comprehensive assessment that considered not only the theoretical validity of techniques but also their practical applicability in clinical settings.

This study had some limitations. First, this study focused solely on techniques pertinent to malposition and did not encompass techniques addressing listhesis. When visualizing a virtual axis traversing the vertical, lateral, and anteroposterior dimensions relative to the lumbar midline, malposition pertains to rotational movement around the axis, while listhesis pertains to parallel movement along the lateral or anteroposterior axes. Within manual therapy, most techniques are designed to address malposition, while those targeted at listhesis are significantly limited, with few existing studies addressing listhesis treatment grounded in radiological diagnosis. Additionally, expert consultation revealed substantial disagreement regarding the techniques for listhesis outlined in available manual medicine textbooks, hindering their confirmation and inclusion in this study's findings. Notably, listhesis is known to correlate with spinal in-

stability due to conditions such as spondylolysis or severe degenerative spinal joint lesions²³⁾. Therefore, expert consensus suggested that manual therapy involving direct manual stimulation could exacerbate the condition or symptoms. Ongoing exploration is necessary to develop individualized techniques for manual therapy targeting spinal listhesis, supported by spinal kinematics and diverse pathological conditions that precipitate listhesis, alongside separate clinical studies focusing on these methodologies.

Second, this study was conducted without a registered research protocol, which represents a methodological limitation. Although this study systematized and evaluated techniques through comprehensive review and expert consultation, it identified only two primary studies specifically addressing radiologically-based CMT for lumbar malposition. It is important to clarify that the results and discussion presented in this study are not based solely on these two included studies from the literature review but rather represent a synthesis of multiple sources. As detailed in the Methods section, given the limited number of studies meeting the inclusion criteria, we expanded our data sources to include standard educational materials and expert-approved literature, specifically the CMT textbook¹⁾, the regular workshop textbook from the CMT academy educational program⁵⁾, and the Korean medicine rehabilitation textbook¹²⁾, as well as other manual medicine-related texts^{13,14)}. The initial draft of treatment techniques was compiled from these comprehensive sources and subsequently refined through the expert consultation process. Additionally, clinical studies on manual therapies including CMT are predominantly conducted using pragmatic designs. These studies typically apply varied treatment methods based on individual subject conditions, making it difficult to identify detailed descriptions of treatment techniques²⁴⁾. The two included studies applied manual therapy techniques to patients with scoliosis, which represents a quintessential case of

lateral flexion-contralateral rotation malposition. Despite this limitation in the literature, the CMT techniques systematized in this study underwent a rigorous expert consultation process with qualified specialists, strengthening their potential for generalization to various types of lumbar malposition. However, the actual clinical effectiveness of these organized techniques was not directly verified in this study. This scarcity of published research highlights the gap between clinical practice of CMT based on radiological diagnosis and documented evidence. Clinical studies involving patients presenting with functional abnormalities and malposition of the lumbar spine utilizing this study's derived data are crucial to ascertain the efficacy and indications of these techniques.

V. Conclusion

This study systematized CMT techniques based on radiological diagnosis of lumbar malposition and established expert consensus through consultation. It highlighted theoretical limitations in the current CMT diagnostic framework and gaps in standardized techniques for certain lumbar malposition classifications, while providing a preliminary evidence base and a structured framework for applying CMT techniques in lumbar spine treatment. Future clinical studies are necessary to confirm the effectiveness of these CMT techniques for each type of malposition based on the framework established in this study.

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Appendix file 1. Overview of the CMT Diagnostic Methods for Lumbar Spine

Diagnostic category	Method	Technique	Description	Reference
Dynamic diagnosis	Palpation	Transverse process palpation (prone)	Palpating transverse processes while patient extends lumbar spine in prone position	[1]
		Transverse process palpation (seated)	Palpating transverse processes while patient flexes trunk in seated position	[1]
		End-feel assessment	Checking end-feel by applying pressure to spinous and mammillary processes	[2]
Static diagnosis	Palpation	Tissue texture assessment	Abnormal tissue texture including paraspinal muscle tension, asymmetry, and tenderness	[3]
	Plain radiography	Radiological structural analysis	Analysis of relative positions of spinal structures to diagnose malposition (flexion, extension, lateral bending, rotation) and listhesis (anterolisthesis, retrolisthesis, laterolisthesis)	[2,4]

1. Korean society of Chuna manual medicine for spine & nerve. Chuna manual medicine academy basic training course workbook; Korean society of Chuna manual medicine for spine & nerve: Seoul, 2023; Volume 2.
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Appendix file 2. Search strategy for each database

1. MEDLINE via PubMed

#1. (Musculoskeletal Manipulations[MeSH] OR Manipula*[TIAB] OR manual therap*[TIAB] OR Chuna[TIAB] OR Chiropract*[TIAB] OR osteopath*[tiab]) AND (lumbar vertebrae[MeSH] OR lumb*[tiab]) AND (Diagnostic Imaging[MeSH] OR Radiography[MeSH] OR Diagnostic X-Ray[tiab] OR radiolog*[tiab] OR Radiograph*[tiab])

2. Embase

#1. ('manipulative medicine'/exp OR 'chiropractic'/exp OR 'osteopathic medicine'/exp OR 'manipula*':ti,ab,kw OR 'chiropract*':ti,ab,kw OR 'osteopath*':ti,ab,kw OR 'chuna':ti,ab,kw) AND ('radiography'/exp OR 'radiodiagnosis'/exp OR 'spine radiography'/exp OR 'radiolog*':ti,ab,kw OR 'radiograph*':ti,ab,kw OR 'Diagnostic X-Ray':ti,ab,kw) AND ('lumbar spine'/exp OR 'lumbar vertebra'/exp OR 'lumb*':ti,ab,kw)

3. Cochrane library

#1. (Manipulat*):ti,ab,kw OR (manual therap*):ti,ab,kw OR (Chuna):ti,ab,kw OR (Chiropract*):ti,ab,kw OR (osteopath*):ti,ab,kw

#2. MeSH descriptor: [Musculoskeletal Manipulations] explode all trees

#3. (lumb*):ti,ab,kw

#4. MeSH descriptor: [Lumbar Vertebrae] explode all trees

#5. MeSH descriptor: [Diagnostic Imaging] explode all trees

#6. MeSH descriptor: [Radiography] explode all trees

#7. (Diagnostic X-Ray):ti,ab,kw OR (radiolog*):ti,ab,kw OR (Radiograph*):ti,ab,kw

#8. #1 OR #2

#9. #3 OR #4

#10. #5 OR #6 OR #7

#11. #8 AND #9 AND #10

4. Research Information Sharing Service (RISS)

#1. (추나|카이로프락틱|정골|chuna|chiropract|osteopath) AND (요추|요부|lumba) AND (엑스레이|엑스선|영상|x-ray|radiograph|radiodiagnos|radiolog)

5. ScienceON

#1. (추나|카이로프락틱|정골|chuna|chiropract|osteopath) AND (요추|요부|lumba) AND (x-ray|엑스레이|엑스선|영상|radiograph|radiodiagnos|radiolog)

6. DBpia

#1. (추나|카이로프락틱|정골|chuna|chiropract|osteopath) AND (요추|요부|lumba) AND (x-ray|엑스레이|엑스선|영상|radiograph|radiodiagnos|radiolog)

7. Korean Association of Medical Journal Editors (KAMJE)

#1. ("Musculoskeletal Manipulations"[MH] OR Manipulative[ALL] OR Manipulation[ALL] OR "manual therapy"[ALL] OR "manual therapies"[ALL] OR Chuna[ALL] OR Chiropractic[ALL] OR Chiropractor[ALL] OR osteopathy[ALL] OR osteopathies[ALL] OR osteopathic[ALL]) AND ("lumbar vertebrae"[MH] OR "lumbar"[ALL]) AND ("Diagnostic Imaging"[MH] OR "Radiography"[MH] OR "Diagnostic X-Ray"[ALL] OR "radiology"[ALL] OR "radiologist"[ALL] OR "radiologic"[ALL] OR "Radiography"[ALL] OR "Radiographic"[ALL])

8. Korea citation index (KCI) via Web of science

#1. ((TS=(chuna)) OR TS=(chiropract*)) OR TS=(osteopath*)

#2. TS=(lumba*)

#3. (((TS=(x-ray)) OR TS=(radiograph*)) OR TS=(radiodiagnos*)) OR TS=(radiolog*)

#4. #3 AND #2 AND #1

#5. ((TS=(추나)) OR TS=(카이로프랙틱)) OR TS=(정골)

#6. (TS=(요추)) OR TS=(요부)

#7. (((TS=(엑스레이)) OR TS=(엑스선)) OR TS=(방사선)) OR TS=(영상)

#8. #7 AND #6 AND #5

#9. #4 OR #8

9. Oriental medicine Advanced Searching Integrated System (OASIS)

#1. xray|엑스레이|엑스선|영상|radiograph|radiodiagnos|radiolog

Appendix file 3. Photographic documentation of basic CMT techniques for simple malpositions



Fig. A1. Basic CMT technique of bilateral flexion malposition.



Fig. A2. Basic CMT technique of bilateral extension malposition.



Fig. A3. Basic CMT technique of rotation malposition.



Fig. A4. Basic CMT technique of lateral flexion malposition.

Appendix file 4. Photographic documentation of advanced CMT techniques for simple malpositions



Fig. B1. Advanced CMT technique of bilateral flexion malposition.



Fig. B2. Advanced CMT technique of rotation malposition.



Fig. B3. Advanced CMT technique of lateral flexion malposition (opened wedge approach).



Fig. B4. Advanced CMT technique of lateral flexion malposition (closed wedge approach).

Appendix file 5. Photographic documentation of basic CMT techniques for complex malpositions



Fig. C1. Basic CMT technique of Extension-rotation-ipsilateral lateral flexion malposition.



Fig. C2. Basic CMT technique of flexion-rotation-ipsilateral lateral flexion malposition.



Fig. C3. Basic CMT technique of lateral flexion-contralateral rotation malposition.



Fig. C4. Basic CMT technique of lateral flexion-contralateral rotation malposition (adapting lumbar flexion-distraction technique).

Appendix file 6. Photographic documentation of advanced CMT techniques for complex malpositions



Fig. D1. Advanced CMT technique of extension-rotation-ipsilateral lateral flexion malposition.



Fig. D2. Advanced CMT technique of flexion-rotation-ipsilateral lateral flexion malposition.



Fig. D3. Advanced CMT technique of lateral flexion-contralateral rotation malposition.