

extension by improper posture, excessive use of muscle, or desk and chair that do not fit the body [5]. Other than those, mental stress, nutritional imbalance, metabolic and endocrine imbalance, and infection have been pointed out as factors causing MPS [6]. Many patients have difficulty in treatment because the symptoms of this syndrome are often mistaken for the symptoms of other diseases [7]. The purpose of the treatment is to reduce pain and relieve the tension to damaged muscle [8]. MPS is an important disease that needs to be treated by physical therapists specialized in rehabilitation. Moreover, the treatment should be given by focusing on systematic and scientific evidence.

Meta-analysis is an evidence-based analysis method, and its goal is to analyze numerous individual studies done in the same themes to integrate the researches [9]. The strengths of meta-analyses are as follows. First, meta-analysis can make an organized and precise conclusion in integrating a series of research results. Second, meta-analysis can control the numerous flaws and biases in previous research. Third, meta-analysis can evaluate a population. Fourth, meta-analysis can identify the relationships among the research method, research target, scope, condition, and experiment period. On the other hand, meta-analysis has a weakness of focusing on results and ignoring the intervention of the moderating variables or interactions. As a result, meta-analysis may simplify the research result excessively [10]. Nevertheless, meta-analysis can enhance the statistical power by integrating the samples of individual research and testing the hypothesis with larger samples. Furthermore, meta-analysis can find the cause when there are conflicting research results. As a result, meta-analysis is a research method used widely in academia, such as medical science, public health, nursing, and pedagogy [11].

The NDI used in this study is a measuring tool with high reliability ($ICC = .59-.89$) in measuring neck pain [12]. In response, this study used meta-analysis to examine the effects of manual therapy methods and their influence

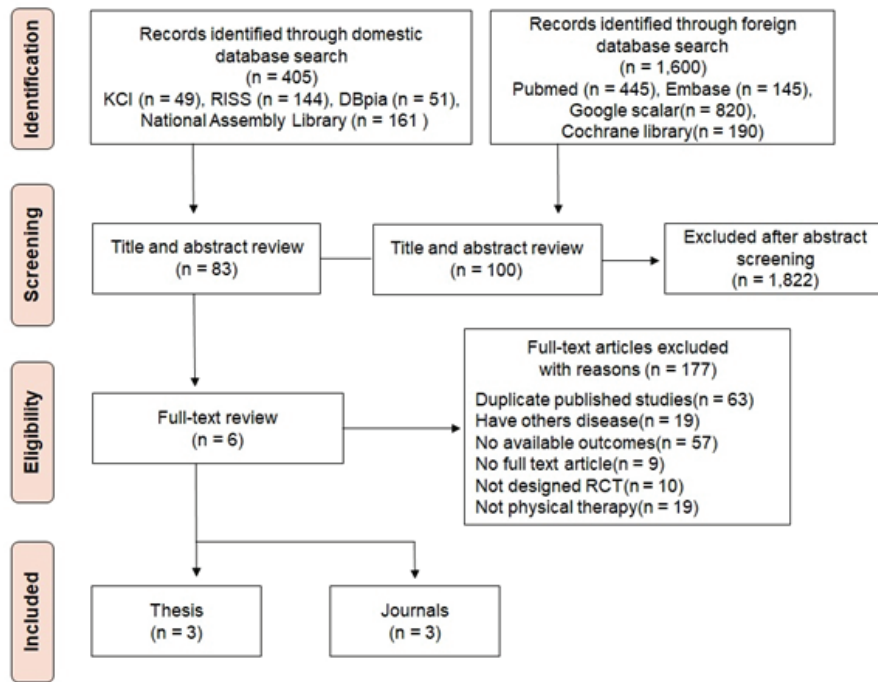
on NDI evaluation in research for MPS on the neck and shoulder and identify the related variables.

II. Methods

The target of this study was the MPS on the neck and shoulder. This study used manual therapy as the intervention method and used different intervention methods from the targeted intervention for the comparative group. The study result was set to the neck disability index, and the study design type was set to the pre/post design experiment.

This study examined the following core question: ‘What is the related variable for physical therapy on MPS?’ Detailed selection standards were as follows: research targeting patients diagnosed with MPS on neck and shoulder, research suggesting an intervention of physical therapy, research suggesting statistical figures, experimental research conducted in a pre / post design, and research conducted within five years from January 1, 2015 to December 31, 2019. The following studies were excluded: research applying diagnosis, drug, injection, acupuncture, or surgery on MPS; research not conducted based on a pre/post design method; research without statistical figures; research without full text or research that was not reported in Korean or English.

The entire process of researching and selecting literature was conducted based on PRISMA systematic review flow chart [13]. This study used four databases, including the Korean Citation Index (KCI), Research Information Sharing Service (RISS), National Assembly Library, and DBpia. One hundred eighty-three papers were searched under the search keyword of ‘myofascial pain’. The current researcher and experts specialized in physical therapy selected the materials. Mendeley and Excel were used to manage the selected studies. The materials were selected by checking the papers under the title and abstract and reviewing the original text in detail based on the selection and exclusion standards (Fig. 1.).



PRISMA: Preferred reporting items for systematic reviews and meta-analysis.

Fig. 1. "PRISMA" flow chart.

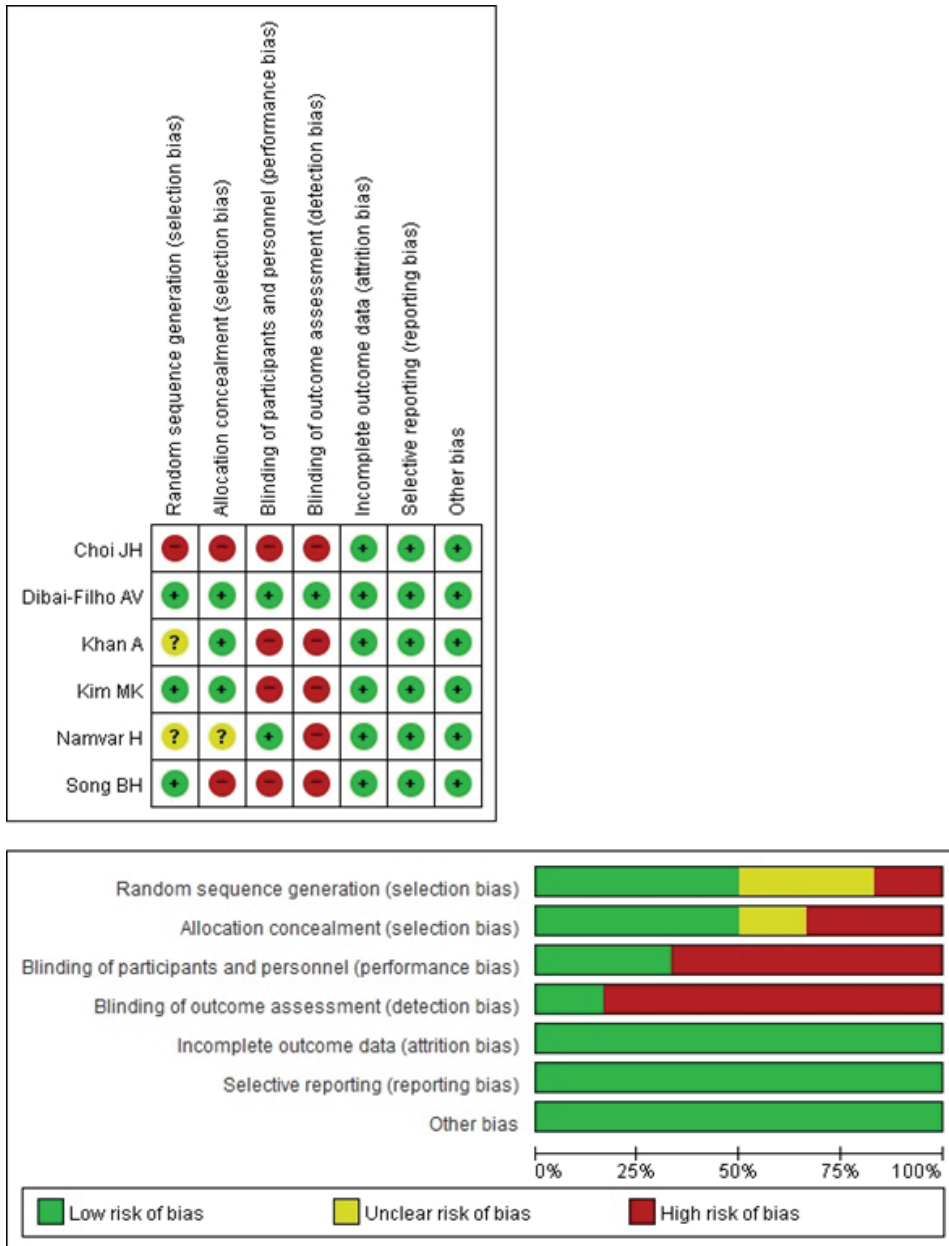
The Risk of Bias Verification Tool developed by the Cochrane Library and Review Manager 5.3 Program was used to evaluate the risk of bias on the 15 finally selected studies (Fig. 2.).

This study used a single-subject (pre-post test) meta-analysis method. Studies with a pre/ post mean and standard deviation for each experiment were selected. The collected materials were entered in Excel in the following order to make a coding sheet: researcher name, therapy method, intervention method, evaluation method, number of participants, therapeutic period, publication year, and thesis title. The coding data was used in the analysis by converting the data into csv file format to use in the R program. The dependent variables were evaluated by combining the evaluations showing positive (Positive number) and negative (Negative number) results. When the VAS showed a negative result, the pre-mean and standard deviation were

replaced with the post-mean and standard deviation to suggest the all-sizes effect of a positive number to solve problems and derive comprehensive results.

R Program package used 'meta' and 'metafor', and each research's different intervention type and risk of bias were large. Therefore, this study calculated the size of the effect by applying a random-effect model. In addition, depending on the type of variables, this study analyzed the moderating effect using Meta-ANOVA on the categorical variables and Meta-Regression on the continuous variables. The effect size was interpreted as the standardized mean difference, and the method of interpreting the modified effect size was the same as Cohen's d interpretation [14].

Heterogeneity refers to the degree of the effect size distribution in each research and the degree of inconsistency. Therefore, the goal of meta-analysis was to understand the heterogeneity of effect size, the whole pattern instead of



Study of risk of bias results.

Fig. 2. Risk of bias.

subtracting the mean of effect size [15]. Q and df were used to test the homogeneity in the effect size between the studies. The rate of heterogeneity is indicated in I^2 . The I^2 statistics represent the rate of variance between the

actual studies for the whole variance and represent the degree of heterogeneity in effect sizes deducted from individual researches[15]. I^2 represents the actual variance (Between studies) for the entire variance (Total observed

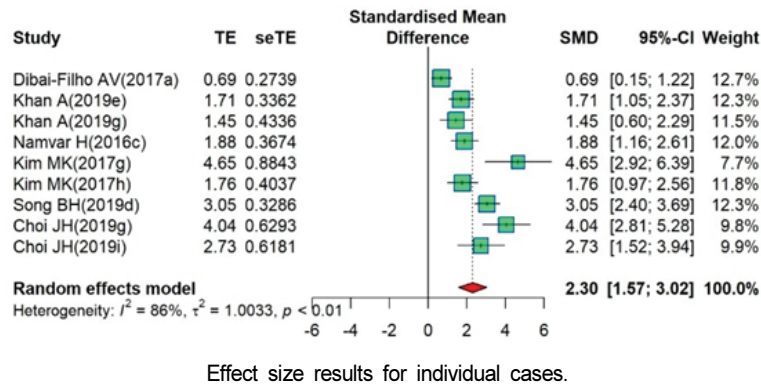


Fig. 3. Overall forest plot.

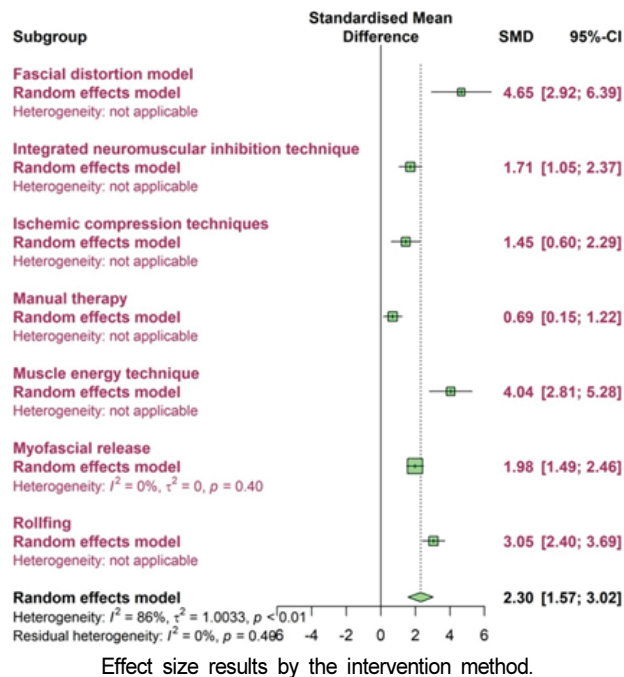


Fig. 4. Intervention forest plot.

variance). In general, I^2 of 25% is interpreted as low heterogeneity, I^2 of 50% as moderate heterogeneity, and I^2 over 75% as very high heterogeneity [16].

III. Results

The total effect size was significant ($p < .001$) with

a large effect size. The heterogeneity was high with I^2 of 85.8% over 75% (Fig. 3). In an analysis of the intervention types, the fascial distortion model was highest with (ES = 4.654), and all were statistically significant at the 95% confidence interval ($p < .001$) (Fig. 4).

Regarding the number of cases, the effect size for the number of patients was high in the number of patients

Table 1. Treatment ES According to the Control Variable

Control Variable	N	k	ES (g)	95% CI		Q (df)	p
				LL	UL		
No. of Participants	> 15	2	1.261	.087	2.435	3.59 (1)	> .058
	≤ 15	7	2.612	1.852	3.373		
No. of Treatments	< 10	5	2.844	1.846	3.843	2.31 (1)	> .129
	≥ 10	4	1.718	.664	2.772		
Publication Type	Journal	4	1.401	.807	1.994	9.48 (1)	< .002
	Thesis	5	3.095	2.194	3.995		

k: Number of effect size; ES: Effect size; 95% CI: 95% Confidence interval
LL: Lower limit; UL: Upper limit

Table 2. Calibration Results for 11 Cases Through "Trim and Fill".

Publication Bias	k	ES (g)	95% CI		Q (df)	p
			LL	UL		
Trim and Fill	11	1.833	1.071	2.596	82.32 (10)	< .001

k: Number of effect size; ES: Effect size; 95% CI: 95% Confidence interval
LL: Lower limit; UL: Upper limit

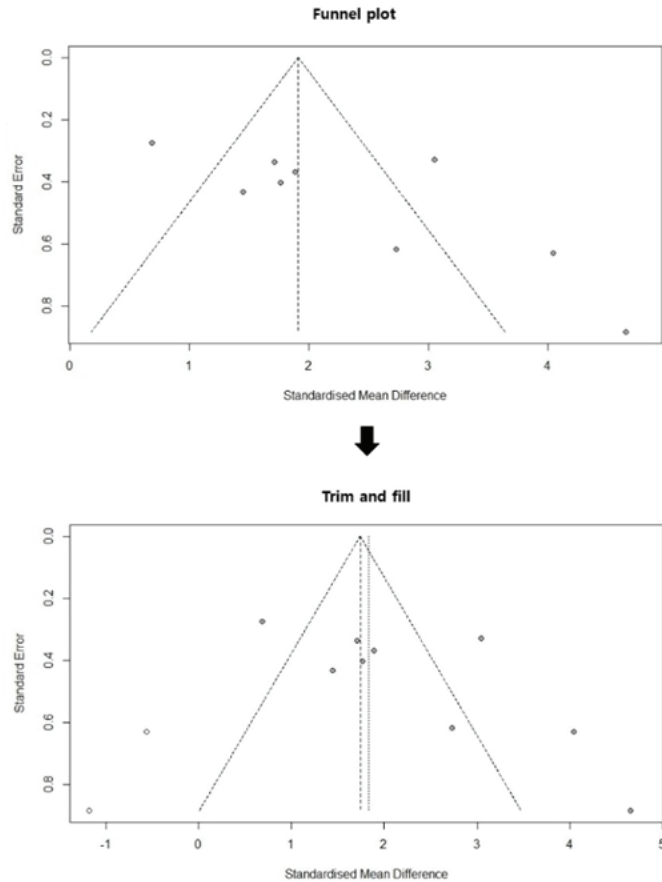
below 15, but the difference was not significant ($p > .058$). With the number of cases and effect sizes for the therapeutic period, the figures were high in less than 10 days, but the difference was not significant ($p > .129$). Regarding the number of cases and the effect size for the publication type, the figures were high in the thesis showing statistical significance ($p < .002$), (Table 1). To analyze the publication error, this study used 'Trim and Fill' and corrected the asymmetry to symmetry [17]. As a result, two cases were added, and the effect size corrected with 11 cases was ($ES = 1.833$), showing statistical significance ($p < .001$) (Table 2) (Fig. 5).

IV. Discussion

This study collected studies that applied manual therapies on MPS of the neck and shoulder and examined the effect on the NDI results and more effective therapeutic methods based on a systematic and integrative meta-analysis.

In this study, the total effect size was ($ES = 2.297$), and the effect size was ($ES = 1.833$) after correcting for the publication bias. This showed that manual therapy largely improved the result of NDI toward MPS on the neck and shoulder. In particular, the effect size of the FDM was large ($ES = 4.654$). According to Kim [18], fascial therapy had a positive effect because of GTO and the function of the muscle spindle. Moreover, the FDM was the fastest and the most effective therapeutic method for controlling the function and pain of MPS. Manual therapy transmits pressure to the muscle to induce intermittent muscular contraction in certain intervals, increase the blood flow rate in the muscle with lower blood flow, supply oxygen and nutrition to lower tension, relieve pain, control sympathetic nerve, and increase movable range [19].

In the moderating variable, the number of cases and effect sizes were high for 15 patients, but the difference was not significant. Therefore, more research on more patients will be needed to make up for the reliability. In



Calibration results for 11 cases through “Trim and Fill”.

Fig. 5. Funnel plot and trim and fill.

addition, the short-term exercise intervention relieved pain and enhanced the body function [20]. On the other hand, more research will be needed to examine the therapeutic effect from a more long-term perspective. In the publication type, the number of cases and effect sizes were high for the thesis. This requires an interpretation considering that this study included both masters and doctorate theses in the thesis group.

To verify the appropriateness of the meta-analysis result, this study corrected the asymmetry to symmetry. By adding the two cases assumed not to be reported due to publication bias, the adjusted effect size was (ES = 1.833), and the 95% confidence interval was (1.071~2.596), showing a

significant result. This study has some limitations. Although the literature was selected by experts and result corrected by utilizing Trim and Fill was suggested to minimize the publication bias, the limit of meta-analysis for publication bias could not be solved completely. Therefore, future research should extend the scope of study and conduct a meta-analysis, including studies of various cases.

V. Conclusion

Manual therapy has a huge effect on the NDI result for MPS on the neck and shoulder and is influenced by the number of patients, therapeutic period, number of

therapies, and publication type. Overall, the study results suggest material for the more effective application of manual therapy systematically and objectively by meta-analysis.

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