Treatment of Chronic Neck Pain Using Different Injections (Comparative Study)

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Abstract: Background: Neck pain is the second most prevalent musculoskeletal dysfunction in the active population. The approach to treatment of neck pain should be conservative and multidisciplinary, and should include education, pharmacological treatment, physical therapy, massage therapy, gentle stretching and exercise. Injections into Trigger point are common and effective treatment in decreasing pain and muscular spasm, increasing ROM and local circulation and cause fibrotic scar formation in trigger points. **Objective:** Our study was aimed to detect the most effective in pain relief in treatment of chronic neck pain with different injections (mesotherapy, prolotherapy and dry needling). **Methods:** This study was conducted at the Department of Physical Medicine, Rheumatology and Rehabilitation in Ain Shams University Hospitals as well as Railway Hospital on 45 patients with chronic neck pain. Their age group 30 to 70 years old and the disease duration ranged from 3 to 36 months. All patients were subjected to history taking, clinical examination, neurological examination and investigations as CBC, ESR and cervical plain x ray. Pain and functional assessment using Northwick park neck pain questionnaire (NPQ), the visual analog scale (VAS), Neck Disability Index (NDI) and chronic pain grade scale (CPGS). All patients were randomly assigned into one of three groups: Group I who received mesotherapy injection, Group II who received prolotherapy injection and Group III who received dry needling injection. **Results:** As regard age, sex and duration of pain there was no significant difference between the three groups. Group I who received mesotherapy, as regard NPQ, NDI, and VAS, there were highly statistically significant difference between the patients before and after injection (improvement) ($p<0.001$). Group II who received prolotherapy, as regard NPQ, NDI, and VAS, there were highly statistically significant difference between the patients before and after injection (improvement) ($p<0.001$). Group III who received dry needling, as regard NPQ, NDI, and VAS, there were highly statistically significant difference between the patients before and after injection (improvement) ($p<0.001$). As regard the percentage of change there was statistically significant difference among group I than group II in the visual analog scale (VAS) and also among group II than group III in Northwick park neck pain questionnaire (NPQ), and the visual analog scale (VAS), i.e. significant improvement in group I versus group II and significant improvement in group III versus group II. There was significant positive correlation between age and duration of pain of all cases before injection. There was significant positive relation in comparison between duration of pain and CPGS before injection. **Conclusion:** The present study showed that the three methods of injection were effective from the first session of injection in treatment of chronic neck pain. The most effective method was the mesotherapy and dry needling over prolotherapy. The three methods of injection were easily and quickly carried out with no local or allergic reactions, but the easiest and least cost method was dry needling. Injection therapy seems to represent an alternative therapeutic technique especially in the presence of other diseases or comorbidities where there is a high risk of drug interaction or when conventional therapy of NSAIDs is contraindicated.

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1. Introduction

Neck pain is an important personal and societal burden, affecting 30–50% of adults in the general population in any given year. Approximately 50–85% of individuals with neck pain do not experience complete resolution of symptoms and some may go on to experience chronic, impairing pain ***(Goode et al., 2010).***

Trigger points can be involved in pain processes in patients with neck pain. Simons et al., 1983 defined an MTrP, as a hyperirritable spot in a taut band of a skeletal muscle that is painful on contraction, stretching, or stimulation and elicits a referred pain distant from the point ***(Muñoz-Muñoz et al., 2012*).**

Injection therapy is found to be effective in decreasing pain and muscular spasm, increasing the range of motion (ROM) and local blood circulation, and cause fibrotic scar formation on trigger points. Local anesthetic, saline, steroid, NSAIDs, botulinum

toxin, and dry needling techniques are used as local injections ***(Ay et al., 2010).***

Local pharmacological therapy; such as local injectable therapies are effective, well tolerated and represent acceptable alternative to systemic NSAIDs. Mesotherapy is a minimally invasive technique that consists of Local Intradermal Therapy (LIT) with pharmaceuticals or other bioactive substances given in small quantities through dermal multi-punctures, where the injection site corresponds to the area of the pathological condition (**Maggiori, 2004).**

Hyperosmolar dextrose or phenol-glycerin-glucose injection, is an irritant substance injected into a joint space, ligament, subcutaneous tissue or tendon insertion site (prolotherapy), is complementary medical treatment, with the main goal being pain relief. Many different solutions have been used through-out the past 100 years that this technique has been in practice. Hypertonic/hyperosmolar dextrose has been successfully used for treatment of enthesopathies with small fiber neuropathies, spondylo-arthropathies, and internal disc derangements ***(Linetsky et al., 2013).***

Dry needling (DN) is a minimally invasive method which is increasingly used for treatment of MTrPs. DN involves inserting a needle into an MTrP without injecting any medication. This technique is reported to be an effective and efficient treatment for reducing somatic pain and dysfunction associated with MTrPs in a muscle ***(Abbaszadeh-Amirdehi et al., 2013).***

Aim of the Work

This study aims to detect the most effective in pain relief in treatment of chronic neck pain with different injections.

2. Patients and Methods

This study included 45 adult patients (30-70 years old) with chronic neck pain (more than 3 months). Patients were selected from outpatient clinics of Physical Medicine, Rehabilitation and Rheumatology Departments, in Ain Shams University Hospitals and Railway Hospital. The study was approved by Committee of Medical Ethics.

Patients with the following criteria were excluded from the study: any neurological manifestations, diabetes mellitus, uncontrolled hypertension, concomitant rheumatic diseases, renal impairment or liver disorders, severe psychiatric illness and seizure disorders and contraindication of injection: allergy to any of the medications, skin pathology at area of injection, pregnancy or breast feeding, recent cervical surgery, tumors, history of coagulation disorders like (Hemophilia, patients on anti-platelets or anti-coagulant drug) and Patients on antiarrhythmic drugs.

All patients subjected to:

1- Full medical history including:

Name, age, gender, marital state, occupation, special habits and residence. Complaint including onset, course and duration, pain profile including: onset, course, duration, character, location, severity, time of day, associated symptoms and triggers (what increase and what decrease). Motor symptoms, sensory disturbances, bladder and bowel disturbances. History of local trauma and allergy to any kind of medication.

2- Clinical examination with special emphasis on:

- **Cervical examination including:**

A. Inspection and palpation of the head and neck.

B. Movements as flexion, extension and lateral rotations and measuring range of motion.

C. Atlanto-axial compression test (Spurling's test).

D. Gait assessment is also important in patients with neck pain, because evidence of myelopathy may appear.

E. Neurological examination of both upper and lower limbs was done.

3- Pain assessment by:

a. Northwick park neck pain questionnaire (NPQ) ***(Leak et al., 1994)***

b. The visual analog scale (VAS) ***(Carlsson, 1983)***

c. Neck Disability Index (NDI) ***(Vernon, 2008)***

d. Chronic pain grade scale (CPGS) ***(Von Korff et al., 1992)***

4- Investigations:

- Complete blood count (CBC) using coulter counter apparatus to exclude any infection or coagulation disorders.
- Erythrocyte Sedimentation Rate (ESR) with Westergern method in (mm) after 1st hour (mm/1st hour) to exclude any inflammatory or rheumatologically disorders.
- Cervical plain X-ray: Anteroposterior (AP) and Lateral views to identify cause of pain.

5- Treatment by injection

- **Classification of patients:**

Patients were randomly classified into three groups for treatment, each group included 15 patients, as follow:

1. Group I received mesotherapy injection.
2. Group II received prolotherapy injection.
3. Group III received dry needling injection.

- **All patients in the three groups were subjected to the following**

1) Instruction to discontinue any ongoing treatments of non-steroidal anti-inflammatory drugs or muscle relaxant for 48 hours before starting the study.

2) To sign an informed consent for approval of the study.

3) To sit in an erect posture with feet on the floor and the hip angle at 90 degree while looking straight ahead.

4) **Identifition of Trigger points:**

Six to ten trigger points were identified at palpation of cervical region as highly localized, hyperirritable spot in a palpable taut band of cervical muscle fibers and according to the criteria of ***Travell and Simons (1983):*** a cord-like taut muscle band containing a discrete nodule, a history of focal tenderness, a local twitch response, and/or a spontaneous exclamation of pain by the patient (`jump sign') as a result of applied pressure.

5) Treatment by injection:

All techniques were under complete aseptic condition, proper hygiene and sterilization using povidone-iodine and Alcohol 70%.

A. Mesotherapy injection technique in Group I patients

- ***Preparation of solution:***

1. 1 ml of 0.9 % normal saline.
2. 1 ml of lidocacine chloridate 10 mg.
3. 2 ml of NSAIDS (ketorlac 30 mg).

- ***Syringe****:* all solution was mixed in 5 ml syringe.

- ***Needle:*** 4 mm needle (30 gauge), disposable and sterile.

- ***Introduction of therapy:*** needle was fully depth inserted (4mm) into the dermis at a 45 degree angle from the skin and 0.4 ml of solution is introduced at the selected trigger points of cervical muscles creating skin bleb using point by point injection technique ***(Hermann et al., 2008).***

B. Prolotherapy injection technique in Group II patients

- ***Preparation of solution:***

1. 1 ml of 0.9 % normal saline.
2. 1 ml of lidocacine chloridate 10 mg.
3. 3 ml of 5% dextrose.

- ***Syringe****:* all solution was mixed in 5 ml syringe.

- ***Needle:*** 0.5 inch needle (28 gauge), disposable and sterile.

- ***Introduction of therapy****:* needle was inserted 10 mm deep, held at a 45 degree angle from the skin, and 0.5 ml of the solution was injected in each trigger point in the subcutaneous tissue while withdrawing the needle to create a skin bleb ***(Conaway et al., 2014).***

C. Dry needling injection technique in Group III patients

- ***Needle*** (0.3 mm diameter x 30 mm length), disposable and sterile**.**

Introduction of needle*:* needle was inserted into the tissues immediately overlying myofascial trigger points (MTrP) to a depth of 10 mm using superficial dry needling injection ***(Baldry, 1995)*** the needle is inserted and withdrawn by means of a rotational movement of the needle for 30 seconds**.**

The needle is then withdrawn, and pressure, equal to that exerted before treatment, is reapplied to the MTrP site to see whether the 'Jump' and 'Shout' reactions have been abolished. If not, the needle has to be reinserted and left in situ for several minutes.

6- All patients in the three groups received one session and reassessed by NPQ, VAS, NDI and CPGS after 2 weeks of injection.

7- Statistical methods

Data were collected, revised, coded and entered to the Statistical Package for Social Science (IBM SPSS) version 23. The quantitative data were presented as mean, standard deviations and ranges when parametric and median with inter-quartile range (IQR) when non parametric. Also qualitative variables were presented as number and percentages. The comparison between groups regarding qualitative data was done by using ***Chi-square test*** and/or ***Fisher exact test*** when the expected count in any cell found less than 5. The comparison between more than two independent groups with parametric distribution was done by using ***One Way ANOVA test***, while non-parametric distribution was done by using ***Kruskall-Wallis test***. The comparison between two independent groups with non-parametric was done by using ***Mann-Whitney test. The student t test: Paired t test*** was used for quantitative varieties to assess the statistical significance difference between two dependent groups with parametric data. ***Wilcoxon Rank test*** was used to compare two dependent groups with non-parametric data. The correlation coefficient denoted symbolically **"r"** defines the strength and direction of linear relationship between two variables. The correlation coefficient between two parametric parameters was calculated by using ***Pearsons Correlation Coefficient.*** The correlation coefficient between two non-parametric parameters was calculated by using ***Spearman Correlation.*** The confidence interval was set to 95% and the margin of error accepted was set to 5%. So, the p-value was considered significant as the following: P-value > 0.05: Non significant (NS), P-value < 0.05: Significant (S) and P-value < 0.001: Highly significant (HS).

3. Results

Our study included 10 drivers (22.2%), 18 office workers (40%), 12 housewives (26.6%), 3 retired (6.6%) and 2 nurses (4.4%).

Comparison between group I before and after injection revealed that there were highly statistically

significant difference (improvement) as regard NPQ, VAS and NDI (P< 0.001 and statistically non significant difference as regard CPGS **(table 2).**

Table (1): Comparison between patient's demographic data in the three groups before injection.

		Mesotherapy No. = 15	Prolotherapy No. = 15	Dry needling No. = 15	F	P-value	Sig.
Age	Mean±SD Range	35.67 ± 8.11 30 – 60	42.53 ± 7.31 31 – 64	38.80 ± 9.06 31 – 56	2.643	0.083	NS

F: One Way ANOVA test

		Mesotherapy No. = 15	Prolotherapy No. = 15	Dry needling No. = 15	X^2	P-value	Sig.
Gender	Male Female	6 (40.0%) 9 (60.0%)	5 (33.3%) 10 (66.7%)	4 (26.7%) 11 (73.3%)	0.600	0.741	NS

X^2: Chi-square test

		Mesotherapy No. = 15	Prolotherapy No. = 15	Dry needling No. = 15	H	P-value	Sig.
Duration	Median (IQR) Range	6 (4 - 12) 3 – 36	8 (4 - 18) 3 – 36	8 (4 - 11) 3 – 18	0.424	0.809	NS

H: Kruskal Wallis test

*** P-value > 0.05: Non significant (NS)**

Table (2): Comparison between group I before and after injection as regard A: NPQ, VAS, NDI and B: CPGS.

A

Mesotherapy		Before No. = 15	After No. = 15	t/z**	P-value	Sig.
Northwick park neck pain questionnaire (NPQ)	Mean±SD Range	55.00 ± 12.94 36.1 – 84.37	34.73 ± 15.74 11.1 – 65.6	8.565•	0.000	HS
The visual analog scale (VAS)	Mean±SD Range	6.40 ± 1.68 4 – 9	3.20 ± 2.62 0 – 8	-3.437**	0.001	HS
Neck Disability Index (NDI)	Mean±SD Range	51.34 ± 11.88 32 – 77.7	34.41 ± 17.73 12 – 75.5	-3.409**	0.001	HS

****: Wilcoxon Rank test; • Paired t- test**

B

Mesotherapy		Before No. = 15	After No. = 15	X^2	P-value	Sig.
Chronic Pain Grade scale (CPGS)	1.0 2.0 3.0 4.0	2 (13.3%) 7 (46.7%) 5 (33.3%) 1 (6.7%)	3(20%) 6 (40%) 5 (33.3%) 1 (6.7%)	0.277	0.964	NS

X^2: Chi-square test

Comparison between group II before and after treatment revealed that there were statistically highly significant differences (improvement) as regard NPQ, VAS and NDI (P< 0.001) and statistically non significant difference as regard CPGS **(table 3).**

Table (3): Comparison between group II before and after injection as regard A: NPQ, VAS, NDI and B: CPGS

A

Prolotherapy		**Before**	**After**	**T**	**P-value**	**Sig.**
		No. = 15	**No. = 15**			
Northwick park neck pain questionnaire (NPQ)	Mean±SD Range	61.48 ± 14.05 40.62 – 84.37	45.12 ± 13.24 18.75 – 65.6	7.058	0.000	HS
The visual analog scale (VAS)	Mean±SD Range	6.40 ± 1.55 4 – 9	4.47 ± 1.55 2 – 7	9.374	0.000	HS
Neck Disability Index (NDI)	Mean±SD Range	51.96 ± 11.39 33.3 – 71.1	36.25 ± 9.93 17.7 – 53.3	8.530	0.000	HS

Paired t- test

B

Prolotherapy		**Before**	**After**	**X^2**	**P-value**	**Sig.**
		No. = 15	**No. = 15**			
Chronic Pain Grade scale (CPGS)	1.0 2.0 3.0 4.0	1 (6.7%) 8 (53.3%) 5 (33.3%) 1 (6.7%)	3 (20.0%) 6 (40.0%) 5 (33.3%) 1 (6.7%)	1.286	0.732	NS

X^2: Chi-square test

Comparison between group III before and after treatment revealed that there were statistically highly significant differences (improvement) as regard NPQ, VAS and NDI (P< 0.001) and as regard CPGS was not applicable **(table 4).**

Table (4): Comparison between group III before and after injection as regard A: NPQ, VAS, NDI and B: CPGS.

A

Dry needling		**Before**	**After**	**t/z****	**P-value**	**Sig.**
		No. = 15	**No. = 15**			
Northwick park neck pain questionnaire (NPQ)	Mean±SD Range	56.04 ± 13.95 28.13 – 81.25	34.16 ± 16.80 12.5 – 65.63	11.207•	0.000	HS
The visual analog scale (VAS)	Mean±SD Range	7.40 ± 1.64 5 – 10	4.13 ± 2.20 2 9	-3.311**	0.001	HS
Neck Disability Index (NDI)	Mean±SD Range	46.76 ± 10.54 28.8 – 64.4	30.02 ± 13.67 11.1 – 55.5	10.629•	0.000	HS

**: Wilcoxon Rank test • Paired t- test

B

Dry needling		**Before**	**After**	**Test value**	**P-value**
		No. = 15	**No. = 15**		
Chronic Pain Grade scale (CPGS)	1.0 2.0 3.0 4.0	1 (6.7%) 10 (66.7%) 3 (20.0%) 1 (6.7%)	1 (6.7%) 10 (66.7%) 3 (20.0%) 1 (6.7%)	NA	NA

NA: Not applicable

Comparison between the three groups before and after injection revealed that there were statistically non significant differences between them as regard NPQ, VAS, NDI and CPGS (P> 0.05) **(table 5-8).**

Table (5): Comparison between the three groups before injection as regard A: NPQ, VAS, NDI and B: CPGS.

A

Before		Mesotherapy No. = 15	Prolotherapy No. = 15	Dry needling No. = 15	F	P-value	Sig.
Northwick park neck pain questionnaire (NPQ)	Mean±SD Range	55.00 ± 12.94 36.1 – 84.37	61.48 ± 14.05 40.62 – 84.37	56.04 ± 13.95 28.13 – 81.25	0.974	0.386	NS
The visual analog scale (VAS)	Mean±SD Range	6.40 ± 1.68 4 – 9	6.40 ± 1.55 4 – 9	7.40 ± 1.64 5 – 10	1.895	0.163	NS
Neck Disability Index (NDI)	Mean±SD Range	51.34 ± 11.88 32 – 77.7	51.96 ± 11.39 33.3 – 71.1	46.76 ± 10.54 28.8 – 64.4	0.950	0.395	NS

F: One Way ANOVA test

B

Before		Mesotherapy No. = 15	Prolotherapy No. = 15	Dry needling No. = 15	X^2	P-value	Sig.
Chronic Pain Grade scale (CPGS)	1.0 2.0 3.0 4.0	3 (20.0%) 6 (40.0%) 5 (33.3%) 1 (6.7%)	3 (20.0%) 6 (40.0%) 5 (33.3%) 1 (6.7%)	1 (6.7%) 10 (66.7%) 3 (20.0%) 1 (6.7%)	3.213	0.782	NS

X^2: Chi-square test

Table (6): Comparison between the three groups after injection as regard A: NPQ, VAS, NDI and B: CPGS.

A

After		Mesotherapy No. = 15	Prolotherapy No. = 15	Dry needling No. = 15	F/H*	P-value	Sig.
Northwick park neck pain questionnaire (NPQ)	Mean±SD Range	34.73 ± 15.74 11.1 – 65.6	45.12 ± 13.24 18.75 – 65.6	34.16 ± 16.80 12.5 – 65.63	2.430 •	0.100	NS
The visual analog scale (VAS)	Mean±SD Range	3.20 ± 2.62 0 – 8	4.47 ± 1.55 2 – 7	4.13 ± 2.20 2 – 9	1.373 *	0.265	NS
Neck Disability Index (NDI)	Mean±SD Range	34.41 ± 17.73 12 – 75.5	36.25 ± 9.93 17.7 – 53.3	30.02 ± 13.67 11.1 – 55.5	0.768 •	0.470	NS

•F: One Way ANOVA test *H Kruskal Wallis test

B

After		Mesotherapy No. = 15	Prolotherapy No. = 15	Dry needling No. = 15	X^2	P-value	Sig.
Chronic Pain Grade scale (CPGS)	1.0 2.0 3.0 4.0	2 (13.3%) 7 (46.7%) 5 (33.3%) 1 (6.7%)	1 (6.7%) 8 (53.3%) 5 (33.3%) 1 (6.7%)	1 (6.7%) 10 (66.7%) 3 (20.0%) 1 (6.7%)	1.675*	0.947	NS

X^2: Chi-square test

As regard comparison between percentage of change in all groups it showed that there was statistically significant difference in VAS (p>0.038) and statistically non significant difference in NPQ (p>0.063) and NDI (p>0.277) **(table 7).**

Table (7): Comparison between the three groups as regard percentage of change as regard NPQ, VAS and NDI

% Change		Mesotherapy No. = 15	Prolotherapy No. = 15	Dry needling No. = 15	H	P-value	Sig
Northwick park neck pain questionnaire (NPQ)	Median (IQR) Range	-33.41 (-58.41 – -21.73) -73.32 – -10.53	-25.92 (-36.34 – -16.03) -60 – -6.15	-50 (-55.56 – -33.38) -69.21 – 0	5.529	0.063	NS
The visual analog scale (VAS)	Median (IQR) Range	-57.14 (-80 – -28.57) -100 – -11.11	-28.57 (-40 – -20) -60 – -12.5	-50 (-60 – -33.33) -75 – 0	6.516	0.038*	S
Neck Disability Index (NDI)	Median (IQR) Range	-27.27 (-57.69 – -19.24) -72.73 – -2.83	-28.54 (-37.55 – -20.05) -55.75 – -10.66	-40.98 (-50 – -33.4) -66.67 – 0	2.565	0.277	NS

H: Kruskal Wallis test

As regard comparison between percentage of change in group I and group II it was showed that there was statistically significant difference in VAS (p>0.028) and statistically non significant difference in NPQ (p>0.120) and NDI (p>0.663) **(table 8).**

Table (8): Comparison between group I and II as regard percentage of change as regard NPQ, VAS and NDI

% Change		Mesotherapy No. = 15	Prolotherapy No. = 15	Z	P-value	Sig
Northwick park neck pain questionnaire (NPQ)	Median (IQR) Range	-33.41 (-58.41 – -21.73) -73.32 – -10.53	-25.92 (-36.34 – -16.03) -60 – -6.15	1.556	0.120	NS
The visual analog scale (VAS)	Median (IQR) Range	-57.14 (-80 – -28.57) -100 – -11.11	-28.57 (-40 – -20) -60 – -12.5	2.203	0.028*	S
Neck Disability Index (NDI)	Median (IQR) Range	-27.27 (-57.69 – -19.24) -72.73 – -2.83	-28.54 (-37.55 – -20.05) -55.75 – -10.66	0.436	0.663	NS

Z: Mann Whitney Test**.**

As regard comparison between percentage of change in group I and group III it was showed that there was statistically non significant difference in NPQ (p>0.633), VAS (p>0.280), and NDI (p>0.548) **(table 9).**

Table (9): Comparison between group I and III as regard percentage of change as regard NPQ, VAS and NDI

% Change		Mesotherapy No. = 15	Dry needling No. = 15	Z	P-value	Sig
Northwick park neck pain questionnaire (NPQ)	Median (IQR) Range	-33.41 (-58.41 – -21.73) -73.32 – -10.53	-50 (-55.56 – -33.38) -69.21 – 0	0.477	0.633	NS
The visual analog scale (VAS)	Median (IQR) Range	-57.14 (-80 – -28.57) -100 – -11.11	-50 (-60 – -33.33) -75 – 0	1.081	0.280	NS
Neck Disability Index (NDI)	Median (IQR) Range	-27.27 (-57.69 – -19.24) -72.73 – -2.83	-40.98 (-50 – -33.4) -66.67 – 0	0.601	0.548	NS

Z: Mann Whitney Test

As regard comparison between percentage of change in group II and group III it was showed that there was statistically significant difference in NPQ (p>0.018), VAS (p>0.048) and statistically non significant difference in NDI (p>0.062) **(table 10).**

Table (10): Comparison between group II and III as regard percentage of change as regard NPQ, VAS and NDI

% Change		Prolotherapy No. = 15	Dry needling No. = 15	Z	P-value	Sig.
Northwick park neck pain questionnaire (NPQ)	Median (IQR) Range	-25.92 (-36.34 – -16.03) -60 – -6.15	-50 (-55.56 – -33.38) -69.21 – 0	2.366	0.018*	S
The visual analog scale (VAS)	Median (IQR) Range	-28.57 (-40 – -20) -60 – -12.5	-50 (-60 – -33.33) -75 – 0	1.974	0.048*	S
Neck Disability Index (NDI)	Median (IQR) Range	-28.54 (-37.55 – -20.05) -55.75 – -10.66	-40.98 (-50 – -33.4) -66.67 – 0	1.867	0.062	NS

Z: Mann Whitney Test

The correlation between age and different parameters before injection revealed that there was a highly statistically significant positive correlation between age and pain duration (p<0.001) and a statistically non significant correlation between age and NPQ, VAS and NDI (P> 0.05). Also comparison between age and CPGS by one way ANOVA test revealed positive relation but not reach statistically significant relation. Correlation between duration of pain and different parameters before injection revealed that there were a statistically non significant correlation between duration of pain and NPQ, VAS and NDI (P> 0.05), but comparison between duration of pain and CPGS by Kruskall-Wallis test revealed statistically significant relation **(table 11- 14).**

Table (11): Correlation between age and duration of pain and other scores of patients before injection.

	Age		
	All Cases		
	r	P-value	Sig.
Duration of pain	0.546*	0.000	HS
Northwick park neck pain questionnaire (NPQ) before	0.214	0.159	NS
The visual analog scale (VAS) before	0.064	0.674	NS
Neck Disability Index (NDI) before	0.234	0.122	NS

Table (12): Comparison between chronic pain grade scale (CPGS): grade before injection as regard age.

		Chronic pain grade scale (CPGS): grade before				F	P-value
		Grade 1	Grade 2	Grade 3	Grade 4		
Age	Mean±SD Range	39.29 ± 11.56 25 – 56	39.05 ± 10.08 27 – 64	41.85 ± 8.09 31 – 62	46.00 ± 12.17 38 – 60	0.579*	0.632

F: One Way ANOVA

Table (13): Correlation between duration of pain and other scores of patients before injection.

	Duration of pain		
	All Cases		
	r	P-value	Sig.
Northwick park neck pain questionnaire (NPQ) before	0.125	0.412	NS
The visual analog scale (VAS) before	0.207	0.173	NS
Neck Disability Index (NDI) before	0.189	0.215	NS

P-value >0.05: Non significant (NS)

Table (14): Comparison between different CPGS before injection as regard duration pf pain

		Chronic pain grade scale (CPGS) before				H	P-value
		Grade 1	Grade 2	Grade 3	Grade 4		
Duration of disease	Median (IQR) Range	6 (3 – 12) 3 – 12	7 (4 – 12) 3 – 36	8 (6 – 10) 4 – 36	24 (9 – 36) 9 – 36	2.873	0.048*

K: Kruskall-Wallis test

4. Discussion

In our study we were motivated to detect the most effective injection methods in relieving chronic neck pain. Our study was conducted on 45 patients, randomly assigned into one of three groups, each group included 15 patients. Patients in group I received mesotherapy injection, patients in group II received prolotherapy injection and patients in group III received dry needling injection. Assessment was done before and 2 weeks after injection by NPQ, VAS, NDI and CPGS.

Our study included 15 males (33.3%) and 30 females (66.6%). The higher incidence in females than males made us to conclude that women are more likely than men to develop neck pain, that was in agreement with ***Côté et al., (2004)*** who did population-based cohort study which included 1100 randomly selected Saskatchewan adults to determine the annual incidence of neck pain and describe its course and stated that women are more likely to suffer from persistent neck problems and less likely to experience resolution.

Also, ***Fejer et al., (2006)*** in their study to determine the prevalence of neck pain in the world population, did a systematic search which reported that women have neck pain more than men in 25 (83%) out of 30 studies.

Our study included age group between 30-70 years old; group I included 15 patients with age ranged from 30 to 60 years old (mean±SD 35.67 ± 8.11), group II included 15 patients with age ranged from 31 to 64 years old (mean±SD 42.53 ± 7.31) and group III included 15 patients with age ranged from 31 to 56 years old (mean±SD 38.8 ± 9.06).

Our patients included 10 drivers (22.2%), 18 office workers (40%), 12 housewives (26.6%), 3 retired (6.6%) and 2 nurses (4.4%). The clinical improvement was observed generally more in males than in females, and in office workers more than other occupations.

Our study agreed with ***Hush et al., (2009)*** study, which estimated the 12 month prevalences of neck pain in office workers was 45.5%. And in a study conducted in 2500 office workers in Sri Lanka by ***Ranasinghe et al., (2011),*** 36% of the participants were found to have complaints of current neck pain. Also, ***Ozer et al., (2016)*** found the prevalence of neck pain in housewives to be high, and concluded that housewives were found to be a risk group in terms of neck pain, explained by, housewives were exposed to extreme demands from family and immediate vicinity and they live a sedentary and monotonous life in society.

As regard mesotherapy injection (group I) in our study, we used (1 ml of 0.9 % normal saline, 1 ml of lidocacine chloridate 10 mg and 2 ml of ketorlac 30 mg, as it more available than others NSAIDS) using point by point technique with 4 mm needle (30 gauge) at the trigger points, showed highly statistically significant difference (improvement) between the patients before and after one session of injection, assessed after 2 weeks, as regard, NPQ, NDI and VAS (P<0.001).

Our results were similar to study done by ***Sciarra et al., (2008)*** which, compared between mesotherapy and analgesic therapeutic exercise in the treatment of chronic neck pain, in 40 patients randomized in three groups, group 1 (10 patients) has undergone therapeutic exercise 3 times a week for 5 weeks, group 2 (20 patients) has been treated by cervical mesotherapy once a week for 5 weeks using lidocaine 2%, lysine acetyl salicylic acid and physiological solution, and group 3 (10 patients) has undergone both treatments for 5 weeks. Results showed a significant beneficial effect on pain and on increasing the normal activity of everyday life in all treatments in relation to time. The goniometric measurements show an improvement of ROM, statistically significant in relation to time, in all three groups.

Sciarra et al., (2008) study concluded that both mesotherapy and therapeutic exercise, even combined, are valid in reducing chronic neck pain, improving (ROM, personal and social) life of the patient but in the 3rd week there is a slight significant difference in flexion in of group I (Mesotherapy).

Similar to our study, a retrospective study was done by ***Ferrara et al., (2017)***, on 220 records compared the short-term and long-term effects of mesotherapy, 110 patients (group D) were treated with the drug cocktail using a mixture of drugs (normal saline solution (1 ml), lidocaine hydrochloride 2% (0.5 ml), and lysine acetylsalicylate (0.5 ml) and 110 (group S) with normal saline solution (NSS) 2 ml in the treatment of patients with chronic spinal pain (CSP).

The drug cocktail used in ***Ferrara et al., (2017)*** study was nearly as to the mesotherapy cocktail used in our study, but the patients in their study received one mesotherapy session/week for 5 weeks, despite patients in our study who received one session of mesotherapy. At the end of treatment, outcome measures showed a statistically significant improvement (P<0.003) in both groups, while the persistence of the statistically significant improvement at 12 weeks of follow-up was in the drug cocktail (group D) than the saline solution (group S) (P<0.05).

Ferrara et al., (2017) concluded that mesotherapy was effective in patients affected by chronic spinal pain, with high patient satisfaction reported irrespective of the agent used. Considering the risks and costs of drugs, normal saline solution appears to be the best agent in cost–benefit terms for treating localized pain by mesotherapy in CSP.

Mesotherapy appears to have three main mechanism of action: the reflex based endorphin production caused by introducing needles, the local effect of the active substances ***(Manchikanti et al., 2013)*** and the mechanical distention of surrounding tissues and sensitive fibers caused by the injected liquid, which suggested by ***Simons and Travell, 1989*** as mechanical damage of muscle fibers and nerve terminations leads to an increase of extracellular potassium, depolarization of nerve fibers, inhibition of central feedback mechanisms, local dilution of nerve-sensitizing substances, increasing vasodilatation, and formation of necrosis in trigger point area and.

As regard prolotherapy injection (group II) in our study, we used (1 ml of 0.9 % normal saline, 1 ml of lidocacine chloridate 10 mg and 3 ml of 5% dextrose) with 0.5 inch needle (28 gauge) subcutaneously at the trigger points, showed highly statistically significant difference (improvement) between the patients before and after one session of injection, assessed after 2 weeks, as regard, NPQ, NDI and VAS (P<0.001).

Also, ***Kim et al., (1997)*** who was similar to our study, concluded that 5% dextrose could be the solution of choice for trigger point injections in a prospective, randomized controlled study comparing 5% dextrose prolotherapy, normal saline and lidocaine 0.5% at trigger point injections. After seven, only the dextrose group showed significantly lower VAS, compared to the normal saline group and the lidocaine group (p<0.01). Also, the increase in pressure threshold with 5% dextrose compared to the other two groups reached statistical significance (p<0.05).

The improvement in the first set of session of prolotherapy in our study were agreed by, ***Kim et al., (2001)*** who treated 67 patients with chronic musculoskeletal pain with two monthly sessions of 15% dextrose prolotherapy. The VAS showed a statistically significant reduction of pain from 7.0 to 4.31 after the first set of injections and went down to 2.55 after the second series of injections and ***Kim et al., (2002)*** did a similar report on 20 patients with chronic musculoskeletal pain treated once with a 12.5% dextrose solution. This study showed that one dextrose prolotherapy treatment reduced VAS by 80%.

Our results were similar to ***Lyftogt in (2007)*** study in which 127 patients with chronic musculoskeletal pain were treated with subcutaneous dextrose prolotherapy. The treatment protocol consisted of weekly injections into all active trigger points and injected subcutaneously with 0.50 ml of a 20% dextrose/0.1% lidocaine solution. The mean length of symptoms was 24 months and the mean length of treatment was seven weeks. The VAS score decreased from 6.7 to 0.76 at 21 month follow-up.

The mechanism of prolotherapy is that the hyperosmolar glucose solutions hyperpolarize nerves by opening their potassium channels, thus causing nerve block decreasing transmission in nociceptive pain fibres. Additionally, hypertonic solutions are thought to produce an inflammatory response through the recruitment of chemical mediators and growth factors that stimulate local healing of injured extra- and intra-articular tissue, thus regenerating weak tendons and ruptured ligaments ***(Hassan, et al., 2017).***

As regard dry needling (Group III) in our study, who received a needle insertion (0.3 mm diameter x 30 mm length) into the tissues immediately overlying trigger points (TrP) by ***Baldry, 1995*** technique, and showed highly statistically significant difference (improvement) between the patients before and after one session of injection, assessed after 2 weeks, as regard, NPQ, NDI and VAS (p<0.001).

Our study were similar to, ***Ay et al., (2010)*** study who did a prospective study to compare the efficacy of local anesthetic injection and dry needling methods on pain using (VAS), cervical range of motion (ROM) measured using goniometry, and depression using Beck Depression Inventory (BDI). Patients were randomly assigned into two groups. Group I (n=40) received local anesthetic injection (2 ml lidocaine of 1%) and group II (n=40) received dry injecting on trigger points. Both patient groups were given stretching exercises aimed at the trapezius muscle to be applied at home.

Ay et al., (2010) results were statistically significant improvements in VAS, cervical ROM, and BDI scores after 4 and 12 weeks in both groups compared to pre-treatment results (p<0.05). No significant differences were observed between both groups (p>0.05), so dry needling was observed to be as effective as local anesthetics in the inactivation of trigger points. The efficacy of injections to the trigger

points was related to reflex mechanisms rather than pharmacologic effects of the solutions.

Our study agreed with study of ***Tekin et al., (2013)*** in which they treated 22 patients with true dry needling using sterile acupuncture needles (0.25mm x 25mm) versus 17 patients treated with sham dry needling using blunted needle which causes a pricking sensation when applied to the trigger points without penetrating the skin and the treatment was composed of six sessions performed in 4 weeks (twice/week for the first four weeks then once/week for another two weeks). The visual analog scale (VAS) and Short Form-36 (SF-36) were used.

The initial values in ***Tekin et al., (2013)*** study, were statistically significant improvement in the dry needling group following the first and sixth sessions as regard VAS scores ($p = 0.000$ and $p < 0.000$, respectively). When improvement compared to sham needling group, VAS scores were found to be statistically significant lower at the second and third assessment in the dry needling group ($p=0.034$ and $p<0.001$, respectively).

In ***Tekin et al., (2013)*** study**,** they used Short Form-36 (SF-36) for assessment of quality of life before and after injection, but in **Our study,** we used assessment measures concerning neck pain intensity and the disability related to that pain so we didn't use Short Form-36 (SF-36), it is an instrument for evaluating general health and related quality of life and not specific for the neck pain.

Comparison between the three groups in our study showed no statistically significant difference ($p>0.5$) between all groups before and after the injection at all the parameters, but **as regard the percentage of change** there were statistically significant reduction in VAS ($p < 0.028$) among group I of mesotherapy than group II of prolotherapy also there were statistically significant reduction in VAS ($p < 0.048$) and NPQ ($p < 0.018$) among group III of dry needling than group II of prolotherapy.

Our results were agreed by short term results of a systematic review and meta-analysis study which conducted by ***Liu et al., (2015)*** and aimed to evaluate current evidence on the effectiveness of dry needling for trigger points associated with neck and shoulder pain. Results suggested that compared with control/sham group, dry needling to MTrPs was effective in short and medium term; however, compared wet needling with dry needling; there were no statistically significant differences observed in short term and the long term; however, significant effects of the comparison were showed in medium term.

Also, ***Paolucci et al., (2016)*** retrospective study, was similar to our study, which was conducted on medical records of outpatients had treated for chronic neck pain (CNP) with mesotherapy with medication or dry mesotherapy in 8 local superficial trigger points of the cervical tract. 42 patients classified into two groups: the drug mesotherapy group (Group A: n=22) who received 1 cc of local anesthetic lidocaine 2% using the same needle we used in our study (30 G 0.4 mm × 4 mm) with the same technique of mesotherapy in our study and the dry mesotherapy Control Group (Group B: n=20) who received, unlike our dry needling group in our study, microinjections performed with the same needle of group A without any drugs.

Paolucci et al., (2016) assessment was done similar to our study using the Visual Analogue Scale (VAS) for pain assessment and Neck Disability Index (NDI) for disability assessment and they used also Verbal Rating Scale (VRS) to measure pain levels, and Short Form-12 Health Survey (SF-12) to evaluate the quality of life. All subjects received 3 treatment sessions, 1 time per week for 3 weeks.

The results of ***Paolucci et al., (2016)*** study showed that at the end of the therapy sessions, highly statistically significant reduction in pain measured by VAS, disability measured by NDI and the SF-12 in group A compared to control group B ($p=0,000$). Also changes measured by VRS was statistically significant reduced more in group A compared to the control group B ($p=0,003$). At 12 weeks after therapy the effect of improvement in pain and disability maintained a statistically significant difference in group A. They revealed that mesotherapy with medications seems to have a good efficacy in CNP; on the other hand, also dry microinjections have a positive effect, not statistically significant, but clinically interesting.

In our study, the statistically significant difference in the percent of change among group I of mesotherapy than group II prolotherapy, made us to suggest that the depth and the route of drug administration play an important role in drug delivery and therefore affect the results, so we agreed ***Milewski et al., (2015)*** study who showed that beyond purely pharmacokinetic considerations, intradermal drug delivery can also produce a difference in the pharmacodynamic response, as compared to the subcutaneous route and demonstrated that systemic uptake from dermis was more rapid as compared to that from the subcutaneous.

For example, Parathyroid Hormone (1–34, PTH) delivered intradermally via drug-coated microneedle patch (ZP patch) demonstrated significant gains in bone mineral density in the lumbar spine as well as the hip over those obtained from a SC-administered PTH (Forteo) as shown in ***Daddona et al., (2011)*** study.

Our study showed significant positive correlation between age and duration of pain of all cases before injection. This is similar to a study was done by ***Leboeuf-Yde et al., (2009)*** who found that pain duration increase with age and become more chronic.

As regard relation between age and CPGS before injection it was found that the grade increased with the increase of the age but it didn't reach statistically significant relation, it may be due to the small sample size of the patients. And **as regard relation between duration of pain and CPGS** before injection, it was found statistically significant relation as the increase in duration of pain lead to increase in grade of CPGS.

Similar to our study, ***Wong and Fielding (2011)*** did comparative perspective study to determine the prevalence of chronic pain in the general population of Hong Kong; (n = 1,731 patients), according to CPGS; grade zero was 2%, grade I was 35%, grade II was 44%, grade III was 15% and grade IV was 6%. The distribution of pain grades was slightly shifted to higher grades in females relative to male respondents, and older pain respondents tended towards more severe gradings relative to their younger counterparts.

As regard NPQ and NDI, they are mostly the same except from some points as (pins and needles or numbness), and duration of symptoms in NPQ and personal care (washing, dressing, etc.) and headache in NDI. But we chose both of them to cover diversity of questions for assessment of pain and disability in patients with chronic neck pain.

As regard CPGS which has been used in epidemiologic studies and clinical trials to evaluate and compare pain severity across groups and in response to treatment effects, and in clinical practice to improve the prognostic judgments of physicians. In our study, results showed no statistically significant difference between groups, it could be due to small number of patients and short duration of follow up. As scores are calculated for 3 subscales: the characteristic pain intensity score, the disability score, and the disability points score, which derived from a combination of ranked categories of number of disability days and disability score over 3-6 months. The 3 subscale scores are used to classify subjects into one of the five pain severity grades.

Local anesthetics are used in the majority of mesotherapy protocols (either lidocaine or procaine) always without epinephrine. Local anesthetics are used for their anesthetic properties that are believed to be longer acting when injected mesotherapeutically. ***Foti and Mahmoud, 2013*** suggested lidocaine to be the anesthetic of choice for mesotherapy as procaine is quite allergenic and has a short duration of action (15-30 min) comparable to lidocaine which has a moderate duration of action (120 min), good potency and is the most versatile and safe local anesthetic agent.

Since some authors consider mesotherapy as an intracutaneous or subcutaneous technique ***(Mammucari et al., 2012);*** subcutaneous prolotherapy which consist of introduction of dextrose into subcutaneous tissue, may considered as mesotherapy. Also, superficial dry needling which consist of introduction of needle into subcutenous tissue may considered as dry mesotherapy.

However, subcutaneously administered drugs may have different pharmacokinetics (diffusion and distribution) and as a result different onset and duration of activity depending on the site of injection ***(Mammucari et al., 2012).***

Also ***Hermann et al., (2008)*** suggested that trigger points mesotherapy develops its therapeutic action through the stimulation of the trigger points (TPs) with a neuroreflex mechanism which integrates the stimulation of the A delta fibres and the free nerve endings of unmyelinated fibers of small size (type c) which, at the level of the posterior horn of the spinal cord, close the "gate", with impulse blockage.

Efficacy of mesotherapy was suggested by ***Kocak (2019)*** that administered drugs via mesotherapy exert local effects close to the inflammatory cells, sensory fibers and vascular mediators. Furthermore, microinjections facilitate the rebalancing of nociceptive system through a series of complex local actions involving nociceptive receptors, nociceptive central feedback mechanisms, and the immune system.

It is better to know source of pain in chronic neck pain; as whatever pathologically and wherever anatomically the source, it will definitely affect the choice of injection therapy from tigger point injections, intraarticular or periarticular injection (e.g. around diseased ligament) and therefore the results.

This study has some limitations, as no placebo group, the sample size was small, single session of injection and short duration of follow up.

Conclusion

The present study showed that the three methods of injection were effective from the first session of injection in treatment of chronic neck pain. The most effective method was the mesotherapy and dry needling over prolotherapy. The three methods of injection were easily and quickly carried out with no local or allergic reactions, less invasive than intradural injection and facet joint injection but the easiest and least cost method was dry needling. Injection therapy seems to represent an alternative therapeutic technique especially in the presence of other diseases or comorbidities where there is a high risk of drug

interaction or when conventional therapy of NSAIDs is contraindicated.

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