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Research Article

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Comparative Study of Methylprednisolone, Platelet-Rich Plasma and Prolotherapy Injections In Management of Shoulder Rotator Cuff Tendinopathies

Dr. Ansh Pal Singh[1], Dr. O. P. Lakhwani[2], Dr Dhruv Suri[3]

[1] Orthopaedic Resident Esic Pgimsr Basaidarapur Delhi.
[2] Hod Orthopaedics Department Esic Pgimsr Basaidarapur Delhi.
[3] Orthopaedic Resident Esic Pgimsr Basaidarapur Delhi.

ABSTRACT

Introduction: RC tendinopathies account for 85% of cases of shoulder pain. Conservative management includes, NSAIDs, Physiotherapy and Local corticosteroid injections. Emerging treatments include local PRP and Prolotherapy injections with the latter one showing promising results. Prolotherapy injections most commonly used are Hyperosmolar dextrose injections (25%) which help in healing of tendinosis and partial tears by stimulating a local inflammatory cascade and release of growth factors and cytokines causing regeneration of connective tissues and tendons. **Methodology**: It was a Prospective Observational Randomized Comparative Double blinded Study with 3 groups having 20 patients each (COR, PRP, PRO). Each patient was assessed clinically and if needed radiologically investigated. All injections were given through a landmark based posterior approach under aseptic precautions and the patient followed up at 3,12 and 24 weeks and pain and functional outcome measured on the basis of VAS and ASES score. **Results**: Median(25th-75th percentile) of visual analogue scale (VAS) on 24th week in COR was 4(3.75-5) which was significantly higher as compared to PRP (3(3-3.25)) (p value=0.007) and PRO(1.5(1-2)) (p value<.0001). Median(25th-75th percentile) of visual analogue scale (VAS) on 24th week in PRP was significantly higher as compared to PRO. (p value=0.0004) Mean ± SD of American shoulder and elbow surgeons shoulder score(ASES) on 24th week in COR was 63.9 ± 12.01 which was significantly lower as compared to PRO (85.75 ± 4.33) (p value<.0001) and PRP (84.55 ± 4.75) (p value<.0001). No significant difference was seen in American shoulder and elbow surgeons shoulder score(ASES) on 24th week between PRP and PRO. (p value=0.631). **Conclusion**: Intra articular shoulder injection is a safe and effective management of shoulder pain. Corticosteroids provide great short term pain relief and improved ROM, but the effect is not well sustained. PRP when injected takes about 6 weeks to show any improvement but with long term follow up of up to 24 weeks there is good amount of pain relief and improved function, the only shortcoming being cumbersome procedure of PRP preparation with many variations in each preparation and reluctance of many patients for venepuncture. Dextrose prolotherapy being a readily available compound in Hospital setting, is a good candidate to provide long term relief in pain with gradual ROM improvement, with no adverse effects even in well controlled diabetics.

Key Words: *Rotator cuff tendinopathy, Corticosteroids, Platelet-rich plasma, Prolotherapy*

***Corresponding Author**
Dr. Ansh Pal Singh
Orthopaedic resident ESIC PGIMSR BASAIDARAPUR DELHI.

INTRODUCTION

Shoulder pain is a common complaint with a reported prevalence of 6.9 to 34% in the general population in different age groups and 21% in those over 70 years of age **(Chard 1991)**. Shoulder disorders account for 1.2% of all general practice encounters, being third only to back and neck complaints in patients reporting to orthopedic OPDs **(Rekola 1993)**[1].

The four most common underlying causes of shoulder pain are rotator cuff disorders (85% of cases), glenohumeral disorders, acromioclavicular joint (ACJ) pathology, and referred neck pain[2].

Rotator cuff (RC) tendinopathies [3,4] are common causes of shoulder dysfunction and pain. Ranging from impingement, tendinitis to tears of tendons (both partial and complete) and subsequent joint injuries. Its cause varies in different age groups.

Rotator cuff tendonitis maybe Acute – caused by direct trauma to the shoulder, poor throw mechanics in case of athletes or by fall on an outstretched hand [5,6,7] ; Chronic tendonitis can be caused by two mechanisms – Intrinsic or

extrinsic.

As popularized by Neer, Extrinsic mechanism of chronic tendonitis in the shoulder occurs due to mechanical impingement and pathological contact between the undersurface of acromion causingrepetitive injury to the cuff[6].

The intrinsic theory of rotator cuff tendinopathies states that increasing age[6], micro vascular compromises[8] and tensile forces on the cuff lead to degeneration of the cuff which makes the cuffsusceptible to extrinsic compressive forces, leading to tendinopathy and tears[9,10].

The prevalence of rotator cuff tears is 25% in those older than 50 years of age [11] and 20% in thoseolder than 20 years of age[12], it can lead to pain and weakness of the shoulder and interfere with sports participation, job performance, and self-care. These conditions are initially treated byanalgesics, and physiotherapy.

Tendons are composed of water which makes up about 40% of its mass, rest of the dry weight of the tendon is 65-80% collagen (Collagen type 1 predominantly) and 15-35% extracellular matrix[13].

Mostly, tendon healing is unsatisfactory with the resultant tendinosis which progresses to partial tear then full-thickness tear[13].

Histopathological study of chronic tendinopathy showed a disturbance in collagen fibers with increased vessel number and leukocyte count denoting inflammatory reaction in chronic tendinopathy[13].

Local Corticosteroid injections have been used for a long time for treating such lesions providing short term relief to the patient by inhibiting the local inflammation, but tendons have limited capacity to repair themselves[14].

Local corticosteroid injections via an anterior or posterior approach, injected into the glenohumeral joint space, sub acromial space, tendons of muscles or on tender points either blindly landmark assisted or ultrasound guided, in various preparations, volumes and combinations provide short term relief[15]. They generally require repetition of injection which carries risks such as tendon atrophy. Emerging treatment includes local infiltration of Platelet rich plasma (PRP) and Hyper osmolar dextrose (Prolotherapy).

Platelet-rich therapies are being used increasingly in the treatment of musculoskeletal soft tissue injuries such as ligament, muscle and tendon tears and tendinopathies. These therapies can be used as the principal treatment or as an augmentation procedure (application after surgicalrepair or reconstruction)[16].

PRP which is a centrifuged blood product that contains a supra-physiologic amount of platelets, containing several cytokines and bioactive factors including basic fibroblast growth factor (FGF2), vascular endothelial growth factor, and transforming growth factor β (TGF). It is implicated in improving proliferation and collagen secretion of tenocytes promoting tendon cell growth and decrease oxidative stress which lead to cell apoptosis[17,18].

Prolotherapy has been used in clinical practice for more than 80 years to treat various chronic musculoskeletal conditions. Formalized by Dr. George Hackett in the 1950s. Prolotherapy is a practical and efficacious therapeutic strategy to treat ligamentous laxity and related musculoskeletal and arthritic conditions[19,20].

Prolotherapy is a regenerative injection therapy that introduces small volumes of a proliferative agent into the insertion sites of the damaged tendon, enthesis, joints, adjacent joint spaces, and ligament, which promotes the growth of normal tissue[21-23]. Although hypertonic dextrose (25%) is primarily used as the agent, polidocanol, manganese, zinc and human growth hormone are alsoused[20].

Currently the mechanism of action of prolotherapy is that the injected prolife rant mimics the natural healing process of the body by initiating a local inflammatory cascade, which triggers the release of growth factors and collagen deposition. This is accomplished when induced cytokines mediate chemo modulation, which leads to proliferation and strengthening of new connective tissue, joint stability, and a reduction in pain and dysfunction[21,23,24].

A study by **Sabaah et al** (2020) What is better for rotator cuff tendinopathy: dextrose prolotherapy,platelet-rich plasma, or corticosteroid injections? A randomized controlled study found Prolotherapy injections improve shoulder ROM, VAS, WORC index, and rotator cuff tendon healing while PRP injections improve WORC index and tendon healing, but steroid injection has no effect on healing.

However, superiority and comparison of these modalities is debatable therefore current study is proposed to compare the local injection of one of the agent steroid methyl prednisolone (MTP) orPlatelet rich plasma (PRP) or Hyper osmolar 25% dextrose solution (Prolotherapy) in cases of Chronic shoulder rotator cuff tendinopathies to evaluate the result in

terms of pain relief and functional outcome.

MATERIALS AND METHODS

Study design - Prospective Observational Randomized Comparative Double Blinded Study.
Venue – ESI PGIMSR and Model Hospital, Basaidarapur.
Duration – December 2020 – May 2023 **Sample size** – 60 (20 each group)

Inclusion criteria –

- Aged 20-60 years had experienced shoulder pain for at least 3 months
- Rotator cuff pathology (bursitis, tendinosis tendinitis, tendinopathies) treated withconservative treatments, analgesics.
- Their condition had been evaluated via clinical and physical examination or confirmedwith suitable investigations as needed.

Exclusion criteria –

- Allergic reactions to disinfectants, local anesthetics, sodium citrate and calcium chloride, acute and chronic infections, any previous shoulder injection, glaucoma, hypertension, systemic allergy, or hypersensitivity, severe renal or hepatic insufficiency
- Any blood dyscrasias
- Malignancy, pregnancy, uncontrolled diabetes
- The presence of a joint prosthesis, joint instability, prosthetic joint
- Significant skin lesions at the proposed injection site
- Severe osteoporosis of bones adjacent to the joint
- Patient suspected of CRPS.

Study design:

The study is planned as a Prospective Observational Randomized Comparative Double Blinded Study in patients with Rotator cuff lesions from orthopedics department and physiotherapy departments. Ethics committee approval will be taken for the study, and a signed informed consentform will be obtained from each patient.

Allotment to groups:

A total of 60 participants with symptoms of Rotator cuff tendon injury will be evaluated betweenDecember 2020 and May 2023. The participants will be randomly assigned by a block randomization as PRO, PRP, COR. Each patient is evaluated before injection, and planned injections will be applied.

Injection method:

The patient sits with their arm resting at their side with the shoulder in neutral rotation resting on their lap. The sulcus between the head of the humerus and acromion is identified. The needle is inserted 2-3cm inferior and medial to the posterolateral corner of the acromion and directed anteriorly towards the coracoid process. An 18 gauge needle should sink completely into the joint and the plunger should push with great ease and no resistance if you are in the glenohumeral joint. If any resistance is encountered, the needle should be withdrawn and readjusted aiming more superiorly under the acromion, as the common error is to inject into the rotator cuff. This should be avoided due to the proteolytic nature of corticosteroids. The same technique is used for all patients.

Patient evaluation:

The patient, and the physician who will evaluate the patient after the injection will not know whichinjection had been applied to the patient. The participants will undergo face-to-face evaluations with the physiotherapist at the clinic at 3,12 and 24 weeks. The standard shoulder strengthening and stretching exercise programs will be given to each group for 6 weeks. After the injection, theparticipants will be told not to take any pain medication other than paracetamol. Among volunteers, who meet the eligibility criteria and included in the study. All injections will be done with sterile 5 mL solutions using a 18 G 38 mm sterile needle.

Prolotherapy injections:

The PRO group will be given 5 mL of prolotherapy solution (a mixture of 4 mL 25% dextroseand 1 mL lidocaine).

Methylprednisolone injections:

The COR group will be given 2 mL 80 mg methylprednisolone, 2 mL 1% lidocaine and 1 mlsaline.

PRP Injections:

PRP is prepared using the literature-based double spin method. A total of 40 mL of blood containing 6 mL of sodium citrate for clotting inhibition is collected for PRP under aseptic conditions. Two centrifugations are performed to obtain 5

mL of PRP (first at 1500 rpm for 6minutes and second at 3500 rpm for 12 minutes). which is used for injection after 30 minutes.

The **VAS** and **ASES** score will be used. The patients scored their pain during abduction and adduction movements on the VAS (0 = no pain; 10 = worst pain). The ASES, one of the most recent evaluations for the shoulder, consists of two parts in which pain (50 points) and function (50 points) are evaluated. For pain, a 0–50 mm scale is used where 0 is unbearable pain and 50 ispain. Function is evaluated as follows: 0 unable; 1 with help; 2 with difficulty; 3 mild impact and4 normal.

Post procedure Protocol:

After giving the injection in the affected shoulder of the patient, patient will be advised to avoid strenuous or prolonged (more than 60 minutes) exercises for the next 2 days along with advice ofcold compression. They will also be informed that they might develop transient pain or swelling after the injection.

Follow up and Assessment

The patients were then followed up at the interval of 3rd week. 12th week, 24th week. We stopped oral analgesic 24hrs before the day of assessment to remove the confounding effectof oral analgesics on this assessment. Tablet PCM 500 mg TDS/SOS given in case of discomfort. Any adverse effects due to the intra articular injections was recorded. Assessment was done using two scores viz. visual analogue score (VAS) and American Shoulder and Elbow SurgeonsShoulder Score (ASES).

RESULTS

Comparison of visual analogue scale (VAS) between COR, PRO and PRP group.

Visual analogue scale (VAS)	**COR(n=20)**	**PRO(n=20)**	**PRP(n=20)**	**P value**
On intial visit				
Mean ± SD	8.7 ± 0.57	8.4 ± 1.23	8.1 ± 0.97	0.119§
Median(25th-75th percentile)	9(8-9)	8(8-9)	8(7.75-9)	COR vs PRO:0.353 COR vs PRP:0.05
Range	8-10	5-10	6-10	PRO vs PRP:0.258
On 3rd week				
Mean ± SD	4.1 ± 1.02	7.55 ± 1.23	6 ± 1.03	
Median(25th-75th percentile)	4(3-5)	8(7-8)	6(5-7)	<.0001§ COR vs PRO:<.0001
Range	3-7	5-9	5-8	COR vs PRP:0.0004
Intra group p value	0.0001**	0.001**	0.0002**	PRO vs PRP:0.007
On 12th week				
Mean ± SD	3.15 ± 0.75	3.2 ± 1.36	3.6 ± 0.88	
Median(25th-	3(3-3.25)	3(2.75-3)	4(3-4)	0.081§

75th percentile)				COR vs PRO:0.729
Range	2-5	1-6	2-5	COR vs PRP:0.081
Intra group p value	0.0001**	0.0001**	0.0001**	PRO vs PRP:0.056
On 24th week				
Mean ± SD	4.1 ± 0.79	1.65 ± 0.75	3.05 ± 0.69	<.0001§
Median(25th-75th percentile)	4(3.75-5)	1.5(1-2)	3(3-3.25)	COR vs PRO:<.0001COR vs PRP:0.007 PRO vs PRP:0.0004
Range	3-5	1-3	2-4	
Intra group p value	0.0001**	0.0001**	0.0001**	

§ Kruskal Wallis test, ** Wilcoxon Signed Ranks Test

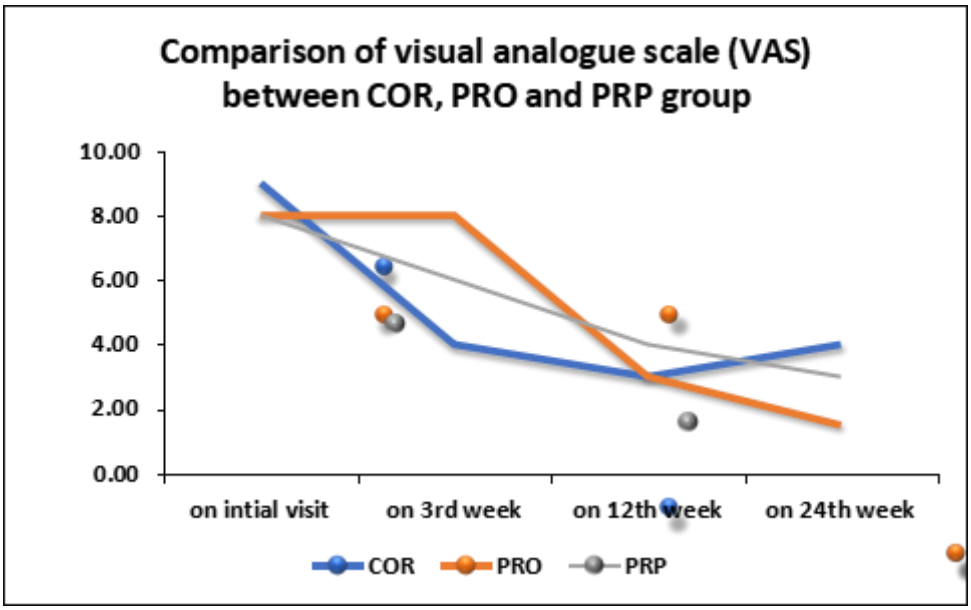

Figure 14:- Comparison of trend of visual analogue scale (VAS) at different time intervalsbetween COR, PRO and PRP group.

No significant difference was seen in visual analogue scale (VAS) on initial visit (p value=0.119)and on 12th week (p value=0.081).

Median(25th-75th percentile) of visual analogue scale (VAS) on intial visit and on 12th week in COR was 9(8-9), 3(3-3.25) respectively, in PRO was 8(8-9), 3(2.75-3) respectively and in PRP was 8(7.75-9), 4(3-4) respectively with no significant difference between them.

Significant difference was seen in visual analogue scale (VAS) on 3rd week (p value<.0001) and on 24th week (p value<.0001).

Median(25th-75th percentile) of visual analogue scale (VAS) on 3rd week in PRO was 8(7-8) which was significantly higher as compared to PRP (6(5-7)) (p value=0.007) and COR (4(3- 5)) (p value<.0001). Median(25th-75th percentile) of visual analogue scale (VAS) on 3rd week in PRP was significantly higher as compared to COR. (p value=0.0004)

Median(25th-75th percentile) of visual analogue scale (VAS) on 24th week in COR was 4(3.75- 5) which was significantly higher as compared to PRP (3(3-3.25)) (p value=0.007) and PRO(1.5(1-2)) (p value<.0001). Median(25th-75th percentile) of visual analogue scale (VAS) on 24th week in PRP was significantly higher as compared to PRO. (p value=0.0004)

Intra group comparison

Significant decrease was seen in visual analogue scale (VAS) at all follow up as compared toinitial visit in all three groups. (p value=0.0001).

It is shown in table 14, figure 14.

Table 15:-Comparison of american shoulder and elbow surgeons shoulder score(ASES)between COR, PRO and PRP group.

American shoulder and elbow surgeonsshoulder score(ASES)	COR(n=20)	PRO(n=20)	PRP(n=20)	P value
On intial visit				
Mean ± SD	24.4 ± 8.78	18.15 ± 7.82	23.1 ± 8.3	0.05‡
Median(25th-75th percentile)	23(17.75-29.25)	15.5(12-22.25)	22(18-29.25)	COR vs PRO:0.051 COR vs PRP:0.623
Range	12-47	7-37	5-42	PRO vs PRP:0.065
On 3rd week				
Mean ± SD	55.8 ± 13.98	34.35 ± 12.45	40.2 ± 13.48	
Median(25th-75th percentile)	60(52.5-65.25)	31.5(25.75-42.25)	36(30-51)	<.0001‡ COR vs PRO:<.0001
Range	24-70	16-56	12-60	COR vs PRP:0.0005
Intra group p value	<0.0001¶	0.0003¶	<0.0001¶	PRO vs PRP:0.17
On 12th week				
Mean ± SD	58.15 ± 13.4	73 ± 10.09	70.3 ± 10.24	
Median(25th-75th percentile)	62(51.5-70)	75(65.25-81)	74(63.5-77)	0.0002‡ COR vs PRO:0.0001
Range	32-72	53-88	52-90	COR vs PRP:0.001
Intra group p	<0.0001¶	<0.0001¶	<0.0001¶	PRO vs PRP:0.455

value				
On 24th week				
Mean ± SD	63.9 ± 12.01	85.75 ± 4.33	84.55 ± 4.75	
Median(25th-75th percentile)	62(55.75-70)	86.5(81.5-90)	85(80-88)	<.0001‡ COR vs PRO:<.0001
Range	40-86	80-92	76-94	COR vs PRP:<.0001
Intra group p value	<0.0001¶	<0.0001¶	<0.0001¶	PRO vs PRP:0.631

‡ ANOVA, ¶ Paired t test

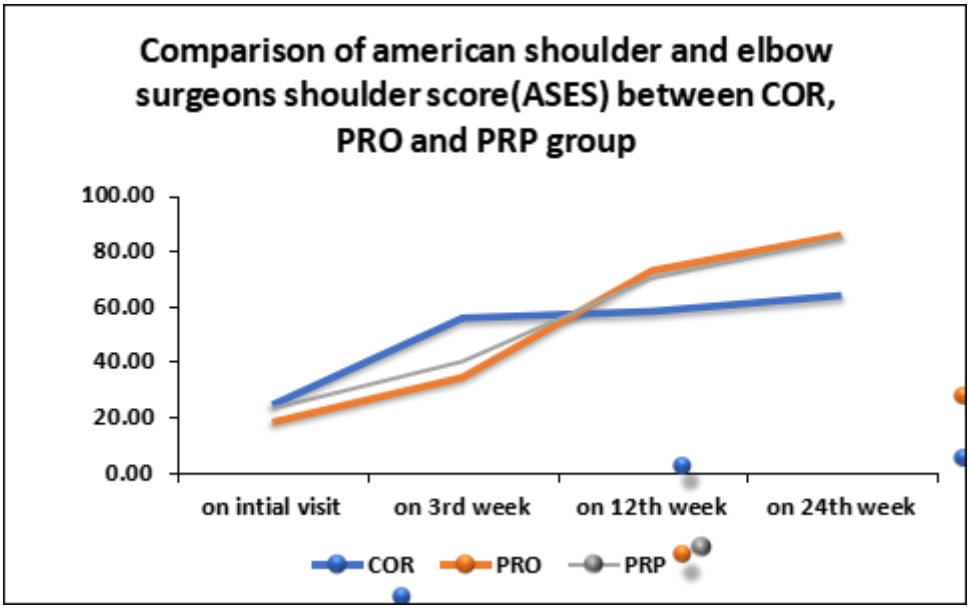

Figure 15:-Comparison of trend of american shoulder and elbow surgeons shoulderscore(ASES) at different time intervals between COR, PRO and PRP group.

No significant difference was seen in American shoulder and elbow surgeons shoulderscore(ASES) on initial visit between COR, PRO and PRP group. (p value=0.05)

Mean ± SD of American shoulder and elbow surgeons shoulder score(ASES) on intial visit in COR was 24.4 ± 8.78, PRO was 18.15 ± 7.82 and PRP was 23.1 ± 8.3 with no significant difference between them.

Significant difference was seen in American shoulder and elbow surgeons shoulder score(ASES) on 3rd week (p value<.0001), on 12th week (p value=0.0002) and on 24th week (p value<.0001) between COR, PRO and PRP group.

Mean ± SD of American shoulder and elbow surgeons shoulder score(ASES) on 3rd week in COR was 55.8 ± 13.98 which was significantly higher as compared to PRP (40.2 ± 13.48) (p value=0.0005) and PRO (34.35 ± 12.45) (p value<.0001). No significant difference was seen in American shoulder and elbow surgeons shoulder score(ASES) on 3rd week between PRP and PRO. (p value=0.17)

Mean ± SD of American shoulder and elbow surgeons shoulder score(ASES) on 12th week in COR was 58.15 ± 13.4 which was significantly lower as compared to PRO (73 ± 10.09) (p value=0.0001) and PRP (70.3 ± 10.24) (p value=0.001). No significant difference was seen in American shoulder and elbow surgeons shoulder score(ASES) on 12th week between PRP and PRO. (p value=0.455)

Mean ± SD of American shoulder and elbow surgeons shoulder score(ASES) on 24th week in COR was 63.9 ± 12.01

which was significantly lower as compared to PRO (85.75 ± 4.33) (p value<.0001) and PRP (84.55 ± 4.75) (p value<.0001). No significant difference was seen in American shoulder and elbow surgeons shoulder score(ASES) on 24th week between PRP and PRO. (p value=0.631)
It is shown in table 15, figure 15.

DISCUSSION

Shoulder pain constitutes a great number of patients presenting to orthopedic OPDs who have no or little relief with chronic NSAID intake with or without adjuvant physical therapy. Hence these patients can be ideal candidates for intra articular injections of corticosteroids, platelet rich plasmaor dextrose prolotherapy.

Corticosteroids have been used since many decades for chronic shoulder pain, with or without rotator cuff injury, and though provide immediate relief and patient satisfaction have a major drawback of not providing any long-term results. They have no effect on the soft tissue healing and tendon recovery and may even weaken them if injected repeatedly.

As for platelet rich plasma, their effect on soft tissue healing in various musculoskeletal pains eg; osteoarthritis of various joints, plantar fasciitis, lateral epicondylitis have been well documented. PRP injections for rotator cuff injuries have been also studied in multiple studies which have shown greater pain relief and better functional outcome in patients as compared to placebo controlgroups and even corticosteroid treated patients. The only shortcoming with PRP injections is the cumbersome process of preparing PRP from the patient's blood. Preparation of PRP is done by various methods, eg; single spin or double spin centrifuging methods, hence non standardization of preparing methods poses another hurdle of PRP injections.

Dextrose prolotherapy injections provide a safe, effective, and easy to administer option for rotatorcuff tendinosis and partial tears. Dextrose prolotherapy injections provide long lasting pain relief and much better functional outcome in such patients. Dextrose 25% being readily available in medical facilities is an inexpensive technique.

An epidemiological study of rotator cuff pathology conducted in 2004 by **White et al** [48] found RC pathology to be more common in females than men, 90 vs 83 cases per 100,000 population as found in our study the female to male ratio was 60:40. With respect to age in whichthis pathology was found to have the highest incidence was 55-59 years with no significant difference between males and females. Another study by **Tempelhof et al** [49] of age related prevalence of RC injuries in asymptomatic shoulders found evidence of a rotatorcuff tear in 23% of the patients in group 1 (aged 50 to 59 years), 13% (22 of 167) of the patients had tears; in group 2 (aged 60 to 69 years), 20% (22 of 108) of the patients had tears; in group 3 (aged 70 to 79 years), 31% (27 of 87) of the patients had tears; and in group 4 (age > 80 years), 51% (25 of 49) of the patients had tears. The peak incidence in our study was found to be between 45 – 50 years, as also in my study only age group of 20 – 60 was included.

On putting hand dominance into perspective, a study conducted by **Milgrom et al** [50] in 1995 found no statistically significant difference between the prevalence of rotator-cuff lesions in each gender for either the dominant or non-dominant arm. Although in our study all right- handed patients (n=54) had symptoms in right shoulder except one, similarly left handed patients (n=6) had symptoms in left shoulder except one of them.

During history taking of the subjects, the most common comorbidity encountered in patients of rotator cuff pathology was diabetes mellitus. It was seen in 14 patients out of 60 patients amounting to around 23.33% patients, of which 12 patients were on oral antidiabetic drugs while 2 were on insulin. A study by **Titchener et al** [51] on comorbidities in rotator cuff pathology found comparable results with 24% diabetics in patients of RC pathology as compared to 13% diabetics in control group. Other comorbidities found that lateral epicondylitis, trigger finger, carpal tunnel syndrome, Achilles tendinitis, insulin use, oral antidiabetic use, oral steroid use, and ''overweight'' BMI of 25.1 to 30 were risk factors for rotator cuff disease. In our study other comorbidities seen were hypertension, coronary artery disease and cancer.

Out of 60 patients enrolled, MRI of the affected shoulder was done in 18 of them. The MRI findings found were, Biceps tendinosis, capsular thickening, partial tear of infraspinatus, partial tear of subscapularis, partial tear of supraspinatus, tendinosis of infraspinatus, suprascapular bursitis, supraspinatus bursitis. Most common finding was partial subscapularis tear which was seen in 5 patients out of 18.

The outcome measures studies in our study were VAS and ASES score which were measured on initial visit, 3rd week, 12th week and 24th week after the injection. As for VAS score for the corticosteroid group it showed a dramatic decrease in the initial weeks of injection with maximumpain relief reported by 9th week of injection after which the pain continued to be of the same intensity or in some cases the VAS score increased minimally. The patients treated with dextroseinjection or platelet rich plasma injection showed minimal decrease in VAS score for the initial few weeks after which the decrease in pain was profound and better sustained pain relief than thepatients treated with corticosteroid.

Alvarez et al [52] conducted a double blinded RCT, on comparison of subacromial injection of betamethasone and xylocaine to xylocaine alone in chronic rotator cuff tendinosis. However, there was no statistically significant difference in scores between the 2 treatment groups for any outcome measurement at any time point, except for active forward elevation at 2 weeks. The VASand WORC scores became better as compared to the initial baseline but on following upto 6 months both groups showed similar scores. As was seen in our study that the improvement of VASand ASES scores was noted but was not well sustained.

Prodromos et al [53] conducted a prospective study of treatment of Rotator cuff tears with platelet rich plasma where dual PRP injections were given for partial rotator cuff tears and tendinosis in patients who had failed conservative management. The study reported global rating scores positive results were seen in 77.9 % of patients at 6 months, 71.6 % at 1 year, and 68.8 % of patients at 2 years. Mean VAS scores improved from 50.2 [CI 44.4–56.0] pre- injectionto 26.2 [CI 19.5–32.9] at 6 months, 22.4[CI 16.1–28.7] at 1 year and 18.2 [CI 12.3– 24.1] at 2 years ($p < 0.0001$ for all). The mean Q- DASH scores (0-100, 100 worse) improved from 39.2 [CI34.3– 44.1] for all patients before treatment to 20.7[CI 15.0-26.4] at 6 months, 18.0[CI 12.9–23.1] at 1 year, and 13.8 [CI 8.4– 18.8] at 2 years ($p < 0.0001$ for all). No patient with partial tear had clinical evidence of progression to full thickness tear. When separated into subgroups based on rotator cuff status, all subgroups showed improvement. Patients in the > 50 % partial tear group had the best overall improvement based on Global Rating scores while those inthe tendinitis group had the poorest outcomes. As in our study the median VAS score decreased from 8 on the initial visit to about 3 after 24 weeks of follow up, as for the ASES score the median score observed in PRP group was 22 which increased to about 85 after 24 weeks of follow up. Both the improvement in VAS and ASES scores was statistically significant and higher as compared to the patients given corticosteroid injections.

Bertand et al [45] found in their study participants with symptomatic ultrasound- confirmedrotator cuff tendinopathy receiving physical therapy found that dextrose prolotherapy significantlyimproved the number of participants who achieved a clinically- important improvement compared to superficial saline injection above painful entheses, with intermediate 234 results for saline injection of entheses, confirming the primary hypothesis. At 9 months 59% of the case group maintained a 2.8 or more improvement in pain compared to 27% of the control group. Participant satisfaction was significantly more in the patients given dextrose injections than in the superficial saline injection group. However, there were no differences of significance either within groups orbetween groups for changes over time in degenerative findings on systemic interval ultrasound grading of rotator cuff tendinopathy. The intermediate performance of enthesis injection with saline is potentially consistent with a therapeutic effect from the direct needling of entheses. As found in our study that dextrose prolotherapy provided the greatest pain relief and best functional outcome in patients with rotator cuff tendinopathy in terms of VAS score and ASES score. The improvement in such patients wasfollowed till about 6 months, hence the effect was long lasting as compared to the corticosteroid group. No imaging study was performed during follow up of patients in our study hence no comment can be made on the improvement of degenerative changes in the shoulder if any.

Wang et al [54] conducted a comparative study of corticosteroid vs PRP for conservative management of rotator cuff lesions where six RCTs were included in this systematic review. Meta- analysis revealed that corticosteroid injection yielded statistically significant superior functional recovery (SMD=0.80; 95% CI, 1.42 to 0.18; P=.01) and pain relief (MD=1.59; 95% CI, 0.30– 2.89; P=.02) compared with PRP injection for rotator cuff lesions during the short- term follow- up period. However, at the medium term and long-term follow-up, no statistically significant difference was identified between the 2 groups. Regarding the ROM of shoulder, no statistically significant difference was found between the 2 groups during the whole follow- up period. As found in our study that corticosteroid injection provided superior pain relief and functional outcome during initial weeks of follow up but PRP fared far better after 24 weeks of follow up both in terms of VAS and ASES score improvement.

Nasiri et al [55] conducted a clinical trial comparison of the Effectiveness of Ultrasound- Guided Prolotherapy in Supraspinatus Tendon with Ultrasound-Guided Corticosteroid Injection of Subacromial Subdeltoid Bursa in Rotator Cuff-Related Shoulder Pain where both corticosteroid and dextrose prolotherapy ultrasound-guided injections in conjunction with a home exercise program are effective in the management of RC-related shoulder pain in both short-term (3 weeks) and long-term (12 weeks) with neither being superior to the other. Therefore,prolotherapy can be an alternative injection to CS due to the lack of steroid's side effects. As compared to our study where long term follow up was done of upto 24 weeks yielded far superior results in patients receiving prolotherapy injections as compared to the patients receiving steroid injections.

Sabaah et al [47], What is better for rotator cuff tendinopathy: dextrose prolotherapy, platelet-rich plasma, or corticosteroid injections? A randomized controlled study found regarding visual analog scale (VAS), it was significantly ($p < 0.001$) improved after injection among group 1 (prolotherapy group) and group 3 (steroid group) patients, while no significant improvement wasnoted among group 2 (PRP group) ($p = 0.212$) patients. The Western Ontario Rotator Cuff (WORC) Index significantly improved among the studied groups ($p < 0.001$, $p = 0.049$, and $p < 0.001$, respectively) after injection. Regarding the range of motion (ROM), a significant improvement ($p = 0.029$) was achieved in group 1 after

injection, but no significant improvements were noted among group 2 and 3 patients (p = 0.529 and 0.121, respectively). There was a significant improvement among group 1 and 2 patients (p < 0.001 and p = 0.020, respectively) regarding the grade of tendon lesions but no improvement occurred among group 3 patients (p = 0.470). The results found in prolotherapy group in our study were like this study, but no commenton radiographical evidence of tendon healing could be made due to lack of post injection radiographic evaluation in our study. In contrast to this study the PRP group in our study reported similar results as the prolotherapy group about pain and functional outcome. Corticosteroid injection receiving patients had similar finding as in the above referenced study.

CONCLUSION

- All patients presenting with complaints of shoulder pain not relieved by NSAIDs and physical therapy can be candidates for intra articular shoulder injections unless contraindicated.
- Intraarticular shoulder injections of various agents provide good pain relief and functional outcome providing adequate patient satisfaction.
- Of the great number of agents available for injection, Corticosteroids, PRP and Dextrose 25% are the three most widely used agents.
- Corticosteroids provide great short term pain relief and improved ROM, but the effect is not well sustained.
- PRP when injected takes about 6 weeks to show any improvement but with long term follow up of up to 24 weeks there is good amount of pain relief and improved function, the only shortcoming being cumbersome procedure of PRP preparation with many variations in each preparation and reluctance of many patients for venepuncture.
- Dextrose prolotherapy being a readily available compound in Hospital setting, is a good candidate to provide long term relief in pain with gradual ROM improvement, with no adverse effects even in well controlled diabetics.
- Pre injection imaging of the shoulder could not be done of all participants due to resourceconstraint in Government hospital setting.
- Due to unavailability of imaging in follow up period healing potential if any could not be proved objectively.
- Sample size was quite less due to time constraint.
- Weighting of the ASES score favors the domains of pain and patient-reported function andis an arduous score to calculate each time.

CONFLICT OF INTEREST – None

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