ORIGINAL ARTICLE:

Grip Strength Test: A Simple Functional Adjunct Tool for Rheumatoid Arthritis

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ABSTRACT:

Objective: To evaluate the usefulness of Grip Strength Test as an adjunctive tool for patients having rheumatoid arthritis. Materials And Methods: A twenty four (24)-week, single-blind, interventional, prospective study was carried out from October, 2009 to March, 2011 in 126 patients of either sex, between 19-64 years of age. They were diagnosed to have rheumatoid arthritis according to the American College of Rheumatology Criteria. They were given tablet Methotrexate, 10 mg (4 tablets of 2.5 mg, orally) weekly for six months. Grip strength was measured by pneumatic method. Patients were made to compress a locked, aneuroid, sphygmomanometer cuff, inflated to 20 mm of Hg, in their palms. The level of pressure reached was recorded as a measure of grip strength.

Results: All patients had morning stiffness, symmetric arthritis, soft tissue swelling and arthritis of hand joints. Baseline values of Hb, TLC, ESR, PC, CRP serum creatinine and SGPT were 10.76 ± 1.12 g/dl, 8572.06 ± 1445.08 per cubic mm, 81.03 ± 17.98 per cubic mm, $290,277.78 \pm 68,813$ per cubic mm, 2.33 ± 0.69 microgram/dl, 0.95 ± 0.16 mg/dl, and 31.67 ± 7.37 IU/L respectively. Grip Strength increased from a baseline of 71.10mm of Hg to 154.04mm ofHg in the right hand and from 70.58mm of Hg to 151.53mm ofHg in the left hand, both values being significant statistically [$p < 0.001$].

Conclusion: Grip strength test is a useful, simple, effective, functional, adjunct tool for assessing patients's response to therapy in rheumatoid arthritis.

Keywords: Grip Strength, Pneumatic Method, Adjunct Tool, Hand Joints, Rheumatoid arthritis.

INTRODUCTION:

Rheumatoid arthritis (RA) is a chronic, systemic, progressive, autoimmune disease in which joint destruction, with resultant loss of function, leads to deterioration in health-related quality of life[1]. It has 1% prevalence world wide, with the greatest incidence between 40 and 50 years and affects women three to five times as often as men[2]. Almost one-sixth of the world population lives in India and Pakistan with prevalence rates of 0.5% and 0.2-1% respectively[3].

In autoimmune diseases, affected individuals have a defect in the ability to distinguish foreign molecules from the body's own. Genetic association with (HLA-DR4)[4], cigarette smoking, use of decaffeinated coffee,[5] presence of Herpes virus, Epstein-Barr virus and Human Herpes Virus- 6 infections[6] are all risk factors and make a person susceptible to RA. In RA, monocytes are attracted to the joints where they differentiate into macrophages and become activated. They secrete tumor-necrosis factor (TNF), interleukin- 1, 6 and 8 (IL-i, IL6, IL-8). Growth factors such as granulocyte—macrophage colony-stimulating factor (GMCSF) and matrix metallo-proteinases (MMP5) contribute further to cartilage and bone destruction[7]. Patients present with joint inflammation and constitutional symptoms like fever, malaise, anorexia, weight loss, pain, local edema, synovial thickening and joint erosion[8]. They have painful, symmetrical joint involvement, initially of the hands, feet and cervical spine with shoulders and knees becoming involved later on. There is morning stiffness. Rheumatoid nodules are seen in 20-30% of patients and are indicative of a poor prognosis. Eventually, synovitis and resultant joint erosion leads to deformity and loss of function[9]. Extra-articular manifestations occur in about 15% of individuals[10].

There is no single test available to diagnose rheumatoid arthritis. Instead, the diagnosis is based upon the combination of American College of Rheumatology criteria [1987][11] (Table 1), physical examination, the results of laboratory tests and x-rays.

Rheumatoid arthritis is usually treated with Methotrexate, Leflunomide, Penicillamine and Cyclosporine etc. along with NSAIDs and Corticosteroids (where and when needed). In our clinical set-ups, the patients presenting with this disease are not too well-off. The repeated visits and laboratory tests, as well as the cost of drugs, proves to be a great financial burden, resulting in frequent drop-outs from therapy. Inadequate patient compliance thus leads to a subsequent increase in morbidity. Present study was designed to evaluate the usefulness of Grip Strength Test as an adjunctive tool in monitoring the patients' response to therapy.

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MATERIALS AND METHODS:

This twenty four (24)-week, interventional, prospective, single-blind study was conducted from October, 2009 to March, 2011 as a part of requirements for the award of MPhil degree. The study was approved by the Institutional Review Board (IRB) and Board of Advanced Studies and Research (BASR), Dow University of Health Sciences (DUHS). It was carried out on patients visiting the out-patients department of a private consultant's clinic in Karachi. 170 patients fulfilling the American College of Rheumatology criteria were enrolled after a written, informed consent. They were given tablet Methotrexate, 10 mg weekly (4 tablets of 2.5 mg, orally) and were advised to return for follow up at 6, 14 and 24 weeks (3 times). Baseline values of hemoglobin (Hb), total leucocyte count (TLC), erythrocyte sedimentation (ESR), platelet count (PC), C-reactive protein (CRP), serum creatinine and serum glutamic pyruvic transaminase (SGPT) were carried out as the drugs used to treat RA can adversely affect them and changes in these parameters help guide the treating physician in tailoring the dose of the medications. They also helped in excluding patients with co-morbids. Financial aspects were mainly catered to by the researcher with minimal burden on the study participants.

Grip Strength:

Disability in patients of rheumatoid arthritis has been associated with loss of hand grip strength and function[12]. Grip Strength Test is one of the methods used to assess and monitor patient response to therapy. It involves the measurement of the force or power exerted by a person while compressing a rolled-up, sphygmomanometer cuff. Results of grip strength testing have been used to determine a baseline measure of performance against which changes following therapy can be compared [13] The grip strength in normal subjects lies mostly between 300 and 600 mm. of Hg. In patients with rheumatoid arthritis the grip strength was seen to be less than 200 mm. of Hg, depending on the severity of the involvement of hand joints[14]. To assess grip strength a pneumatic type of apparatus was used in which an aneuroid, adult, sphygmomanometer cuff was evenly rolled to conform to a normal, functional,

hand position for grip. A rubber band was placed around each end of the cuff to hold it in position. The cuff was then inflated to 20 mm of Hg, which was the starting position for measurement of each subject.

Pre-requisites:

A standard testing position approved by the American Society of Hand Therapists (ASHT) is recommended[15]. This requires that the patient sit in a straight-backed chair with the feet flat on the floor, the shoulders adducted in a neutral position and the arms unsupported. The elbows should be flexed at 90 degrees with the forearm and wrist rotated in a neutral position and the fingers flexed, as needed for maximal contraction. The patient should breathe in through the nose and blow out through pursed lips as a maximum grip effort is made for 3 seconds[16]. A prior demonstration of how to perform the procedure should be given.

STATISTICAL ANALYSIS:

The results are shown as mean ± SD. P-value of < 0.05 was considered to be statistically significant.

RESULTS:

A total of 170 patients were enrolled out of which 126 completed the study, with the rest being lost to follow up due to their own reasons. Of the 126 patients 37 (29.4%) were males and 89 (70.6%) females. All of them had morning stiffness of more than 60 minutes duration, swelling of the involved joints along with symmetric arthritis and arthritis of the hand joints. Their mean age was 35.76 years ± 10.47 with a range of 19-64 years (Table 2). The mean baseline grip strength in the right hand was 71.10 ±16.49 mm of Hg while that in the left hand was 70.58 ± 16.81 mm of Hg (Table 2). The values of baseline laboratory investigations like Hb, TLC, ESR, PC, CRP, serum creatinine and SGPT (Table 3).

The grip strength in the right hand rose from the baseline value of 71.10 mm of Hg to 154.04 ±19.76 mm of Hg with p<0.001, while the grip strength in the left hand rose from the baseline value of 70.58 mm of Hg to 151.53 ± 16.15 mm of Hg with p<0.001. Both values were found to be significant statistically (Table 4).

Table 1
The American College of Rheumatology Classification Criteria

S. No.	Parameter	Features
1	Morning stiffness	>1 hour most mornings
2	Arthritis and soft-tissue swelling	of > 3 of 14 joints/joint groups
3	Arthritis of hand joints	
4	Symmetric arthritis	
5	Subcutaneous nodules	
6	Rheumatoid factor	Present
7	Radiological changes	suggestive of joint erosion

Criteria 1-4 should have been present for at least 6 weeks.

At least 4 criteria have to be met for classification as Rheumatoid arthritis

Table 2
Demographic data & baseline Grip Strength
(N=126)

S.No.	Parameter	No (%)
1	Gender	
	Male	37 (29.4)
	Female	89 (70.6)
		Mean +_SD
2	Age	35.76 + 10.47
3	Grip strength (mm of Hg) Right hand	71.10 + 16.49
4	Grip strength (mm of Hg) Left hand	70.58 + 16.81

Table 3
Laboratory parameters (Baseline values)
(N=126)

S.No.	Parameter	Baseline values Mean ± SD
1	Hb (g/dl)	10.76 ± 1.12
2	TLC (per cubic mm)	8,572.06 ± 1,445.08
3	ESR (per cubic mm)	81.03 ± 17.98
4	PC (per cubic mm)	290, 277.78 ± 68, 813 .68
5	CRP (microgram/dl)	2.33 ± 0.69
6	Serum creatinine (mg/dl)	0.95 ± 0.16
7	Liver Enzyme (sgpt, IU/L)	31.67 ± 7.37

Table 4
Comparison of grip strength values at baseline and 24 weeks
(N=126)

Right hand Baseline values (Mean ± SD)	(mm of Hg) 24 weeks (Mean ± SD)	P value	Left hand Baseline values (Mean ± SD)	(mm of Hg) 24 weeks (Mean ± SD)	P value
71.10 ± 16.49	154.04 ± 19.76	< 0.001	70.58 ± 16.81	151.53 ± 16.15	< 0.001

DISCUSSION:

It has been noted that people suffering from RA have demonstrated a 5-10 year reduction in their life span[17] along with a doubling of the risk for cardiac diseases[18]. Hence an early diagnosis with institution of immediate treatment with disease-modifying, anti-rheumatic drugs (DMARDs) is required to prevent the onset of deformities and morbidity in RA. Despite this a large number of patients exhibit evidence of impaired activities of daily living with almost 33% of sufferers disabled after 5 years of disease and almost half having substantial functional disability after 10 years[19]. Tilley et al conducted a 48-week, randomized, double-blind, multi-center trial to determine the efficacy and safety of Minocycline in rheumatoid arthritis. This MIRA trial was a placebo-controlled trial comparing Minocycline (mean age ± S.D. 55 ± 12.8 y, 76% women,

Eberhardt studied 183 patients with recent onset RA taking part in a longitudinal study initiated at Lund in 1985. There were 116 females (64%) with a mean age ± S.D. of 51.4 ± 12.4 years and grip strength was measured by a sphygmomanometer. They received either D-Penicillamine, antimalarial drugs or methotrexate. Grip strength values at the end of two years showed significant changes with p values of< 0.07[21].

Clark et al studied 126 patients with early rheumatoid arthritis in a double-blind, randomized trial over 24 weeks, who were randomly assigned to receive hydroxychloroquine, 400 mg/d, or placebo. Grip strength was assessed using a sphygmomanometer with a standard grip bag. The patients showed a 22% greater mean improvement with a p value of 0.01[22].

In a trial of the therapeutic effectiveness of flurbiprofen, contrasting different times of day and frequencies of administration grip strength was measured with an inflatable, grip bag, attached to an aneuroid sphygmomanometer. It was inflated to an initial pressure of 20 mm of Hg. The researchers found that grip strength was minimal in the morning when subjective pain and stiffness scores were highest and it consistently decreased with increasing pain and stiffness making it a valid measure of symptom severity[23]. Ferraz and colleagues evaluated the degree of morning variation in assessment of grip strength in patients with rheumatoid arthritis and their results also showed significant changes[24]. All the above mentioned studies were carried out on diagnosed patients of RA with the Grip Strength Test being a common denominator. The changes seen in the grip strength test in these studies are comparable to those seen in our study and indicate the usefulness of the grip strength test in monitoring the patients' response to therapy in RA. Wessel conducted a systematic review of related articles to evaluate the efficacy of hand exercises for persons with rheumatoid arthritis by searching the databases of Medline, Cumulative Index to Nursing and Allied Health Literature (CINAHL), EMBASE, PEDro, and Cochrane. He concluded that grip strength should be used along with other parameters in patient assessment[25]. It is an easy-to-perform, reliable, reproducible, non-invasive test which does not cost the patient anything[26]. Appropriate key words and phrases were put into PubMed, Medline, Google Search etc. and the authors have not found any study against the grip strength test. This again emphasizes the effectiveness of this simple test.

In patients with RA follow-ups entail a financial burden. The patients have to undergo various blood tests repeatedly. In our study, where the patients are generally not well off, this frequently results in patients dropping out from therapy or wandering from one doctor to the other in search of rapid relief. A monitoring tool that is easy to perform, takes very little time of a busy consultant or physician, is reliable and, most importantly, is free of cost to the patient would go a long way in lowering the patient drop-out rate and subsequent morbidity and mortality. Grip strength is one such available tool which can be a part of the armamentarium of a physician or rheumatologist. It can be used for monitoring the response of patients to therapy and at the same time it can be used to minimize the costly laboratory investigations by ordering them only at times when they are actually required.

CONCLUSION:

Grip strength test is a useful, simple, effective, functional, adjunct tool for assessing patients' response to therapy in rheumatoid arthritis. Furthermore it is a non-invasive and costeffective test suitable for use in clinical settings of a resource-poor country like Pakistan. Multi-center studies with large sample size are open horizons for future research.

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