# *Original Article*

# Effect of Ultrasound Therapy on Patients With Osteoarthritis of The Knee Joint

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## *Abstract*

***Background:*** *Osteoarthritis (OA) is the most common form of arthritis accounting for about 30% of general physician visits.*

***Objectives:*** *To detect the effects of ultrasound therapy on patients with osteoarthritis of the knee joint.*

***Methodology:*** *It was a prospective non randomized clinical study, conducted in the Department of Physical Medicine and Rehabilitation, Bangabandhu Sheikh Mujib Medical University, Shahbagh, Dhaka during the periods of 1st March, 2012 to 31st August, 2012. Fifty four patients between 35-75 years of age without consideration of gender with a history of not less than three months knee pain with radiographic confirmation of primary osteoarthritis were selected purposefully. Then they were divided randomly in group A & group B. Group A received → NSAID [Aceclofenac 100mg B.D.-10 days]+Omeprazol (20mg B.D.-10days) + Therapeutic exercise + ADL and Group B received →UST+NSAID [Aceclofenac 100mg B.D.-10 days]+ Omeprazol (20mg B.D.-10days) + Therapeutic exercise + ADL. In both groups the patients were observed for six weeks. Outcome measured by VAS, ROM, 50 feet walking time and WOMAC index.*

***Results:*** *Mean ± SD of age in group A and group B were 52.33 ± 9.62 years and 52.29 ± 9.67 years respectively. Among the 27 patients in group A 9 (33.3%) were male and 18 (66.7%) were female. Among the 27 patients in group B 10 (37.0%) were male and 18 (63.0%) were female. Mean ± SD of VAS during pre treatment in group A and group B were 6.22 ± 1.60 and 7.15 ± 1.56 respectively. Mean ± SD of ROM during pre treatment in group A and group B were 117.33 ± 13.05 and 112.37 ± 19.01 respectively. Mean ± SD of time taken to walk 50 feet during pre treatment in group A and group B were 18.22 ± 2.39 and 18.81 ± 2.13 minutes respectively. Mean ± SD of WOMAC index in group A and group B were 60.85 ± 15.86 and 67.33 ± 16.33 minutes respectively. After treatment in both groups VAS, time taken to walk 50 feet and WOMAC index gradually decreased and ROM gradually increased.*

***Conclusion:*** *Although the study conducted with small sample size in a single centre in Dhaka city which may not be representative for the whole country it was found that there was statistically significant difference found in VAS, ROM, and time taken to walk 50 feet and WOMAC index between the groups.*

***Keywords:*** *UST, OA Knee, NSAID.*

## Introduction

Osteoarthritis (OA) is the most common form of arthritis accounting for about 30% of general physician visits[1]. It may be defined as a heterogeneous group of conditions that lead to joint symptoms and signs which are associated with defective integrity of articular-

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cartilage, in addition to related changes in the underlying bone and at the joint margins[2]. It is usually classified as either primary (idiopathic) or secondary (associated with a known condition). Although OA is present by histologic or radiographic criteria in nearly 80% of people by the age of 80 years, only half have symptoms[3], and these are often variable and intermittent. There is a modest correlation between the presence of symptoms & the severity of anatomic changes.

Although variable in its presentation and course of OA often carries significant morbidity. In addition to the effects on the individual, the cost of OA to society is significant[4], related to its high prevalence, the reduced ability of those affected to perform both occupational and non-occupational activities, the occasional loss of a patient's ability to undertake self-care, and the related drain on health-care resources[5].

Osteoarthritis is no longer considered a 'degenerative' or 'wear and tear' arthritis, but rather involves dynamic biomechanical, biochemical and cellular process[6]. Indeed, the joint damage that occurs in OA is, at least in part, the result of active remodeling involving all the joint structures. Although articular cartilage is at the center of change, OA is currently viewed as a disease of the entire joint and therefore, the failure of the joint as an organ[7].

Although symptoms are often unilateral, evidence of OA is almost always present bilaterally. However, even when symptoms are bilateral, there is a tendency for one side to be more symptomatic than the other. The symptomatic side may also alternate over time. Unilateral disease may suggest OA secondary to trauma. In contrast to systemic inflammatory arthritides, OA lacks constitutional symptoms. When OA is symptomatic, the most prominent complaint is pain. The onset of OA symptomatology is insidious. OA is characterized clinically by pain, swelling of joint and limitation of motion. Pathologically & Radiologically the disease is characterized by focal erosive lesions, cartilage destruction, subchondral sclerosis, cyst formation and large osteophyte at the margin of the joints[8]. The knee is a complex joint with three major compartments: the medial and lateral tibio-femoral joints and the patellofemoral joint[9]. Knee osteoarthritis (OA) is a disease characterized mainly by cartilage degradation[10], which is reflected clinically by a gradual development of pain, stiffness and loss of motion of the joint. Pain relief is still a primary goal in treating patients who have knee OA. However, pain may have a protective role for the affected knee by causing a reduction in weight bearing[11]. Therefore, simply alleviating pain may lead to further joint and cartilage damage[10].

Until a structure modifying agent is available, the objectives in managing the patient with OA knee are: reducing/eliminating pain and stiffness, maintain /improve mobility, Optimizing function and hence minimizing disability. So, the goals in management of OA are patient education, individualize therapeutic regimen, treating symptoms, minimizing disability & slowing disease progression. Therapeutic approaches include pharmacological e.g. - Analgesic and NSAID, intra-articular agents, glucosamine, hyaluronic acid & topical capsaicin, non-pharmacological e.g.- patient education, exercise, personal contact, physiotherapy, assistive device, patellar tapping appropriate footwear and surgical intervention may be needed[12]. In 1995, the American College of Rheumatology (ACR) published guidelines for the treatment of OA knee (Hochberg 1995)[13]. These were updated in 2000 (ACR 2000) and 2003 (ACR 2003) and state that, for mild symptomatic OA, treatment may include non-pharmacologic methods (patient education, physical & occupational therapy and other therapies), and pharmacologic therapy {including non-opioid oral and tropical (i.e. applied ato skin) analgesic}.

For patient who is unresponsive to this regimen, the use of non steroidal anti inflammatory drugs (NSAIDs) is considered appropriately. A corticosteroid injection is recommended for patients with knee OA, particularly when signs of local inflammation with joint effusion are present. Patients with severe symptoms of OA of the knee may require surgical intervention e.g. osteotomy or local joint arthopathy[14]. Autologous chandrocyte implantation may be a possible treatment. Clinical trials employing tissue-engineering methods have demonstrated regeneration of cartilage in damaged knees, including those that had progressed to osteoarthritis[15]. But so far as we know, a little study was done to see the effects of UST. But for proper management we should know the beneficial effects of UST and their specification. The large number of patients should be managed properly for improvement of their working capacity and thus they may be able to contribute themselves for the prosperity of the country.

For this purpose, we observed the effects of UST on osteoarthritis of the knee to improve the present situation. Ultrasound therapy is frequently prescribed to patients with symptomatic knee osteoarthritis (OA).
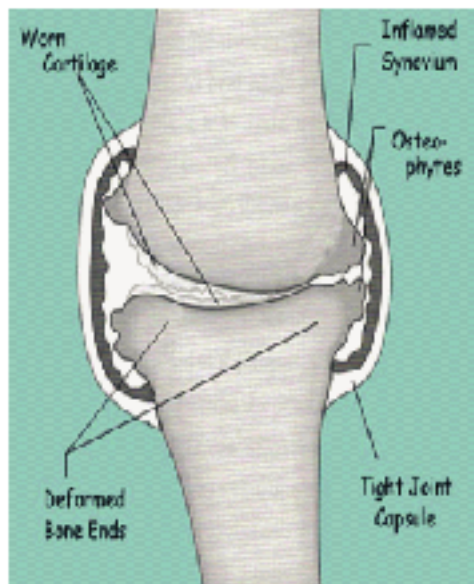


**Figure 1:** Anatomy of Knee joint



**Figure 2:** Pathological changes in OA Knee8

Ultrasound is defined as a form of acoustic vibration occurring at frequencies too high to be perceived by the human ear. Therapeutic ultrasound is a form of medical treatment by means of mechanical vibrations with a frequency of above 20kHz[16]. Ultrasound therapy is a high frequency alternating current. The ultrasonic frequency of 0.8-1.0 MHz with intensities of 0.5-4 Watt/cm2 for 5-10 minutes can be used. A coupling media must be used for proper transmission of ultrasound between the applicator and the skin. Ultrasound is propagated in the form of longitudinal compression waves. The movement of the particles in the medium occurs parallel to the direction of the wave propagation.

## Materials and Methods

It was a Prospective Interventional non-randomized clinical study. This study was conducted in the Department of Physical Medicine and Rehabilitation, Bangabandhu Sheikh Mujib Medical University, Shahbag, Dhaka. This study was conducted during the periods of 1st March, 2012 to 31st August, 2012.

## Selection criteria

**(i) Inclusion criteria -** (a) Men and women aged $\geq$ 35 years & $\leq$ 75 years. (b) Having primary OA of knee joints. (c) Moderate, mono or bilateral knee osteoarthritis. (d) Pain lasting for at least 3 months. (e) Osteoarthritis with radiological findings. (f) Limitation/ difficulty of movement of knee joint.

### (ii) Exclusion Criteria -

(a) Inability or unwillingness to sign informed consent. (b) Previous surgery of the affected knee. (c) Intra-articular injections with steroids or hyaluronic acid. (d) Congenital or acquired inflammatory or neurological (systemic or local) diseases involving the knee. (e) Chronic NSAID or steroid treatment. (f) Cognitive or psychiatric disorders. (g) Pregnancy or breastfeeding. (h) Contra indications to intra-articular injection. (Malignancy, TB, local infections or systemic acute infections, local thrombosis, impaired arterial circulation, altered cutaneous thermal sensitivity, metal implants or prosthesis, severe osteoporosis).

Fifty four patients between 35-75 years of age without consideration of gender with a history of not less than three months knee pain with radiographic confirmation of primary osteoarthritis was be selected purposefully. Then they were divided randomly in group A & group B. Group A received → NSAID [Aceclofenac 100mg B.D.-14 days] + Omeprazol (20mg B.D.-14days) + Therapeutic exercise + ADL and Group B received →UST + NSAID [Aceclofenac 100mg B.D. -14 days] + Omeprazol (20mg B.D.-14days) + Therapeutic exercise + ADL. In both groups the patients were observed for six weeks. Study parameters used for comparing the treatment are visual analogue scale, range of motion (ROM), 50 feet walking and WOMAC index.

Osteoarthritis (OA) - OA may be defined as a condition in which low grade inflammation results in pain in the joints, caused by abnormal wearing of the cartilage which covers and acts as a cushion inside joints and destruction or decrease of synovial fluid which lubricaties those joints.

## OA knee:

Mild - Radiologically definite osteophyte(s) with possible joint space narrowing or definite mild joint space narrowing, with or without osteophytes.

Modified Kellgren & Lawrence scale -2.

Moderate - Definite moderate joints space narrowing (at least 50%), cystes or sclerosis may be present and osteophytes are usually present.

Modified Kellgren & Lawrence scale -3.

Severe - severe joint space narrowing

Modified Kellgren & Lawrence scale -4.

Activities of daily living (ADL) 42 - Criterias are

1. Not to bent the knee more than $90^0$
2. To use walking stick on the opposite hand of the affected knee/more painful knee joint during walking.
3. To climb a stair, use the handle of the stair and climb slowly and the body weight should be transferred to the handle by the hand opposite to the affected knee/ more affected knee.
4. To reduce body weight for overweight person
5. To use high commode in bathroom, dining table for eating and knee cap during activity.
6. To avoid high healed shows, prolonged walking/ sitting/running
7. To cook on standing or sitting on a tool
8. To bath in standing or sitting position with a shower and not to take water from a pot by kneeling.

After taking the formal consent of the patient, details history was taken and a preset data form was filled up for every patient. Past history of illness & any systemic disease was inquired cautiously. Clinical examination was done systematically. Base line investigations were done e.g. CBC, ESR & Hb%, RBS, Serum creatinin, Urine for R/M/E, serum uric acid & SGPT. X-ray of the affected knee joint B/V view was also done. All reports were properly recorded in the data sheet. Treatment was delivered in each group as per scheduled. Every patient was followed up in each week with up to six weeks.

(i) Group A: 27 patients were received - NSAID (Aceclofenac 100mg bd, 14 days) + Therapeutic exercise + ADL

(ii) Group B: 27 patients were received UST followed by NSAID + Therapeutic exercise + ADL

Data were analysed by SPSS-PC+Programme for Windows 16.00 version. In descriptive statistics, the frequency, percentage, mean and standard deviation was included. Important tables were prepared on the basis of the findings relevant to the study.

## Results

In group A, highest number of patients were in the age group of 40 to 49 years (44.4%) followed by 50 to 59 years (25.9%). Patients in other age group <40 years and above 60 years were 7.4% and 22.3% respectively. In group B 9 (33.3%) patients were in the age group of 40 to 49 years (44.4%) and another 9 (33.3%) patients were in the age group of 50 to 59 years. Patients in other age group <40 years and above 60 years were 11.1% and 22.3% respectively. Mean ± SD of age in group A and group B were 52.33 ± 9.62 years and 52.29 ± 9.67 years respectively. There is no statistically significant difference in mean age among the groups (p>0.05) [ Table 1]. Among the 27 patients in group A 9 (33.3%) were male and 18 (66.7%) were female. Among the 27 patients in group B, 10 (37.0%) were male and 18 (63.0%) were female. There is no statistically significant difference in sex among the groups (p>0.05) [ Table 2]. But female patients were more in both groups. In socio economic status most of the patients in both groups were in the middle class. There is no statistically significant difference in socio-economic status among the groups (p>0.05)[ Table 3]. In group A, BMI of 07 (25.9%) was normal and 20 (74.1%) were overweight. In group B BMI of 14 (51.9%) was normal and 13 (48.1%) were overweight. There is no statistically significant difference in BMI among the groups (p>0.05) [ Table 4].

**Table 1:** Distribution of patient by age group

| Age group | Group | | p value |
| --- | --- | --- | --- |
| | Group -A | Group -B | |
| <40 | 02 (07.4) | 03 (11.1) | |
| 40 - 49 | 12 (44.4) | 09 (33.3) | |
| 50 - 59 | 07 (25.9) | 09 (33.3) | |
| 60 and above | 06 (22.3) | 06 (22.3) | |
| Total | 27 (100.0) | 27 (100.0) | |
| Mean ± SD | 52.33 ± 9.62 | 52.29 ± 9.67 | 0.989 |

*t test was done to measure the level of significance.
Figure within parentheses indicates in percentage.

**Table 2:** Distribution of patients by sex

| Sex | Group | | p value |
|---|---|---|---|
| | Group -A | Group -B | |
| Male | 09 (33.3) | 10 (37.0) | |
| Female | 18 (66.7) | 17 (63.0) | |
| Total | 27 (100.0) | 27 (100.0) | 0.776 |

*Chi-square test was done to measure the level of significance.
Figure within parentheses indicates in percentage.

**Table 3:** Distribution of patients by socio-economic status (n=54)

| Socio -economic status | Group | | p value |
|---|---|---|---|
| | Group -A | Grou p-B | |
| Poor | 10 (37.0) | 08 (29.6) | |
| Middle | 16 (59.3) | 13 (48.1) | |
| High | 01 0(3.7) | 06 (22.2) | |
| Total | 27 (100.0) | 27 (100.0) | 0.128 |

*Chi-square test was done to measure the level of significance.
Figure within parentheses indicates in percentage.

**Table 4:** Distribution of patients by BMI (n=54)

| BMI | Group | | p value |
|---|---|---|---|
| | Group -A | Group -B | |
| Normal | 07 (25.9) | 14 (51.9) | |
| Overweight | 20 (74.1) | 13 (48.1) | |
| Total | 27(100.0) | 27 (100.0) | 0.051 |

*Chi-square test was done to measure the level of significance.
Figure within parentheses indicates in percentage.

**Table 5:** Distribution of patient according to personal history (n=54)

| Component | Group | | p value |
|---|---|---|---|
| | Group -A n (%) | Group -B n (%) | |
| Smoking | | | 1.000 |
|   Yes | 10 (37.0) | 10 (37.0) | |
|   No | 17 (63.0) | 17 (63.0) | |
| If yes, number of stick/day (Mean ± SD) | 5 ± 1.33 | 7 ± 2.79 | |
| Drag abuse | 01 (03.8) | 01 (03.6) | 1.000 |
| Alcohol intake | 03 (11.5) | 04 (14.8) | 0.685 |

Table 5 shows the distribution of patient according to personal history. About 37.0% patients in both groups were smoker. There is no statistically significant difference in smoking habit between the groups (p>0.05).

**Table 6:** Distribution of patient according to examination of the knee (n=54).

| Examination of the knee | | Group | | p value |
|---|---|---|---|---|
| | | Group -A | Group -B | |
| **Contour** | Normal | 03 (11.1) | 02 (07.4) | 0.639 |
| | Swelling | 24 (88.9) | 25 (92.6) | |
| **Local Swelling** | Absent | 03 (11.1) | 04 (14.8) | 0.685 |
| | Present | 24 (88.9) | 23 (85.2) | |
| **Local Temperature** | Normal | 12 (44.4) | 08 (29.6) | 0.260 |
| | Raised | 15 (55.6) | 19 (70.4) | |
| **Eliciting fluctuation** | Absent | 02 (07.4) | 01 (03.7) | 0.552 |
| | Present | 25 (92.6) | 26 (96.3) | |
| **Leg length discrepancy** | Yes | 02 (07.4) | 01 (03.7) | 0.552 |
| | No | 25 (92.6) | 26 (96.3) | |
| **Deformity** | Genu varus | 07 (25.9) | 10 (37.0) | 0.379 |
| | No deformity | 20 (74.1) | 17 (63.0) | |

Table 6 shows the distribution of patient according to examination of the knee. There is no statistically significant difference in contour, local swelling, local temperature, eliciting fluctuation, leg length discrepancy and deformity of knee joint between the groups (p>0.05).

**Table 7:** Distribution of patient according to VAS (n=54)

| Treatment period | Group | | p value |
|---|---|---|---|
| | Group -A n (%) | Group -B n (%) | |
| Pre treatment | 6.22 ± 1.60 | 7.15 ± 1.56 | 0.036 |
| After 1 week | 5.22 ± 1.58 | 5.30 ± 1.54 | 0.862 |
| After 2 week | 4.85± 1.70 | 3.92 ± 1.46 | 0.037 |
| After 3 week | 4.25 ± 1.70 | 3.29 ± 1.51 | 0.032 |
| After 4 week | 4.07 ± 1.66 | 2.48 ± 1.45 | 0.001 |
| After 5 week | 3.48 ± 1.78 | 1.92 ± 1.17 | 0.001 |
| After 6 week | 3.04 ± 1.72 | 1.33 ± 1.10 | 0.001 |

Table 7 shows the mean ±SD of VAS of the patient in both groups. Mean ± SD of VAS during pre treatment in group A and group B were 6.22 ± 1.60 and 7.15 ± 1.56 respectively. Subsequently after treatment in both groups VAS gradually decreased. Treatment after 4 week, 5 week and 6 week there is highly significant difference observed in VAS between the groups (p<0.01).

**Table 8:** Distribution of patient according to ROM (n=54)

| Treatment period | Group | | p value |
|---|---|---|---|
| | Group -A n (%) | Group -B n (%) | |
| Pre treatment | 117.33 ± 13.05 | 112.37 ± 19.01 | 0.269 |
| After 1 week | 119.67 ± 12.03 | 118.18 ± 12.92 | 0.665 |
| After 2 week | 121.66 ± 11.29 | 122.03 ± 10.80 | 0.902 |
| After 3 week | 122.92 ± 10.51 | 125.44 ± 8.96 | 0.348 |
| After 4 week | 124.81 ± 9.62 | 128.29 ± 6.84 | 0.132 |
| After 5 week | 125.96 ± 9.25 | 129.96 ± 5.48 | 0.059 |
| After 6 week | 127.29 ± 8.60 | 131.67 ± 4.35 | 0.022 |

Table 8 shows the mean ± SD of ROM of the patient in both groups. Mean ± SD of ROM during pre treatment in group A and group B were 117.33 ± 13.05 and 112.37 ± 19.01 respectively. There is no statistically significant difference observed in pretreatment ROM between the groups (p>0.05). Subsequently after treatment in both groups ROM gradually increased. Treatment after 6 week there is significant difference observed in ROM between the groups (p<0.05).

**Table 9 :** Distribution of patient according to time taken to walk 50 feet (n=54)

| Treatment period | Group | | p value |
|---|---|---|---|
| | Group -A n (%) | Group -B n (%) | |
| Pre treatment | 18.22 ± 2.39 | 18.81 ± 2.13 | 0.341 |
| After 1 week | 17.18 ± 2.30 | 17.14 ± 2.10 | 0.951 |
| After 2 week | 16.81 ± 2.18 | 15.96 ± 1.81 | 0.125 |
| After 3 week | 16.40 ± 2.42 | 15.33 ± 1.90 | 0.076 |
| After 4 week | 15.96 ± 2.28 | 14.78 ± 2.02 | 0.049 |
| After 5 week | 15.40 ± 2.60 | 14.44 ± 1.86 | 0.125 |
| After 6 week | 15.07 ± 2.49 | 13.62 ± 2.04 | 0.024 |

Table 9 shows the mean ±SD of time taken to walk 50 feet by the patients in both groups.Mean ±SD of time taken to walk 50 feet during pre treatment in group A, and group B, were 18.22 ± 2.39 and 18.81 ± 2.13 minutes respectively. There is no statistically significant difference observed in pretreatment time taken to walk 50 feet between the groups (p>0.05). Subsequently after treatment in both groups ROM gradually decreased. Treatment after 6 week there is significant difference observed in time taken to walk 50 feet between the groups (p<0.05).

**Table 10:** Distribution of patient according to WOMAC index (n=54)

| Treatment period | Group | | p value |
|---|---|---|---|
| | Group A n (%) | Group B n (%) | |
| Pre treatment | 60.85 ± 15.86 | 67.33 ± 16.33 | 0.145 |
| After 1 week | 53.96 ± 15.54 | 55.63 ± 14.91 | 0.689 |
| After 2 week | 47.74 ± 15.97 | 47.03 ± 15.21 | 0.869 |
| After 3 week | 41.18 ± 15.74 | 38.96 ± 14.49 | 0.592 |
| After 4 week | 35.89 ± 15.46 | 30.96 ± 13.74 | 0.222 |
| After 5 week | 30.89 ± 16.11 | 22.48 ± 11.58 | 0.032 |
| After 6 week | 25.29 ± 15.30 | 13.85 ± 9.62 | 0.002 |

Table 10 shows the mean ± SD of WOMAC index of the patients in both groups. Mean ± SD of WOMAC index in group A and group B were 60.85 ± 15.86 and 67.33 ± 16.33 minutes respectively. There is no statistically significant difference observed in WOMAC index between the groups (p>0.05).

Subsequently after treatment in both groups WOMAC index gradually decreased. Treatment after 6 week there is significant difference observed in WOMAC index between the groups (p<0.05).

## Discussion

In our study, significant improvement was observed in response to UST. The result is in the line of the results presented by Bansil KC et al. in their study[17]. Chard J et al. also found that there are moderate improvement of pain and function with physical therapy[18]. We also found significant improvement in response to treatment with NSAID. We used tablet aceclofenac (100 mg) twice daily. Chard J et al. found in a review that NSAIDs were highly effective for pain and function but with potential side effects[19]. We compared between UST and non-steroidal anti inflammatory drugs and found significant improvement in UST plus NSAID group than only NSAID group (p=0). On the other hand there were potential side effects of NSAID rather than physical therapies[19]. Gastrointestinal (G I) complication related to NSAID therapy are the most prevalent category of adverse reaction[20-21]. But UST may have negligible side effect. So NSAID should be used cautiously. And if it is possible we should go for non-pharmacological therapy like UST, SWD and exercise to reduce the dose of NSAID. Jan et. al. found significant improvement after treatment with ultrasound therapy (UST) or SWD only and UST plus exercise and SWD plus exercise[22].

## Conclusion

In conclusion it may be said that UST plus NSAID is effective to reduce the symptoms of chronic OA-knee joint. On the other hand, NSAID have its potential side effects. So UST may be used to reduce the dose of NSAID to avoid some side effects. Our study have its obvious limitations. It was confirmed to a highly selected group of patients in a specialised hospital BSMMU. Follow up period also short. Only two types of conservative measures were observed in the study. However it is necessary to investigate a large sample and a multicentre trial of physical therapy for a longer period of follow up.

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