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Original Research Article

A Comparative Study between Treatment of Rickets with Stoss Therapy and Daily Dose of Vitamin D3 Therapy

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Conflict of interest: Nil

Abstract:

Objectives: This study aims to compare the efficacy and side effects of stoss therapy and daily dosing with vitamin D3 in the treatment of rickets. Participants- The study included 30 children aged 6 months to 5 years with clinically and radiologically confirmed rickets.

Materials and Methods: Group 1 n=15 received a single oral dose of 300,000 IU of vitamin D3, while Group 2 n=15 received a daily oral dose of 4000 IU of vitamin D3 for 10 weeks. Radiological healing was assessed after 12 weeks, and serum 25-hydroxyvitamin D levels were compared at baseline and after 12 weeks.

Results: Serum 25-OH vitamin D levels significantly increased from baseline to 12 weeks in both groups. However, stoss therapy resulted in a significantly greater increase in vitamin D levels compared to daily dosing. Two children in Group 1 developed hypercalcemia at 12 weeks, but no cases of hypervitaminosis D were observed.

Conclusion: Radiological and biochemical parameters did not differ significantly between the two treatment groups. However, patients treated with stoss therapy had higher vitamin D3 levels.

Keywords: rickets, stoss therapy, daily dosing therapy of rickets, vitamin D deficiency, genu valgus, genu varus, windswept deformity, hypovitaminosis, treatment outcomes.

Introduction

Rickets is disease of growing bone derived from word "wrickets" meaning twisted referring to characteristic bony deformities of 'bowlegs' of rickets. [1] Vitamin D is critical for calcium homeostasis and for mineralization of the skeleton and neuromuscular conduction. The normal requirement is about 400 IU per day. [2] Prevalence of hypovitaminosis D is 77% in toddlers and 16.4% children among them had rickets.Vitamin D is produced primarily by absorption of UV-B rays from sun (wavelength 290-315 nm), as well as through the dietary intake. [3] The most active form of vitamin D i.e., 1,25-DHCC (calcitriol) which acts on the lining cells of the small intestine. It increases absorption of calcium and phosphate. In bone it acts together with PTH to promote osteoclastic resorption and also enhances calcium transport across the cell membrane and indirectly assists with osteoid mineralization. The causes of rickets include conditions that lead to hypocalcaemia and/or hypophosphatemia, either isolated or secondary to vitamin D deficiency. [4,5] Calcipenic rickets is characterized by deficiency of calcium or more commonly vitamin D. Indian children's diets are typically low in calcium and high in phytate. [6]The classical feature of rickets includes swelling of the wrist and ankle and leg deformities in form of bowlegs (genu varum) or knock knees (genu valgum), delay in closure of the anterior fontanelles, parietal and frontal bossing, Craniotabes (soft skull bones), Rachitic rosary (enlargement of costochondral junction of ribs). [7,8]

X- ray of wrist and knees shoes:

widening of growth plates and delayed appearance of epiphysis

- Cupping, widening and splaying of metaphysis
- Osteopenia
- Rare fraction of long bones
- Green stick fractures
- Bowing of tibia
- Scoliosis
- Triradiate pelvis
- Biochemical features show
    - Decreased serum calcium levels
    - Decreased serum phosphate
        - Increased alkaline phosphatase levels
        - Decreased 25-oh vitamin d levels

Children with vitamin D deficiency should receive

vitamin D, calcium and phosphorus supplementation. There are two strategies for administration of vitamin D in nutritional rickets. Physicians usually administer daily lower-dose vitamin D (2000–5000 U/day) therapy for 6 weeks to 3 months to avoid the risk of hypercalciuria often seen in stoss therapy. Although daily vitamin D supplementation is supposed to have fewer side effects than stoss therapy, stoss therapy is ideal in situations where compliance to the therapy is poor.

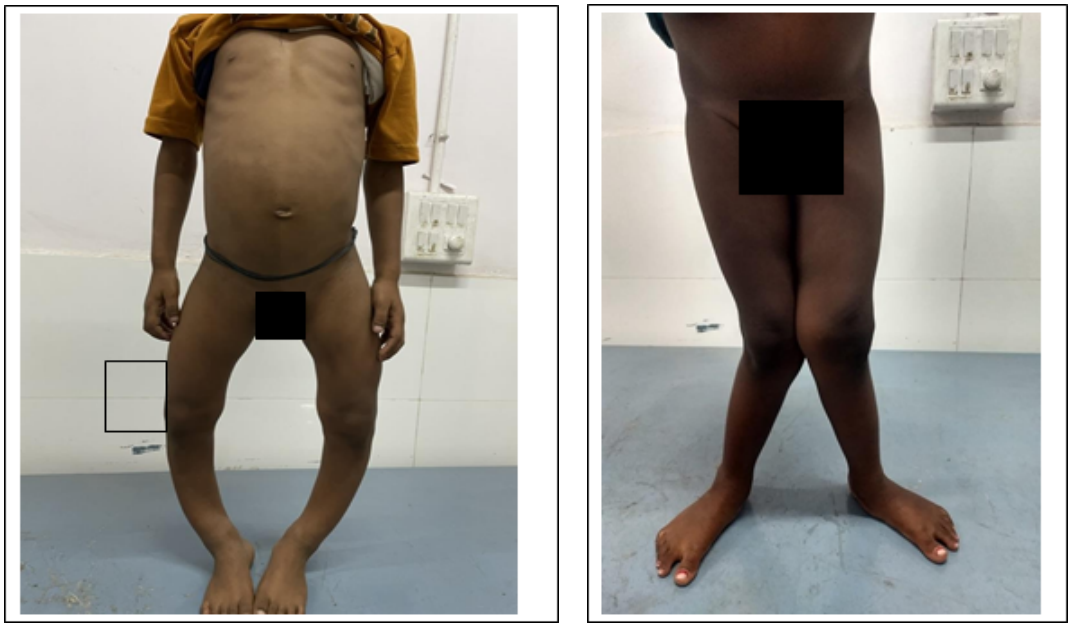

Figure 1: genu varus and genu valgus

Materials and Methods

30 children between age 5 months to 5 years who were diagnosed with rickets were included in the study. The study was conducted between January 2022 to January 2023. The patients came to Nalanda medical college hospital, Patna with complains of swelling around wrists and knee and leg deformities. Critically ill children and children having history of vitamin D supplementation in previous 6 months were excluded. Baseline assessment included a detailed socio- demographic and clinical history and physical examination at the time of enrolment. X–rays of the wrist and knee were obtained for all participants at enrolment. Severity of rickets was evaluated using a TEN- point radiographic scoring method categorised as mild (<4), moderate (5-8), severe (>8). Serum venous sample was obtained for the estimation of serum calcium (8.5-10.5mg/dl), serum phosphate (3.4-4.5 mg/dL), serum alkaline phosphatase(44-147 U/L) and serum 25(OH)D (>20ng/mL). 25(OH) is the best available marker of vitamin D deficiency with reading less than 20ng/ml accepted as vitamin deficiency. We treated half the patients in group 1 with 300,000IU of vitamin D granules (BMSICL supply) dissolved in 100mL milk. This Initial Parameters at time of presentation dose was divided in 2 equal halves and given at interval of 4 hours under direct supervision. These children were kept in hospital for 24 hours to monitor for adverse effects such as vomiting, crying, abdominal distension and rash. At discharge these children were advised to continue calcium supplementation(50 mg/kg/day) orally for 12 weeks. The other group was treated with 4000IU units of vitamin D drops (arachitol kits- 400IU/0.5mL) in two divided doses along with daily supplementation of calcium. Calcium supplementation used was Meyers' - Calcimax-P syrup.All children were asked to report for follow-up at 1 week, 4 weeks and 12 weeks to check for adverse effects such as headache, vomiting, abdominal pain, seizures and comparison between both groups. At 12 weeks interval, X rays were repeated of wrist and knees to check for radiological healing. Serum calcium, phosphorus, alkaline phosphatase and 25(OH)D was also repeated at 12 weeks.

Result

The mean age of the first group treated with Stoss Therapy was 2.2 years ± 5.8 months and the second group treated with daily lower dose was 2.8 years ± 3.2 months.

	Group 1 (n=15)	Group 2 (n=15)
Calcium (mg/dL)	6.70 ± 0.48	7.2 ± 0.56
Phosphorus (mg/dL)	3.6 ± 0.7	2.7 ± 0.17
ALP (U/L)	385.62 ±	316.58 ± 30.39

	48.82	
Vitamin D (ng/mL)	8.88 ± 3.14	12.6 ± 4.9
Ten Point Score	7.64 ± 1.60	7.2 ± 2.8

Age, gender & differences in amounts of Vitamin D supplementation were statistically insignificant.

The patients in both groups received Calcium phosphorus syrup 5 mL orally for 12 weeks.

Serum calcium, phosphorus, serum ALP and Vitamin D levels were checked after 12 weeks.

Biochemical Parameters at the end of study (12 weeks)

	Group 1 (n=15)	**Group 2 (n=15)**
Calcium (mg/dL)	10.1 ± 0.5	9.13 ± 0.48
Phosphorus (mg/dL)	4.75 ± 5.38	4.26 ± 3.03
ALP (U/L)	77.58 ± 30.39	80.82 ± 52.56
Vitamin D (ng/mL)	50.4 ± 19.6	28.42 ± 4.96
Ten Point Score	1.02 ± 1	1.08 ± 1

Final Vitamin D level in single dose Stoss therapy was significantly increased compared with daily lower dose Vitamin D therapy group. Renal ultrasounds were normal at the end of the therapies for each group. No nephrocalcinosis or renal stones were detected. None of the patients developed hypervitaminosis D.

Adverse Effects:

No child required a repeated dose of study medication or developed any sign of drug intolerance (nausea, vomiting, headache, persistent cry, etc) No clinical adverse effect of Vitamin D3 therapy was noted in both groups. Hypercalcemia was documented in 2 children in group1.

Discussion

The aim of the treatment in Vitamin D deficiency is to fill vitamin stores and to improve the biochemical, radiological and clinical findings of rickets. [9] Inadequate sunlight exposure at presentation and breast feeding for more than 6 months were found to increase the incidence, severity and recovery time in nutritional rickets. [10] The first radiological sign of response is the appearance of the healing line of rickets (white line of calcification), which is the appearance of the radio- opaque line in the metaphysis signifying mineralization of the provisional zone of calcification. [11] It was found that initial radiographic changes were present in the distal ulna in 100% cases followed by the distal radius, distal femur and proximal tibia in 88.6%, 95.5%, 90.9% of cases respectively. It was found that radiological sign of nutritional rickets decreased with time with Stoss therapy as well as daily therapy and were absent in 100% cases by 12 weeks. [12] Stoss therapy with single dose (300,000 IU) oral vitamin D had sufficient efficacy compared with daily lower dose vitamin D therapy. [13] In both groups hypocalcemia was not detected at the end of the therapy, which may be explained by the daily oral calcium phosphorus regime supplementation. [14] Results from our study showed increase in serum calcium and 25-OH vitamin D and a significant decrease in serum alkaline phosphatase. [15] Decrease in 10- point score was also seen. There was no evidence of hypercalciuria with Stoss therapy and optimum vitamin D levels were reached with Stoss therapy. No evidence of hypervitaminosis in any of the patients was seen. [16] Hypervitaminosis D can cause anorexia, vomiting, hypertension, renal insufficiency and failure to thrive. Hypercalcemia has its own features of moans, groans, bones and stones which include psychiatric problems like anxiety, delirium, abdominal upset, nausea and vomiting, bone pains and chances of development of renal stones. Hypercalcemia was seen in 2 patients in group 1 who were treated with Stoss regimen but no significant side effects was seen. [17] So, when compliance to daily therapies is poor, Stoss therapy seems more suitable. Good adherence to therapy by parents was needed in lower vitamin D supplementation therapy group. Additional oral calcium was suggested 50-100 mg/kg/day at the beginning of therapy for both group to prevent Hungry Bone syndrome. Vitamin D has a modulatory role on systems other than skeletal and vitamin D deficiency without rickets should also be considered as a serious health problem. [18]

Limitations of the Present Study

The present study had few drawbacks such as less number of participants in the study and lesser time for evaluation. We did not differentiate between calcium deficient rickets and Vitamin D deficient rickets. We also did not study the effect of Vitamin D3 therapy on nutritional status and reversal of deformities after correction of rickets. Neither our study considered to evaluate those patients who are not responding to Vitamin D therapy.

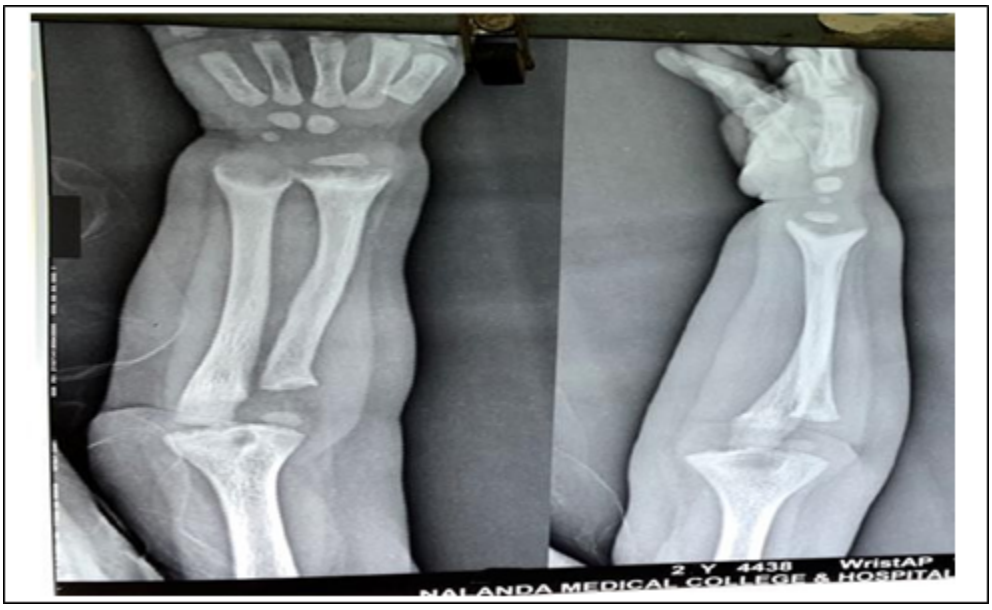

Figure1: - shows features of rickets in wrist

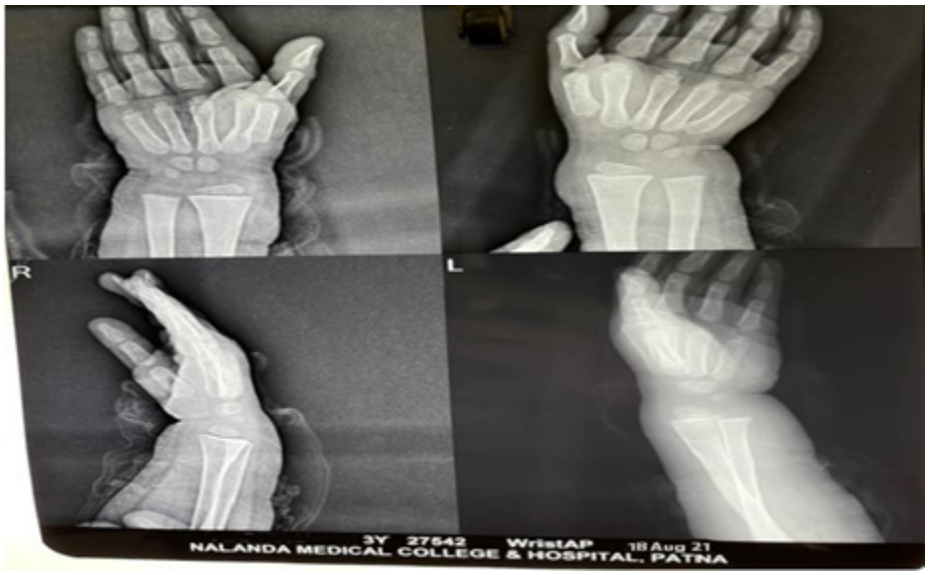

Figure 2: - shows healed rickets after STOSS therapy

Conclusion

Stoss therapy is safe, easy to administer and highly effective. This regimen has a better compliance, requires less follow up and less frequency of investigations. Thus, this regimen can be considered as a pocket friendly treatment for patients in our country who are generally of low socio-economic status. Admission of patients for a day in hospital for administration of Vitamin D makes it easier for the doctor and the patient's attendant to monitor and treat any adverse effects if occurs. The 10 points of Thacher's scoring strategy for evaluating the seriousness of rickets guarantees as a valuable methodology for analysts and clinicians. This study not only shows the severity of the disease but also can be used for evaluation of the healing of rickets in response to the treatment. Thus, we conclude from this study that STOSS therapy is safe, effective and economical for the patient. For revaluating the seriousness of the disease and effectiveness of the treatment, Thacher's 10 points scoring is effective.

Significance

This study contributes to the understanding of different treatment approaches for rickets by comparing the efficacy and side effects of stoss therapy and daily dosing with vitamin D3. The findings provide valuable insights into the optimal treatment strategy for improving vitamin D levels in children with rickets, considering both radiological and biochemical parameters.

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