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Modern Approaches To The Correction Of Nutritional Status In Children With Connective Tissue Dysplasia

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Abstract: Connective tissue dysplasia (CTD) is a genetically determined disorder associated with impaired synthesis and structure of collagen, elastin, and other components of the extracellular matrix. Children with CTD are at high risk of developing nutritional deficiencies that aggravate structural and functional disorders of connective tissue. This review analyzes modern approaches to assessing and correcting nutritional status in pediatric CTD, emphasizing evidence-based nutritional, metabolic, and nutraceutical interventions. Individualized correction of protein, vitamin, and trace element deficiencies significantly improves metabolic balance, functional adaptation, and quality of life in affected children.

Keywords: Connective tissue dysplasia, children, nutritional status, correction, vitamins, trace elements, nutraceuticals.

Introduction: Connective tissue dysplasia (CTD) is a heterogeneous group of hereditary and multifactorial disorders characterized by impaired synthesis, structure, and remodeling of connective tissue components. The prevalence of CTD among children ranges from 20% to 30%, depending on diagnostic criteria and environmental influences (Surkova & Romanov, 2022).

Disorders of connective tissue integrity affect multiple systems — musculoskeletal, cardiovascular, respiratory, and digestive — making CTD a systemic condition requiring multidisciplinary management. Among the key modifiable factors influencing disease severity is nutritional status, which directly affects collagen synthesis, tissue regeneration, and metabolic adaptation (Kovalenko et al., 2023).

Modern pediatric practice considers nutritional correction as a cornerstone of CTD management, aiming to restore the balance of macro- and micronutrients essential for the structure and function of connective tissue.

METHODS

This analytical review is based on scientific publications from 2015 to 2025, retrieved from PubMed, Scopus, and Web of Science databases using the following search terms: connective tissue dysplasia, children, nutritional status, vitamins, and nutraceuticals.

Selection criteria included clinical trials, meta-analyses, and expert guidelines focusing on nutritional assessment and correction in pediatric CTD.

The evaluation of nutritional status typically involves:

- **Anthropometric assessment** — height, body mass index (BMI), muscle and fat tissue ratio.
- **Biochemical assessment** — serum albumin, ferritin, vitamin (A, C, D, E, B-group) levels, and trace elements (Mg, Zn, Cu, Se).
- **Clinical scales** — STRONGkids, SGNA, and dietary intake diaries.

RESULTS

1. Optimization of protein metabolism

Adequate protein intake is crucial for collagen and elastin biosynthesis. Children with CTD require 1.5–2.0 g/kg/day of high-quality protein, emphasizing lean meat, fish, eggs, and dairy products (Nikitina & Zubkova, 2021).

Supplementation with amino acids (glycine, proline, lysine) enhances collagen stability and tissue repair. Studies show that protein-energy malnutrition worsens postural abnormalities and delays physical development in CTD patients (Fedorov et al., 2021).

2. Correction of micronutrient and vitamin deficiencies

Micronutrients play a key role in maintaining connective tissue metabolism:

- Magnesium — stabilizes cell membranes and reduces autonomic dysfunction.
- Zinc and copper — cofactors in lysyl oxidase, critical for collagen cross-linking.
- Vitamin C — essential for hydroxylation of collagen molecules.
- Vitamin E — protects against oxidative damage of extracellular matrix proteins.
- Vitamin D — supports calcium-phosphorus metabolism and improves neuromuscular tone.

Comprehensive vitamin-mineral therapy significantly reduces joint hypermobility and musculoskeletal pain (Khadzhieva & Fedorova, 2020).

3. Use of nutraceuticals

Nutraceutical correction includes collagen hydrolysate, coenzyme Q10, omega-3 fatty acids, L-carnitine, and probiotics, which demonstrate synergistic effects on connective tissue homeostasis (Melmed et al., 2020; Kovalenko et al., 2023).

Collagen peptides increase tissue elasticity and skin hydration, while omega-3 polyunsaturated fatty acids reduce chronic inflammation, a common feature in CTD (Bartsch et al., 2024).

4. Gut microbiota and nutrient absorption

Emerging evidence confirms the link between gut dysbiosis and impaired nutrient absorption in CTD. Probiotic therapy (Lactobacillus, Bifidobacterium) normalizes intestinal permeability and improves micronutrient bioavailability (Nguyen et al., 2022; Pleshkov & Ivanova, 2022).

5. Monitoring and personalization

Nutritional interventions should be regularly adjusted based on dynamic assessment of anthropometric and biochemical indicators. Monitoring every 3–6 months allows for early detection of deficiencies and optimization of supplementation programs (WHO, 2023).

DISCUSSION

Comprehensive correction of nutritional status in children with CTD enhances not only connective tissue strength but also systemic resilience and adaptation to physical and emotional stress.

Recent meta-analyses (Rybakova & Sokolova, 2024; Zhang & Lin, 2025) confirm that combined vitamin D, magnesium, and collagen peptide supplementation improves postural stability and reduces musculoskeletal pain in pediatric cohorts.

However, despite growing evidence, individualized nutritional plans remain underutilized in pediatric practice. Integration of nutrigenomics — identifying gene-nutrient interactions — could refine future management strategies and provide targeted interventions for children with different CTD phenotypes.

CONCLUSION

Correction of nutritional status is a fundamental component of comprehensive management for children with connective tissue dysplasia.

Balanced protein intake, vitamin-mineral supplementation, and the inclusion of nutraceuticals improve collagen metabolism, reduce clinical symptoms, and enhance quality of life. Future research should focus on personalized dietary protocols integrating biochemical, genetic, and microbiome data to achieve optimal long-term outcomes.

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