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A Modified Dynamic 3-Dimensional Tri-planar Corrective Brace for Management of Torticollis - A Case Study

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ABSTRACT

Torticollis is a congenital condition caused by the shortening of the sternocleidomastoid muscle, leading to abnormal head positioning with lateral tilt and contralateral rotation. Traditional cervical orthoses, such as static rotational control cervical braces, often lack adjustability, comfort, and dynamic functionality. This study aims to design and develop a lightweight, adjustable, and dynamic 3-dimensional tri-planar corrective torticollis brace. The proposed orthosis provides gradual correction in all three planes, relieving neurological conditions associated with compressed nerves and chronic pain, while enhancing the patient's ability to perform routine activities. The brace realigns the cervical spine and cervical-occipital joint, redistributes gravitational stress, and maintains the head in the desired posture through its biomechanical design. Results indicate improved daily living activities, reduced upper extremity pain, and a significant decrease in contracture angle from a mean of 30° to 10°.

Keywords: Torticollis, cervical orthosis, 3D tri-planar correction, biomechanical design, posture correction, cervical spine realignment.

INTRODUCTION

Congenital muscular torticollis (CMT) is a well-recognized clinical condition that predominantly affects new-borns and infants, characterized by the shortening of the sternocleidomastoid muscle, CMT results in the lateral tilt of the head towards the affected side and elevation and rotation of the chin towards the opposite side. [1] Torticollis, sometimes referred as wry neck, is a physical symptom found in all ages, in which the head laterally tilts towards the affected side and chin elevates and turns to the opposite side. [2] Torticollis can be hereditary, acquired, or idiopathic (occurring without a recognised cause), and it can strike at any age. Torticollis acquired after trauma or sickness is far more difficult to treat. Surgical release of the tight sternocleidomastoid muscle is usually recommended, followed by rigorous physical therapy to lengthen the contracture.

Frequently, the surgeon is interested in treating the abnormality by gently repositioning the head in correct position. [3, 4]

Traditional cervical orthoses, such as static rotational control cervical orthoses, tubular orthoses, and Buckminster-Brown orthoses, play a crucial role in maintaining head and neck positioning post-surgery or during immobilization. However, these designs are often static, bulky, and uncomfortable, offering limited adjustability and functionality. Such limitations reduce their effectiveness in providing dynamic correction or accommodating gradual adjustments over time. As a result, patients often face challenges in achieving optimal posture correction or maintaining head and neck positioning during daily activities. [5-9]

An ideal orthosis must address these shortcomings by being lightweight, less bulky, and highly adjustable in all planes. Furthermore, it should not only maintain the corrected posture but also exert corrective forces to facilitate further correction or even over-correction. This study focuses on the development of an innovative 3-dimensional tri-planar corrective torticollis brace designed to meet these needs, offering improved adjustability, dynamic functionality, and enhanced patient comfort.

MATERIALS & METHODS

Case Report: A 19-year-old male presented with congenital muscular torticollis (CMT) involving the left sternocleidomastoid (SCM) muscle reported at NILD, Kolkata. The condition was diagnosed during the first year of life, with no associated family history of congenital deformities or other abnormalities. According to the patient's parents, the first symptoms were noted within the first year of life, manifesting as asymmetrical positioning of the head and neck.

On examination, the patient exhibited moderate physical disproportionality, primarily characterized by a raised left shoulder and a shortened neck on the affected side. The range of motion in the cervical spine was significantly restricted, with notable deficits in cervical rotation and lateral flexion. The left SCM muscle appeared shortened, tight, firm, and fibrous but was non-tender on palpation. These findings were consistent with the diagnosis of long-standing congenital muscular torticollis.

Despite the absence of other systemic abnormalities, the patient's posture and mobility were notably impacted. Functional limitations, combined with aesthetic concerns, led to challenges in performing routine activities and maintaining proper cervical alignment. A corrective orthosis was deemed necessary to address these issues, with the goal of improving posture, relieving symptoms, and restoring functional mobility in the cervical region.

METHODOLOGY

The subject was included in the study after obtaining informed consent. A musculature test was conducted to determine whether the deformity was fixed or flexible. Following this, measurements of cervical lateral flexion and rotation were recorded using a conventional goniometer. After baseline measurements, a custom-designed 3-dimensional tri-planar corrective torticollis orthosis was provided to the patient. The orthosis was worn consistently for a period of two months. A follow-up assessment was conducted after this period to evaluate the effectiveness of the orthosis, with the same parameters being re-measured to analyze improvements.

Orthosis Components and Functions:

Mandible Piece / Head Piece - Covers the mandible and the posterior part of the head on the affected side, ensuring stability and proper positioning.

Shoulder Piece - Envelops the affected side's shoulder, extending to the midline of the chest both anteriorly and posteriorly. Equipped with straps to secure the orthosis in position.

Turnbuckle - Functions as a distraction force mechanism. Acts as a rotational axis for the head through the terminal ball attachment.

Terminal Ball - A metallic ball with a diameter of 1 inch, welded onto the turnbuckle head.

Facilitates head rotation by working with the base plate retainer.

Base Plate Retainer (Plastic) - A plastic casket in which the terminal ball is inserted. Enables 360-degree rotational movement of the head within the orthosis.

Straps - Three straps are strategically attached to provide secure suspension and stability of the orthosis during usage.

Components of the Orthosis

RESULT

The dynamic orthosis demonstrated its ability to gradually increase the corrective force applied by manually adjusting the turnbuckles. This adjustability allowed for a controlled and progressive correction of the deformity.

Key outcomes observed:

- The orthosis effectively addressed tri-planar deformities, offering simultaneous correction of lateral flexion, cervical flexion, and lateral rotation.
- Unlike static orthoses, which primarily focus on postural maintenance or distraction to prevent deformity progression, this dynamic orthosis provided a comprehensive solution by enabling active correction in all three planes of motion.
- Existing dynamic orthoses were limited to correcting lateral flexion; however, this concept expanded functionality to include correction of cervical flexion and lateral rotation.

Clinical measurements after two months of orthosis usage showed a significant decrease in the contracture angle, reducing from a mean of 30° to 10°. Additionally, the patient reported improved performance in daily living activities, reduced upper extremity pain, and enhanced overall quality of life due to the restoration of proper cervical posture and mobility.

DISCUSSION

This study highlights the effectiveness of a novel 3-dimensional tri-planar corrective orthosis in addressing congenital muscular torticollis (CMT). The dynamic design of the orthosis overcomes the limitations of traditional static and dynamic orthoses, which either focus solely on postural maintenance or provide restricted correction, often limited to a single plane of motion. The innovative approach in this orthosis provides simultaneous correction of lateral flexion, cervical flexion, and lateral rotation, offering a comprehensive solution for managing complex tri-planar deformities.

The ability to apply gradual corrective forces through manually adjustable turnbuckles allows clinicians to customize the treatment process according to individual patient needs. This feature not only enhances patient comfort but also promotes compliance by enabling progressive and controlled adjustments over time. The results from this case study demonstrate that such a design can effectively reduce contracture angles while improving range of motion and functional mobility.

The patient exhibited a significant reduction in the contracture angle from 30° to 10° within two months of orthosis usage. Furthermore, improvements in daily living activities and relief from upper extremity pain indicate the broader functional benefits of the orthosis. By redistributing gravitational stress and maintaining proper cervical alignment, the device addresses both structural and symptomatic aspects of the condition, contributing to an improved quality of life.

In comparison to existing orthoses, this design offers distinct advantages in terms of dynamic functionality, adjustability, and patient comfort. Traditional static orthoses, while effective for immobilization, lack the versatility to actively correct deformities or accommodate progressive adjustments. Similarly, existing dynamic orthoses are limited in their scope, often addressing only lateral flexion. The tri-planar corrective approach introduced here marks a significant advancement in the management of CMT.

CONCLUSION

The 3-dimensional tri-planar corrective orthosis developed in this study demonstrates significant potential as an effective intervention for congenital muscular torticollis. By enabling progressive correction in all three planes of motion—lateral flexion, cervical flexion, and lateral rotation—the orthosis addresses the limitations of traditional designs.

Clinical outcomes from the case study show marked improvements in cervical posture, range of motion, and functional mobility, alongside a reduction in contracture angles and symptomatic relief. These findings underscore the utility of the orthosis in improving quality of life for patients with CMT. Future studies with larger sample

sizes and longer follow-up periods are recommended to further validate the efficacy and long-term benefits of this innovative orthosis.

Declaration by Authors

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REFERENCES

1. Cheng CY, Ho KW, Leung KK. Multi-adjustable post-operative orthosis for congenital muscular torticollis. Prosthetic and orthotic international 1993; 17:115-119.
2. Cheng JCY, Tang SP, Chen TMK, et al. The clinical presentation and outcome of treatment of congenital muscular Torticollis in infants – a study of 1,086 cases. J Pediatr Surg 2000; 35:1091-1096.
3. Cooperman DR: The differential diagnosis of torticollis in children. Phys Occup Ther Pediatr 1997; 17:1–11.
4. Lidge RT, Betchtol RC, Lambert CN. Congenital muscular torticollis—Etiology & pathology. JBone Joint Surg [Am] 1957; 39-A: 1165-1182.
5. Cheng, J. C, Wong, M. W, Tang, S. P, Chen T. M., Shum S. L, Wong, E. M. Clinical determinants of the outcome of manual stretching in the treatment of congenital muscular Torticollis in infants: A prospective study of eight hundred and twenty-one cases. Journal of Bone and Joint Surgery – America. 2001; 83-A (5): 679–687.
6. ITOI E, FUNAYAMA K, SUZUKI T, KAMIO K, SAKURAI M (1990). Tenotomy and postoperative brace treatment for muscular torticollis. Contemp Orthop 20, 515 - 523.
7. Chandler FA, Altenberg A. Congenital Muscular Torticollis. JAMA 1944; 125:476-483.
8. Coventry MB, Harris LE. Congenital muscular torticollis in infancy: Some observations regarding treatment. J Bone Joint Surg [Am] 1959; 41-A: 815-822.
9. Binder H, Eng G, Gaiser JF, Koch B. Congenital muscular torticollis: results of conservative management with long-term follow-up in 85 cases. Arch Phys Med Rehabil.1987;68:222-225.

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