Original Research

Combined Effect of a Biomimetic Oral Appliance and Atlas Orthogonist Cervical Adjustment on Leg Lengths in Adults

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Abstract

Objective: The etiology of leg length discrepancy (LLD) is incompletely understood although its relationship with systemic conditions such as low back pain is broadly accepted. The aim of this study is to quantify the effect of a biomimetic oral appliance when combined with an atlas orthogonist adjustment on LLD in adults.

Subjects and Methods: A consecutive series of 10 adult patients (mean age 44.8yrs; 7 female, 3 male) were included in this study. Each subject was evaluated for the presence of malocclusion, and a biomimetic DNA appliance® was prescribed by a dentist following a positive diagnosis. Each subject was assessed also for the presence of an atlas subluxation, and a transdermal atlas positioning procedure (TAPP) was performed by an atlas orthogonist following a positive diagnosis. The patients were asked to lie horizontally on a chiropractic table and leg length was measured: without the appliance; with the appliance in situ, and again after the TAPP. The LLDs were subjected to statistical analysis using t-tests.

Results: The mean LLD was 12.4mm (± 5.5) without the appliance. The mean LLD was reduced to 5.8mm (± 3.3) with the DNA appliance in situ ($p < 0.001$). The mean LLD was further reduced to 2mm (± 2) after the TAPP was completed ($p < 0.01$).

Conclusions: When a biomimetic oral appliance is used in combination with transdermal atlas repositioning, there appears to be a synergistic effect that significantly reduces LLD in adults. However, further studies are required to ascertain the veracity of these initial findings.

Key words: *leg_length_inequality, oral_appliance, atlas_subluxation*

Introduction

Chiropractic research on leg length discrepancy (LLD) has focused on: the reliability of methods used for measuring structural differences; how LLD affects the biomechanics of stance and ambulation; and how LLD may alter spinal growth.[1] One study[2] showed that 40% of subjects had LLD > 6mm while 70% had LLD > 3mm.

Although the results of that study indicated no strong correlation between any particular postural adaptations to LLD, at least one abnormal spinal adaptation, such as scoliosis or hypo/hyperlordosis, was found in over half of subjects who had a LLD > 6mm. Indeed, Knutson[3] found a high incidence (85%) of LLD in patients with chronic back pain; patients with back pain/recurrent back pain were significantly more likely to have LLD. Therefore, LLD has a positive, predictive value in back pain. Earlier, Knutson[4] noted that LLD may be of value in determining the necessity of an atlas adjustment when describing a case of upper extremity thermal asymmetry, which may have resulted from an atlas subluxation.

Cervical spine misalignment has also been reported in the orthodontic literature. For example, Huggare[5] found an association between the atlas and dentofacial morphology, noting the prevalence of severe malocclusions. Later, Huggare et al.[6] reported a high prevalence of lateral malocclusions in young people with scoliosis. Thus, Huggare[7] concluded that there is plausible evidence for an increased prevalence of malocclusions associated with hyperlordosis of the cervical spine, and an increased risk of lateral malocclusions in children affected by scoliosis and torticollis.

Further, Eriksson et al.[8] showed an association between mandibular derangement and cervical disorders, noting that jaw movements are the result of activation of jaw and neck muscles, which lead to simultaneous movements in the temporo-mandibular, atlanto-occipital and cervical spine joints. Thus, a functional relationship exists between the jaw and the head–neck sensorimotor systems.

This notion supports the assertion that malocclusions are associated with variations in normal 3-D spinal status in the sagittal, coronal and transverse planes; and, consequently, these spinal abnormalities might also correlate with LLD. Therefore, the null hypothesis to be tested in this study is that LLD is not affected by combined oral appliance/atlas orthogonist adjustment.

Sample and Methods

For this study, the rights of the subjects were protected by the guidelines of the Declaration of Helsinki, which were adhered to regarding the inclusion of human subjects. After obtaining informed consent, a consecutive series of 10 adult patients (mean age 44.8yrs; 7 female, 3 male) were recruited for this study. Each subject was evaluated for the presence of malocclusion, and a DNA appliance® was prescribed by a dentist following a positive diagnosis.

The DNA appliance (Fig. 1) putatively differs from traditional removable, functional and fixed appliances[9] as it has a biomimetic approach, which attempts to mimic or harness developmental mechanisms. Indeed, this appliance system has been successfully deployed in children[10] and adults.[11-12] The DNA appliance is preferentially worn for approx. 12-16hrs during the afternoon, evening and at nighttime, but not during the day and not while eating, partly in line with the circadian rhythm of tooth eruption.[13]

Figure 1. The acrylic-based DNA appliance® used in this study showing 6 (patented) anterior 3-D axial springs®, a midline screw, posterior occlusal coverage, retentive clasps, and a labial bow. Note that other designs are customized depending on patient presentation.

Each subject was also assessed for the presence of a Type 1 atlas subluxation (atlanto-axial rotation ≤ 3mm), and a transdermal atlas positioning procedure (TAPP), which reduces the atlas subluxation, was performed by an atlas orthogonist following a positive diagnosis.

The atlas subluxation assessment consisted of 5 definitive examinations: 1) bilateral scanning palpation of the posterior sub-occipital regions in the area superficial to the C1 nerve root, the vertebral arteries and the dorsal root ganglion of C2[14]; 2) postural assessment using a fixed anatometric instrument, which measures axial rotation around the vertical and sagittal axes; 3) supine leg length assessment against a fixed grid with photographic record; 4) bilateral digital weight analysis, and 5) radiographic and/or cone-beam computerized axial tomographic scan (CBCT) assessment.

In this study, the subjects were asked to lie horizontally on a chiropractic table and LLD was measured and photographed on a grid: without the appliance; with the appliance in situ, and again after the TAPP (Fig. 2). The LLDs were subjected to statistical analysis using t-tests.

Figure 2. Upon lying horizontal on a chiropractic table, LLD was measured and photographed: without the appliance; with the appliance in situ, and again after an atlas-orthogonist adjustment. Note the position of the heels in this case, revealing evidence of leg length discrepancy.

Results

The initial, mean LLD was 12.4mm (± 5.5) without the appliance. The mean LLD was reduced to 5.8mm (± 3.3) with the oral appliance in situ ($p < 0.001$). The mean LLD was further reduced to 2mm (± 2) after the TAPP was completed ($p < 0.01$). The results are presented in Table 1.

Discussion

Following the cranio-caudal gradient of human development, the DNA appliance system is designed to primarily address maxillo-mandibular underdevelopment. The acrylic-based DNA appliance typically has: 6 (patented) anterior 3-D axial springs, a midline screw, posterior occlusal coverage, retentive clasps, and a labial bow (Fig. 1). The DNA appliance is worn for approx. 12-16hrs during the afternoon, evening and at nighttime.

During this time, corrections of developmental compensations can be achieved in both children[10] and adults[11-12] but correction needs to extend post-cranially. Therefore, an atlas-orthogonist procedure is ideally-preferred to correct misalignment of the atlas, which appears to have beneficial (decompensative) effects further distally[15]. Re-positioning the atlas vertebra, i.e., reducing the atlas subluxation, can be done by hand or through the use of a fixed-stylus instrument, which delivers a vector transdermally into the atlas vertebra.

In this study, the TAPP was accomplished using a Sweat Instrument (Advance Engineering, Decatur, GA, USA; Fig. 3a & 3b). An analysis of examination findings was completed prior to performing the TAPP. In this study, CBCT or radiographic imaging analysis consisted of computerized, stereotaxic calculations in order to derive the corrective angle of the vector, which was then programmed into the Sweat instrument.

Figure 3a. The Sweat Instrument used in this study was an Atlas Orthogonal M2 Classic Precision Adjusting Instrument, which delivered the Transdermal Atlas Positioning Procedure (TAPP) using a fixed-stylus (white) while the radial arm of the instrument was adjusted to the proper setting to initiate the corrective trajectory of the atlas.

Figure 3b. Patient positioned for the atlas-orthogonist procedure that was used to correct the misalignment of the atlas, using the Sweat Instrument, which delivered a vector transdermally into the atlas vertebra.

The Sweat instrument delivered a targeted, percussive wave into the transverse process of C1, thereby reducing the craniovertebral subluxation. The wave is thought to initiate an osteokinetic transmission of energy in order to reduce angular displacement of C1 around the occipital condyles and superior articular facets of C2[16].

On post-procedural physical examination, it is common to find: diminution of LLD; a reduction in sub-occipital pain, muscle spasm and inflammation; a more vertical posture of the spine, neck and head; a leveling of the iliac crests, and equalization of the pelvic innominates.

We believe the findings of this preliminary study reinforce the clinical model of co-management. The treatment plan was to use the biomimetic oral appliance to change the initial maxillo-mandibular spatial relations, and bring cranial structures closer to the ideal craniofacial architecture, thus initiating descending, developmental decompensation. Indeed, the post-appliance-insertion LLD findings (Table 1) showed that this objective was met, at least in part.

Furthermore, the treatment plan was to use the TAPP to mechanically reduce Y-axis torque, and bring axial structures closer to the vertical axis. The post-TAPP LLD results (Table 1) show that this objective was met, at least in part (at this point in time, the subjects had not completed their course of care). Therefore, we can infer that a postural decompensation process has been initiated. Indeed, it appears that the junction of descending developmental compensation and ascending postural compensation might occur at the level of C1.

Furthermore, the initial findings of this preliminary study suggest that both descending developmental and ascending postural decompensation might be maintained or improved through the continued use of the combined biomimetic oral appliance and atlas-orthogonist procedures. However, further studies are required to ascertain the veracity of these initial findings.

Conclusion

When a biomimetic oral appliance is used in combination with transdermal atlas repositioning, there appears to be a synergistic effect that significantly reduces LLD in adults. However, further studies should be undertaken to determine the validity of these preliminary results.

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Table 1. Patient data displaying leg length discrepancies at baseline, with DNA, and with DNA plus TAPP

Patient	Age (yrs)	Sex	Initial LLD (mm)	LLD with DNA (mm)	LLD with DNA and TAPP (mm)
Patient 1	60	F	19	6.3	0
Patient 2	60	F	12.7	6.3	0
Patient 3	56	F	9.5	3.1	3.0
Patient 4	56	F	6.3	3.1	3.0
Patient 5	16	F	25.4	12.7	6.3
Patient 6	29	M	6.3	3.1	0
Patient 7	52	F	6.3	0	3.0
Patient 8	41	F	12.7	6.3	3.1
Patient 9	25	M	12.7	6.3	3.1
Patient 10	53	M	12.7	9.5	0
Mean (p-value)			**12.4**	**5.7 (< 0.001)**	**1.9 (< 0.01)**