

Evidence-based protocol for structural rehabilitation of the spine and posture: review of clinical biomechanics of posture (CBP[®]) publications

Paul A. Oakley, DC, MSc*

Donald D. Harrison, PhD, DC, MSE **

Deed E. Harrison, DC†

Jason W. Haas, DC††

BACKGROUND: *Although practice protocols exist for SMT and functional rehabilitation, no practice protocols exist for structural rehabilitation. Traditional chiropractic practice guidelines have been limited to acute and chronic pain treatment, with limited inclusion of functional and exclusion of structural rehabilitation procedures.*

OBJECTIVE: *(1) To derive an evidence-based practice protocol for structural rehabilitation from publications on Clinical Biomechanics of Posture (CBP[®]) methods, and (2) to compare the evidence for Diversified, SMT, and CBP[®].*

METHODS: *Clinical control trials utilizing CBP[®] methods and spinal manipulative therapy (SMT) were obtained from searches in Mantis, CINAHL, and Index Medicus. Using data from SMT review articles, evidence for Diversified Technique (as taught in chiropractic colleges), SMT, and CBP[®] were rated and compared.*

RESULTS: *From the evidence from Clinical Control Trials on SMT and CBP[®], there is very little evidence support for Diversified (our rating = 18), as taught in chiropractic colleges, for the treatment of pain subjects, while CBP[®] (our rating = 46) and SMT for neck pain (rating = 58) and low back pain (our rating = 202) have evidence-based support.*

CONCLUSIONS: *While CBP[®] Technique has approximately as much evidence-based support as SMT for neck pain, CBP[®] has more evidence to support its methods than the Diversified technique taught in chiropractic colleges, but not as much as SMT for low*

ANTÉCÉDENTS : *Quoi qu'il y ait des protocoles d'exercice établis pour la manipulation vertébrale et la réadaptation fonctionnelle, il n'existe aucun protocole pour la réadaptation structurale. Les directives d'exercices chiropratiques traditionnels se limitent à des traitements pour la douleur aiguë et chronique avec une inclusion limitée des procédures de réadaptation fonctionnelle et une exclusion des procédures de réadaptation structurale.*

OBJECTIF : *(1) Faire dévier des publications sur les procédures biomécaniques cliniques de la posture (BCP) un protocole d'exercice, avec preuve à l'appui, pour la réadaptation structurale, et (2) Comparer la preuve pour la technique diversifiée, la manipulation vertébrale et la procédure biomécanique de la posture (BCP).*

PROCÉDURES : *Des essais de contrôle clinique avec l'utilisation des procédures biomécaniques cliniques et la manipulation vertébrale ont été obtenus, suite à des recherches dans Mantis, CINAHL et Index Medicus. En utilisant, les données des rapports de synthèse sur la manipulation vertébrale pour la technique diversifiée (tel qu'enseigné dans les collèges de chiropractie), la manipulation vertébrale et les procédures BCP ont été évaluées et comparées.*

RÉSULTATS : *Fondés sur la preuve des essais de contrôle clinique sur la manipulation vertébrale et les procédures BCP, il existe peu de preuve pour soutenir la technique diversifiée (notre taux = 18), tel qu'enseigné dans les collèges de chiropractie, pour le traitement de la douleur des sujets, contrairement aux procédures BCP*

* Corresponding author: Paul A. Oakley, DC, MSc, 11C-1100 Gorham Street, Newmarket, Ontario L3Y 8Y8, Phone 905-868-9090
Email p.oakley@juno.com

** PO BOX 1590, Evanston, Wyoming, USA, 82931.

† 123 Second Street, Elko, NV, USA 89801.

†† 1180 Main Street, Suite 7, Windsor, CO, USA 80550.

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back pain. The evolution of chiropractic specialization has occurred, and doctors providing structural-based chiropractic care require protocol guidelines for patient quality assurance and standardization. A structural rehabilitation protocol was developed based on evidence from CBP® publications.

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KEY WORDS: chiropractic, spinal manipulation, rehabilitation.

Introduction

Recently, the buzzwords “evidence-based,” “evidence-based medicine” (EBM), and “evidence-based practice” (EBP) have appeared in clinical practice protocols. EBP is defined as clinical decision-making based on (1), sound external research evidence combined with individual clinical expertise and (2), the needs of the individual patient.^{1,2} EBP protocols have recently been written for several conditions.^{2–9}

The goal of EBP is to improve patient outcomes, quality of care, and provide some standardization of treatment. Systematic reviews of available published evidence are required. The value of these literature reviews, however, depends on the quality of the review (selection bias by those doing the review) and the quality of the publications.¹⁰ To have “evidence” on aspects of all treatment methods is nearly impossible in any healthcare discipline, including medicine¹¹ and chiropractic.¹²

The highest form of “evidence” would seem to be reli-

(notre taux = 46) et la manipulation vertébrale pour la cervicalgie (taux = 58) et le lumbago (notre taux = 202) qui sont soutenues par la preuve.

CONCLUSION : Tandis que la procédure BCP possède approximativement, autant de preuve à l'appui que la manipulation vertébrale pour la cervicalgie, la méthode BCP possède davantage de preuves à l'appui, pour soutenir ses procédures que la méthode diversifiée, enseignée dans les collèges de chiropractie, mais pas autant que la manipulation vertébrale pour le lumbago. L'évolution de la spécialisation de la chiropractie est devenue une réalité et les médecins qui fournissent des soins de chiropractie, à base structurale, nécessitent des directives de protocole pour offrir aux patients une assurance de la qualité des soins et une normalisation. Un protocole de réadaptation structurale a été élaboré, fondé sur la preuve des publications, reliées aux procédures BCP.

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MOTS CLÉS : chiropractie, manipulation vertébrale, réadaptation.

ability studies, validity studies, and randomized clinical control trials (RCTs). Critics of a certain healthcare method often condemn that method if RCTs have not been published. This might seem unreasonable as there may be more agreement amongst researchers for other types of evidence. There are other types of clinical (non-randomized clinical trial, cohort, case report, etc.) and basic scientific studies that can provide “evidence” that a certain type or method of care might be reasonable, sufficient, or standard. In fact, the RCT may not be the best source of evidence for the clinical practice of chiropractic.^{1,13,14}

The exact question being debated is “what does and what does not provide evidence in EBM.^{15–17} In 2001, Bolton¹ discussed the reliance on RCTs in EBP protocols. Although the first few published RCTs on spinal manipulative therapy (SMT) were important for the chiropractic profession, RCTs are so narrow in methodology as to not often be useful in clinical chiropractic prac-

tice.^{1,14} Although the RCT is unarguably the best research design, “randomization and controlled conditions play no part in everyday clinical practice”¹ and thus, evidence for effectiveness in that arena cannot be collected by RCTs. The strengths and limitations of the RCT have been discussed elsewhere.¹⁸

Given the limitations of the RCT in evaluating chiropractic treatment,¹⁴ it has been stated that it does not make sense to exclusively pursue the RCT in the future.¹³ Other research designs such as qualitative and outcomes research are now being recognized as very meaningful ways of providing the evidence in EBP.¹ Additionally, it is known today that well-done case studies most often demonstrate findings consistent with that of the RCT.^{19,20}

Since 1975, the chiropractic profession has enjoyed improved political support in a number of countries due to some published analyses favorable to chiropractic care.^{21–25} Unfortunately, because early evidence (RCTs) for manipulation had been on the effectiveness for treating acute and chronic pain complaints (i.e. LBP), the ensuing guidelines have primarily been based on acute/chronic pain care. Consequently, in North America, chiropractic’s inclusion in government health insurance and private insurance programs has coincided with restrictions in frequency and duration of the care permitted. In response, some chiropractic organizations have written their own guidelines in an attempt to obtain fairness in these systems.^{26–28}

Chiropractic treatment protocols could ideally be categorized into either: (a) Acute pain care, (b) Chronic pain care, (c) Functional rehabilitation care, or (d) Structural rehabilitation care. Recently, the profession has shown renewed interest in structural rehabilitative care. In a survey of 108 participating North American practices, Hawk et al.²⁹ (their Table 10, page 167) reported Clinical Biomechanics of Posture (CBP®) technique to be the 7th most utilized technique in chiropractic practices. Problematically, there is only one manuscript detailing proposed guidelines for structural rehabilitation of the spine; this was based on a few preliminary studies.³⁰

Our objectives are two-fold: (1) Compare the evidence for Diversified, General Spinal Manipulative Therapy (SMT), and CBP® for reduction in neck and low back pain intensity; (2) Derive an evidence-based practice protocol for structural rehabilitation from publications on Clinical Biomechanics of Posture (CBP®) methods. We

will use some of Bolton’s¹ ideas of evidence for EBP guidelines when discussing recent published research concerning CBP® structural rehabilitation procedures. To insure communication with the reader, a table of definitions is presented^{31–35} (Table 1).

Methods

In order to compare the evidence for Diversified, SMT, and CBP®, literature searches were conducted in Mantis, CINAHL, and Index Medicus for Clinical Control Trials on SMT, Diversified, and CBP® methods.

We identified 73 RCTs on SMT, including only two clinical control trials on Diversified technique (as defined in Table 1), and 6 non-randomized clinical control trials on CBP® technique methods. In 2004, Bronfort et al.³⁶ had identified 69 of the RCTs on SMT and performed a meta-analysis. This manuscript will adapt the Bronfort et al.³⁶ analysis of the 69 RCTs identified before February 2003, and apply this analysis to two additional RCTs located since February 2003.^{37–38} Additionally, there have been two other review articles discussing SMT.^{39–40}

In these RCT papers’ methods, we were looking for (1) any pain scales, (2) any disability scores, (3) the number of subjects, (4) whether SMT was actually used or only PT Mobilization, (5) if Diversified technique was used (as defined in Table 1), and (6) if DCs, MDs, or PTs performed the treatment, and (7) the number of treatments (visits).

Bronfort et al.³⁶ deleted RCTs with 10 subjects or less, while in this manuscript, we deleted any RCTs if (1) there were 11 subjects or less (there were 3 such RCTs) and (2) if instead of SMT, authors utilized Physical Therapist’s mobilization (MOB) techniques. Table 2 provides our adapted analysis from Bronfort et al.,³⁶ who categorized RCTs into acute pain, chronic pain, and mixed pain in each of the neck and low back regions, and our number of RCTs excluded and included for analysis. In 2004, two additional RCTs were published.^{70–71} While Hurwitz et al.’s 2004 study⁷¹ is a re-look at previous 2002 data,⁵⁹ the 2004 Haas et al. study⁷⁰ had less than 10 subjects in the treatment groups. We compared pain scale data in the 29 remaining RCTs^{41–69} and the two RCTs published since February 2003^{37–38} to the CBP® published clinical control trials.^{72–77}

Table 3 provides the authors’ rating scale for Clinical Control Trials used in this manuscript. This rating scale is

Table 1
Definitions of terms used in this manuscript

Term	Operational Definition
Functional Rehabilitation	Rehabilitation with a purpose of treating/preventing deconditioning syndrome and abnormal illness behaviors via: relaxing/stretching overactive/tight muscles, mobilizing/adjusting stiff joints, facilitating/strengthening weak muscles, re-educating movement patterns (Liebenson, 1996). ³¹
Structural Rehabilitation	Rehabilitation with a purpose to normalize both posture and spine alignment primarily via mirror image exercises, mirror image adjusting, mirror image/extension traction.
Weak Muscle	Muscles that result in loss of movement if that muscle cannot contract sufficiently to move a body part through its partial or complete range of motion (Kendall et al. 1993). ³²
Shortened Muscle	Muscles with a degree of shortness that results in slight to moderate loss of range of motion (Kendall et al. 1993). ³²
SMT (Spinal Manipulative Therapy)	Spinal Manipulative Therapy defined as application of high-velocity, low-amplitude manual thrusts to the spinal joints slightly beyond the passive range of joint motion (Haldeman & Phillips, 1991). ³³
Diversified Technique	Specific Spinal Manipulation Technique with the following steps: 1) spinal listing (body left, PRS, etc) derived from Motion Palpation or X-ray analysis; 2) specific patient position; 3) specific doctor position; 4) specific contact point; 5) specific line of drive opposite the spinal listing.
Acute pain	Pain less than 6 weeks duration.
Subacute pain*	Pain of 6 weeks to 3 months duration.
Chronic Pain*	Pain of greater than 3 months or of multiple occurrences (Carr, 2004). ³⁴
MMI (Maximum Medical Improvement)	Term often used interchangeably with Maximum Chiropractic Improvement (MCI) or Maximum Therapeutic Benefit (MTB) indicating that further recovery and restoration of function can no longer be anticipated to a reasonable degree of medical/therapeutic certainty (Bryans, 2000). ³⁵

* Bronfort et al.³⁶ defined chronic pain as greater than 6 weeks and did not use the subacute category.

Table 2
RCT studies using SMT as the treatment

Health conditioned studied in RCT	RCTs identified by Bronfort ^{3 6}	Number excluded by Bronfort ³⁶	Number excluded if MOB & not SMT utilized	Number excluded for ≤ 11 patients	Number used as evidence in this manuscript
Acute LBP	15	9	1	0	5 ⁴⁰⁻⁴⁴
Chronic LBP	15	4	4	1	6 ⁴⁵⁻⁵⁰
Mix LBP	16	2	0	2	12 ⁵¹⁻⁶²
Acute NP	5	3	1	0	1 ⁶³
Chronic NP	7	2	2	0	3 ⁶⁴⁻⁶⁶
Mix NP	11	6	2	0	3 ⁶⁷⁻⁶⁹

MOB = Physical Therapy Mobilization without SMT cavitation.

Acute = Pain for a duration of less than 6 weeks.

Chronic = Pain greater than 6 weeks duration, as defined by Bronfort et al.³⁶

LBP = Low Back Pain.

NP = Neck Pain.

RCT = Randomized Clinical Control Trial.

SMT = Spinal Manipulative Therapy.

Table 3
Rating scale for clinical control trials used in this manuscript

	Rating* for Index where published		
	Mantis	CINAHL	Index Medicus
Controlled Trial			
RCT with greater than 29 patients	6	8	10
RCT with less than 30 patients	4	6	8
Non-RCT with greater than 29 patients	4	6	8
Non-RCT with less than 30 patients	3	5	7

*If the RCT methods do not provide pain scales, which negates analysis of pain improvement, then 2 additional points are subtracted from the ratings above.

based on four parameters including: indexing data base of manuscript publication, type of clinical trial (RCT vs. non-RCT), the number of subjects, and use of pain scales, at minimum, either a numerical rating scale (NRS) or visual analogue scale (VAS). Outcome tools construction is rather a difficult procedure and, although simple and intuitively obvious, our new rating tool (Table 3) has not been tested.

In order to derive an evidence-based practice protocol for structural rehabilitation from publications on Clinical Biomechanics of Posture (CBP[®]) methods, data from the

six identified clinical trials on CBP[®] technique were extrapolated to estimate durations of care necessary to correct varying postural displacements. The extrapolations are reasonable as the CBP[®] controlled trial data is not linear (i.e. multiple pairs of data points, x_i, y_i , that make a line when plotted), but are average improvements for 36 treatments in a sample of more than 30 subjects, over a long time period (36 treatments over 3 months), and is exactly the kind of average data that can be extrapolated to another time period.

Table 4
Rating and analysis of 25 RCTs for low back pain using general SMT and Diversified

Low Back Pain RCT	# Treated patients	# visits	Pain score VAS/NRS pre/post	Treatment DC, MD, DO, PT?	Diversified used?	General SMT used?	Rating
*Glover et al, 1974 ⁴¹	43	1	NR	PT	no	yes	8
*Godfrey et al, 1984 ⁴²	22, 22	1	NR	MD/DC	no	yes	6
Hadler et al, 1987 ⁴³	26	1	NR	MD	no	yes	6
*MacDonald et al, 1990 ⁴⁴	49	5	NR	DO	no	yes	8
Mathews et al, 1987 ⁴⁵	165	<10	NR	PT	no	yes	8
*Bronfort et al, 1996 ⁴⁶	71, 51	10	5.4 / 3.7	DC	yes	no	10
Burton et al, 2000 ⁴⁷	20	6–18	NR	DO	no	yes	6
*Coxhead et al, 1981 ⁴⁸	8G of 16	5–10	NR	PT	no	yes	6
Herzog et al, 1991 ⁴⁹	16	10	3.2 / 1.8**	DC	no	yes	8
Pope et al, 1994 ⁵⁰	69	9	Improved 2.4	DC	no	yes	10
Triano et al, 1995 ⁵¹	47	12	3.8 / 1.3	DC	no	yes	10
*Anderson et al, 1999 ⁵²	83	12	4.9 / 3.2	DO	no	yes	10
Cherkin et al, 1998 ⁵³	133	6.9	5.5 / 2.0	DC	no	yes	10
Doran et al, 1975 ⁵⁴	116	6	NR	MD	no	yes	8
Evans et al, 1978 ⁵⁵	15, 17	9	NR	MD	no	yes	6
Giles et al, 1999 ⁵⁶	23	6	5.0 / 2.5	DC	NR	NR	8
Hoehler et al, 1981 ⁵⁷	56	2–8	NR	MD	no	yes	8
Hsieh et al, 2002 ⁵⁸	49	9	NR	DC	yes	no	8
*Hurwitz et al, 2002 ⁵⁹	171	NR	4.7 / 2.5**	DC	NR	yes	10
Meade et al, 1990 ⁶⁰	384	9	NR	DC	NR	?	8
Postacchini et al, 1988 ⁶¹	87	16–22	NR	DC	no	yes	8
Skargren et al, 1997 ⁶²	138	7	NR	DC	NR	NR	8
*Wreje et al, 1992 ⁶³	18	1	4.0 / 4.0	MD	no	yes	8
Williams et al, 2003 ³⁷	72	3	NR	DO	no	yes	8
Licciardone et al, 2003 ³⁸	91	7	NR	DO	no	yes	8
Totals (Pain & Rating)			Mean 4.6 / 2.6				202

* Methods include additional treatments besides just SMT.

** Interpreted from graphs.

NR = Not Reported.

Results

Overall, there is a considerable amount of evidence supporting the use of SMT for low back (our rating = 202) and neck pain (our rating = 58), as well as support for CBP® technique for pain (our rating = 46). Surprisingly, there is little data existing on Diversified technique (as defined in Table 1) for either low back (our rating = 18) or neck pain (our rating = 0). Tables 4–6 summarize this data.

Using reported VAS (divided by 10) or NRS scores in Tables 4–6, an average pain reduction can be computed for the clinical control trials for low back pain using SMT techniques, neck pain SMT techniques, and CBP® methods. This comparison shows that the average reported numerical rating of initial (I) and follow-up (F) pain for Neck SMT studies is I/F = 4.8 / 2.5, the average for Low Back SMT studies is 4.6 / 2.6, while the average for CBP® studies is 4.0 / 1.0. Thus, while the average pain reduction (NRS) in SMT studies is approximately 48%, the average for CBP® studies is 75%.

Using only the papers that reported numerical pain data in Tables 4–6, ending clinical pain can be assessed. Simple pain outcome data (i.e. NRS, VAS) comparing pre-to-post treatment results indicate that, although partial reductions in pain levels are achieved for SMT trials, post-treatment pain levels are reported to be at significant clinical levels, e.g., an average of ending NRS = 2.6 in Table 4 and ending NRS = 2.5 in Table 5. The same pain data comparison found for the CBP® clinical trials indicate minimal-to-negligible pain levels in the post-treatment groups (average ending NRS = 1.0 in Table 6).

A similar analysis to numerical pain using disability scores (not shown) from the RCTs in Tables 4 and 5 indicates that treatment subjects, on average, have significant disability at follow-up in these SMT studies (using those papers which report disability with NDI, SF-36, Roland-Morris, and/or Oswestry). For example, the reader is referred to the recent study by Leboeuf-Yde.⁷⁸

Extrapolated CBP® clinical trial average data (Table 7) could be easily interpreted to estimate hypothetical treatment durations based on the magnitude of postural deviations (millimeters/degrees) as starting points in patient care (see Table 8).

Discussion

From the analysis presented on RCTs with the treatment

of SMT in Tables 4–6, there is considerable evidence for the treatment of general spinal manipulation to be utilized for neck pain (our rating = 58) and back pain (our rating = 202). However, there is very little evidence for Diversified Technique, as defined in Table 1 (rating = 18). Thus, there is more evidence for CBP methods (our rating = 46) than for the Diversified technique (rating = 18), which is the technique method mandated by the Council on Chiropractic Education (CCE-USA and CCE-Canada) to be taught in all Chiropractic College curricula in the USA and Canada.

According to our review of studies on SMT and reduction in chronic pain intensity, it is readily apparent that the average neck pain subject is left with a NRS/VAS = 2.5 and the average for low back pain subject is left with a NRS/VAS = 2.6 (review Table 5). We note, the definition of a 2 = *Constant Minimal to Intermittent Slight Pain* and a 3 = *Constant Slight Pain with some handicap*. In contrast, the same pain data comparison found for the CBP® clinical trials indicate an ending value of NRS/VAS = 1 = *Minimal Pain or annoyance* (Table 6). Therefore, it is obvious that while short-term usage of SMT reduces chronic pain intensity, it does not relieve it and in fact these subjects would not be described as MMI. The recent studies by Haas et al.⁷¹ and Leboeuf-Yde et al.⁷⁸ are good examples of this. Thus, practice protocols based on pain in SMT studies are incomplete. Also, such practice protocols must include more visits than 12 because treated subjects, in published RCTs, were left in chronic pain (NRS = 2.6) after up to 12 treatments of SMT.

In a pilot RCT with a small number of subjects (n = 8 in each group), Haas et al.⁷¹ found that an increased number of treatments, up to 12, was associated with greater improvement of headache pain. However, even in the 12 treatment group, the headache pain was still less than 50% improved.⁷¹ Likewise, in a recent large multi-center trial, after 4 treatments of SMT for lower back pain, Leboeuf-Yde et al. found that subjects were left with a NRS of 2.6 (12 month follow up data). Leboeuf-Yde et al.⁷⁸ also reported that these subjects still had significant levels of disability on the Oswestry scale (35-Moderate Disability down to 22.2-Moderate Disability).

Recent publications have found that health related quality of life and functional disability measures (Short Form-36, Oswestry, Neck Disability questionnaires, etc. ...) are more sensitive and important than simple pain in-

Table 5
Rating and analysis of seven SMT RCTs for neck pain

Neck Pain RCT	# Treated patients	# visits	Pain: VAS/NRS Pre/post	Treatment by DC, MD, DO, PT?	Diversified Used?	General SMT used?	Rating
*Howe et al, 1983 ⁶⁴	26	1–3	NR	MD	no	yes	6
*Bronfort et al, 2001 ⁶⁵	64	24	5.7 / 3.7	DC	no	yes	8
Jordan et al, 1998 ⁶⁶	33	12	4.3 / 2.0	DC	NR	NR	10
*Sloop et al, 1982 ⁶⁷	21	1	Improved 1.8	MD	no	yes	6
Giles et al, 1999 ⁵⁶	23	6	4.5 / 1.5	DC	no	yes	8
Hurwitz et al, 2002 ⁶⁸	171	1	4.8 / 2.6	DC	no	yes	10
Skargren et al, 1997 ⁶⁹	41	7	4.6 / 2.5	DC	no	yes	10
Totals (Pain & Rating)			Mean 4.8/2.5				58

*Methods include additional treatments besides just SMT.
NR = Not Reported.

Table 6
Rating & analysis of six CBP® clinical control trials^{72–77}

CBP® Clinical Control Trials	# Treated patients	# visits	Chronic Pain: NRS Pre/post	Treatment by DC, MD, DO, PT?	Diversified Technique Used?	General SMT used?	Rating
Harrison et al, 1994 ⁷²	35	60	NR	DC	no	yes	6
Harrison et al, 2002 ⁷³	30	35	4.3 / 1.6	DC	no	yes, 0–3 wk	8
Harrison et al, 2002 ⁷⁴	30	38	4.1 / 1.1	DC	no	yes, 0–3 wk	8
Harrison et al, 2003 ⁷⁵	48	38	4.4 / 0.6	DC	no	yes, 0–3 wk	8
Harrison et al, 2004 ⁷⁶	51	37	4.0 / 0.7	DC	no	no	8
Harrison et al, 2004 ⁷⁷	63	36	3.0 / 0.8	DC	no	yes, sporadic	8
Totals (Pain & Rating)			Mean 4.0 / 1.0				46

NRS = Numerical Rating Scale for pain (0 = no pain, 1, 2, ..., 8, 9, 10 = severe disabling pain).

Diversified = a specific conglomeration of SMT maneuvers that requires specific listing, patient position, doctor position, and thrust opposite the listing (see definition Appendix 1).

NR = Not Reported.

0–3 wk = SMT given only in first 3 weeks of care out of 12 weeks of care.

sporadic = only a few subjects received an SMT, in only 0–3 weeks of care.

tensity outcomes.⁷⁹ It is of interest that recent publications have found strong correlations between altered sagittal spinal alignment (specifically loss of the distal lumbar lordosis), health quality of life, and physical function as measured with the Short Form-36 questionnaire.⁸⁰ Therefore, we recommend that clinicians utilize health status and disability questionnaires at all initial and follow-up examinations. In this manner, strong evidence can be used to support the need and outcome effects of CBP® treatment methods (or any other chiropractic care) past the 8–12 visit “bench mark” of traditional SMT based studies.

Thus, CBP® multi-modal methods can be utilized to achieve health and disability improvements. But improvements in structural alignment are the primary intervention goal. Before deriving a protocol for structural rehabilitation from CBP® publications, a brief review is given for an appreciation of the clinical relevance of structural rehabilitation of the spine and posture.

Clinical relevance for structural rehabilitation

It is known that spinal function is directly related to spinal structure, as has been proven for the cervical and lumbar spinal regions.^{80–84} With mal-alignment in neutral posture, static and especially dynamic function from this mal-alignment dictates altered stress/strain relationships of associated spinal structures, including the bones,^{85–87} intervertebral discs,^{88–91} facet joints,⁹² musculotendinous tissues,⁹³ ligamentous tissues,⁹⁴ and neural elements.^{95–100}

Postural alterations are known to be associated with a plethora of human afflictions from general pain syndromes,^{101–109} to problems with specific joints such as the hip^{110–111} and the knee,¹¹² to problems with specific spinal regions such as the flat-back syndrome,¹¹³ and cervical kyphosis,¹⁰⁹ to local organ ailments such as uterine prolapse,^{114–115} gastric herniation,¹¹⁶ and respiratory function,^{117–119} to thinking,^{118,120} and even to morbidity and mortality.^{121–125} Improved posture alignment has been one of the most sought-after goals in the treatment of human ailments for ages; this continues today in all medical arenas, such as dentistry, physiotherapy, physiatry, surgery, and chiropractic.^{126–134}

Since traditional SMT has not been found to be associated with routine improvement in spinal alignment, its therapeutic effects are thought to be in reducing pain and facilitating increased spinal motion.¹³⁵ Of interest, how-

ever, many monotherapies, have been found to have either limited effectiveness or complete lack of success in treating chronic low back pain. Bogduk¹³⁶ has discussed that these monotherapies include analgesics, NSAIDs, muscle relaxants, antidepressants, physiotherapy, surgery, and manipulative therapy. In contrast, Gross et al.¹³⁷ have reported that the multi-modal care of exercise combined with cervical manipulation provides better results than either procedure used alone. The criticism of monotherapies is taken into consideration by CBP® technique as it uses a multi-modality care regimen of SMT as well as mirror image® exercises, mirror image® adjusting and mirror image®/extension spinal traction procedures, other stretching procedures, and ergonomic counseling.

Limitations

Limitations of using data from RCTs on SMT and CBP® Clinical Control Trials in this review study are the same as those expressed by Bronfort et al.³⁶ The interested reader is referred to page 350 of their study.

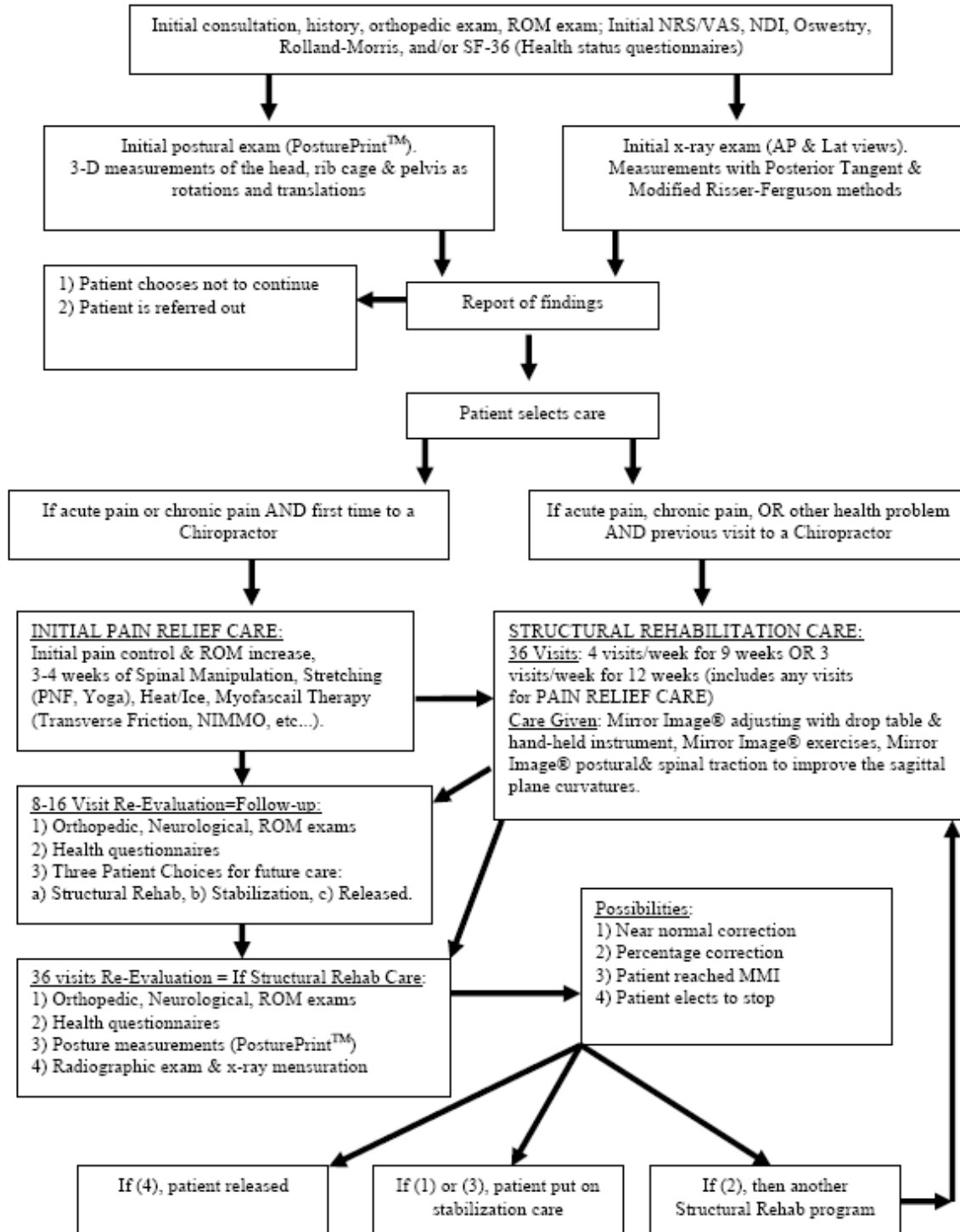
Goals in structural rehabilitation

If we categorize chiropractic treatment into: (a) acute pain care, (b) chronic pain care, (c) functional rehabilitation care, and (d) structural rehabilitation care, the goals of care in structural rehabilitation may encompass the first two (acute and chronic pain care). Considering the relationship between spinal function and structure,^{80–84} it is probable that functional rehab and structural rehab are attempts to treat the same patient dysfunction; albeit with different approaches.

For example, a patient presenting with acute or chronic neck pain with 50 mm of anterior head translation, initially would be treated with a trial of traditional SMT including any ancillary procedures (heat, ice, massage, stretching, etc. ...) for about 2–4 weeks to attempt to improve pain levels and spinal motion. Following this, functional rehabilitation would seek to improve strength in weakened muscles and flexibility in shortened or tightened muscles; muscle dysfunction is considered to be the cause of the displacement.³² In the case of anterior head translation it has been found that the neck flexors have decreased endurance and maximal isometric contraction strength.¹³⁸

In contrast, structural rehabilitation procedures would seek to improve the postural abnormality by exercising

Figure 1. Algorithm for Structural Rehabilitation



the head in the exact opposite displacement (i.e., posterior head translation). Posterior head translation causes contraction of the upper neck flexors and stretches the upper neck extensors.¹³⁹ Therefore, it is apparent the two approaches (functional vs. structural) are attempting to treat the same disorder by different means.

Figure 1 provides an algorithm that outlines the protocols, procedures, and time frames for a structural rehabilitation program of chiropractic care. This structural rehabilitation algorithm will be first supported and then detailed in the duration of the manuscript. The uniqueness of structural rehabilitation is the goal of normalizing both posture and spine alignment to evidence based values. This goal requires (1) a precise definition of normal posture; (2) reliability and validity of postural measurement; (3) a precise definition (model) of the normal spine; and (4) reliability and validity of spinal measurements.

Overview of CBP® Procedures

1) Radiographic Procedures

Radiographic line drawing analysis has been shown to be one of the most reliable tools in clinical practice.¹³⁴ The Harrison posterior tangent method for measurement of sagittal spinal curves and the modified Riser-Ferguson method for measurement of frontal plane spinal displacements have both been studied for reliability. These two methods have been found to have good to excellent inter and intra-examiner reliability with small mean absolute values of observer differences for both angles and distances.¹⁴⁰⁻¹⁴³

The validity of radiographic analysis is supported by knowledge of posture and coupling, termed main motion (posture) and coupled motion (spinal segmental movements) in the literature.¹⁴⁴⁻¹⁴⁸ The radiographic spinal alignment (spinal coupling) can be compared to the initial posture of the patient (main motion) to determine if the coupling patterns are the same as published movements in the literature. This is valid, however, only if the clinician utilizes the same radiographic positioning methods as that used in the published studies;¹⁴⁹ in fact, the CBP® standardized x-ray positioning procedures have been studied for their repeatability. Harrison et al.¹⁴⁹ presented data on pre-post lateral and AP spinal x-rays ascertained in six different control groups and compared

their results to twenty other manuscripts in the literature. Their¹⁴⁹ results were similar to previous investigators, namely that x-ray positioning is highly repeatable even when taken by different examiners.

2) Ideal and Average Spinal Model

To determine abnormality of radiographic spinal alignment, the radiographic measurements are compared to a published normal spinal model that provides ideal and average alignment values (Figure 2). This normal spinal model is based, in part, on average values from normal subjects and has been published in orthopedic and chiropractic journals.¹⁵⁰⁻¹⁵⁶ Normal values have been published for each sagittal vertebral segmental angle (RRA = relative rotation angle, e.g., T8-T9) and for sagittal regional global angles (ARA = absolute rotation angle, e.g., C2-C7, T3-T10, and L1-L5). This model is "evidence-based." In fact, the CBP® sagittal lumbar model¹⁵³ and the sagittal cervical model¹⁵⁶ were found to have discriminative validity in as much as they can distinguish between normal subjects, acute pain subjects, and chronic pain subjects.^{153,156}

Further validity for an optimum upright spinal position comes from an analysis of loads and stresses based on minimum energy expenditure.^{89,121,157-159} Also, statistical analyses have derived an average normal spine.^{160,161} A biomechanical analysis of spinal loads dictates a vertical spine in the antero-posterior view (see AP view in Figure 3A), while more work must be done to derive a normal postural position in the sagittal view. Both ideal and average sagittal human postural alignments have been discussed.^{134,160-163} Figures 3B and 3C illustrate the ideal and average sagittal postures, respectively. The average sagittal posture in Figure 3C has a forward head posture and poor sagittal balance of C1, T1, T12, and S1; recent publications negate this position as normal due to increased muscle and disc loads, and tissue stresses.^{89,109,121,128,158,163,164}

With normal posture precisely described (Figures 3A and B), abnormal posture can be determined. Using biomechanical concepts, abnormal posture has been described as rotations and translations of the head, rib cage, and pelvis from normal position in a 3-dimensional coordinate system (Figures 4 and 5).^{165,166} The last item necessary to complete the goals of structural rehabilitation protocols is the measurement of standing human posture.

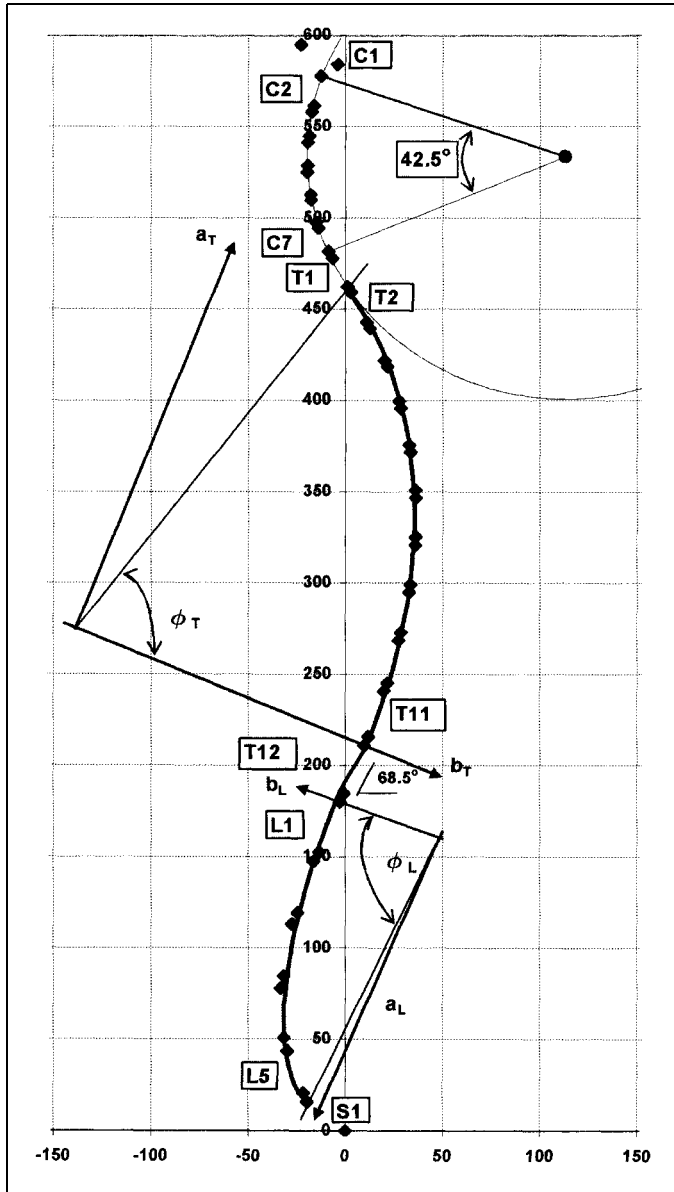


Figure 2. The CBP® Full-spine Normal Model is the path of the posterior longitudinal ligament through the posterior body margins. It is composed of separate ellipses in the different spinal regions (cervicals, thoracics, & lumbar). It has near perfect sagittal balance of vertical alignment of C1-T1-T12-S1. This model provides normal sagittal plane curves and normal values for all segmental angles and global angles. The sagittal curves have points of inflection (mathematic term for change in direction from concavity to convexity) at inferior of T1 and inferior of T12. Reprinted with permission from Harrison DE et al. Spinal Biomechanics for Clinicians. Vol. I. Evanston, WY: Harrison CBP® Seminars, Inc., 2003.

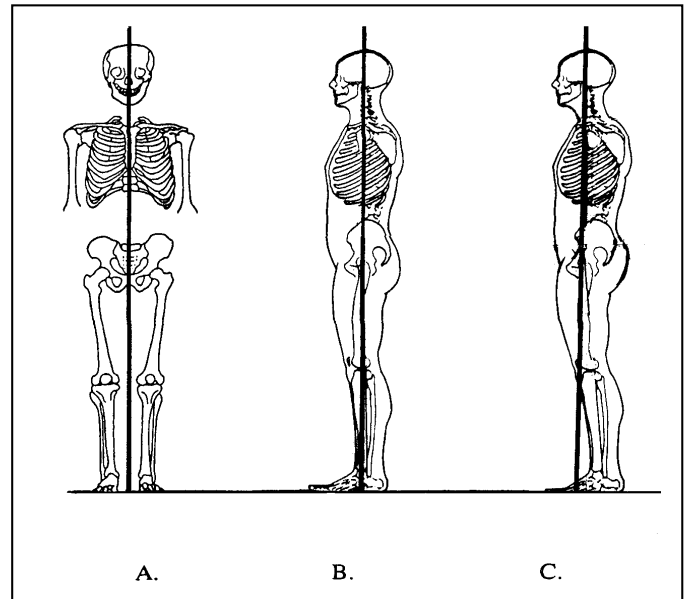


Figure 3. In A, normal AP postural alignment is depicted. In B and C, ideal sagittal and average sagittal alignment are illustrated, respectively. Since the average human sagittal alignment (C) has forward head posture and poor C1, T1, T12, and S1 sagittal balance, it is not considered normal. Adapted with permission from Harrison DE et al. Spinal Biomechanics for Clinicians. Vol. I. Evanston, WY: Harrison CBP® Seminars, Inc., 2003.

There are several computerized systems offered by various companies (e.g., Biotonix, PosturePro, ChiroVision) that use digital images of a patient to analyze their posture. Only one, however, can determine abnormal posture as numerical data of rotations (in degrees) and translations (in millimeters) for each displacement of the head, thorax, and pelvis (Biotonix's new module: Posture-Print™).¹⁶⁷⁻¹⁶⁸

As with measures of pain intensity, range of motion, and quality of life, periodic assessment of structural alignment is important to evaluate progress and determine when maximum medical improvement has been reached (Figure 1). Posture analysis via digital photography is non-invasive. While use of multiple follow-up radiographs are deemed necessary for use in surgical treatment by orthopedic surgeons,¹⁶⁹ some chiropractors have condemned the use of post-radiographs to collect alignment data.¹⁷⁰⁻¹⁷⁵ Importantly, these condemnations¹⁷⁰⁻¹⁷⁵ can

Table 7
Average data from six CBP® non-randomized clinical control trials⁷²⁻⁷⁷

CBP® Study	Traction Minutes	Number of Visits	Number Months	Initial ARA	Post ARA	Average Improvement
<i>Sagittal Cervical:</i>						
Compression-Extension ⁷²	10	60	3.0	-14.5°	-27.7°	13.2°
2-way ⁷³	20	35	3.0	-12.4°	-26.6°	14.2°
Combined 2-way & Comp-Extension ⁷⁴	20	38	3.4	-4.2°	-22.1°	17.9°
<i>Sagittal Lumbar:</i>						
APM&R 2002 ⁷⁵	20	38	3.0	-22.4°	-33.7°	11.3°
<i>AP Cervical:</i>						
Lateral Translation ⁷⁶	20	37	3.0	13.7 mm	6.8 mm	6.9 mm
<i>AP Lumbar:</i>						
Lateral Translation ⁷⁷	20	36	3.0	15 mm	7.3 mm	7.7 mm

Note: The only CBP® non-randomized clinical control trial to not have pain data is Ref #72.

be considered expert opinion evidence only, without supporting data. In contrast, there is data to show that the use of medical x-rays constitutes a very minor health risk.¹⁷⁶⁻¹⁸⁵ In fact, Cohen (University of Pittsburg) has written extensively on the over-exaggeration of exposure from medical x-rays.^{171,181-184} The following section will review the relative health risks of spinal radiography.

Health Risks of Radiography in Structural Rehabilitation

In structural rehabilitation care, it is necessary that the Doctor obtain initial and follow-up posture and radiographic measurements. The frequency suggested for radiography is an initial examination, with follow-up measurements at 36 visit intervals, which could be 4 visits per week for 9 weeks or 3 visits per week for 12 weeks.¹⁸⁶⁻¹⁸⁷ Data from CBP's® 6 clinical control trials⁷²⁻⁷⁷ indicate that the average chronic pain patient needs 6 months of intensive care to achieve a near normal spinal and postural alignment. This would mean, on average, one initial set of x-rays and single plane follow-up x-rays depending on the part of the spine being treated.

The structural rehabilitation algorithm for x-ray imaging frequency is minimal, compared to that of orthopedic surgeons, who often take initial pre-operative, immediate post-operative, one month, 6-12 months, and long-term follow-up radiographs (total of 5 sets of x-rays) for surgery cases.¹⁶⁹ In fact, according to Fischgrund (2005, pp 1017 and 1023), "Routine cervical spine radiographs taken for the evaluation of degenerative disc disease and cervical radiculopathy include lateral, anteroposterior, and oblique views."¹⁶⁹ "Typical follow-up of these patients includes an office visit at 1 week, with routine anteroposterior and lateral radiographs. By 6 weeks, lateral flexion and extension views usually show that the fusion construct is stable ...".¹⁶⁹ Fischgrund further stated that follow-ups are ascertained at 1 year, 2 years, or 5 or more years depending upon the specific study. Therefore, according to Fischgrund, surgery patients receive initial, 1-week post op, 6-week post op, and 1, 2, or 5 year follow ups.¹⁶⁹

As orthopedists use radiographs to evaluate and monitor structural spinal changes, so too do doctors utilizing CBP® structural rehabilitation protocols.

Table 8
Hypothetical programs extrapolated from data from 6 CBP® clinical control trials⁷²⁻⁷⁷

CBP® Study	Example Initial ARAs or Tx	Normal ARA ^{150,153} or Tx ¹⁵⁰	Expected Average Improvement in 3 months	Number of 3 Months Programs needed	Number of Visits Suggested
<i>Cervical:</i>					
JMPT 1994 ⁷²	-27.7°	-43°	13.2°	1	60
Comp-Ext	-14.5°	-43°	13.2°	2	120
	-1°	-43°	13.2°	3	180
APM&R 2002 ⁷³	-26.6°	-43°	14.2°	1	35
2-way	-12.4°	-43°	14.2°	2	70
	+2°	-43°	14.2°	3	105
JMPT 2002 ⁷⁴	-22.1°	-43°	17.9°	1	38
Combined 2-way	-4.2°	-43°	17.9°	2	76
& Comp-Ext	+14°	-43°	17.9°	3	114
JRRD 2003 ⁷⁶	7 mm	0	6.9 mm	1	37
Lateral Translation	14 mm	0	6.9 mm	2	74
	21 mm	0	6.9 mm	3	111
<i>Lumbar:</i>					
APM&R 2002 ⁷⁵	-33°	-40°	11.3°	1	38
Extension	-22.4°	-40°	11.3°	2	76
	-11.1°	-40°	11.3°	3	114
Eur Spine J 2003 ⁷⁷	7 mm	0	7.7 mm	1	36
Lateral Translation	15 mm	0	7.7 mm	2	72
	22 mm	0	7.7 mm	3	108

ARA = absolute rotation angle.

Tx = translation on the x-axis.

From Maurer:¹⁷⁸ “Authorities agree that while no radiation dose level is risk-free, the level used in diagnostic radiology provides low-dose risk and is considered as acceptable to the average individual.” The 1949 National Council on Radiation Protection and Measurements (NCRP) defines permissible dose as: “the dose of ionizing radiation that, in light of present knowledge, is not expected to cause appreciable bodily injury to a person at any time during his lifetime.” Since this NCRP state-

ment, the trend in science has been away from the “permissible or acceptable” dose concept to the current “risk” concept. In either approach, the end result is similar: “for the information gained with diagnostic radiology, the radiation risk is minimal.”

To educate the reader to the minimal risks of medical x-rays, some equivalent risks are provided from the literature. Medical x-rays are of very minimal health risk compared to the risks associated with environmental fac-

Table 9
Relative Risks of Different Environmental Exposures^{176,178,179,184}
 (These values relate to equivalence of reduced life expectancy)

<i>Environmental Item</i>	<i>Exposure Equivalent</i>	<i>Exposure Equivalent</i>
Pilot Flying: New York City-Athens	4200 microSv/yr	420 mrem/yr
Pilot Flying: Chicago-San Francisco	2800 microSv/yr	280 mrem/yr
Chest x-ray	100 microSv	10 mrem
Extremity x-ray	10 microSv	1 mrem
Dental x-ray	100 microSv	10 mrem
Head/neck x-ray	200 microSv	20 mrem
Cervical Spine x-ray	220 microSv	22 mrem
Lumbar spinal x-rays	1300 microSv	130 mrem
Smoking a Cigarette	70 microSv	7 mrem
Fat Person Eating Pie-a-la-mode	350 microSv	35 mrem

tors such as air travel (in Table 9, exposure equivalent relates to life expectancy). From Butler,¹⁷⁹ for example, one can calculate the routine exposure of airplane passengers and crew; based on 0.60 mSv (0.6 x 0.1 rem) per 100 block hours (the mean for a flight between New York City and Athens, Greece), a pilot flying 700 block hours per year would receive an annual occupational exposure of 4.2 mSv (0.42 rem). In contrast, a pilot flying 700 block hours on a Chicago-to-San Francisco route (0.41 mSv/100 block hours) would receive an annual dose of approximately 2.8 mSv (0.28 rem).

This Chicago-San Francisco dose is 0.28 rem/yr = 280 mrem/yr = 5.4 mrem/wk. For comparison, according to Cohen and Lee,¹⁷⁶ "smoking a cigarette has the risk equivalent of 7 mrem of radiation, and an overweight person eating a pie a-la-mode runs a risk equal to that of 35 mrem." Equating absorbed dose and dose equivalent, 1 rem = 0.01 J/kg = 1 rad, Table 9 provides the minimal dose equivalent for medical x-rays. However, it is noted that current high-frequency machines and use of filtration systems (i.e. Nolan filters) allow human exposures to be reduced very significantly (50%) as compared to earlier equipment.¹⁸⁸

It now becomes obvious why Federal Governments and airplane companies do not tell pilots to stop flying after one year. By simply reducing rich desserts, cigarettes,

or soft-drinks, a pilot can cancel out his *equivalent* radiation risks! The government website states that a flight from LA to NY and back is approximately worth one chest x-ray due to being in the upper atmosphere. Thus, pilots who fly two round trips from LA to NY per week, get the dose equivalent of two chest x-rays per week or about 100 per year! After 10 years, for example, an airline pilot could accumulate an equivalent of 1,000 chest x-rays!

Cohen and Lee¹⁷⁶ and Cohen¹⁸⁴ provided a look at radiation risk levels, along with other examples of risks associated with various activities and how they translate into equivalence in loss of life expectancy. It provides the likely results of both general patterns of behavior and one-time occurrences. According to their study, the drinking of one diet soft drink per day reduces life expectancy by two days; ingesting 100 calories per day by drinking regular soft drinks increases body weight by 7 pounds and reduces life expectancy by 210 days. If you are 30 percent overweight you lose 1,300 days; 20 percent overweight 900 days; unmarried males lose 3,500 days; smokers lose 2,250 days.¹⁷⁶ These studies and many others point out that risks are associated with nearly all activities of daily living.

While DACBRs' (chiropractic radiologists) opinions, with minimal supporting data, condemned the use of ini-

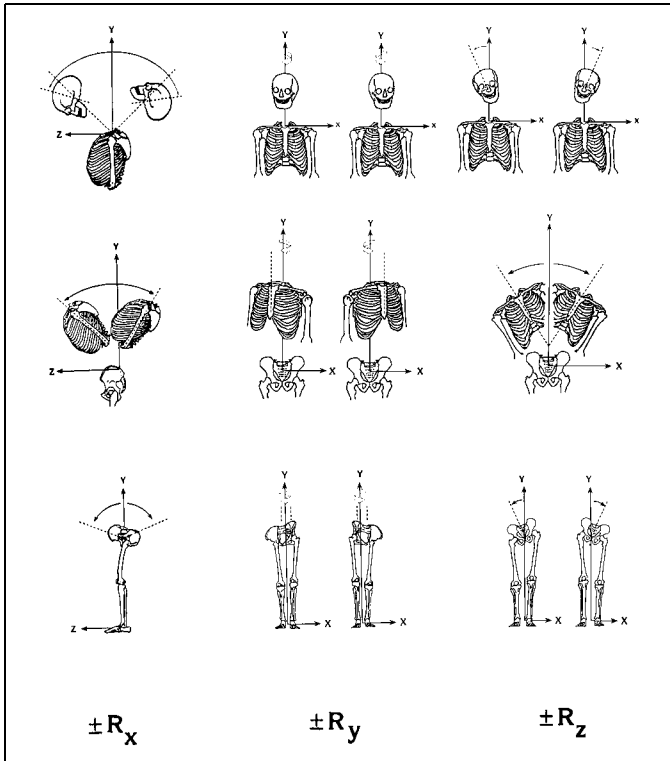


Figure 4. Abnormal Postural Rotations. Rotations of the head relative to the thorax; thorax relative to the pelvis; and pelvis relative to the feet are depicted from the top to bottom rows, respectively. Regional rotations about the x, y, and z-axes are depicted from the left to right columns, respectively. Reprinted with permission from Harrison DE et al. Spinal Biomechanics for Clinicians. Vol. I. Evanston, WY: Harrison CBP® Seminars, Inc., 2003.

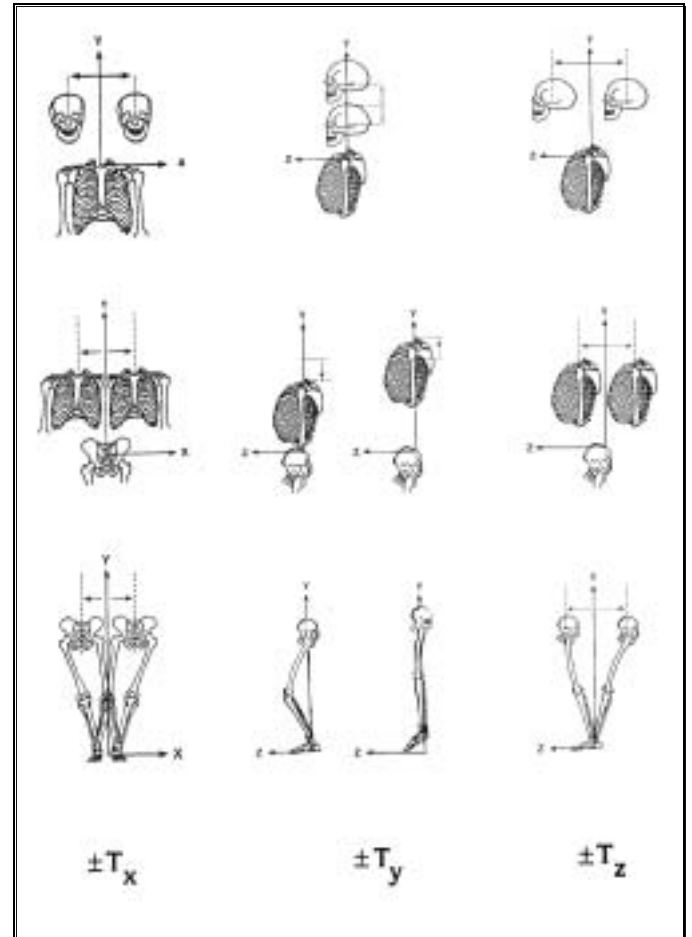


Figure 5. Abnormal Postural Translations. Translations of the head relative to the thorax; thorax relative to the pelvis; and pelvis relative to the feet are depicted from the top to bottom rows, respectively. Regional translations along the x, y, and z-axes are depicted from the left to right columns, respectively. Reprinted with permission from Harrison DE et al. Spinal Biomechanics for Clinicians. Vol. I. Evanston, WY: Harrison CBP® Seminars, Inc., 2003.

tial and post-radiographs to collect alignment measurements,¹⁷⁰⁻¹⁷⁵ data actually exists that indicates medical x-ray exposure may have a health benefit.¹⁹¹ However, minimal risk is inherent in everything we do as part of the human experience. While we must constantly work towards the reduction of health risks in all endeavors, we may be led to accept a minimal level as normal. While there is no data indicating diagnostic radiology has a present risk, any radiation dose must be compared to the benefits of useful information gained. The necessity for appropriate treatment selection is indeed an acceptable trade-off when put into perspective. The need for x-ray imaging is especially clear when one considers that radiographic imaging is the only valid method for attaining spinal align-

ment values; whereas surface contour methods (e.g., flexible ruler) are invalid and unreliable.¹⁹²⁻¹⁹⁶

Radiation Hormesis

Radiation hormesis is the stimulatory or beneficial effect of low doses of ionizing radiation. While an actual benefit from radiation exposure may seem outrageous, there is much scientific evidence for this phenomenon. This topic is in direct conflict with the “Linear No-Threshold Hy-

pothesis” (LNT), which has been assumed to be true for more than 50 years. This LNT model comes from estimating the risks at lower doses of radiation, in the *absence of data*, by extrapolating in a linear model from large doses of radiation from atomic bombs dropped on Japan in the 1940s.

This LNT model has been used to set limits of radiation exposure by all official and governmental associations.¹⁸⁵ Recently in 2003, Kauffman¹⁸⁰ reiterated that authors critical of exposure from diagnostic radiation always use the LNT model. This use of the LNT model includes the recent 2005 report by the USA National Research Council.¹⁹⁷ This report stated, “there will be some risk, even at low doses (100 mSv or less), although the risk is small” and “there is no direct evidence of increased risk of non-cancer diseases at low doses.”¹⁹⁷ This 2005 report ignored and contradicted an earlier 2003 review by Kant et al.¹⁹⁸

For a comparison of exposures, USA citizens are exposed to an average annual natural background radiation level of 3 mSv, while exposure from a chest x-ray is approximately 0.1 mSv and exposure from a whole body computerized tomography (CT) scan is approximately 10 mSv.¹⁹⁷ Also it is noted that 10mSv = 1,000mrem, which equates to about 46 cervical series or 8 lumbar series (see Table 9).

The LNT model has been questioned for its application to low levels of exposure by many researchers.^{183,189,199–202} Actually, below a certain level of exposure, there are beneficial health effects, (termed radiation hormesis), which do not follow from extrapolation of the high-dose portion of the curve.^{182,189–191,203–217}

Structural Rehabilitation Protocols

While other methods may provide evidence for structural rehabilitation, we discuss only recent research outcomes in CBP® Technique. CBP® is unique in chiropractic, in that it utilizes a “mirror image®” concept applied to human posture; this basic tenet has a sound foundation in Linear Algebra, an area of study common to both engineering and mathematics.²¹⁸ CBP® multi-modal care consists of three primary procedures: mirror image® exercises, mirror image® adjustments, and mirror image®/extension traction. These mirror image® posture positions are the rotation and translation pairs in or about each coordinate axis (Figures 4 and 5).

The reason for postural mirror image® exercises, adjustments, and traction procedures is to address all the tissues involved in spine and posture alignment. Although strength and conditioning exercise has not proven to correct posture,²¹⁹ mirror image® exercises have shown initial promise in the reduction of posture and spinal displacements.^{220–224} These exercises are performed to stretch shortened muscles and to strengthen those muscles that have weakened in areas where postural muscles have adapted to asymmetric or ill-positioned postures.

Postural adjustments as performed with drop table, hand-held instrument, or even mirror image® manipulation procedures, are performed for resetting the nervous system regulation of postural muscle balance.^{225,226} Postural mirror image® extension traction provides sustained loading periods of 10–20 minutes and is necessary to cause visco-elastic deformation to the resting length of the spinal muscles, ligaments, and discs.²²⁷

From 1994–2004, CBP® has completed seven case studies,^{228–234} and has completed six non-randomized clinical control trials.^{72–77} While case studies are ranked as the lowest level of clinical studies evidence on the traditional scientific evidence hierarchy, non-randomized control trials are the *2nd highest type of evidence*; ranked second only to the RCT.^{1,14} Recalling that RCTs are inadequate for evaluating multi modal chiropractic care regimens,¹ these seven CBP® case studies^{228–234} and six CBP® control trials^{72–77} provide a growing clinical evidence base to support the need for CBP® structural care programs of sufficient durations to provide as near normal as possible posture and spine structural rehabilitation/re-alignment. From CBP’s® six clinical control trials,^{72–77} Table 7 presents the average total number of visits, frequency, duration of care, and the amount of spinal alignment improvement found for the cervical and lumbar lordoses and cervical/lumbar frontal plane alignments, respectively.

Table 8 presents actual and extrapolated data estimating durations of care necessary for correcting hypothetical sagittal plane displacements; we note that a negative sign means lordotic curvature and a positive sign indicates kyphotic curvature for measurements in the cervical and lumbar regions.^{140–142} Table 8 also gives average and extrapolated data estimating the duration of care necessary to reduce/correct a head and trunk list (side shift posture) in the AP cervico-thoracic and lumbar radio-

graphs as measured appropriately (i.e. measured as a horizontal displacement of: 1) Mid-C2 dens compared to vertical line up from estimated center of mass (CM) of Thoracic #4 in an AP cervico-thoracic analysis;¹⁴⁴ 2) Estimated CM of T12 compared to a vertical line up from the S2 tubercle in an AP lumbar analysis.^{143,235}

From Table 8 one can estimate structural care durations based on extrapolations from the CBP® clinical trials. It should be mentioned that these are merely averages; and are in fact extrapolations from the current clinical trial data. Therefore, individual patients may change in shorter or longer times; thus, follow-up radiological exams provide the clinician with valuable insight into individual patient response to treatment. The following provide examples of estimating average durations of care hypothetically necessary to restore a patient's spine to ideal spinal alignment:

- a) If a patient had a kyphotic cervical curve ARA (C2 to C7) measuring $+12^\circ$, then 3 programs (treatment blocks of 38 sessions) of 2-way extension-compression traction would hypothetically correct the misalignment. That is, three increments of average improvement of -17.9° , results in an extrapolated average correction of $3 \times (-17.9) + 12^\circ = -41.7^\circ$, which approximates the ideal cervical lordosis of -43° .¹⁵⁰
- b) If a patient had a hypolordotic cervical ARA (C2 to C7) measuring -29° , then one program of 35 visits of CBP® 2-way traction would be expected to correct the misalignment: $-29^\circ + 1 \times (-14.2^\circ) = -43.2^\circ$ (ideal normal).¹⁵⁰
- c) If a patient had a hypolordotic lumbar curve ARA (L1 to L5) of -18° , then two programs of CBP® lumbar extension traction of 38 visits would hypothetically correct the misalignment. That is, two increments of average improvement of -11.3° , results in an extrapolated correction of $2 \times (-11.3^\circ) + -18^\circ = -40.6^\circ$, which approximates the average/ideal normal lumbar lordosis value of -40° ¹⁵³ (see Table 8).

Criticisms of CBP Methods

In the past, criticisms of CBP® methods and x-ray protocols have been based on the 1999 Commentary by Haas et al.¹⁷⁰ These criticisms often neglect to provide the Harrison rebuttal written in 2000,¹³⁴ which reported that Haas et al.¹⁷⁰ misrepresented references, misinterpreted referenc-

es, misquoted references, and performed a selective literature review.¹³⁴ In fact, this Harrison-Haas debate was a series of three publications.^{134,170,236} Additionally, the uniformed often state that the extension position in CBP® cervical traction methods are dangerous.

Numerous articles from the literature lead to the conclusion that this is definitely not the case. In fact, in a 1999 thorough review of the literature on varying positions of the head associated with vertebral and basilar artery blood flow and dissection, Haldeman et al.²³⁷ concluded that "examination of the data fails to show a consistent position or movement of the neck that could be considered particularly dangerous."

In addition, Thiel et al.²³⁸ found no occlusion of vertebral artery blood flow during various head and neck positioning tests on the patient, including head extension.

Inaccurate personal opinions about the dangers of extension come from "Beauty Parlor Stroke." There has been anecdotal criticism of the hyper-extension head position at Beauty Parlors. Much of this criticism seems to be based on several letters to editors and case reports in the Index Medicus literature concerning "beauty parlor stroke."²³⁹⁻²⁴³ The positions referred to were prolonged (1-hour or more) hyper-extension combined with axial rotation,²³⁹⁻²⁴³ although Endo et al.²⁴³ did not discuss any rotation of the head. In 1992 and 1993, Weintraub²³⁹⁻²⁴¹ reported on seven cases of "Beauty Parlor Stroke" in which clients at beauty parlors had symptoms of nystagmus, ataxia, slurred speech, facial weakness, nausea, vomiting, vertigo, and dysarthria after having their hair shampooed. Six of these seven individuals were older than 75 years and one was 54-years-old. The 54-year-old subject had been left in a position of cervical hyper-extension over the edge of a shampoo bowl in excess of two hours. In 1995, Stratigos²⁴² reported on the condition of his mother after a trip to a beauty parlor.

All four of these articles discussed in detail that the mechanism of vertebrobasilar injury is associated with cervical axial rotation while in hyper-extension. In 2000, Endo et al.²⁴³ reported a single case of a woman aged 62 who suffered a "beauty parlor stroke." There was no mention of the duration of shampoo treatment or a detailed explanation of the position of the head.

Unlike beauty parlor employees, individuals employing CBP® spinal traction methods are trained physicians, who do screening examinations on patients for tolerance

to head extension. Using our cervical traction protocol, patients are screened and then monitored while traction time periods are increased at only a few minutes per visit, starting at 3–5 minutes, over a period of many visits to a maximum of 20 minutes. These traction methods are also not used or modified for those of advanced age and do not involve axial rotation in the extended position. While any induced stroke symptoms would be unacceptable, these “beauty parlor strokes” should not be applied to CBP® cervical extension traction methods, when used by trained physicians.

Conclusions

Besides the RCT, other forms of scientific evidence, if existing, may be more than adequate to create goal-oriented clinical guidelines.^{1,13,14,244} CBP® studies provide the typical type of chiropractic care, as several procedures are provided to the patient on each visit. At present, there is evidence for SMT for neck and low back pain. From published research for the treatment of chronic neck and back pain at this time, CBP® Technique has more supporting evidence than Diversified Technique, as taught in all Chiropractic Colleges.

This paper has presented guidelines as a clinical tool for the practice of structural rehabilitation by CBP® technique methods. CBP® is unique, in that, unlike most chiropractic techniques,²⁴⁵ CBP® has laid a solid foundation of basic science research (spine modeling, x-ray line drawing reliability, x-ray positioning repeatability, posture reliability, biomechanical stress analysis), clinical research (case studies, clinical trials), and educational research (reviews, position papers).

Because traditional practice protocols in chiropractic have considered only acute and chronic pain conditions, limited inclusion of functional rehabilitation, and a total neglect of structural rehabilitation, there is a need to have published protocols for structural rehabilitation of the spine and posture. This manuscript has proposed structural protocol guidelines based on clinical evidence from a significant quantity and quality of CBP® technique publications. Tables 6–8 are based on CBP® mirror image® methods. The use of multiple clinical methodologies in these CBP® studies is consistent with Bolton’s ideas¹³ of clinical applications in EBP. Because of the focused literature herein, this guideline serves as a tool only for the doctor practicing structural rehabilitation utilizing CBP®

mirror image® exercise, adjusting, and traction procedures.

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