**A tale of specialization in two professions: comparing the development of radiology in chiropractic and medicine**


## ABSTRACT

### Objective

The purpose of this paper is to describe the development of radiology as a specialty in chiropractic with a comparison to the specialty of radiology in medicine.

### Discussion

Specialization in medicine has been notably successful, with advanced training and enhanced capabilities in specialized skills leading to better outcomes for patients and increased prestige for practitioners. However with chiropractic, as with other complementary and alternative medicine professions, no specialization has been recognized within it. Specialist radiology training in chiropractic bears a resemblance to that of medicine, with competitive entry for "residencies," certification exams, and the creation of a journal as well as specialist professional organizations. In order to facilitate the comparison, I have divided the development of radiology into 4 phases from the chiropractic perspective. Phase 1 starts with the discovery of x-rays in 1895, in which medicine adopts them but chiropractic does not. Phase 2 begins in 1910 when BJ Palmer introduces radiography to show chiropractic subluxations. Phase 3, starts in 1942 when Waldo Poehner advocated for the mainstream diagnostic use of radiography in addition to subluxation analysis. Phase 4, starts in 1957 when an examining board for certification in diagnostic radiology is assembled and chiropractors fully embrace the mainstream use of radiography.

### Conclusion

In this tale of two professions, radiology was able to gain official specialty designation in medicine. The medical profession had a monopoly on healthcare, thus had few internal and external forces to overcome. Chiropractic was oppressed by organized medicine, which


**Commented [cj1]:**

Trying to make this section more clear. Tried to clarify, as well as keep it within scientific writing style. Would you please confirm that the meaning has been retained? Is this correct?

**Commented [KY2R1]:** Hi Claire, yes, this will work.

helped to create the unofficial specialty of chiropractic radiology but thus later helped to limit it. Chiropractic radiology has maintained its independence and autonomy, but also remains on the fringe of mainstream healthcare.

INTRODUCTION

Division of labor has existed since pre-industrial days and has increased productivity and efficiency in many fields, including medicine. New ideas, though, are not always immediately accepted. Initially, medical specialization encountered resistance. (1) Some resistance was economically based, on the grounds that more practitioners meant less money in the fee-for-service model that dominated. (2) Some of the opposition was based on the perception that specialization denigrated general practice. (3) There was also public distrust of "specialist" practitioners, who prior to the 20th Century were often lay people, achieving suboptimal results in areas like tooth pulling or the treatment of sexually transmitted infections. (4) Societal changes helped break down the attitude favoring general over specialty practice during the industrial revolution as specialization increased in other fields like manufacturing and farming. Medical specialization became firmly established in the mid-nineteenth century, although the debate continued into the twentieth. (5) The physician versus the surgeon was the basic divide, and subdivisions were established in both areas. One of the first specialties, ophthalmology, became part of medical practice when a few determined physicians like Samuel Cooper and William Lawrence advocated for the idea that diseases of the eye were a proper occupation for medical practitioners, particularly surgeons. (6) Further, they stated that patients could be best served by people with detailed knowledge of disease in general, rather than by lay practitioners. (7) Further, they stated that patients could be best served by people with detailed knowledge of disease in general, rather than by lay practitioners. (5) Similarly, treatment of genito-urinary diseases languished due to social mores associating many of those diseases with the concepts of shame and sin. (1) Again, the advocacy of individuals like Hugh Cabot and Ernst G. Mark first established urology as a legitimate specialty, practitioners of which had been previously referred to as "clap doctors." (1) Later, specialization increased as biomedical knowledge expanded with discoveries in

disease aetiology and treatment methods, then rapidly accelerated with the technological advancements of the late 19th and 20th centuries. (8) It became increasingly difficult for one person to know everything about all diseases and treatments. Physicians eventually discovered that benefits of specialization included increased fees, less onerous working hours, and the prestige of being an expert. (7)

The history of medical radiology as a specialty has been written largely focusing on technology and the scientific achievements that have allowed ever more detailed visualization of internal anatomical structures and function. (9) (10) (11) (12) (13) (14) (15) (16) Radiologists are doctors who coordinate the insights they glean from images with other doctors who then provide treatment based on that information. But it was not technological advancement that created this familiar specialty; rather it was the conscious effort of individuals and groups to develop radiology within medicine as a specialty. In medicine, the success is evident; in chiropractic, however, this has not been the case. The purpose of this paper is to describe my opinions about actions of people in attempting to create a radiology specialty in chiropractic as compared to the creation of a radiology specialty in medicine.

METHODS

By examining key individuals, associations, and publications in both chiropractic and medicine, I describe the difficulties of starting a speciality in any profession. For this paper, I have defined success as the official recognition of a specialist's skills by registration/licensing boards and accreditation agencies. This recognition exists in medicine, but not in chiropractic.

Chiropractic has a substantial challenge that is not found in medicine, in that there is no profession-wide agreement on the basic principles that govern health and disease. There is lack of homeogenaiety in the use of radiographs in the chiropractic profession. Some chiropractors use x-ray films to identify chiropractic vertebral subluxations (CVS), whereas

others only use radiographs to rule out pathology, then there are still others who use them to do both. This makes it difficult for a speciality that focuses on pathology to gain acceptance, and nearly impossible for radiology, because the primary use of radiography varies with a chiropractor's healthcare paradigm as either traditional or biomedical. The granting of specialty status within a profession involves demonstrating that the specialty is useful, necessary, and congruent with the profession's overarching identity. This is usually accomplished through a process of professionalization in the specialty. I will examine the attempted creation of diagnostic radiology as a specialty in chiropractic, comparing radiology in chiropractic with radiology in medicine over time, examining the forces that have led to the different outcomes. This paper will focus mainly on the United States of America (USA). The USA is also home to the majority of chiropractic radiologists, about 190 in total. (17) Only a handful are found elsewhere, in Canada, the United Kingdom, Australia, and New Zealand. (17) This is probably because USA has the highest concentration of chiropractors in general, and because it is where chiropractic radiology originated. The relevant events in chiropractic will be compared to concurrent events in medical radiology, demonstrating differences in the forces acting upon each as well as the outcomes achieved.

Much of the development of the specialty of radiology in chiropractic was chronicled in a monthly publication, the *Journal of the NCA* and later the *Journal of the ACA*. To augment this, I drew on interviews and other personal communications with the surviving members of the earliest generations of chiropractors certified in radiology by the ACBR, as well as relatives and colleagues of deceased chiropractors who were involved with organizing biomedically-oriented radiology in the profession. Ethical approval for interviews, surveys, and access to private archives was granted by the Murdoch University Human Research Ethics Committee, permit number 2012/152. Signed consent forms were collected from interviewees.

I suggest that the the history of radiology be divided into 4 phases. This division is based on how the chiropractors most closely involved with diagnostic radiology and radiography viewed its use within the profession. These phases demonstrate the evolution of x-ray use in chiropractic from a traditional/vitalistic use (to identify chiropractic vertebra; subluxations) towards a mainstream/biomedical use (to identify biomedical pathology). This is shown to parallel the movement in the rest of the profession from alternative to complementary practice. For the most part, the suggested phases are artificial boundaries, not clear demarcations of change, and there is overlap between them, but the years listed below have been chosen because in each of them a prominent figure or group broke from what had been the norm to that point. The phases of the chiropractic radiology specialty are as follows:

- Pre-chiropractic radiology (1895 – 1910)
- Separate and distinct (1910 – 1942)
- Transition (1942 – 1957)
- Biomedically-oriented (1957 – present)

HISTORICAL REVIEW

Pre-chiropractic phase (1895 – 1910)

Medicine

Röntgen's December 1895 paper proclaiming the discovery of the x-ray circulated rapidly around the world. "This announcement produced a sensation not only in scientific circles but also in the medical profession and even among laymen." (18) In medicine, the technology was immediately recognized for its potential diagnostic benefit and many doctors began experimenting with it clinically. Heber Robarts had a larger vision and took some of the first steps toward helping create radiology as a medical specialty. Robarts was an eclectic practitioner of electrotherapy, a mine sanitation inspector, and a railroad surgeon, from St

Louis. His imagination was captured by the possibilities of the x-ray. In 1896, he created the first publication on the subject in the USA, the *American X-Ray Journal*. (19) In 1899, Johann (John) Rudis-Jicinsky, a physician in Cedar Rapids, Iowa, wrote to Robarts, encouraging him to form a society to explore the medical use of x-rays. Forty invitations were sent and fifteen physicians met in Robarts's office, forming the Roentgen Society of the United States. Robarts was elected as the first president and Rudic-Jicinsky as secretary. The *American X-Ray Journal* was created as its official organ. Subsequently, two thousand letters were sent to physicians and members of scientific societies, inviting them to the first annual meeting in New York in December of that year. The meeting was described as having a good literary program, as well as many exhibits and speakers. Five committees were formed, including one on standards, one on medicolegal status, and one on scientific research. (19) After a battle between physicians and non-physicians in 1902, electro-therapeutists gained control of *Journal*, while physicians who were aligned with the American Medical Association (AMA) held the Society, although it remained independent of the AMA. The name was changed to the American Roentgen Ray Society (ARRS). (20)

Within medicine, radiology was not valued initially as a legitimate specialty. It was viewed by some as nothing more than an amusing novelty, (11) and so an issue of perception had to be overcome before radiology was considered a healthcare procedure. There were "studios" run by lay people, at which "customers" could have a "sitting" for an x-ray "photograph." (21) In addition to the very nature of these businesses, the use of these terms was more akin to artistic endeavor than medical procedure. (21) X-ray machinery was set up at carnivals and expositions like the Crystal Palace Exhibition in London in 1896, promoting 'the greatest scientific discovery of the age' and allowing visitors to see through a block of wood, or have coins counted while still in their purses. (21)

But there were also many advocates for adopting the x-ray as a physician's tool. In the preface to the first edition of his text *The Roentgen Rays in Medicine and Surgery* in 1901, Francis Williams noted that he had intended to add a list of all papers published on the medical uses of the x-ray to that point, but had to omit it because it would have added one hundred pages to the book. (22) Egbert Rankin, a medical doctor in New York, had William Diffenbach, an electrician and electrotherapeutist, wrote the x-ray chapter for his 1905 text book *Diseases of the Chest*. Diffenbach noted that the value of the x-ray in diagnosis was slowly being recognized and applied. (23) Arthur Christie, an editor of the *American Journal of Roentgenology (AJR)*, later wrote of the time: "The Society has jealously guarded the ideal that the practice of radiology is the practice of medicine; thus its practitioners must be broadly trained in general medicine; that they, like other physicians, must maintain a close personal relationship with their patients…"(24)

In the early 20th century, there were no regulations restricting the use of x-rays. In 1901, Heber Robarts wrote that he was surprised the quacks had not taken them up. (25) But these mysterious rays, generated by complicated machinery, penetrating human tissue to the bone, did not fit with the paradigm of natural healing. Around the turn of the 20th Century there was no evidence that chiropractors considered that the x-ray could be useful as a diagnostic aid in their practices.

Chiropractic

Chiropractic was founded in 1895 by Daniel David (D.D.) Palmer as an alternative to medicine. (26) His initial chiropractic theory was that vertebrae could impinge on nerves causing an alteration the transmission of a vital force he called Innate Intelligence. (26) He referred to these as "luxations" or "subluxations." (26) (27) He proposed that health depended on the flow of Innate Intelligence and when subluxations were corrected, health

**Commented [cj3]:** Consider including an additional reference about DD's use of the term.

Use of the term **subluxation** in publications during the formative years of the **chiropractic**profession.
**Johnson** C.
J Chiropr Humanit. 2011 Dec;18(1):1-9. doi: 10.1016/j.echu.2011.10.004.

**Commented [KY4R3]:** Good idea. Done.

naturally restored itself in the body. (26) Thus, the aim of chiropractic treatment was to replace the vertebra with a manual thrust called an "adjustment". (26) This approach was similar to other alternative healthcare systems during that time, such as homeopathy, naprapathy, naturopathy, Thomsonianism, Christian Science, and particularly osteopathy. (28) Until his death in 1913, D.D. Palmer was adamant that chiropractic palpation and adjustments were to be done by hand. No tools other than the chiropractor's hands were necessary. D.D. listed the appropriate contents of a chiropractor's room: a bifid table. There was to be nothing else, no electrical therapeutic devices such as vibrators, no osteopathic tables or "instruments of torture," microscopes, drugs or mortar and pestle with which to mix substances. (26) This anti-technology attitude may be why his students hesitated to adopt the use of x-ray. Thus, from 1985 until 1910, x-ray diagnosis advanced in medicine while chiropractors may have viewed radiology as outside their purview. (29)

**Commented [cj5]:** Trying to make this section more clear. Tried to clarify, as well as keep it within scientific writing style. Would you please confirm that the meaning has been retained? Is this correct?

**Commented [KY6R5]:** Yes, looks good.

Separate and distinct phase (1910 – 1942)

Medicine

While chiropractic was starting to organize the dissemination of information on radiology and setting the most basic standards for the use of the x-ray, the medical profession made major advances in radiology. But the path to acceptance was not easy, even in medicine. In the 1910s and 1920s, questions remained as to whether radiology was a proper activity for doctors or a technical exercise more suited to tradespeople. "Those who possessed special knowledge in electricity, engineering and photography progressed more than their fellows who had not had such advantages." (18) Physicians who saw the potential of the x-ray as a tool augmenting items like the stethoscope, microscope, and chemical blood tests argued to acquire it. Howard Ruggles and George Holmes, authors of a popular radiology text and faculty at University of California and Harvard respectively, cautioned that

interpretation of x-ray images was fraught with sources of potential error. Those sources included the use of divergent rays, the fact that three-dimensional structures are projected on to a two-dimensional image, that scatter may reduce quality, patient clothing may create shadows, and anatomical structures are only seen when they vary in density from nearby tissues. Because of these factors, they wrote, “The necessity of medical training as a prerequisite in this field is, of course, recognized … [and] a knowledge of pathology is as essential to the roentgenologist as anatomy to the surgeon.” (30) W. Edward Chamberlain noted: “Radiology is a kind of medical practice, and not simply a group of technical procedures.” (31) With this statement in 1929, he was not just vying for control of the practice of radiology by the medical profession but also arguing for its recognition by them as a legitimate branch of medicine. To emphasize the latter, he continued his narrative, bemoaning the referral of patients by doctors to radiology laboratories run by lay persons, rather than by other doctors with specialized knowledge of radiological procedures and diagnosis. By failing to integrate radiology as a medical practice, the medical profession was stifling its growth and relegating its development to other groups. (31)

There were also arguments made against radiology as a medical specialty on economic grounds. Hospitals could employ technicians more cheaply than physicians. Sometimes the professional staff would interpret the images, but sometimes the technicians would interpret them. This made a certain practical sense. Those staff working with the equipment were the most intimately familiar with the process that created the images, and they also saw more images than many physicians. When interpretation was performed by professional staff, often they were internists or surgeons with little training in radiology. (18) By the late 1920s, radiology and radiography were beginning to become separate professions, although debate continued through the 1930s. (32) Radiographers (radiographic technicians) began writing books specializing in the technical aspects of using x-rays for diagnosis. (33)

They established their professional identity in the realm of creating the highest quality radiographs to provide the most diagnostic information for radiologists to interpret. (34)

Professionalization of medical radiology increased during this time. In 1911, the ARRS increased the requirements for membership to include two years of x-ray work after graduation and three letters of recommendation from members and physicians. It maintained strict membership requirements and eventually the ARRS gained the reputation of a prestigious organization. A new journal was started, which became the *AJR* in 1913, and medals for outstanding work in the field were awarded at meetings. (11) There were issues with the ARRS, but they were geographic, not professional. Physicians in western states complained that too many of the group's activities occurred in eastern cities. Despite efforts on the part of the ARRS, westerners formed their own organizations, the Western Roentgen Society (WRS) in 1915, and others whose membership requirements were less stringent than those of ARRS. In 1919, WRS was rapidly expanding its membership, becoming more nationally representative than ARRS, and the name was changed to the Radiological Society of North America (RSNA). It offered refresher courses in radiology and awarded medals for outstanding work. There was little animosity between the groups, though; in 1919, the RSNA Gold Medal went to Heber Robarts. In 1918, WRS President Benjamin H. Orndoff started its official publication, the *Journal of Roentgenology.* In 1923, after an intermediary name change, it became *Radiology*. (11)

By 1922, RSNA membership was greater than ARRS, but RSNA did not have the same level of prestige. Albert Soiland of Los Angeles, an innovator in radiation therapy and then President of RSNA, proposed an honorary and highly exclusive society, the American College of Radiology (ACR). For its first 11 years, it functioned primarily to bestow prestige on its Fellows, Honorary Fellows, and Chancellors. Soiland was also instrumental in

expanding the AMA's fifteen specialty Sections to include Radiology as the sixteenth in 1924. (35) In 1935, ACR President W. Edward Chamberlain began an expansion of the College. He increased the number of categories of membership and changed the ACR's mission to that of advancing the practice of radiology through attention to standards in radiology practice, radiation protection, education, public health, health insurance, radiological technologist issues and hospital radiology unit concerns. (11) Membership expanded and the ACR became a true professional organization. (36)

The American Board of Radiology (ABR) was a joint effort of the ARRS, RSNA, ACR, AMA Section on Radiology, and the American Radium Society in 1934. (36, 37) Prior to the creation of specialty Boards, any physician could limit practice to any area of medicine and present him/herself as a "specialist." Board certification allowed the public to distinguish between specially trained and qualified specialists and those who just had a special interest in an area. (11) In addition to helping ensure a high standard of practice, this move had political motives. It was anticipated that state licensing authorities might begin regulating entry to specialties as they did for medicine in general. The prospect of dealing with a different specialty authority for each state was unpalatable, so steps were taken to demonstrate high standards of self-regulation, including improvements in training and certification. The first radiology residency program was started by George Holmes at Massachusetts General Hospital in 1915, formalizing what had previously been an apprenticeship-like arrangement. (38) Since its inception, standards have been continually raised by the ABR, and the types of certifications have multiplied as technology and techniques have advanced. (39) All physicians certified by the American Board of Radiology became eligible to join the ACR. Membership of the ACR grew into the thousands through the years as the ABR continued certifying radiologists. (16) The increasing professionalization of radiology as well as

participation of its members and organizations on government panels and international congresses helped solidify radiology's specialty status in medicine. (20)

Chiropractic

In 1910, B.J. Palmer was an early adoptor in the use of x-ray technology for chiropractic. He claimed to be the first chiropractor to use x-ray imaging. (40) He stated that the only purpose was to prove the existence of chiropractic subluxations; he wrote that he was unconcerned with using x-rays to find pathology:

> "The original Chiropractic purpose was not to use the X-Ray for therapeutic purposes, to ascertain normal or abnormal tissues, the character of a fracture or whether there was renal calculi [sic] or a bullet in the body. We had already settled how a cure occurred; we did not care much about pathological plates … the advent of the X-Ray into Chiropractic was to prove that vertebral subluxations did actually exist." (41)

To differentiate radiographs used by chiropractors from those used by medical doctors, Palmer called his images "spinographs." (42) He declared them the supreme method of subluxation detection in November 1910. (43) He wrote that palpation was seventy-five percent wrong, and that full spine radiographs should be taken on all patients, with adjustments being based on these x-ray images. "The spinograph means the difference between failure and success: No results and results. Guess and knowledge. Doubt and positiveness. Theory and fact." (41) Further, he claimed that all the chiropractic adjustments that had been successful prior to the visualisation of subluxations on radiographs were due to luck. The odds of determining by palpation the spinal levels that were out of alignment were

no better than guesswork without x-ray, and many adjustments had been misapplied as a result. (41) This changed in 1924, when BJ adopted a temperature-sensing device known as the neurocalometer, which then took precedence, but did not completely supplant radiography. (44)

Chiropractors used the terms “separate and distinct” as a legal defense against allegations of practicing medicine without a license in the early 20th Century. The phrase applies well to this era of radiology in chiropractic. During this phase, chiropractors used radiography solely to try to support chiropractic theories. (41, 45)

From 1902, when he took over the Palmer School, until his death in 1961, B.J. Palmer’s voice was a strong influence on chiropractic identity. He retained vitalism in his theories, but was unafraid to reshape elements of those theories to suit his changing purposes. (46) In the x-ray, B.J. saw potential direct the profession and to prove the theory of chiropractic subluxation. (47) He proposed the use of the x-ray as a form of diagnosis, or in the parlance of chiropractic, “analysis.” (48) Over time, a number of chiropractors developed slight variations on how best to find chiropractic vertebral subluxations (CVS) on radiographs, and they created systems around those theories in which chiropractic adjustments were based on the visualized changes. (49) Prominent chiropractor Clarence Gonstead, who advocated full-spine radiographs for CVS analysis, was notable for his quote that encapsulated this approach to healthcare: “Find the subluxation, accept it where you find it, correct it and leave it alone.” (50)

After B.J. Palmer introduced x-ray use, others helped spread its use. Ernest A. Thompson was B.J. Palmer’s main radiographer, or “spinographer” as he was known in chiropractic circles, from 1915 to 1925 at the Palmer School of Chiropractic (PSC). He authored several editions of *Chiropractic Spinography*, which was first published in 1918. (51) Much of this book was devoted to the details of using x-ray equipment in order to obtain

quality radiographs. In this way, it was similar to the medical versions of x-ray books of the day. It differed in that there was no discussion of pathology but rather a sole focus on the depiction of CVS in various areas of the spine. Thompson was also president of an early chiropractic x-ray organization, the American Spinographic Society, which formed in 1928 on the east coast of the USA. Little is known about the group, which was likely the second attempt at a national organization of its type after the Universal Spinographic Society. As their names indicated, they were dedicated to the chiropractic-specific use of the x-ray. (52) But it brought together people holding similar interests within the profession.

Warren L. Sausser was an inventor and organizer for radiology in chiropractic. (53) He was devoted to traditional chiropractic and B.J. Palmer. After graduating from the PSC in 1917, Sausser learned of a limited-time induction to the Army leading to commissioned officer status in Roentgenology and took it. After completing the training, he was stationed in France and New York City. In 1918 he wrote a letter to B.J. about his experiences in the army, decrying the surgery and medicine he saw practiced on soldiers and advocating chiropractic as a panacea. (54) After being discharged, Sausser started a referral spinography practice for other chiropractors in greater New York by setting up the Metropolitan X-Ray Laboratory at 200 West 72nd Street. The tag line for its advertisement was "Results obtained with patients are as good only as your spinographic readings." (55) New York state law required all x-ray facilities to be operated by medical doctors, so Sausser found one who consented to being a silent partner, signing the papers for the permit, but leaving Sausser with operational control. (56) (57)

In 1922, Sausser considered that chiropractic had 2 needs. First was a voice in the political process and second was a way to help ensure best practice in the use of the x-ray. He enlisted the assistance of Waldo Poehner of Chicago and other chiropractors with an interest in x-ray. (56) In 1923, they formed the Universal Spinographic Society. However, by

this time, B.J. Palmer had introduced the neurocalometer. B.J. demanded that the Spinographic Society join with his Neurocalometer organization to form the Neurocalometer and Spinographic Society. This arrangement was found untenable by all and the organization dissolved shortly thereafter. (58)

Sausser attempted to gain a license to operate x-ray equipment under his own name, filed lawsuits, and eventually arrived at the Supreme Court of New York. He argued that he was not using radiographs for diagnostic purposes, but for chiropractic and biomechanical purposes and that he should be granted a limited license to obtain radiographs due to his training and expertise in the field. On January 12, 1926, the Court ruled in his favor. (56) In 1932, Sausser tried again to form an x-ray organization. He enlisted Ernest Thompson and Arthur W. Schweitert of Sioux Falls, South Dakota, creating the Board of Counselors of Spinographers and X-ray Operators as a new committee within the National Chiropractic Association (NCA). (45) There were several advantages to this affiliation with the NCA. Members of the new Board could call on the expertise of others in the organization when necessary, and they had audiences for their work in the forms of conference attendees as well as subscribers to its magazine, *The Chiropractic Journal*, to which they regularly contributed a column entitled "Spinograph and X-Ray." This group began professionalizing by setting standards for radiographic analysis, establishing of a code of ethics for x-ray operators including guidelines on the use of advertising, and they adopted an emblem, "which would be symbolic of the highest type of X-ray service." (58) In 1934, at the NCA conference, the name was changed to the National Council of Chiropractic Roentgenologists (NCCR). They also developed a certificate of membership in the Council and an x-ray marketing brochure. (58)

In 1938, B.J. Palmer acolyte Percy A. Remier published *Modern X-Ray Practice and Chiropractic Spinography* while working at the PSC. The main content of the book was

similar to Thompson's but reflected Palmer's new "upper cervical" theory. It claimed that all disease was traceable to CVS in the uppermost part of the spine, that is, the articulations of the atlas and axis vertebrae and the occiput. In addition to the technical details of obtaining radiographs such as focal-film distance, x-ray beam factors, and the recently developed stereoscopy, Remier's book focused on how these could be maximized in order to visualize CVS in the upper cervical spine. (59)

I propose that during this phase, radiography was not used to prompt the development of knowledge. Rather, the use of the x-ray by early chiropractors was limited to providing evidence that misalignments were the cause of ill health. Although the writings of the authors cited here contained frequent reference to science, their understanding and use of the term science was different to that of others. It is true that science has matured since the early 20th Century, but it has also been noted that chiropractors have often utilized their own understanding of "science." (60) (61) The chiropractic x-ray/spinography groups were made of those who believed in traditional chiropractic principles. They shared refinements of their technique with a sincere belief that they were helping humankind. Dye noted that communication between chiropractic organizations concerned with spinography and the PSC improved into the 1930s, and that starting around 1925 there were: "various associations of X-ray technicians for the purpose of improving Chiropractic X-ray technique" and "…clubs and societies holding monthly or biweekly meetings for discussing Chiropractic in relation to adjusting for various types of dis-ease." (62)

**Commented [cj7]:** Trying to make this more clear. Tried to clarify, as well as keep it within scientific writing style. Would you please confirm that the meaning has been retained? Is this correct?

**Commented [KY8R7]:** Yes, looks good.

Transitional phase (1942 – 1957)

Medicine

During this period, medical radiology consolidated as a legitimate specialty and continued growth. Private and public third-party systems reimbursed for radiology services

performed by certified medical specialists. (63) (64) Thirty new radiology organizations were established between 1940 and 1970. (11) The ARRS began to allow ABR or equivalently certified physicians to join without additional requirements, and its membership expanded. (20) By 1940, medical radiologists were physicians with additional training in radiology. Thomas wrote in 1930 that "it has long since reached a plane where no one can achieve recognition as a roentgenologist who has not had a complete course in an approved medical school in addition to special instruction in the science and art of radiology." (14) Medical radiologists were called into service in World War II, where by 1943 the Army had 400 and the Navy 100. (16) By 1951 there were 3000 board-certified radiologists practicing full time in the USA, and all general hospitals with more than 50 beds and ¾ of hospitals with fewer than 50 beds had x-ray equipment. (11) Medical schools had a standard 4 year curriculum and in 1955 the ABR enacted a rule requiring 3 additional years of full-time study and clinical work to qualify to sit the ABR exam. (16) Throught the 1950s, about 300 candidates per year sat the ABR exam, and in 1957, the ABR had a role of 5966 certified radiologists. (16)

Chiropractic

Waldo Poehner made the first substantial change in attitude toward radiography in 1942. He graduated from the PSC in 1918 and practiced in Chicago. Poehner held offices in state and national chiropractic organizations, helped organize the NCCR in 1945, and conducted what is acknowledged as the first chiropractic postgraduate course on radiology in 1946. (65) (66) In the early 1940s he began to express an advocacy for critical thinking within the profession. The first indication of a change in attitude away from radiography for subluxation analysis alone and toward its use for diagnosis of pathology came in a column Poenher wrote in 1942, entitled "Let's Consider Arthritis." In it he wrote:

**Commented [cj9]:** Now this makes sense.

**Commented [KY10R9]:** ☺

> We have all gone through the period of coming out of school with a bright new outlook on life with courage and conviction of bringing help to a sick world, and confident that our particular method of approach was the ultimate, only to find that we were entering a disorganized field of many ideas and techniques built upon the true Chiropractic principle as expounded by Dr. Daniel David Palmer. The regrettable part of this situation was that each and every one felt that his particular interpretation of our science was the only correct one. (67)

Poehner directly acknowledged the issue that few in the profession wanted to face, that most of their chiropractic knowledge was derived from the epistemologies of "appeal to authority" and "appeal to tradition." In addition, he specifically characterized the people involved with diagnostic imaging as well positioned to make change:

> Yes, progress is difficult. It was ever so, because of those who remain in ruts, hold back and act as a millstone on the neck of those who have the courage to think and go ahead. The X-ray Council [NCCR] is comprised of a progressive type of men or it would not be so forward looking and so consistent in its radiographic endeavors. It is gradually winning its way into the minds and hearts of those who are seeking sound progress. (68)

He also argued for adoption of the biomedical model of disease and against the "one cause, one cure" dogma of chiropractic, (68) and those who would use radiography purely to detect CVS, noting that "[pathological conditions are] the most dangerous thing with which we deal." (69) Poehner indicated an open-mindedness regarding the acquisition of healthcare information, and recommended a number of medical books in his column in *The Journal of the National Chiropractic Association*. Some readers wrote letters to the editor objecting to

this but Poehner maintained that anatomy, physiology, and pathology in medical books was useful, and he rebuked those who objected in a subsequent issue of the journal. (68)

Poehner may have been moving towards a scientific approach, but maintained some elements of traditional chiropractic. He argued that there were two ways to take and interpret radiographs, and that both should be employed. He recommended that "Analytical" radiographs were full spine, always upright, weight-bearing, and used to determine postural alterations. "Diagnostic" radiographs were to be used for purposes of finding pathology such as tumor, infection, and arthropathy. (68) Although chiropractic traditionalism was still evident, there was a shift of thinking toward a biomedical understanding of health and disease. Poehner was an advocate of this shift, and used his positions and public voice to try to persuade the profession to move in that direction.

By the late 1940s, more movement towards the general diagnostic use for radiography was becoming more evident. At the January 1948 meeting of the Council on Education of the ACA, it was resolved that "greater emphasis should be placed upon the teaching of diagnostic roentgenology, the opinion being expressed that the teaching of spinography alone or as a major in X-ray could not be sufficient." (70) However, practical considerations sometimes out-pressured attempts to reform educational standards that more closely resembled their medical counterparts. For instance, in 1955 a proposal was put to the ACA's Council on Education to require 2 years of tertiary education as a prerequisite to entry to chiropractic schools. The proposal failed because Council members asserted that several schools would not survive financially. (71) Western States Chiropractic College instituted the requirement independently. In an interview, long-time WSCC radiology instructor Appa Anderson suggested that the college reached a dire financial situation because potential students chose schools with lesser entrance requirements. (72) Also in 1955, Council member and future chiropractic radiologist Leo Wunsch proposed that the NCCR should take greater control

over the chiropractic teaching institutions' radiology curricula. (71) At the July meeting of the ACA Council on Education, he advised the members that the Council on Roentgenology wanted to inspect the x-ray departments of all accredited chiropractic schools. (71) In December 1957, the NCC announced that it would offer a 126-hour course in radiology and radiography. (73) The course included instruction in how to take quality radiographs and the interpretation of pathology in bones, joints, the chest and abdomen, obstetretics and gynecology, postural studies of spine, pelvis and feet, but did not include CVS analysis; it was accredited by the NCCR. (73) The NCCR would continue to exert efforts to move away from the traditional chiropractic paradigm and toward a biomedical model.

Joseph Janse, a chiropractic radiologist and long-time president of NCC, worked to create a rational basis on which to rest chiropractic, but his thinking included an element of vitalism. He argued for the therapeutic appropriateness of chiropractic manipulation for patients with various diseases such as polio and meningitis. (74) He advocated higher professional and educational standards, including accreditation, but also that all practice styles should be accommodated, and that chiropractic should remain separate and independent, not integrated with mainstream healthcare, asserting that: "There is an ever-increasing evidence for the need of an alternative primary contact practitioner…" (75) He also expressed the opinion that "…chiropractic practice does not lend itself to a great deal of specialization, simply because the basis of the chiropractic concept is that of systemic correction." (76) Although Janse is often depicted as the "father of scientific chiropractic," some statements he made throughout his career suggest that he did not fully advocate adopting the biomedical model. This reflects the transition that chiropractic, and radiology within it, was going through.

At this time, the AMA forbade its members from referring to or from chiros. Individual chiros sometimes had cooperation from local doctors/hospitals but this was not the

rule. (77) Chiropractors either needed to find a cooperative local medical physician or hospital, or consider investing in x-ray equipment for their own offices. By this time, many states had licensed chiropractors to take radiographs, so the latter became a viable option. Because of medical exclusion, because radiology was an established specialty in medicine, and because some chiropractors were moving beyond traditional beliefs about health and disease, some chiropractors began to consider the need for a radiology specialty of their own.

Biomedical phase (1957 – present)

Medicine

In 1958 the Association of University Radiologists (AUR) had 74 members at 38 institutions. (16) They requested membership on the ABR to provide input on educational matters and were accepted, (16) improving communication and cooperation increased between academia and clinical practice. Starting around 1960, medical radiology entered its "golden age," (16) augmenting its status as a recognized specialty, expanding exponentially with new technologies like computed tomography (CT) and magnetic resonance imaging (MRI), as well as with improved techniques in nuclear medicine, diagnostic ultrasound, and contrast enhancement. Chiropractors have been involved with these advances in limited ways. During the mid 1960s, the AMA enacted its "contain and eliminate" policy against chiropractic in the USA and similar events occurred in Australia. (78) (79) This meant that many medical physicians would neither accept referrals from chiropractors nor would they refer patients to them, thus limiting chiropractic access to medical radiologists and x-ray facilities. Chiropractic's scope of practice prohibition on invasive techniques and continued lack of inclusion in hospitals, imaging centers, and national health reimbursement schemes

have meant that many chiropractic radiologists based their practices mainly on plain radiographs referred by chiropractors who took them in their own offices. (80) (81)

Chiropractic

The first chiro radiology board exam began organizing in 1957. During the 1950s, the NCCR developed a radiology specialty to focus on mainstream pathological diagnosis. Other specialties, such as orthopedics, were also being considered around this time. (82) Since the NCCR was governed by the NCA, it needed approval by the larger organization. Hillary W. Pruitt, former secretary of the NCCR, first presented the idea of postgraduate certification in x-ray for chiropractors to the mid-year meeting of the Education Committee of the NCA in 1957. (83) The NCA established a committee to determine requirements for eligibility and examination procedures, naming Michael Giammarino as Chair, with the other members being Ed Kropf, then president of the NCCR, Waldo Poehner, and Leonard G. Van Dusen from Sodus, New York. (84) The initial requirements for eligibility to sit a certification exam included having used x-ray in practice for at least 5 years, 100 hours of postgraduate study in x-ray, and having graduated from a school recognized by the NCCR. The National Examining Board of Chiropractic Roentgenology was created, and included Poehner and Giammarino, as well as senior members of the NCCR, Fred Baier of St. Louis, Leo E. Wunsch from Denver, and Duane Smith from Huntington Beach, California. (85) The exam consisted of written and viva parts. Topics included osseous and soft-tissue pathology of the skull and sinuses, gastrointestinal and genitourinary tracts, lung and heart, myelography, arthropathies, spinography, extremities, gall bladder, osseous pathology of the spine and pelvis, and radiation safety factors. Chiropractic vertebral subluxation was not included, and just 3 of the first 15 candidates passed. (85)

**Commented [cj11]:** Now this makes sense.

**Commented [KY12R11]:** ☺☺

Initially, this postgraduate training was mostly offered in weekend seminars, some led by Giammarino. In 1965, Lincoln College of Chiropractic, under the direction of Earl Rich, started a course to meet all the required hours. (29) Shortly thereafter, National College of Chiropractic (NCC), Los Angeles College of Chiropractic (LACC), Western States Chiropractic College (WSCC), and the Northwestern College of Chiropractic (NWCC) also started postgraduate radiology courses. (29) Over subsequent decades, the educational requirements to take the exam were increased from 100 hours to 240, then 300, and finally candidates were required to participate in a 3-year, full-time radiology residency program at an accredited chiropractic teaching institution prior to becoming eligible to sit the exam. (86) (87)

On July 2, 1964, reflecting a combination of political factors and a strengthening of educational requirements, the NCCR was dissolved and the American Council on Chiropractic Roentgenology was formed in its place. (88) This new organization was affiliated with the American Chiropractic Association, which was formed from the old NCA. Chiropractic radiology trainees were called “residents”, the same term used by medical radiology trainees. Successful chiropractic radiology candidates were referred to as ”Diplomates,” that is, Diplomates of the American Chiropractic Board of Radiology (DACBR), similar to the medical Diplomates of the American Board of Radiology (DABR). The American Chiropractic College of Radiology (ACCR) grew out of the membership of the American Council on Chiropractic Roentgenology and consisted of those members who successfully completed the American Chiropractic Board of Radiology examinations and were thus recognized as Diplomates. Membership in the Council did not require the status of DACBR, only that members were also members of the ACA. Membership in the ACCR required the status of DACBR and required membership in the ACA. (88) Both the ACCR, which was the educational and administrative body, and the ACBR, the certifying body, were

technically governed by the ACA's Council on Roentgenology. It was later renamed the Council on Diagnostic Imaging (CDI), and largely consisted of members of the ACCR. These structures and practices were similar to the medical community's structure of radiology organizations with the American College of Radiology (ACR) and its certifying body, the American Board of Radiology (ABR), but were instituted more than two decades after their medical counterparts. (89) (90) (91) (92)

The ACCR assumed the role of providing annual refresher courses for its members at its conferences, much as RSNA had. They did not limit their speakers to chiropractors, and invited medical radiologists to present. The minutes and agendas of the annual conferences of the ACCR from 1975 through the 1990s show a number of medical radiologists as speakers, including some of high esteem, like Stephen Rothman, Deborah Forester, and Donald Resnick. (93) The ACCR chiropractic radiologists also sought other avenues of association with medical radiologists, such as having their residents observe radiology practices in hospitals and attend radiology rounds at institutions like the University of California, Los Angeles. Several institutions adopted this type of interchange between their chiropractic radiology residents and medical radiology training programs, including LACC, NCC, and NWCC in USA and at the International College of Chiropractic located at the Philip Institute of Technology in Melbourne, Australia. (94)

The opportunities for chiropractic radiology residents to learn in medical settings relied on the personal connections created between individuals, not formal institutional agreements. This education did not represent interprofessional integration and was dependent on the largesse of individual medical practitioners who donated their time and other resources in order to accommodate chiropractors. In these programs, the chiropractors typically only observed, rather than acting as participants in diagnosing patients. These were tenuous, fragile links, reflecting that chiropractic was not perceived as legitimate by mainstream

medicine or that the Wilk v AMA trial had not yet been resolved. My first-hand perception of this situation is that some medical doctors were happy to teach anyone who wanted to learn. However, I felt that because I was a chiropractor, I could never be considered an equal colleague with them.

However, the DACBRs' focus on diagnosis of pathology rather than CVS and the strength of some of the personal connections meant that a few medical radiologists were able to accept them as colleagues. For example, chiropractic radiologist, John Taylor, co-authored a book with Donald Resnick, (95) who is one of the world's most esteemed medical radiologists. Other chiropractic radiologist collaborated with medical radiologists as contributing authors. (96) (97) Chiropractic radiologists Joseph Howe and Terry Yochum initiated and developed a professional relationship with Donald Resnick. In the 1980s, this resulted in radiology residents at to the LACC observing Resnick's practice at the San Diego Veterans Administration Hospital once a week for over 2 decades. (94) In addition, the relationship with Resnick allowed several chiropractic radiologists to participate fully in Fellowships in Osteoradiology at UCSD, alongside medical radiologists. (98) These efforts demonstrate the DACBRs attempts at professionalization and integration with mainstream healthcare, lifting the status of radiology in chiropractic.

In the 1950s, as the ACCR became the dominate chiropractic radiology group and was beginning to take a position of advocacy for the biomedical model, the members were conscious that public perception was important to their identity. The ACCR worked to separate themselves visibly from subluxation-based, vitalistic practitioners. In 1959 an admonition was given to members of the National Board of Roentgenological Examiners (precursor to the ACBR) who were participating in training students at a vitalistic institution. (99) They were told during an association meeting that they should not "lend themselves in any way to the educational endeavors of any non-accredited school or group." (99) Leo

Wunsch, one of the first certified chiropractic radiologists, argued for promotion of the group within accredited institutions. He suggested that all chiropractic institutions should have a chiropractic radiologist on staff, and that such a program would strengthen both the schools and the specialty of chiropractic radiology. (100)

The institutions that did have chiropractic radiologists such as WSCC in Oregon with Appa Anderson, NCC in Chicago with James Winterstein, LACC with Joseph Howe, and NWCC with Vinton Albers became leaders in evidence-based education for chiropractors. Throughout the 1970s and 1980s, all chiropractic schools that were accredited by the Council on Chiropractic Education had DACBRs teaching radiology. (94) Those schools adopted medical radiology teaching methods including using the ACR (medical) teaching file on radiographic pathology. (101) (102) (103) Winterstein bemoaned the difficulty he believed traditionalism was causing chiropractic: "Again because of the old dogma that chiropractors are completely and totally different from allopaths and the practice of chiropractic is unique and separate from any other form of health care, the position taken by these members of the profession is that there cannot be real integration which is, on its face, counterproductive to good chiropractic practice." (104)

Joseph W. Howe was another advocate for adopting the scientific paradigm of health and disease into chiropractic. A 1952 graduate of PSC, he worked as a radiographer in the Army Medical Corps for two years. Then, while in private practice, he studied under Michael Giammarino, one of the designers of the first chiropractic radiology certification exam, and what he characterized as "semi-cooperative" local medical radiologists to improve his radiographic interpretation of pathology. (77) (66) (65) Howe continually reached for links with the medical community, creating opportunities for his radiology residents observe several world-renowned medical radiologists. In addition to Donald Resnick, these included Deborah Forrester at the University of Southern California School of Medicine, William

Glenn, pioneer in multiplanar imaging (Magnetic Resonance and Computed Tomography), and neuroradiologist Stephen Rothman. Howe took residents to the annual conference of the RSNA in Chicago every year. (77) He also advocated integration with the mainstream medical community: "The separatism of chiropractic from the rest of healing arts has not served chiropractic, other healing arts, or the public well." (105) He was the first to hold the post of radiological health consultant, created in 1968 by the ACCR. In this capacity, he acted as liaison to the National Center for Radiological Health, a division of the United States Public Health Service. (106) By speaking a common scientific language with other health professionals, Howe was able to gain some collegiality from medical radiologists and to have a voice in a national forum. These efforts to adopt mainstream values for radiology can be interpreted as professionalization, negotiating and reinterpreting traditional chiropractic concepts in order to gain cultural authority and acceptance. (107)Another element in the professionalisation of a specialty is the creation of organs of information dissemination, (108) such as through textbooks and scientific journals. Of those, Resnick's *Diagnosis of Bone and Joint Disorders* (109) is likely the most significant for chiropractors. In contrast to medicine, chiropractors and chiropractic radiologists have written only a few books on mainstream radiographic pathology or radiography. Prior to the Taylor and Resnick chiropractic-medical co-production, Earl Rich of the Lincoln Chiropractic College wrote the first substantial book on radiographic pathology for chiropractors in 1965. It was a red, three-ring binder called the *Atlas of Clinical Roentgenology*, and was published in the thousands. (110) Divided into sections by body area, it included high quality photos of the radiographic appearance of pathological conditions of bones, joints, and soft tissues, including chest, gastrointestinal and genitourinary systems. However , in these example texts, the evaluation for chiropractic vertebral subluxation was not included. Terry Yochum and Lindsay Rowe wrote the first edition of *Essentials of Skeletal Radiology* in 1987. Since then, the book has sold over

110,000 copies in three editions and is used in 50 chiropractic courses as well as over 100 medical schools. (96) Yochum has lectured around the world and taught skeletal radiology at the University of Colorado School of Medicine. (111) Roy Hildebrandt was founding editor of *JMPT*, but was not a chiropractic radiologist. In 1980 he authored *Chiropractic Spinography*. (112) It was partially evidence-based but did promote full-spine radiography. Dennis Marchiori wrote *Clinical Imaging* in 1999, which took a different approach to teaching radiographic pathology, but was still essentially a competitor to Yochum and Rowe's book. (97) Ray Sherman and Felix Bauer authored *X-Ray X-pertise – from A to X* in 1982 which focused on radiographic technique and quality assurance. (113)

In 1993 the CDI started a radiology journal, *Topics in Diagnostic Imaging*, edited by chiropractic radiologist John Stites. It was primarily an outlet for radiology residents to develop the skills for scholarly publishing, and they were nominally paid for contributions. But contributions were inconsistent and the journal was discontinued in 2007. (89) The *Journal of Chiropractic Medicine*, which is indexed in PubMed, now takes the place of *Topics in Diagnostic Imaging* with a Diagnostic Imaging section. (114)

FIGURE 1 ABOUT HERE.

**Legend for Figure 1:** Timeline comparison of a selection of professional developments in chiropractic and medical radiology. Organizations are referred to by their current names for ease of reference, but may not have been initially founded under the name on this timeline (e.g. RSNA was founded as WRS in 1915 but became RSNA in 1919). Journal names are italicized; books are underlined.

**Discussion**

As part of their developing identity and professionalization, chiropractic radiologists from the ACCR sought education from mainstream healthcare. Embracing the biomedical model has affected the way complementary and alternative practitioners, such as

chirorpactors, communicate with each other, adopting biomedical-type structures for conferences and presentations. (115) Isomorphism and behavior mimicry have been used by alternative practitioners in order to gain legitimacy. (116) The subordinate group generally follows organizational and behavioral patterns of the dominant groups in their field as part of their attempt to achieve acceptance. (117) As an example, the structures and names of the chiropractic organizations are similar to those of their medical counterparts. The surviving senior chiropractic radiologists that I was able to contact recalled no conscious effort to adopt the structures or principles of the ACR/ABR. However, they acknowledged that most of those decisions had been made before their time. (118) (91) (90)

Chiropractic radiologists were not just mimicking the outward appearance of the medical groups. The rigor of the exams and the iterative increases in the candidate requirements for eligibility to sit those exams indicated a sincere desire to be recognized as experts in diagnostic imaging. These structures and the requirements for qualification exerted a force on the profession to move away from its vitalistic origins, and toward a more biomedical identity. Professionalization may act as a subtle hegemonic process, causing alternative practitioners to internalize some of the philosophical premises, therapeutic approaches, and organizational structures of biomedicine. (119) (120)

Biggs noted that “in the process of gaining legitimacy, chiropractic has adopted a scientific discourse.” (120) In addition, “Chiropractic increasingly adapted its knowledge base to conform both in terms of its structure and content with scientific knowledge.” (121) Although internalization of the biomedical model occurred over time for the chiropractic radiologists and the chiropractic profession, a vitalistic faction still remains. (122)

Reasons for lack of official recognition of chiropractic radiology

Adopting the biomedical model seems to have made some ACCR members peripherally acceptable to some medical doctors, but at the same time it may have alienated some vitalistic chiropractors. Some chiropractors who take their own radiographs and analyze them for CVS refer these radiographs to chiropractic radiologists for pathological interpretation. However, from my personal experience, some chiropractors have told me that they see no necessity in referring to a radiologist, particularly when third-party payers will not reimburse them for the consultation service. I have observed that others are actively hostile towards radiologists for diagnosing pathology rather than focusing on the using radiography to find CVS or postural changes. (123) For example, after publication of one of my papers indicating the lack of evidence for CVS identification on radiographs, a leader of a chiropractic technique system that requires radiographs on all patients addressed me publically with angry profanity at a conference. Some of my colleagues and I have received *ad hominem* attacks on social media for our refutation of traditional CVS theory. (124) (125) (126) (127) Thus, by focusing on the biomedical model of disease the ACCR refutes the traditional identity of chiropractic, which focuses on identification of CVS. By doing so, this has raised the ire from some of the traditionals/vitalists in the profession.

I propose that the tension between the vitalistic and biomedical factions has resulted in the lack of support for chiropractic radiologists and this may have contributed to limiting the development of a radiology specialty within chiropractic. The growth of the chiropractic radiology specialty may have also been limited by the chiropractic patients themselves. Patient self-selection may have resulted in non-specialist chiropractors being comfortable with interpreting their own radiographs. It is presumed that people with serious illness or acute trauma generally report to hospitals or their primary care medical doctors, not their chiropractors. (91)

I suggest that structural reasons may also be at the root of absent recognition of chiropractic radiology as a specialty by registration/licensing bodies and third-party reimbursement organizations. Chiropractic radiologists have lacked the resources of their medical counterparts, both in numbers of practitioners and finances to lobby for specialty status. Only about 250 chiropractors have become certified chiropractic radiologists since the inception of the program in 1958, and currently about 190 are currently active. (128) There are about 77,000 chiropractors in the USA, (129) about 3000 in the UK (130) and about 5000 in Australia. (131) This means chiropractic radiologists comprise less than one-half of one percent of all chiropractors. Medical radiologists are about 2.5% of the physician work force in the USA. (132, 133) In the UK, Clinical Radiology comprises 5.4% of the Specialist Register. (134) Norman Kettner, former ACCR President, could recall no concerted effort by DACBRs to achieve specialty status. (135) Long-time officer of the Council on Diagnostic Imaging of the ACA Larry Pyzik noted that little money was available "to pursue accreditation" for chiropractic radiologists. (89) Reed Phillips, chiropractic radiologist and former President of LACC indicated that there was a desire on the part of chiropractic specialists to establish those credentials with external authorities. But there was an inability to achieve recognition even within the chiropractic profession. Phillips stated, "I don't think state regulatory boards or even the National Board had the expertise to offer any recognition of specialty training," and that "I don't think any of the specialty groups had the horsepower and resources to mount any sustained effort." (90)

Chiropractic scope of practice limitations (ie, being unable to perform invasive procedures such as contrast administration, imaging-guided injections and biopsies) may further diminish the possibility of recognized specialization. Although professionalized and generally esteemed by much of the chiropractic community, chiropractic radiology has not proved itself necessary to its own profession, and therefore has been limited in its

**Commented [cj13]:** Tried to clarify this section so it stayed on focus with the purpose of the paper, as well as keep it within scientific writing style. Would you please confirm that the meaning has been retained? Is this correct?

**Commented [KY14R13]:** Yes, this works.

development. The services provided by chiropractic radiologists may not be different enough for registration boards and accreditation bodies to elevate them above other chiropractors. Bruce Walker, veteran of chiropractic registration boards and former Head of Chiropractic at Murdoch University in Australia, described the perspective of governing bodies. Specialties had been considered in the state of Victoria during his time there. One of the issues for radiology was that in medicine, radiologists inject contrast media and perform other special procedures that general practitioners do not. For the Victorian chiropractic registration board, Walker said that the question they asked any group seeking specialty status was, "What skills and knowledge differentiate the practice of a specialty from those required by a standard registered chiropractor?" This test was then applied to all special interest groups in chiropractic that requested recognition as a specialty. The results of this test were that radiology, orthopedics, pediatrics, and other the groups in chiropractic did not add sufficient value to the practice of chiropractic to be considered for a special category of registration. No further attempts at developing specialties have been seriously considered in Australia. (136) James M. Cox, past president of the Council on Diagnostic Imaging expressed a similar sentiment: "We lack a definite addition to imaging interpretation that is recognized by organized medicine and the public we serve." (137) Conversely, imaging interpretation is a high-level, specialized skill that is unlikely to be practiced well by generalists, and it may be inflexibility of thinking on the part of these authorities that inhibits progress on this front.

Comparably, specialty groups have failed to achieve recognized specialty status in medicine. One example is Health Promotion Specialists (HPS) in the United Kingdom. In this case, the specialists struggled to agree on their tasks as well as how to go about them. (138) They also never found a place in the National Health Service (NHS). Finally, medicine lay claim to public health, and put health promotion within this realm. (138) Unlike HPS, chiropractic radiologists largely agreed on their tasks, however the other reasons HPS failed

do apply to chiropractic radiology. No chiropractic radiologists work in the NHS, nor are they reimbursed by Medicare in the USA or Australia for radiological reporting. In addition, chiropractors can usually find imaging centers or hospitals that will accept referrals for radiological investigations and interpretations.

The issue of chiropractic radiology as a specialty has not been permanently decided. Halpern, in her study of American pediatrics, noted that specialties were dynamic and constantly changing. (139) Miller (140) and Brosnan (141) have also indicated that professional identity is negotiated with different constituencies, and is fluid over time. Chiropractic radiology will continue to negotiate its status within its larger profession, the community of patients, as well as with physicians and the owners of independent imaging facilities.

Political power must be acknowledged in healthcare, and organized medicine has had the control. Chiropractic radiology has maintained its independence and autonomy, and currently remains on the fringe of mainstream healthcare.

**Commented [cj15]:** This is discussion, so has been moved up here.

**Commented [KY16R15]:** Okay.

LIMITATIONS

This paper has limitations. This article reflects my thoughts and interpretation of historical writings and theories, others may offer differing viewpoints. In this paper I attempted to provide detail about the development of the specialty of radiology within chiropractic. It is possible that I may have missed sources of information that would alter some of the viewpoints offered in this paper. It cannot be said with certainly what may or may not have caused the professions lack of embrace of the radiology specialty. Further and more systematic research would be necessary to answer these questions.

**Commented [cj17]:** I noticed you were missing your limitations section. This has been added for you. Please feel free to add.

**Commented [KY18R17]:** You have addressed the issues that I thought of.

**Conclusion**

In this tale of two professions, radiology gained official specialty designation in the medical profession. Those involved worked diligently to gain exclusive status and demonstrated that their services were useful, necessary, and congruent with medicine's identity. They started within the medical profession, which had a monopoly on healthcare, thus had few internal and external forces to overcome. Chiropractic was oppressed by organized medicine, which helped to create the unofficial specialty of chiropractic radiology but this then later helped to limit it.

List of acronyms

| | |
|---|---|
| **ABR** | American Board of Radiology |
| **ACA** | American Chiropractic Association |
| **ACBR** | American Chiropractic Board of Radiology |
| **ACCR** | American Chiropractic College of Radiology |
| **ACR** | American College of Radiology |
| **AJR** | American Journal of Roentgenology |
| **AMA** | American Medical Association |
| **ARRS** | American Roentgen Ray Society |
| **AUR** | Association of University Radiologists |
| **CAM** | Complementary and Alternative Medicine |
| **CCE** | Council on Chiropractic Education |
| **CDI** | Council on Diagnostic Imaging |
| **CVS** | Chiropractic Vertebral Subluxation |
| **CT** | Computed Tomography |
| **DACBR** | Diplomate of the American Chiropractic Board of Radiology |
| **FCLB** | Federation of Chiropractic Licensing Boards |
| **FFS** | Fee-for-service |
| **GP** | General Practitioner |
| **HPS** | Health Promotion Specialists |

**Commented [cj19]:** This is only for the typesetters, correct?

**Commented [KY20R19]:** Yes, however you may find it useful. Some journals like one included with the paper.

| | |
|---|---|
| **ICA** | International Chiropractors Association |
| **JACA** | Journal of the American Chiropractic Association |
| **JAMA** | Journal of the American Medical Association |
| **JMPT** | Journal of Manipulative and Physiological Therapeutics |
| **JNCA** | Journal of the National Chiropractic Association |
| **LACC** | Los Angeles College of Chiropractic |
| **MRI** | Magnetic Resonance Imaging |
| **NBCE** | National Board of Chiropractic Examiners |
| **NCA** | National Chiropractic Association |
| **NCC** | National College of Chiropractic |
| **NCCR** | National Council of Chiropractic Roentgenologists (Radiologists) |
| **PSC** | Palmer School of Chiropractic |
| **RSNA** | Radiological Society of North America |
| **SCUHS** | Southern California University of Health Sciences |
| **PCCRP** | Practicing Chiropractors' Committee on Radiology Protocols |
| **UCSD** | University of California San Diego |
| **WRS** | Western Roentgen Society |

References


1. Rosen G. Changing attitudes of the medical profession to specialization. Bulletin of the History of Medicine. 1942;12(1):343-54.
2. Weisz G. The emergence of medical specialization in the nineteenth century. Bulletin of the History of Medicine. 2003;77(3):536-75.
3. Lyons AS, Petrucelli RJ. Medicine: An Illustrated History. Melbourne, Australia: Macmillan; 1979.
4. Weisz G. Divide and Conquer: A Comparative History of Medical Specialization. Oxford: Oxford University Press; 2006.
5. Stevens RA. Medical Practice in Modern England: The Impact of Specialisation and State Medicine. New Haven: Yale University Press; 1966.
6. Rosen G. The Specialization of Medicine with Particular Reference to Ophthalmology New York: Froben Press; 1944.
7. Clendening L. Rise of the Specialties. In: Clendening L, editor. Source Book of Medical History. New York: Dover; 1942. p. 634-65.
8. Casper ST, Welsh R. British Romantic Generalism in the Age of Specialism, 1870-1990. Social History of Medicine.29(1):154-74. doi: 10.1093/shm/hkv103.
9. Unknown. Remarks Made at the Demonstration of the Roentgen Ray, at Stated Meeting, February 21, 1896. Proceedings of the American Philosophical Society. 1896;35(150):17-36.
10. Eisenberg R, L. Radiology: An Illustrated History. St. Louis: Mosby Year Book; 1992.

11. Brecher R, Brecher EM. The Rays: A History of Radiology in the United States and Canada. Baltimore: Williams and Wilkins; 1969. xix, 484 p. p.
12. Glasser O. The Science of Radiology. Springfield, IL: Charles C. Thomas; 1933.
13. Hall O. The Informal Organization of the Medical Profession. The Canadian Journal of Economics and Political Science / Revue canadienne d'Economique et de Science politique. 1946;12(1):30-44. doi: 10.2307/137330.
14. Thomas AMK, Banerjee AK. The History of Radiology. First ed. Gardner-Thorpe C, editor. Oxford: Oxford University Press; 2013.
15. Patuzzi J. The Story of Radiology. Vienna: European Society of Radiology; 2012.
16. Linton OW. The American Board of Radiology: 75 Years of Serving the Public. Tucson, AZ: The American Board of Radiology; 2009.
17. Amercan Chiropractic College of Radiology. Find a DACBR 2019 [cited 2019 20 August 2019]. Available from: https://accr.org/2015-04-15-08-48-56.
18. Desjardins AU. The status of radiology in America. Journal of the American Medical Association. 1929;92(13):1035-9.
19. Rudis-Jicinsky J. The first annual meeting of the Roentgen Society. The American X-Ray Journal. 1900;7(6):805-6.
20. Gagliardi RA. Radiologic Organizations in the United States. In: Gagliardi RA, editor. A History of the Radiological Sciences. Leesburg, VA: American Roentgen Ray Society; 2017. p. 518-33.
21. Kevles BH. Naked to the Bone: Medical Imaging in the Twentieth Century. Reading, Massachusetts: Helix Books/Addison-Wesley; 1997.
22. Williams FH. The Roentgen Rays in Medicine and Surgery. 3rd ed. New York: Macmillan And Co.; 1903.
23. Diffenbach WH. Roentgen or x-ray in the diagnosis and therapeutics of diseases of the chest. In: Rankin EG, editor. Diseases of the Chest. Philadelphia: Boericke and Tafel; 1905. p. 715-27.
24. Christie AC. The American Roentgen Ray Society; a historical sketch - "Lest we forget". American Journal of Roentgenology. 1956;76(1):1-6.
25. Robarts H, ed. The x-ray in quackery. The American X-Ray Journal. 1901;8(5):819-20.
26. Palmer DD. The Chiropractor's Adjuster: Textbook of the Science, Art and Philosophy of Chiropractic for Students and Practitioners. Portland, Oregon: Portland Printing House Co; 1910.
27. Johnson C. J Chiropr Humanit. 2011 Dec;18(1):1-9. doi: 10.1016/j.echu.2011.10.004
28. Moore JS. Chiropractic in America: The History of a Medical Alternative. Baltimore, MD: Johns Hopkins Press; 1993.
29. Canterbury R. Radiography and Chiropractic Spinography. In: Peterson D, Wiese G, editors. Chiropractic: An Illustrated History. St. Louis: Mosby Year-Book; 1995.
30. Holmes GW, Ruggles HE. Roentgen Interpretation: A Manual for Students and Practitioners. First ed. Philadelphia: Lea and Febiger; 1919.
31. Chamberlain WE. Radiology as a medical specialty. Journal of the American Medical Association. 1929;92(13):1033-5.
32. Jerman EC. Modern X-Ray Technic. First ed. Saint Paul/Minneapolis: Bruce Publishing Company; 1928.
33. Ferris C. Specialism in radiography – a contemporary history of diagnostic radiography. Radiography. 2009;15(Supplement 1):e78-e84. doi: https://doi.org/10.1016/j.radi.2009.10.006.
34. Medelman JP. History of the section on radiology. Journal of the American Medical Association. 1961;178(8):785-8.

35. Ochsner SF. A history of the AMA section council on radiology. American Journal of Roentgenology. 1993;160(4):714-. doi: 10.2214/ajr.160.4.8456650.
36. Radiology ACo. ACR History Archive - Institution Chronology2017. Available from: https://www.acr.org/~/media/ACR/Documents/PDF/About-Us/History/ACR-History-Institutional-Chronology.pdf.
37. American Board of Radiology. ABR Information and History: American Board of Radiology; 2017 [cited 2017 02/05/2017]. Available from: https://www.theabr.org/about-landing.
38. Vydareny KH. A short history of ABR certifying examinations in diagnostic radiology. The BEAM. 2016:11-3.
39. Linton O. Moments in Radiology History: Part 11 - the first residents2013. Available from: http://www.auntminnie.com/index.aspx?sec=nws&sub=rad&pag=dis&ItemID=102153.
40. Young KJ, Bakkum B, W. , Siordia L. The Hangover: The Early and Lasting Effects of the Controversial Incorporation of X-Ray Technology into Chiropractic. Health and History. 2016;18(1):111-36. doi: 10.5401/healthhist.18.1.0111.
41. Palmer BJ. Introduction of Spinography: Its origin, purpose, field of labor and why. In: Thompson EA, editor. Chiropractic Spinography. 2nd ed. Davenport, IA, USA: Palmer School of Chiropractic; 1919.
42. Notes from the clinic desk: This week in the clinic: Regional radiography [Internet]. Davenport, IA: Palmer College of Chiropractic; 1959; 21 February 1959; [3]
43. Palmer BJ. Minutes of the UCA convention. The Chiropractor. 1910 November 1910.
44. Palmer BJ. The hour has struck. Davenport, IA, USA: Palmer School of Chiropractic; 1924.
45. Canterbury R, Krakos G. Thirteen years after Roentgen: the origins of chiropractic radiology. Chiropractic History. 1986;6:25-9. Epub 1986/01/01. PubMed PMID: 11621186.
46. Keating JC, Jr. B.J. of Davenport : The Early Years of Chiropractic. Davenport, Iowa: Association for the History of Chiropractic; 1997. x, 313 p. p.
47. Kemerink GJ, Kütterer G, Wright A, Jones F, Behary J, Hofman JA, et al. Forgotten electrical accidents and the birth of shockproof X-ray systems. Insights into Imaging. 2013;4(4):513-23. doi: http://dx.doi.org/10.1007/s13244-013-0238-8. PubMed PMID: 1652780176.
48. Palmer BJ. The Science of Chiropractic. 3rd ed. Davenport, IA, USA: Palmer School of Chiropractic; 1920 1920.
49. Young KJ. Evaluation of Publicly Available Documents to Trace Chiropractic Technique Systems That Advocate Radiography for Subluxation Analysis: A Proposed Genealogy. Journal of Chiropractic Humanities. 2014;21(1):1-24. doi: 10.1016/j.echu.2014.09.001. PubMed PMID: PMC4245702.
50. Gonstead Clnical Studies Society. The Gonstead Adjustment 2013 [April 05, 2013]. Available from: http://www.gonstead.com/index.php?content_type=general_content&content=12.
51. Thompson EA. Chiropractic Spinography. 2nd ed. Davenport, Iowa, USA1919. 194 p.
52. Thompson EA. Spinographically speaking. Bulletin of the American Chiropractic Association. 1930;7(2):8.
53. Young KJ. Warren L. Sausser, D.C.: Influence Unrecognized. Chiropractic History. 1997;17(1):75-83.
54. Sausser WL. Letter to B.J. Palmer. The Fountain Head News. 1918:5-6.
55. Sausser WL. The Recoil. In: Standard School of Chiropractic, editor. 12 ed. New York: Standard School of Chiropractic,; 1922. p. 8.

56. Sausser WL. Recalling the day when a national council was born. Journal of the National Chiropractic Association. 1956;25(12):24-5.
57. Sausser K. Interview. with Young K. 28 August 1996.
58. Sausser WL. The President's Message. The Chiropractic Journal. 1936;5(10):18, 28.
59. Remier PA. Modern X-Ray Practice and Chiropractic Spinography. Davenport, IA, USA: Palmer School of Chiropractic; 1938.
60. Martin SC. "The only truly scientific method of healing": Chiropractic and American science, 1895 - 1990. Isis. 1994;88:207-27.
61. Keating JC, Jr., Green BN, Johnson CD. "Research" and "Science" in the first half of the chiropractic century. Journal of Manipulative & Physiological Therapeutics. 1995;18(6):357-78. PubMed PMID: 1995037668. Language: English. Entry Date: 19951201. Revision Date: 20050428. Publication Type: journal article.
62. Dye AA. The Evolution of Chiropractic: Its Discovery and Development. 1st ed. Philadelphia, PA, USA: A Aug Dye, DC; 1939. 343 p.
63. Linton O. Moments in Radiology History: Part 6 - Radiology Wins Medicare2013 02 February 2017. Available from: https://www.auntminnie.com/index.aspx?sec=sup&sub=imc&pag=dis&ItemID=99856.
64. Timins JE, Linton OW. A brief economic history of radiology. N J Med. 1995;92(11):739-42. Epub 1995/11/01. PubMed PMID: 8570107.
65. Giammarino MA. Audio tape letter. In: Young KJ, editor. 1997.
66. Giammarino MA. Letter. In: Canterbury R, editor. 1994.
67. Poehner WG. Let's consider arthritis. The National Chiropractic Journal. 1942 September 1942:7.
68. Poehner WG. Progress is difficult. The National Chiropractic Journal. 1940 November 1940:24.
69. Poehner WG. X-ray facts and findings. The National Chiropractic Journal. 1940 October 1940:20.
70. Peterson TC. Minutes of the Council on Education of the National Chiropractic Association. National Chiropractic Association, 1948 23-5 January 1948. Report No.
71. Wunsch LE. Minutes of the Council on Education of the National Chiropractic Association. National Chiropractic Association, 1955 4-8 July 1955. Report No.
72. Anderson A. with Young KJ. 28 December 1999.
73. Janse J. National College to sponsor graduate course in radiology. The Journal of the National Chiropractic Association. 1957:23, 71.
74. Smith RL. At Your Own Risk: The Case Against Chiropractic. New York: Pocket Books; 1969.
75. Janse J. Observations after forty years. The ACA Journal. 1978;15(9):27-31.
76. Keating JC, Callender AK, Cleveland CS, Association for the History of Chiropractic., Council on Chiropractic Education (U.S.). A History of Chiropractic Education in North America : Report to the Council on Chiropractic Education. Davenport, Iowa: The Association; 1998. ix, 516 p. p.
77. Howe JW. Interview. with Young KJ. 25 October 2015.
78. Wilk C. Chiropractic Speaks Out: A Reply to Medical Propaganda, Bigotry, and Ignorance. Park Ridge, IL: Chester A Wilk; 1973.
79. Simpson JK. The Influence of Political Medicine in the Development of the Chiropractic Profession in Australia: University of Queensland; 2002.
80. Young KJ. Historical influence on the practice of chiropractic radiology: part I - a survey of Diplomates of the American Chiropractic College of Radiology. Chiropractic & manual therapies. 2017;25(1):14. doi: 10.1186/s12998-017-0146-y.

81. Young KJ. Historical influence on the practice of chiropractic radiology: part II - thematic analysis on the opinions of Diplomates of the American Chiropractic College of Radiology about the future. Chiropractic & manual therapies. 2017;25(1):15. doi: 10.1186/s12998-017-0145-z.
82. Green BN, Johnson CD. The early years of organized chiropractic orthopedics, 1954 - 1973: a social history. Journal of the Canadian Chiropractic Association. 2009;53(2):129 - 43.
83. Pruitt HW. Minutes of the mid-year meeting of the Education Committee of the National Chiropractic Association. National Chiropractic Association, 1957 5-8 January 1957. Report No.
84. Giammarino MA. Certified roentgenologist program. Journal of the National Chiropractic Association. 1958;28(9):30.
85. Giammarino MA. Minutes of the Annual Meeting of the National Council on Education of the National Chiropractic Association. 1958 15-18 June 1958. Report No.
86. Yochum TR. 1895-1995: diagnostic imaging in its first century. Journal of Manipulative & Physiological Therapeutics. 1995;18(9):618-25. PubMed PMID: 1996010998. Language: English. Entry Date: 19960401. Revision Date: 20050428. Publication Type: journal article.
87. Gregerson D, Adams TL, Smoley C, Tatum RS, Quinlan-Ruof E, Bedle J, et al. Candidate Guide - The American Chiropractic Board of Radiology. American Chiropractic Board of Radiology, 2018.
88. Ulrich HO. First meeting of ACCR held. The ACA Journal of Chiropractic. 1964;1(9):48.
89. Pyzik L. Email correspondence. In: Young KJ, editor. 2017.
90. Phillips RB. Email correspondence. In: Young KJ, editor. 2017.
91. Guebert GM. Email correspondence. In: Young KJ, editor. 2017.
92. American Chiropractic Council of Radiology. Minutes of the Annual Meetings. American Chiropractic Council of Radiology, 1975 - 1998.
93. Canterbury R. Email correspondence. In: Young KJ, editor. 2017.
94. Phillips RB. Email correspondence. In: Kenneth JY, editor. 2018.
95. Taylor JAM, Resnick D. Skeletal Imaging: Atlas of the Spine and Extremities. Philadelphia: Saunders; 2000.
96. Yochum TR, Rowe LJ. Essentials of Skeletal Radiology. First ed. Philadelphia: Lippincott/Williams & Wilkins; 1987.
97. Marchiori DM. Clinical Imaging: With Skeletal, Chest and Abdomen Pattern Differentials: Elsevier Health Sciences; 2004.
98. UCSD Musculoskeletal Radiology. Former Fellows Page San Diego: University of California San Diego; 2017 [cited 2017 20 August 2017]. Available from: http://bonepit.com/Former%20fellows/Former%20fellows%20all.htm.
99. Janse J. Minutes of the Semi-Annual Meeting of the Council on Education. National Chiropractic Association, 1959.
100. Wunsch LE. Minutes of the Semi-Annual Meeting of the Council on Education. National Chiropractic Association, 1959.
101. Gatterman B. Interview. with Young KJ. 14 October 2017.
102. Taylor JAM, Yochum TR. Joseph W. Howe: A pioneer in the evolution of chiropractic radiology. Chiropractic History. 1993;13(1):35-8. Epub 1993/06/01. PubMed PMID: 11613045.
103. Phillips RB. Joseph W. Howe and the development of modern chiropractic radiology. with Young KJ. 27 January 1998.

104. Winterstein J. Intraprofessional concerns. Journal of Chiropractic Medicine. 2002;1(4):171-4. doi: http://dx.doi.org/10.1016/S0899-3467(07)60031-7.
105. Howe JW. A contemporary perspective on chiropractic and the concept of subluxation. The ACA Journal of Chiropractic 1976;10(Supplement):S165-S9.
106. Howe JW. ACCR report. ACA Journal of Chiropractic. 1968;5(5):23-4.
107. Givati A. Performing 'pragmatic holism': Professionalisation and the holistic discourse of non-medically qualified acupuncturists and homeopaths in the United Kingdom. Health. 2014;19(1):34-50. doi: 10.1177/1363459314530739.
108. Gargan JJ. Specifying elements of professionalism and the process of professionalization. International Journal of Public Administration. 1993;16(12):1861-84. doi: 10.1080/01900699308524879.
109. Resnick D. Diagnosis of Bone and Joint Disorders. Philadelphia: W.B. Saunders; 1981.
110. Rich EA. Atlas of Clinical Roentgenology. First ed. Indianapolis, IN, USA: Rae Publishing; 1965.
111. Yochum TR, Barry M. Our Credentials: Rocky Mountain Chiropractic Radiological Center; 2017 [18 September 2017]. Available from: http://www.rmcrc.com/our-credentials/.
112. Hildebrandt RW. Chiropractic Spinography: A Manual of Technology and Interpretation. 2nd ed. Wheaton, IL, USA: MS Hilmark Publications; 1980.
113. Sherman R, Bauer F. X-ray X-pertise - from A to X: Parker Chiropractic Research Foundation; 1982.
114. Johnson C. The Journal of Chiropractic Medicine: an update on selected specialties in the chiropractic profession. Journal of chiropractic medicine.11(4):231-2. doi: 10.1016/j.jcm.2012.10.001.
115. Shuval JT, Mizrachi N, Smetannikov E. Entering the well-guarded fortress: alternative practitioners in hospital settings. Social Science & Medicine. 2002;55(10):1745-55. doi: https://doi.org/10.1016/S0277-9536(01)00305-7.
116. Mizrachi N, Shuval JT, Gross S. Boundary at work: alternative medicine in biomedical settings. Sociology of Health & Illness. 2005;27(1):20-43. doi: 10.1111/j.1467-9566.2005.00430.x.
117. Scott WR. Organizations: Rational, Natural, and Open Systems. 3rd ed. New Jersey: Prentice Hall; 1992.
118. Winterstein J. Email correspondence. In: Young KJ, editor. 2017.
119. Baer HA. The American dominative medical system as a reflection of social relations in the larger society. Social Science & Medicine. 1989;28(11):1103-12. doi: http://dx.doi.org/10.1016/0277-9536(89)90002-6.
120. Baer HA. Osteopathy in Australasia: From marginality to a fully professionalised system of health care. International Journal of Osteopathic Medicine. 2009;12(1):25-31. doi: http://dx.doi.org/10.1016/j.ijosm.2008.05.002.
121. Biggs CL. No bones about chiropractic? The quest for legitimacy by the Ontario chiropractic profession, 1895 to 1985 [Ph.D.]. Ann Arbor: University of Toronto (Canada); 1990.
122. Strahinjevich B, Simpson JK. The schism in chiropractic through the eyes of a 1st year chiropractic student. Chiropractic & manual therapies. 2018;26(1):2. doi: 10.1186/s12998-017-0171-x.
123. Harrison D, Kent C, Betz J, Harrison D, Oakley P. Summary. 2006 2013. In: Practicing Chiropractors' Committee on Radiology Protocols [Internet]. Practicing Chiropractors' Committee on Radiology Protocols; [1-7]. Available from: http://www.pccrp.org.

124. News Staff. The Chronicle of Chiropractic: The Source for News on Conservative, Traditional Chiropractic [Internet]. McCoy M, editor. Kennesaw, Georgia: Chronicle of Chiropractic. 2019. [13 June 2019]. Available from: http://chiropractic.prosepoint.net/153673.
125. Staff N. The Chronicle of Chiropractic: The Source for News on Conservative, Traditional Chiropractic [Internet]. McCoy M, editor2019. [10 July 2019]. Available from: http://chiropractic.prosepoint.net/165059.
126. News Staff. The Chronicle of Chiropractic: The Source for News on Conservative, Traditional Chiropractic [Internet]. McCoy M, editor. Kennesaw, Georgia: Chronicle of Chiropractic. 2019. [13 June 2019]. Available from: http://chiropractic.prosepoint.net/155710.
127. News Staff. The Chronicle of Chiropractic [Internet]. McCoy M, editor2019. Available from: http://chiropractic.prosepoint.net/163929.
128. Heagey T. Query on DACBR numbers to Executive Assistant of ACCR. In: Young KJ, editor. 2017.
129. Stochkendahl MJ, Rezai M, Torres P, Sutton D, Tuchin P, Brown R, et al. The chiropractic workforce: a global review. Chiropractic & manual therapies. 2019;27(1):36. doi: 10.1186/s12998-019-0255-x.
130. General Chiropractic Council. Annual registration report. London: General Chiropractic Council, 2018.
131. Chiropractic Board of Australia. Chiropractic Board of Australia Registrant Data. Australian Health Practitioner Regulation Agency, 2019.
132. Erikson C, Jones K, Whatley M, Hampton S. 2014 Physician Specialty Data Book. Washington, D.C.: Association of American Medical Colleges, 2014.
133. Young A, Chaudrhy HJ, Pei X, Arnhart K, Dugan M, Scyder GB. A census of actively licensed physicians in the United States, 2016. Journal of Medical Regulation. 2017;103(2):7-21.
134. General Medical Council. List of Registered Medical Practitioners - Statistics: General Medical Council; 2017 [updated 03 July 2017; cited 2018 22 January 2018]. Available from: https://www.gmc-uk.org/doctors/register/search_stats.asp.
135. Kettner N. Email correspondence. In: Young KJ, editor. 2017.
136. Walker BF. Interview. with Young KJ. 04 December 2017.
137. Cox J. Interview. with Young KJ. 24 October 2015.
138. Duncan P. Failing to Professionalise, Struggling to Specialise: The Rise and Fall of Health Promotion as a Putative Specialism in England, 1980-2000. Medical History. 2013;57(3):377-96. doi: http://dx.doi.org/10.1017/mdh.2013.19. PubMed PMID: 1356629754.
139. Halpern SA. American Pediatrics: The Social Dynamics of Professionalism, 1880 - 1980. Berkeley, CA: University of California Press; 1988.
140. Miller K. The evolution of professional identity: the case of osteopathic medicine. Social Science & Medicine. 1998;47(11):1739-48. doi: http://dx.doi.org/10.1016/S0277-9536(98)00247-0.
141. Brosnan C. Alternative futures: Fields, boundaries, and divergent professionalisation strategies within the chiropractic profession. Social Science & Medicine. 2017;190(1):83-91. doi: http://dx.doi.org/10.1016/j.socscimed.2017.08.018.