

Brief Communication:

The Proximal Ulna as an Additional Diagnostic Feature of Advanced Rheumatoid Arthritis

Davina D. Craps* and Rebecca Gowland

Durham University, Dawson Building, Department of Archaeology, South Road, Durham, DH1 3LE, UK

Abstract

Rheumatoid arthritis (RA) is considered to be an uncommon condition in paleopathology, although several case studies have recently been published. These studies tend to focus on changes in the small joints of the hands and feet, which are the most diagnostic, though these skeletal elements are often poorly preserved in archaeological contexts. This study aims to highlight another common trait that has been observed in multiple cases of RA in the clinical and paleopathological record: erosive lesions on the proximal ulna. RA frequently affects the elbow in clinical cases, with erosions observable in the radial head, the proximal ulna, and the distal humerus, in the later stages of the disease. Lesions produced by RA in the proximal ulna demonstrate a remarkable consistency in appearance between paleopathological cases from different periods and places. Although overlooked, erosive lesions on the proximal ulna provide an important diagnostic indicator of RA and yields additional information concerning disease progression.

Keywords: Diagnostic criteria, erosive lesions, joint disease, palaeorheumatology

* Corresponding author: e-mail address: d.d.craps@gmail.com; Present address: Doggeweg 21 Zaventem 1930, Belgium.

Introduction

Rheumatoid arthritis (RA) is the most common erosive joint disease in the world today, yet in paleopathology it is considered a relatively rare condition (Burt et

al. 2013; Maradit Kremers and Gabriel 2004). While a number of paleopathological case studies on RA have been published, its expression is not well understood and no comparative analysis of erosive lesions related to RA has been attempted to identify potential similarities in their expression (Burt et al. 2013; Ortner 2003; Rogers and Waldron 1995; Waldron 2009). The majority of reports focus on lesions in the hands and feet; however, in archaeological contexts peripheral bones are often poorly preserved. A common feature of advanced RA in the clinical literature is symmetrical elbow erosion (Brasington Jr. 2008; Dryer and Blazar 2011). While this is observed in palaeopathological case studies (Blondiaux et al. 1997; Hacking et al. 1994; Kacki 2013; Leden et al. 1988; Rothschild and Woods 1991), photographic evidence is rarely presented. This brief communication aims to highlight the significance of erosive lesions in the proximal ulna as a reliable diagnostic indicator of advanced RA in bioarchaeological contexts.

Materials and Methods

This study focuses on erosive lesions present in the ulnae of two post-medieval individuals from England. The RA diagnosis for these skeletons was established based on the characteristic, symmetrical presence of marginal erosive lesions in the hands, wrists, feet and other skeletal elements commonly affected by RA. The presence of osteoporosis and the absence of erosive lesions in the sacroiliac joints and lower spine, typical for seronegative spondyloarthropathies, further supported the diagnosis of RA (Figure 1). FAO90 1151 has previously been published by Waldron et al. (1994) and is re-examined for the purposes of this study, while DCV10 Sk12 represents an unpublished case. These examples were compared to the only two published paleopathological case studies of RA that included photographic evidence of erosive lesions of the ulna (McKinnon et al. 2013; Ortner and Utermohle 1981).

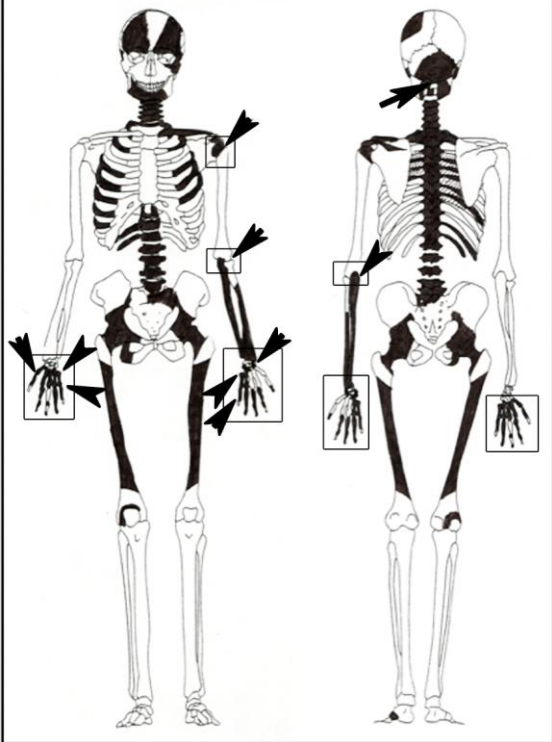
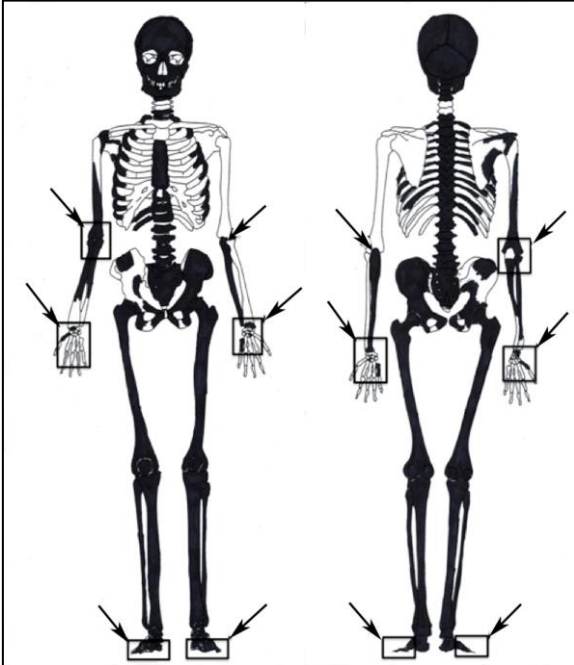
Skeleton ID	Information	Distribution of Lesions
DCV10 Sk12	Site: St Nicholas Church Durham (UK) Time Period: AD 18 th – 19 th Century Sex: Female Age: 46+	 Anterior and posterior views of skeleton DCV10 Sk12. Arrows indicate erosive lesions on the scapula, humerus, radius, ulna, carpal bones, and metacarpals of both hands. The lesions are more extensive on the right side (viewer's left).
FAO90 1151	Site: Farringdon, St Bride's Lower, London (UK) Time Period: AD 1770 – 1849 Sex: Female Age: 46+	 Anterior and posterior views of skeleton FAO90 1151. Arrows indicate erosive lesions on the scapula, humerus, radius, ulna, carpal bones, and metacarpals of both hands. The lesions are more extensive on the right side (viewer's left).

Figure 1: Examined cases of probable rheumatoid arthritis (the arrows indicate the anatomical location of the erosive lesions).

Results

The expression of erosions in the left proximal ulnae of DCV10 SK12 and FAO90 1151 exhibit remarkable similarities (Figure 2.A-B1). The marginal erosions are present on the lateral margin of the head of the ulna and encroach on the radial notch and the trochlear notch (Figure 2.C). In both cases the coronoid process has eroded away and, despite the erosions, the original shape of the bone is still discernable. The lesions fulfill Waldron's (2012, 521) criteria for true lesions: cortical destruction, undercut edges, exposed trabeculae, sharp or scalloped edges, and a scooped floor. The right ulna in FAO90 1151 is in a more advanced state of degeneration than the left side (Figure 2.B2), as the olecranon process has eroded entirely and only the inferior part remains. While the distal humerus and radial head are also affected in FAO90 1151, these skeletal elements are not preserved in DCV10 Sk12. Osteoporosis is observable on the radiograph of the left ulna and radius from DCV10 Sk12 (Figure 2.D) and Waldron et al. (1994, 165) describes the presence of osteoporosis in FAO90 1151.

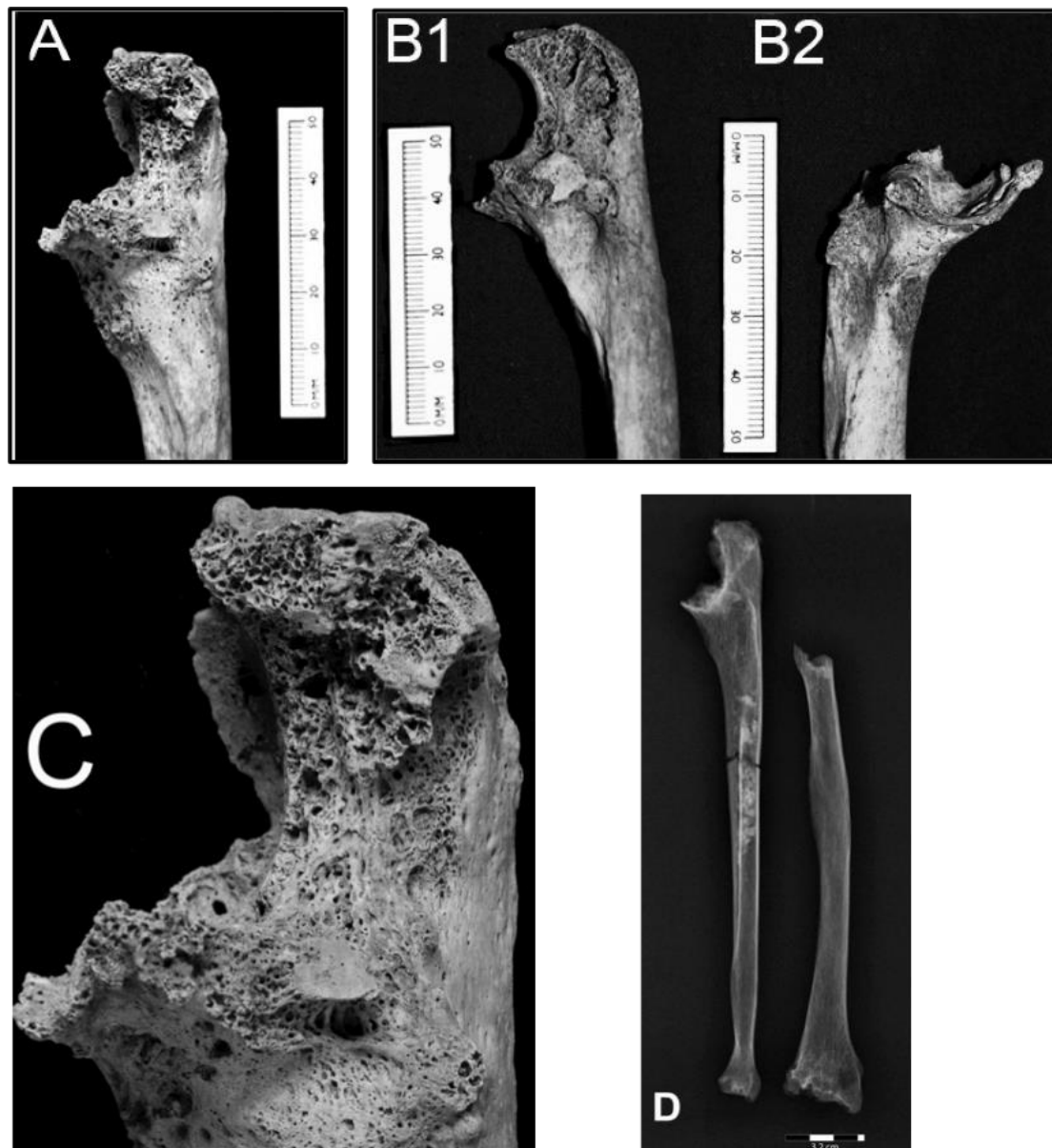


Figure 2: Erosions and deformations of shape observed on five proximal ulnae. **A.** The left proximal ulna of DCV10 Sk12; **B1.** The left proximal ulna of FAO90 1151; **B2.** The right proximal ulna of FAO90 1151. **C.** Close-up of the erosive lesions in the proximal ulna. **D.** Radiograph of the left ulna and radius of DCV10 Sk12.

McKinnon et al. (2013) diagnose RA in a probable male, greater than 55 years of age, dating to the Anglo-Saxon period (c. AD 650 – 900), from Sedgeford cemetery in Norfolk, England. The left and right proximal ulnae of this individual exhibit erosive lesions on the lateral side that are almost identical to the cases presented here (McKinnon et al. 2013, 123; Figure 3). Ortner and Utermohle (1981) diagnose probable juvenile RA in a 30-35 year old female from the Uyak site on Kodiak Island in Alaska, U.S.A., dating to the pre-Columbian period (estimated first century BC – AD1100-1200). The left and right proximal ulnae of this individual

exhibit “*porous degeneration and cystic erosion of the joint*”, which is, again, remarkably similar to the cases already presented (Ortner and Utermohle 1981, 26; Figure 4). There is a striking consistency in the expression of these erosive lesions on the ulnae in RA sufferers, despite their diverse temporal and geographical origins.

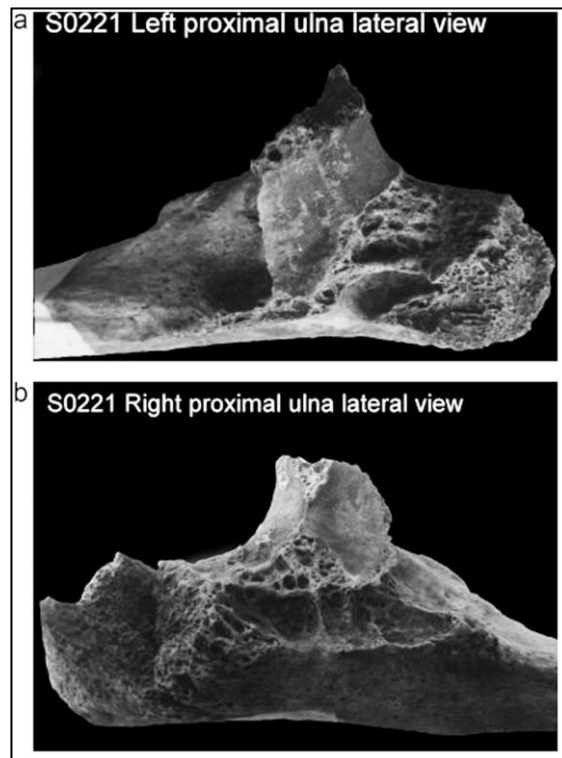


Figure 3: Images of the left and right proximal ulna with erosive lesions, reproduced from McKinnon et al. (2013, 123, Figure 2) with permission from Elsevier, license number: 3562410603444.

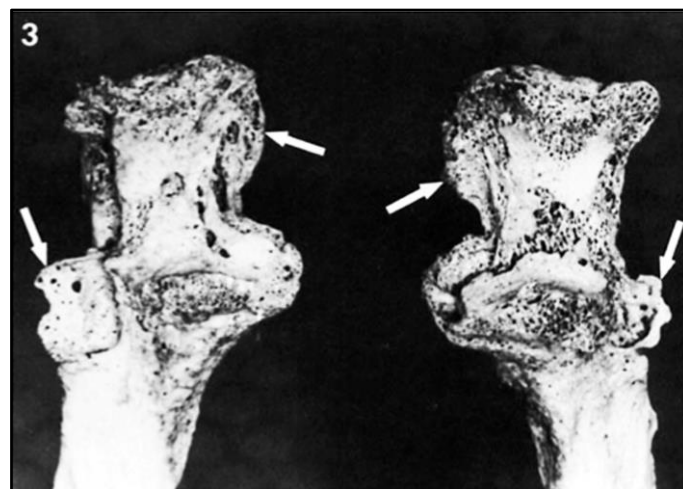


Figure 4: Image of the right and left proximal ulna with erosive lesions, reproduced from Ortner and Utermohle (1981, 26, Figure 3) with permission from John Wiley and Sons, license number: 3562410205933.

Discussion

In modern RA cases, approximately half of patients develop radiographic signs of erosive lesions in the elbow approximately 10 to 15 years after onset of the disease. Erosions are caused by synovial joint inflammation and can lead to olecranon bursitis, with rheumatoid nodules commonly occurring at the olecranon and the extensor surface of the proximal ulna. As is typical for lesions in RA, the erosions at the ulna occur symmetrically; however the severity of these erosions can vary between the left and right sides, as observed in FAO90 1151 (Brasington Jr. 2008; Dryer and Blazar 2011; Kitamura et al. 2007; Lehtinen et al. 2002). Erosions in the ulna progress over time and tend to be more characteristic of the later disease process. This is in contrast to erosions observed in hands and wrists, where severe destruction occurs within the first few years and then reaches a plateau (Abe et al. 2008; Brasington Jr. 2008; Dryer and Blazar 2011; Kent and Matteson 2004; Kitamura et al. 2007; Lehtinen et al. 2002). Erosive lesions do not affect the ulna in isolation and also occur in the other bones of the elbow (i.e. distal humerus and proximal radius), as observed in FAO90 1151 (Resnick and Kransdorf 2005; Wynn Parry 1973).

A differential diagnosis concerning erosive lesions at the elbow includes gout, which can result in olecranon bursitis and often leads to erosions. However, in gout, erosions tend to be asymmetrical and with characteristic overhanging margins (Martel hook). In these paleopathological cases the lesions are symmetrical and exhibit no overhanging margins. Furthermore, osteoporosis is uncommon in gout, but common in RA and present in both of these cases (Resnick and Kransdorf 2005; Waldron 2009). Erosive lesions at the elbow are not commonly mentioned in the disease pattern for seronegative arthropathies, as evidenced in studies by Burt et al. (2013), Ortner (2003), Aufderheide and Rodríguez-Martin (1998), and Waldron (2009), nor in the target approach by Resnick and Kransdorf (2005). The overall pathological pattern of RA does not resemble other erosive conditions, except psoriatic arthritis, which sometimes mimics RA. However, enthesitis and pencil-in-cup lesions at the distal interphalangeal joints of the hand discern psoriatic arthritis from RA (Aletaha and Radner 2013; Waldron 526).

Septic arthritis (SA) and tuberculosis (TB) of the elbow may also result in destructive lesions. SA occurs asymmetrically, most often in the knee, but can affect any joint, and RA is a major risk factor in developing septic arthritis. Approximately

10-20% of patients have polyarticular involvement, especially patients with RA. The overlapping presence of septic arthritis does not influence the pattern of joint involvement for RA. While the presence of septic arthritis is nearly impossible to definitively determine in paleopathology, due to the absence of synovial fluid, it is possible to detect the pathological pattern of rheumatoid arthritis (Goldenberg 1998; Weston et al. 1999). Clinical research states that tuberculosis of the elbow is rare, tends to be unilateral, and without the typical hand erosions observed in RA (Aggarwal and Dhammi 2006; Chen et al. 1997; Parkinson et al. 1990). When comparing the lesions observed here with an example published by Ortner (2003, 244 figures 10-22 and 10-23), it is clear that the macroscopic expression of lesions at the ulna is different in TB. This discussion of the differential diagnoses has shown why erosions at the ulna are a good indicator for advanced RA, but should not be used as the sole indicator for RA.

Conclusion

This study demonstrates the consistency in the appearance of erosive lesions associated with RA in the proximal ulna, even between archaeological cases from diverse temporal periods and geographical locations. Erosive lesions in the proximal ulna provide an important additional diagnostic feature in the identification of advanced cases of RA in the past. At present it is not possible to state that these lesions can be used for diagnosis in the absence of the hand or foot bones. However, special attention should be paid to the proximal ulna when examining potential cases of RA. This feature is likely to contribute towards the future diagnosis of additional cases in the bioarchaeological record.

Acknowledgements

The authors would like to thank the Fenwick Laboratory in the Archaeology department at Durham University and Archaeological Services Durham University (ASDU) for allowing the study of individual DCV10 Sk12. The archaeological excavation of Durham Market Place was funded by Durham City Vision, Durham County Council and Carillion Civil Engineering. Dr. Rebecca Redfern and Ms Jelena Bekvalac from the Centre for Human Bioarchaeology at the Museum of London are gratefully acknowledged for providing access to individual FAO90 1151. A research visit to the Museum of London was partially funded by the Rosemary Cramp Fund

(Archaeology Department, Durham University) and the Norman Richardson Fund (Ustinov College, Durham University).

Bibliography

- Abe, A., Ishikawa, H., Murasawa, A., and Nakazono, K. 2008. "Disease Activity and Course of Elbow Joint Deterioration over 10 Years in Patients with Early Rheumatoid Arthritis." *Clinical Rheumatology* 27: 867-872.
- Aggarwal, A. and Dhammi, I. 2006. "Clinical and Radiological Presentation of Tuberculosis of the Elbow." *Acta Orthopaedica Belgica* 72: 282-287.
- Aletaha, D., and Radner, H. 2013. "Rheumatoid Arthritis - Diagnosis." in: R.A. Watts, P.G. Conaghan, C. Denton, H. Foster, J. Isaacs and U. Müller-Ladner (Eds.) *Oxford Textbook of Rheumatology*. Oxford University Press, Oxford, 849-857.
- Aufderheide, A. C. and Rodriguez-Martin, C. 1998. *The Cambridge Encyclopaedia of Human Paleopathology*. Cambridge, Cambridge University Press.
- Blondiaux, J., Cotten, A., Fontaine, C., Hänni, C., Bera, A., and Flipo, R-M. 1997. "Two Roman and Medieval Cases of Symmetrical Erosive Polyarthropathy from Normandy: Anatomico-pathological and Radiological Evidence for Rheumatoid Arthritis." *International Journal of Osteoarchaeology* 7: 451-466.
- Brasington Jr., R.D. 2008. "Clinical Features of Rheumatoid Arthritis." in: M.C. Hochberg, A.J. Silman, J.S. Smolen, M.E. Weinblatt and M.H. Weisman (Eds.) *Rheumatology*. Mosby, Philadelphia, 763-772.
- Burt, N.M., Semple, D., Waterhouse, K., and Lovell, N.C. 2013. *Identification and Interpretation of Joint Disease in Palaeopathology and Forensic Anthropology*. Springfield: Charles C. Thomas - Publisher, Ltd.
- Chen, W.-S., Wang, C.-J., and Eng, H.-L. 1997. "Tuberculous Arthritis of the Elbow." *International Orthopaedics (SICOT)* 21: 367-370.
- Dryer, A., and Blazar, P.E. 2011. "Rheumatoid Elbow." *Hand Clinics* 27: 43-48.
- Goldenberg, D.L. 1998. "Septic Arthritis." *Lancet* 351: 197-202.
- Hacking, P., Allen, T., and Rogers, J. 1994. "Rheumatoid Arthritis in a Medieval Skeleton." *International Journal of Osteoarchaeology* 4: 251-255.
- Kacki, S. 2013. "Erosive Polyarthropathy in a Late Roman Skeleton from Northern France: A New Case of Rheumatoid Arthritis from the Pre-Columbian Old World?". *International Journal of Palaeopathology* 3, no. 1: 59-63.
- Kent, P.D., and Matteson, E.L. 2004. "Clinical Features and Differential Diagnosis."

- in: E.W. St. Clair, D.S. Pisetsky and B.F. Haynes (Eds.) *Rheumatoid Arthritis*. Lippincott Williams & Wilkins, London, 11-25.
- Kitamura, T., Hashimoto, J., Murase, T., Tomita, T., Hattori, T., Yoshikawa, H., and Sugamoto, K. 2007. "Radiographic Study of Joint Destruction Patterns in the Rheumatoid Elbow." *Clinical Rheumatology* 26: 515-519.
- Leden, I., Persson, E., and Persson, O. 1988. "Aspects of the History of Rheumatoid Arthritis in the Light of Recent Osteo-archaeological Finds." *Scandinavian Journal of Rheumatology* 17: 341-352.
- Lehtinen, J.T., Kaarela, M., Mäenpää, H.M., and Lehto, M.U.K. 2002. "Bone Destruction Patterns of the Rheumatoid Elbow: A Radiographic Assessment of 148 Elbows at 15 Years." *Journal of Shoulder and Elbow Surgery* 11: 253-258.
- Maradit Kremers, H., and Gabriel, S.E. 2004. "Epidemiology." in: E.W. St. Clair, D.S. Pisetsky and B.F. Haynes (Eds.) *Rheumatoid Arthritis*. Lippincott Williams & Wilkins, London, 1-10.
- McKinnon, K., Van Twest, M.S., and Hatton, M. 2013. "A Probable Case of Rheumatoid Arthritis from the Middle Anglo-Saxon Period." *International Journal of Paleopathology* 3 (2): 122-127.
- Ortner, D. 2003. *Identification of Pathological Conditions in Human Skeletal Remains*. London, Academic Press.
- Ortner, D.J., and Utermohle, C.J. 1981. "Polyarticular Inflammatory Arthritis in a Pre-Columbian Skeleton From Kodiak Island, Alaska, U.S.A." *American Journal of Physical Anthropology* 56: 23-31.
- Parkinson, R.W., Hodgson, S.P., and Noble, J. 1990. "Tuberculosis of the Elbow: A Report of Five Cases." *Journal of Bone and Joint Surgery* 72-B (3): 523-524.
- Resnick, D., and Kransdorf, M.J. 2005. *Bone and Joint Imaging*. Philadelphia: Elsevier Saunders.
- Rogers, J. and Waldron, T. 1995. *A Field Guide to Joint Disease in Archaeology*. Chichester, John Wiley & Sons.
- Rothschild, B.M., and Woods, R.J. 1991. "Symmetrical Erosive Disease in Archaic Indians: The Origins of Rheumatoid Arthritis in the New World?". *Seminars in Arthritis and Rheumatism* 19, no. 5: 278-284.
- Waldron, T. 2009. *Palaeopathology*. Cambridge: Cambridge University Press.
- Waldron, T. 2012. "Joint Disease." In: Grauer, A.L. (Ed.) *A Companion to Paleopathology*. Wiley-Blackwell, Chichester: 513-530.

Weston, V.C., Jones, A.C., Bradbury, N., Fawthrop, F. and Doherty, M. 1999.

“Clinical Features and Outcome of Septic Arthritis in a Single UK Health District 1982-1991.” *Annals of the Rheumatic Diseases* 58: 214-219.

Wynn Parry, C.B. 1973. *Rehabilitation of the Hand*. Butterworths, London.