Orthobiologics and Knee Osteoarthritis

A Recent Literature Review, Treatment Algorithm, and Pathophysiology Discussion

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KEYWORDS

• Knee osteoarthritis • Fat lipoaspirate • Orthobiologics • Tissue engineering
• Meniscus • Extrusion • Stem cell depletion model • Multinodal pathophysiology

KEY POINTS

- There has been a tremendous growth in the regenerative medicine health care space since the beginning of platelet-rich plasma use in 1987.
- Tissue engineering is becoming a reality; however, difficult decisions such as how to best optimize care and treatment plans to treat knee osteoarthritis remain.
- In these early days of orthobiologics, we are seeing a pattern of studies emerge that seem to support the safety of these products.
- The literature seems to support orthobiologics in the treatment of knee osteoarthritis for 1 year or longer, depending on the age of the patient and disease severity.
- The current array of orthobiologic treatments and combinations will be a barrier of entry for many providers and patients.

INTRODUCTION

This article provides the reader with information in several areas regarding the use of orthobiologics in the treatment of knee osteoarthritis (OA).[1] These goals are (1) to provide a recent, brief literature review of the current options in orthobiologics as they pertain to the clinical treatment of knee OA. These treatments include, but are not limited to platelet-rich plasma (PRP), autologous conditioned plasma (ACP), bone marrow concentrate (BMC), and mesenchymal stem cells (MSC). (2) We describe a

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new model of knee OA that fills the gap in our understanding of it as a purely traumatic and/or inflammation-induced cartilage degenerative condition, to a current model of multinodal pathophysiology. The goal of this new model of OA is to provide physicians, stem cell scientists, and physical therapy and movement specialists with a new paradigm on which to perform tissue engineering, thus providing a scaffold to understand on what layer/level new therapies and studies will take place. (3) Graft choice and patient selection in the current state of understanding of the treatment of knee OA in a tissue engineering model with orthobiologics is discussed. (4) We present a sample treatment algorithm and decision "nest" (or multinodal decision tree) as it pertains to the decision on how to proceed with patient care in this complex problem.

PREVALENCE OF DISEASE

Knee OA represents a large and progressively worsening problem for the developed world. The rates of progression follow other diseases of lifestyle, and indeed affect a large portion of the population in the United States with current prevalence of 280 in 1000 patient population aged greater than 45 years of age. This is approximately 26.9 million US adults, which is believed to be a conservative estimate (prevalence data from 2005, up from 21 million in 1990).[2] With the annual total knee replacement percentage expected to increase by 601% by 2030,[3] we as a society will require a better understanding of pathophysiology, as well as an improved and earlier detection and treatment model of knee OA, to reduce the current progression of total joint arthroplasty. With the cost of total knee arthroplasty or joint replacement hovering around US$57,000, and with a reported mortality rate of approximately 0.25% (or 1 in 400 patients), and complications ranging from deep venous thrombosis to infection to persistent pain,[4] a more sustainable treatment model will be necessary to effectively deal with this growing public health problem.

CURRENT ORTHOBIOLOGIC TREATMENT OPTIONS

There are many treatments that now fit this overarching label (also known as regenerative injection therapies or biocellular grafts, depending on use). These options include (in order of appearance over the past decades) whole blood therapy, traditional prolotherapy, PRP, ACP or autologous conditioned serum, bone marrow aspirate concentrate, adipose biocellular autograft (as whole lipoaspirate without manipulation or stromal vascular fraction of adipose [SVF]), MSC allograft cellular concentrates, amniotic cellular concentrates, cord-derived cellular concentrates, interleukin receptor antagonist receptor peptides, and alpha 2 macroglobulins. This number of treatments can leave the clinician bewildered with regard to what treatment paradigm to offer the patient suffering with knee OA. This article focuses on the use of ACP, PRP, BMC, and briefly on whole lipoaspirate in the treatment of knee OA; as they have been, and remain, the most well-studied and prevalent grafts of current use. This article does not focus in on the growth factor cellular preparations constituted with amnion or cord-derived cells.

To help the reader, the author will put a shorthand delineation of graft composition after each reference that will include (A) the cellular concentration of autograft product (ie, ACP, PRP, BMC, or MSC), (B) the leukocyte concentration consisting of leukocyte-rich (LR) or leukocyte-poor (LP) platelet concentrated product (or unknown), (C) high red cell hemoglobin concentration (8%–15% heme or + heme) or low hemoglobin concentration (2%–7% heme or -heme) or unknown, and (D) the presence or absence of a matrix (+mtx or −mtx, or unknown). Examples may look like (BMC + PRP LR + heme −mtx) or (ACP LP −mtx). Leukocyte concentrations will be defined as