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Operative Techniques in
Orthopaedics

Tendon-Derived Stem Cells for Rotator Cuff Repair

Pietro Randelli, MD,[*,†] Davide Cucchi, MD,[*,†] Federico Cabitza, Eng,[‡] Riccardo Compagnoni, MD,[§] and Alessandra Menon, PhD[*]

Rotator cuff tear is a common cause of shoulder pain and disability, and arthroscopic repair is a frequently performed procedure. To improve results and reduce failure rate of this surgery, biological solutions to enhance tendon repair are being investigated. Mesenchymal stem cells contribute in creating a suitable microenvironment for tissue repair, and therefore therapeutic use of tendon tissue-specific stem cells in clinical practice is one of the most promising challenges in regenerative medicine approaches to rotator cuff repair.

The aim of this article is to revise the current literature on tendon-derived stem cells for rotator cuff repair. Identification and characterization of a reservoir of progenitor cells in human shoulder periarticular tissues has been successfully confirmed by different authors. The first animal studies on the healing potential of these mesenchymal stem cells showed encouraging results. No clinical trials have been published yet. Rigorous preclinical translational studies are needed to ensure safety and efficacy of stem cells–based treatments before routine use in clinical practice.

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KEYWORDS tendon-derived stem cells, regenerative medicine, rotator cuff repair, shoulder tissues

Introduction

Rotator cuff tears (RCTs) represent most of shoulder diseases in adult population. RCTs are a common contributing factor to shoulder pain and occupational disability, and the incidence of this condition is increasing, along with an aging population. Prevalence of RCTs diagnosed in cadaver specimen and by instrumental analysis varies from 5%-39%, depending on patients' age.[1-3] Among the risk factors associated with RCTs, older age, history of trauma, and hand dominance are well recognised.[2] Painful, atraumatic RCTs in older patients may benefit from an initial rehabilitative approach; on the contrary, for younger patients with a traumatic history or older patients unresponsive to the rehabilitation program, surgery is the recommended treatment.[4]

Rotator cuff (RC) repair techniques evolve at a fast pace and a wide variety of surgical options are available to reduce pain and restore function after RCTs. However, an overall high retear rate remains.[5-7] Although patients with failed RC repairs can experience outcomes comparable with those after successful repairs, sometimes additional therapies or reinterventions are required.[8,9]

Several biological strategies have been investigated to enhance tendon healing after arthroscopic repair, to improve the repair site microenvironment, promote activation of cells and signaling pathways involved in the natural healing response, and prevent the formation of scar tissue. These include the use of growth factors, cell therapy, and tissue engineering.[10-12]

Mesenchymal stem cells (MSCs) have been isolated from a number of different tissues. Bone marrow is a well known and easily accessible source of MSCs. Adipose-derived stem cells have also been isolated and their regenerative potential is being tested.[13]

Tendon-derived stem cells (TDSCs) have been first isolated in murine patellar and human hamstring tendons and are

*IRCCS Policlinico San Donato, San Donato Milanese, Milan, Italy.
†Department of Biomedical Sciences for Health, University of Milan, Milan, Italy.
‡Department of Informatica, Sistemistica e Comunicazione, University of Milano-Bicocca, Milan, Italy.
§Azienda Ospedaliera Bolognini, Seriate, Italy.
*Address reprint requests to Pietro Randelli, MD, Department of Biomedical Sciences for Health, University of Milan, piazza Malan 2, 20097 San Donato Milanese, Milan, Italy. E-mail: pietro.randelli@unimi.it

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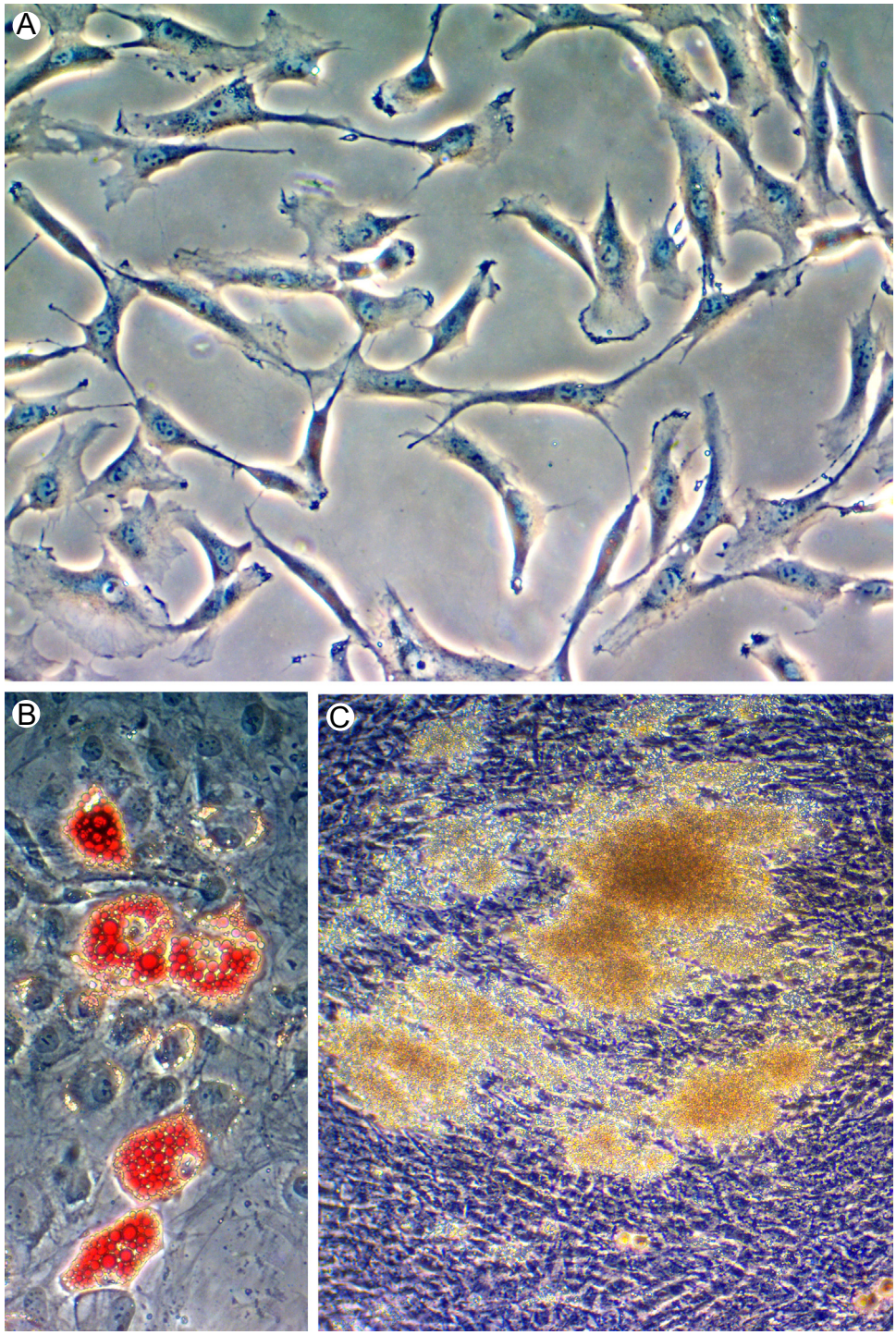

Figure TDSCs morphology: phase-contrast microphotograph (original magnification ×20) (A). Adipogenic and osteogenic differentiation ability of TDSCs cultured in the appropriate differentiation medium was evaluated by Oil Red O (B) and Alizarin Red-S (C) staining, respectively. Lipid intracellular droplets (red) in the adipocytes were stained with Oil Red O solution (phase-contrast microphotograph, original magnification ×20) (B). Alizarin Red-S staining revealed the presence of yellowish-brown calcium deposits (phase-contrast microphotograph, original magnification ×10) (C). Typical results are shown.