

# In silico testing of the ability of meniscus implant to convert compressive loads in to hoop stresses

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## Introduction

It is known that there is a hard conflict with peripheral meniscus tissue renders this part non amenable to healing due to its inherited avascular nature and the treatment using lazy dull ectomy<sup>1</sup> is no longer a choice. This part, unfortunately, is the most injured part of the meniscus. This exceptional paradox needs exceptional interdisciplinary approach based on new concepts, Biological Surgery.<sup>2</sup>

In 2009, Rick W. Wright wrote, the majority of meniscus tears observed at the time of ACL reconstruction are still treated by partial meniscectomy (55% medial meniscectomy, 67% lateral meniscectomy). A relatively large potential market (approximately 160,000) exists for functional tissue engineering strategies to preserve meniscus function through scaffolds (approximately 74,000), advancing repairs to avascular zone (approximately 56,000) and performing all-biologic repairs without implants (approximately 30,000). We hope that many of these options will be available in the future. End citation

Though it is clear that the investment in the treatment of this issue is an excellent business affaire; however, the inexperienced out of the field-essence approaches lead to inverted cost-effectiveness.<sup>3</sup> With the help of the Advances in the IT, Different planning of Treatment Can Be credited When Compared to the in silico Simulation of the implant.<sup>4</sup> From this point of view, a Project concerning meniscal replacement options can be raised.

## Polyvinyl alcohol (PVA) hydrogel

The polyvinyl alcohol (PVA) hydrogel<sup>5,6</sup> implant of Kobayashi et al.<sup>7</sup> was one of the first non-porous permanent replacement approaches. Compressive strength and viscoelastic behavior of the material was highly similar to that of the native (human) meniscus, even after two years of implantation in a rabbit knee. The implant proved to be chondro protective when compared to meniscectomy; however, no sham-operated controls were included to evaluate the influence of the replacement surgery on cartilage condition.<sup>8</sup> In a large animal model, however, the implant caused severe damage to the articular cartilage and benefits in comparison with meniscal allograft could not be proven. Moreover, structural integrity was compromised by complete radial tears in the posterior horn of all implants. It was speculated that the adverse effects were caused by hypermobility of the implant's body.<sup>9</sup>

Recently, an American group has renewed interest in PVA hydrogels for meniscal substitution. It has been shown that by the incorporation of polyethylene fibres into the hydrogel both the compressive and tensile moduli of the biomaterial can be tuned to resemble that of the native meniscus,<sup>10</sup> which is an important step towards the ability of any meniscus implant to convert compressive loads into hoop<sup>11</sup> stresses. In Simulating the polyvinyl alcohol (PVA) hydrogel would be conceived as Knee Interposition Distraction Meniscus.

## Some roadmaps to approach the idea :

- I. Using Medical 3D Imaging Extracted from MRI.
- II. 3D Printing of the (PVA) as different Knee Interposition Distraction Meniscus.
- III. In Silico Testing by simulation.

## Benefits

- i. The conception of (PVA) as KIDM Can Be controlled in a manner that The Alteration of the Knee Compartments Biomechanics caused by Meniscus replacement can be monitored In Silico.
- ii. Improvement of credibility-cost-effectiveness triad<sup>12</sup> for translational Animal<sup>13</sup> Research in Sports Medicine.<sup>14,15</sup>

## In silico testing of (PVA) as (KIDM) can be

- a. A Simulation of Total, Partial, Temporary, Permanent replacement.
- b. A Simulation of Traumatology.<sup>16</sup>
- c. A Simulation of Mechanical Knee Deviations in Multiple Planes.<sup>17</sup>
- d. A simulation of Meniscus repair.<sup>18,19</sup>
- e. A Simulation of Meniscus Surfacing.<sup>20</sup>
- f. Simulation Cartilage Surfacing or Replacements<sup>21</sup> by the interface of (PVA).

When all the hope is expected from one scientific branch, as nowadays in the case of genetic engineering, then the security cannot be totally secured,<sup>22</sup> simply because the wholeburden is put on one side.

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## Conflicts of interest

None.

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