Jun 10, 2024

Three-dimensional models of skeletal muscle under tension and methods to induce traumatic injury: systematic review search protocol

DOI
dx.doi.org/10.17504/protocols.io.q26g71m81gwz/v1

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OPEN ACCESS

DOI: dx.doi.org/10.17504/protocols.io.q26g71m81gwz/v1

Protocol Citation: Kunal Bhanot, Robert Staruch 2024. Three-dimensional models of skeletal muscle under tension and methods to induce traumatic injury: systematic review search protocol. **protocols.io https://dx.doi.org/10.17504/protocols.io.q26g71m81gwz/v1**

Protocol status: Working
We use this protocol and it's working

Created: June 08, 2024

Last Modified: June 10, 2024

Protocol Integer ID: 101455

Abstract

Volumetric
muscle loss (VML) is defined as the significant loss of skeletal muscle as a result of traumatic injury or surgical intervention, resulting in functional and regenerative impairment. It is a considerable form of morbidity and is implicated in blast, penetrating or blunt trauma. Current research on VML is centred around models that are not specific to the injury patterns or environments usually encountered. In order to examine the effects of traumatic injury on skeletal muscle, more representative *in vitro* models are required to generate a deeper cellular picture prior to preclinical validation. Whilst *in vivo* models are invaluable, they are expensive and have a lower throughput platform for discovery research. The aim of this systematic review is to examine the types of *in vitro* muscle models that are applicable to understanding VML. We have therefore designed an inclusive search protocol to incorporate all relevant muscle models under tension and endeavour to subcategorise these depending on methods of inducing injury. “Skeletal muscle” was the major inclusion criterion, followed by “three dimensional” and “model”. The Ovid interface was used to search MEDLINE, EMBASE and Web of Science Core Collection databases to yield 4,895 eligible articles after de-duplication. As of 30/05/2024 articles are in the process of being blindly screened by two independent reviewers. Major inclusion criteria are three dimensional *in vitro* models under tension. A sub analysis will subsequently be performed to examine how injury is induced in such muscle models.

Methods

1 This systematic review was reported in compliance with the PRISMA 2020 checklist. The protocol was developed prospectively in collaboration with a research librarian (NT) at the Nuffield Department of Rheumatology and Musculoskeletal Sciences (NDORMS).

2 All databases were searched from inception until 13/03/2024. The Ovid interface was used to search MEDLINE (1946-present), EMBASE (1974-present) and Web of Science Core Collection (1900-present) databases. No date or language limits were applied. Synonyms were produced in line with elements of the research question. “Skeletal muscle” was the major inclusion criterion, followed by “three dimensional” and “model”. Synonyms for skeletal muscle included “myotube”, “slow-twitch muscle fibres” and “fast-twitch muscle fibres”. Synonyms for “three-dimensional” included “3D”, “organoid” and “lab on a chip”. Synonyms for “model” included “scaffold”, “architecture” and “platform”. Full search strategies can be found in the appendix.

Inclusion criteria

3 In vitro studies that utilised any skeletal muscle cell lines (primary or immortalised, single or multicellular) of any species cultured with an anchor system were eligible for inclusion. Models that used organic hydrogel compounds native to the human body (fibrin or collagen) were included. Where studies reported minor experimental modifications of previously reported models (with detailed methods), the most comprehensive study or studies were included.

Exclusion criteria

4 Models that did not impose axial strain or loading, self-assembly models (spheroids etc) or tissue explant models (including slice culture) were excluded. In vitro models that cultured cells on patterned surfaces (to include orientation) were also excluded, even if they used 3D systems. In vitro monolayer systems were excluded. Ex vivo perfusion systems were also excluded. Models that synthesised hydrogels using materials that were incapable of biodegradation (breakdown of organic matter into constituent elements) within humans (or human tissue) were excluded. Studies without detailed methods, opinion pieces, reviews, letters, conference abstracts, in vivo work and book chapters were excluded.

Appendix

5 EMBASE search:

Total Records downloaded (enter this number here to update	1970		

SearchReport tab):			
Search Strategy			
Embase 1974 to present			
1	skeletal myoblast/	596	
2	(skeletal adj2 myoblast*).tw,kf.	2170	
3	skeletal muscle cell line/	83	
4	(cell* adj2 (stem or primary or satellite)).tw,kf.	624478	
5	(myogenic or skeletal muscle).tw,kf.	172977	
6	4 and 5	11204	
7	skeletal muscle/	144693	
8	slow muscle fiber/	2149	
9	fast muscle fiber/	2212	
10	10	skeletal.tw,kf.	299053
10			
11	(muscle* adj2 fiber*).tw,kf.	35259	

12	10 and 11	13999	
13	(fast-twitch or intermediate or white or type II).tw,kf.	1117798	
14	(red or slow-twitch or type I).tw,kf.	630013	
15	13 or 14	1657758	
16	11 and 15	6707	
17	myotube*.tw,kf.	15390	
18	(skeletal adj2 myocyte*).tw,kf.	751	
19	(myogenic or skeletal muscle).tw,kf.	172977	
20	(cell* adj2 c2c12).tw,kf.	6130	
21	19 and 20	3398	
22	1 or 2 or 3 or 6 or 7 or 8 or 9 or 12 or 16 or 17 or 18 or 21	171236	
23	3d.tw,kf.	324905	
24	three d.tw,kf.	638	
25	3 dimension*.tw,kf.	38685	
26	organoid/	13217	
27	organoid*.tw,kf.	23541	

28	exp lab on a chip/	11240	
29	lab on a chip.tw,kf.	3765	
30	organ on a chip.tw,kf.	1453	
31	exp bioengineering/	235895	
32	bioengineer*.tw,kf.	15596	
33	biological engineer*.tw,kf.	1427	
34	tissue engineer*.tw,kf.	80668	
35	23 or 24 or 25 or 26 or 27 or 28 or 29 or 30 or 31 or 32 or 33 or 34	628442	
36	22 and 35	3934	
37	model*.tw,kf.	5000672	
38	scaffold*.tw,kf.	158968	
39	architecture*.tw,kf.	197564	
40	platform*.tw,kf.	357571	
41	(system or systems).tw,kf.	4417710	
42	37 or 38 or 39 or 40 or 41	8919326	
43	36 and 42	2505	
44	conference*.pt.	5859448	

45	43 not 44	1970	

6 MEDLINE search:

Total Records downloaded (enter this number here to update SearchReport tab):	2650		
Search Strategy			
Medline (Ovid MEDLINE‰ Epub Ahead of Print, In-Process & Other Non-Indexed Citations, Ovid MEDLINE‰ Daily and Ovid MEDLINE‰) 1946 to present			
1	exp Myoblasts, Skeletal/	4090	
2	(skeletal adj2 myoblast*).tw,kf.	1795	
3	(cell* adj2 (stem or primary or satellite)).tw,kf.	422521	
4	(myogenic or skeletal muscle).tw,kf.	139662	
5	3 and 4	8576	
6	Muscle, Skeletal/	166516	
7	Muscle Fibers, Skeletal/	17604	
8	Muscle Fibers, Slow-	2488	

	Twitch/		
9	Muscle Fibers, Fast-Twitch/	3131	
10	skeletal.tw,kf.	237495	
11	11	(muscle* adj2 fiber*).tw,kf.	29880
11			
12	10 and 11	11474	
13	(fast-twitch or intermediate or white or type II).tw,kf.	844075	
14	(red or slow-twitch or type I).tw,kf.	493609	
15	13 or 14	1266664	
16	**11 and 15**	5555	
17	myotube*.tw,kf.	12495	
18	(skeletal adj2 myocyte*).tw,kf.	600	
19	(myogenic or skeletal muscle).tw,kf.	139662	
20	(cell* adj2 c2c12).tw,kf.	4658	
21	19 and 20	2556	

22	1 or 2 or 5 or 6 or 7 or 8 or 9 or 12 or 16 or 17 or 18 or 21	193945	
23	3d.tw,kf.	249537	
24	three d.tw,kf.	468	
25	3 dimension*.tw,kf.	29970	
26	Organoids/	13773	
27	27	organoid*.tw,kf.	15510
27			
28	Lab-On-A-Chip Devices/	7533	
29	lab on a chip.tw,kf.	3690	
30	organ on a chip.tw,kf.	1382	
31	exp Bioengineering/	62819	
32	bioengineer*.tw,kf.	12040	
33	biological engineer*.tw,kf.	432	
34	Tissue Engineering/	45681	
35	tissue engineer*.tw,kf.	64407	

36	23 or 24 or 25 or 26 or 27 or 28 or 29 or 30 or 31 or 32 or 33 or 34 or 35	387881	
37	22 and 36	3428	
38	model*.tw,kf.	3967863	
39	scaffold*.tw,kf.	135360	
40	methods.fs.	4360174	
41	architecture*.tw,kf.	172933	
42	platform*.tw,kf.	271052	
43	(system or systems).tw,kf.	3641694	
44	38 or 39 or 40 or 41 or 42 or 43	10499757	
45	37 and 44	2650	

7 Web of science search strategy:

Search Strategy

Search Query Database Results

1 "myotube OR (skeletal NEAR/2 myoblast*) OR ""skeletal muscle"" OR ""fast twitch muscle fibre*"" OR ""slow twitch muscle fibre*"" OR (skeletal NEAR/2 myocyte*) (Topic) AND 3d OR ""three dimension*"" OR ""three d"" OR organoid* OR ""lab on a chip"" OR ""organ on a chip"" OR bioengineer* OR ""tissue engineer*"" OR ""biological engineer*"" (Topic) AND model* OR scaffold* OR architecture* OR platform* OR system OR systems (Topic) "

Web of Science Core Collection	2811