Author Year Country Research Design Score Total Sample Size	Methods	Outcome
Crane et al. 2016 USA RCT Crossover PEDro=5 N=10	**Population:** Mean age= N/R; Gender: males=9, females=1; Level of injury: N/R; Mean time since injury= 20 yr. **Intervention:** Comparison of interface pressure between an off-loading cushion in three conditions: fully off-loading (C0-off), addition of the top well insert (C1-off), addition of both well inserts (C2-off) to a 10cm-high air flotation cushion (C3-float). The order of cushions was randomized for each participant with each trial being completed 5 times for 2 mintues each time. Risk of the pressure mat hammocking was accommodated. Sittng surface bony prominences weremanually palpated and located in relation to the pressure readings. **Outcome Measures:** Peak pressure index (PPI); Ischial tuberosity (IT) peak pressure; Dispersion Index; Contact Area; Average pressure using Interface Pressure Mapping.	1. PPI averaged values ranged from a low of 39±18mmHg (C0-off) to a high of 97±30mmHg (C3-float));(C1 - 61±19, C2 -78±30). Differences between all conditions was significant at P<.001 2. PPI , IT peak pressure, dispersion index, were all significantly lower in C0, C1 and C2 than C3 but significantly higher for contact area and average pressure
Sonenblum et al. 2018a USA RCT Crossover PEDro=5 N=4	**Population:** Mean age= 42.0 yr; Gender: males=1, females=3; Level of injury: T2-T12; Mean time since injury= 15.8 yr. All participants had significant muscle atrophy at their sitting surface therefore were considered high risk for developing pressure injuries. **Intervention:** Participants buttocks' were scanned sitting in a FONAR Upright MRI. Scans were collected with the individuals' buttocks fully suspended without pelvic support and seated on 3 different wheelchair cushions: Enveloping cushions: Roho HP, Matrx Vi; Offloading cushion: Java. **Outcome Measures:** Bulk tissue thickness, percent of gluteus coverage under the peak of the ischial tuberosity, muscle volume, tissue deformation, greater trochanter bulk tissue thickness measured using an MRI, sacro-coccygeal angle changes and Peak pressure Index using an IPM. ..	1. All participants had similar buttock anatomy with significant muscle atrophy (muscle volume avg: 265 cm^3) and limited soft ticcue at the ischium (bulk tissue thickness ranged between 28 and 40 mm) 2. Bulk tissue thicknesses at the ischium were reduced by more than 60% on Roho HP and Matrx Vi, and more variably (23–60%) on Java. 3. Bulk tissue thickness under the greater trochanter was consistent acorss participants and cushions, ranging from 12-27mm in the loaded condition and displaced laterally in the loaded condition, 4. Peak pressure indeces ranged varied across participants and cushions (50-290mmHg) – lowest PPIs seen with the Java and highest on the MatrixVi. 5. The gluteus maximus displaced superiorly and laterally on the Roho cushion, superiorly and laterally on the MatriVi, and was most similar to the unloaded condition on the Java, with the gluteau maximus not being loaded whiel sittign on the Java cushion.

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Gil-Agudo et al. 2009 Spain RCT PEDro=5 N=48	**Population:** Mean age: 42 yr; Gender: males=38, females=10; Mean weight: 67.6 kg; Mean BMI: 23.3 kg/m^2; Level of injury: cervical=13, thoracic=35; Severity of injury: AIS A. **Intervention:** Use of interface pressure mapping to determine its utility in cushion selection. Comparison of cushions: 1) single compartment low profile air cushion; 2) single compartment, high profile air cushion; 3) dual compartment air cushion; 4) gel and firm foam cushion. Wheelchair set-up was normalized (hips, knees and ankles at 90°, seat parallel to floor, back perpendicular or tilted up to 10 °); air cushions all individually adjusted at set-up for each trial based on manufacturer instructions. **Outcome Measures:** Pressure mapping using the Xsensor to compare distribution of pressure (peak maximum pressure of entire map and peak pressure at ischial tuberosities (IT)) and contact surface (total contact area with readings greater than 60mmHg and less than 60mmHg) from a 1.5 min reading.	1. The interface pressure mapping system was useful for assessing the mechanical characteristics of this sample of cushions. 2. The dual compartment air cushion had significantly lower peak maximum pressure across the mapping surface, and lower peak pressure in the area of the IT than other cushions evaluated in this study 3. The gel and firm foam cushion had the highest mean pressure values ($p<0.05$ versus low-profile air, high-profile air, dual compartment air) but had significantly lower peak pressure values at the ITs over the single compartment, low profile air cushion; there were no statistically significant differences ($p<0.05$) in any variable between the single compartment air cushions - low and high profile. 4. For surface variable measurements, the dual compartment air cushion had the largest total contact surface ($p<0.05$) compared to the three other cushions; the dual compartment air cushion had the lowest percentage of the total contact surface with pressure readings over 60mmHg ($p<0.05$) compared to the other three cushions); the dual compartment air cushion had the lowest contact surface with pressure readings over 60 mmHg ($p<0.05$) except for the low profile single compartment air cushion ($p=0.11$). 5. The cushion with the least favorable total contact surface was the single compartment low profile air cushion ($p<0.05$) compared to the other three cushions. 6. The cushion with the largest surface area above the 60 mmHg threshold was the gel and firm foam cushion ($p<0.05$) compared to the other cushions.
Burns & Betz 1999 USA Prospective Controlled Trial	**Population:** Mean age: 46 yr; Gender: males=16, females=0; Level of injury: tetraplegia=16; Severity of injury: AIS A=7, B=9. **Intervention:** Two static wheelchair cushions (dry flotation and gel) upright	1. When compared in the high-pressure condition, all cushions were significant ($p<0.001$), with means of 111 mmHg (dry flotation), 128 mmHg (gel), and 157 mmHg (dynamic).

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N=16	and at 45° tilt, compared to a dynamic cushion that was composed of two air bladders (H and IT) that alternated between inflation and deflation. **Outcome Measures:** Interface pressure at ischial tuberosities (IT) was assessed with Clinseat seating interface pressure sensor.	2. When compared in the low-pressure condition, only gel flotation (86 mmHg), and the dynamic cushion (71 mmHg), were significant ($p<0.05$). 3. The IT had a significantly higher mean during IT bladder inflation of the dynamic cushion than the high-pressure position in the static cushions ($p<0.01$), with the dry flotation having significantly lower pressure than the gel cushion ($p<0.01$). 4. The IT had significantly lower mean in the lower pressure position only for the dynamic cushion as compared to the gel cushion ($p<0.01$).
Garber 1985 USA Prospective Controlled Trial N=251	**Population:** Gender: males=207, females=44; Injury etiology: SCI=251 **Intervention:** Assessment of pressure distribution for seven cushions. **Outcome Measures:** Seated pressure distribution.	No statistical results reported. 1. The air-filled cushion (ROHO which was 1 of 2 used) produced the greatest pressure reduction in 51% of the subjects. 2. A foam cushion (the stainless comfy hard cushion) was effective for only 18% of the subjects even though it was the second most frequently prescribed cushion. 3. More subjects with tetraplegia received the ROHOs than subjects with paraplegia (55% versus 45%) while more paraplegic subjects were prescribed the Jay cushion (a combination of foam and flotation materials (19% versus 7%).
Makhsous et al. 2007b USA Cohort N=60	**Population:** Mean age: 37 yr; Gender: males=45, females=15; Level of injury: paraplegia=20, tetraplegia=20, and able-bodied=20. **Intervention:** Two 1-hr protocols. 1) Alternative-sitting position was altered every 10 min between normal and WO-BPS (partially removed ischial support and lumbar support). 2) Normal-normal posture and push-ups every 20 min. **Outcome Measures:** XSensor pressure mapping system measuring Interface pressure measures of total contact area, average pressure and peak pressure on backrest and anterior middle and posterior sections of the seat.	1. Those with tetraplegia had a larger contact area at the anterior portion of the cushion, as compared to the other groups. 2. The mean pressure over the whole cushion was significantly different for each group ($p<0.001$). 3. Those with tetraplegia had the highest mean pressure during the WO-BPS posture, as compared to the other groups ($p<0.001$). 4. The contact area of the posterior portion of the cushion and the peak interface pressure decreased in all groups, with the largest decrease in those with tetraplegia for the latter. The mean pressure on the anterior and middle portions of the cushion increased in all groups.

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		5. At the posterior portion of the seat where ischial tuberosities are usually positioned, average pressure was higher for those with paraplegia (88.9 mmHg). 6. Average push up time was 49 sec for those with paraplegia.
Seymour & Lacefield 1985 USA Case Control N=20	**Population:** Age range: 16-35 yr; Weight range: 40.6-72.5 kg; Injury etiology: SCI=10, healty control=10. **Intervention:** Seven commercially available cushions and one experimental cushion were evaluated for each subject. **Outcome Measures:** Temperature and pressure effects for each cushion. Subjects were asked to rate each cushion as to cosmesis, handling and suitability for purchase.	1. Greatest pressure was seen under the soft tissue areas of most subjects; no significant differences between the cases and controls. 2. Temperatures were lowest for gel, water and air cushions and highest for alternating pressure and foam cushions. 3. SCI group - Greatest pressure under a bony area occurred most often with the Spenco cushion (90.10 mmHg); controls - it occurred most often with the Tri-pad (89.20 mmHg) indicating that these cushions did not compare favorably to others. 4. There was wide variability in pressure measurements in individual subjects (SD=12.21 mmHg). However, air filled (Bye Bye Decubiti) had the best pressure readings. 5. Cosmesis (83%) and handling (73%) were related to purchase decisions.
Vilchis-Aranguren et al. 2015 Mexico Pre-Post N=16	**Population:** Mean age: 31.8 yr; Gender: males=9, females=7. **Intervention:** Participants were administered a prototype wheelchair cushion designed to adjust the anthropometry of the user's ischio-gluteal area and prevent pressure ulcer formation. Participants were assessed at baseline and at 2 mo. **Outcome Measures:** Functional independence measure (FIM), Modified ashworth scale (MAS), Pressure distributions, Balance performance; Perceived satisfaction.	1. No significant differences were found between the previous cushion and after using the prototype cushion for: transfer capacity indicated by FIM scores ($p>0.05$); MAS scores ($p>0.05$). 2. Pressure distributions decreased significantly after using the prototype cushion ($p=0.012$). 3. There were no statistical differences in balance performance using the prototype cushion ($p>0.05$). 4. Participants reported higher perceived satisfaction with the prototype cushion in performing activities of daily living ($p=0.006$).
Hamanami et al. 2004 Japan Pre-Post N=36	**Population:** Mean age: 40.1 yr; Gender: males=28, females=8; Level of injury: paraplegia=36; Severity of injury: AIS A=35, B=1.	1. In all subjects, the highest pressure points were at the ischial areas. 2. The maximum surface pressure was related to the ratio of high concentration areas to seating

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	Intervention: ROHO High Profile multi-cell air cushion. **Outcome Measures:** Tekscan pressure measurement system measuring total seat surface area, maximum pressure and area of high concentration.	surface area at the point of minimum pressure (r=0.466, p=0.0042). 3. A significant relationship between point of minimum pressure and maximum interface pressure or body weight was not found. 4. The cushion air pressure was significantly related to body weight (r=0.495, p=0.0021).
Gilsdorf et al. 1991 USA Post-Test N=17	**Population:** *Paraplegia (N=6):* Mean weight: 83 kg; *Tetraplegia (N=5):* Mean weight: 66 kg; *Able-bodied controls (N=6):* Mean weight: 76 kg. **Intervention:** 30 min sitting intervals, on different surfaces [Jay cushion; ROHO cushion; hard surface (controls only)] in a wheelchair that had a force plate attached to it. **Outcome Measures:** Normal and shear seating forces; Armrest forces; Centre of mass location.	1. On Jay cushion, those with tetraplegia had higher amplitude lateral movements and those with paraplegia had more lateral zero-crossings, when compared to ROHO cushion. 2. Larger arm force variation was found among those with paraplegia. 3. On the ROHO cushion, all subjects had larger normal and shear forces and an anterior centre of mass. 4. Those with paraplegia had more variation, while those with tetraplegia had less, on static force factors between cushion types. 5. SCI groups had higher force measurements than control group. 6. Armrest forces applied by those with paraplegia were larger than those applied by those with tetraplegia (8-9% versus 5%, p<0.11).
Trewartha & Stiller 2011 Australia Case Series N=3	**Population:** Age range: 27-48 yr; Gender: males=3, females=0; Injury etiology: traumatic SCI=3; Level of injury: paraplegia=1, tetraplegia=2; Mean time since injury: 7.0 mo. **Intervention:** Xsensor pressure mapping system used to measure interface pressure of two cushions (Roho Quadtro Select HP versus Vicair Academy Adjuster) in two phases (both mapped daily x7 days and 3x/d for an additional 3 d with the cushion that demonstrated the lowest pressure in phase 1). **Outcome Measures:** Number of cells with pressure >100 mmHg, and 60-99 mmHg, compared between the two cushions.	1. The number of cells with pressure >100 mmHg was consistently lower on the Roho Quadtro Select HP cushion compared to the Vicair Academy Adjuster cushion (p<0.001; 95% confidence interval 1.86 Vicair, 5.58 for Roho). 2. There was variability across participants in the number of cells within the 60-99 mmHg range for each cushion type (no significant difference between the cushions; p=0.32).
Takechi & Tokuhiro 1998 Japan Case Series	**Population:** Age range:18-48 yr; Gender: males=6, females=0; Level of	1. If the area of contact was more widespread, the peak pressure was found to be lower.

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N=6	injury: paraplegia=6; Severity of injury: complete=6. **Intervention:** Five different cushions (air cushion, contour cushion, polyurethane foam cushion, Cubicushion, silicone gel cushion). **Outcome Measures:** Tekscan BigMat pressure mapping system measuring peak pressures and area of total contact.	2. The air cushion had the largest area of pressure distribution and the lowest peak pressure (257-87g/cm^2). The silicone cushion had the second lowest (292-129g/cm^2) peak pressure.
Effects of different sitting surface loading on blood flow and tissue displacement		
Sonenblum & Sprigle. 2018b USA Pre-Post $N_{initial}$=34 $N_{initial}$=28	**Population:** Age range= 18-40 yr; Gender: males=28, females=0; Level of injury: N/R; Time since injury >2 yr. **Intervention:** The seated buttock was unloaded, and loaded at lower (40–60 mmHg) and high (>200 mmHg) loads. **Outcome Measures:** Blood flow at the ischial tuberosity; tissue compliance using the Myotonometer measuring buttock tissue displacement at ischial tuberosity and ratio of displacment; risk factors of level fo injury, body mass index, blood pressure, smoking status, hematocrit, serum albumin, and lymphopenia.	1. Tissue compliance varied widely with on BMI being related to the amount of buttock tissue displacement (beta=0.229, 95% CI [0.106, 0.492) 2. Ratio of displacement was associated with the smoking staus risk factor only (beta=0.070, 95% CI [0,018, 0.122] 3. Blood flow was significantly reduced at high loads ($p<0.05$), while no significant changes were found at lower loads ($p>0.05$). 4. Blood lfow at lower loads differed according to having a history of pressure injuries, with those no history having a greater blood flow (mean(SD) – 1.5(0.7), p=0.006, 95%CI for difference =[0.2, 1.2]