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**\*Key Words:**

Stroke, Orthotic devices, Upper limb static orthosis, Lower limb static orthosis, QUEST, MIRAD ACCORT II.

**Barriers to Acceptance and Satisfaction of Static Orthosis among stroke patients A Descriptive Study**

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**Abstract**

**Introduction:** Stroke has been stated as the other leading cause of death and ranked as the third leading source of disability. The WHO explained stroke as “rapidly developed clinical signs of focal disturbance of cerebral function, lasting further than 24 hours or leading to death, with no apparent cause other than of vascular origin.” To treat stroke the intravenous thrombolytic program was found to be effective. Orthotics can be used to treat cases with CNS conditions that are custom-made and prefabricated with variable cost.

**Aim:** To find the barriers to acceptance and satisfaction of static orthosis in patients suffering from stroke living in Bangalore.

**Method:** 210 stroke cases of age between 40-65 years of age were included in the study. The baseline data including demographic data and stroke assessment was recorded. Questionnaire QUEST version 2.0 and MIRAD-ACCORT II were administered by the Physiotherapist.

**Result:** In general, patients were satisfied with their orthotic devices of both the upper and lower limb. One-fifth of the patients consider visual aspects and the used material as a barrier to satisfaction whereas one-third of the population was not satisfied with the ability to hide.

**Conclusion:** Maximum number of patients were satisfied with their static orthotic devices of both the upper limb and lower limb. Pain and discomfort and being viewed as disabled by others were the major barriers to the acceptance of orthotic devices.

**Introduction**

Stroke has been stated as the leading cause of death and disability ranked as second and third respectively(1). Low and middle-income countries are substantially affected and a majority of the population belongs to these countries(2). Half of the population that survived stroke are facing serious disabilities and as a result, stroke has become the leading cause of morbidity(3). The World Health Organization refers to stroke as the incoming epidemic of the 21st century(4). Life expectancy has increased to 60 years of age in India (5-7) thus as a result age-related disease, and non-communicable disease is increasing ranking stroke at 4th position in the case of death and disability at 5th position(5)

The World Health Organization explained stroke as “rapidly developed clinical signs of focal (or global) disturbance of cerebral function, lasting further than 24 hours or leading to death, with no apparent cause other than of vascular origin.”(8,9)

Stroke can be classified into 2 types that are ischemic, which occurs due to a lack of blood flow substantially due to clots in blood vessels, or haemorrhagic, due to bleeding(13,14). Ischaemic stroke can be defined as “an episode of

neurological dysfunction caused by focal cerebral, spinal, or retinal infarction with symptoms persisting for further than 24 hours”, whereas a transient ischaemic attack is defined as a “transient episode of neurological dysfunction caused by focal brain, spinal cord or retinal ischemia without acute infarction”(1,13,15). TIAs are generally appertained to mini-strokes with symptoms being transient (i.e. lasting from minutes to hours but lower than 24 hours)(13,14).

Haemorrhagic stroke can be of 2 types: Subarachnoid Haemorrhage and Intracerebral Haemorrhage (ICH). SAH is caused by the “rupture of a cerebral blood vessel, aneurysm or vascular malformation into the subarachnoid space, the space girding the brain where blood vessels lie between the arachnoid and pia mater” (as shown in figure 2)(13).

A stroke resulting from ICH is defined as “rapidly developing clinical signs of neurological dysfunction attributable to a focal collection of blood within the brain parenchyma or ventricular system that is not caused by trauma”(10,13). When a weakened blood vessel within the brain bursts, it leads to leakage of blood which further results in increased intracranial pressure causing damage to the girding cells(13,16).

87 % of strokes are classified as ischemic(17).

To treat stroke the intravenous thrombolytic program was found to be effective. The aim of the drug was to increase fibrinolysin formation, therefore enhancing the dissolution of a clot leading to cerebral vessel blockage. A drug used in this program helps to reduce clot diameter within 3 hours of stroke incidence whereas Intra – arterial thrombolysis can be considered as another option to treat stroke. Certain exercises can be recommended for cases with mild to moderate stroke. Specified exercises are general aerobic exercises with frequency ranging from 3 to 5 days per week whereas duration ranges from 20 to 40 minutes and if patients are not able to achieve the goal of exercise in a single bout, the duration can be maintained through multiple 10 minutes bouts. Apart from that, advanced exercises can also be used. This frequency ranges from 5 to 7 days per week with a duration of 60 minutes. Different types of orthotics can be used to treat cases with CNS conditions that are both custom-made and prefabricated, of variable cost(22). Various orthosis such as posterior leaf spring, Swedish knee cage, and knee ankle foot orthosis can be used in case of stroke(23).

An orthosis is defined as an “externally applied device which can help neuromuscular and skeletal systems by modifying their functional and structural characteristics(24,25).” Not only immobilization, support, correction, or protection is provided by the orthosis but for musculoskeletal injuries or dysfunctions also they are largely in demand(26). Spinal orthosis gives support and helps to

incapacitate the spine whereas limb orthosis can be used in various conditions such as in case of fractures, injuries, or peripheral nerve injuries. They provide support, immobilize, or stabilize joints or skeletal parts which are weak, misshaped, or injured. AFOs are currently the type of orthosis that qualified orthotists in the United States most regularly prescribe, making up 26% of clinical practice—twice as much as any other type of orthosis(31).

Patient evaluation, ease of adjustment, and device modification are all parts of orthotic care. Orthotic devices are thought of as a crucial component of rehabilitation. These devices are used to help patients with movement impairments, deformities, contractures, and instability, which are most common in neurological patients (such as those with multiple sclerosis (MS), spinal cord injuries, strokes, Guillain-Barré syndrome, and cerebral palsy), as well as those with musculoskeletal disorders and orthopaedic injuries. The use of devices encourages the patients to engage in social environments or other activities. There are various studies that are focused on their uses, and effects. During the rehabilitation phase, it is necessary to teach the correct use of the device and it is directly proportional to the acceptance and satisfaction of the orthotic device. A number of studies which are related to the acceptance of orthosis in different cases have been done in different countries. But that data among the Indian population is not there, following can be reasons for same- psychological status, secondary & tertiary care support, family burden, nuclear family, and architectural barrier such as residence/ homes are major hindrances to functional independence of patients with impairments and supportive orthotic use, cosmetic reason, social stigma. These limitations/ hindrances sometime may cause limitations of use. Adding to the best of our knowledge, we could not retrieve studies conducted in India to find out the barriers to acceptance and satisfaction of static upper limb orthosis and lower limb orthosis in the patient suffering from a stroke. This study provides the barrier to the acceptance and satisfaction of static orthotic devices.

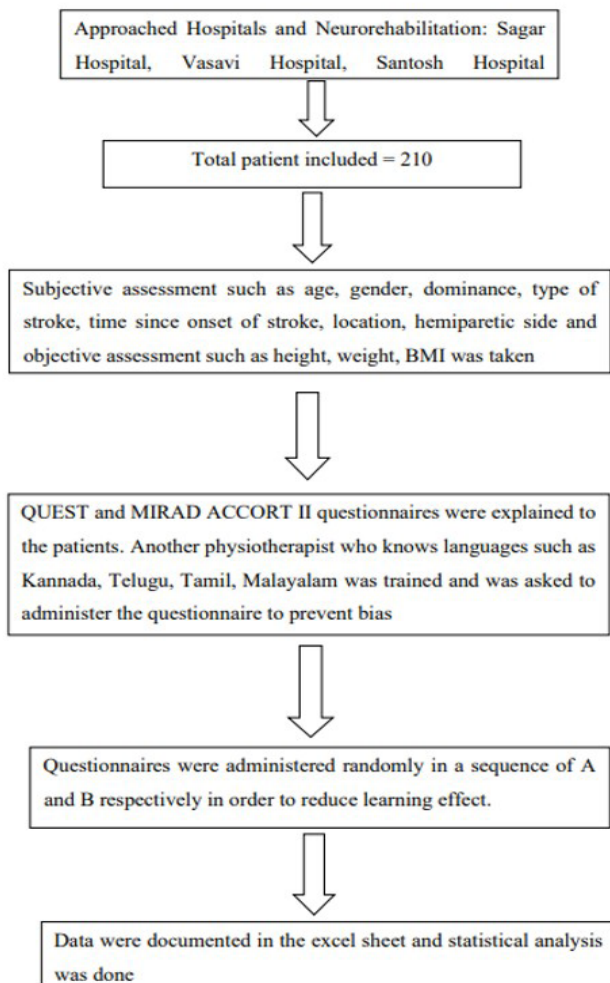
## Methodology

The Sample size (N) was calculated to be 210 at a 95% confidence interval (CI), using the formula  $Z\alpha/2pq/d^2$ . Considering the need to study stroke patients who fulfill the inclusion criteria were included after the ethical clearance; the purpose and procedure of the study were explained to them. Informed consent was taken from the participants. At the beginning of the study, demographic details such as age, gender, height, weight, dominance, time since onset, type of stroke, hemiparetic side, socioeconomic background, who prescribed the orthosis, and duration of wearing orthosis were recorded. Questionnaire QUEST version 2.0 and MIRAD-ACCORT II were administered by the

physiotherapist. The questionnaire's goal was to determine how satisfied a person is with an assistive device, whereas the MIRAD-ACCORT II questionnaire was designed to measure reasons for acceptance of orthotic devices. It has five parts: part 1 asks about opinions about orthotic devices, part 2 lists the advantages and disadvantages of orthotic devices, part 3 lists the most crucial aspect of orthotic devices, part 4 includes the reasons not to use orthotic devices, and Part 5 consist of what they want to change. Statistics tools were used to capture and analyze responses.

### Data Analysis:

The data so collected from the research were entered into Excel sheets and systematically compiled. Required descriptive tables, diagrams, and graphs were generated. The data on Excel sheets were imported to SPSS software (version 22). Descriptive statistics were performed to find the mean and SD of demographic variables such as age, gender, BMI, dominance, hemiparetic side, type of stroke, QUEST, and MIRAD ACCORT II. Comparison of males and females with mean QUEST, opinion about Orthotic Device and Reasons not to use Orthotic Device anymore



**Figure 1:** Flowchart: Methodology

**Table 1:** QUEST question-wise response

Quest questions	No of patients	% Of patients
<b>How satisfied are you with the dimensions (size, height, length, width) of your assistive device?</b>		
Not satisfied at all	16	7.66
Not very satisfied	37	17.70
More or less satisfied	68	32.54
Quite satisfied	60	28.71
Very satisfied	29	13.80
<b>How satisfied are you with the weight of your assistive device?</b>		
Not satisfied at all	17	8.13
Not very satisfied	39	18.66
More or less satisfied	58	27.75
Quite satisfied	64	30.62
Very satisfied	31	14.83
<b>How satisfied are you with the ease in adjusting (fixing, fastening) the parts of your assistive device?</b>		
Not satisfied at all	23	11.00
Not very satisfied	40	19.14
More or less satisfied	57	27.27
Quite satisfied	64	30.62
Very satisfied	25	11.96
<b>How safe and secure your assistive device is?</b>		
Not satisfied at all	36	17.22
Not very satisfied	12	5.74
More or less satisfied	59	28.23
Quite satisfied	70	33.49
Very satisfied	32	15.31
<b>How satisfied are you with the durability (endurance, resistance to wear) of your assistive device?</b>		
Not satisfied at all	19	9.09
Not very satisfied	17	8.13
More or less satisfied	53	25.36
Quite satisfied	91	43.54
Very satisfied	29	13.88
<b>How easy it is to use your assistive device?</b>		
Not satisfied at all	26	12.44
Not very satisfied	25	11.96
More or less satisfied	62	29.67
Quite satisfied	68	32.54
Very satisfied	28	13.40
<b>How comfortable your assistive device is?</b>		
Not satisfied at all	25	11.96
Not very satisfied	45	21.53
More or less satisfied	49	23.44
Quite satisfied	59	28.23
Very satisfied	31	14.83
<b>How effective your assistive device is (the degree to which your device meets your needs)?</b>		
Not satisfied at all	16	7.66
Not very satisfied	36	17.22
More or less satisfied	60	28.71
Quite satisfied	55	26.32
Very satisfied	42	20.10
<b>How satisfied are you with the service delivery program (procedures, length of time) in which you obtained your assistive device?</b>		
Not satisfied at all	34	16.27
Not very satisfied	28	13.40
More or less satisfied	88	42.11
Quite satisfied	44	21.05
Very satisfied	15	7.18

How satisfied are you with the repairs and servicing (maintenance) provided for your assistive device?		
Not satisfied at all	26	12.44
Not very satisfied	37	17.70
More or less satisfied	95	<b>45.45</b>
Quite satisfied	43	20.57
Very satisfied	8	<b>3.83</b>
How satisfied are you with the quality of the professional services (information, attention) you received for using assistive device?		
Not satisfied at all	28	13.40
Not very satisfied	24	11.48
More or less satisfied	103	<b>49.28</b>
Quite satisfied	43	20.57
Very satisfied	11	<b>5.26</b>
How satisfied are you with the follow-up services (continuing support services) received for your assistive device?		
Not satisfied at all	28	<b>13.40</b>
Not very satisfied	31	14.83
More or less satisfied	101	48.33
Quite satisfied	41	19.62
Very satisfied	8	<b>3.83</b>
Total	210	100.00

**Table 2: Part 1: Patient's opinion about Orthotic Device question wise responses of patients**

MIRAD questions	No of patients	% of patients
<b>Visual Aspects</b>		
Not good/Not bad	135	<b>64.59</b>
Very bad	43	20.57
Very good	31	<b>14.83</b>
<b>Used Material</b>		
Not good/ Not bad	135	<b>64.59</b>
Very bad	36	<b>17.22</b>
Very good	38	18.18
<b>Ability to Hide</b>		
Not good/ Not bad	113	<b>54.07</b>
Very bad	72	34.45
Very good	24	<b>11.48</b>
<b>Affordability</b>		
Not good/ Not bad	128	<b>61.24</b>
Very bad	27	<b>12.92</b>
Very good	54	25.84
<b>Ease of Use</b>		
Not good/Not bad	91	<b>43.54</b>
Very bad	47	<b>22.49</b>
Very good	71	33.97
<b>Comfort</b>		
Not good/ Not bad	78	<b>37.32</b>
Very bad	55	<b>26.32</b>
Very good	76	36.36
<b>Firmness</b>		
Not good/Not bad	90	<b>43.06</b>
Very bad	43	<b>20.57</b>
Very good	76	36.36
<b>Functionality</b>		
Not good/Not bad	87	<b>41.63</b>
Very bad	35	<b>16.75</b>
Very good	87	41.63
Total	210	100.00

scores by independent t-test, comparison of Type of stroke (Haemorrhagic and Ischemic) with mean QUEST, opinion about Orthotic Device and Reasons not to use Orthotic Device anymore scores by independent t-test and correlation between QUEST, opinion about Orthotic Device and Reasons not to use Orthotic Device any more scores by Karl Pearson's correlation method.

**Table 3: Part 2: Advantages and Disadvantages of Orthotic Devices wise responses of respondents**

ADVANTAGES	No of patients	% of patients
Maintain Position	40	19.04
Easy to maintain	4	1.9
Easy to use	16	7.6
Able to do required movements	3	1.42
Maintain stability	10	4.76
Improve function	16	7.6
Maintain Stability	12	5.7
Prevent deformity	15	7.14
Prevent unwanted movement	10	4.76
Protects the area	3	1.42
Provide support	13	6.19
Secure	2	0.95
Help in movement	2	0.95
Help to reduce tightness	2	0.95
Nothing	24	11.42
Not answered this component	38	18.09
Total	210	100

DISADVANTAGES	No of patients	% of patients
Looks disabled	69	32.8
Swelling	34	16.19
Pain	22	10.4
Redness	32	15.2
Expensive	16	7.61
Can't wear for long time	3	1.42
Hard material	3	1.42
Doesn't improve function	4	1.90
Instability	3	1.42
Total	210	100

**Table 4: Part 3 and 4: Most Important aspect related to Orthotic Devices and Reasons not to use Orthotic Devices any more question-wise responses of patients.**

P3: Imp Aspect	No of patients	% of patients
Affordability	13	6.22
Appearance	6	2.87
Comfort	22	10.53
Convenient & Helpful	9	4.31
Durability	9	4.31
Effectiveness	1	0.48
Firmness	13	6.22
<b>Functionality</b>	<b>44</b>	<b>21.05</b>
Nothing	8	3.83
Positioning	32	15.31
Protection	10	4.78
Stability	39	18.66
Support	3	1.44
Total	210	100.00
MIRAD questions	No of patients	% of patients
<b>Ugly Look</b>		
No	143	68.42
Yes	66	31.58
<b>Function does not improve</b>		
No	170	81.34
Yes	39	18.66
<b>Difficult to put on/off</b>		
No	99	47.37
Yes	110	52.63
<b>Pain and Discomfort</b>		
No	69	33.01
Yes	140	66.99
<b>Feeling of being disabled</b>		
No	87	41.63
Yes	122	58.37
<b>Viewed as disabled by others</b>		
No	52	24.88
Yes	157	75.12
Total	210	100.00

**Table 5: Part 5: What would you change**

MIRAD questions	No. of patients	% of patients
Appearance	8	3.8%
Material	20	9.5%
Design	17	8.09%
Less expensive	6	2.8%
More Comfortable	29	13.8%
Easy to put on/off	16	7.6%
Firmness	4	1.9%
Natural looking	20	9.5%
Quality of device	6	2.8%
Reduce hours of usage	13	6.19%
Shape of device	3	1.4%
Less painful	13	6.19%
Nothing	59	28%
Total	210	100

## Results

This study included 210 stroke populations who were using static orthosis including upper limb and lower limb orthosis. The baseline characteristics of subjects are as follows. Table 1 mentions the total number and percentage of patients with stroke on the basis of age, gender, BMI, dominance, hemiparetic side, type of stroke, and risk factors. Hypertension (67.4%) served as the leading comorbidity among patients having a stroke followed by Diabetes mellitus which is serving as the second leading comorbidity among stroke patients. Some of the studies related to the risk factors of stroke proved that the most prevalent risk factor of stroke is hypertension. This study also claimed that by the year 2030, 3.88% of the population (US adults >18 years) will have had a stroke with an increase in predominance from 2012 that is by 20.5%(42).

Table 5 shows that 28% of patients don't want to change anything. 13.8% want to make the device more comfortable. Only 1.4% of patients want to change to the shape of the device.

## Discussion

Burdens like transmittable and non-transmittable conditions are faced by developing countries and India is one of them. Whether the condition is minimal or extreme its prevalence on the base of gender, age area, and so on changes every time. The objective of the study was diploid. Primarily, to see the satisfaction of static orthosis among patients having a stroke. Second, to find the barriers to acceptance of orthosis among stroke patients.

Satisfaction and acceptance are vast concepts and can be affected by external factors and internal factors. These factors include the type of disorder, deformity, involvement of the limb, amount of time the orthotic device is worn, and so on. According to this study, patients were most satisfied with the following features: "safety," "durability," and "comfort." Patients were more or less satisfied with

the aspects of 'repairs and servicing', 'delivery services', 'professional services', and 'follow-up services' (Table 3, Figures 3 and 4). Some published studies showed analogous results whereas other studies such as Boer et al and Magnusson et al reported that patients were highly satisfied with repair and services, and durability whereas they were least satisfied with comfort, dimension, and weight of the devices(40,43).

A developed questionnaire, MIRAD ACCORT II was taken in order to probe the factors which are acting as barriers in the acceptance of orthotic devices. This constructed questionnaire is divided into 5 components. Results showed that in part 1 of the questionnaire, advanced chances of the patient's opinion about the device was not good/not bad whereas in visual aspects, used material and ability to hide components case opinion was by very bad followed by not good/not bad. Adding further, ease of use, comfort, firmness, and functionality have a higher percentage of not good/not bad followed by very good (Table 4).

Part 2 results showed that maintenance of the position was one of the main advantages whereas less number of patients consider safety and cosmetic as an advantage. On the other hand, pain, swelling, and redness were considered the major disadvantage of the orthotic devices (table 5,6).

In section 3, it was said that the stability and functionality of the orthotic device were more crucial than its appearance, effectiveness, and support (Table 7). In the recent study of Bulley et al(44). the appearance of the orthotic device was considered the main criticism among multiple sclerosis patients whereas another study by Swinnen et al. showed that functionality was more important than other factors(29).

Viewed as disabled, pain and discomfort, the feeling of being disabled, and difficulty to put on/off were considered to be the main reasons for not using the orthotic device with the percentage of 75.12%, 66.99%, 58.37%, and 52.63% respectively (Table 8). Besides from that function does not improve was not considered as a reason for not using the device anymore. Some of the studies that are Boer et al and Philipsen et al show comparable results with regard to pain which means the main reason for discontinuing the device was pain and discomfort(29,43,45).

28% of patients don't want to change anything whereas 13.8% of patients want the device to be more comfortable followed by a change in material and more natural looking (9.5%). Change in design, ease to put on/off, reduce hours of usage, less pain, quality of device, less expensive, firmness, and shape of the device were the other components that patients would like to change in the orthotic device in part 5(Table 9).

## Conclusion

Most patients reported being happy with their upper limb and lower limb static orthotic devices. A third of the population was not content with the "ability to hide," while one-fifth of patients cited "visual features" and "used material" as barriers to satisfaction. Additionally, "pain and discomfort" and "being perceived as disabled by others" were the main barriers to the acceptance of orthotic devices, according to research.

## Limitations

The study is limited to the heterogeneity of age of samples with a large range from 40-65 years could have an impact on the outcome. Data were not analyzed for the barriers to acceptance and satisfaction of static orthotic devices separately among individuals who are using upper extremity devices or lower extremity devices as the impairments and functional limitations differ among them.

The majority of the orthotic devices used by the population were ankle foot orthosis and cock-up splint and less population was available for other orthotic devices.

**Conflict of Interest:** There was no conflict of interest in this study.

**Ethical Clearance:** Ethical clearance was obtained from the Ethical committee of Dayananda Sagar College of Physiotherapy, DSU, Bangalore, as per the ethical guidelines for Biomedical Research on Human Subjects, 2000 ICMR, New Delhi.

## References

1. Donkor ES. Stroke in the 21st Century: A Snapshot of the Burden, Epidemiology, and Quality of Life. Vol. 2018, Stroke Research and Treatment. Hindawi Limited; 2018.
2. Feigin VL, Stark BA, Johnson CO, Roth GA, Bisignano C, Abady GG, et al. Global, regional, and national burden of stroke and its risk factors, 1990–2019: a systematic analysis for the Global Burden of Disease Study 2019. *The Lancet Neurology* [Internet]. 2021 Oct;20(10):795–820. Available from: <https://linkinghub.elsevier.com/retrieve/pii/S1474442221002520>.
3. Kannan V, Justin C, Prashanth PRS, Alexander N. Clinical prevalence of stroke in a tertiary care hospital in Southern India. *International Journal of Research in Medical Sciences*. 2021 Feb 25;9(3):838.
4. Sarikaya H, Ferro J, Arnold M. Stroke prevention - Medical and lifestyle measures. *European Neurology*. 2015 Apr 25;73(3–4):150–7.
5. Pandian JD, Panagos PD, Sebastian IA, Sampaio Silva G, Furie KL, Liu L, et al. Maintaining stroke care during the COVID-19 pandemic in lower- and middle-income countries: World Stroke Organization Position Statement endorsed by American Stroke Association and American Heart Association. Vol. 17, *International Journal of Stroke*. SAGE Publications Inc.; 2022. p. 9–17.
6. Horton R, Das P. Indian health: the path from crisis to progress. 2011; Available from: <http://www.ophi.org.uk/wp-> A Y, Sulaja S. Old Age Mortality in India ?An Exploration from Life Expectancy at Age 60. *International Journal of Asian Social Science*. 2016;6(12):698–704.
7. Coupland AP, Thapar A, Qureshi MI, Jenkins H, Davies AH. The definition of stroke. *J R Soc Med*. 2017 Jan 1;110(1):9–12.
8. Aho K, Harmsen P, Hatano S, Marquardsen J, Smirnov VE, Strasser & T. Cerebrovascular disease in the community: results of a WHO Collaborative Study\*. Vol. 58, *Bulletin of the World Health Organization*. 1980.
9. Sacco RL, Kasner SE, Broderick JP, Caplan LR, Connors JJ, Culebras A, et al. An updated definition of stroke for the 21st century: A statement for healthcare professionals from the American heart association/American stroke association. *Stroke*. 2013;44(7):2064–89.
10. Caplan LR. *Caplan's stroke : a clinical approach*. Elsevier/Saunders; 2009. 656 p. Ashrafian H. Familial stroke 2700 years ago. Vol. 41, *Stroke*. 2010.
11. Parmar P. Stroke: Classification and diagnosis. *Clinical Pharmacist*. 2018 Jan 1;10(1). State of the nation Stroke statistics. 2017.
12. Easton JD, Saver JL, Albers GW, Alberts MJ, Chaturvedi S, Feldmann E, et al. Definition and evaluation of transient ischemic attack: A scientific statement for healthcare professionals from the American heart association/American stroke association stroke council; council on cardiovascular surgery and anesthesia; council on cardiovascular radiology and intervention; council on cardiovascular nursing; and the interdisciplinary council on peripheral vascular disease. Vol. 40, *Stroke*. 2009. p. 2276–93.
13. Elliott J, Smith M. The acute management of intracerebral hemorrhage: A clinical review. Vol. 110, *Anesthesia and Analgesia*. Lippincott Williams and Wilkins; 2010. p. 1419–27.
14. Koh SH, Park HH. Neurogenesis in Stroke Recovery. *Transl Stroke Res*. 2017;8:3–13.
15. T Ojha P, Basak S, Aglave V, Yadav J. Incidence of stroke in adults according to age, sex and subtypes in urban Indian population. *Neurology and Neuroscience Reports*. 2020;3(1).
16. Kasper D, Fauci A, Hauser S, Longo D, Jameson JL, Loscalzo J. *Cerebrovascular Diseases*. In: *Harrison's Principles of Internal Medicine*. 17th ed. Anthony S. Fauci, Eugene Braunwald, Dennis L. Kasper, Stephen L. Hauser, Dan L. Longo, J. Larry Jameson, et al., editors. New York; 2015.
17. Kuriakose D, Xiao Z. Pathophysiology and treatment of stroke: Present status and future perspectives. Vol. 21, *International Journal of Molecular Sciences*. MDPI AG; 2020. p. 1–24.
18. Kim Y, Lai B, Mehta T, Thirumalai M, Padalabalanarayanan S, Rimmer JH, et al. Exercise Training Guidelines for Multiple Sclerosis, Stroke, and Parkinson Disease: Rapid Review and Synthesis. Vol. 98, *American Journal of Physical Medicine and Rehabilitation*. Lippincott Williams and Wilkins; 2019. p. 613–21.
19. O'Connor J, McCaughan D, McDaid C, Booth A, Fayter D, Rodriguez-Lopez R, et al. Orthotic management of instability of the knee related to neuromuscular and central nervous system disorders: Systematic review, qualitative study, survey and costing analysis. Vol. 20, *Health Technology Assessment*. NIHR Journals Library; 2016. p. 1–296.
20. *Physical Rehabilitation*. Fisk JR, DeMuth S, Campbell J, DiBello T, Esquenazi A, Lin RS, et al. Suggested guidelines for the prescription of orthotic services, device delivery, education, and follow-up care: A multidisciplinary white paper. *Military Medicine*. 2016 Feb 1;181(2):11–7.
21. Condie DN. *AAOS Atlas of Orthoses and Assistive Devices*. 4th ed. Hsu JD, Michael JW, Fisk JR, editors. Philadelphia; 2008. 3–7 p.
22. Barrios-Muriel J, Romero-Sánchez F, Alonso-Sánchez FJ, Salgado DR. Advances in orthotic and prosthetic manufacturing: A technology review. *Materials*. 2020 Jan 1;13(2).
23. Wong MS, Beygi BH, Zheng Y. Materials for exoskeletal orthotic and prosthetic systems. In: *Encyclopedia of Biomedical Engineering*. Elsevier; 2019. p. 352–67.
24. Tyson SF, Kent RM. Orthotic devices after stroke and other non-

- progressive brain lesions. *Cochrane Database of Systematic Reviews*. 2009 Jul 8;
25. Swinnen E, Lafosse C, van Nieuwenhoven J, Ilsbrouckx S, Beckwée D, Kerckhofs E. Neurological patients and their lower limb orthotics: An observational pilot study about acceptance and satisfaction. *Prosthetics and Orthotics International*. 2017 Feb 1;41(1):41–50.
  26. The role of the orthotist in the management of stroke Providing ankle-foot orthoses to improve walking and balance in stroke survivors [Internet]. 2016. Available from: [www.aopa.org.au](http://www.aopa.org.au)
  27. Whiteside SR, Allen MJ, Barringer WJ. Practice analysis of certified practitioners in the disciplines of orthotics and prosthetics. *American Board for Certification in Orthotics and Prosthetics*. 2007;
  28. Condie E, Campbell J, Martina J. Report of a Consensus Conference on the Orthotic Management of Stroke Patients. 1st ed. Condie E, editor. Copenhagen; 2004.
  29. M Nadler, Mmh Pauls. Shoulder orthoses for the prevention and reduction of hemiplegic shoulder pain and subluxation: systematic review. *Clinical Rehabilitation*. 2017 Apr;31(4):444–53.
  30. Maeshima S, Okamoto S, Okazaki H, Hiraoka S, Funahashi R, Yagihashi K, et al. Lower Limb Orthotic Therapy for Stroke Patients in a Rehabilitation Hospital and Walking Ability at Discharge. *International Journal of Physical Therapy & Rehabilitation*. 2017 Jul 28;3(2).
  31. Bettoni E, Ferriero G, Bakhsh H, Bravini E, Massazza G, Franchignoni F. A systematic review of questionnaires to assess patient satisfaction with limb orthoses. Vol. 40, *Prosthetics and Orthotics International*. SAGE Publications Inc.; 2016. p. 158–69.
  32. Peaco A, Halsne E, Hafner BJ. Assessing satisfaction with orthotic devices and services: A systematic literature review. Vol. 23, *Journal of Prosthetics and Orthotics*. 2011. p. 95–105.
  33. Swinnen E, Lefeber N, Werbrouck A, Gesthuizen Y, Ceulemans L, Christiaens S, et al. Male and Female Opinions About Orthotic Devices of the Lower Limb: A Multicentre, Observational Study in Patients with Central Neurological Movement Disorders. *Neuro Rehabilitation*. 2018;42(1):121–30.
  34. Eva Swinnen, Lisa Cuelemans, Yelena Gesthuizen, Sofie Christiaens, Lise De Wael, Nina Lefeber, et al. Orthotic devices of the lower limb in multiple sclerosis and stroke patients: inquiring acceptance and satisfaction. In: 3rd european congress on neurorehabilitation 2015. Vienna; 2015. p. 41.
  35. Demers L, Monette M, Lapierre Y, Arnold DL, Wolfson C. Reliability, validity, and applicability of the Quebec User Evaluation of Satisfaction with assistive Technology (QUEST 2.0) for adults with multiple sclerosis. *Disabil Rehabil*. 2002;21–30.
  36. Magnusson L, Ramstrand N, Fransson EI, Ahlström G. Mobility and satisfaction with lower-limb prostheses and orthoses among users in Sierra Leone: A cross-sectional study. *Journal of Rehabilitation Medicine*. 2014;46(5):438–46.
  37. Pandian JD, Sudhan P. Stroke Epidemiology and Stroke Care Services in India. *Journal of Stroke*. 2013;15(3):128.
  38. Boehme AK, Esenwa C, Elkind MSV. Stroke Risk Factors, Genetics, and Prevention. Vol. 120, *Circulation Research*. Lippincott Williams and Wilkins; 2017. p. 472–95.
  39. de Boer IG, Peeters AJ, Runday HK, Mertens BJA, Huizinga TWJ, Vliet Vlieland TPM. Assistive devices: Usage in patients with rheumatoid arthritis. *Clinical Rheumatology*. 2009;28(2):119–28.
  40. Bulley C, Mercer TH, Hooper JE, Cowan P, Scott S, van der Linden ML. Experiences of functional electrical stimulation (FES) and ankle foot orthoses (AFOs) for foot-drop in people with multiple sclerosis. *Disability and Rehabilitation: Assistive Technology*. 2015 Nov 2;10(6):458–67.
  41. Philipsen AB, Ellitsgaard N, Krogsgaard MR, Sonne-Holm S. Patient compliance and effect of orthopaedic shoes. Vol. 23,