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A study on changes in weight and body mass index of patients post below knee amputation secondary to diabetes

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Abstract

Introduction: The number of people with lower-limb amputations (LLA) is expected to double by the year 2050, largely because of vascular disease associated with an aging population and increased incidence of diabetes and heart disease. The change in weight pattern will help us in designing linear spring based osseointegrated prosthetics for people living in hilly areas with amputation who living in hilly terrain.

Methodology: N were selected for the study. We used weights and heights obtained during inpatient and outpatient clinical encounters. N going under transtibial amputation were selected and the patients were categorized under two groups Type-1 and Type -2 diabetes. Height and B.M.I. was taken from the case record form at the time of entry of a patient in the general surgery department. Percent weight change, calculated as the difference between weight at time x and weight at baseline, divided by baseline weight x 100, was the primary outcome of interest.

Results: Among 20 patients selected for the study (n=100). Out of which 6 patients were Type-1 diabetic and the rest 14 were type two diabetic. The height of twenty patients ranged from 154cm-174cm. with a mean height of 163.8cm. As expected based on our matching, the distribution of ages, BMI, reference years, and presence of a diabetes: 65 percent of individuals were between the ages of 25 and 74 yr, 73 percent had diabetes, and nine patient were overweight (range 25.5-29.9) where rest eleven patients were obese, out of which nine have B.M.I. 30-35 and rest two were above 35.1.The difference in change in weight between type one and type two patient were noted. Type one patient showed mean weight increase of 5055gm, where as type two diabetic showed an increase of 4894gm within the span of three months.

Keywords: Transtibial Amputation; Weight; Body Mass Index; Prosthetic Placement; Amputations; Below Knee

1. Introduction

World wide there are more than one million amputations every year. With upto 70% of these amputation related to diabetes. A study conducted on the prevalence and incidence statistic in general for amputation in various countries showed that USA, about 293,655,405 population estimated for this study and the extrapolated prevalence of amputation is 2,055,587. but in Britain the estimated population was 60,270,708 and the prevalence rate was 421,879. In India the rate was 1,065,00,607 and 7,455494 respectively.[3] Lower-limb amputation is prevalent in India and America, with approximately 1,027,000 people in the United States living with lower-limb amputation in 2005. Of all this population, more than half (n=623,000) had major lower-limb loss (excluding the toes). The number of people with lower-limb amputations is expected to double by the year 2050, largely because of vascular disease associated with an aging population and increased incidence of diabetes and heart disease[1][2] .People with amputations need further prosthetic services throughout their lifetime and are likely to receive a new prosthetic limb, on average, once every 1 to 2 years and they will see their prosthetist between 4 and 9 times per year[3][4] .Changes in body composition as a result of weight gain or loss, fluid retention, and age necessitate frequent adaptation of the prosthetic limb. There are 2 main

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types of prosthetic limbs: battery powered and electric limbs. The disadvantage of a battery powered limb, when compared to an electric limb, it has a more mechanical appearance. The battery powered limbs have diificulty in learning curve, since they require the input of more physical strength. The electric limbs are more heavier, and they have high maintaienance and more costly compared to the battery powered limbs. The main mechanism is osseointegration. It is a two-staged surgical procedure.The most commonly used technique (OPRA: Osseointegrated Prosthesis for Rehabilitation of Amputees), and it was originally developed by Brånemark.

In the first stage, a threaded titanium implant is being inserted into the bonemarrow of the residual limb. The implant is called a "fixture." This fixture will soon become integrated into the bone over time; in other words, it becomes a part of the bone.

In the second stage, a titanium extension known as an "abutment" is attached to the fixture. This is brought out through the soft tissues and skin. It takes 6months after the first stage. Now, the prosthesis can be directly attached to the abutment.

After both stages of the surgery, a very strict rehabilitation program is required. Professor Brånemark's team has defined a strict regimented protocol for a successful outcome. This protocol encourages a gradual and progressive weight-bearing on this prosthesis. It begins with technical aids and aims for a complete integration of the prosthesis into daily activities over a period of 6-months.

A safety component called a "failsafe" is being integrated as a prosthetic component and it will release itself to prevent any fracture of the bone or excessive forces on the implant if a fall occurs[5].

Objective of research

With the help of this study, we can know the height and changes in the weight pattern in transtibial diabetic males. The change in the weight pattern will help us in designing linear spring based osseointegrated prosthesis. This prosthetic is useful for people living in hilly area with amputation and having difficulty in walking due to irregular surfaces like in Himalayan foot hill. Approximately 13.4% of land mass is covered with hills. Osseointergrated prosthesis are built with fewer components, thus having a simple frame design and lightweight design and lightweight feel. They provide better control, extension, and suspension to perform normal daily activities such as working out and walking down design. K Level is a classification system for amputee K Level is actual leg of functional mobility K-0 – Does not have the ability to ambulate or potential to ambulate safely with or without assistance, and a prosthesis in these patients do not enhance the quality of life. It is generally given by the doctor or prosthesis maker according to need of an individual. K1 : they have the ability or potential to use a prosthesis for transfer or ambulation in level surfaces at a fixed cadence. Typical of limited and the unlimited household ambulator. K2 : they have the ability or potential for ambulation to transverse low level environmental barriers such as curbs, stairs or uneven surfaces. Typical of the limited community ambulatory. K-3: The community ambulator which has ability to transverse most of the environmental barriers and may have vocational therapeutic or exercise activity that prosthetic use beyond locomotion [4].

2. Methodology

Twenty patients were selected for the study (n=100). We used heights and weights obtained during our inpatient or outpatient clinical encounters. Twenty patients undergoing transtibial amputation were selected. The patients were categorized into two groups: Type-1 diabetes and Type -2 diabetes. B.M.I and height was taken from the case records, at the time of admission in orthopaedics department. As,we were assessing weight changes because of limb loss, in persons with an amputation, baseline weight is calculated. Baseline weight was obtained as the median of weights two to four days after their index amputation. We selected this time period because of fluctuation of weights, often in the first 2 weeks after an amputation. This is due to changes in the fluid balance. We have divided follow-up at 3 month intervals and calculated the median for recorded weight of each individual during every visit.

To elicit the problems during measurement or any errors in data entry, we have used a multistep process to select only valid heights and weights (Appendix). Among the individuals with multiple height measures over time, the modal height was used to calculate BMI.

Percent weight change, it was as calculated as the difference between weight at time x weight at baseline, divided by baseline weight x 100, was described as the primary outcome of interest.

3. Results

Among twenty patients selected for the study (n=20), Out of which six patients were Type-1 diabetics and rest 14 were type -2 diabetics. The height of twenty patients were ranging from 154cm-174cm with a mean height of 163.8cm.

As expected based on our matching, the distribution of ages, BMI, reference years, and presence of a diabetes: 65 percent of individuals were between the ages of 25 and 74 yr, 73 percent had diabetes, and nine patient were overweight (range 25.5-29.9) where rest eleven patients were obese, out of which nine have B.M.I. 30-35 and rest two were above 35.1.The difference in change in weight between type one and type two patient were noted. Type one patient showed mean weight increase of 5055gm, where as type two diabetic showed an increase of 4894gm within the span of three months.

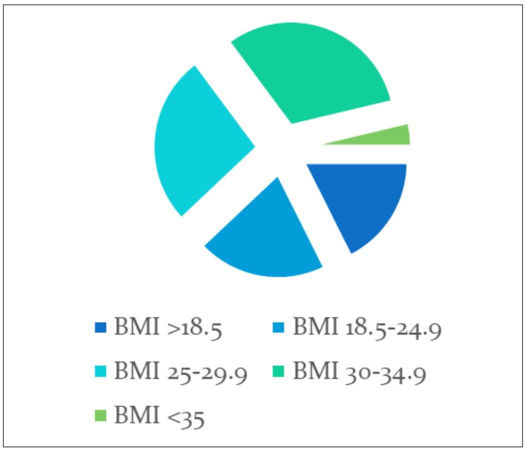


Figure 1 Number of Patients

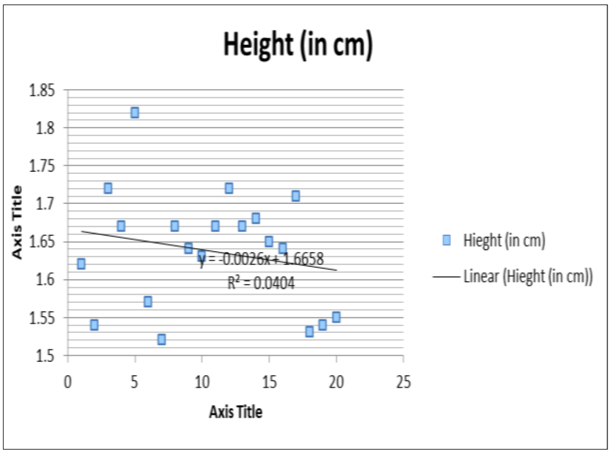


Figure 2 Height Axis

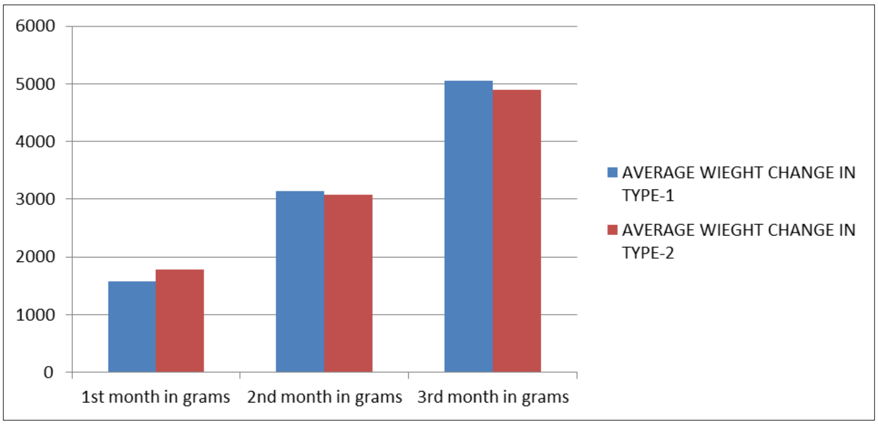


Figure 3 Weight Axis

Over the time period of three months n=100 in both type one and type 2 diabetes, an increase in first month of amputation was 1497 gram from mean weight, in second month weight 3142 gm and in third month 5055 grams, where the average increase in B.M.I. after first month is 0.62 kg/m^2 and in second month is 1.1732 kg/m^2 and in third month,it was 1.89 kg/m^2.

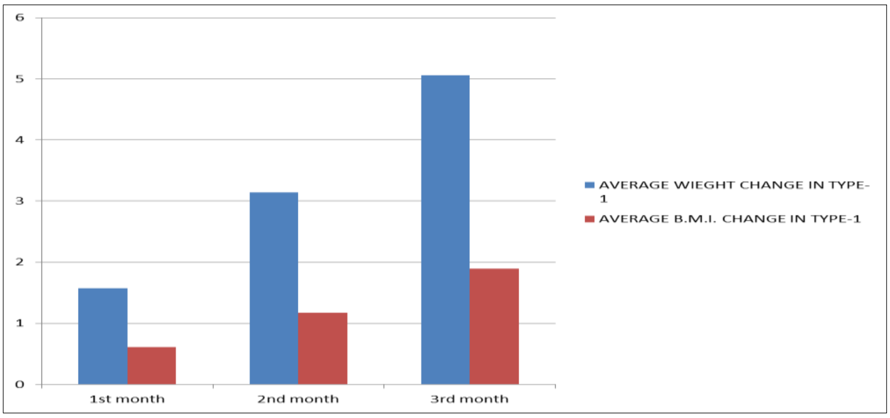
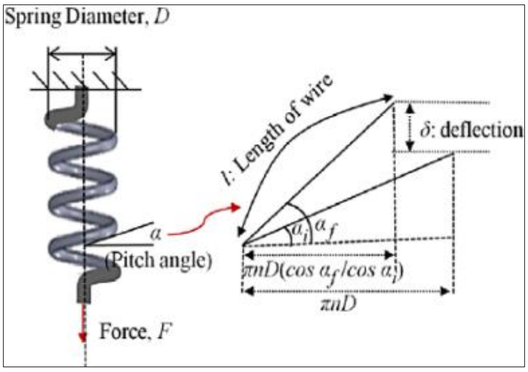


Figure 4 Weight/BMI Axis Comparison

4. Discussion



Specifications	d		h		H	Unit:mm
	min	max	min	max	min	max
M2	2.1	2.35	0.42	0.58	1	1.25
M2.5	2.6	2.85	0.57	0.73	1.3	1.63
M3	3.1	3.4	0.7	0.9	1.6	2
M4	4.1	4.4	1	1.2	1.4	2.6
M5	5.1	5.4	1.2	1.4	2.6	3.25
M6	6.1	6.68	1.5	1.7	3.2	4
M8	8.1	8.68	2	2.2	4.2	5.25
M10	10.2	10.9	2.45	2.75	5.2	6.5
M12	12.2	12.9	2.95	3.25	6.2	7.75
M14	14.2	14.9	3.4	3.8	7.2	9
M16	16.2	16.9	3.9	4.3	8.2	10.25
M18	18.2	19.04	4.3	4.7	9	11.25
M20	20.2	21.04	4.8	5.2	10	12.5

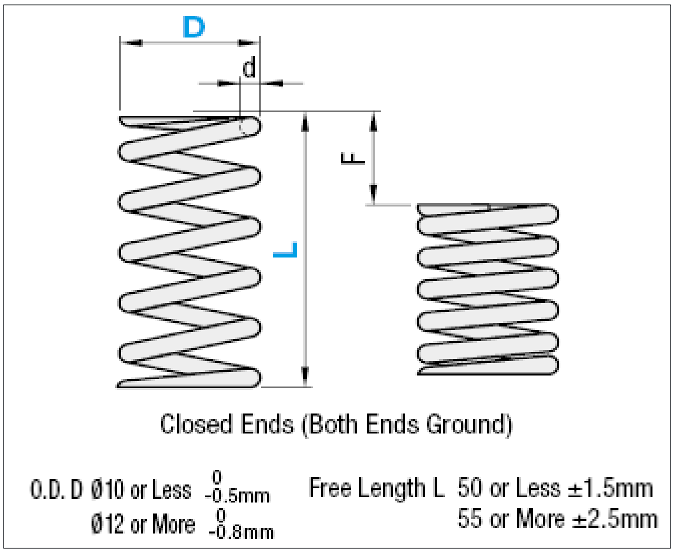


Figure 6 Different weights, different springs

Designing The Prosthetic – Important component of loading response, While the foot plays an important role, the entire limb contributes to shock absorption. Stance phase knee flexion follows ankle plantar flexion, Eccentric dorsi flexor muscle action provide muscular shock absorption during ankle motion. The anatomical structure of the foot contributes to shock absorption through tarsal mobility and various joint articulation. The series of lower limb joint motion transforms the lower limb and specially the foot and ankle complex into a loosed packed structure that accepts weight bearing and provide shock absorption. Weight bearing Stability is essential as contra lateral limb leaves the ground. Advancement of the loading force vector from the Hindfoot to forefoot place increasingly greater demand on Intertarsal and metatarsal alingment to alter the foot and ankle complex from a loose packed flexible structure to close packed right structure, Mean while, the medial longitudenal arch reamians effective at absorbing energy and adapting to uneven surface and variable ground reaction and force.

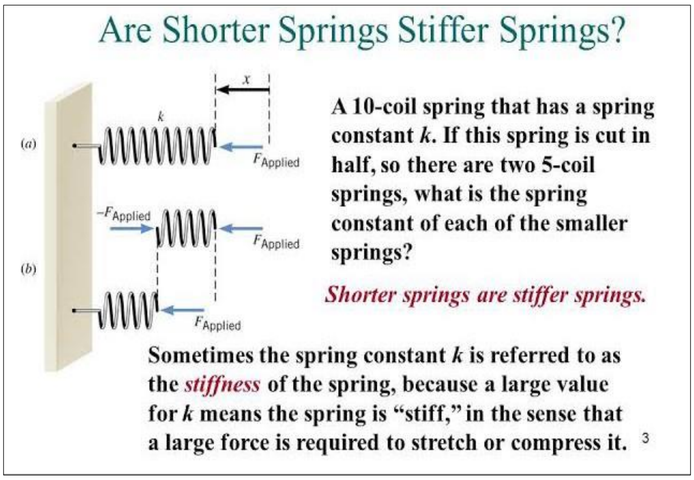


Figure 7 Short springs

5. Conclusion

It is well known that obesity is related with many health conditions, among which our sample is susceptible to conditions like additional amputations, heart disease, and stroke. Thus, utilizing this period of amputation to improve lifestyle habits and to promote weight loss could result in a change of physical, mental status along with social benefits. Our preliminary findings suggest that LLA is often followed by clinically important weight gain, but future studies will need to verify our results using standardized measures of BMI, larger samples, and longer follow-up periods. It would also be informative to measure lifestyle habits such as physical activity, mode of ambulation (e.g., prosthesis, crutches, manual wheelchair, and motorized wheelchair), dietary behaviours, sedentary behaviours, and health status changes in order to accurately identify the likely causal factors. Finally, future studies are also needed to determine whether promoting weight loss following amputation is feasible and can result in health and quality of life benefits.

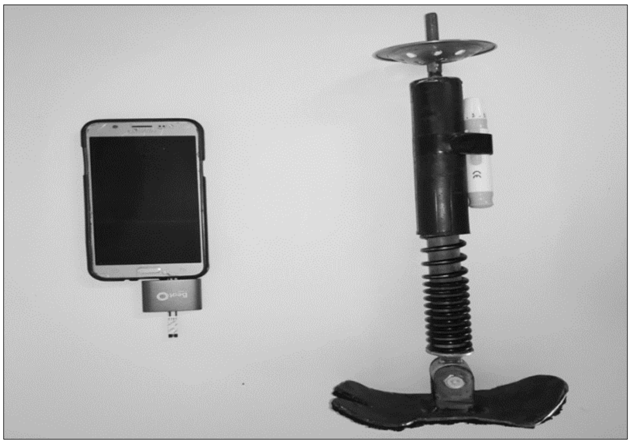


Figure 8 Shank with insulin holder

The above mentioned knowledge had helped in developing indigenous prosthetic below 5,000 rs for lower socio-economic status. An additional feature of insulin holder was added which can be connected to the mobile glucometer to keep in account of patients regular blood glucose level. The above mention weight change and B.M.I. can be used to change the no. of coils and the length of the spring for daily activity. The damping effect of spring was minimized, so no further complications can be seen.

Compliance with ethical standards

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Disclosure of conflict of interest

No conflict of interest.

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