

Amit Jain's Destructive/Amputation Ladder and its Variants

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Abstract

Over past few years, there has been an increase in various new concepts in diabetic foot few of which are derived from other fields like oncology as some of those concepts serves to be suitable in diabetic foot too. One known model over past 3 to 4 decade was reconstructive ladder model in field of reconstructive surgery. Reconstructive ladder was extremely popular over years and with introduction of newer techniques, various people proposed modifications of it like reconstructive elevator, reconstructive triangle, reconstructive pie, etc all being variants of reconstructive ladder. Antonym of reconstruction is destruction and amputations are destructive surgeries. Similar to the line of reconstructive ladder model and its variants, the author redesigned, encompassed and implemented all the variants that are suitable in the new amputation models and other subsets in diabetic foot. Interestingly, over so many years, no attempt were done to apply these interesting models to diabetic foot field, some of which the author believes, would suit it appropriately. The author attempts to create various models of amputation and different subsets in diabetic foot field some of which are akin to reconstructive ladder and its variants and some being relatively new like diabetic foot wheel. All these are open models which means any newer concept developed later over years can be directly added to any of these models.

Keywords: Amputation, Diabetic, Foot, Ladder, Elevator, Triangle, Clock, Amit Jain, Wheel.**Copyright @ 2020:** This is an open-access article distributed under the terms of the Creative Commons Attribution license which permits unrestricted use, distribution, and reproduction in any medium for non-commercial use (NonCommercial, or CC-BY-NC) provided the original author and source are credited.

INTRODUCTION

Diabetic foot is a well-known complication of diabetes resulting in increased morbidity and mortality in most countries [1, 2]. Amputation is one such unfortunate outcome that results in decreased quality of life, increases cost and has an overall negative impact on patient's well-being. Diabetic patients have more than ten times greater risk of amputation compared to non-diabetics [3].

Amputation, which today is performed most commonly for diabetic foot, is also performed for trauma, tumour, vascular disease, etc [4]. Amputation is a distressing and mutilating procedure [3, 4]. A few consider it as a personal failure of his efforts [3], few consider it as a reconstructive procedure as residual limb is designed to restore ambulation [3] and few consider it to be a destructive procedure as it is involved in removal of destroyed parts of a limb [3, 5]. The author believes that one can also consider it as a rescue procedure as surgeon aims at rescuing the healthy parts and also life. Thus, different surgeons have different perception but the common unanimous agreement is that it involves removal of destroyed parts.

The author proposes various models for amputation which are derived from different fields like wound care, reconstructive plastic surgery, general surgery, etc and extended from them and collectively applied to amputation and different subsets of diabetic foot field. Although most of the discussion in this article is on amputation of lower extremities, suitable models are applicable to upper extremity also.

Reconsonstructive Ladder and its Variants

One of the popular concepts in the plastic surgical field is the reconstructive ladder which is said to be proposed by Mathes and Nahai [6, 7]. The ladder aims at wound management wherein the option starts from simple and proceeds to complexity as one climbs the ladder [6]. The reconstructive ladder provided an algorithm for wound closure that aimed to select the appropriate procedure [8]. This concept has its supporters and opposers [6, 9, 10].

Subsequently, various extensions/variants/modifications were made by different surgeons and they include reconstructive elevator, reconstructive triangle, reconstructive pie, reconstructive clockwork, etc [11-13].

The reconstructive elevator concept was introduced by Gottlieb and Krieger and it allows the surgeons to directly ascend to the technique desired [9, 13]. Another concept is reconstructive triangle that was proposed by Mathes and Nahai and it encompasses 3 components namely tissue expansion, flap transposition and free tissue transfer [13, 14]. It was later expanded to reconstructive quadrangle [14]. Further, reconstructive clockwork [12] reconstructive stage [15] and plastic surgery compass [16], etc were proposed by different surgeons all being extension or variants of reconstructive ladder and each having their own merits and demerits. These models came into existence to incorporate more sophisticated methods in closure of wounds [15, 16]. However, a few felt that all the newer surgical techniques/advances can be incorporated in ladder by adding an extra rung [6, 16].

Antonym of reconstruction is destruction. No one attempted earlier to apply these reconstructive concepts on amputation which is considered by many as destructive procedure involved in removing destroyed parts. The author, hence made an attempt to utilize the above concepts, extends and applies them to amputation and different subsets in diabetic foot field.

Amit Jain’s Amputation Ladder/Destructive Ladder (Figure-1)

This ladder is for extremity amputation and the rungs represents different types of amputation done in extremities starting from distal to proximal. It is advisable to prefer the distal amputation as far as possible for successful limb salvage [17]. The aim of reconstructive ladder was options for wound closure whereas the aim in amputation ladder is to limit the amputation and salvage the limb as much as possible. The amputation ladder can also be represented as destructive ladder, as amputation surgery is done to remove the destroyed parts. One can incorporate any new amputation procedure by adding an extra rung at an appropriate suitable place there by rendering this an open model and this is one unique difference between reconstructive ladder (where some felt that you cannot incorporate new methods in ladder [17]) and amputation ladder.

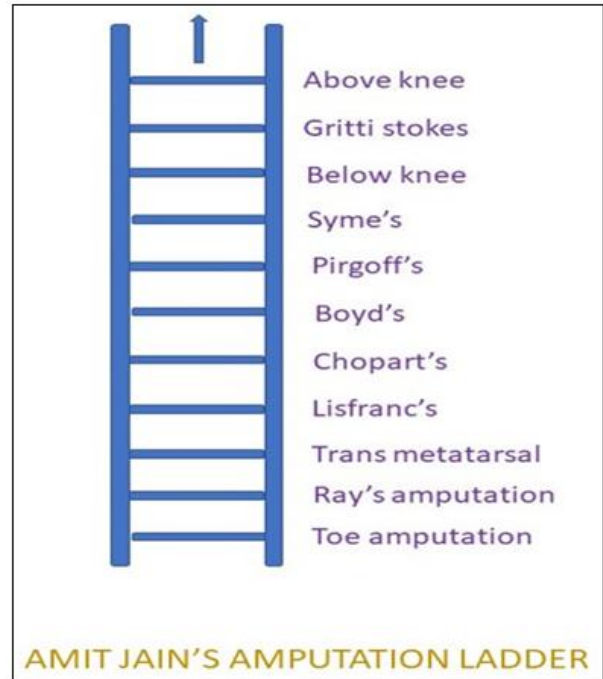


Fig-1: Showing the destructive ladder akin to reconstructive ladder

Like reconstructive ladder had its variants/modifications proposed by different experts, the amputation ladder can also have its suitable variants like Amputation Pie, Amputation Clock, Amputation Staircase or Amputation Pyramid.

In Amputation Staircase/escalator, the steps reflect the type of amputation (Figure-2).

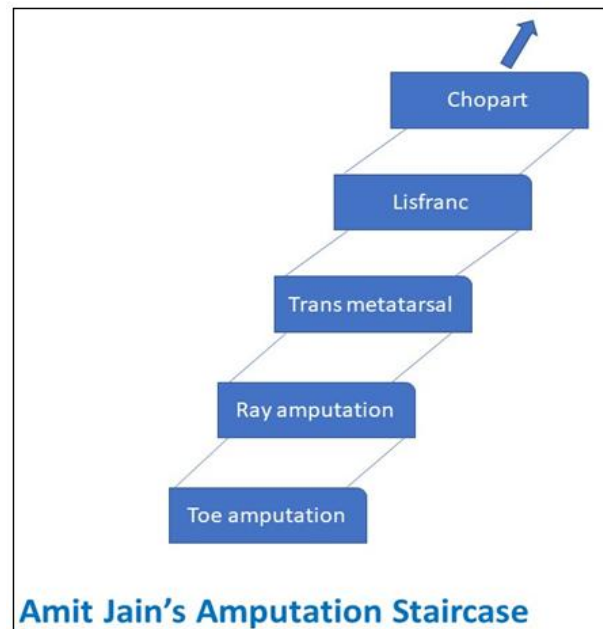


Fig-2: Showing amputation staircase

In Amputation Pyramid, the base of pyramid represents the distal most amputation and apex represents the proximal most major amputation (Figure-3).

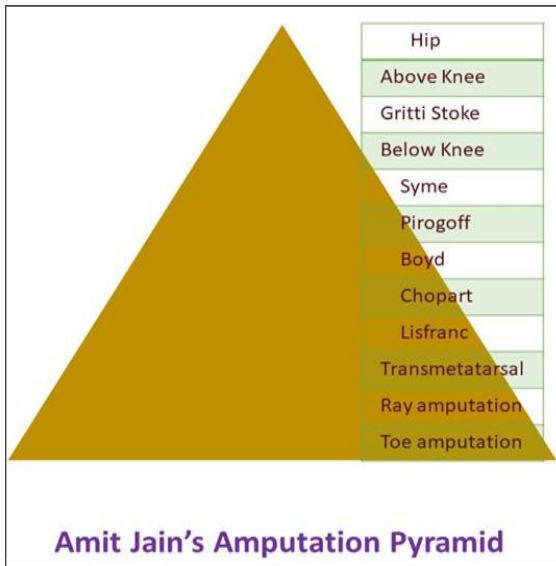


Fig-3: Showing the amputation pyramid

aim of it is again to remove as smallest sector as possible for successful limb salvage.

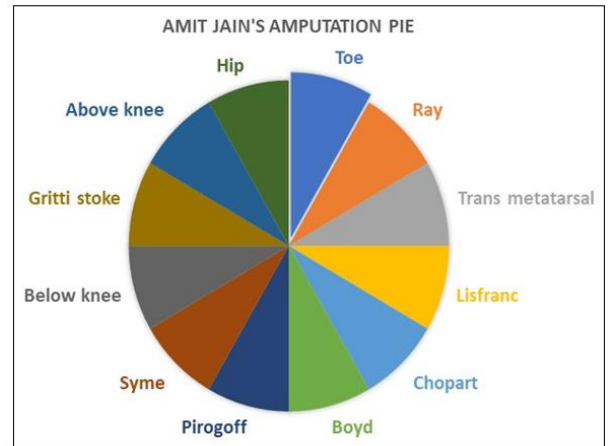


Fig-4: Showing amputation pie

In Amputation Clock, the numbers represent the types of amputation and the clock hands represents the limb. With all varieties of amputations encase in it, the clock can have modifications based on surgeon's perception (Figure-5).

In Amputation Pie, the whole circle represents the limb and each portion/sector/arc represents a type of amputation wherein a part is removed (Figure-4). The

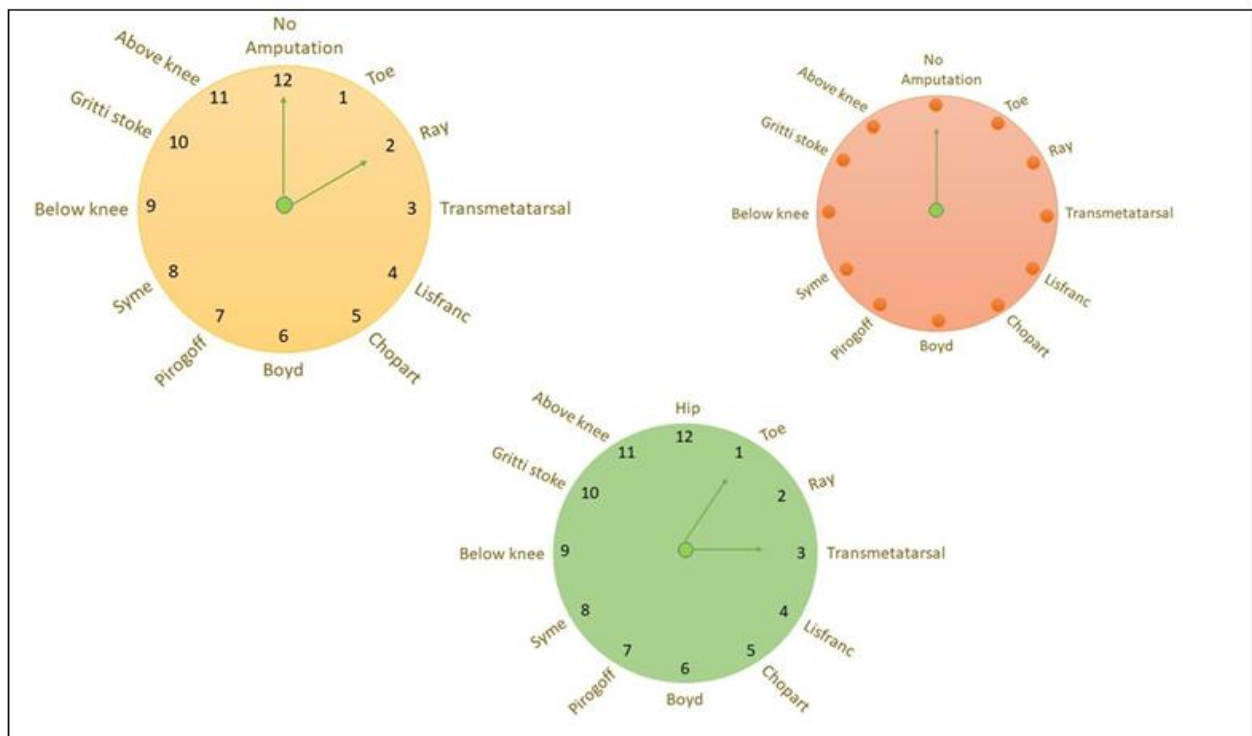


Fig-5: Showing Amit Jain's amputation clocks and its variants

Similar to reconstructive elevator, one can use the amputation elevator/ lift (Figure 6) and go straight to the procedure (floor) that gives the best results. This can occur in ascending infection, stump complications,

in cases of underlying peripheral arterial disease etc. For example, a patient has undergone trans metatarsal amputation and later its stump is gangrenous and there is non-revascularizable peripheral arterial disease, then

one may use the elevator to go directly to the appropriate procedure (floor) representing below knee amputation. In the amputation models of the author, one has the liberty to use amputation ladder and elevator

together/ synchronously based on surgeons' preference as there is only one aim and that is to salvage limb as much as possible.

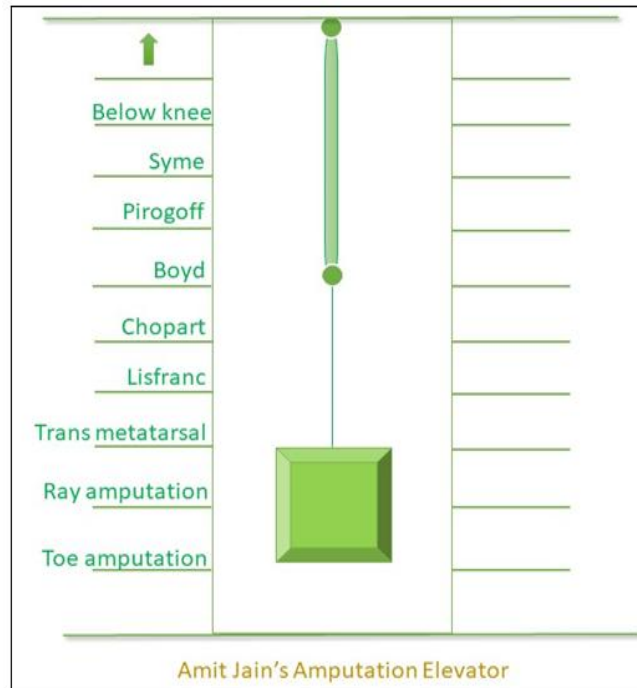


Fig-6: Showing amputation elevator

Amit Jain's Triangle of Foot Amputation

Just like in wound care field, there is triangle of wound assessment [18], in plastic surgical field, there is reconstructive triangle [13], in general surgery, there is triangle of pain and triangle of doom in hernia repair [19], etc, the author proposes the triangle of foot amputation (Figure-7). This is based on Amit Jain's

extended 'SCC' classification of foot amputation [1, 20]. The corners of the triangle of foot amputation represents 3 distinct categories of amputation that encompasses varieties of amputation options in foot and one can choose the most appropriate one based on clinical scenario.

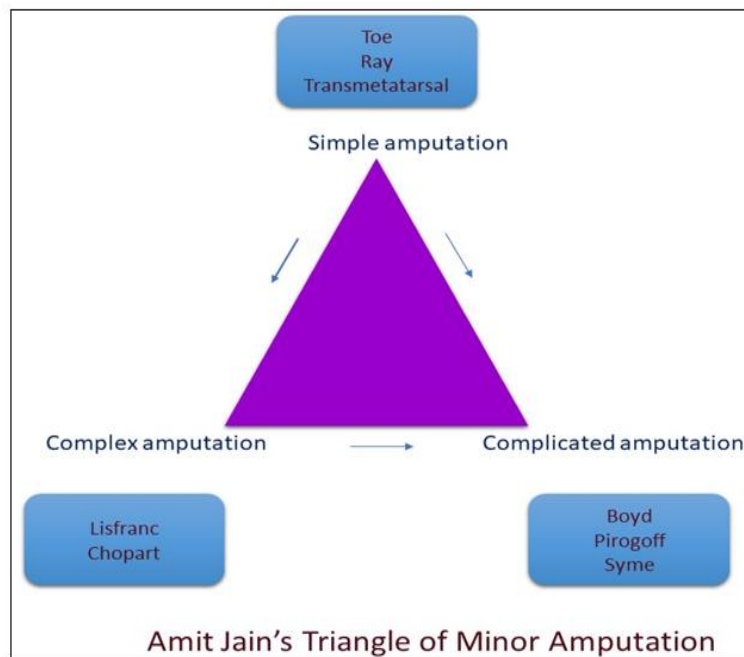


Fig-7: Showing the Triangle of Foot amputation

DISCUSSION

There are so many variant models to reconstructive ladder and these alternatives were made by different surgeons claiming their version to be more appropriate though some of the variants are not accepted by many to be better alternatives. But all of these came into existence with introduction to newer techniques and more complex procedures in reconstructive field. Few consider them to be nuance of semantics [9], few consider them to have little didactic value [16], few believe that it all revolves around initial ladder concept.

In authors model of amputation ladder and variants, this is not the case. There is only one single author who applied all the appropriate variants in this model and further the author doesn't claim any one to be better than other amputation model, rather one should use whichever is suitable and one can also use combination of them. The whole purpose of creating this akin model for antonym of reconstructive ladder and variants was to introduce newer concept in diabetic foot to improvise our approach in this neglected field and many have made attempts in past to incorporate various different concepts from various different surgical field and applied to diabetic foot. The amputation/destructive ladder and its variant are also one such attempt by the author and many of these are effective teaching tool.

There are further some other reconstructive variants like reconstructive stages [15], reconstructive

solar system [21], etc which the author did not find suitable, feasible and relevant to be applied as amputation ladder variant. For example, the reconstructive stages are aimed at plastic surgeons' skills as stage wise progression from lower procedure to be learned first to higher end procedure in last. It is not possible in amputation model as, some major amputations like below knee amputation and above knee amputation are learned earlier and better than some distal amputation like Syme's which though minor, are difficult to perform or rarely performed or not at all performed in most surgeon's lifetime. Similarly, in plastic surgery compass model [16], which is extension of reconstructive ladder, there are 4 poles representing 4 factors. It is not suitable to have a diabetic foot compass as there are not just 4 factors but many more which are crucial in this complex disease. Rather, the *Amit Jain's Diabetic Foot Wheel* (Figure-8) would serve as a better and advance model wherein the spikes of the wheel represent different aspects within diabetic foot [22]. This wheel model of author is a relatively new concept that can also be applied to subsets like footwear, offloading, adjunctive therapies, etc in diabetic foot field [22]. This wheel offers the best 360^o evaluation of diabetic foot as it can focus on every aspect of the entity in discussion in diabetic foot. *Amit Jain's Diabetic Foot Wheel* and *Amit Jain's Diabetic foot Pentagon* are the latest new independent teaching models of the author for diabetic foot [22, 23] and they are beyond the scope of this article and wouldn't be discussed in detail.

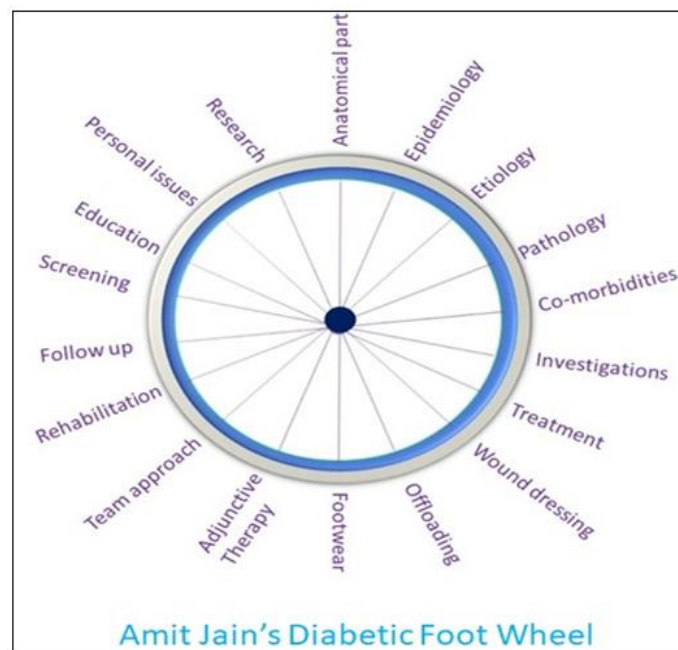


Fig-8: Showing the Amit Jain's Diabetic Foot Wheel which covers the entire spectrum in brief

Most of the concepts like amputation ladder, amputation elevator, etc are also applicable for upper limb amputations (Figure-9). Further the above Amit Jain's models for amputation are open models which

means if a new variety of amputation is designed in future or existed in past and needs to be added to the ladder and its variant, then one is free to place it at appropriate location.

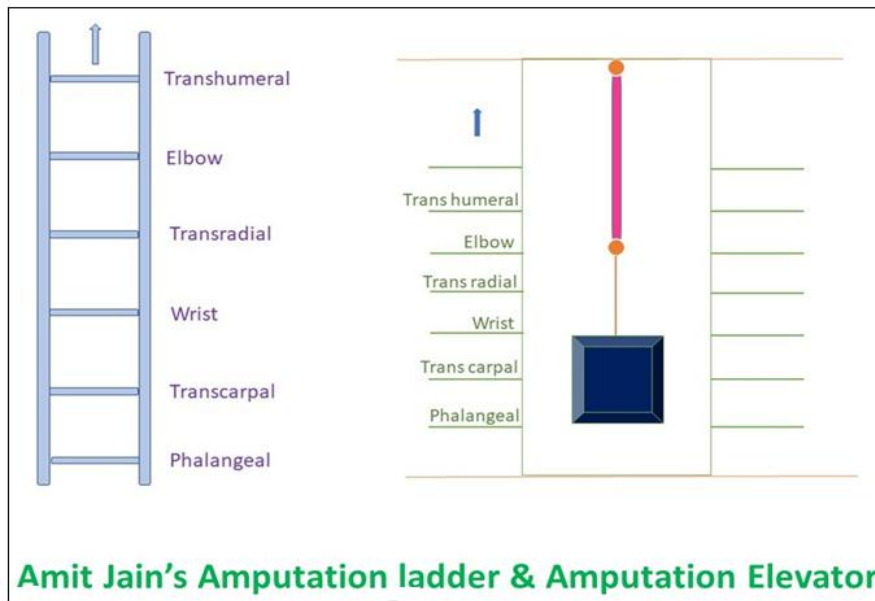


Fig-9: Showing the Amit Jain's amputation models being applicable to upper extremities too

In reconstructive ladder model, few felt that a defect may sometimes require a complex procedure (like flap) to be better compared to a simple procedure (like skin grafting) [9, 13, 15]. In all these amputation models, though there are patients who may end in proximal major amputations, they are never better than distal most and whenever option exist it is still the distal most amputation which should be the best option as long as biomechanical viable foot is obtained for ambulation. Hence, finding extensions in the amputation models and introducing newer amputation techniques above the existing one in present scenario looks less likely to come in existence as the whole motive in diabetic foot worldwide is to prevent amputation.

Extension of Above Models to Subsets in Diabetic Foot

Just the way amputation ladder and its variants were derived by the author akin to its antonym reconstructive ladder, some of the suitable extensions can be done in footwear and offloading in view of both of them having Amit Jain's extended "SCC" classification [20]. The suitable models in footwear based on "SCC" classification are footwear ladder/stairs (Figure 10 & 11), footwear elevator (Figure-12) and triangle of diabetic footwear (Figure-13). The suitable model in offloading based on "SCC" classification is triangle of offloading (Figure-14). The author did not find ladder, elevator, clock, pie, etc suitable in offloading in view of just 3 categories of offloading based on Amit Jain's "SCC" classification [20].



Fig-10: Showing footwear ladder



Fig-11: Showing footwear staircase

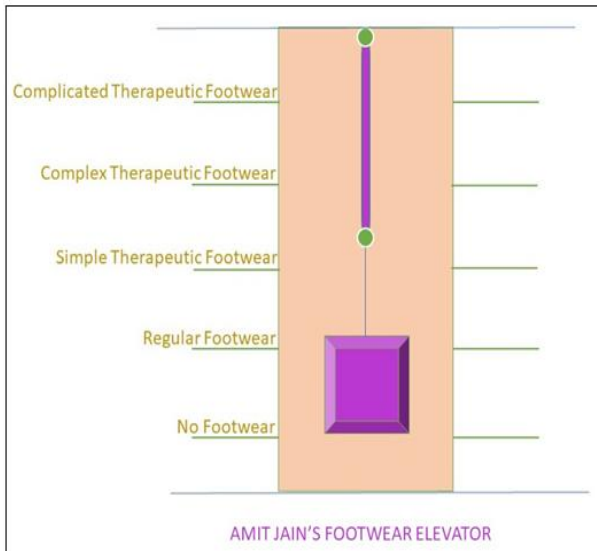


Fig-12: Showing footwear elevator

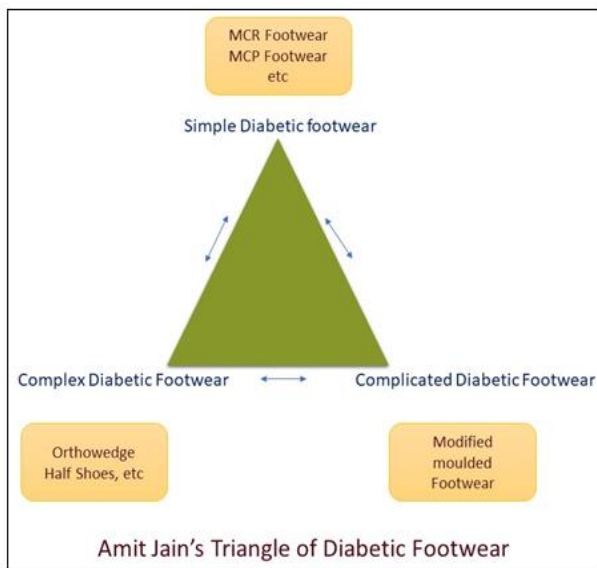


Fig-13: Showing Triangle of Diabetic/Therapeutic footwear



Fig-14: Showing Triangle of offloading

CONCLUSION

Various new concepts that suits in diabetic foot field had been attempted over past few years with a few being derived from other existing concepts from another field and few are created new with a novel aim of improvising the diabetic foot concepts. The Amit Jain's amputation model and its variants are one such attempt which is akin to the existing reconstructive models and its variants that were proposed by different surgeons from different part of the world.

Note: A Boolean search was done using words like amputation ladder, amputation elevator, amputation pie etc in Pubmed, google scholar and google images and we could not find anyone prior to this article to have taught of this concept and its variants in diabetic foot.

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