5．柔道の「崩し」・「作り」と抵抗性反応理論

カリフォルニア州立大学サクラメント校　今村 *T. Rodney*
東京学芸大学　射手矢　岬
筑波大学研究生　石井　孝法

5. *Kuzushi* and *Tsukuri* and the Theory of Reaction Resistance

Rodney T. Imamura　(California State University Sacramento)
Misaki Iteya　(Tokyo Gakugei University)
Takanori Ishii　(University of Tsukuba, Graduate Researcher)

要約

受けは取りの崩し動作に対して反応（反射も含めた広義の意味）する。即ち、取りは巧みな押し・引きにより受けを崩そうとする時に、受けの一定の反応を生み出して崩し、その後一連の「作り」・「掛け」を行う。我々はこれを抵抗性反応理論と定義した。本総説では、３つの先行研究における知見を基に、科学的な立場からこの理論を提唱した。

抵抗性反応動作とは、受けの捉え難いしかも微妙な防衛動作であり、これは受けを硬直させる様な取りの操作とも言える。この動作を引き起こすために、取りは最大の力を必要としない。例えば、取りの素早い引きや手首のスナップを効かせた引きは、受けを硬直した状態に反応させる。それ故「崩し」における取りの押し・引きは、受けを最適な場所で瞬時に硬直させるという一つの目的をもって行われる。

最初の研究では、投げ込み練習において受けの重心は、投げられる直前に、その方向とは逆方向に動くことが報告された。残り２つの研究では試合においても同様に受けの重心が一度投げられる方向とは逆方向に動いていることが証明された。これは、取りが受けの自然発生的な防御動作（身体のバランスや平衡を保とうとして、身体が硬直する）を起こさせるための崩しの一部と考えられる。熟練者（コーチ）は、技術と力の調和で、意識的または無意識的に受けに反応を起こさせることを長年学習してきた。彼らは崩しの初期に手首のスナップなどを用いて受けの抵抗性反応を引き起こし、受けの重心を最適な場所に導くように指導する。抵抗性反応理論は「崩し」の学習における実用的なアプローチとして役立つと思われる。

Introduction

Perhaps the most intriguing concept in judo is the understanding of Jigoro Kano's famous philosophy of "maximum efficiency with minimal effort" . The thought of perfecting one's technique such that it requires the least amount of strength or effort is a level that judo practitioners will spend years and years of training trying to achieve. Practitioners who have at one time or another experienced this type of execution understand the meaning of this concept.

From a physical standpoint, technical skill and power must be in synchrony for a throw to be successful. Kano attempts to explain the timing of throws by breaking it down into different phases. There are three main phases: *kuzushi* the preparatory phase defined as breaking an opponent's balance or simply preparing them for a throw, *tsukuri* the process of fitting into the throw, and *kake* the phase describing the execution of the throw itself. *Kuzushi* and *tsukuri* are considered important aspects of the throw simply because without their effectiveness *kake* may not occur at all or may occur with larger contributions from power, which in turn constitutes greater effort.

Imamura et al. (2006) measured the gross movements of *uke* by measuring the center of mass (COM) momentum during the execution of *harai-goshi, seio-nage,* and *osoto-gari.* The study also found a slight movement of *uke's* COM towards *tori* in the front-to-back and sideways directions for *osoto-gari.* It was thought that these movements may be important precursors to a successful *tsukuri.* In general, a proper fit-in is based on good body contact between *tori* and *uke* such that the two bodies become one. If *uke* does not resist *tori's* pull in any way, *tsukuri* cannot be performed well. If *uke* resists *tori* too much this is considered good defense and, likewise, *tsukuri* cannot be performed well. Thus, it is conceivable that a slight resistance by *uke* may be beneficial. Furthermore, assuming that *uke's* movements are influenced by the actions of *tori,* it is also conceivable that *tori's* pull during *kuzushi* creates a reaction from *uke.* This is the theory of reaction resistance.

Research Findings

The study by Imamura et al. (2006) comprised of four *tori* subjects (mean age = 34 yrs; height = 1.73 m; mass = 91.5 kg) and one *uke* subject (age = 38 yrs; height = 1.75 m; mass = 89 kg) who received throws for all subjects. The throws were simulated as *nage-komi* exercise where *uke* offered no conscious resistance to *tori's* efforts. In this respect, the throws were assumed to be perfect throws in which *kuzushi, tsukuri,* and *kake* were executed optimally. Figures 1 and 2 illustrate the COM momentum of *uke* in the anteroposterior (x), vertical (y), and mediolateral (z) directions during the different phases of the *seio-nage* and *harai-goshi* throws. There was a reaction resistance found in the direction away from *tori's* pulling hand in the mediolateral (sideways) direction. Figure 3 illustrates the COM momentum for the *osoto-gari.* During this throw reaction resistance did not occur in the mediolateral direction, rather, it occurred in the anteroposterior (front-to-back) direction against *tori's* push.

The execution of throws in simulated conditions are not completely revealing as to the true nature of throws. This is particularly true for *kuzushi.* Very rarely are throws executed while the *tori* and *uke* are in a stationary position. Thus, the question that one might ask is how different

are the movements of *uke* during simulated and real-life (competitive) conditions? A few studies have investigated the movement of *uke* during competition. Imamura et al. (2006) performed a case study comparing the *harai-goshi* throw during both conditions. The *tori* subject (age = 32 yrs; height 1.78 m; mass = 89 kg) executed *harai-goshi* against two different *uke* during a simulated condition (age = 38 yrs; height = 1.75 m; mass = 89kg) and during competition (age = 21 yrs; height = 1.77 m; mass = 78 kg). They found a reaction resistance during the *kuzushi* and *tsukuri* phases of the throw for both conditions (Figure 4). The competitive reaction resistance was very small compared to the simulated condition. Furthermore, the competitive condition had longer *kuzushi* and *tsukuri* phases due to the defensive efforts of *uke*. While it is difficult to make any solid conclusions about reaction resistance based on a case study using two different *uke*, it is likely that the degree of reaction resistance will vary from person to person and from throw to throw.

Ishii et al. (2005) measured the COM location of *uke* with respect to their feet in successful and unsuccessful *osoto-gari* during competition. The study measured the estimated COM relative to the base of support for two successful and one unsuccessful *osoto-gari*. The findings indicated that during *kuzushi* the COM was positioned towards the toes in the anteroposterior direction during successful *osoto-gari*. The COM distance was measured at approximately 0.26 m from the heel line during *kuzushi* and 0.07 m during *kake* (Figure 5). On the contrary, during unsuccessful *osoto-gari*, the study found the COM to be positioned closer to the heel line (Figure 6). It is likely that reaction resistance occurred during successful *osoto-gari*. While the theory of reaction resistance is based on velocity measurements, the distance of the COM away from the heel line in the anteroposterior direction during *kuzushi* certainly indicates an attempt by *uke* to resist *tori's* push much like what was found by Imamura et al. (2006). The study also reinforces a well established concept of keeping one's center of mass within their base of support for greater stability. It is possible that reaction resistance is a momentary shift in *uke's* COM such that it moves away from the base of support and is the point in time in which *tori* is able to perform a successful *tsukuri* and *kake*.

Practical Implications

If the reaction resistance theory or at least some form of it is true, it is likely that the concept is already being applied. Highly skilled judo players have already developed the ability to initiate reaction resistance whether they are conscious of it or not. Furthermore, skilled players will always attempt to objectify the best moment to execute a throw. For example, some players will execute *seio-nage* during the time in which *uke* steps forward with their right leg (for right-handed *seio-nage*). This timing gives *uke* no choice but to push off the ground and resist *tori* in the opposite direction of *tori's* pull in the sideways direction, the same movement described by Imamura et al. (2006). Likewise, based on the findings for *osoto-gari*, there is a propensity for *uke* to create reaction resistance in the forward direction towards *tori's* push while positioning their COM underneath their swept leg. Therefore, strategies for initiating reaction resistance for this throw might include preceding the throw with *ouchi-gari* in order to force *uke's* left leg backwards

(for right handed *osoto-gari*) thereby leaving them no choice but to plant and push off the ground, forcing their COM forwards and towards their swept leg. The latter are just examples of many different movements and throw combinations that may initiate reaction resistance.

It should be emphasized that reaction resistance is a subtle movement, described as an indecisive movement by *uke* or what is theorized as "freezing" *uke*. It is not a requirement for *tori* to create large amounts of pulling or pushing power to achieve reaction resistance. In fact, the very nature of certain throws, like *harai-goshi* and *seio-nage*, make it difficult for *tori* to create large pulling forces since they must turn their body 180 degrees during *kuzushi*. Therefore, a quick non-maximal pull, or what some instructors refer to as a snap pull, may be all that is required to make *uke* react. The freezing reaction of *uke*, in turn, allows *tori* to successfully execute *tsukuri* and *kake*. Thus, the purpose of pulling or pushing during *kuzushi* may not be necessarily based on power but the ability to make *uke* momentarily freeze in an optimal position.

Conclusion

The theory of reaction resistance is based on the natural occurrence of *uke* to defend the throwing efforts of *tori*. In the process of doing so, *uke's* body becomes rigid against the pulling or pushing efforts of *tori* in an attempt to maintain balance and stability. If this rigidity is too strong *uke* is successful at maintaining their stability and likewise *tori's* throw is unsuccessful. If the rigidity is minimal, it may actually enhance *tori's* ability to execute *tsukuri* and *kake* for a successful throw. Highly skilled judo players have learned to synchronize their technique and power to initiate this process whether they are conscious of it or not. From a practical standpoint, instructors and coaches may teach their students to initiate reaction resistance by using a snap pull rather than a slow powerful pull and look for positions in which *uke's* COM is forced in particular directions before executing *kuzushi*. While the theory of reaction resistance does not presume to replace years of judo training, it does offer a pragmatic approach to learning the proper execution of *kuzushi* and *tsukuri*.

References

Imamura, R.T., Hreljac, A., Escamilla, R.F., & Edwards, W.B. (2006). Three dimensional analysis of center of mass for three different judo throwing techniques. *Journal of Sport Science and Medicine, Vol. 5, CSSI, 122-131 (On-line)*. Available: http://www.jssm.org

Imamura, R.T., Iteya, M., Hreljac, A., & Escamilla, R.F. (2006). *A kinematic comparison of the Judo Throw harai-goshi during competitive and non-Competitive Conditions – a case study.* Manuscript submitted for publication.

Imamura, R. T., Iteya, M., & Takeuchi, Y. (2005). The biomechanics of Osoto-gari, Bulletin of the association for the scientific studies on Judo, Report X, 47-55, Kodokan: Tokyo.

Ishii, T., Iteya, M., Komata, K., Ae, M., Okada, H., Sakamoto, M., Kubota, H. (2005). A biomechanical investigation of kuzushi of osoto-gari in Kano cup international Judo tournament. Poster presented at the conference of Japan Society of Physical Education, Health and Sport Sciences, the University of Tsukuba, November

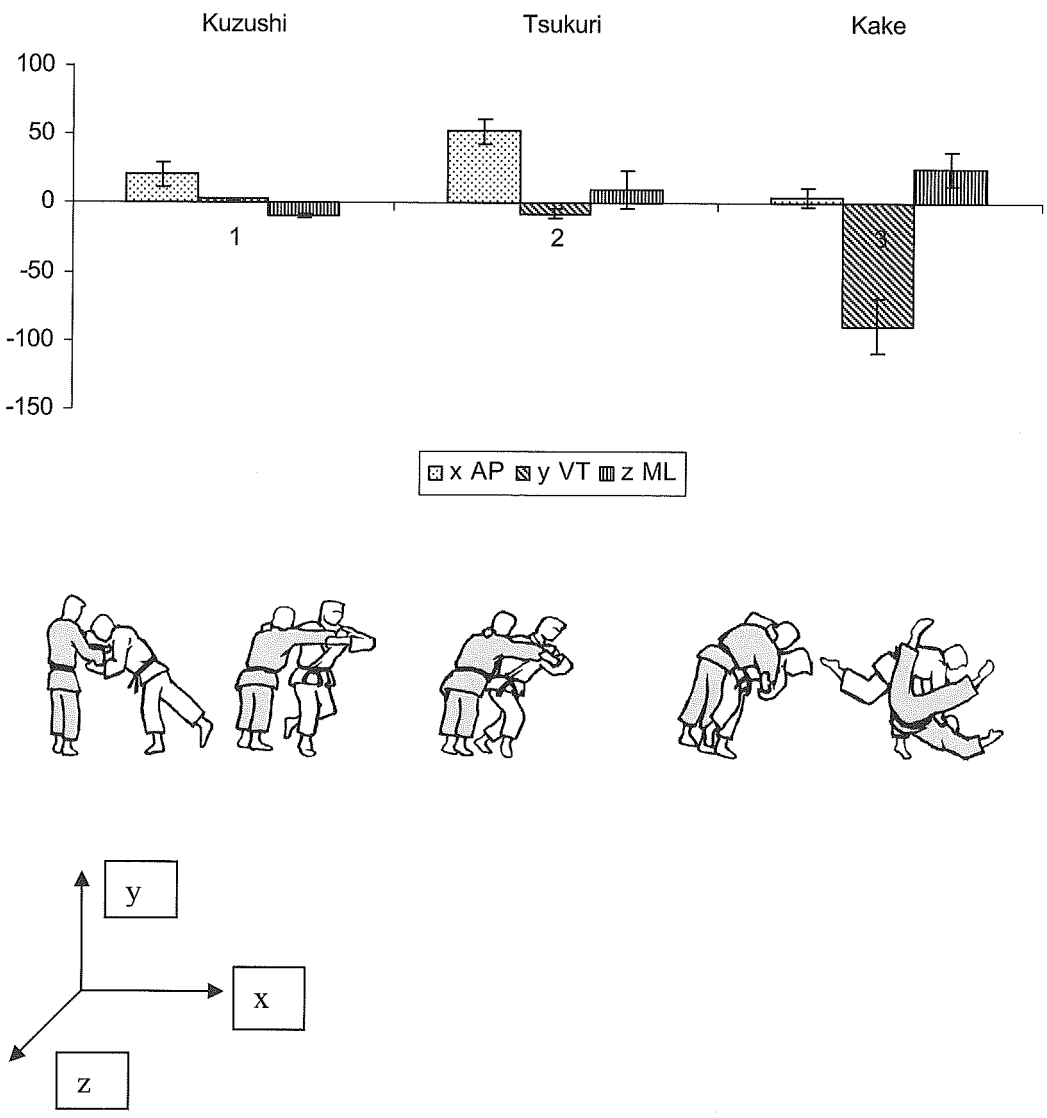


Figure 1. *Harai-goshi* throw momentum mean ((kg • m)/s) and standard deviation values in the anteroposterior (x AP), vertical (y VT), and mediolateral (z ML) directions (left to right columns respectively) for each phase (1 = *kuzushi*, 2 = *tsukuri*, 3 = *kake*). The reaction resistance is the negative value within the kuzushi phase along the ML direction.
Source: Imamura, et al. (2006). Three dimensional analysis of center of mass for three different judo throwing techniques. Journal of Sport Science and Medicine, CSSI, 122-131 (On-line). Available: http://www.jssm.org
図1．右払腰の崩し・作り・掛け局面のx（前後），y（上下），z（左右）方向への重心の運動量：崩し局面で抵抗性反応は左右方向で負の値となって現れた．Imamura, et al. (2006)から引用

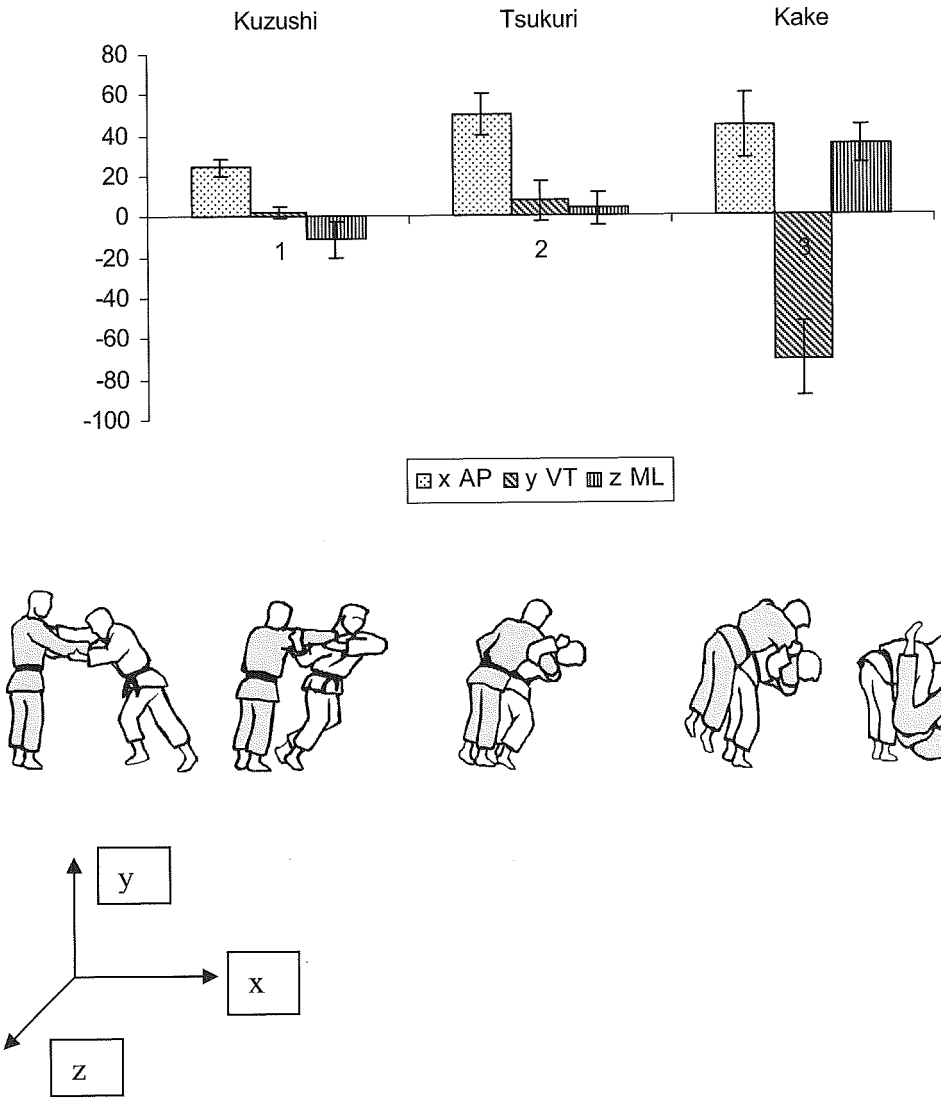
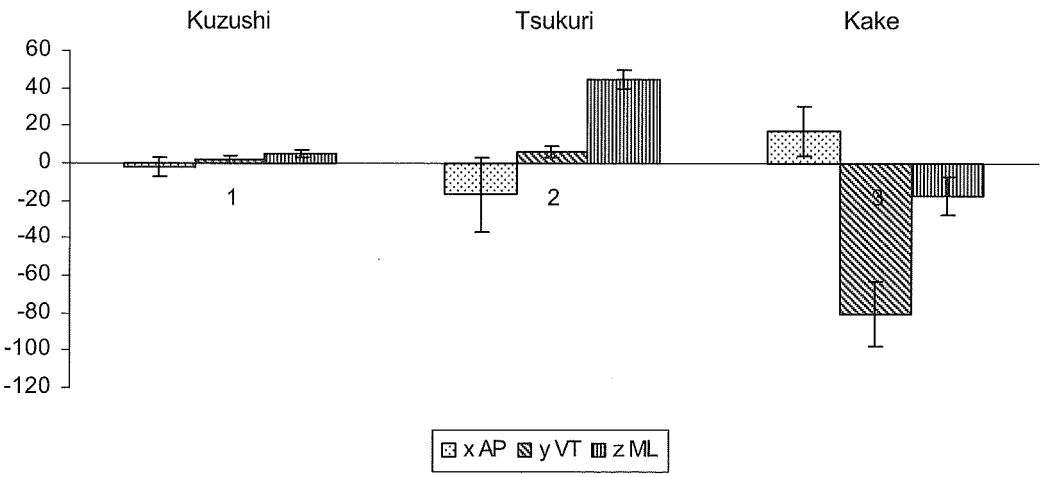


Figure 2. *Seoi-nage* throw momentum mean ((kg•m)/s) and standard deviation values in the antero-posterior (x AP), vertical (y VT), and side-to-side (z ML) directions (left to right columns respectively) for each phase (1 = *kuzushi*, 2 = *tsukuri*, 3 = *kake*). The reaction resistance is the ML negative value occurring within the *kuzushi* phase.
Source: Imamura, et al. (2006). Three dimensional analysis of center of mass for three different judo throwing techniques. *Journal of Sport Science and Medicine*, CSSI, 122-131 (On-line). Available: http://www.jssm.org
図2．右背負投の崩し・作り・掛け局面のx（前後），y（上下），z（左右）方向への重心の運動量：崩し局面で抵抗性反応は左右方向で負の値となって現れた。Imamura, et al. (2006)から引用



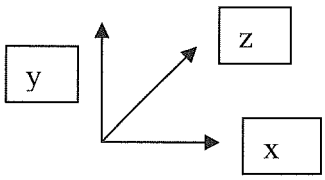


Figure 3. *Osoto-gari* throw momentum mean ((kg•m)/s) and standard deviation values in the antero-posterior (x AP), vertical (y VT), and side-to-side (z ML) directions (left to right columns respectively) for each phase (1 = *kuzushi*, 2 = *tsukuri*, 3 = *kake*). (Note: *uke's* forward movement is negative in this case and the z orientation is altered so that *uke's* right shoulder is facing positive z). The reaction resistance is the AP negative value occurring within the *tsukuri* phase.
Source: Imamura, et al. (2006). Three dimensional analysis of center of mass for three different judo throwing techniques. *Journal of Sport Science and Medicine*, CSSI, 122-131 (On-line). Available: http://www.jssm.org
図3．右大外刈の崩し・作り・掛け局面のx（前後），y（上下），z（左右）方向への重心の運動量（注意；受けの後方がXの正の値、受けの右側がZの正の値となる）：作り局面で抵抗性反応は前後方向で負の値となって現れた。Imamura, et al. (2006)から引用

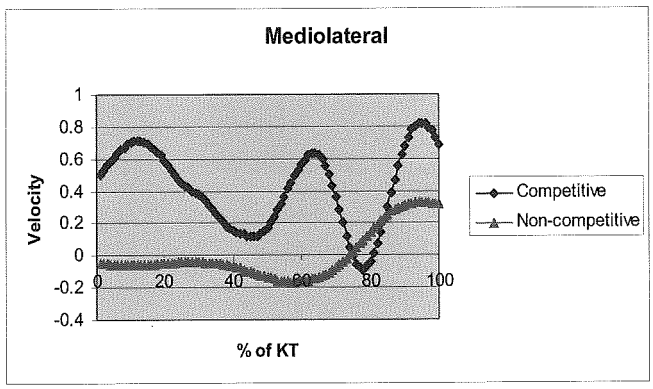


Figure 4. *Uke's* center of mass velocity (m/s) along the mediolateral axis in *Harai-goshi* throw during competitive and non-competitive conditions as a percentage of *kuzushi/tsukuri* (KT). The reaction resistance is negative velocity in this case.
図4．試合・非試合条件下の崩し・作り局面における払腰の受けの左右方向の重心速度：抵抗性反応はこの場合負の値として現れる。

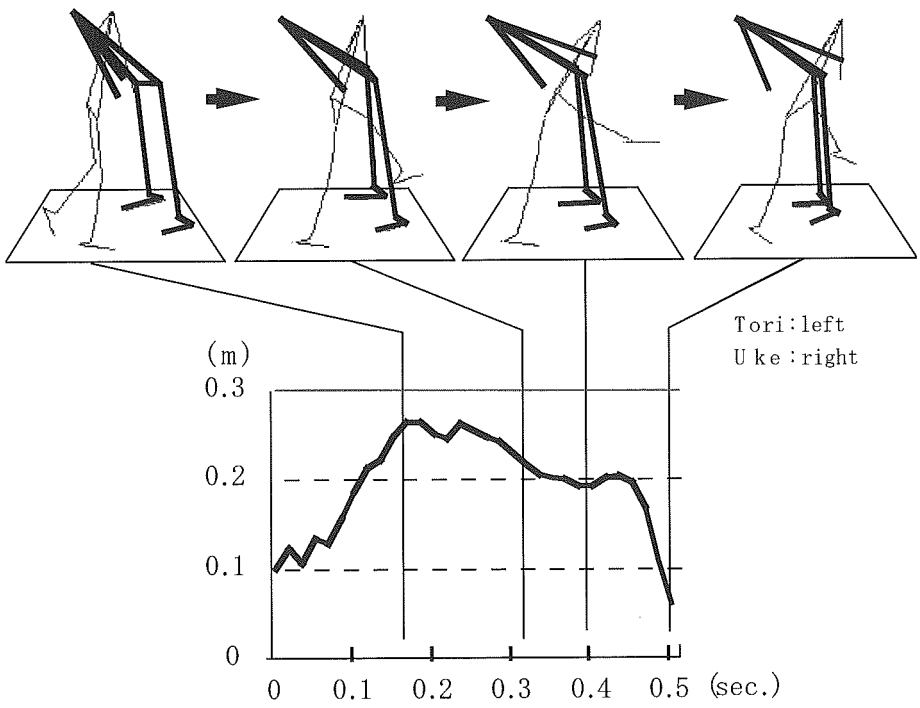


Figure. 5 The distance of the Uke's COM from both heels line in successful Osoto-gari during competition.
図5．試合で成功した大外刈における踵ラインからの受けの重心距離

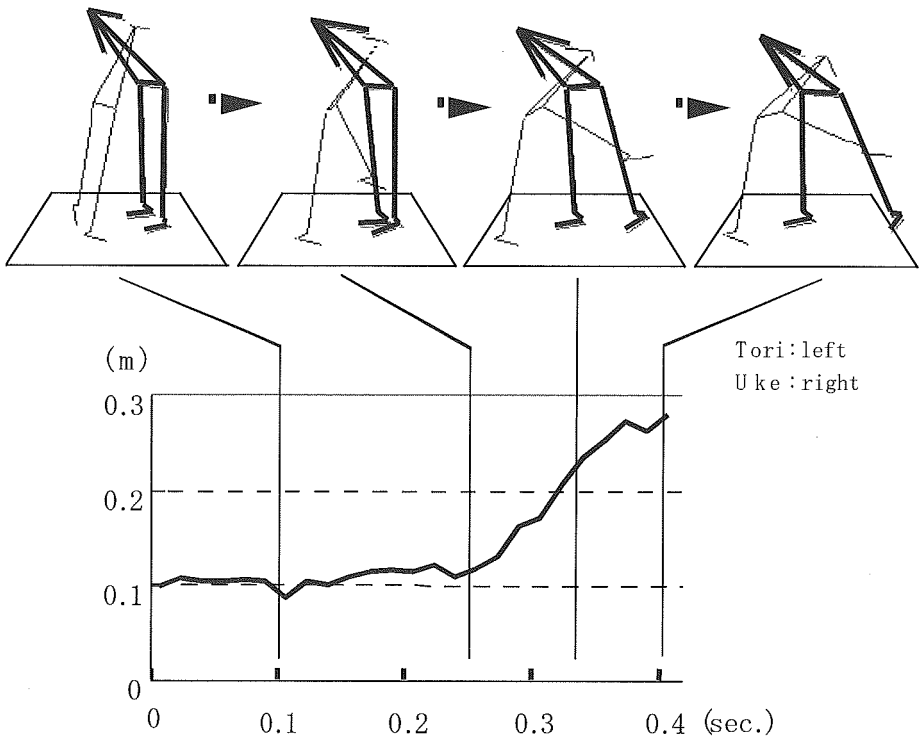


Figure. 6　The distance of the Uke's COM from both heels line in unsuccessful Osoto-gari　during competition.
図６．試合で失敗した大外刈における踵ラインからの受けの重心距離